Appendix H
Bus Stop Review Report

National Transport Authority

Blanchardstown to City Centre Core Bus Corridor Scheme

Bus Stop Review Report

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Job number 268401

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Contents

1 Introduction

This report presents a summary of the Bus Stop Review process which was conducted for the Blanchardstown to City Centre Core Bus Corridor (CBC) scheme (hereinafter referred to as the 'Proposed Scheme').

The purpose of the process was to review the locations of the existing Dublin Bus stops and to determine whether a stop should be removed, relocated, or remain where it is. This exercise was carried out to optimise the performance of the bus services on the Proposed Scheme by reducing the journey time of the bus service, increasing the walking catchment of the bus stops and ensuring that key trip attractors located along the route are sufficiently covered within the catchment of bus stops.

In a number of locations, existing and proposed bus stops were therefore rationalised based on best practice principles related to bus stop placement. The outcome of this study was to develop a more efficient route which would attract more passengers by creating a wider population catchment and offering a shorter journey time to destinations.

2 Methodology

2.1 Overview

The methodology followed as part of this review is set out in the Bus Stop Review Methodology Report which is included in Appendix A of this report. The appended report outlines the methodology which was followed for the bus stop reviews, the various considerations to be made when assessing a stop location, and the background reasoning for those considerations.

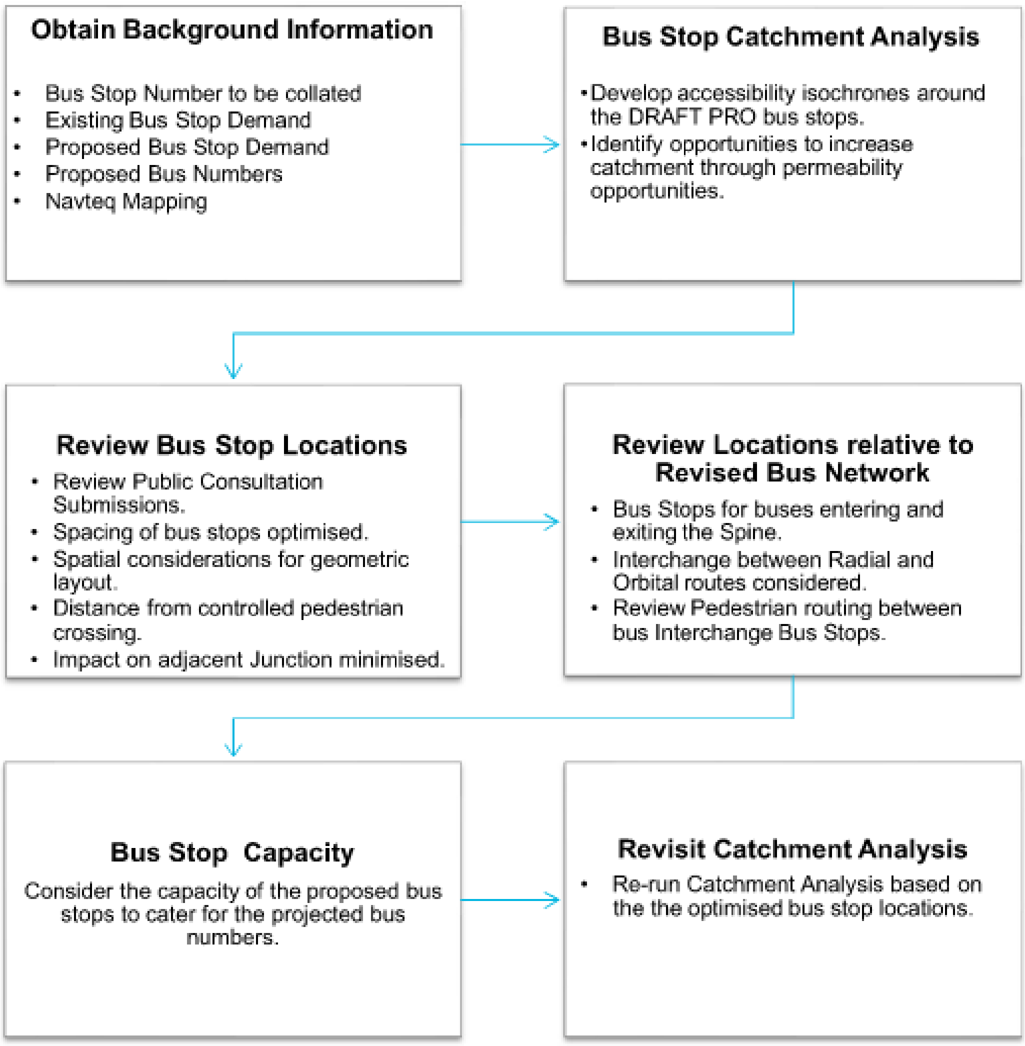


Figure **2.1** presents a flowchart which outlines the methodology used.

Each of the study components as outlined below are discussed in more detail in the remainder of this report and applied to the Proposed Scheme.

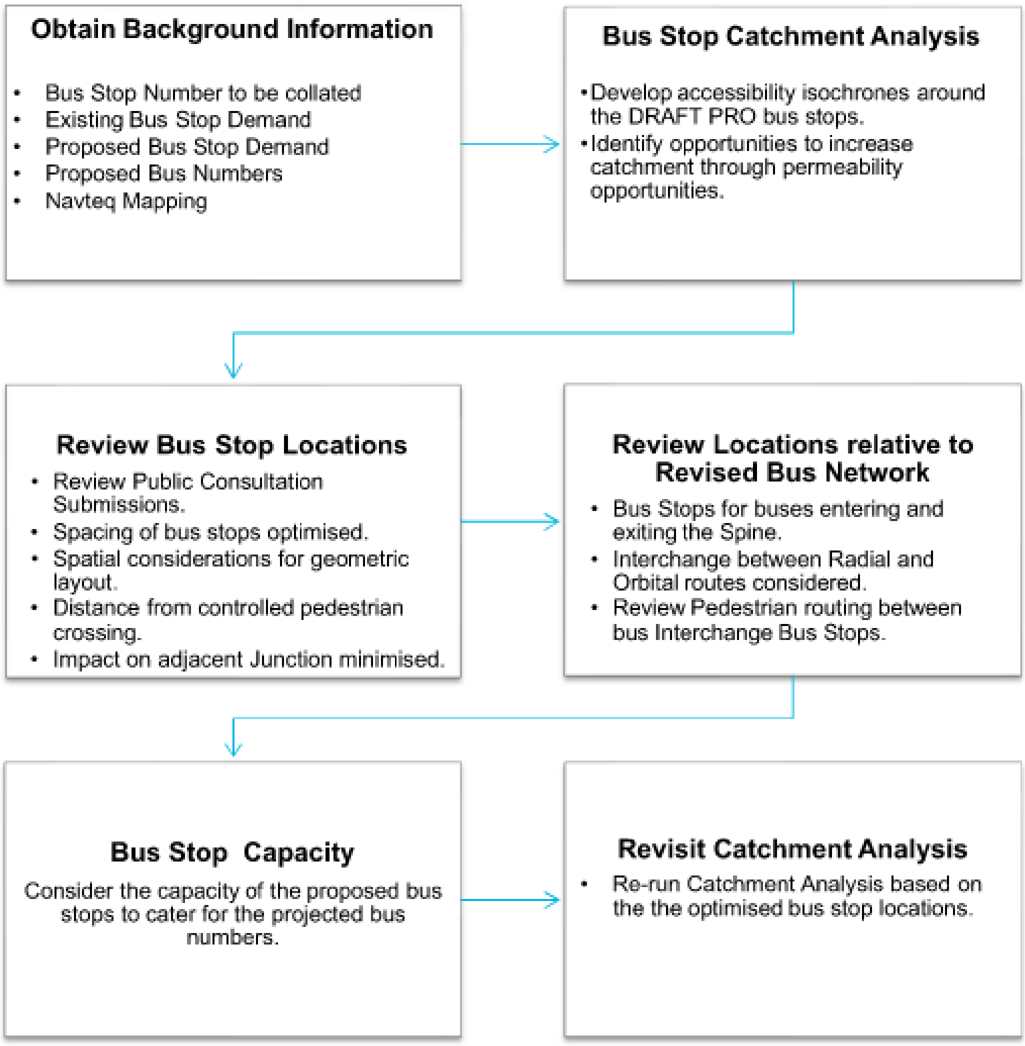


Figure 2.1: Bus Stop Review Methodology Flowchart

3 Background Information

In order to assess the bus stop locations with a variety of considerations in mind, certain key data was acquired, measured, or calculated. This information was compiled in a spreadsheet which is contained in Appendix B.

The background information obtained for the study along with the source of the information is within Table 3.1.

Table 3.1: Background information and sources

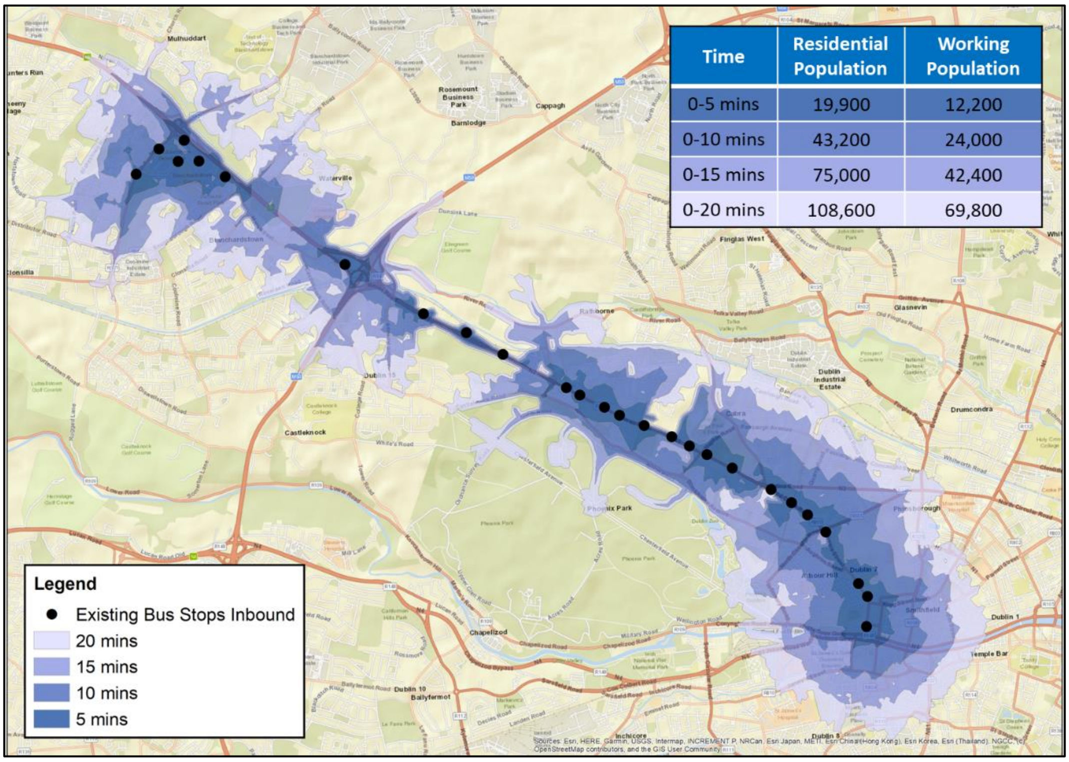
Information	Source
Stop Numbers for all inbound and outbound stops along the route	Dublin Bus Automatic Vehicle Location (AVL) Data
Stop Names	Dublin Bus AVL Data
Current Stop Location Coordinates	Google Maps (MyMaps .kml export)
Current distance to previous stop	Google Maps (Measured)
Stop location as per PRO (relative to existing location)	PRO Design Drawings
PRO Distance to previous stop	PRO Design Drawings & Google Maps
Peak Boarding and alighting volumes & Times	NTA
Future Buses per Hour	Planned bus schedule based on 2028 modelled scenario (provided by Systra)
Current Distance to junction/ped crossing	Google Maps (Measured)
PRO distance to junction/ped crossing	PRO Design Drawings & Google Maps
Potential for interchange with Orbital Routes	BusConnects Revised Network Layout

4 Existing Bus Stop Catchment analysis

To develop a baseline against which any bus stop relocation recommendations could be tested, a catchment analysis was conducted on existing populations living and working up to a 20-minute walk from existing bus stops. This was chosen as the upper limit as any longer than 20 minutes is deemed to be an undesirable distance to walk to a bus stop for the purposes of this assessment. This analysis was carried out in GIS using Navteq mapping as the network dataset, along with the coordinates of the existing bus stop locations. For each of the routes, the current catchment of both the inbound and the outbound bus stops at their existing locations are shown in 5 minute walking intervals up to 20 minutes in Figure 4.1 and Figure 4.2.

4.1 Inbound

Figure 4.1 shows the catchments for the existing bus stop locations for the inbound stops on the scheme.



Time	Residential Population	Working Population
0-5 mins	19,900	12,200
0-10 mins	43,200	24,000
0-15 mins	75,000	42,400
0-20 mins	108,600	69,800

Figure 4.1: Existing Inbound Bus Stop Catchments

4.2 Outbound

Figure 4.2 shows the catchments for the existing bus stop locations for the outbound stops on the scheme.

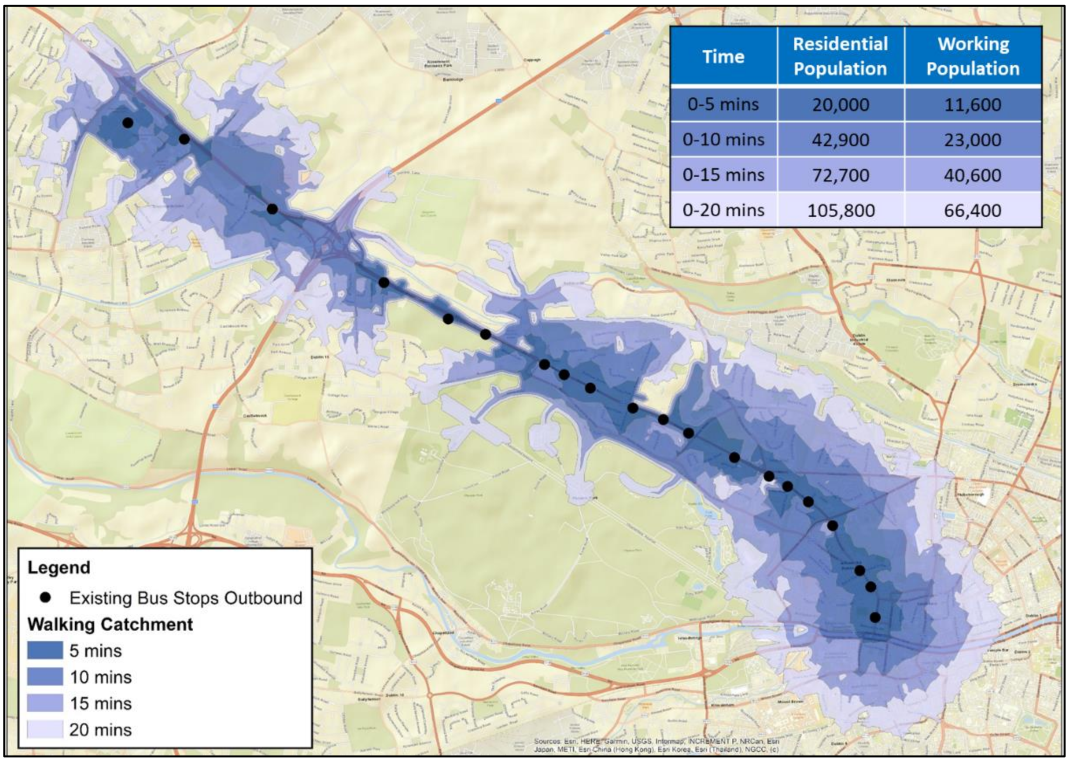


Figure 4.2: Existing Outbound Bus Stop Catchments

5 Bus Stop Location Review

The locations of the bus stops were reviewed in accordance with the 'Bus Stop Review Methodology Report' included in Appendix A.

Appendix B includes a table of features for each bus stop, which were used when considering the possible relocation of each bus stop.

The main principles considered as part of the review were as follows:

- Aim to achieve a bus stop spacing of 400m in suburban locations, and 250m in urban centres;
- Locate bus stop as close as possible to nearest junction/pedestrian crossing;
- Locate bus stop downstream of junction rather than upstream;
- Consider space requirements to provide bus stop including shelter, waiting area, cycle lane and footpath provision and information displays;
- Review existing and proposed boarding & alighting volumes to determine the usage of the bus stop; and
- Consider the potential for interchange with orbital bus services proposed as part of the New Dublin Area Bus Network.

The above principles were considered to determine whether a bus stop should remain where it is, be relocated or be removed.

If a bus stop was found to be spaced at an acceptable interval, located optimally in relation to a junction or pedestrian crossing, frequently used, and serving key land uses sufficiently, the default decision was to maintain it in its current position.

