Údarás Náisiúnta Iompair
National Transport Authority

Draft Transport Strategy for the Greater Dublin Area

Inner Orbital Study

DOCUMENT IDENTIFICATION TABLE	
Client/Project owner	National Transport Authority
Title of Document	Dublin Inner Orbital Corridor Study Report
Task Order	065
Task	GDA Strategy Corridors
Deliverable Code	MSF 065 Report/Report/03
Version	4
Document Status	Final

DOCUMENT STATUS TABLES

Version 1

	Name	Position	Date
Originated by	John Paul FitzGerald	Project Manager	07-05-2015
Checked by	Ian Byrne	Director, Systra	07-05-2015
Approved by	Brian Sloey	Divisional Director, Jacobs	18-05-2015
NTA Reviewer			

Version 2

	Name	Position	Date
Originated by	John Paul FitzGerald	Project Manager	25-06-2015
Checked by	Ian Byrne Sinéad Canny	Director, Systra Associate Director, Systra	25-06-2015 29-05-2015
Approved by	Brian Sloey	Divisional Director, Jacobs	29-06-2015
NTA Reviewer	Michael MacAree	Head of Integrated Planning	15-07-2015

Version 3

	Name	Position	Date
Originated by	John Paul FitzGerald	Project Manager	04-08-2015
Checked by	Ian Byrne Sinéad Canny	Director, Systra Associate Director, Systra	04-08-2015
Approved by	Brian Sloey	Divisional Director, Jacobs	06-08-2015
NTA Reviewer	David Clements	Land Use and Transportation Planner	

Version 4

	Name	Position	Date
Originated by	Dieckmann Cogill	Task Manager	23-09-15
Checked by	John Paul Fitzgerald	Project Manager	23-09-15
Approved by	Brian Sloey	Division Director (Jacobs)	23-09-15
NTA Reviewer	Michael MacAree	Head of Integrated Planning	

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1 Introduction

1.1 Background

The National Transport Authority (NTA) is preparing a new transport strategy for the Greater Dublin Area (GDA) which will consider the future of the transport system in the GDA for the period up to year 2035. As a means towards informing the direction of the new strategy the NTA has defined eight Study Areas to be assessed for this review in order to understand more fully the 2035 travel demand coming from the Study Areas, and the public transport services that will be required to effectively meet that demand.

Jacobs Engineering Ireland (Jacobs) and SYSTRA provide consultancy services to the NTA through a Modelling Services Framework. By this means Jacobs and SYSTRA were commissioned by the NTA to undertake a desktop transport assessment of six of the eight identified corridors within the GDA.

This report focuses on the **Inner Orbital Corridor Study Area**. There are also Study Areas being examined by Jacobs / SYSTRA covering the South East, South West, West, North West and Navan. Reports that consider the role of Park and Ride and Demand Management in increasing public transport usage will also be informing the transport strategy for the Greater Dublin Area. The provision of public transport for orbital movements outside of the M50 have been considered by Clifton Scannell Emerson Associates in the *Dublin Orbital Movement Strategy Options Report.* The *Dublin Orbital Movement Strategy Option Report* recommendations focus on serving the area outside the M50, while the focus of this report is on the Inner Orbital movements, inside the M50.

1.2 Study Objectives and Principles

This study examines the future transport needs of the Inner Orbital Study Area. Consideration is given to the role and function of the strategic road network as well as the performance of existing public transport provision.

A particular aim of the study is to explore and identify public transport options that could effectively meet the growth in travel demand to the year 2035 within the Inner Orbital Study Area.

The study objectives for the Inner Orbital Study Area were outlined by the NTA and have guided the study and assessment process. These objectives include developing public transport measures that will:

- cater for the orbital demand;
- cater for existing public transport usage;
- cater for 100 per cent of future demand growth; and
- cater for more of the existing car-based demand, if feasible.

The focus is placed on meeting the demand of those trips that are greater than 3km in distance, as it has been assumed that the majority of trips less than 3km may be taken via active modes such as walking and cycling.

Based on the level of demand that is identified, and considering functionality and cost, a set of appropriate public transport solutions are presented. Packages may include bus, bus rapid transit (BRT), light rail, metro and heavy rail. Interchange between public transport modes has been considered. The public transport options identified are considered to offer the most effective, efficient and sustainable solution to serve growth in transport demand and provide the best means of contributing to an integrated public transport strategy for the GDA.

This study has considered the existing road network in the Study Area and has included the various significant road proposals that are under consideration. Discussions have been held by the NTA with the National Roads Authority and local authorities to establish the likely road network changes that will be required during the period of the transport strategy. While many of these road proposals have not yet been developed in detail, and designs are not available, the impacts of these proposals have accounted for in the analysis of the public transport requirements. Accordingly, while the analysis of the public transport necessary for the future is the focus of this study, it has involved a composite consideration of the road network.

1.3 Study Methodology

The study has been undertaken in four stages;

- Stage 1 established travel demand within the 2011 base year and 2035 forecast year using the demand from the Greater Dublin Area Regional Model (GDARM);
- Stage 2 identified public transport options that have the potential to meet the demand identified in Stage 1 based solely on capacity thresholds by public transport mode (e.g. rail, light rail, BRT and bus);
- Within Stage 3 the most appropriate public transport options that meet the demand requirements were scored and sifted based on functionality (journey time and ability to meet demand) and cost (capital cost as related to service level); and
- Stage 4 tested the preferred option in the GDARM to confirm its viability.

These stages are discussed in the following sections.

1.3.1 Stage 1 - Establish Demand

To forecast the strategic public transport needs for each of the Study Areas in 2035, demand was established using the GDARM, which has a base year of 2011. To produce the 2035 forecast, planning data was provided by the NTA based on the 2035 population and employment projections.

The 2011 demand outputs were generated for the GDA for the AM peak hour (08:00–09:00). This identified trip ends for all trips greater than 3km for the AM peak hour time periods. The same process was applied for the 2035 demand. The morning peak hour was chosen for the demand analysis because this is when the travel demand is at its highest over the day. The PM peak was not used as demand tends to be spread over a longer time and it also does not typically cater for both work and school trips.

Screenlines were used to develop a broader understanding of travel demand passing through the Study Area. This analysis is primarily used to help inform the capacity requirements for future public transport options for the Study Area.

1.3.2 Stage 2 - Public Transport Option Development

The second stage of the study focuses on developing public transport options to meet the travel demand growth from 2011 to 2035, from the Study Area orbiting the Dublin City Centre during the AM peak hour (08:00-09:00).

Catchment bands for existing public transport services were defined and applied to identify growth within the catchment of existing service areas and to identify areas where the level of service provided by public transport is low or where no service is provided.

Service capacities for possible public transport modes were then defined. This includes the definition of the seating capacity and crush capacity for DART, Commuter Rail, Light Rail, Bus Rapid Transit, Urban Bus, Intercity Bus and Shuttle Bus. For the purpose of option development for the

2035 transport strategy, public transport options are considered based on design capacity which is equivalent to an operating level of service that is at or below 85 per cent of crush capacity. This ensures that at no time will the entirety of the target demand be accommodated by a service that is underutilised, or is so busy as to make the service less desirable.

Crush capacity is an industry standard expression relating to the loading upper limit of public transport services that allow standing as a means of catering for higher levels of patronage. Design capacity is assumed at 85 per cent of this to allow for a more comfortable and attractive level of service to be provided.

Development of public transport options for Stage 2 of the study focused on utilising the capacity and frequency definitions to determine the appropriate public transport mode to meet AM peak hour demand.

1.3.3 Stage 3 - Public Transport Option Scoring

Stage 3 takes the output of the high level public transport options developed in Stage 2 and scores them based on categories relating to demand, functionality and cost.

The functionality scoring category analysed the capacity of the public transport option to meet the 2035 travel demand from the Study Area orbiting Dublin City Centre during the AM peak hour. It also considered the maximum duration of the journey.

The cost scoring category is based on the capital costs per option. It also considers the extent to which existing infrastructure is utilised and maximised for efficiency. Typical capital costs have been assumed, generally based on a cost per km. Typical costs include a level of risk. A more detailed review would be required to confirm the likely cost, for example to account for land acquisition and all major risks. Operational costs are not considered. Despite this, the outline costs are considered to provide a reasonable estimation of costs at a suitable level for comparative purposes for this stage of review.

The public transport options with the best score were recommended to be considered further as part of the larger 2035 Greater Dublin Area Transport Strategy.

The Do Minimum scenario, described in Section 2.3 is used as a basis for the development of the public transport options to serve the growth in demand to 2035 originating within the South East Corridor.

1.3.4 Stage 4 – Transport Modelling Assessment

This stage tested the preferred option in the Greater Dublin Area Regional Model (GDARM). The modelling exercise was undertaken to determine the likely viability, usage and operation of the proposed services for implementation by 2035.

In addition to the Do-Minimum scenario, the GDARM includes additional schemes assumed (described in Section 2.3) as part of the wider GDA Strategy.

The modelling exercise has not included the collective benefits that could be provided by Park and Ride and demand management measures. It should be noted that because the Park and Ride facilities and Demand Management Measures were not included in the modelling stage, the actual benefits of the proposed measures are likely to be greater than reported.

1.4 Report Structure

The report is structured as follows:

- Section 2 describes the Inner Orbital Study Area and outlines the Do Minimum scenario;
- Section 3 details the results of the demand analysis for the Study Area and identifies the 2035 public transport target demand;
- Section 4 develops the public transport options to meet the demand established in Section 3;
- Section 5 scores the public transport options developed in Section 4 outlining an emerging preferred option to be brought forward to the modelling assessment;
- Section 6 outlines the modelling assessment of the proposed public transport services;
- Section 7 describes the Preferred Emerging Scheme; and
- Annex 1 outlines the Stage 2 capacity analysis of the different options considered.

2 Study Area

2.1 Corridor Description

The Dublin IOC, shown in Figure 2-1 generally covers the area between the M50 and the City Centre, from Finglas to Rathmines, forming a half ring shape around Dublin City Centre. The IOC was defined using electoral area boundaries and in two locations the IOC extends beyond the M50 to the west. The boundary between the IOC and Dublin City Centre comprises of North Circular Road to the north, the South Circular Road to the west, and the Grand Canal to the south.

The IOC covers an area of approximately 75km^2. The IOC consists primarily of suburban residential and employment areas. Phoenix Park and Liffey Valley comprise an east-west running green belt through IOC Study Area.

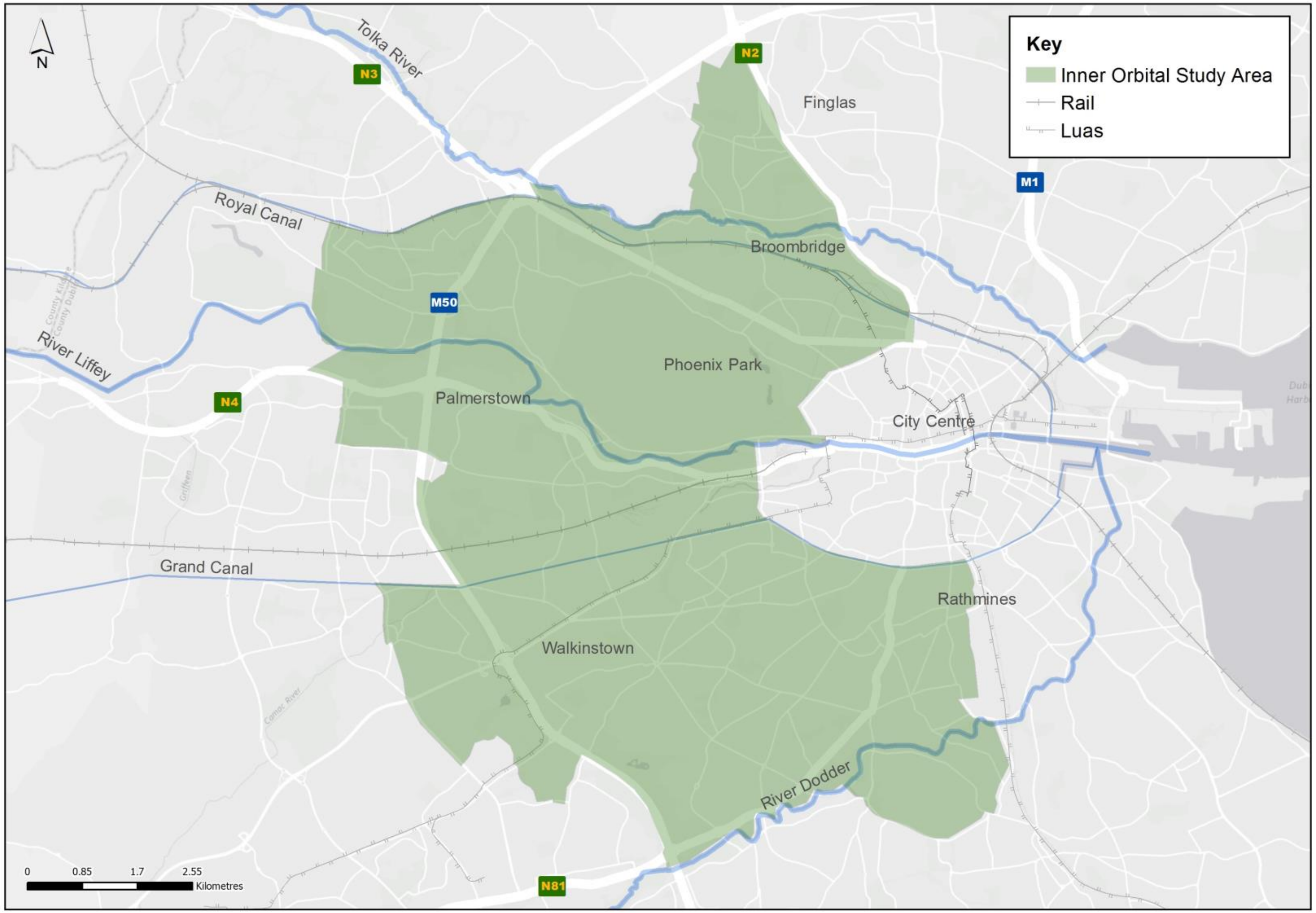


Figure 2-1: Dublin Inner Orbital Corridor – Study Area

2.1.1 Constraints

The following lists the key constraints to the provision of orbital public transport services within the IOC.

- Tolka River – two bridge crossings;
- North West Rail Line – two level crossings and two bridge crossings;
- Royal Canal – four bridge crossings;
- Phoenix Park – nine access points;
- River Liffey – one bridge crossing;
- South West Rail Line – four bridge crossings;
- Grand Canal – four bridge crossings; and
- M50.

2.2 Existing and Planned Strategic Road Network

The corridor contains the M50 major national inter urban route which caters for significant volumes of orbital traffic . In addition, the radial routes of the R127 Navan Road, the R148 Palmerstown Bypass, the R110 Naas Road and the R137 Templeogue Road accommodate high levels of traffic accessing the City Centre from the national road network.

The capacity of the M50 must be protected for strategic traffic movements, including the distribution of goods. Congestion along the M50 is an increasingly serious issue, particularly at peak times.

There is limited opportunity for significant road capacity enhancements in the IOC Study Area from the perspective of both physical constraints and environmental considerations. Therefore, providing for increasing transport demand through alternative modes, such as public transport, will be necessary to protect the function and operation of the M50 as a strategic corridor.

Figure 2-2: Existing Strategic Road Network

2.3 Existing Public Transport Provision

The existing public transport provision in the IOC consists predominantly of radial services that cater for the demand to and from Dublin City Centre for trips originating outside and within the IOC Study Area.

- Heavy Rail – North West Line and South West Line;
- Light Rail – Luas Red Line; and
- Urban Bus – including 20 Dublin Bus core services.

It is apparent from reviewing the public transport services within the IOC that the public transport services traverse through the IOC Study Area to/from Dublin City Centre. Whilst there are some local orbital bus services, there is no high capacity, high quality, public transport service that travels in an orbital manner around the City Centre within the IOC. As such, much of the demand for orbital movements within the IOC Study Area is catered for by private car usage or by utilising two radial public transport services, with an interchange in the City Centre.

Notable orbital bus services include:

- Route 17 from Rialto to Blackrock – three services per hour during the AM Peak.
- Route 18 from Palmerstown to Sandymount – three services per hour during the AM peak.