If it was found that access to a bus stop could be improved by relocating it to a better proximity in relation to local features or to better align with the principles outlined above, the decision was made to move it if feasible to do so. This would typically include cases where bus stops are currently upstream from a junction or crossing, or when the stop is not located optimally in terms of a catchment area or key land use access.

When a bus stop was found to be too close to a previous or following stop, the decision was made to either remove the bus stop or to consolidate it with another stop to obtain better spacing intervals if feasible to do so. This was an iterative process with the location of bus stops considered on an individual basis, but also within the context of all other bus stops on the scheme.

The location of existing bus stops and the proposed locations as a result of the review are illustrated in Figures C.1 to C.6 in Appendix C.

6 Revisited Catchment Analysis

Following the review of bus stop locations, the catchment analysis was re-run to review the impact of the changes on the bus network. The results of this assessment are presented in Figure 6.1 and Figure 6.2 with population numbers presented in Table 6.1 to Table 6.4. This is also presented graphically in Appendix D.

The catchment population comparison tables present the number of residents and employees within each catchment zone for the existing and proposed bus stop locations, along with the difference between them.

These figures were calculated using Small Areas and Workplace Zones from the 2016 Census. When only part of a zone was located within the catchment zone, the population of the zone was divided proportionally to the area of the zone covered by the catchment.

6.1 Inbound

Figure 6.1 shows the catchments for the proposed bus stop locations for the inbound direction.

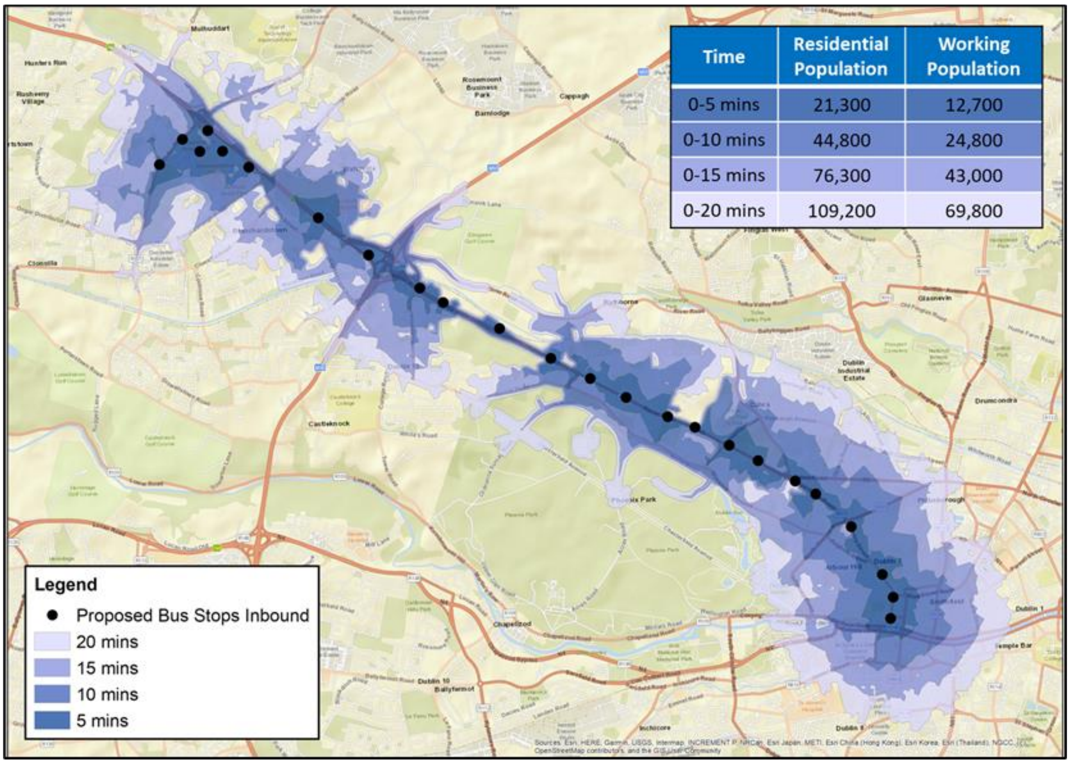


Figure 6.1: Proposed Inbound Bus Stop Catchments

Table 6.1 and Table 6.2 show the existing and proposed catchment populations and indicates the change that occurred as a result of the bus stop relocation proposals, for both the residential and workplace populations.

Table 6.1: Inbound Residential Catchment Populations

Catchment	Existing	Proposed	Difference
0-5	21600	22700	1100
0-10	46800	48400	1600
0-15	80900	82200	1300
0-20	117500	118100	600

Table 6.2: Inbound Workplace Catchment Populations

Catchment	Existing	Proposed	Difference
0-5	12500	13000	500
0-10	24700	25400	700
0-15	43600	44200	600
0-20	71800	71800	0

From the tables above, it is noted that the proposed bus stop locations bring about an increase in both residential and workplace catchments for the inbound direction. The residential population increases more than the workplace populations, which is likely due to the largely suburban nature of the area through which the route passes.

6.2 Outbound

Figure 6.2 shows the catchments for the proposed bus stop locations for the outbound direction.

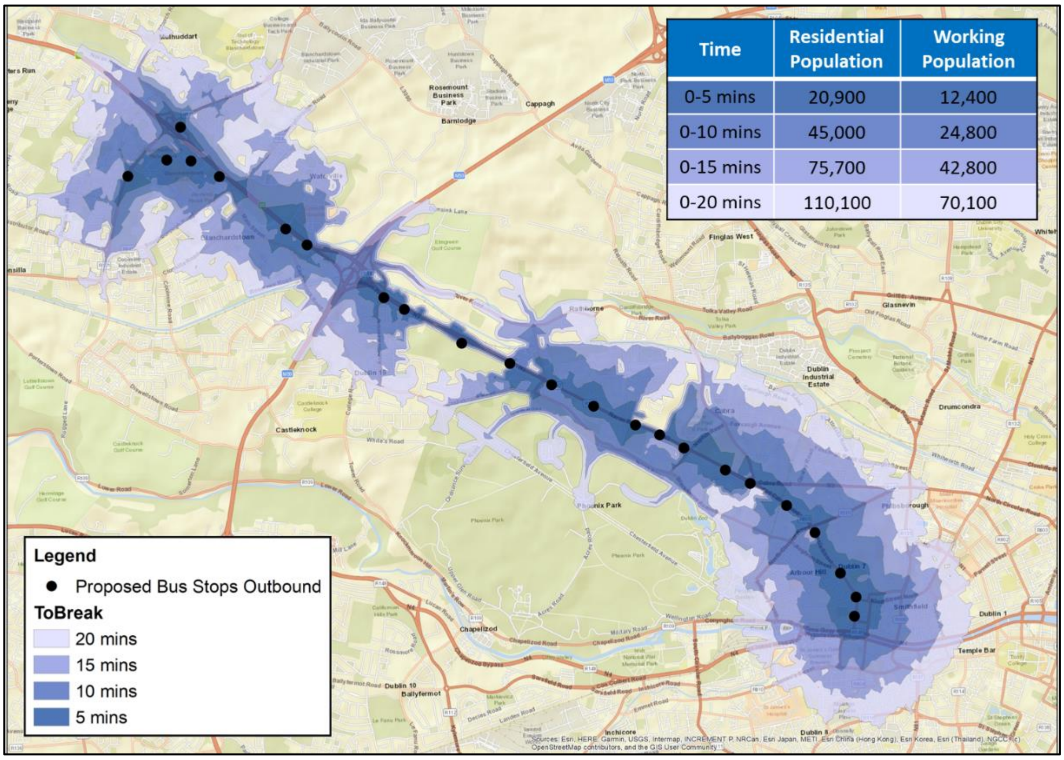


Figure 6.2: Proposed Outbound Bus Stop Catchments

Table 6.3 and Table 6.4 show the existing and proposed catchment populations and indicates the change that occurred as a result of the bus stop relocation proposals, for both the residential and workplace populations.

Table 6.3: Outbound Residential Catchment Populations

Catchment	Existing	Proposed	Difference
0-5	23100	23100	0
0-10	49000	49300	300
0-15	81600	82100	500
0-20	119100	119400	300

Table 6.4: Outbound Workplace Catchment Populations

Catchment	Existing	Proposed	Difference
0-5	13000	13000	0
0-10	24500	24500	0
0-15	42800	42900	100
0-20	70100	70100	0

From the tables above, it is noted that the proposed bus stop locations bring about an increase in both residential and workplace catchments for the outbound directions. The residential population increases more than the workplace populations, which is likely due to the largely suburban nature of the area through which the route passes.

7 Route Summary

Table 7.1 and Table 7.2 below shows a summary of the outcome of the bus stop review process.

Table 7.1: Blanchardstown to City Centre Inbound Route Summary

Number of Existing Stops	26
Number of Stops Moved	8
Number of Stops Removed	4
Number of Stops Added	6

Table 7.2: Blanchardstown to City Centre Outbound Route Summary

Number of Existing Stops	23
Number of Stops Moved	9
Number of Stops Removed	4
Number of Stops Added	8

On the inbound route, eight of the 26 stops are proposed to be moved. Four stops are proposed to be removed from the route, and six to be added, increasing the total number of stops from 26 to 28.

On the outbound route, nine of the 23 stops are proposed to be moved. Four stops are proposed to be removed, and eight to be added, increasing the total number to 27.

8 Conclusion

A bus stop review was carried out for the Blanchardstown to City Centre CBC scheme. The purpose of the exercise was to rationalise the bus stop locations to reduce the total journey time of bus services on the corridor and to improve the catchment of the bus stops.

The study was carried out by reviewing key features of the inbound and outbound bus stops including location, proximity to junctions, road crossings and major land use attractions next to the route. The study also reviewed existing and projected passenger volumes and local considerations such as space to provide shelters, waiting areas, footpath and cycle routes.

As part of the exercise, population catchment analysis has been carried out to demonstrate the impact of the proposed recommendations. The results show that the catchment footprints along the routes have increased to some extent to include larger residential and employment populations. This is largely due to the improved spacing of the stops, and the fact that stops are positioned closer to intersections, resulting in the catchment area spreading further along side roads.

It is recommended to relocate 33% of the inbound and outbound bus stops along the corridor. It is also proposed to remove eight stops from this route, and to add five new stops, such that in this case the number of stops on the proposed scheme will be reduced by three.

It is expected that the overall bus journey time along this route will be optimised as a result of these changes, while also maximising catchment. The removal and consolidation of stops south of Navan Road Parkway will lead to less time lost due to dwell times at stops and the associated time lost due to deceleration and acceleration before and after the stops, while additional stops on the N3 dual carriageway and at Blanchardstown Shopping Centre will increase catchment.

Appendix A

Bus Stop Review Methodology

Bus Stop Review Methodology (REV 3)

Project name	Date	Prepared by
Bus Connects Core Bus Corridor	21 June 2020	Joe Seymour - AECOM

1.0 Introduction

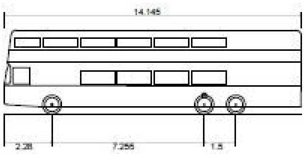
The location and design of bus stops will be critical to the success of the operation of BusConnects Dublin. Bus stop catchment areas and safety will need to be maximised, the size of the stop needs to be sufficient to meet the expected passenger and bus demand, and the bus stop itself must not become a bottle neck to the operation of the corridor. This methodology outlines how each corridor shall be assessed so as the location and operation of bus stops can be optimised.

This Note does not relate to the physical layout of the bus stops which is addressed in Chapter 11 of the Preliminary Design Guidance Booklet, although spatial considerations are discussed in section 5.4. Standard details for bus stop layouts are to be included in the next draft of the Design Guidance Booklet.

It is important to note that existing bus stops located along the Core Bus Corridors will have been subject to considerable thought by Bus Operators, An Garda Siochana, and the Local Authority. For this reason, it is imperative that each location is closely examined before it is considered for relocation or removal.

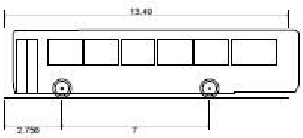
For avoidance of doubt this manual assumes the standard bus is a twin axle double decker bus (10 to 11m in length) with a front and middle doors. Other vehicles, such as 3-axle double decker, are in use by Dublin Bus and should be considered when undertaking the Geometric Design.

Figure 1.2 Standard Bus being used on the CBC's.



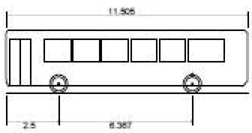
Double Decker Regional Bus	
Overall Length	14.145m
Overall Width	2.550m
Overall Body Height	4.002m
Min Body Ground Clearance	0.342m
Track Width	2.540m
Lock-to-lock time	1.00s
Wall to Wall Turning Radius	12.150m

VEHICLE TYPE 1



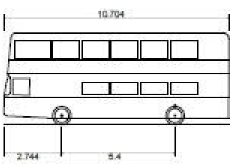
Low Entry Regional Commuter Bus	
Overall Length	13.490m
Overall Width	2.550m
Overall Body Height	3.216m
Min Body Ground Clearance	0.194m
Track Width	2.530m
Lock-to-lock time	1.00s
Wall to Wall Turning Radius	12.200m

VEHICLE TYPE 2



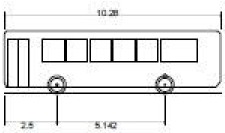
Single Deck City Bus	
Overall Length	11.505m
Overall Width	2.445m
Overall Body Height	3.000m
Min Body Ground Clearance	0.309m
Track Width	2.425m
Lock-to-lock time	1.00s
Curb to Curb Turning Radius	10.250m

VEHICLE TYPE 3



Double Decker City Bus	
Overall Length	10.704m
Overall Width	2.520m
Overall Body Height	4.397m
Min Body Ground Clearance	0.335m
Track Width	2.500m
Lock-to-lock time	1.00s
Curb to Curb Turning Radius	9.000m

VEHICLE TYPE 4



Single Deck Midi Bus	
Overall Length	10.280m
Overall Width	2.445m
Overall Body Height	3.000m
Min Body Ground Clearance	0.314m
Track Width	2.425m
Lock-to-lock time	1.00s
Curb to Curb Turning Radius	10.111m

VEHICLE TYPE 5

GENERAL NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE WORKS REQUIREMENTS & SPECIFICATION.

Figure 1.3 Standard Transport for Ireland Bus Specifications.

Considerations for Bus Stop Locations

The basic criteria for consideration when locating a bus stop:

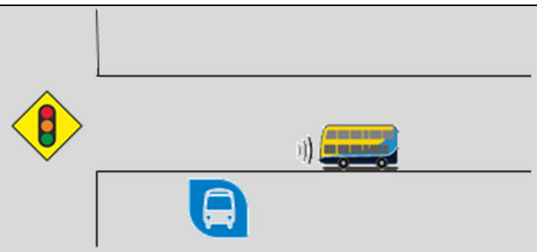
- Driver and waiting passengers are clearly visible to each other;
- Located close to key local facilities;
- Located close to main junctions without affecting road safety or junction operation;
- Located to minimise walking distance between interchange stops;
- Where there is space for a bus shelter;
- Located in pairs, ‘Tail to tail’ on opposite sides of the road;
- Close to (and on exit side of) pedestrian crossings;
- Away from sites likely to be obstructed; and
- Adequate footway width.

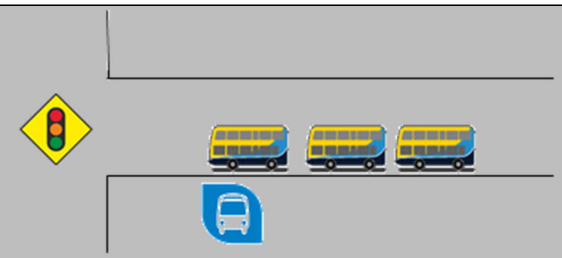
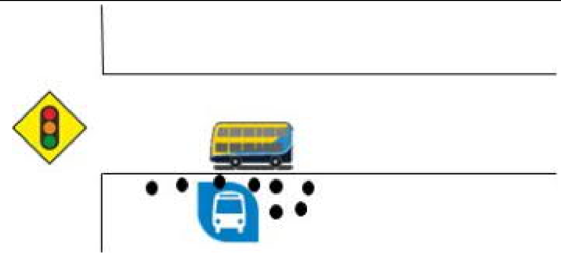
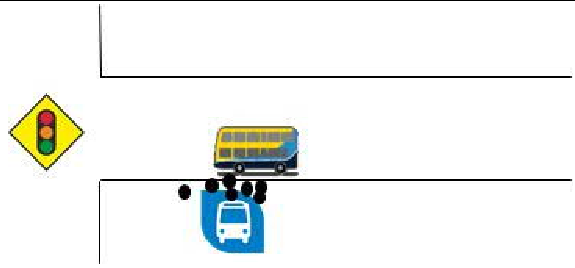
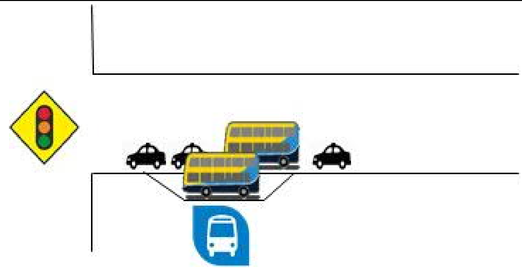
Principals of Bus Stop on high capacity Bus Systems.

The Core Bus Network Report (2015) noted that the distances between bus stops influences the efficiency of the bus network. In general, the lower the distances between stops along a corridor, the higher the delay that is incurred for buses. This delay is caused through acceleration and deceleration and delays associated with pulling in and out of bus stops with some estimates suggesting that stopping at bus stops makes up in excess of 20% of the journey times along the QBC corridors. International literature on bus stop spacing recommends a distance of 300 to 500m (NTA Report on Core Bus Network Infrastructure Network, February 2015) between stops in suburban areas is optimum, whereas in Dublin many routes have bus stops located at far lower spacing. The Core Bus Network Report concluded that increasing spacing between bus stops was part of the solution to reduce delays along the corridors.

The following indicates where delay materialises when accessing bus stops.

Table 1.1 Sources of Bus Delay associated with Bus Stops (TCQoSM, TRB)

1 Deceleration Time spent slowing to serve the stop.	

2 Bus stop failure Waiting for other buses to clear the stop	
3 Boarding lost time Waiting for passengers to reach the bus	
4 Passenger service time (dwell time) Opening the doors, boarding and alighting passengers, and closing the doors	
5 Traffic signal (traffic control) delay Waiting for the signal to turn green, or other traffic control delay	
6 Re-entry delay Waiting for a gap in traffic	
7 Acceleration Time spent getting back up to speed	

Boarding of passengers, layout of stations are not being examined as they are either not relevant in this case or dealt with elsewhere as part of the overall BusConnects Programme.

The acceleration and deceleration will be similar at all stops and clearly the overall impact is dependent on the number of bus stops along a route; this will be dealt with by examining the number of bus stops along a corridor.

Bus Stop failure is linked to the amount of time buses are stopped and the frequency of buses along the route and has a significant impact on the overall corridor capacity and efficiency, particularly where non stopping buses are present (Express or Regional Buses). A situation where a bus arrives at a bus stop to find all loading areas full:

- The bus must wait until space becomes available;
- Slows down the bus and creates schedule reliability issues; and
- Delay can also increase further as bus bunching occurs and bus dwell and traffic control delay times will increase.

The proximity of a bus stop to signalised junctions has an impact on bus speeds with far-side stops having the least negative impact on speed and capacity, and also favored as passengers cross the road behind the bus which increases safety.

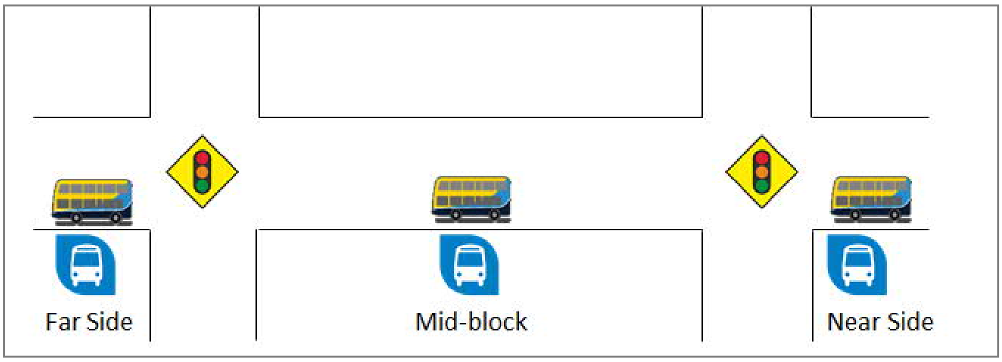


Figure 1.4 Typical Location of Bus Stops.

Ability to overtake slower buses is an important parameter where the route is made up of both express (rarely stopping) and slower (stopping at all stops) buses. For example, on the N11 QBC lay-bys (or passing lanes) were introduced after the original QBC was built to increase the capacity and allow express buses to pass the slower vehicles. On some of the BusConnects schemes this will need to be considered particularly on those routes that include regional and intercity services.

Figure 1.5 Stillorgan QBC with high bus flows and no bus laybys resulted in bus bunching/ platooning; bus lay-by’s provided at key locations to allow express buses to pass slower buses. (Source: Google Maps)

Figure 1.6 A typical bus lay-by adjacent to a bus lane; note concrete surface for additional durability.

Consideration should also be given to locations where coaches stop along the Corridors, particularly those serving the airport which could require longer dwell time to allow passengers to load/unload their luggage. In these cases, a layby separate to the CBC Bus Stop maybe desirable (Figure 1.7).

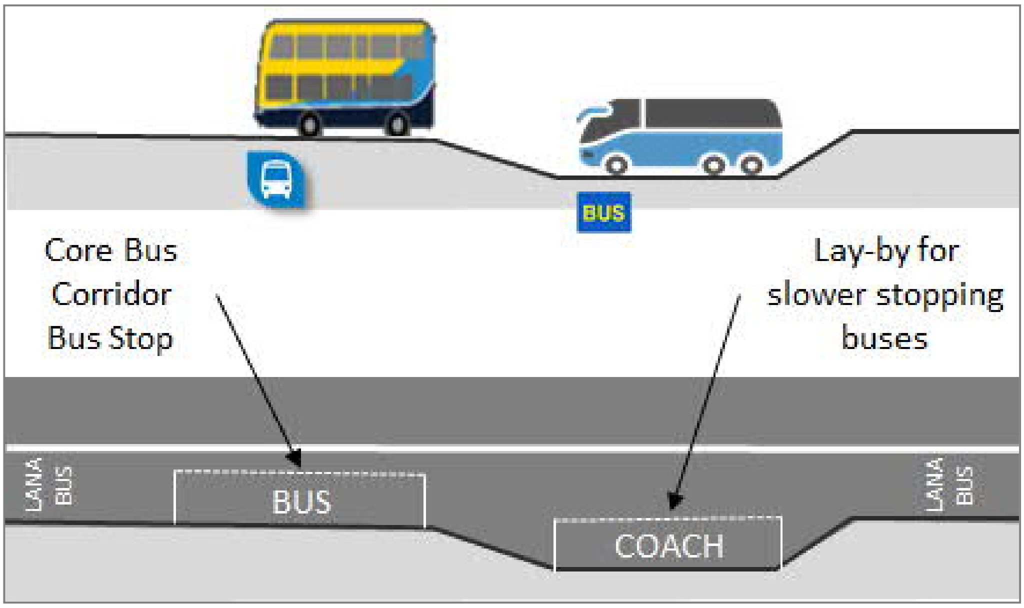


Figure 1.7 Double Bus Stop (in-line for BusConnects routes) concept for locations with buses requiring different dwell times.

Figure 1.8 Multiple bus operators may be using bus stops along the Corridors.

In general, most bus stops along corridors will be in-line (bus stops within the bus lane), as a result re-entry delays will not impact the operation of buses. However, on busier corridors where lay-bys are used re-entry may delay buses. ED's need to consider the flow of buses and taxis passing lay-by's, and where there is increased risk of delay additional measures may be required to generate gaps in traffic (far-side) or the installation of a yellow box to allow buses to renter the traffic queue (near-side).

Pedestrian accessibility

Another important aspect of bus stop positioning is proximity to pedestrian crossings. Failure to provide high quality pedestrian facilities on the pedestrian desire line may lead to a higher accident risk associated with a bus stop. Therefore, designers need to consider how passengers are going to cross the road to get access to the stop, in general this will require bus stops to be located close to safe crossing points.

2.0 Methodology

This section outlines the process for examining each BusConnects Corridor and assessing and reporting on the bus stops along each route. The flow chart summarises the process and this is followed by a more detailed description of the tasks to be undertaken.

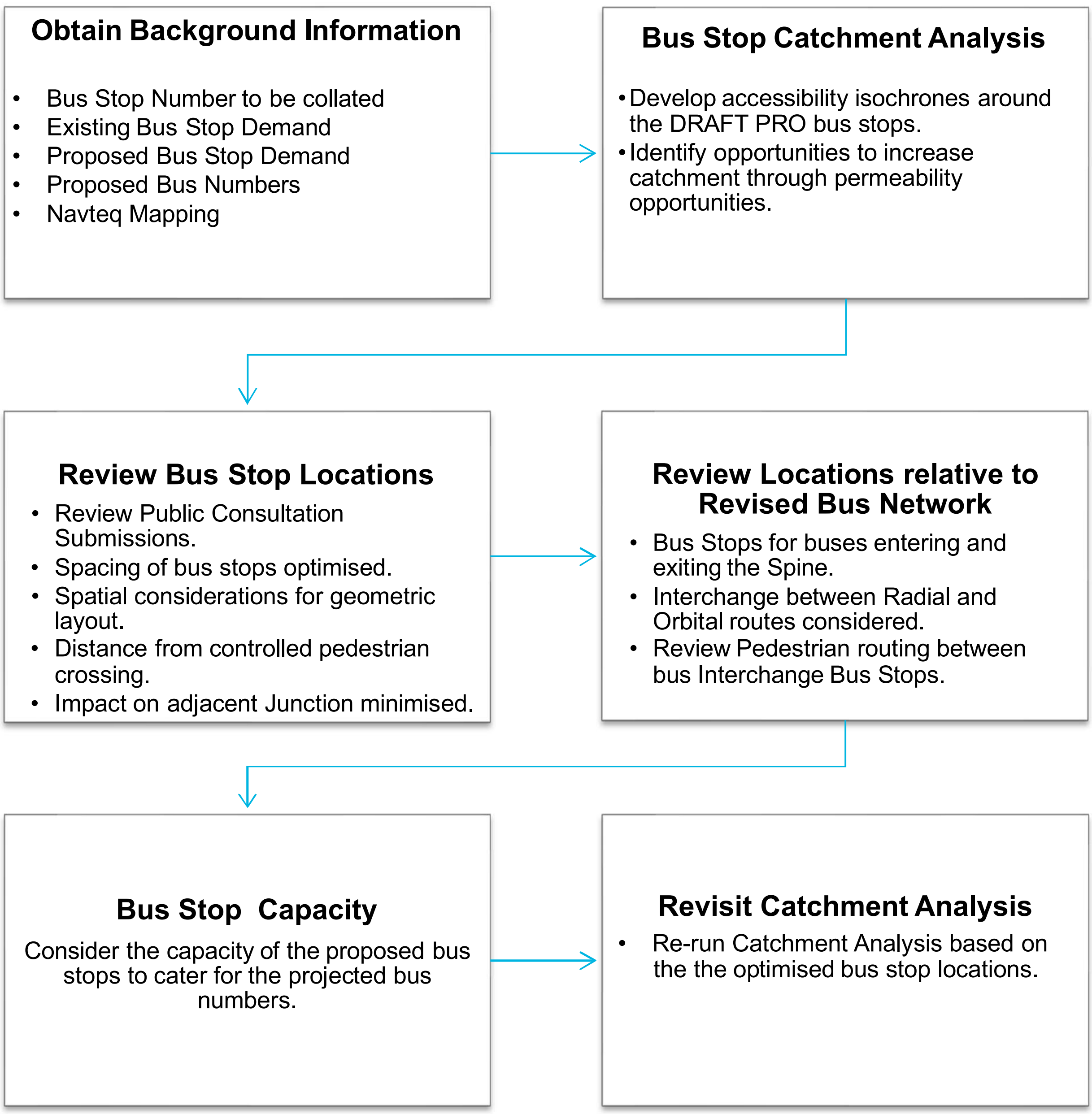
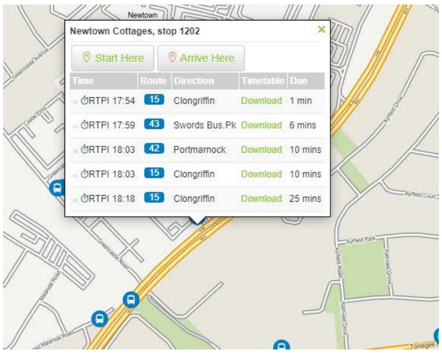


Figure 2.1 Flow Chart for proposed Bus Stop Review.

3.0 Background Information

In order to undertake the review of the bus stops along each corridor background information must be gathered. The following section outlines this information and how to obtain it.

Table 3.1 Information to be gathered to undertake the Bus Stop Review

Item	Description	Location/Contact
Bus Stop Number	Bus Stop Numbers can be obtained from a number of online sources. 	https://www.transportforireland.ie/plan-a-journey/
Existing Bus Stop Demand	Estimated boarding and alighting figures are available from NTA Business Intelligence Unit. Using Leap Card Data and Machine Learning the NTA has recently developed a tool for estimating where passengers are alighting buses along each route. The format that this will be available in is currently under development. This information can include details on use of Free Travel Pass which may help in identifying locations which are a higher priority for the elderly and those with accessibility issues.	**NTA Business Intelligence Unit**
Proposed Bus Stop Demand	Obtain future passenger demand for each corridor, this will come from the ERM. This will not be linked to specific bus stops, but zonal. The bus stop demand will then be linked to bus stops by using the existing bus stop data and factoring up existing boarding and alighting figures.	TIAR Consultant
Proposed Bus Numbers	The number of buses on each corridor is available from the BusConnects Network Redesign Team. This information has already been issued to each ED. It is the ED's responsibility to confirm that these figures are correct at this time.	Confirm that the numbers provided are the revised network data.
Navteq Mapping	The GIS Mapping is required to understand permeability in the area surrounding bus stops. NTA has this information and will provide it to each ED. Note that this base data will need to be reviewed thoroughly as from experience there will be many permeability routes that are missing.	NTA to issue mapping to all teams.

4.0 Bus Stop Catchment Analysis

Bus stop passenger catchment areas are critically important to the success of a high-quality bus corridor. The catchment at each bus stop needs to be maximised so as each stopping movement collects sufficient passengers to justify the loss in journey speed; a bus stopping at each bus stop to pick up one passenger will result in a very slow journey time, the ideal scenario is to stop less often and collect more passengers at each stop. Clearly too few bus stops could also be detrimental to the success of the scheme. To assess if bus stops are optimally spaced to maximise the passenger catchment area it is recommended that a catchment analysis using the NTA Navteq data(or similar process) is undertaken.

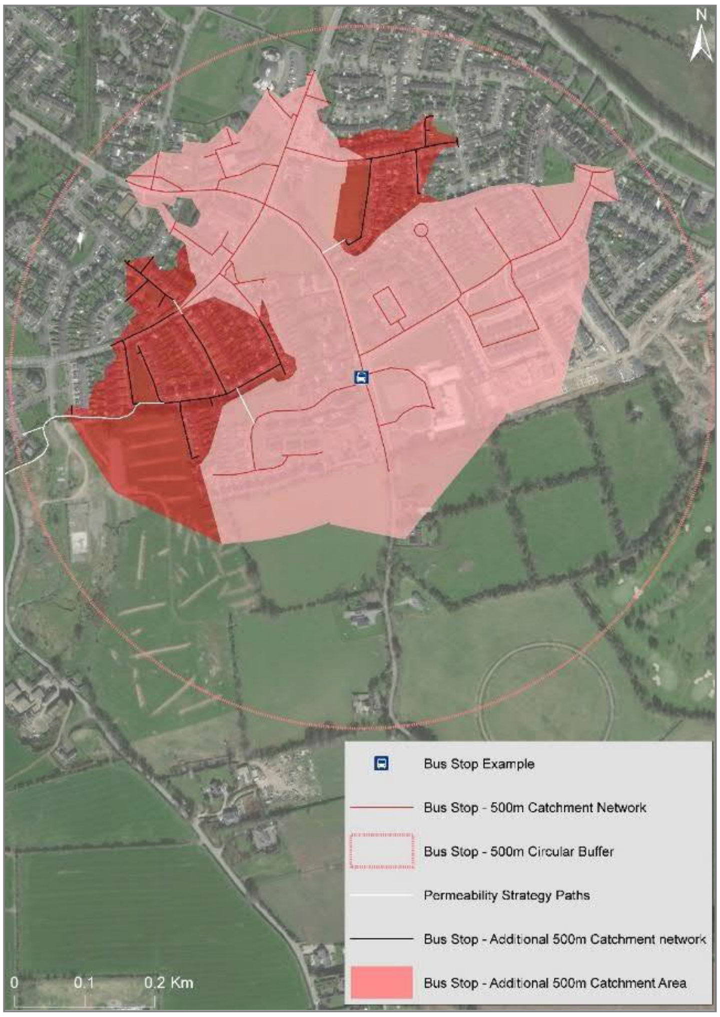


Figure 4.1 Passenger catchment analysis for a bus stop indicating the existing and possible catchment areas assuming permeability improvements can be undertaken.

Figure 4.1 indicates the area that is within a standard walking distance of a bus stop (400m for BusConnects CBC's) based on the actual walking distance rather than "as crow flies" analysis which can be misleading particularly where there are long sections of blank, inaccessible, wall along corridors. The number of people living within this area can be obtained from GeoDirectory data. In addition, permeability solutions can be identified and the impact of making these changes can be quickly assessed in terms of increased catchment area. The process of undertaking this analysis is outlined below:

Task 1: Enhancing the Navteq network using OpenStreetMap to add footpaths, greenways, cut throughs which are accessible to most people, paths over greens or parks, etc., this is required as the network supplied by the NTA is a primarily a driving network not a pedestrian network.