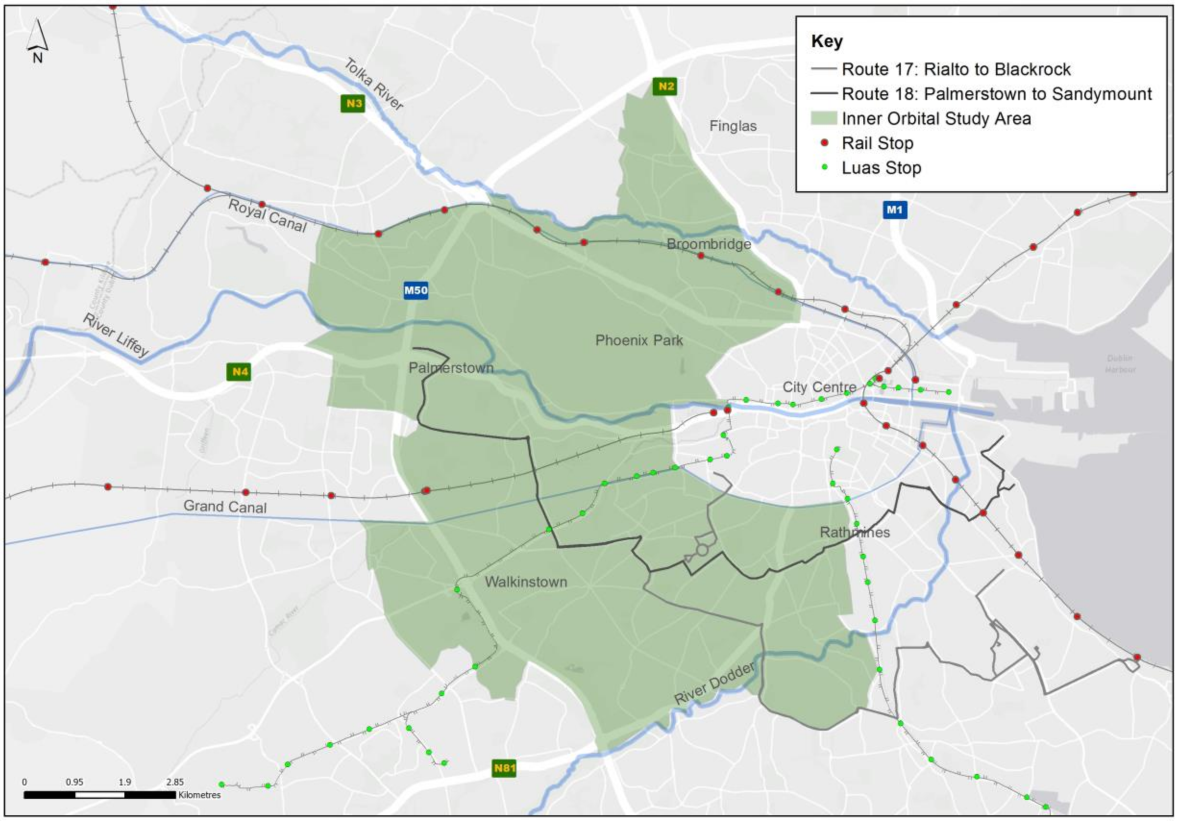


Figure 2-3: Existing Rail and Luas Services

2.4 Do Minimum – Proposed Public Transport Provision

This section describes the Do Minimum scenario. The Do Minimum is the baseline against which all of the proposed public transport options are compared against. The Do Minimum scenario includes for some public transport improvements within Dublin City Centre, the Do Minimum public transport improvements include the following:

- Phoenix Park Tunnel;
- Dublin City Centre Rail Re-Signalling Project; and
- Luas Cross City.

In addition, the following minor road and localised bus schemes, located in the South East corridor, are included in the Do Minimum scenario:

- Lucan QBC Enhancements;
- Firhouse-Ballycullen QBC; and
- Ratoath Road including Reilly's Bridge.

Figure 2-4 illustrates the proposed Do Minimum public transport provision. It should be noted that the Do Minimum measures will have a minimal impact on orbital demand within the IOC Study Area as the Do Minimum public transport measures largely affect radial movements. Further details of the major public transport improvements assumed as part of the Do Minimum network are outlined below.

2.4.1 Phoenix Park Tunnel

The re-opening of the Phoenix Park Tunnel will allow for rail connectivity from the South West Line to the South East Line serving Drumcondra, Connolly, Tara Street, Pearse and Grand Canal Dock Stations. The trains using the Phoenix Park Tunnel will not stop at Heuston Station.

The proposed improvements can accommodate four trains per hour (4thp) in one direction and 3tph in the other direction. It is likely that the 4tph would travel eastbound from the South West line using the tunnel in the AM peak and westbound in the PM peak to cater for the peak tidal demand into and out of the city centre.

2.4.2 Dublin City Centre Rail Re-Signalling Project

The Dublin City Centre Rail Re-Signalling project will enable increased train path capacity across the City on the Loopline Bridge over the Liffey. The current capacity constraint of 12tph will be raised to 17tph. It is considered possible to operate with 20tph but operational resilience may be compromised at this level. A new turn-back platform at Grand Canal Dock is proposed, providing turn-back facility for 9tph, leaving at least 8tph to carry on southbound.

2.4.3 Luas Cross City

The Luas Cross City is an extension of the existing Luas Green Line beginning at the current Green Line Terminus at St. Stephen’s Green, interchanging with the Luas Red Line at O’Connell Street / Abbey Street and continuing northbound to the DIT Grangegorman Campus, Phibsborough and terminating at the Broombridge Rail Station on the Maynooth line. A loop is included at O’Connell Street and Marlborough Street to enable northbound services to return south.

Luas Cross City is currently under construction and the planned operation is for 10 trains per hour extended from the increased 20 trains per hour Green Line service using lengthened 53m long trains. This will provide a design capacity of approximately 3,000 in the peak hour. As demand increases, frequency of service can be increased to 20 trains per hour, with a maximum design capacity of approximately 6,000.

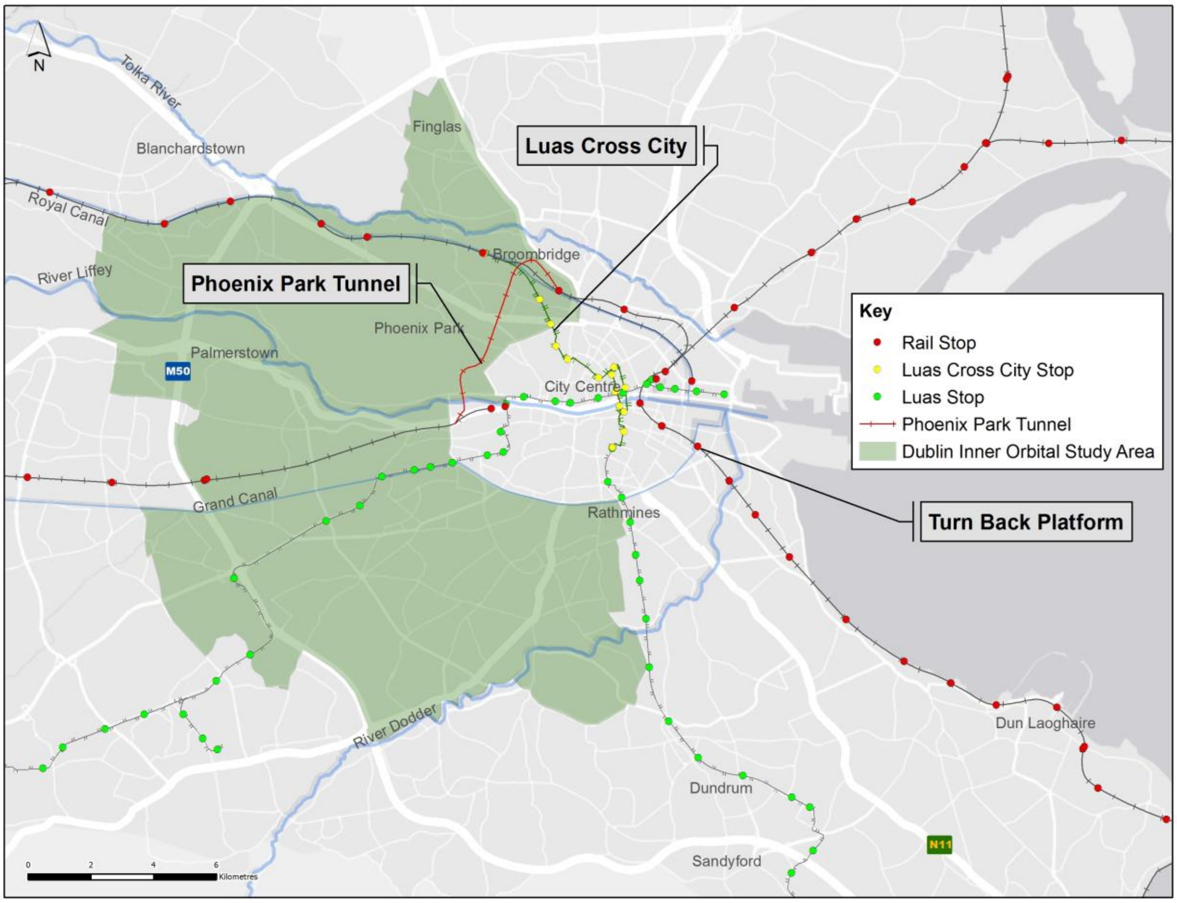


Figure 2-4: Do Minimum Proposed Public Transport Provision

2.4.4 Additional Schemes

The Do Minimum represents the future network supply based on current commitments. However, for the purpose of this study the additional schemes of the DART Underground, Metro North and the M50 multi-point tolling are also considered to be part of the future network for the Greater Dublin Area. A core bus network for the Outer Orbital Corridor outside the M50, as well as the Bus Rapid Transit Network was also considered as additional schemes. Although these schemes are not fully committed, they have been considered as these could influence the choice of schemes that could evolve from the study. All of these schemes will increase the attractiveness of public transport within the GDA and are therefore tested with the preferred public transport option for the Inner Orbital Study Area through the GDARM (please refer to Chapter 6: Transport Modelling Assessment).

The specifics of these additional schemes are still yet to be finalised but for the purposes of this study it is assumed that Metro North would connect the City Centre to the Airport and Swords and would connect with the Luas Green Line. DART Underground is assumed to be a tunnel linking Heuston Station to St. Stephen's Green and Pearse Stations.

The M50 multi-point tolling scheme is assumed to be as per the proposals contained with the M50 Demand Management Report, published by the NRA (now Transport Infrastructure Ireland, TII) in April 2014. Strategic Park and Ride locations within the Greater Dublin Area have also been identified are considered to be a component of the public transport system, although there are no strategic locations within the South West Study Area. It should be noted that demand management measures and Park and Ride are not included in the modelling exercise described in

Section 6 of the report. It is assumed that with the addition of these measures, the benefits of the proposed options will be greater than those reported.

The Bus Rapid Transit Network would operate between Blanchardstown and UCD, and Clongriffin and Tallaght through the study Area. Additionally a western Luas would run through the Study area as well. These services would cater for demand into the City Centre, however the focus on this study is to meet orbital demand, rather than radial demand into the City Centre. The Orbital Core Bus network outside the M50 would operate between Donaghmede and Blanchardstown, Blanchardstown to Tallaght, and Dundrum and Dun Laoghaire.

In a scenario without DART Underground and without Metro North we would consider expanding on the Do Minimum through electrification of the Maynooth Line followed by the electrification of the Kildare Line to Hazelhatch and through the Phoenix Park Tunnel to Connolly Station and also the Docklands on the remodelled Church Junction and Spencer Dock. The benefits of electrification in terms of operating efficiency are well known and by using DART rolling stock the crush capacities are more than doubled. The connectivity across the city is much improved and the timetable could be recast to equalise current Commuter and DART services.

The upgrade of the Green Line would proceed as in the Do Minimum and the increased services on the South East DART line would be as before to make full use of the increased City Centre capacity of 20tph. The use of EMU DART trains on the newly electrified lines would enable much improved connectivity between South East and North West corridors and also between the South West and North East corridors.

The introduction of the DART Underground is a step change in capacity for the heavy rail network in Greater Dublin. Increased electrified services are made possible in a more efficient manner across the City with more connectivity and a much increased capacity. With a reasonable 12tph through the tunnel in each direction a design capacity of 14,400 is available on 8-car DART trains.

With the introduction of Metro North it should be possible to operate northwards of Sandyford with 30tph, reducing to 20tph in tunnel just south of St Stephen’s Green, leaving 10tph for the Luas Cross City route. The metro trains would be designed for in-tunnel operation.

3 Demand Analysis

3.1 Establishing Demand

3.1.1 Establishing Base Year and 2035 Forecast Demand

The demand data utilised for this study considers assessment of a typical AM (08:00 – 09:00) peak hour. The assessment considers the 2011 base year and a 2035 forecast year.

The trip end data for the GDA was derived from planning data for both the Base Year and 2035 forecast scenarios. The base year data is based on Small Area Population Statistics available from the Central Statistics Office as well as a combination of NACE building data, and POWSCAR variables and has been used in the calibration of the base year trip end model and demand model. The forecast data has been prepared by the NTA based on their most up to date forecasted land use assumptions which cover the entire country, although particular focus is given to the GDA region.

Having derived trip ends the GDA demand model applies destination choice algorithms to derive travel matrices which have been calibrated in the base year to replicate observed mode shares and trip length distributions. For this analysis, only trips with a distance of longer that 3km were considered as it is assumed that trips with a distance of less than 3km will be provided for through walking and cycling and local public transport. As such these trips were not considered in the assessment of the strategic public transport requirements for the study area.

3.1.2 Target Demand Level

There are limited direct public transport services catering for orbital demand within the IOC. The majority of orbital trips are made by private vehicles. If existing trends were to continue, nearly 100 per cent of all future orbital demand would not have a viable public transport alternative.

In order to mitigate this potential scenario, this review examines the potential public transport services required to meet a target level of 100 per cent of demand growth and 30 per cent of existing orbital demand. 100 per cent of demand growth has been identified as an absolute minimum to accommodate.

3.1.3 Overall Demand Levels

Table 3-1 outlines the overall demand levels for 2011 and 2035, also highlighting overall demand growth and the overall target demand. The demand levels show the typical AM peak hour demand wholly internal to the IOC Study Area and the total demand that includes trips entering or exiting the Study Area.

Table 3-1 also outlines the approximate public transport percentage that would be achieved if the target demand levels are met. The proportion levels exclude short trips (<3km) which are considered to be generally made as a walking or cycling trip.

It is apparent that trips with an origin or destination external to the IOC study area make up a significant element of the demand, and as such are essential to their inclusion in the demand assessment.

Table 3-1: Overall Demand Levels - AM Peak Hour

	2011	2035	Growth	Target Demand: Growth + 30% Existing
Internal Demand	10,200	11,700	1,500	4,500
Total Demand	25,600	29,500	3,900	11,600
PT Percentage	<1%	40%	100%	39%

As can be seen above in Table 3-1**Error! Reference source not found.** there were approximately 10,200 journeys internal to the study area completed while trips starting or ending externally equated to 25,600. The assumed percentage of public transport patronage is <1 per cent however some additional trips may travel on the existing limited services, or on existing services interchanging via the City Centre.

3.2 Demand Assessment

3.2.1 Inner Orbital Screenlines

In order to determine the level of demand to be accommodated by the potential options, seven screenlines were applied to the IOC study area. The screenlines were developed to address the orbital demand moving in clockwise / anti-clockwise directions around the City Centre within the M50 ring. The following lists the screenlines used in the demand assessment:

- Phoenix Park / N3;
- River Liffey;
- Grand Canal;
- Walkinstown / Kimmage; and
- N81.

3.2.2 Screenline Demand

Figure 3-1 illustrates the level of demand crossing the seven screenlines for the 2011 base year, 2035 forecast year, the demand growth from 2011 to 2035, and the target demand (demand growth plus 30 per cent of 2011 demand).

It is apparent that there is greater orbital demand at the Grand Canal and Walkinstown screenlines of the study area. The Phoenix Park / N3 and N81 screenlines have 1,000 / 1,200 and 900 / 1,200 respectively.

There is greater demand on the south side of City than on the north side. The Walkinstown / Kimmage screenline in the 2011 demand image is the only cordon in the study area with a combined value (both directions) in excess of 3,500 (3,700-) in the AM peak.

Figure 3-1 and Table 3-2 also shows that there is no tidality to the demand across the screenlines, with demand crossing the screenlines in both directions being relatively balanced. Percentage differences from lower flow to higher flow for 2011 demand are outlined in Table 3-2 indicating differences as low as 5.9 per cent. This would help to ensure public transport viability as both clockwise and anti-clockwise trips would be relatively balanced in terms of patronage.