To do this you will add walk links extracted from OpenStreetMap's data clearly coding these into the Navteq supplied by the NTA. Google Streetview should be used as a check to ensure any link added to the Navteq exist on the ground and are accessible to all. Informal walk links should not be added at this stage.

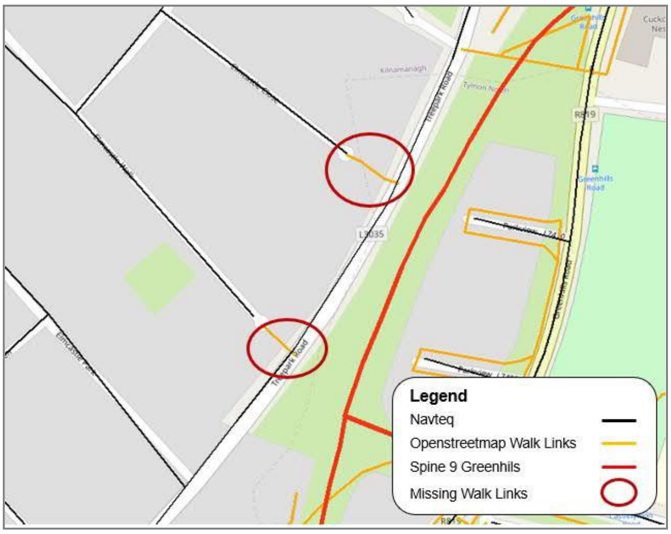


Figure 4.2 Example of permeability link missing from Navteq mapping on Tallaght/Clondalkin Cor Bus Corridor.

Task 2: Once the Navteq has been enhanced to the required level to capture all major pedestrian movement within bus stop catchment areas, catchment analysis shall be run for the proposed and existing bus stops. Using the Network Analyst Extension in ArcGIS generating 400m and 800m walking bands to reflect 5 and 10-minute walking catchments of bus stops.

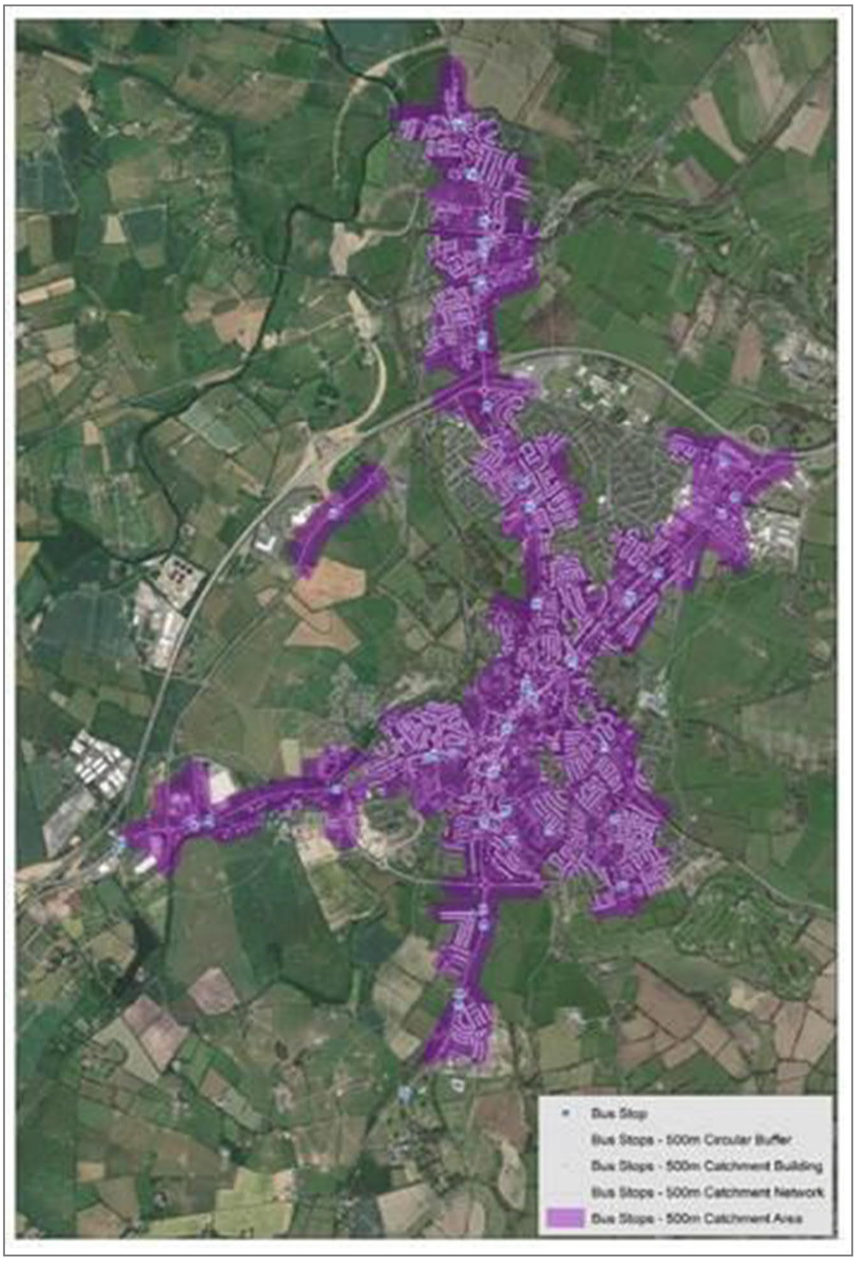


Figure 4.3 Example of catchment analysis run for all bus stops in Naas

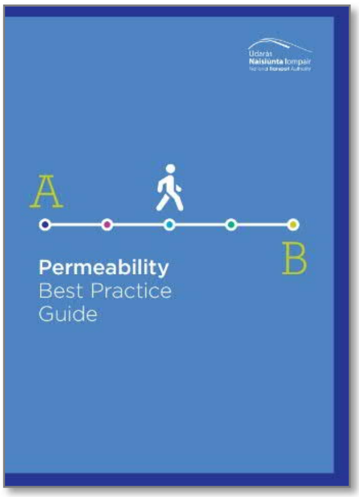
Task 3: Production of catchment tables identifying number of households using Geo Directory or population estimate using census 2016 and Geo Directory to apportion sections of Census Small Area within 400m and 800m catchments of each bus stop. Catchments will be non-overlapping to avoid double counting between stops along the same alignment.

Task 4: Maps will be generated for each stop along each of the alignment, or stops can be grouped together to reflect particular study areas. Maps can be generated in any particular format to match the theme of previous reports (EPR Reports).

Task 5: Quality Assurance and Checking of catchments is critical as missing, or additional, links will be easily identified by the public and could discredit the analysis if there are errors.

Having developed a detailed understanding of the catchment areas consideration should then be given to how the catchments can be widened through identification of permeability opportunities along the corridors. Permeability describes the extent to which an urban area permits the movement of people by walking or cycling. Such an approach is known as “filtered permeability”. Barriers to filtered permeability can include:

- Boundary walls around estates and within residential areas that prevent movement along natural desire lines, being usually the shortest and most direct route connecting two points;
- Cul-de-sacs which prohibit through movement;
- Poorly designed linkages that are difficult or unattractive to use; and
- Connections which require much longer travel distances than direct linkages.



The NTA Permeability Best Practise Guide should be followed for the identification and assessment of these opportunities. Careful consideration should be given to whether or not these proposals should form part of the Bus Connects scheme or if they should be identified to the Local Authority for actioning. Only those linkages that are directly linked to the corridor should be considered as part of this application.

An example from the Clongriffin to City Centre CBC can be seen in Figure 4.4 where a very large housing estate which is located immediately adjacent to the proposed bus corridor has a continuous boundary wall that runs for over 800m preventing easy access to the bus routes and requiring a walk of almost 1km to access the bus routes. Opening a pedestrian access on the boundary wall could create a much shorter route to the buses and substantially increase the bus passenger catchment area.

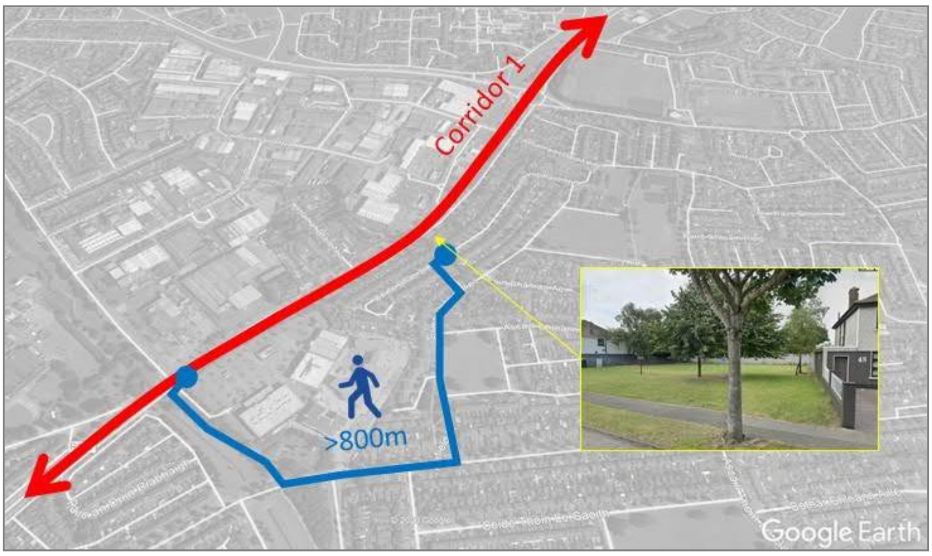


Figure 4.4 Permeability option on the Malahide Road (Source: Google Maps).

Figure 4.5 Boundary wall along Malahide Road (Corridor 1) where local residents have opened up individual doors to access the existing QBC route.

5.0 Review Bus Stop Locations

5.1 Public Consultation Feedback.

An important aspect of the bus stop review is to review feedback received from the general public in relation to the position of an existing, or proposed, bus stop along the corridor. This may identify a specific issue that the reviewer should be aware of before beginning the review. For example, the relocation of a bus stop away from a destination for people with mobility impairments may not have been identified during the preliminary design process and should now be considered. It is also important to review these comments against commitments that may have been given during the "one to one" meetings held during the initial, and subsequent, consultation stages.

Please note that some bus stops were relocated after the EPR public consultation as a result of public consultation comments, if a bus stop is being considered for relocation please also check whether it had been relocated previously by checking the EPR drawings and discussing with the NTA IPO.

5.2 Usage of Bus Stops.

In order to help the reviewer, understand the passenger movements at a bus stop it is recommended that the existing Boarding and Alighting Data is reviewed at this early stage and is used as an approxi for future passenger movements. This will provide an indication of the numbers using a bus stop in an area and would indicate the number of pedestrians movements having to be catered for. It will also indicate those bus stop locations that are relatively lightly used and could be considered for amalgamation with a nearby bus stop, relocation to a more convenient location, or removal completely.

5.3 Spacing of Bus Stops.

The spacing of bus stops has a significant impact on the average speed of a bus corridor, clearly the more times a bus stops the slower the overall journey time will be. A bus incurs a minimum of 15 seconds delay with each stop on an urban street just to decelerate, open and close the bus doors, and accelerate back to speed (25 seconds on a busway). Table 5.1 uses information extracted from the Transit Capacity and Quality of Service Manual (TRB) and indicates the estimated average speed on an 80kph busway. This clearly indicates that bus stop spacing, and dwell time have a large impact on average speed on bus corridors.

Table 5.1 Average Bus Speed (km/h) in Bus Priority Corridors, 80km/h running speed.

Average Stop Spacing (km)	Average Dwell Time (s)				
	0	15	30	45	60
0.8	50	37	32	27	24
1.6	61	51	45	40	37
2.4	68	58	53	48	45

For BusConnects it is proposed that bus stops should be spaced approximately **400m** apart on typical suburban sections of the route, dropping to approximately **250m** in urban centres (CIHT Buses in Urban Developments, January 2018). This spacing should be seen as a recommended spacing rather than an absolute minimum spacing.

The ability to increase stop spacing depends in part on the quality of the pedestrian connectivity in the area and also the availability of safe crossing points in the vicinity of the proposed bus stop. It may also depend on the characteristics of the passengers using the stop, e.g. persons with limited mobility may find it difficult to walk to the next stop. It is therefore recommended that for locations that may generate high number of elderly or mobility impaired bus passengers (health facilities, local businesses) consideration should be given to locating the bus stop within **100m** of the location if spatial considerations permit.

5.4 Spatial considerations for geometric layout.

The provision of high-quality bus stop infrastructure that is customer orientated is considered an essential part of the BusConnects offering, including:

- Being fully accessible for all bus passengers;
- Having a bus shelter for waiting passengers;
- Having both timetable and real time passenger information (RTPI) available to passengers;
- Having sufficient footpath space to allow the free movement of pedestrians passed the bus stop;
- Continuous cycle lane past the bus stop; and
- Provision of Cycle Parking at, or close to, the bus stop.

All of which requires significant space along the already congested radial routes that the Core Bus Corridors run along. Therefore, an important aspect of locating bus stops is identifying locations that have sufficient space to accommodate all, or most, of these elements.

The BusConnects Design Guide suggests that an Island Bus Stop (Figure 34) is the preferred bus stop option to be used as standard on the CBC project where space constraints allow. The **minimum footpath width within which an island bus stop can be implemented is 5.4m** (1.8m footpath + 1.2m cycle track + 2.4m island with shelter). This option assumes a shelter with half bay end panels. Should full panels (as seen on Figure 5.2) be required the width requirement will increase to approximately 6.3m.

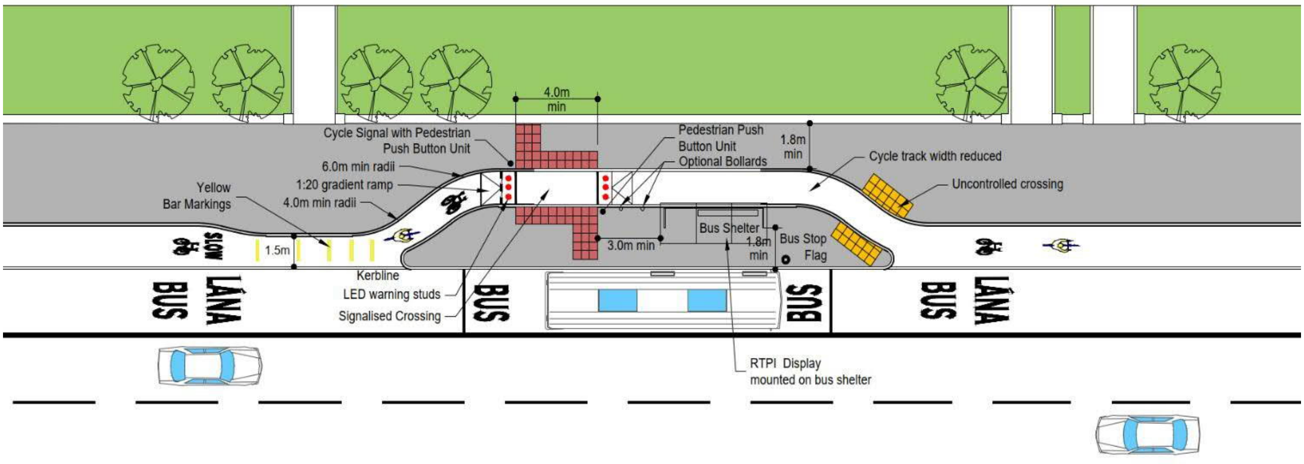


Figure 5.1 Typical Island Bus Stop Arrangement (Bus Connects Design Guideline).

Figure 5.2 Standard 3 Bay Reliance Mark Shelter with full width advertising panel.

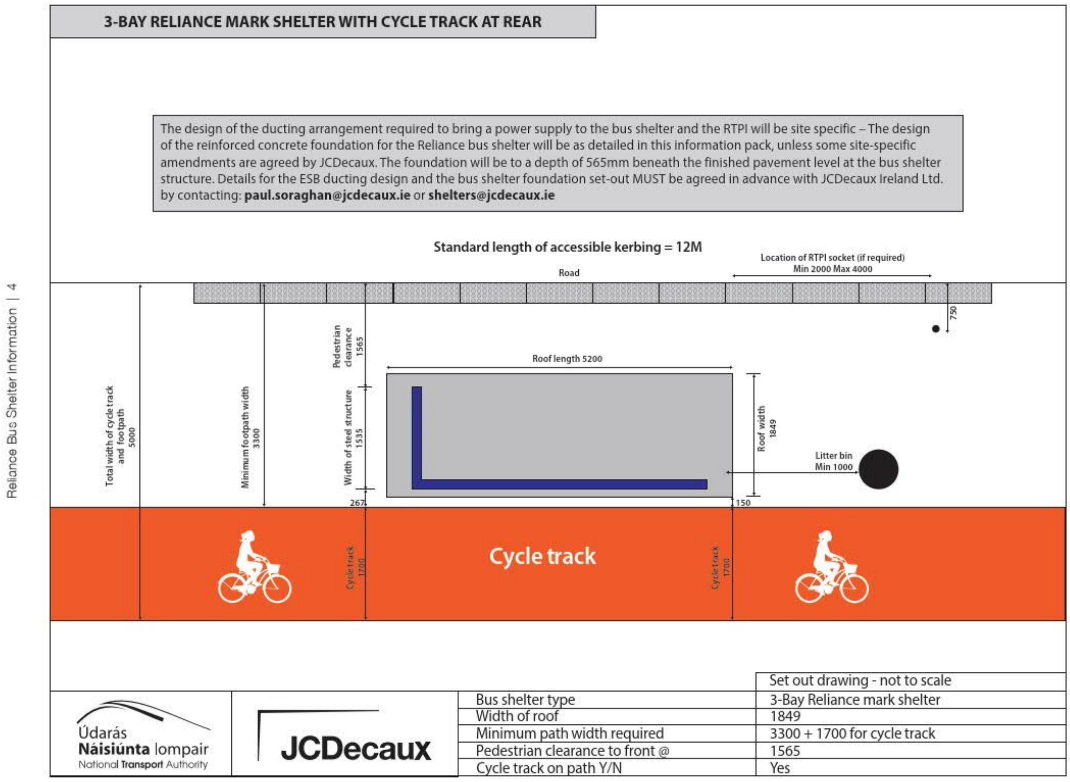


Figure 5.3 Standard layout for a 3 Bay Reliance Mark Shelter with full width advertising panel and cycle lane to the rear (note cycle lane width is to be determined by designers).

For locations where space is constrained an option consisting of a shared bus stop landing zone can be considered. This option is indicated in Figure 5.4 and should only be considered on a case-by-case basis to ensure suitability with particular attention paid to the volume of cyclists and volumes of boarding and alighting passengers. **Using the narrowest non-standard bus shelter this would require a minimum width of approximately 4.0m** (1.9m footpath with shelter + 1.2m cycle track + 0.75m island).

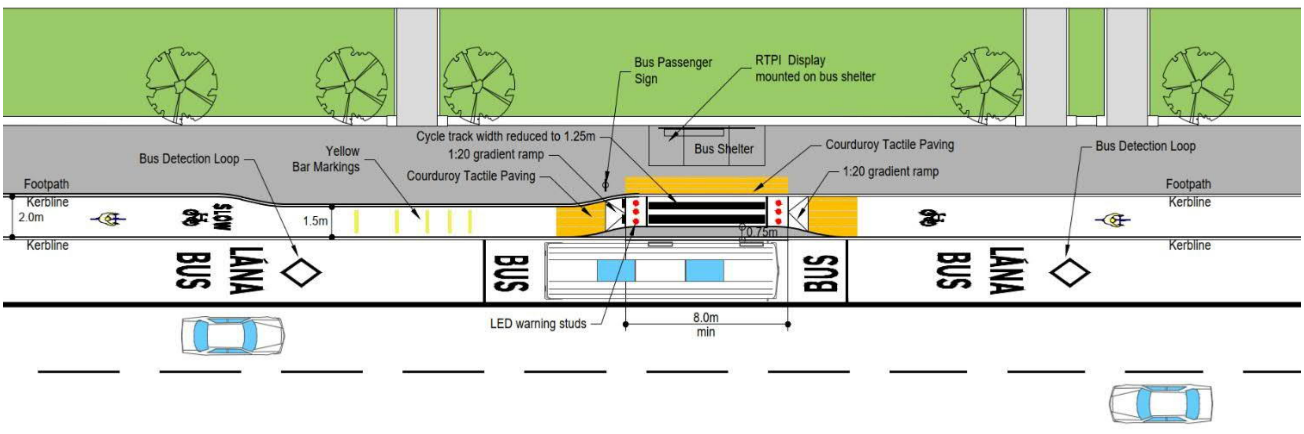


Figure 5.4 Shared Bus Stop Landing Zone Arrangement (Bus Connects Design Guideline).

Figure 5.5 Cantilever narrow roof Bus Shelter

It is important that ED's do not immediately choose the minimum sized shelter as this will impact on the weather protection provided to bus passengers and potentially advertising revenue share received by the NTA. Where there are a substantial number of bus stops using the nonstandard bus shelter it is recommended that the NTA IPO are consulted prior to finalising the proposals.

Providing cycle parking at bus stops has the potential to increase the catchment area of a bus corridor by providing a safe place for cyclists to secure their bike for the duration of their trip. ED's should look to provide cycle parking at all bus stops along the BusConnects Corridors where space permits. The **minimum provision is 3 Sheffield Stands** (accommodating 6 bicycles) in the vicinity of a bus stop. Where larger numbers of cyclists can be expected consideration should be given to providing a larger covered area of approximately 10 Sheffield Stands (accommodating 20 bicycles).

Figure 5.6 Sheffield Bicycle Stands provided at a Bus Stop on the N11.

Figure 5.7 Covered Sheffield Bicycle Stands provided at a Bus Stop on the N11.

5.4 Distance from controlled pedestrian crossing.

Pedestrians by their nature often take the quickest route to their destination rather than the safest route, particularly if they feel the safety risk is low. This results in bus passengers leaving buses stepping out in front of, or behind, buses and crossing the road in a hazardous manner. The placement of bus stops near safe pedestrian crossing points is therefore a critical aspect of bus stop design. Providing a bus stop where there is no, or an indirect, pedestrian crossing will lead to “jaywalking” and pedestrians making higher risk movements.

There are many examples of bus stop located immediately outside a pedestrian opening into a housing estate which makes it easy for passengers to access the bus stop in the morning, however on the return journey the passenger can often be isolated on the other side of the road with no safe crossing point available. While this may be satisfactory on some roads, it may not be on others, and how is a person with a mobility impairment to cross a busy radial route? **All bus stops along the CBC’s should be located within a short distance of a controlled crossing point.**

The optimum location to locate a bus stop is adjacent to junctions which have signalised pedestrian crossings provided on all desire lines. Much research has been undertaken in relation to the optimum location for a bus stop adjacent to a junction, either before (near-side) or after a junction (far-side), while there are advantages and disadvantages of both, all guidance recommends that locating the bus stop on the **far-side of a junction is the optimum solution**. While this may be theoptimum location in terms of the operation of a corridor a near-side bus stop may still be appropriatewhen spatial constraints, routing, or distance from junction are considered.

Figure 5.8 indicates various locations for bus stops at junctions with particular consideration for interchange between Spine and Orbital Core Bus Corridors. This indicates that all options which require passengers to interchange will require passengers to cross at least one arm of a junction (on average over both legs of their journey), emphasizing the importance of locating bus stops at junctions and providing controlled crossings on all desire lines between interchanging bus stops.

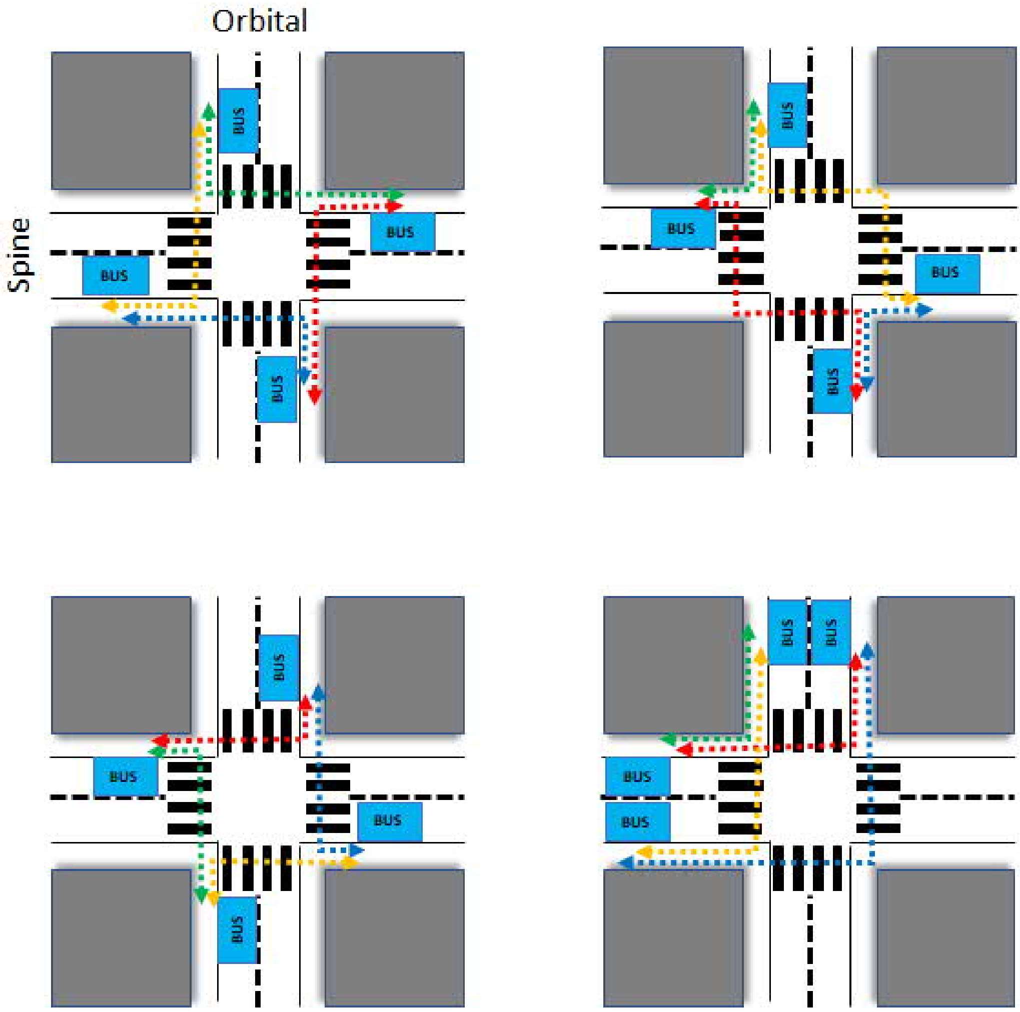


Figure 5.8 Bus stop locations and passenger interchange routes between them.

The DfT document Inclusive Mobility (2005) suggests recommended distance limits without rest for various Mobility Impaired Groups that ranges from 50 to 150m, which limits the distance between interchanging bus stops significantly. It is therefore recommended that the distance between the key interchange bus stops is limited to approximately **100m walking distance** where possible to enable all impaired groups to be able to interchange, consideration must be given to providing a rest spots at approximately 50m between the bus stops to cater for those that will not make this distance without a rest.

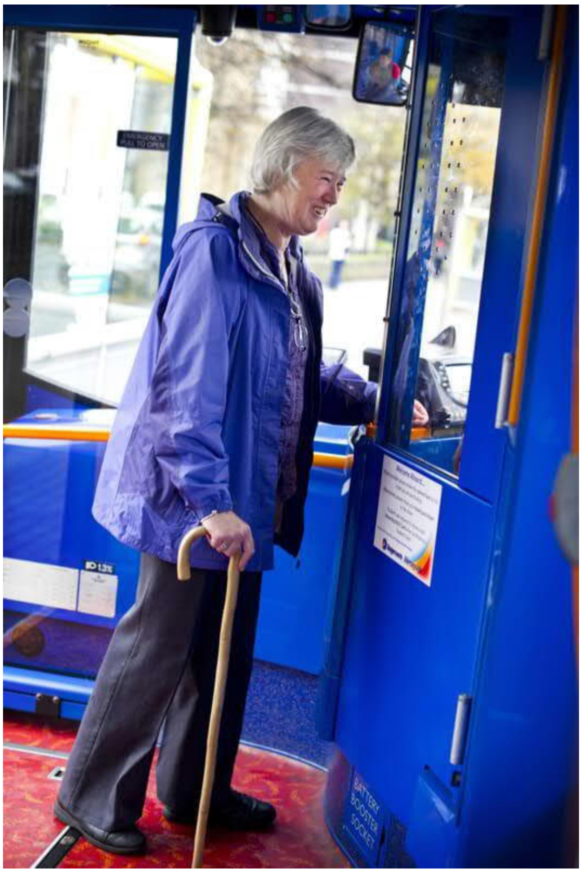


Figure 5.9 Pedestrians using sticks have a limited range of 50m before needing a rest.

For mid-block (between junctions) bus stops it is important that consideration is given to the location of a safe crossing point. It is recommended that a signalised crossing is located in close proximity to these stops to allow all passengers to cross the road safely. It is also recommended that bus stops are positioned upstream of this crossing to avoid buses blocking visibility to the crossing and that passengers walk to the back of the bus where they are more visible to oncoming traffic.

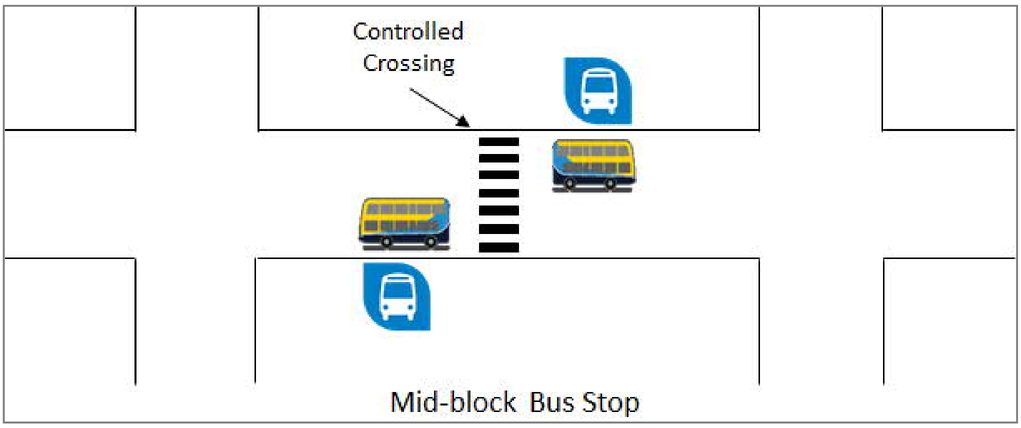


Figure 5.10 Mid-block bus stop optimum layout.

5.5 Impact on Adjacent Junction.

Locating bus stops close to junctions is optimum for pedestrian connectivity and safety, however it clearly can impact on the capacity of a junction and may result in increased congestion. Designers will need to review the location of the bus stops in order to minimise the impact on the operation and capacity of the junctions; things to consider include:

- Distance from the far-side bus stop to the junction. Buses will be running at headways of approximately 2 minutes at peaks on some corridors, while every effort will be made to avoid bunching it is likely that buses will end up meeting each other as they wait for a green signal. As a result, it is important that sufficient space for a bus to wait behind a stopped bus is provided at all junctions. Importantly this offset should start beyond the pedestrian crossing point in order to avoid blocking the crossing. Table 2.2 provides guidance on offset distance from key features.
- For near-side bus stops it is important that the location is reviewed in the context of visibility to the traffic signals for general traffic (bus, or the bus stop infrastructure, impacting on visibility to primary traffic signals) and also interaction with left turning traffic. Reference DMRB DN-GEO-03044 and DTTaS Traffic Signs Manual Chapter 9.
- Where a bus is joining a Spine from a side road it is important that the bus stops are fully accessible by the turning vehicle and sufficient space is provided to allow the bus to pull in flush with the bus stop so as the gap between the kerb and the bus is minimised (both doors). It is also important to ensure that the manoeuvring bus does not require the bus to sweep over the kerb line.

Figure 5.11 Tracking of a turning bus entering a bus stop.

Figure 5.12 Having buses flush with the bus stop is important to allow the ramp to lower correctly, but also to speed up the boarding and alighting of all passengers as gaps slow this down.

Table 5.2 Indicative Distances of Features from Bus Stops

(DRAFT NTA Bus Stop Design Guidance)

Feature	**Distance (m) to bus stop sign**
Prior to isolated pedestrian crossing signals or Zebra	18m
After pedestrian crossing signals or Zebra	10m + bus length*
Prior to signalised junction	20-30m
After signalised junction	20m + bus length*
Prior to or after a side road	20m
After a side road	10m + bus length*
Prior to a roundabout (no diverge)	20-30m
After a roundabout (no merge)	20m + bus length*

***the bus length should be the longest bus using the stop**

6.0 Review Locations relative to Revised Bus Network

The revised BusConnects Network is based on the Connective Network Principle which will rely on some interchange between routes to reduce journey times across the City. This Interchange will primarily occur in the City Centre where the spines overlap rather than along the Spines. However, some interchange will occur between the High Frequency Spines and the Frequent Orbital routes and also between the routes before Branches peel off the spine. Seamless interchange between these bus routes will be critical for the successful operation of this system.