Table 3-2: Percentage Differences at each Screenline for 2011 Demand

Screenline	% Difference by Direction
Phoenix Park / N3	20.%
River Liffey	33.3%
Grand Canal	5.9%
Walkinstown / Kimmage	17.6%

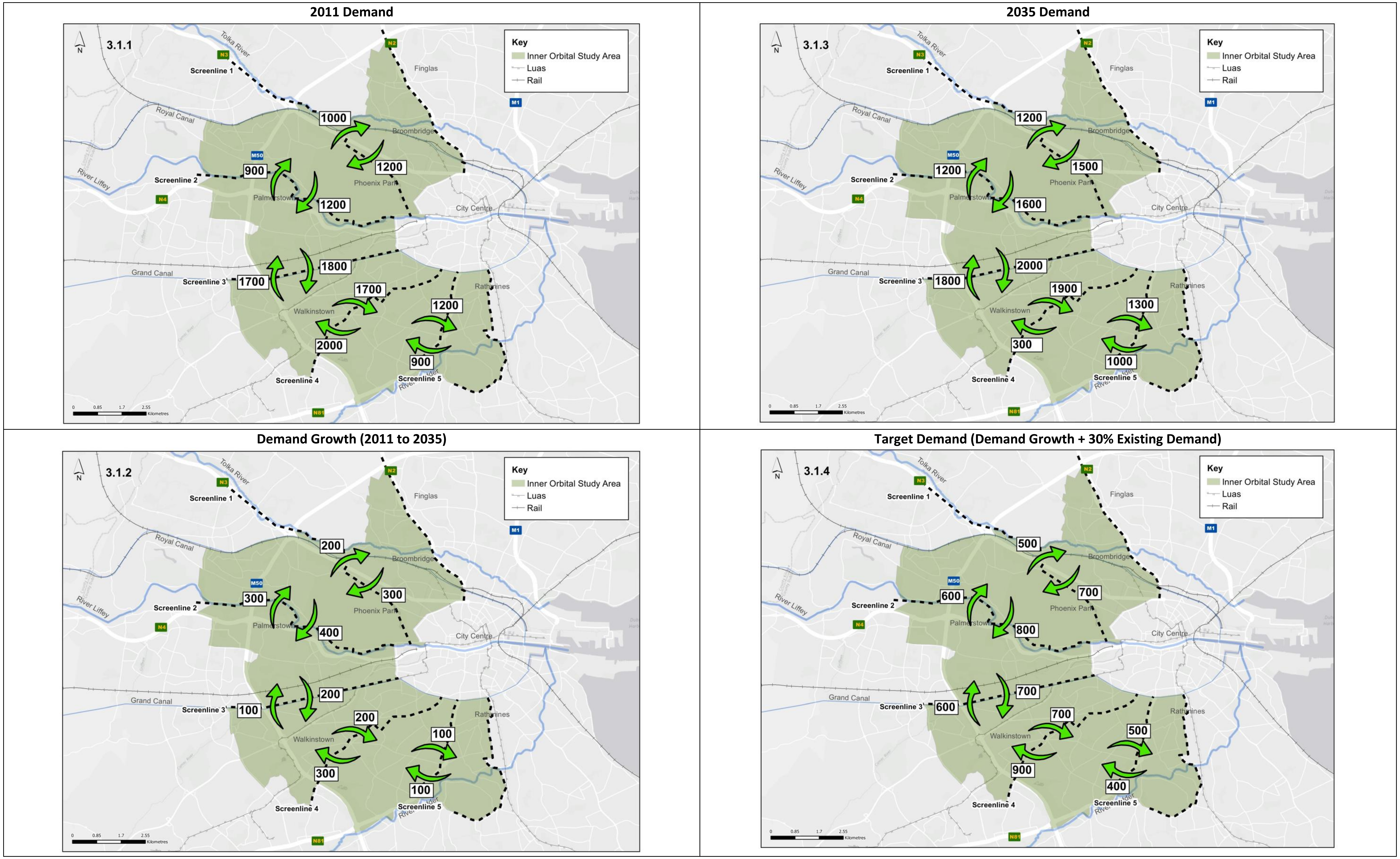


Figure 3-1: Screenline Demand – AM Peak Hour

4 Public Transport Option Development

4.1 Introduction

This section outlines the development of various public transport options at a high level in order to meet the target demand (demand growth plus 30 per cent of existing demand) crossing the screenlines. From Image 3.1.4, in Figure 3-1: Screenline Demand – AM Peak Hour, the target demand to be accommodated by public transport is 500 and 700 in the clockwise and anti-clockwise directions respectively at the Phoenix Park / M3 screenline and 400 and 500 clockwise and anti-clockwise at the N81 screenline. The peak level of target demand within the study area is 900 (clockwise) at the Walkinstown / Kimmage screenline.

For the purposes of the assessment it is assumed that during the AM peak hour the current public transport services are generally close to or at capacity and therefore can accommodate little or no increase in demand. It is therefore assumed for the purpose of this study, that the target demand to be served by public transport for the Inner Orbital Corridor in both clockwise and anti-clockwise directions is approximately up to 900.

It is necessary, therefore, to generate likely public transport options that can provide a level of service to accommodate this target demand level. The options, in the first instance, were generated by focussing solely on the proposed public transport services/modes ability to accommodate the screenline demand. This method was adopted so that the option generation process was not restricted by current network constraints that could be removed in the future.

As mentioned previously in Chapter 2, the Do Minimum Network is used as a basis for the development of the public transport options to serve the Corridor. The recommended public transport option is then assessed further within the GDARM with other additional schemes such as DART Underground, Metro North, BRT, and West Luas which could have an impact on the demand for public transport in the Outer Orbital Study Area. However because these services focus on serving radial routes to the Dublin City Centre they won't substantially serve the Orbital demand inside the M50.

4.2 Design Capacity of Public Transport Modes

The following lists the potential alternative Public Transport Modes that could be considered to meet the target demand:

- Heavy Rail (DART and Commuter);
- Light Rail (Luas and Metro);
- Bus Rapid Transit (BRT);
- Urban Bus Services (including feeder and express bus services);
- Intercity Bus Service; and
- Shuttle Bus.

Each service type has a predefined seated capacity and crush capacity (peak standing capacity). In order to ensure that a quality level of service is provided by the proposed options, design capacities for each of the above service type were developed. Design capacity is assumed to be 85 per cent of crush capacity or 100 per cent of seated capacity, whichever figure is greater. This ensures that at no time will the entirety of the target demand be accommodated by a service that is underutilised or is so busy as to make the service less desirable.

Crush capacity is an industry standard expression relating to the loading upper limit of public transport services that transport services that allow standing as a means of catering for higher levels of patronage. Design capacity is

capacity is assumed at 85 per cent of this to allow for a more comfortable and attractive level of service to be service to be provided.

Table 4-1 details the design capacity for each of the services and outlines the peak hour design capacity for each service based on the frequency of the service.

Table 4-1: Design Capacity and Peak Hour Service Frequency

Service Type	DART	Commuter	Light Rail Transit	Bus Rapid Transit	Urban Bus	Intercity Bus	Shuttle Bus
Design Capacity per Service Vehicle/Train	1,190	409	259	102	75	50	30
Frequency	**Capacity**						
60 min	1,190	409	259	102	75	50	30
40 min	1,785	613	389	153	112	75	45
30 min	2,380	818	519	204	150	100	60
20 min	3,570	1,227	778	306	224	150	90
15 min	4,760	1,635	1,037	408	299	200	120
12 min	5,950	2,044	1,296	510	374	250	150
10 min	7,140	2,453	1,556	612	449	300	180
8 min	8,925	3,066	1,944	765	561	375	225
6 min	11,900	4,089	2,593	1,020	748	500	300
5 min	14,280	4,906	3,111	1,224	898	600	360
4 min	17,850	6,133	3,889	1,530	1,122	750	450
3 min	23,800	8,177	5,185	2,040	1,496	1,000	600
2 min	35,700	12,266	7,778	3,060	2,244	1,500	900

Note: the highlighted text above indicates where the target demand of approximately 900 trips (in both clockwise and anti-clockwise directions) could be provided by a single transport mode operating at the specified service frequency.

4.3 High Level Public Transport Options

This section outlines the different public transport options developed at a high level to cater for screenline target demand based on service frequencies and capacities. The sole focus at this high level options development stage is to outline public transport services than can accommodate the maximum clockwise and anti-clockwise screenline demand within the IOC Study Area.

The following lists the five public transport options considered:

- Option 1: Light Rail Transit (LRT);
- Option 2: LRT & two supplementary urban bus services;
- Option 3: Bus Rapid Transit (BRT);
- Option 4: BRT & two supplementary urban bus services; and
- Option 5: Two orbital urban bus services & two supplementary urban bus services.

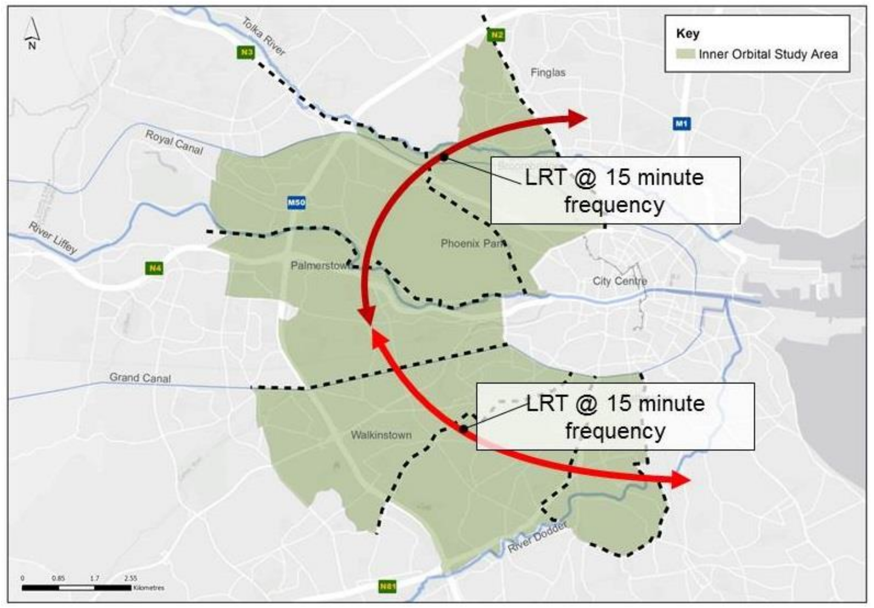
Figure 4-1 illustrates the high-level coverage of the proposed service for each option and identifies the service frequency required to meet the screenline demand.

4.4 Capacity Assessment of Proposed Public Transport Options

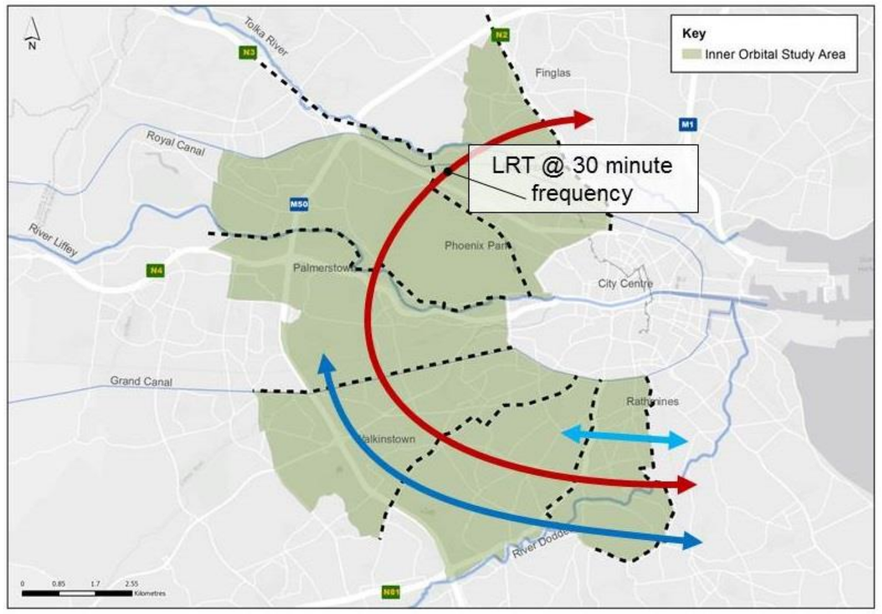
A capacity assessment of the proposed public transport options was undertaken and is included in Annex A. The capacity assessment highlights that for each option the proposed public transport provision can accommodate all of the target demand.

The target varies throughout the corridor in each direction. In the clockwise direction the target demand varies from 900, at Walkinstown / Kimmage screenline, to 400, at the N81 screenline. In the anti-clockwise direction, the target demand varies from 800 to 500 at the same locations.

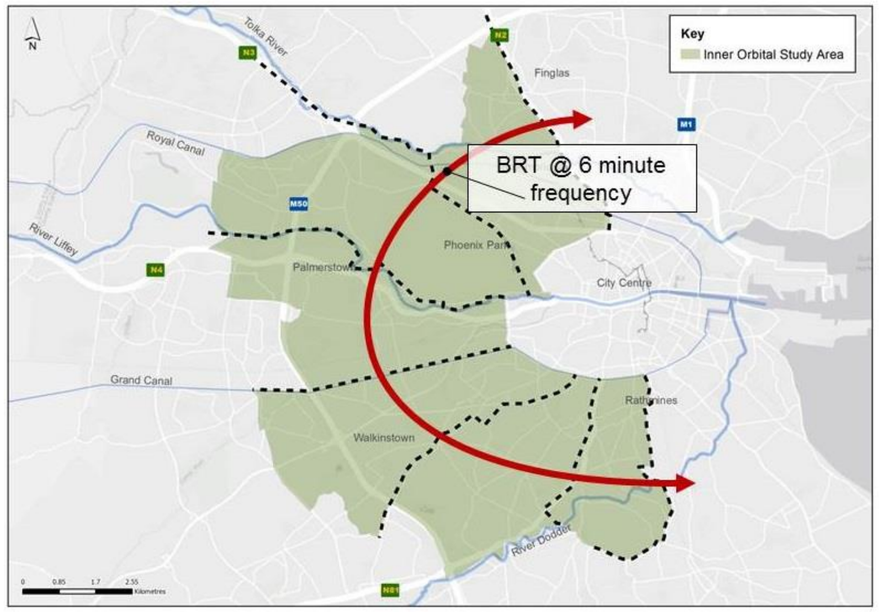
Option 1: Luas



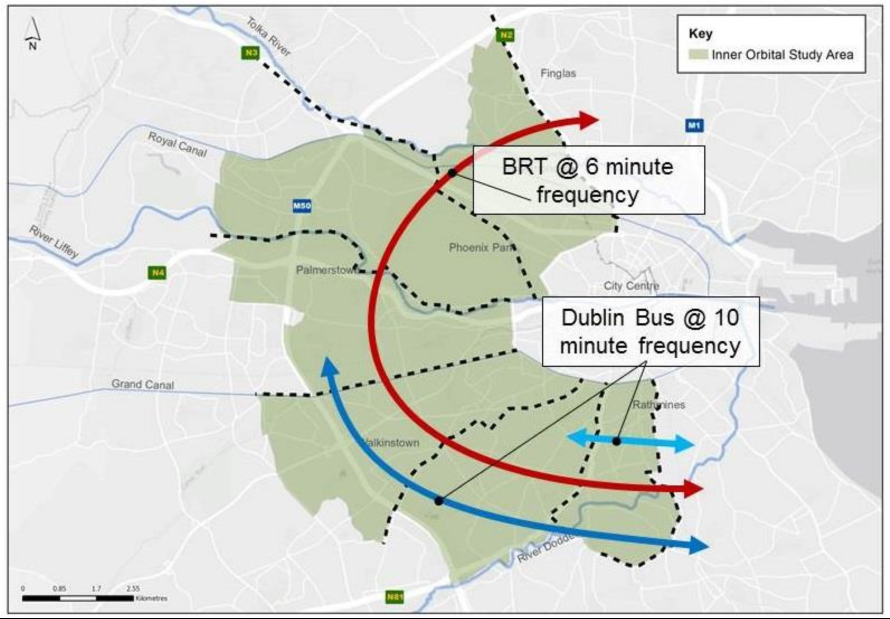
Option 2: Luas + Two Supplementary Bus Services



Option 3: Bus Rapid Transit



Option 4: Bus Rapid Transit & Two Supplementary Bus Services



Option 5: Two Orbital Bus Services & Two Supplementary Bus Services

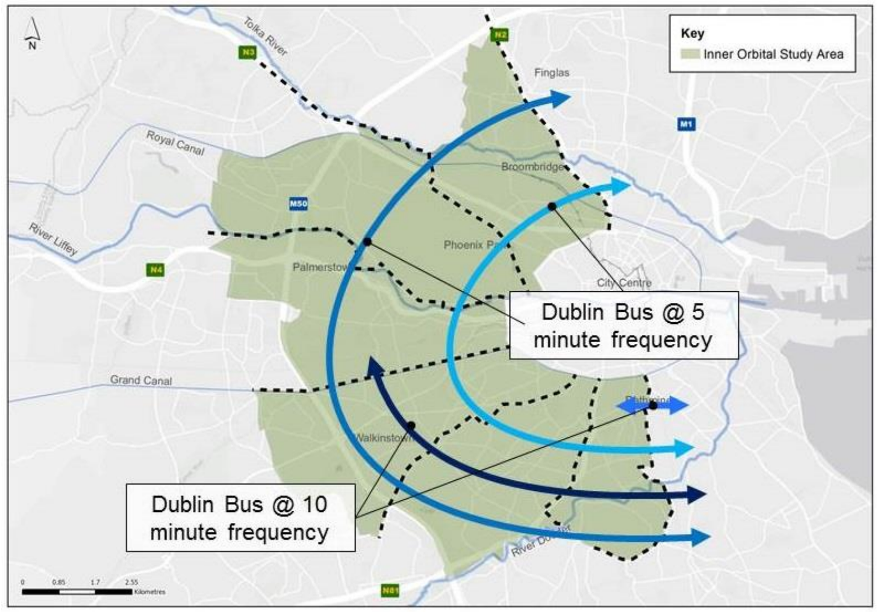


Figure 4-1: Proposed Public Transport Options

5 Public Transport Option Scoring

This section outlines the comparison of the five options that were brought forward from the option development stage. This comparison is based on the ranking of the options against three criteria:

- demand accommodated within catchment;
- journey time; and
- cost.

The higher the ranking score, the better the option achieved the criteria. The overall ranked scores for each criterion are then summed for each option. The highest scoring option is considered as the preferred option, which can be taken forward to the modelling stage.

5.1 Proposed Public Transport Options

As part of the option scoring assessment a more detailed approach to the public transport options was undertaken. The routing of the proposed public transport services was undertaken in greater detail, taking into account: proposed demand growth locations, network constraints and interchange with existing public transport. The demand represents the growth between years 2011 and 2035 for morning peak hour plus 30 per cent of existing demand. Figure 5-1 to Figure 5-5 illustrate the identified routes of the proposed public transport options.

The routes identified are shown to terminate at the boundaries of the IOC Study Area; however, these services will need to continue beyond the Study Area boundary in order to ensure that they can provide access to the significant level of orbital demand identified as having an origin or destination external to the study area earlier in the report.

It should be noted that the public transport routes highlight indicative routes and frequency. Multiple services may be required, as the length of the longest public transport routes may actually take two or three overlapping services along the entirety of the route to cater for the logistics of service operation.

5.1.1 Option 1: Light Rail Transit

Option 1 proposed a Light Rail Transit (LRT) service running in an orbital route with the aim of bisecting the IOC Study Area. The proposed route includes the following locations and infrastructure provision:

- Terenure;
- Walkinstown;
- Potential for interchange with new rail station at Kylemore;
- Ballyfermot;
- Liffey Bridge near Chapelizod;
- Castleknock;
- Rathborne;
- Ashtown; and
- Finglas.

To meet target demand, the LRT north of the River Liffey requires a service frequency of 15 minutes.

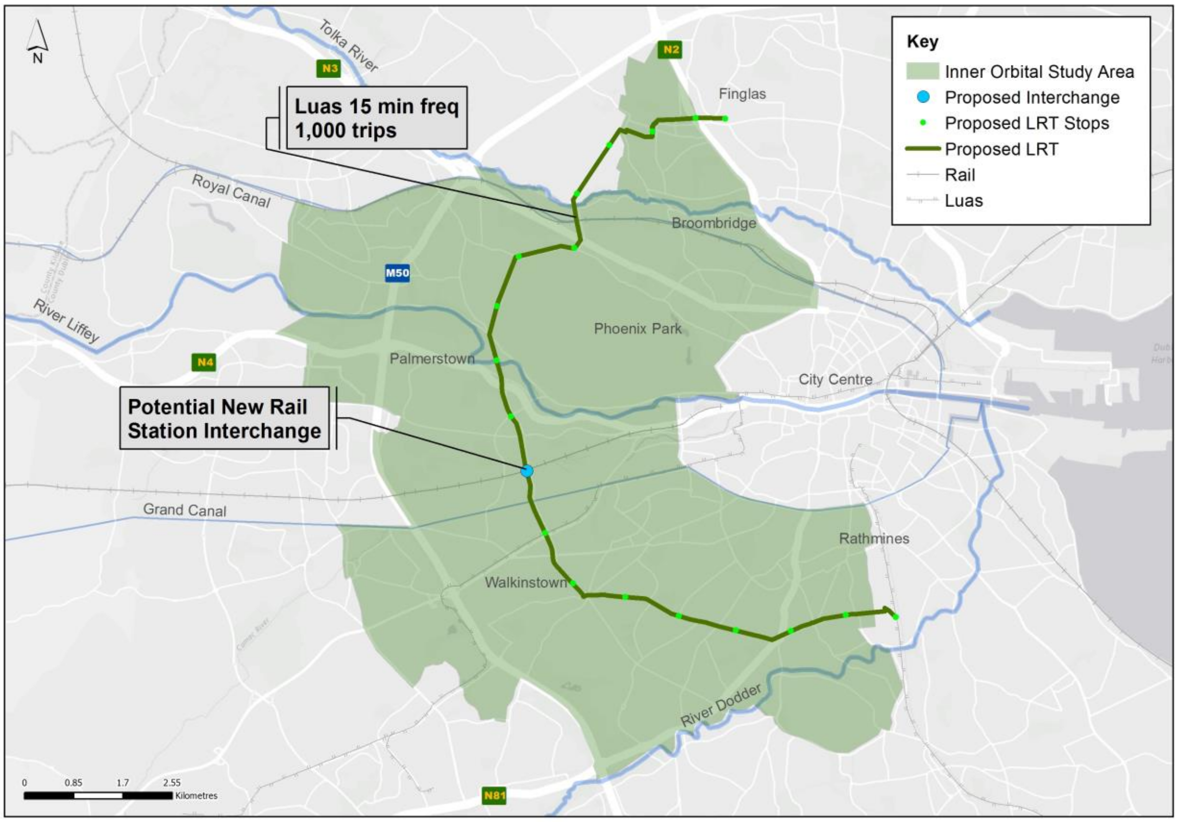


Figure 5-1: Option 1: Light Rail Transit

5.1.2 Option 2: LRT & Two Supplementary Urban Bus Services

Option 2 proposed a LRT service with a similar route to that in Option 1 which is supplemented on the south side of the River Liffey by the introduction of two bus routes to cater for the target areas of increased demand and to widen the service catchment.

The longer of the two bus routes covers the following areas:

- Rathmines;
- Kimmage;
- Drimnagh;
- Inchicore; and
- Park West.

The shorter of the two bus routes covers the following area:

- Templeogue; and
- Walkinstown.

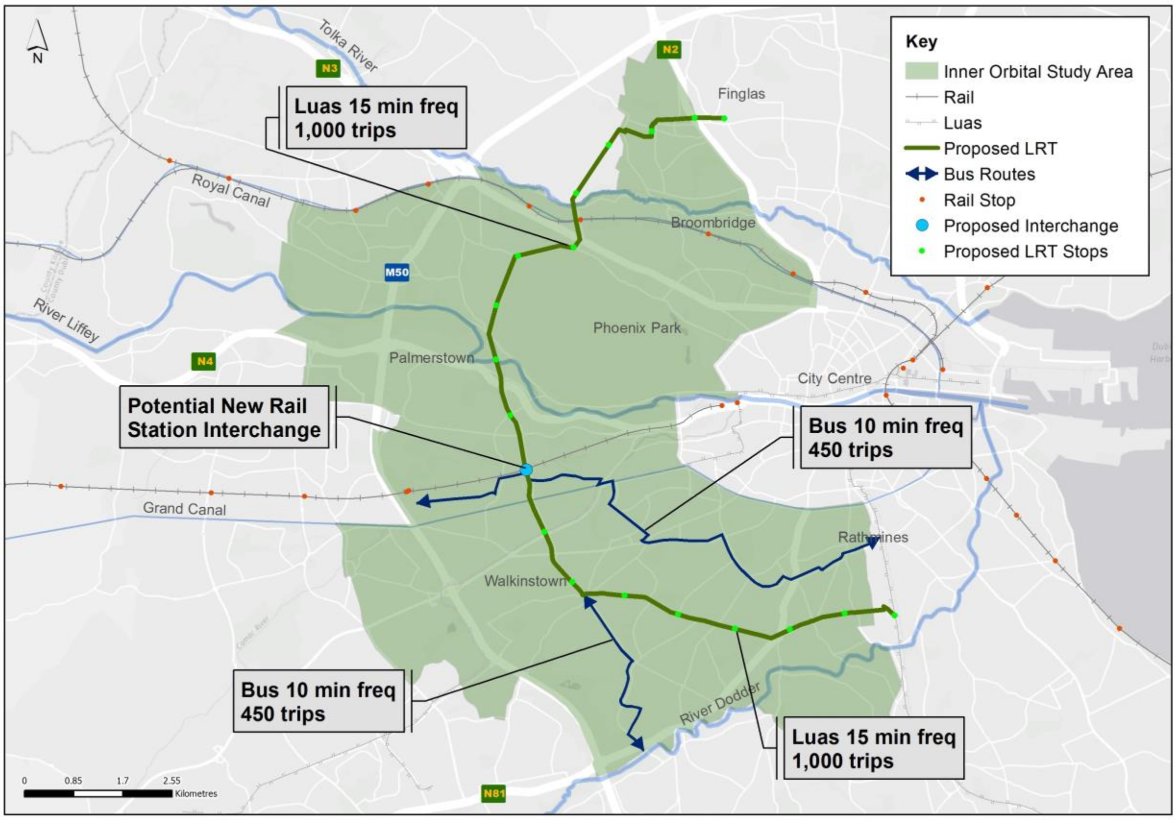


Figure 5-2: Option 2: LRT & Two Supplementary Bus Services

5.1.3 Option 3: Bus Rapid Transit

Option 3 proposed a Bus Rapid transit (BRT) service with a similar route to the LRT outlined in Option 1. The BRT requires a service frequency of 6 minutes providing a capacity of up to 1000 trips per hour.

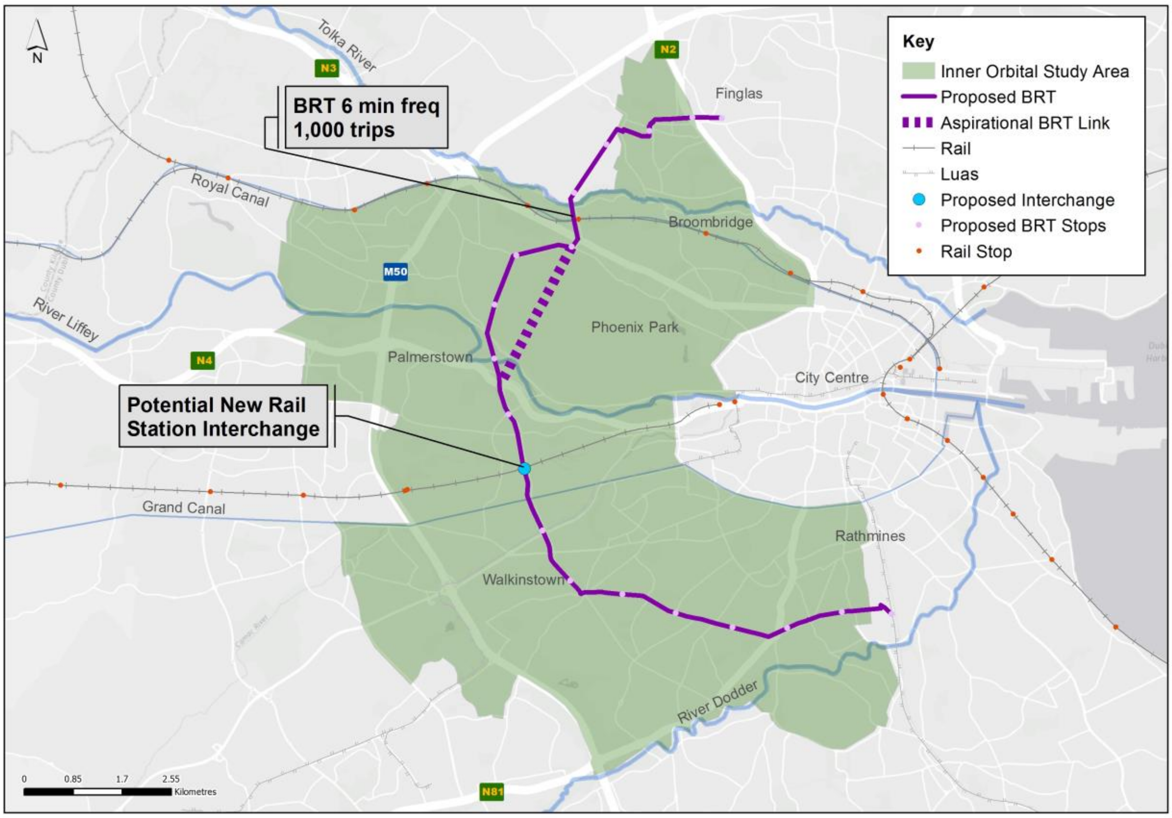


Figure 5-3: Option 3: Bus Rapid Transit

5.1.4 Option 4: Bus Rapid Transit & Two Supplementary Bus Services

Option 4 proposed a BRT service with a similar route to that in Option 3. This is supplemented on the south side of the River Liffey by the introduction of two bus routes as outlined in Option 2.

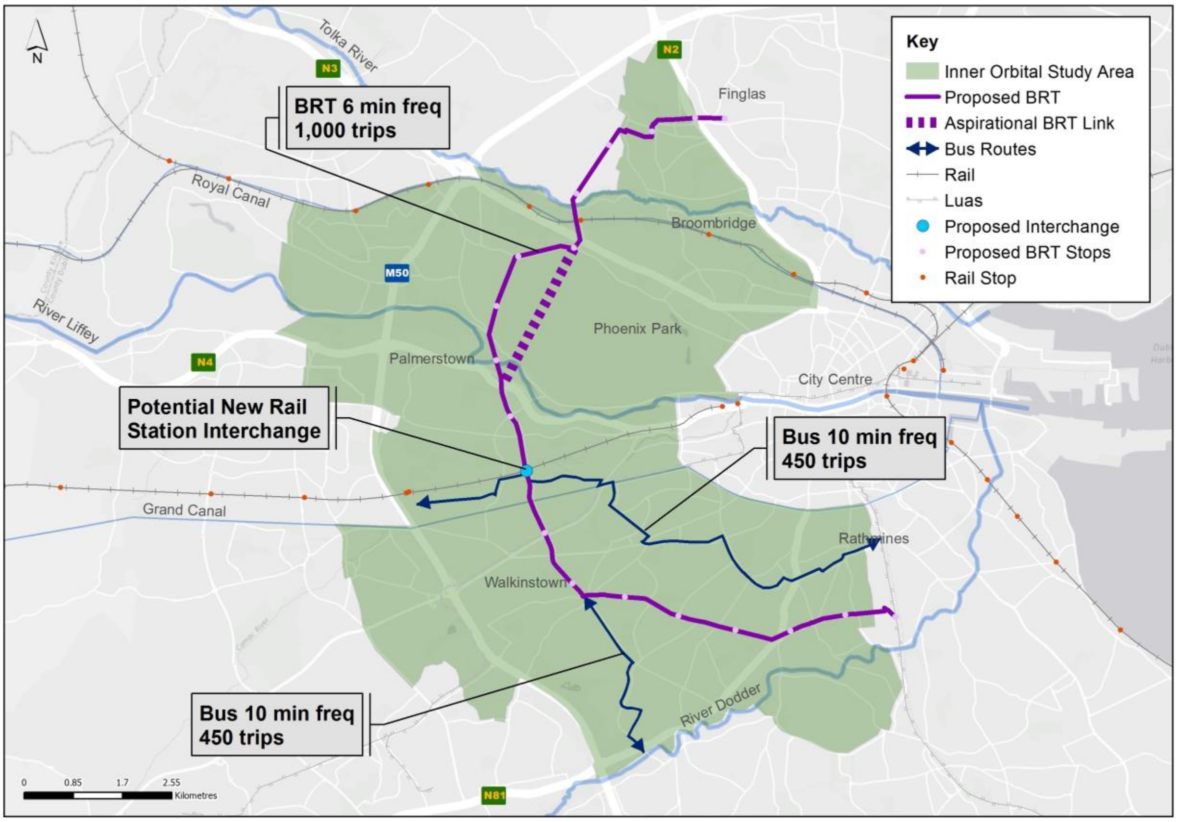


Figure 5-4: Option 4: Bus Rapid Transit & Two Supplementary Bus Services

5.1.5 Option 5: Two Orbital Bus Services & Two Supplementary Bus Services

Option 5 proposed two long orbital bus routes to cater for the overall orbital movements in the IOC Study Area. The two long bus routes would have a frequency of 5 minutes to cater for the target demand. The level or provision and priority for the bus routes is envisaged to be similar to that of a Quality Bus Corridor (QBC). The proposed outer long bus route includes the following locations and infrastructure provision:

Outer Long Bus Route

- Churchtown;
- Rathfarnham;
- Templeogue;
- Walkinstown;
- Ballyfermot;
- Liffey Bridge west of Chapelizod;
- Castleknock;
- Rathborne;
- Ashtown; and
- Finglas.

Inner Long Bus Route

- Rathmines;
- Kimmage;
- Drimnagh;
- Inchicore;
- Island Bridge;
- Cabra; and
- Glasnevin.