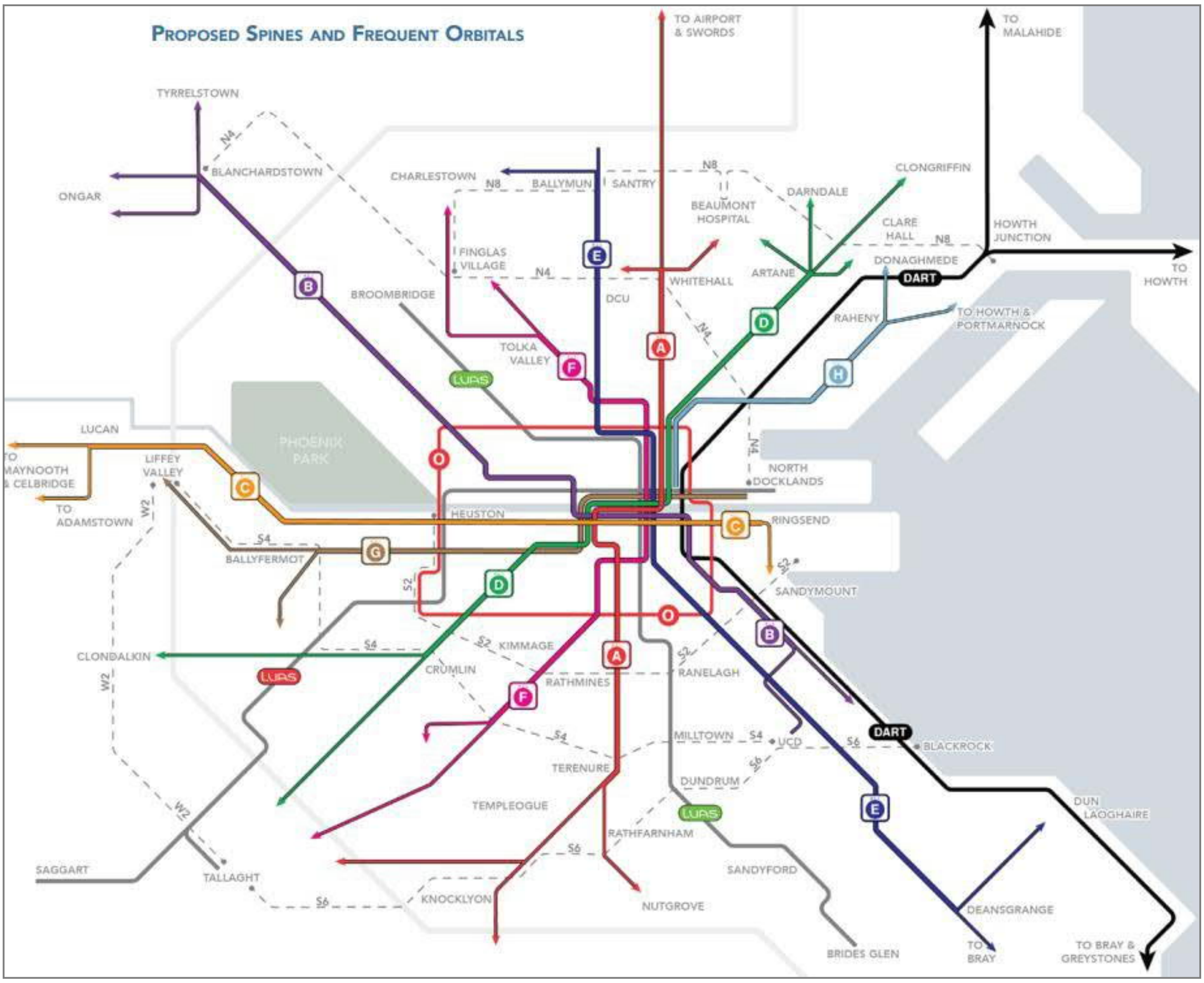


Figure 6.1 Simplified diagram of spines and frequent orbitals in the proposed network

The latest maps need to be obtained by each ED from the NTA IPO. In addition, the ED's can make use of the NTA's Remix system, which is an on-line route and stop information system for the proposed bus network.

6.1 Buses entering and exiting the Spine.

For buses entering and exiting the Spine, consideration should be given to how passengers may switch from one branch to another branch route. While this can happen anywhere along the Spine it will most regularly occur at the last stop before the branch route peels off the Spine. An existing example of this can be seen at Foxrock Church where two high frequency routes (46A/145) deviate at this point. At the last stop before the 46A deviates to Kill Avenue significant numbers switch from one route to the other.

Figure 6.2 Foxrock Church Bus Stop on the N11 QBC

For the Core Bus Corridors consideration should be given to the size and location of the stops before branch routes leave the main Spine. The optimum location of stops at this location will allow all routes to overlap prior to the junction thus removing the necessity for passengers to walk to anotherbus stop.

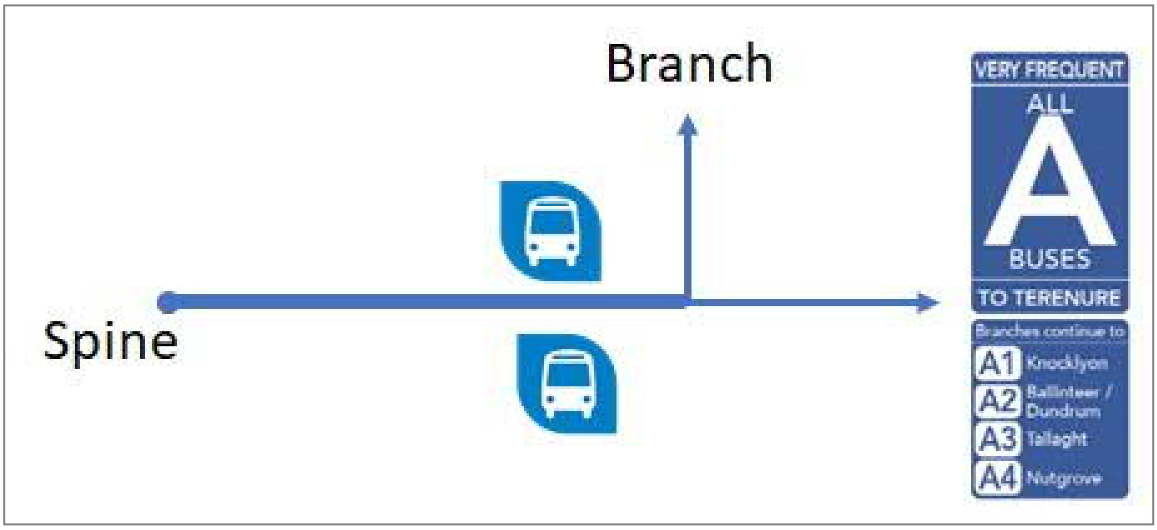


Figure 6.3 Location of Bus Stops Immediately before Branch Route Peels Off Spine

6.2 Interchange between Radial and Orbital routes.

The movement of passengers from one corridor to another is critically important to make Dublin more accessible by public transport. Making this interchange as easy as possible is thus critical to the successful delivery of the BusConnects Programme. Figure 3.4 indicates two typical scenarios that will arise on this project; the crossing movement (D/N4) and the overlapping movement (D/N2).

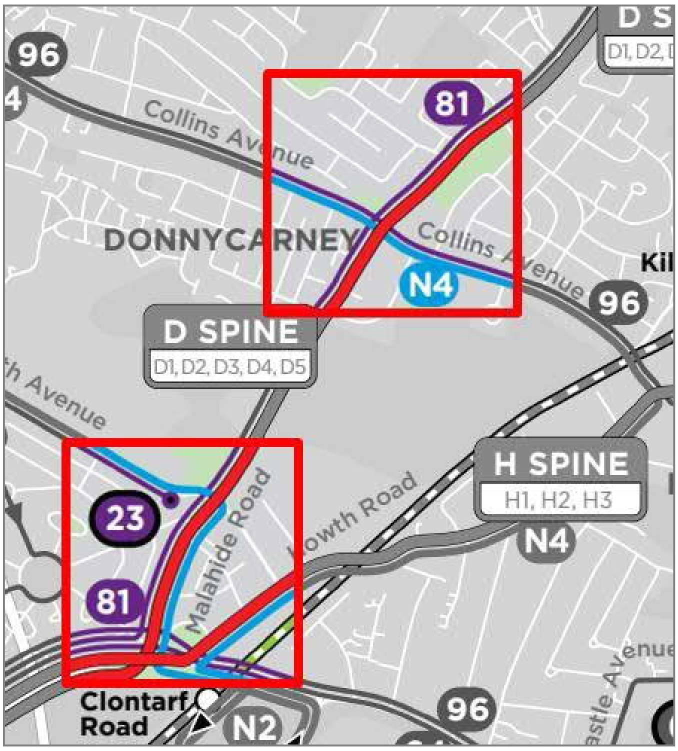


Figure 6.4 Two Different Scenarios for Interchange between orbital and radial corridors.

The optimum solution, but the less likely one, is the overlapping of routes which will allow passengers to leave one route and access another one via the same bus stop (or the opposite pair) making it a very easy interchange. For this option it is important that the designer considers the location of bus stops in a similar manner to the previous section on peeling off of branch lines.

For the more common crossing of routes the location of the bus stops needs to be carefully considered to minimise the distance passengers have to walk and to ensure there is a safe crossing location to facilitate this movements. This was outlined in section 5.4. **For locations where interchange is expected it is recommended that the desirable maximum distance between the interchanging bus stops is 100m,** with rest stops provided at 50m for those with impairments that restrict the maximum walking distance to below 100m.

7.0 Bus Stop Capacity

The capacity of bus stops is a complex and dependent on many variables which may constantly vary throughout a typical peak hour. For this reason it is proposed to undertake a high level assessment of bus stop capacity at this time and a more detailed assessment at a later stage when the Microsimulation Models are available for each corridor which can include the interaction between junctions and bus stops (potential bunching of buses), taxi numbers on the corridor, and the number of express or stopping coaches. Information on the calculation of capacities is available in the TRB, Transit Capacity and Quality of Service Manual, 3rd Edition and for complex locations it is recommended that the designer review applicable sections of this document to gain an understanding of the critical parameters.

7.1 Number of Bus Bays

The TFL Bus Stop Design Guidance states that bus stop capacity is a function of bus length, service frequency, the number of serving routes and their average dwell time. The BusConnects Dublin Corridors will generally carry between 15 to 20 buses per hour at peak times, which equates to a bus every 3 minutes. Assuming a maximum dwell time of 1 minute it could be assumed that one bus stop will be sufficient in most cases. However, the spine corridors will have multiple branches joining at different points with buses running at different frequencies resulting in buses not running at a constant headway. Figure 7.1 below indicates a bus arrival scenario from the TFL Bus Stop Design Guideline which shows how buses may arrive at a stop. This shows the estimated volume of buses at a single bus stop, depending on the frequency of the respective services. For example, Scenario C shows that although there is a frequency of 26 buses per hour, the stop, would theoretically operate well below capacity, however the arrival pattern of buses means that at times more than one bus will be on the stop. For this reason, it would be recommended that this bus stopshould have sufficient space to board and alight two buses at once.

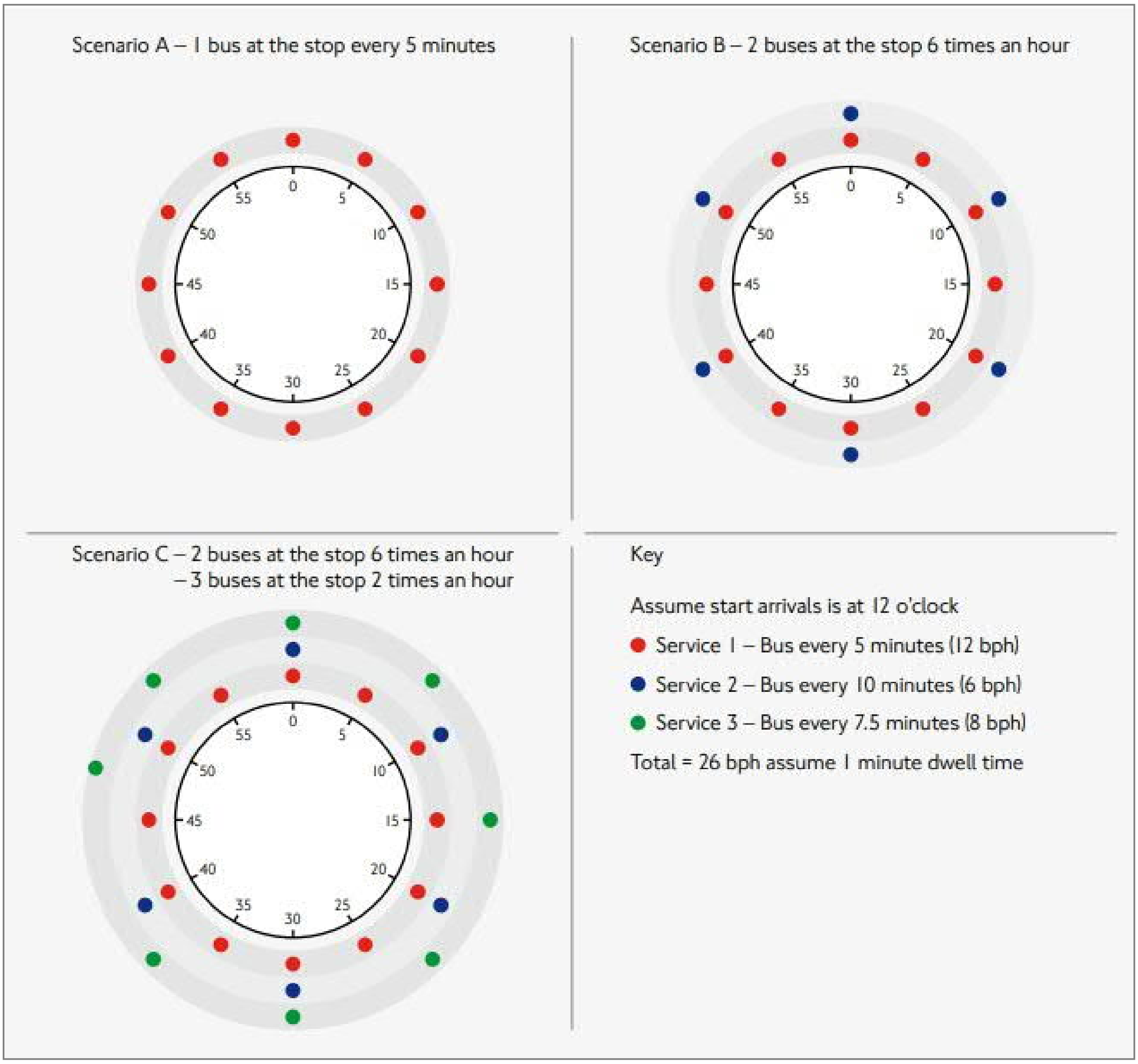


Figure 7.1 Bus Arrival Pattern at a Bus Stop (Source: TFL Bus Stop Design Guidance)

Detail on the buses using each corridor can be obtained from the NTA Remix site (obtain access from NTA IPO), or the frequency information from the BusConnects website. This can be used to make an estimate of the number of bays required at a bus stop by generating scenarios for the stops based on the headways for each route similar to Figure 7.1 above. These assessments will be superseded on completion of the micro-simulation analysis of each route, for this reason it is proposed to undertake this initial assessment based on the assumption that 2 bus bays will likely be required where there are between 25 and 30 buses on the route. This would require a longer bus cage that will accommodate two buses stopped simultaneously, approximately 24m in length (end to end bus), with Kassel Kerbs provided over its length to assist passengers, particularly those with a mobility impairment, to board and alight with ease from both buses.

Number of Bays at a Bus Stop	Where a Corridor is carrying approximately **25 to 30 buses** or more per hour, consideration be given to lengthened the bus stop cage and kerbing to provide space for 2 buses stopping simultaneously. Independent arrival and departure is not required.

Figure 7.2 Where space permits double bus bay should be provided where more than one bus is expected to arrive at a bus stop simultaneously (source: Google)

7.2 Passing Lanes

For corridors with large number of buses, particularly express buses that are not stopping at bus stops it may be necessary to provide a passing lane, or to indent the bus stop in a lay-by, to allow these faster moving buses to overtake the slower ones. This is likely to be particularly important on high capacity corridors where Regional Buses are accessing the City Centre. The TIAR Consultant has undertaken an initial assessment of this and have concluded that where the **hourly bus numbers exceed 40 the addition of a bus stop layby** will help maintain bus capacity and reliability along the corridor. The specific number for each corridor will be obtained from detailed microsimulation analysis at a later date.

Requirements for passing Lanes	Where a section of corridor is carrying approximately **40 to 50 buses** or more an hour**,** consideration should be given to providing passing lanes at bus stops.

Figure 7.3 In-line bus stops on a heavily used bus corridor can lead to express, or non-stopping buses, being delayed or making overtaking manoeuvres. (source: Dublin Bus Stuff).

8.0 Revisit Catchment Analysis

On completion of the review of bus stops along each corridor the catchment analysis for each corridor should be undertaken. The process was detailed in Section 4.0. The analysis should be undertaken and presented on a corridor basis with both Residential and Employment/Education population within 5 and 10 minutes presented.

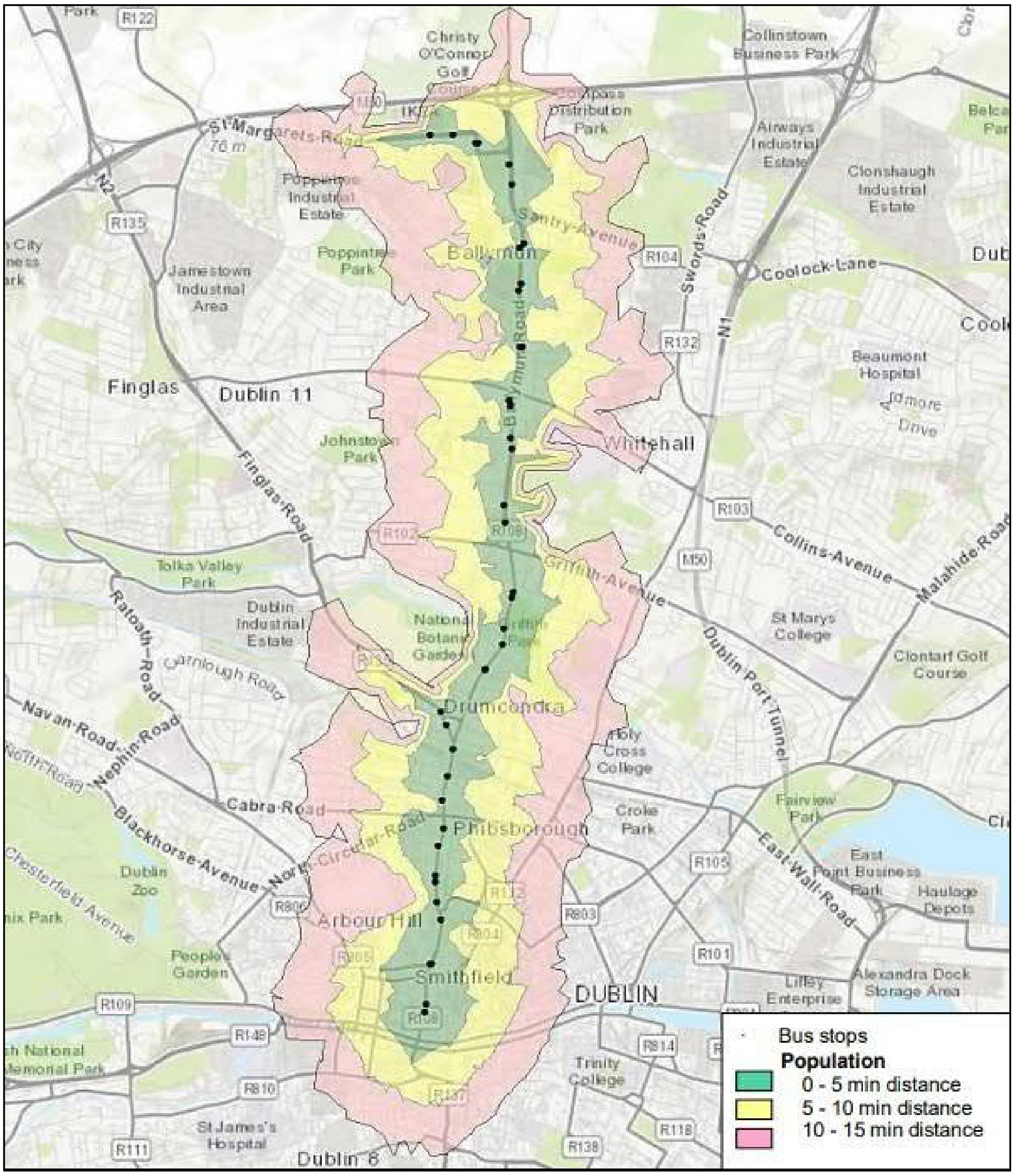


Figure 8.1 Typical map of bus corridor catchment areas

8.1 Presentation of Review

For consistency it is recommended that this review is undertaken, and presented, on the PRO drawings. High-level comments can be listed against each stop with distance between stops also noted (Document 1).

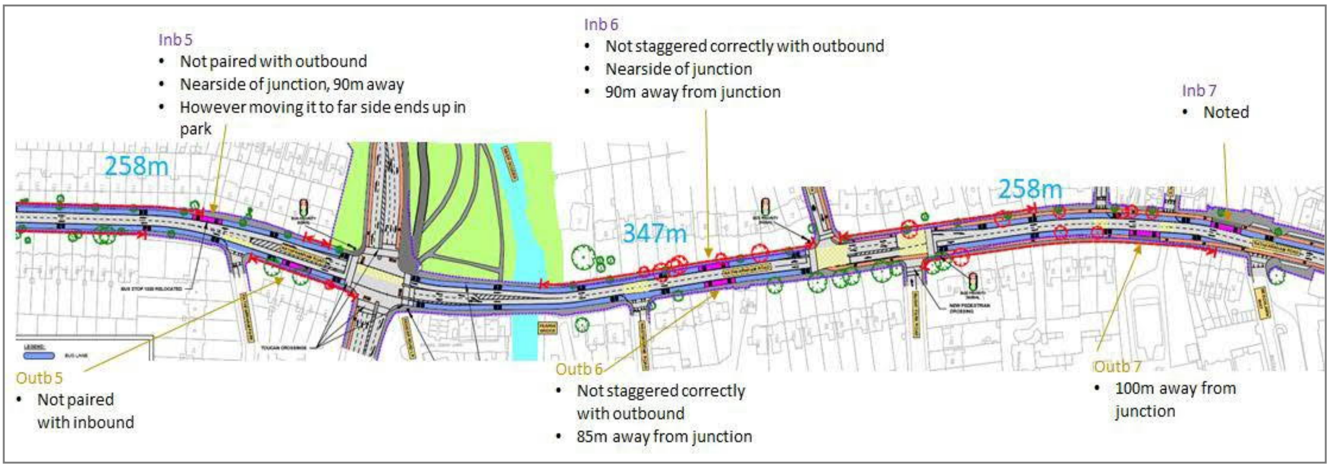


Figure 8.2 Example Review of Bus Stop Locations (Source: ARUP, Rathfarnham CBC).

This document should then be followed by a recommended bus stop strategy (Document 2) for each corridor indicating where bus stop are to be located and that all variables have been considered for each stop. This should be in a similar drawing to the review drawing in Figure 8.2, but focused on those stops that have been altered from the original PRO drawings. A summary table for each corridor should be placed on the front drawing of the recommendations summarising the existing and proposed bus stop strategy:

Corridor Name			
Number of Existing Bus Stops		**Length (KM)**	
	Existing	**Proposed**	**Comment**
Average Spacing of Bus Stops (m)			
All stops located adjacent to a controlled crossing?	Y/N	Y/N	
Have all accessibility / spatial requirements and consultation suggestion been accommodated?	-	Y/N	

Document 2 shall include a report providing specific details of each bus stop along a corridor and detailing the results of the catchment analysis for the optimised bus stops.

Appendix B

Bus Stop Review Table

Stop Number	Stop Name	Direction	Latitude	Longitude	Current Distance to previous stop	Current Peak Passenger Demand (Boarding)	Peak Boarding Time	Current Passenger Demand (Alighting)	Peak Alighting Time	Modelled Future Buses per hour (AM Peak)	Location (mid-block or within 100m of junction)	Before/ After Junction	Distance to controlled pedestrian crossing	Potential for interchange with Orbital Routes	Stop to be amended?	Reason for decision
Unknown	Old Navan Road (Slip Rd Eastbound)	Inbound	53.397376	-6.389861							80m	after	80m		No	Stop for use by inter-urban buses
7475	Blanchardstown Road South	Inbound	53.395445	-6.395227	480m	N/A	N/A	N/A	N/A		Mid block		115m		Move 40m to north	To facilitate the left turn manoeuvre into the service yard downstream, and to tie-in to new infrastructure for bus layover.
4362	Blanchardstown Road South	Inbound	53.393104	-6.398717	300m	N/A	N/A	N/A	N/A		50m	before	50m	Yes, same route	No	This location has good catchments to the west and is far enough from the Blakestown Way junction to allow buses to manoeuvre from the stop to the right-turn lane.
4747	Blanchardstown Town Centre	Inbound	53.394333	-6.391852	700m	90	4:00 pm	63	3:30 pm	44	60m	after	60m	Yes, same route	No	This is the terminus location
2960	Blanchardstown Town Centre	Inbound			280m						Mid Block		30m		Move 30m south	The existing layby bus stop will be used as an inter-urban stop.
New Stop	New Stop - Blanchardstown Town Centre	Inbound									Mid Block		30m		New	Stop for use by inter-urban buses
1545	Westend Office Park	Inbound			270m	N/A	N/A	N/A	N/A		30m	after	40m		No	This location is after the proposed signal-controlled junction and has good catchment via the signal crossing at the junction to the west.
New Stop	New stop - Mill Road	Inbound									Mid Block		0m		New	A new pedestrian connection is proposed to connect this stop to Mill Road to serve Connolly Hospital and Main St, Blanchardstown.

Stop Number	Stop Name	Direction	Latitude	Longitude	Current Distance to previous stop	Current Peak Passenger Demand (Boarding)	Peak Boarding Time	Current Passenger Demand (Alighting)	Peak Alighting Time	Modelled Future Buses per hour (AM Peak)	Location (mid-block or within 100m of junction)	Before/ After Junction	Distance to controlled pedestrian crossing	Potential for interchange with Orbital Routes	Stop to be amended?	Reason for decision
7374	Blanchardstown Bypass	Inbound	53.38398	-6.36524	1.5km	N/A	N/A	N/A	N/A	33	60m	after	60m		Yes, move 30m east	The existing layby bus stop will be used as an inter-urban stop.
New Stop	New Stop - Blanchardstown Bypass	Inbound	53.38398	-6.36524							60m		60m		New	Stop for use by inter-urban buses
New Stop	New stop - Auburn Avenue	Inbound									25m	after	25m		New	This stop serves the catchment along Auburn Avenue to the south of Navan Road and the hotel to the north.
1845	Morgan's Place	Inbound	53.379023	-6.352717	1030m	34	8:00 am	21	4:00 pm	38	mid-block		55m	Yes, same route	No	This location is directly after the pedestrian crossing, serving the catchment to the south
New Stop	New Stop – Parkway Station	Inbound	53.377064	-6.345712							30m		30m		New	Stop for use by inter-urban buses
7166	Parkway Station	Inbound	53.377094	-6.345787	490m	10	8:00 am	17	8:00 am	38	45m	before	45m	Yes, same route	Move 100m East	Moving the stop after the junction improves the operation of the bus route
1847	Phoenix Pk Avenue	Inbound	53.374928	-6.339979	917m	49	8:00 am	11	3:30 pm	38	80m	after	80m	Yes, same route	Move 160m west	This location better serves the catchment at Phoenix Park Avenue
New Stop	New Stop - Phoenix Pk Avenue	Inbound	53.374928	-6.339979							50m	before	50		New	Stop for use by inter-urban buses
1696	Ashtown Roundabout	Inbound	53.371542	-6.329831	318m	59	8:00 am	15	7:30 am	45	35m	before	35m	Yes, same route	No	This location is after the junction, and maintains good spacing between the previous stop and stop 1698
1697	Kempton	Inbound	53.370801	-6.327666	163m	4	7:30 am	8	8:30 am	45	mid-block		105m	Yes, same route	Remove	This stop is located only 175m from the previous stop

Stop Number	Stop Name	Direction	Latitude	Longitude	Current Distance to previous stop	Current Peak Passenger Demand (Boarding)	Peak Boarding Time	Current Passenger Demand (Alighting)	Peak Alighting Time	Modelled Future Buses per hour (AM Peak)	Location (mid-block or within 100m of junction)	Before/ After Junction	Distance to controlled pedestrian crossing	Potential for interchange with Orbital Routes	Stop to be amended?	Reason for decision
1698	Ashtown Grove	Inbound	53.369577	-6.323717	296m	18	8:00 am	9	7:30 am	45	20m	after	20m	Yes, same route	No	This stop is located after a junction, and is an appropriate distance between the previous and next proposed stops.
1699	Baggot Road	Inbound	53.368744	-6.321315	184m	3	7:30 am	6	3:30 pm	45	mid-block		220m	Yes, same route	Remove	There are no side roads between this stop and the two adjacent stops. This means the stop only serves the houses along this stretch of the Navan Road
1700	Kinvara Avenue	Inbound	53.367709	-6.317403	280m	45	8:30 am	14	4:00 pm	46	35m	after	35m	Yes, same route	Move 20m East	To facilitate the bus stop design layout (while minimising conflict with driveways)
1701	Our Lady's Church	Inbound	53.366567	-6.31294	317m	42	8:30 am	44	7:30 am	46	mid-block		15m	Yes, same route	No	This stop serves the church and John Bosco school, and is directly after the pedestrian crossing serving Villa Park Gardens
1702	Nephin Road	Inbound	53.365611	-6.310138	228m	5	8:00 am	51	7:30 am	46	mid-block		125m	Yes, same route	Remove	This stop is located just 200m from both the stop before and the stop after
1703	Nephin Road	Inbound	53.364735	-6.307348	208m	32	8:00 am	10	8:00 am	45	40m	after	40m	Yes, same route	No	The stop is located directly after the Nephin Rd junction and is well spaced from stop 1702
1905	Skreen Road	Inbound	53.363375	-6.3033	335m	46	8:30 am	34	7:30 am	45	55m	after	55m	Yes, same route	No	This stop serves the Skreen road catchment along with the Holy Family school and other attractors in close proximity

Stop Number	Stop Name	Direction	Latitude	Longitude	Current Distance to previous stop	Current Peak Passenger Demand (Boarding)	Peak Boarding Time	Current Passenger Demand (Alighting)	Peak Alighting Time	Modelled Future Buses per hour (AM Peak)	Location (mid-block or within 100m of junction)	Before/ After Junction	Distance to controlled pedestrian crossing	Potential for interchange with Orbital Routes	Stop to be amended?	Reason for decision
1906	Cabra Cross	Inbound	53.361201	-6.297076	455m	23	8:30 am	13	7:00 am	32	50m	after	50m	No	No	This stop is directly after the Cabra Rd junction, and is well spaced from the previous stop
1907	Railway Bridge	Inbound	53.359905	-6.293822	260m	8	7:30 am	7	5:00 pm	32	mid-block		30m	No	No	Although this stop is only 260m from the previous stop, it is difficult to move due to spatial constraints and house entrances
1908	Cabra Drive	Inbound	53.358691	-6.291256	222m	4	8:00 am	5	3:30 pm	32	mid-block		220m	No	Remove	This stop is only 220m from the previous stop. It is expected that users from the north would use Annamoe Rd and stop 1909
1909	North Circular Road	Inbound	53.35696	-6.288411	267m	23	8:30 am	28	7:30 am	32	40m	after	40m	Juction, 95m	Move 30m south	This location allows for more space for waiting passengers to congregate
1713	Stanhope Street Convent	Inbound	53.351908	-6.283325	652m	30	8:30 am	27	7:30 am	32	30m	after	30m	Yes, same route	No	Well located for spacing to stops upstream and downstream, and with sufficient footpath width to accommodate cyclists and bus shelter.
1714	Brunswick Street	Inbound	53.350638	-6.281889	183m	26	8:00 am	39	8:00 am	32	20m	after	20m	Yes, same route	Move 100m south	Under the proposed design, there is reasonable space in this location, and it places the stop after the junction, where the road becomes bus-only
1715	Blackhall Street	Inbound	53.347712	-6.282187	392m	15	8:00 am	46	8:00 am	35	20m	before	20m	Yes, same route	No	This stop is already well situated close to the Luas and the Quays.