These two long orbital Bus Routes are supplemented on the south side of the River Liffey by two shorter bus routes to cater for the target areas of increased demand and to widen the service catchment. One bus route caters for the demand between the two long bus routes and covers Terenure, Walkinstown and Ballymount. The other short bus route caters for demand in the Templogue / Knocklyon area. These services would run between 10 minute and 30 minute frequencies to meet the screenline demand.

The orbital routes and supplementary services are required to extend beyond the boundary of the Study Area to the east, capturing greater demand and interchanging with major radial services.

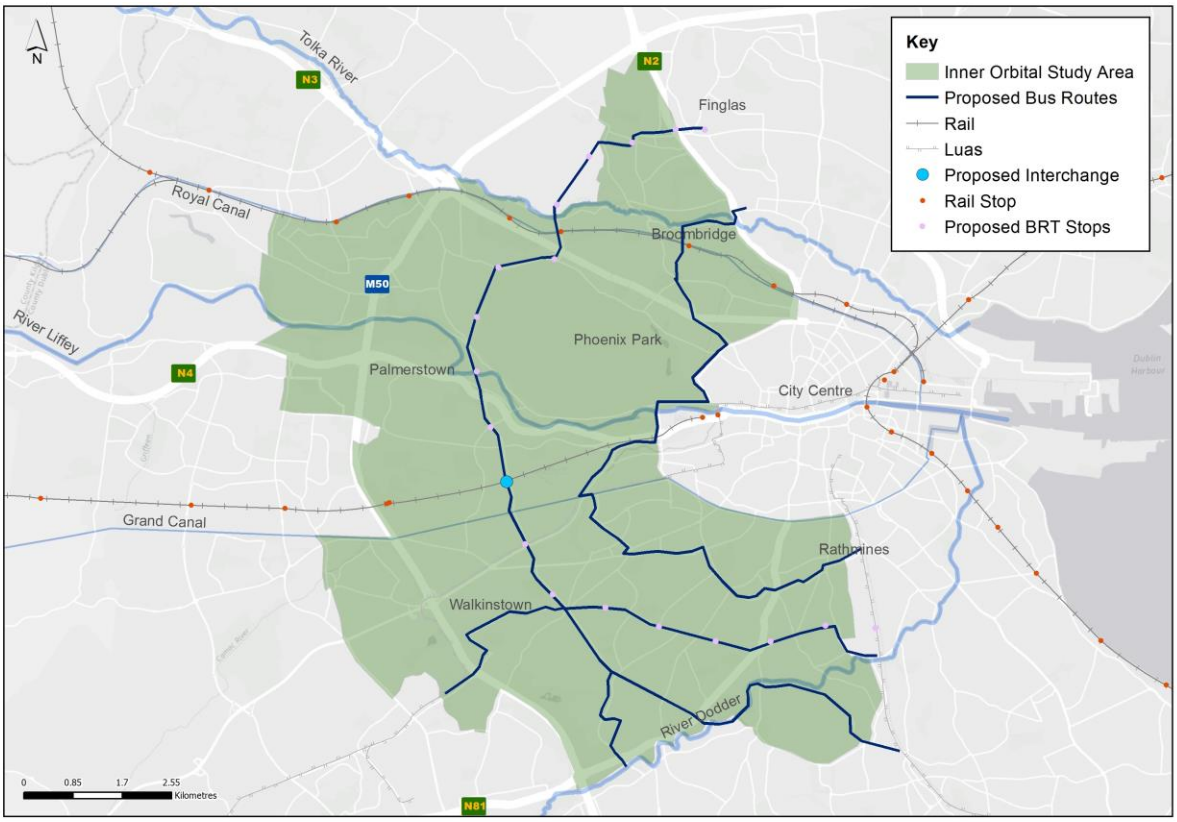


Figure 5-5: Option 5: Two Orbital Bus Services & Two Supplementary Bus Services

5.2 Comparison of Target Demand Assessment

As already outlined earlier in the report, each of the proposed six options provides adequate service capacity that can cater for 100 per cent of the target demand. In order to score how well each option accommodates the target demand level a catchment analysis has been undertaken.

5.2.1 Service Catchment

The catchment analysis is based on agreed catchment areas associated with the different types of public transport service. Table 5-1 outlines the catchment associated with each public transport service.

Table 5-1: Service Catchment

Service Type	Catchment Distance	Catchment Band Type
DART	1,000m	Radius from stop
Commuter	1,000m	Radius from stop
Light Rail Transit	800m	Radius from stop
Bus Rapid Transit	800m	Radius from stop
Urban Bus	400m	Band out from route
Intercity Bus	400m	Band out from route
Shuttle Bus	400m	Band out from route

5.2.2 Public Transport Service Interchange Levels

As part of the catchment analysis the level of interchange to/from the orbital service can also be derived. The following lists how the interchange levels are determined:

- No Interchange – trips with both origin and destination within public transport catchment;
- One Interchange – trips with either an origin or destination within public transport catchment; and
- Two Interchanges – trips with neither origin nor destination within public transport catchment.

It is unlikely that demand requiring two interchanges to utilise the orbital service will consider this as a desirable route, and will potentially revert to private car usage or use linked radial public transport services. Considering this, the catchment assessment considers only trips that require one or no interchange as being accommodated within the public transport service catchment.

5.2.3 Catchment Analysis of Proposed Options

Table 5-2 outlines the percentage of trips that require one or no interchange to reach their destination using the orbital public transport services for each option. The catchment analysis shows that for all options a range of 5 per cent to 8 per cent of trips are catered for without requiring an interchange, within the catchment of the proposed public transport services.

The catchment assessment shows that the single Luas and BRT lines proposed in Options 1 and 3 cater for the least level of demand at 39 per cent with one or no interchange. This increases to 65 per cent with the introduction of the supplementary services to cater for the wider catchment demand in the southern part of the Study Area.

Option 5 caters for the highest catchment with a catchment level of 66 per cent through the use of one or no interchange. A sub option to Option 5 could be to provide a more circuitous route that would target areas of greater demand; however, the less direct service could potentially reduce the appeal of the orbital service.

If all of the IOC orbital target demand was within the identified catchment then the previously identified target of 46 per cent public transport mode share would be achieved. However, as the catchments do not cover all of the IOC Study Area this mode share target will likely reduce on a pro-rata basis, based on the catchment area.

It should be noted that these levels are considered conservative as they do not include trips made by walking or cycling that may be made above the catchment criteria. For example, a number of cyclists who may travel more than 1,000m to a service are ignored. In addition, the provision of a Park and Ride is not considered as part of this study, although it is considered as part of the wider GDA Transport Strategy. Park and Ride facilities will increase the catchment area for those able to drive to the public transport station, in some cases increasing the attractiveness and accessibility of the public transport service.

The results of the catchment analysis highlight the challenge in catering for orbital demand with a single service provision, as the majority of trips require at least one interchange. This also highlights the importance of radial public transport services in the successful delivery of the orbital service in terms of providing quality access to and from the orbital service. This is a result of the orbital demand being diverse and diffuse, and therefore not lending itself to a single concentrated public transport alignment.

In order to cater for trips to get to and from the orbital services, the existing 20 core radial services will need to increase service numbers by approximately three buses per hour on average per route.

Table 5-2: Demand Accommodated Analysis

Demand Captured Percentage of Demand	No Interchange Required	One Interchange Required	Total Demand with One or No Interchange	2035 Mode Share Achieved
Option 1	6%	33%	**39%**	**18%**
Option 2	8%	57%	**65%**	**30%**
Option 3	6%	33%	**39%**	**18%**
Option 4	8%	57%	**65%**	**30%**
Option 5	5%	60%	**66%**	**31%**

5.3 Journey Time Comparison

5.3.1 Journey Time Analysis

The journey time analysis considered a weight average journey time for the overall demand being served, including trips that require interchange between radial services and the proposed orbital services.

The journey time analysis for each of the options is based on combinations of the following:

- Average distances of trips within catchment, out with catchment and from external to study area;
- Speed of proposed orbital service;
  - LRT: 22.2kph
  - BRT: 20kph
  - QBC: 17.2kph

- Interchange penalty of 5 minutes (for each interchange);
- Speed of radial service to interchange with primary orbital service;
    - Radial QBC: 17.2kph; and
- Assumed distance of 1.5km travelled on radial service to interchange with primary orbital service.

There is the potential for conflict of priority between existing radial services and the proposed orbital services. However, it is assumed that the provision of the orbital services will reduce orbital car demand, and coupled with the provision of public transport priority on the approach to junctions with radial services, there should be a negligible impact on either radial or orbital services.

5.3.2 Journey Time Analysis of Proposed Options

Table 5-3 details the journey time analysis for the six options. The first column outlines the weighted average speed of trips that can be accommodated entirely within the catchment of the orbital services provided. This shows that the proposed LRT provides the quickest direct journey times (Options 1 and 2), while the proposed bus services provide the longest direct journey time (Option 5). The second and third columns outline the weighted average journey times for each option taking into account the level of interchange required. The Option 1 LRT provides the fastest weighted average journey time, with Option 5 providing the slowest weighted average journey time.

Table 5-3: Journey Time Analysis

	Description	Direct Journey Time (min)	Weighted JT One or No Interchange (min)	Weighted JT Two or Less Interchange (min)
Option 1	LRT	27.5	32.5	38.9
Option 2	LRT & Two Supplementary Bus Routes	27.9	34.0	38.3
Option 3	BRT	30.6	38.9	43.0
Option 4	BRT & Two Supplementary Bus Routes	30.2	35.6	40.3
Option 5	Two Orbital Bus Routes & Two Supplementary Bus Routes	33.0	39.1	44.0

5.4 Cost Comparison

The estimated cost of each option proposed was considered as one of the scoring criteria.

Table 5-4 outlines the service and infrastructure unit cost for the proposed services and required infrastructure. These high level unit costs per meter of infrastructure have been based on recent schemes developed and introduced in Dublin, and have been agreed with the NTA. Detailed cost estimates would be necessary at a later stage of assessment.

Table 5-4: Service & Infrastructure Unit Cost

Service / Infrastructure	Units	Unit Cost	Source
Luas	€M/km	**40**	Luas B1 RPA Proof of Evidence 2006
BRT	€M/km	**11**	NTA / RPA Presentation on BRT
QBC	€M/km	**3.65**	Assumed 1/3 of BRT Cost
Bridge	€M/km	**90**	Average of Taney Bridge / Waterford Bypass Bridge Costs

Table 5-5 details the comparison of the cost estimates for each proposed option. Due to the significant costs associated with the foundation and track infrastructure associated with Light Rail, Options 1 and 2 have the highest cost estimates at over €720M. Option 3 to Option 5 have a similar range of costs between €220M and €270M, this is due to Option 5 providing significantly more service length than the BRT in Option 3 and Option 4, even though they cost significantly less per km.

Table 5-5: Cost Estimate Comparison

Option	Description	Cost €M
Option 1	LRT	720
Option 2	LRT & 2 Supplementary Bus Routes	770
Option 3	BRT	220
Option 4	BRT & 2 Supplementary Bus Routes	270
Option 5	2 Orbital Bus Routes & 2 Supplementary Bus Routes	225

5.5 Summary of Option Scoring

Table 5-6 outlines the summary of the option scoring process. For each scoring criteria the options are ranked from 1 to 5; 1 representing the lowest performance in that criterion and 5 representing the highest performance. Each criteria rank is summed to provide a total value for each option. The option with the highest score is considered to best meet the criteria. No cost benefit analysis or modelling has been undertaken and therefore this is intended to provide a high level scoring method to compare of the options considered.

Based on this scoring approach, Option 5 (two orbital bus routes supplemented by two shorter bus routes) is seen to score the highest in overall terms. The BRT Option 4 scored second place, with the LRT Options 1 and 2 and BRT Option 3 scoring joint with the lowest score.

Table 5-6: Option Scoring Summary

Scoring Summary	Description	Demand Coverage Rank	Journey Time Rank	Cost Rank	Overall Scoring
Option 1	LRT	1	5	2	**8**
Option 2	LRT & 2 Supplementary Bus Routes	3	4	1	**8**
Option 3	BRT	1	2	5	**8**
Option 4	BRT & 2 Supplementary Bus Routes	3	3	3	**9**
Option 5	2 Orbital Bus Routes & 2 Supplementary Bus Routes	5	1	4	**10**

6 Transport Modelling Assessment

6.1 Background

Following identification of the preferred public transport option for the Inner Orbital corridor, a modelling exercise has been undertaken to determine the likely usage and operation of the proposed new services that may be in place by year 2035.

The modelling testing exercise is reported within this chapter. The emerging measures were tested within the Greater Dublin Area Regional Model (GDARM).

This testing stage also includes the majority of initiatives that form the GDA Strategy and therefore takes cognisance of the impacts of both the corridor initiatives and interaction with those services being proposed within the overall strategy.

It should be noted that within this modelling exercise, the model testing does not include the full impact of Demand Management Measures that may be utilised to further enhance the level of journeys made by public transport. In addition, Park and Ride facilities and shuttle bus services to rail and light rail stations have not been modelled and therefore the model output is likely to under represent the actual level of use on public transport. The outcome of the current model testing, therefore, provides a conservative view of demand levels that may use the measures included within the Strategy. Implementation of strategic Park and Ride facilities, and demand management measures are likely to increase the attractiveness of the public transport measures. These benefits are not encompassed in the modelling results.

Further information on the transport modelling and strategy measures tested is provided within an overarching Transport Modelling Report.

Figure 6-1 illustrates the proposed GDA public transport proposals in the context of the Orbital Study Area corridor.

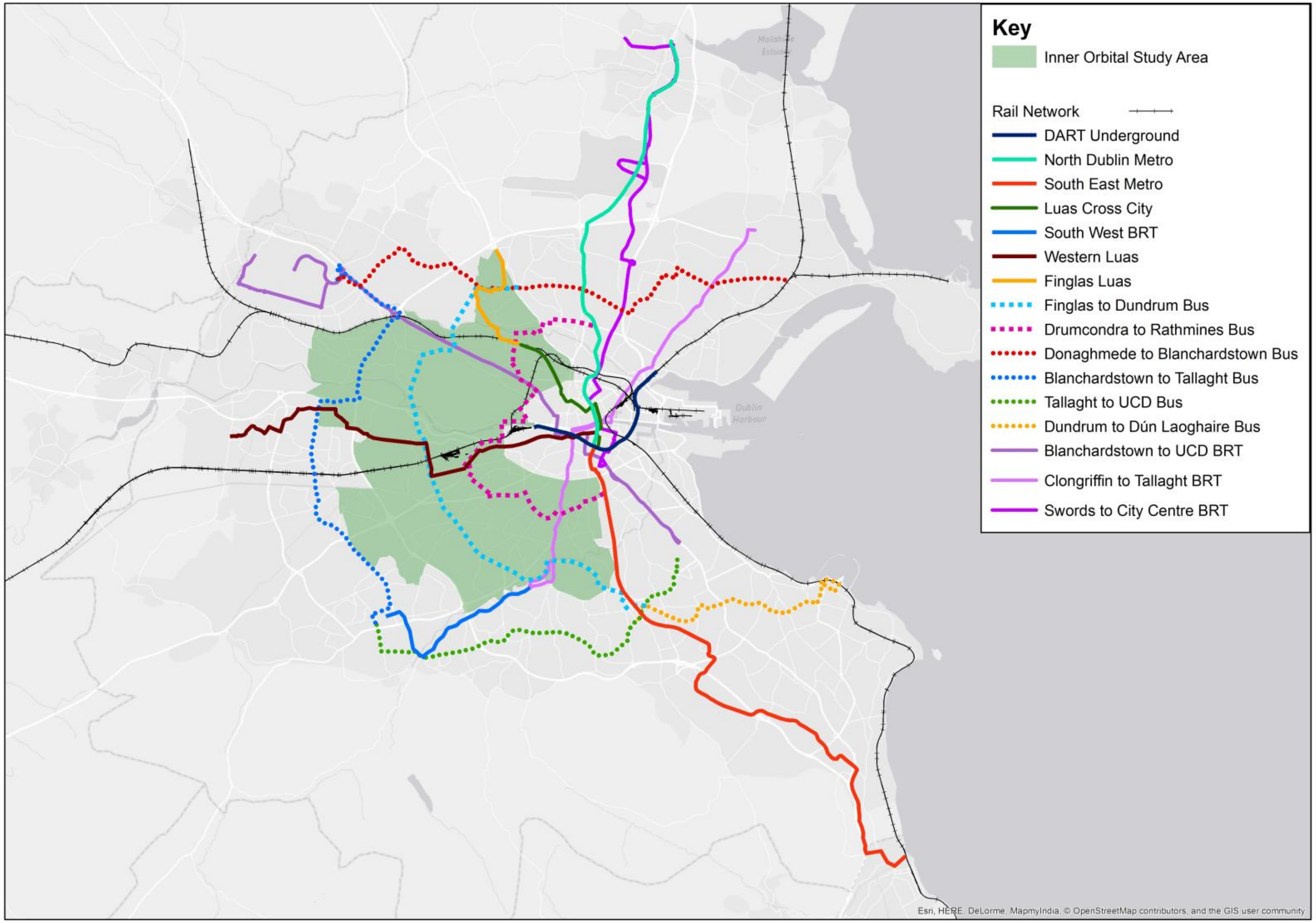


Figure 6-1: Proposed GDA Strategy Public Transport Proposals

6.2 Modelled Public Transport Proposal

The proposed transport provision for the Inner Orbital Corridor tested within the GDRAM includes two parallel long orbital bus routes from Dundrum to Finglas and Rathmines to Drumcondra. There is an overlap and interchange between the inner orbital bus services and the outer orbital bus services at the northern and southern boundary of the study area resulting in the inner orbital bus services being rationalised to operate a more efficient service, this culminated in the removal of the supplementary bus services from the proposal.

While providing a high frequency bus service for journeys made along orbital routes, they may also provide interchange with radial rail and Luas services at key transfer locations and thereby widening the catchment of overlapping study areas.

No reduction in road network provision was applied with the introduction of the orbital bus services, and as such the likely impact of the orbital services on private car speeds has not been determined. The impact of not reflecting any improved priority for orbital services, is also likely to underestimate the demand that may use the proposed services. The benefits of the measures are therefore likely to be understated within this review and greater levels of demand may therefore be attracted to the proposed services.

Table 6-1 describes the public transport service plan for orbital bus movements.

Table 6-1: Proposed Public Transport Service Plan

Service	Vehicle	AM headway	IP headway	PM headway
Bus Services				
Inner Orbital: Drumcondra to Rathmines	Double decker bus	5	5	5
Inner Orbital: Finglas to Dundrum	Double decker bus	10	10	10

6.3 Modelling Assessment

6.3.1 Screenline Assessment

As described earlier in the report, the demand level was defined across screenlines within the corridor Study Area, in order to determine the appropriate service to accommodate the forecast demand growth. Figure 6-2 illustrates the AM peak hour public transport patronage on the orbital services crossing each of the screenlines.

Comparing the preliminary demand assessment (Figure 3-1) against the modelling results reveals significant notable differences.

1. The passenger numbers on the inner orbital bus services are of a level that closely match the estimated demand growth up to 2035.
2. In particular, the River Liffey, Grand Canal and N81 screenlines show very high passenger number when compared against the demand growth. On the River Liffey, Grand Canal and N81 screenlines of the IOC the passenger numbers captured by the proposed services are approx. 71%, 70% and 94% respectively.
3. For the screenline crossing the River Liffey the passenger numbers are seen to be 71% of the forecast demand growth.
4. On average across all screenline the total intrazonal trips met by the proposed service equates to 70% of the target demand being met by the new inner orbital services.

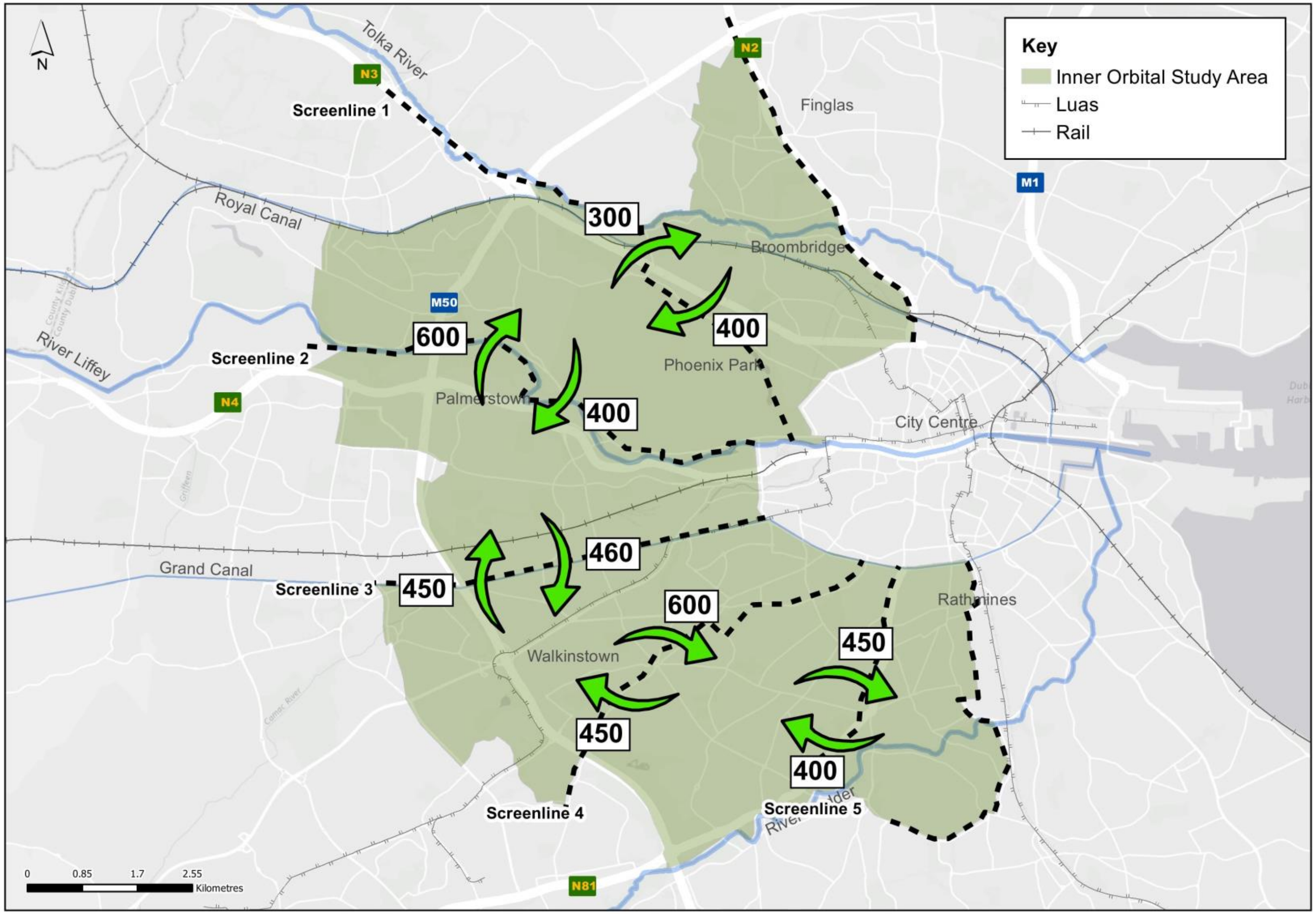


Figure 6-2: IOC AM Peak Screenline Public Transport Patronage

6.3.2 Corridor Study Area Mode Share

The introduction of the proposed public transport measures within the corridor study area, and the introduction of wider GDA public transport proposals can accommodate increased public transport patronage. Figure 6-3 outlines the overall mode share (all productions) for trips originating within the IOC study area. Overall it shows that private car mode share is 70 per cent, with the public transport mode share making up 30 per cent of trips.

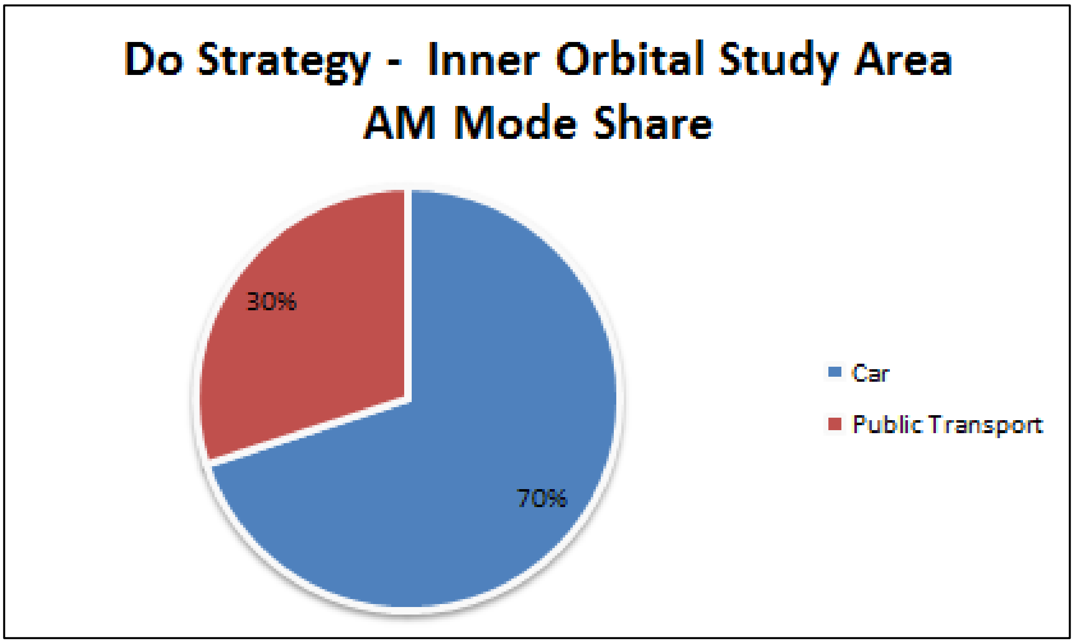


Figure 6-3: AM Peak Corridor Study Area Mode Share

6.3.3 Public Transport Boarding and Alighting Profile

Figure 6-6-4 and Figure 6-6-5 detail the boarding and alighting profiles for the proposed clockwise/anti-clockwise Dundrum-Finglas service. Each graph shows the cumulative passenger numbers for the service in each orbital direction.

The Dundrum-Finglas clockwise service is seen to have maximum passenger numbers mid-way between Dundrum and the River Liffey Crossing. The Dundrum-Finglas anti-clockwise service is seen to have maximum passenger numbers mid-way between the River Liffey Crossing and Dundrum.

Figure 6-6-6 and Figure 6-6-7 detail the boarding and alighting profiles for the proposed clockwise/anti-clockwise Rathmines-Drumcondra service. Each graph shows the cumulative passenger numbers for the service in each orbital direction.

The Rathmines-Drumcondra clockwise service is seen to have maximum passenger numbers between River Liffey and Drumcondra.

Drumcondra-Rathmines anti-clockwise service is seen to have maximum passenger numbers between the River Liffey crossing and Rathmines.

At no point do the passenger numbers exceed the seated capacity of the orbital bus services provided. Seated capacity of these services is 440 passengers. Peak passenger total for the corridor is approximately 400 passengers south of the River Liffey.

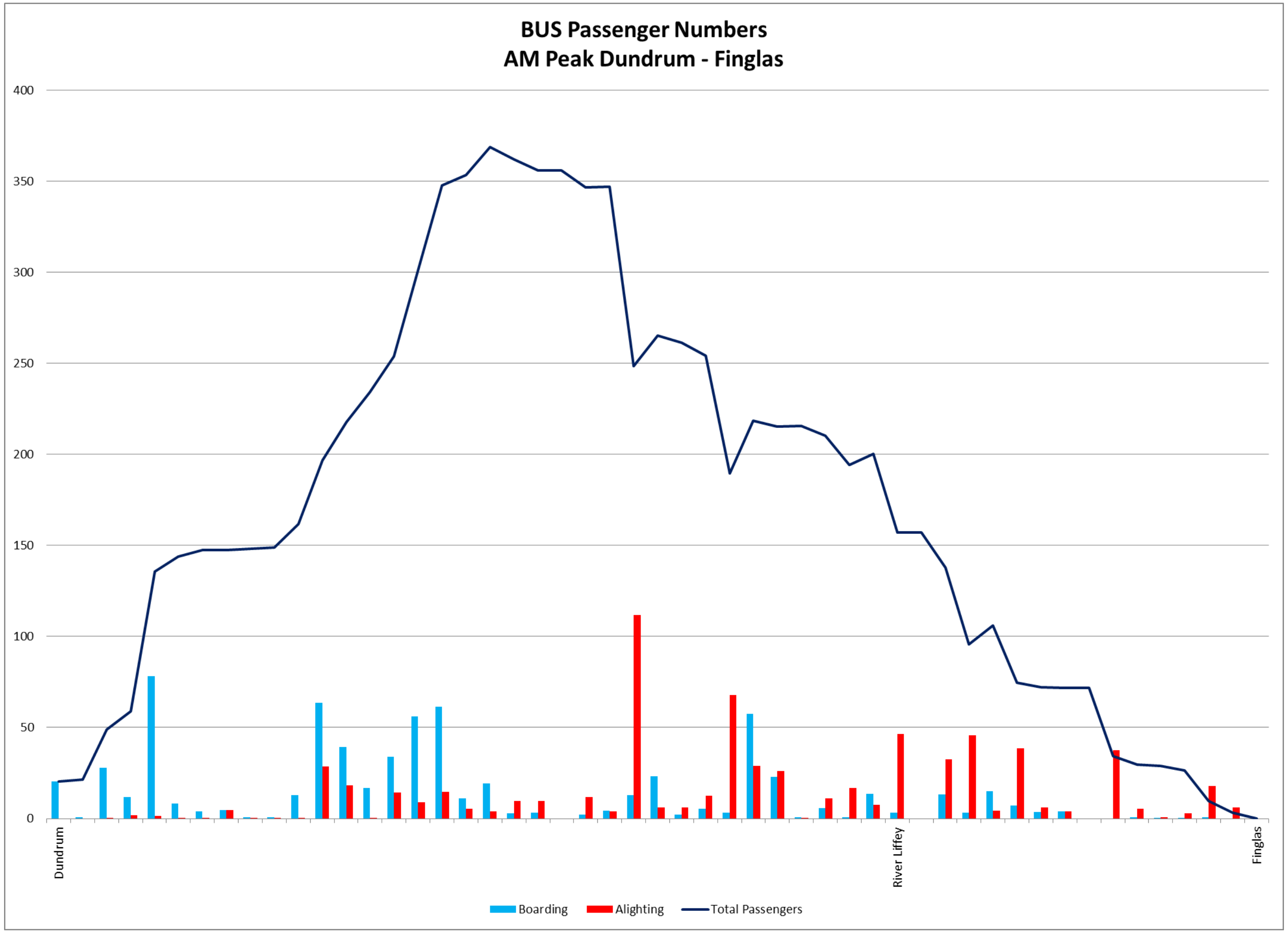


Figure 6-6-4: Dundrum/Finglas Inner Orbital Route (Clockwise) Boarding and Alighting Profile

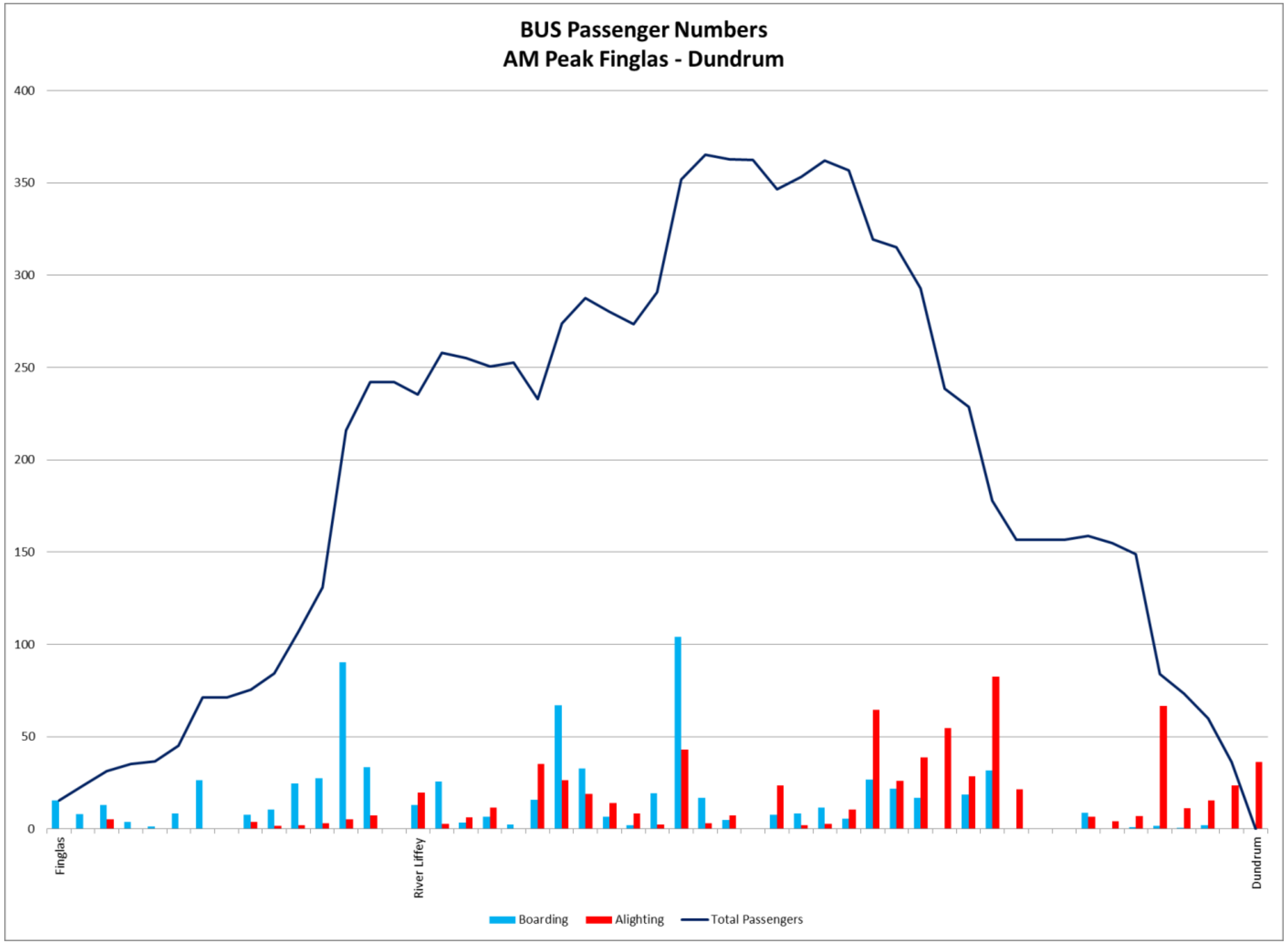


Figure 6-6-5: Finglas/Dundrum Inner Orbital Route (Anti Clockwise) Boarding and Alighting Profile

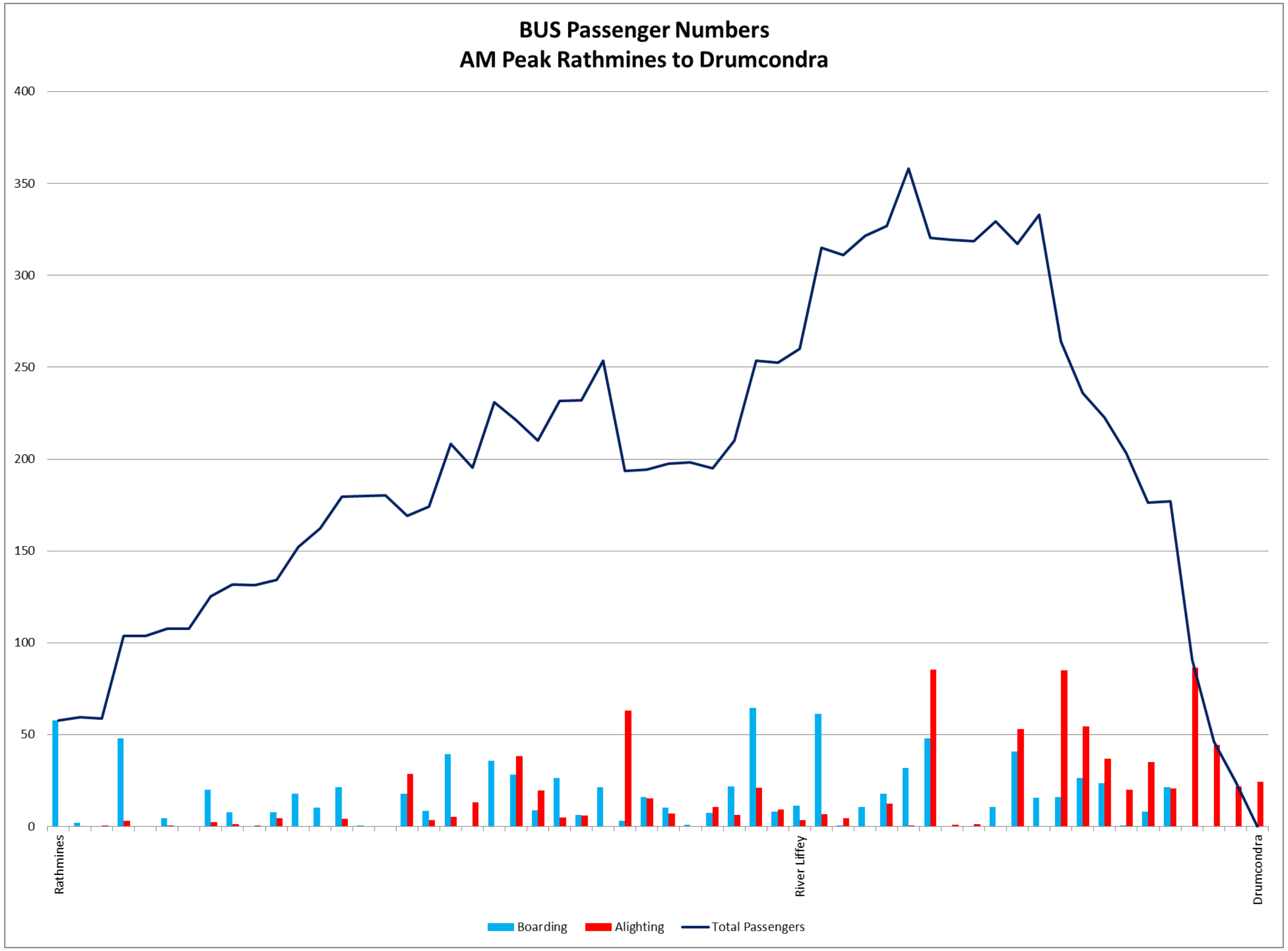


Figure 6-6-6: Rathmines/Drumcondra Inner Orbital Route (Clockwise) Boarding and Alighting Profile

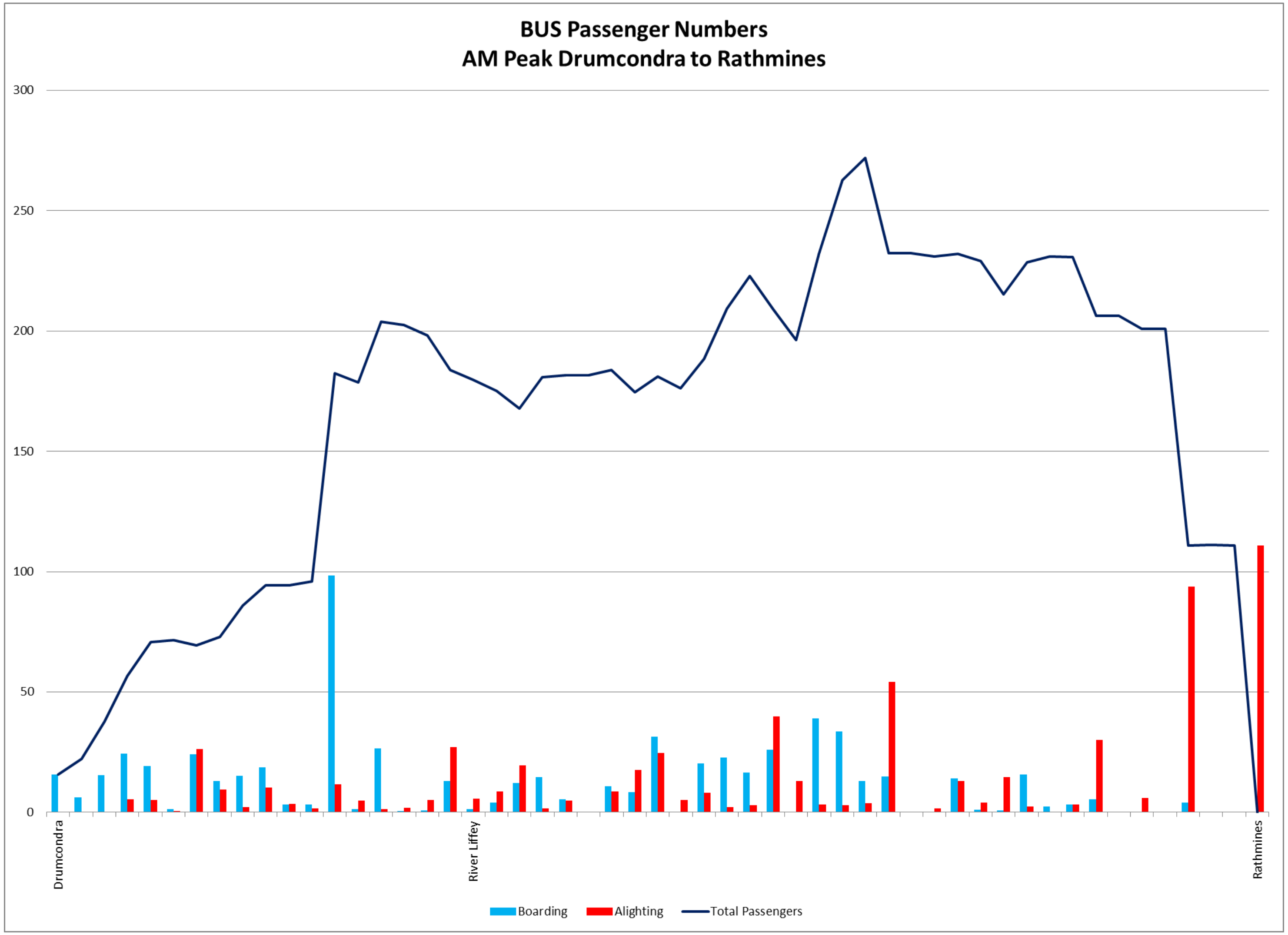


Figure 6-6-7: Drumcondra/Rathmines Inner Orbital Route (Anti Clockwise) Boarding and Alighting Profile

6.3.4 Journey Times and Service Speeds

Table 6-2 outlines the high level journey times and average service speeds for the proposed orbital public transport provision travelling clockwise and anti-clockwise between Dundrum and Finglas and between Drumcondra and Rathmines in the AM peak hour. Table 6-2 shows that orbital passengers from Rathmines can access Drumcondra (and vice versa) in between 48 and 52 minutes while passengers from Dundrum can access Finglas in between 48 and 51 minutes. This provides multiple, alternative public transport routes to cater for the different origin and destination locations in the Inner Orbital Corridor study area.

Table 6-2: Proposed Public Transport Journey Times and Service Speeds

	Distance Km	Journey Time min	Speed kph	Travel Distance pas.km
Dundrum/Finglas Clockwise	22	48.4	27	3729
Finglas/Dundrum Anti Clockwise	22	51	25	4296
Rathmines/Drumcondra Clockwise	18	48	22	3,685
Drumcondra/Rathmines Anti Clockwise	18	52	21	2,645

6.4 Modelling Summary and Conclusions

The modelling assessment has shown that the proposed services, while providing adequate capacity to cater for forecast demand growth, in general do not achieve passenger numbers that meet the demand growth. The screenline demand accommodated in the model runs by the orbital services varies from 58% per cent at the Phoenix Park / N3 screenline to 94 per cent crossing the N81, to 71 per cent at the River Liffey. The assessment shows the total journey times on these orbital services as ranging from 48 minutes to 52 minutes, in a frequent and reliable service.

The modelling exercise hasn't included the collective benefits that could be provided by Park and Ride and demand management measures. Benefits of the proposed measures are likely to be greater with the introduction of Park and Ride and demand management.

The screenline assessment shows that the five screenlines combined accommodate up to 70% of the anticipated level of demand.

In addition, no reduction in road network provision was applied with the introduction of the orbital bus services, and as such the likely impact of the orbital services on private car speeds has not been determined. This would have the effect of catering for certain orbital movements with private car provision instead of using the public transport services provided.

In summary the proposed public transport measures can accommodate the proposed growth in travel between Rathmines/Dundrum and Finglas/Drumcondra. However, further consideration as to the routing and priority provided to the orbital bus services will need to be undertaken to ensure that it captures the greatest demand numbers and is provided as a competitive alternative to private car transport.

7 Emerging Inner Orbital Public Transport Scheme

7.1 Recommendation

The following outlines the recommended orbital public transport proposal for the to 2035 GDA Public Transport Strategy.

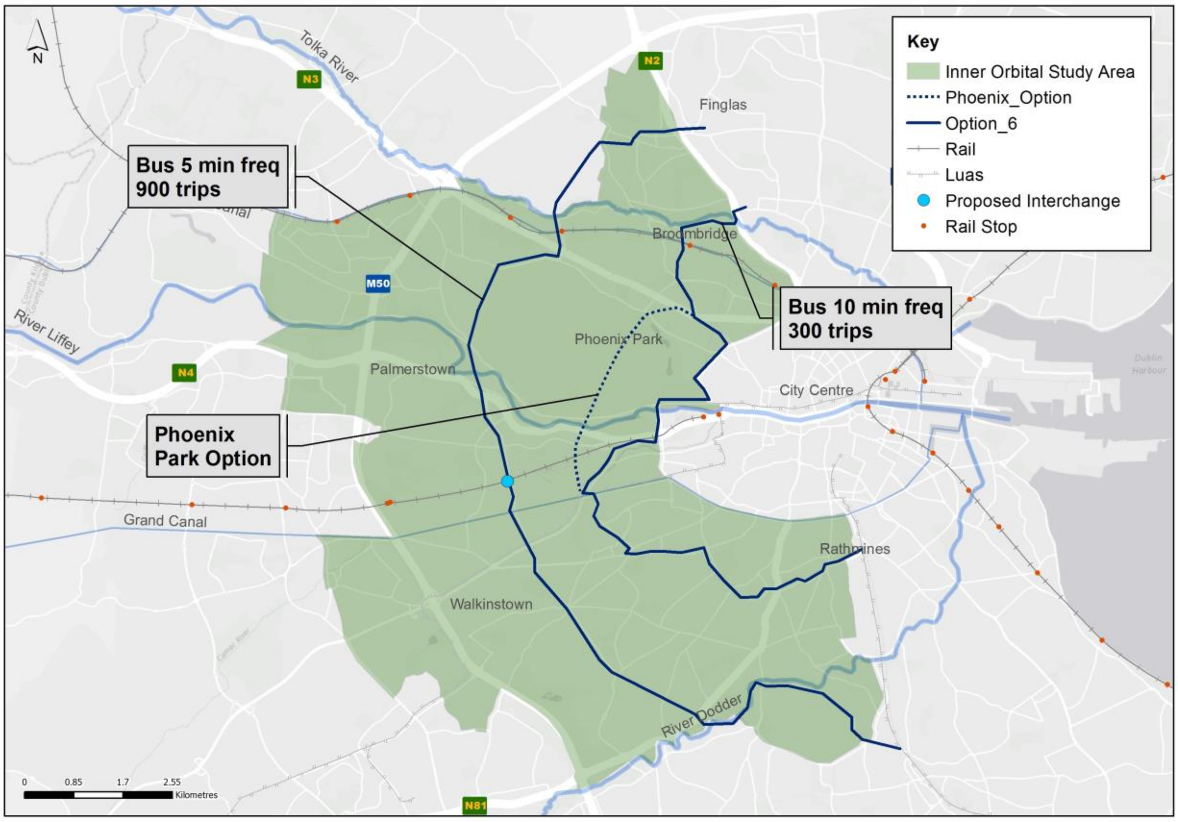


Figure 7-1: Recommended Option: Two Orbital Bus Services

The preferred schemes comprise:

- providing a long orbital bus route from Churchtown / Rathfarnham to Finglas; and
- providing a long orbital bus route from Rathmines to Glasnevin.

The routes can avoid the Phoenix Park; however a more direct link through this area would provide improved journey time, potentially making the service more attractive and successful.

The orbital routes and supplementary services are required to extend beyond the boundary of the Study Area to the east, capturing greater demand and interchanging with major radial services.

7.2 Specification of Public Transport Offering

The preferred schemes will provide the following levels of service:

- bus services to be of Quality Bus Corridor standard;
- bus lanes and junction priority to be provided along routes;
- long orbital bus service to run at five minute frequency;
- increase in core radial bus services by three buses per hour; and

- extend beyond study area to east to widen catchment and interchange with major radial services.

7.3 Benefits

The benefits of the preferred schemes include the following:

- this option provides a feasible alternative to travel demand that currently uses car;
- this option makes a significant contribution in accommodating the demand growth to 2035 plus 30 per cent of existing demand
- 30% of trips in the AM Peak Do Strategy scenario are accommodated by public transport;
- 70% of the target growth (intra zonal movements) is accommodated for by the provision of the IOC bus services.
- this would provide for approximately 31 per cent public transport mode share for orbital movements;
- the proposed bus services can be increased in a phased manner over time in order to meet the growing demand;
- this option makes most of existing infrastructure;
- this option provides improved access to key services for non-car owners;
- the provision of orbital services actually frees up radial public transport service capacity due to the provision of a viable alternative orbital service;
- the provision of orbital public transport services removes orbital traffic from junctions, that could otherwise be impacting on radial services; and
- this option provides for interchange with existing rail, light rail, Dublin Bus and proposed BRT services.
- Benefits may be greater, as potential Park & Ride and Demand Management measures may further encourage the use of the proposed option.

7.4 Risks

The risks associated with the preferred schemes include the following:

- heavily reliant on radial public transport services to provide access to orbital service;
- will need to provide a faster service than orbital private car travel;
- will need to provide a faster service than radial public transport interchange;
- required to extend further east beyond the extents of Study Area;
- Quality Bus Corridor type service may not be deemed appropriate to require the construction of new bridge crossings over River Liffey;
- balance between orbital and radial priority will be challenging;
- there may be logistical issues in delivering this service, e.g.: travel time for drivers, and therefore multi-leg services on the routes may be necessary;
- detailed cost and risk assessment required; and
- cost excludes operation costs.

7.5 Cost

Below is a conceptual high-level capital cost estimate for the recommended public transport option for the Inner Orbital Study Area. These costs were estimated using per/km costs derived from similar recent projects, details of which are included in Section **Error! Reference source not found.** of the report.

- Outer Long Bus Route: €110M (includes €27M for River Liffey Bridge Crossing);
- Inner Long Bus Route: €50M ; and

- **Total Cost: Up to €160M.** Cost would increase towards this level as demand dictates greater frequency.

Annex 1

A1.1 Orbital Movements

The IOC has been divided up into 13 internal settlements, each covering a distinct area. Figure A1-1 illustrates the IOC internal settlements.

The Greater Dublin Area (GDA) external to the IOC Study Area has been divided into 15 external Sectors. Figure A1-2 illustrates the coverage of the external Sectors.

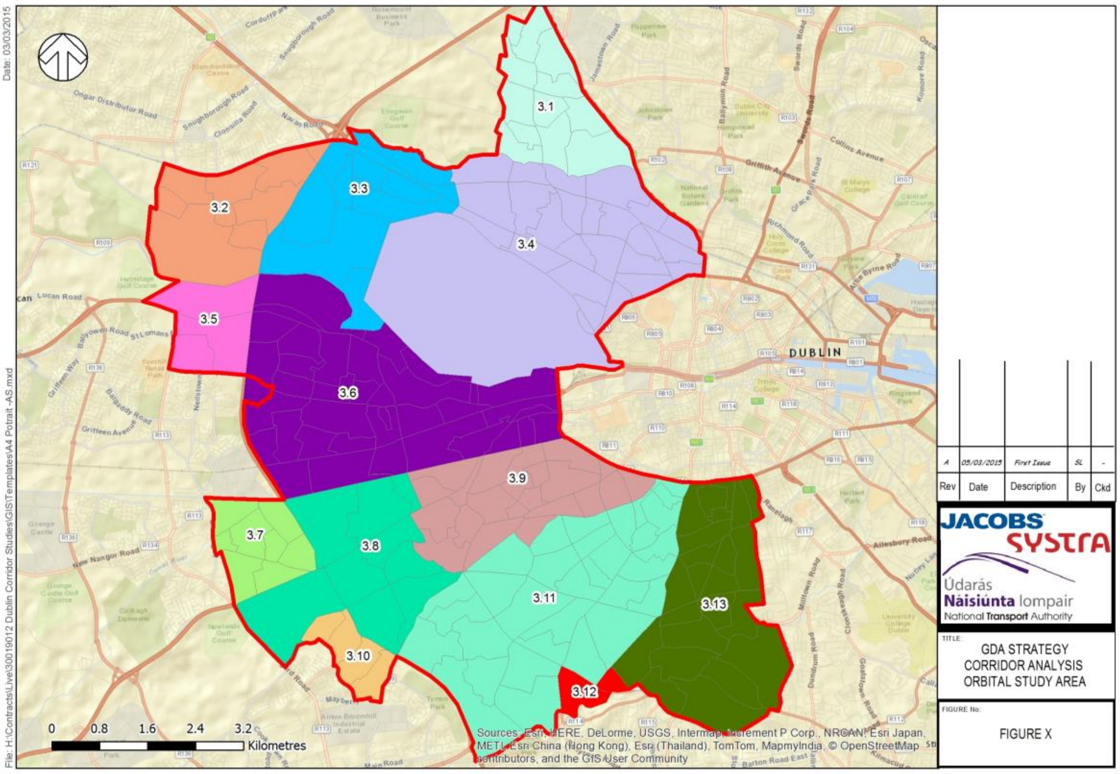


Figure A1-1: Dublin Inner Orbital Corridor – Internal Settlements

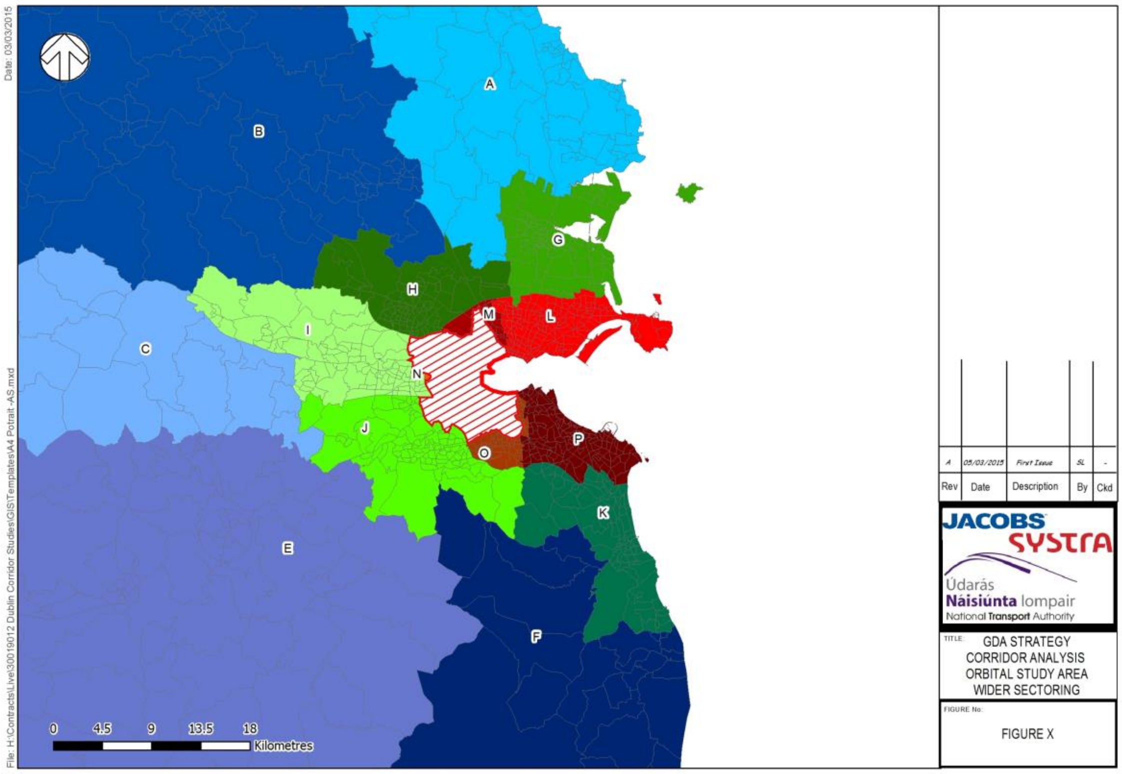


Figure A1-2: Dublin Inner Orbital Corridor – External Sectors

A1.2 Capacity Assessment

Table A1-7-1 and Table A1-7-2 detail the capacity assessment (internal trips) undertaken for the demand growth and the target demand respectively. Both tables outline the following for each of the five options considered:

- **Right Column:** Proposed service type and frequency at each screenline;
- **Left Column:** Comparison of proposed service design capacity and maximum screenline demand; and
- **Middle Column:** Comparison of proposed service crush capacity and maximum screenline demand.

It can be seen in both Table A1-7-1 and Table A1-7-2 that there are screenline demands that are met by the design capacity.

Table A1-7-1: Growth Demand Assessment for the Proposed Options (Minimum Target Requirement)

Option Sifting for Growth (2011 to 2035)
Design Capacity

Option 1	Maximum	LRT	0	0	0	
Screenlines	Demand					Surplus
Phoenix Park / N3	145	1037				-892
River Liffey	107	1037				-930
Grand Canal	261	1037				-776
Walkinstown / Kimmage	120	1037				-917
N81	42	1037				-995
Total Surplus						-4509

Option 2	Maximum	LRT	DB	DB	0	
Screenlines	Demand					Surplus
Phoenix Park / N3	145	778				-633
River Liffey	107	778				-670
Grand Canal	261	778	224			-741
Walkinstown / Kimmage	120	778	224			-882
N81	42	778	224	150		-1109
Total Surplus						-4035

Option 3	Maximum	BRT	0	0	0	
Screenlines	Demand					Surplus
Phoenix Park / N3	145	1020				-875
River Liffey	107	1020				-913
Grand Canal	261	1020				-759
Walkinstown / Kimmage	120	1020				-900
N81	42	1020				-978
Total Surplus						-4424

Option 4	Maximum	BRT	DB			
Screenlines	Demand					Surplus
Phoenix Park / N3	145	765				-620
River Liffey	107	765				-658
Grand Canal	261	765	299			-803
Walkinstown / Kimmage	120	765	299			-944
N81	42	765	299			-1022
Total Surplus						-4046

Option 5	Maximum	DB	DB	DB	DB	
Screenlines	Demand					Surplus
Phoenix Park / N3	145	449	898			-1202
River Liffey	107	449	898			-1239
Grand Canal	261	449	898			-1085
Walkinstown / Kimmage	120	449	898			-1226
N81	42	449	898			-1304
Total Surplus						-6056

Option Sifting for Growth (2011 to 2035)
Crush Capacity

Option 1	Maximum	LRT	0	0	0	
Screenlines	Demand					Surplus
Phoenix Park / N3	145	1220				-1075
River Liffey	107	1220				-1113
Grand Canal	261	1220				-959
Walkinstown / Kimmage	120	1220				-1100
N81	42	1220				-1178
Total Surplus						-5424

Option 2	Maximum	LRT	DB	DB	0	
Screenlines	Demand					Surplus
Phoenix Park / N3	145	915				-770
River Liffey	107	915				-808
Grand Canal	261	915	264			-918
Walkinstown / Kimmage	120	915	264			-1059
N81	42	915	264	176		-1313
Total Surplus						-4867

Option 4	Maximum	BRT	0	0	0	
Screenlines	Demand					Surplus
Phoenix Park / N3	145	1200				-1055
River Liffey	107	1200				-1093
Grand Canal	261	1200				-939
Walkinstown / Kimmage	120	1200				-1080
N81	42	1200				-1158
Total Surplus						-5324

Option 4	Maximum	BRT	DB	0	0	
Screenlines	Demand					Surplus
Phoenix Park / N3	145	900				-755
River Liffey	107	900				-793
Grand Canal	261	900	352			-991
Walkinstown / Kimmage	120	900	352			-1132
N81	42	900	352			-1210
Total Surplus						-4880

Option 5	Maximum	DB	DB	DB	DB	
Screenlines	Demand					Surplus
Phoenix Park / N3	145	528	1056			-1439
River Liffey	107	528	1056			-1477
Grand Canal	261	528	1056			-1323
Walkinstown / Kimmage	120	528	1056			-1464
N81	42	528	1056			-1542
Total Surplus						-7244

Proposed Service Frequency

Option 1	LRT			
Screenlines				
Phoenix Park / N3	15 min			
River Liffey	15 min			
Grand Canal	15 min			
Walkinstown / Kimmage	15 min			
N81	15 min			
Total Surplus				

Option 2	LRT	DB	DB	
Screenlines				
Phoenix Park / N3	20 min			
River Liffey	20 min			
Grand Canal	20 min	20 min		
Walkinstown / Kimmage	20 min	20 min		
N81	20 min	20 min	30 min	
Total Surplus				

Option 4	BRT			
Screenlines				
Phoenix Park / N3	6 min			
River Liffey	6 min			
Grand Canal	6 min			
Walkinstown / Kimmage	6 min			
N81	6 min			
Total Surplus				

Option 4	BRT	DB	DB	
Screenlines				
Phoenix Park / N3	8 min			
River Liffey	8 min			
Grand Canal	8 min	15 min		
Walkinstown / Kimmage	8 min	15 min		
N81	8 min	15 min		
Total Surplus				

Option 5	DB	DB	DB	DB
Screenlines				
Phoenix Park / N3	10 min	5 min		
River Liffey	10 min	5 min		
Grand Canal	10 min	5 min		
Walkinstown / Kimmage	10 min	5 min		
N81	10 min	5 min		
Total Surplus				

Table A1-7-2: Target Demand Assessment for the Proposed Options (Growth + 30% of Existing Demand)

Option Sifting for Growth (2011 to 2035) + 30% of Existing Demand – Design Capacity

Option 1	Maximum	LRT	0	0	0	
Screenlines	Demand					Surplus
Phoenix Park / N3	462	1037				-575
River Liffey	429	1037				-608
Grand Canal	731	1037				-306
Walkinstown / Kimmage	671	1037				-366
N81	359	1037				-678
Total Surplus						-2532

Option 2	Maximum	LRT	DB	DB	0	
Screenlines	Demand					Surplus
Phoenix Park / N3	462	778				-315
River Liffey	429	778				-348
Grand Canal	731	778	224	#N/A		#N/A
Walkinstown / Kimmage	671	778	224	#N/A		#N/A
N81	359	778	224	150		-793
Total Surplus						#N/A

Option 3	Maximum	BRT	0	0	0	
Screenlines	Demand					Surplus
Phoenix Park / N3	462	1020				-558
River Liffey	429	1020				-591
Grand Canal	731	1020				-289
Walkinstown / Kimmage	671	1020				-349
N81	359	1020				-661
Total Surplus						-2447

Option 4	Maximum	BRT	DB			
Screenlines	Demand					Surplus
Phoenix Park / N3	462	765				-303
River Liffey	429	765				-336
Grand Canal	731	765	299			-333
Walkinstown / Kimmage	671	765	299			-393
N81	359	765	299			-705
Total Surplus						-2070

Option 5	Maximum	DB	DB	DB	DB	
Screenlines	Demand					Surplus
Phoenix Park / N3	462	449	898			-884
River Liffey	429	449	898			-917
Grand Canal	731	449	898			-615
Walkinstown / Kimmage	671	449	898			-675
N81	359	449	898			-988
Total Surplus						-4079

Option Sifting for Growth (2011 to 2035) + 30% of Existing Demand – Crush Capacity

Option 1	Maximum	LRT	0	0	0	
Screenlines	Demand					Surplus
Phoenix Park / N3	462	1220				-758
River Liffey	429	1220				-791
Grand Canal	731	1220				-489
Walkinstown / Kimmage	671	1220				-549
N81	359	1220				-861
Total Surplus						-3447

Option 2	Maximum	LRT	DB	DB	0	
Screenlines	Demand					Surplus
Phoenix Park / N3	462	915				-453
River Liffey	429	915				-486
Grand Canal	731	915	264	#N/A		#N/A
Walkinstown / Kimmage	671	915	264	#N/A		#N/A
N81	359	915	264	176		-996
Total Surplus						#N/A

Option 4	Maximum	BRT	0	0	0	
Screenlines	Demand					Surplus
Phoenix Park / N3	462	1200				-738
River Liffey	429	1200				-771
Grand Canal	731	1200				-469
Walkinstown / Kimmage	671	1200				-529
N81	359	1200				-841
Total Surplus						-3347

Option 4	Maximum	BRT	DB	0	0	
Screenlines	Demand					Surplus
Phoenix Park / N3	462	900				-438
River Liffey	429	900				-471
Grand Canal	731	900	352			-521
Walkinstown / Kimmage	671	900	352			-581
N81	359	900	352			-893
Total Surplus						-2903

Option 5	Maximum	DB	DB	DB	DB	
Screenlines	Demand					Surplus
Phoenix Park / N3	462	528	1056			-1122
River Liffey	429	528	1056			-1155
Grand Canal	731	528	1056			-853
Walkinstown / Kimmage	671	528	1056			-913
N81	359	528	1056			-1225
Total Surplus						-5267

Proposed Service Frequency

Option 1	LRT			
Screenlines				
Phoenix Park / N3	15 min			
River Liffey	15 min			
Grand Canal	15 min			
Walkinstown / Kimmage	15 min			
N81	15 min			
Total Surplus				

Option 2	LRT	DB	DB	
Screenlines				
Phoenix Park / N3	20 min			
River Liffey	20 min			
Grand Canal	20 min	20 min		
Walkinstown / Kimmage	20 min	20 min		
N81	20 min	20 min	30 min	
Total Surplus				

Option 3	BRT			
Screenlines				
Phoenix Park / N3	6 min			
River Liffey	6 min			
Grand Canal	6 min			
Walkinstown / Kimmage	6 min			
N81	6 min			
Total Surplus				

Option 4	BRT	DB	DB	
Screenlines				
Phoenix Park / N3	8 min			
River Liffey	8 min			
Grand Canal	8 min	15 min		
Walkinstown / Kimmage	8 min	15 min		
N81	8 min	15 min		
Total Surplus				

Option 5	DB	DB	DB	DB
Screenlines				
Phoenix Park / N3	10 min	5 min		
River Liffey	10 min	5 min		
Grand Canal	10 min	5 min		
Walkinstown / Kimmage	10 min	5 min		
N81	10 min	5 min		
Total Surplus				