Stop Number	Stop Name	Direction	Latitude	Longitude	Current Distance to previous stop	Current Peak Passenger Demand (Boarding)	Peak Boarding Time	Current Passenger Demand (Alighting)	Peak Alighting Time	Modelled Future Buses per hour (AM Peak)	Location (mid-block or within 100m of junction)	Before/ After Junction	Distance to controlled pedestrian crossing	Potential for interchange with Orbital Routes	Stop to be amended?	Reason for decision
1647	Law Society	Outbound	53.348351	-6.282252	515m	52	5:00 pm	6	8:00 am	35	mid-bock		25m	Yes, same route	No	Well located for catchment to north and south and adjacent to pedestrian crossing at Blackhall Street junction.
1648	Arbour Place	Outbound	53.351091	-6.282802	330m	28	8:00 am	16	4:30 pm	32	15m	after	30m	Yes, same route	Move 115m south, before Arbour Hill	In this location, there is more space created due to the new road layout. This location also achieves better spacing from the next stop
1649	Aughrim Street	Outbound	53.35257	-6.28438	188m	11	2:00 pm	6	5:00 pm	32	20m	after	20m	Yes, same route	Move 20m north	This location facilitates the provision of a toucan crossing at the location of the existing stop.
1911	Drumalee	Outbound	53.356635	-6.288259	534m	17	4:30 pm	13	9:00 am	32	60m	after	60m	No	No	This location serves as an important interchange with stops on the North Circular Road. It was decided to keep the stop before the junction, due to the distance from the previous stop.
1913	Cabra Drive	Outbound	53.358806	-6.291792	331m	4	8:30 am	14	10:30 pm	32	mid-block		95m	No	Remove	This stop is being consolidated with stop 1913
1914	Glenbeigh Road	Outbound	53.360216	-6.294816	254m	3	2:00 pm	5	10:30 pm	32	mid-block		254m	No	Move 150m South	This location serves as a replacement for both stops 1913 and 1914
1805	Dunard	Outbound	53.361163	-6.297558	200m	7	3:30 pm	9	4:30 pm	32	60m	after	60m	Junction, 180m	Move 85m west	This location brings the stop after the junction, and closer to the pedestrian crossing

Stop Number	Stop Name	Direction	Latitude	Longitude	Current Distance to previous stop	Current Peak Passenger Demand (Boarding)	Peak Boarding Time	Current Passenger Demand (Alighting)	Peak Alighting Time	Modelled Future Buses per hour (AM Peak)	Location (mid-block or within 100m of junction)	Before/ After Junction	Distance to controlled pedestrian crossing	Potential for interchange with Orbital Routes	Stop to be amended?	Reason for decision
1806	Hampton Green	Outbound	53.362907	-6.302642	400m	30	3:30 pm	23	3:30 pm	45	35m	after	35m	Yes, same route	No	This location provides adequate space for passengers to congregate and doesn't impact any residential accesses
1660	Nephin Road	Outbound	53.365187	-6.309374	512m	48	4:00 pm	18	4:00 pm	46	55m	after	55m	Yes, same route	No	This location allows for more space for passengers to congregate than anywhere nearby
1661	Our Lady's Church	Outbound	53.366444	-6.313096	290m	60	3:00 pm	19	7:30 am	46	mid-block		50m	Yes, same route	Move 20m east	Relocated further from toucan crossing stop line to provide sufficient visibility for approaching drivers of traffic signals, when bus stationary. Addresses issue raised in road safety audit.
1662	Kinvara Ave	Outbound	53.367541	-6.31759	330m	16	7:30 am	19	6:00 pm	46	65m	before	65m	Yes, same route	Move 40m east	This location avoids the left turn slip, moving this stop ahead of the junction was unpopular during consultation
1664	Ashtown Grove	Outbound	53.369409	-6.323859	465m	7	3:00 pm	20	5:30 pm	45	65m	before	65m	Yes, same route	No	This stop serves the St Vincent's Centre; if the stop were moved after the junction it would be spaced too far from the previous stop.
1665	Kempton	Outbound	53.370658	-6.327702	293m	4	7:30 am	12	5:00 pm	45	mid-block		104m	Yes, same route	Remove	This stop is 200m from the next stop
1666	Ashtown Roundabout	Outbound	53.371597	-6.330596	213m	22	8:00 am	32	5:00 pm	45	70m	before	70m	Yes, same route	No	This location achieves better spacing between previous and next stops than if it were to be moved after the roundabout

Stop Number	Stop Name	Direction	Latitude	Longitude	Current Distance to previous stop	Current Peak Passenger Demand (Boarding)	Peak Boarding Time	Current Passenger Demand (Alighting)	Peak Alighting Time	Modelled Future Buses per hour (AM Peak)	Location (mid-block or within 100m of junction)	Before/ After Junction	Distance to controlled pedestrian crossing	Potential for interchange with Orbital Routes	Stop to be amended?	Reason for decision
1807	Phoenix Pk Avenue	Outbound	53.374414	-6.339263	666m	11	8:00 am	25	5:00 pm	38	30m	after	30m	Yes, same route	Move 150m East	This location better serves the catchment at Phoenix Park Avenue side road.
New Stop	New Stop – Phoenix Park Avenue	Outbound	53.373356	-6.335798							30m	before	30m		New	Stop for use by inter-urban buses
New Stop	New Stop – Parkway Station	Outbound	53.375866	-6.344783							20m		20m		New	Stop for use by inter-urban buses
7167	Parkway Station	Outbound	53.375866	-6.344783	406m	7	5:30 pm	25	4:00 pm	38	10m	before	10m	Yes, same route	No	Location provides appropriate space for two-way cycle track and bus stop facilities, and has good links to the north and south.
1808	Peck's Lane	Outbound	53.379242	-6.354227	727m	7	2:30 pm	74	5:00 pm	38	mid-block		20m	Yes, same route	No	This stop is adjacent to the pedestrian crossing and serves Castleknock Manor
New Stop	New stop - Auburn Avenue	Outbound									45m	before	45m		New	This stop serves the catchment along Auburn Avenue
7389	Navan Road	Outbound	53.386018	-6.370608	1407m	5	3:30 pm	48	5:00 pm	42	35m	after	35m	Yes, same route	Move 60m East	This location is closer to the connection to Old River Road
New Stop	New stop - Navan Road	Outbound	53.386018	-6.370608							35m		35m		New	Stop for use by inter-urban buses
New Stop	New stop - Mill Road	Outbound									mid-block		0m		New	A new pedestrian connection is proposed to connect this stop to Mill Road to serve Connolly Hospital and Main St, Blanchardstown.
661	Westend Office Park	Outbound	53.392425	-6.383457	1110m	N/A	N/A	N/A	N/A	26	90m	before	90m	Yes, same route	Move 65m West	This location brings the stop closer to the junction to the west
New Stop	New Stop – Westend Office Park	Outbound	53.392434	-6.383531							mid-block	before			New	Stop for use by inter-urban buses

Stop Number	Stop Name	Direction	Latitude	Longitude	Current Distance to previous stop	Current Peak Passenger Demand (Boarding)	Peak Boarding Time	Current Passenger Demand (Alighting)	Peak Alighting Time	Modelled Future Buses per hour (AM Peak)	Location (mid-block or within 100m of junction)	Before/ After Junction	Distance to controlled pedestrian crossing	Potential for interchange with Orbital Routes	Stop to be amended?	Reason for decision
New Stop	New stop - Blanchardstown Town Centre	Outbound									mid-block		120m		New	This stop provides an equivalent to the outbound stop, and allows for more flexibility for buses to stop before the terminus
7025	Blanchardstown Town Centre	Outbound	53.393991	-6.391835	1845m	91	5:30 pm	63	5:00 pm	38	mid-block		0m	Yes, same route	No	This is the terminus location
1882	Blanchardstown Road South	Outbound	53.392728	-6.398839	460m	N/A	N/A	N/A	N/A		65m	after	65m		No	Location is retained as it allows a 2-lane to 1-lane merge for traffic going south, and is close to revised signal controlled junction for pedestrians to cross to the north.
New Stop	New stop - Crowne Plaza	Outbound													New	New stop for use by inter-urban buses travelling via N3 slip road - with good catchment on foot to the shopping centre.
4323	Whitestown Grove	Outbound	53.396331	-6.393935		N/A	N/A	N/A	N/A		mid-block		115m	No	Remove	All outbound buses will route via the proposed bus interchange, and hence stop is redundant.
101281	Crowne Plaza	Outbound	53.395791	-6.391095		N/A	N/A	N/A	N/A		mid-block		150m	No	Remove	Replaced by new bus stop on N3 westbound off-slip serving inter-urban buses.

Appendix C

Bus Stop Location Maps

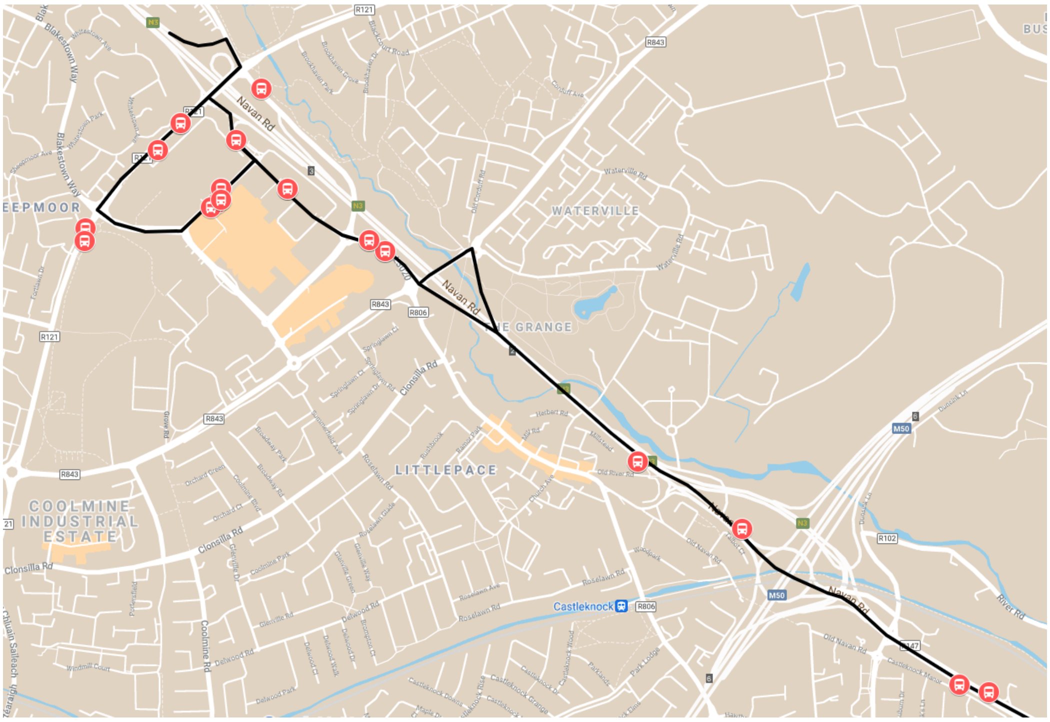


Figure C.1: Existing Stop Locations (Part 1)

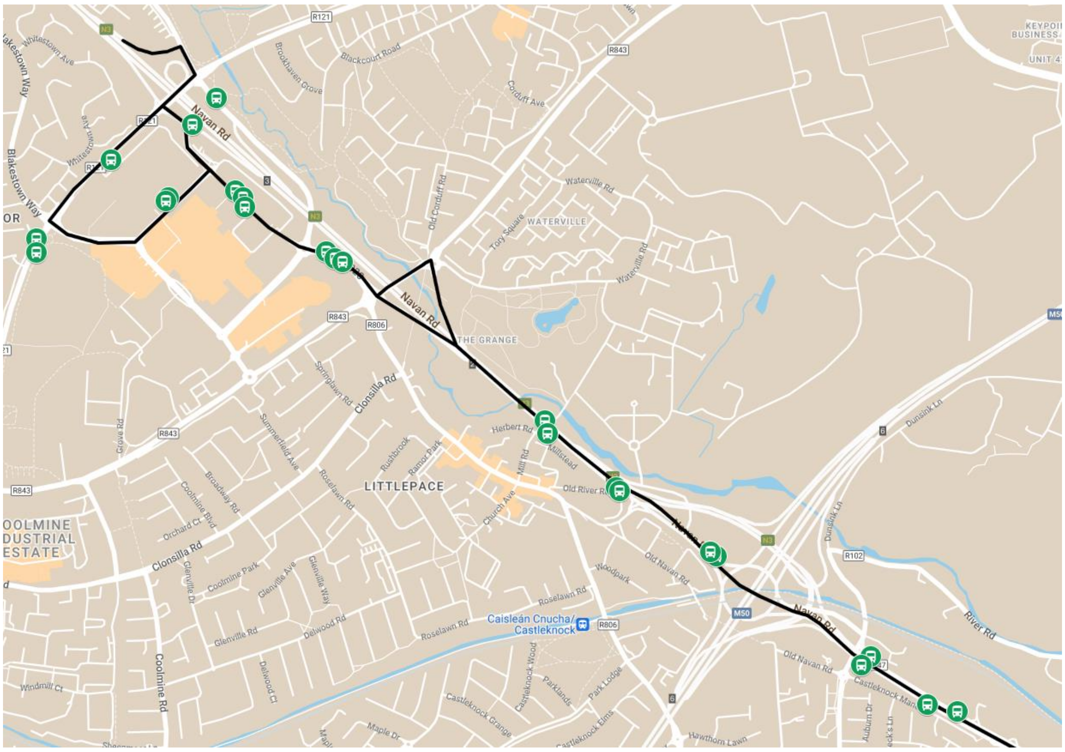


Figure C.2: Proposed Stop Locations (Part 1)

Figure C.3: Existing Stop Locations (Part 2)

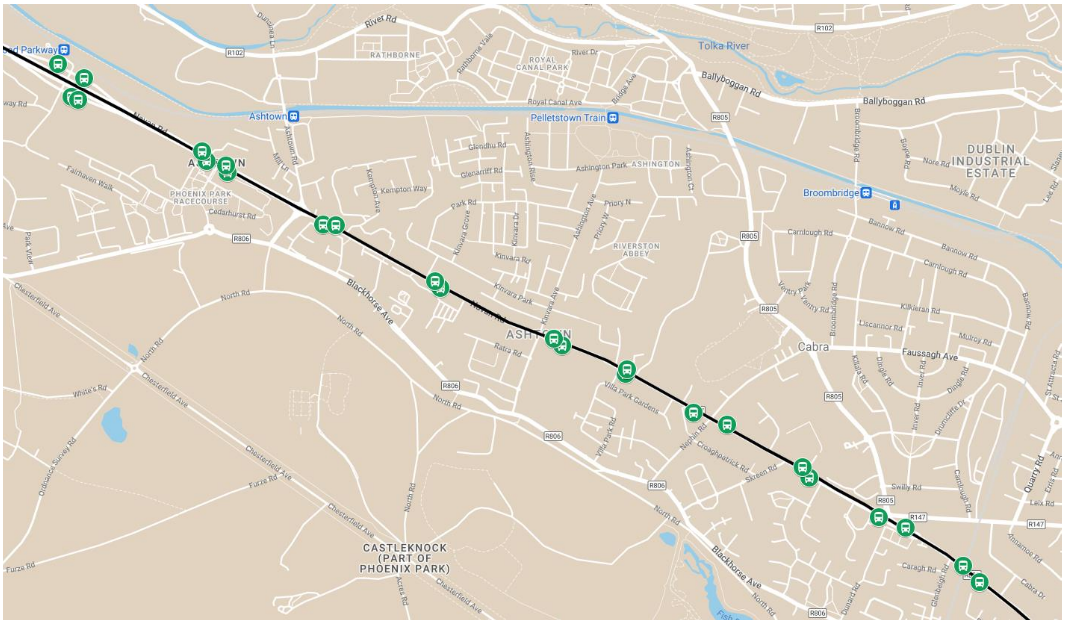


Figure C.4: Proposed Stop Locations (Part 2)

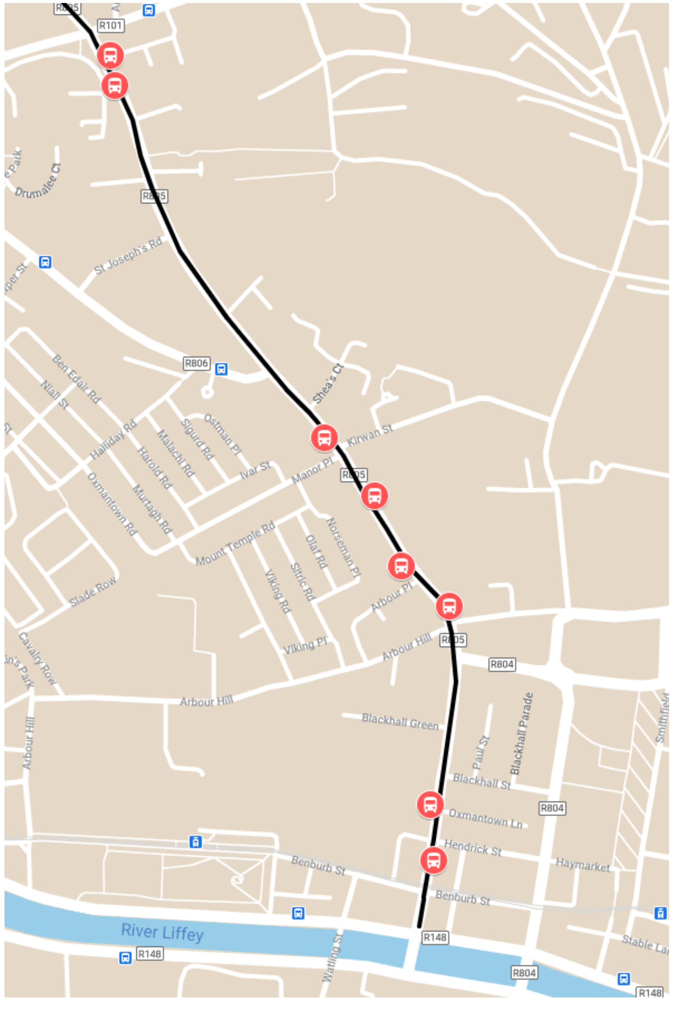


Figure C.5: Existing Stop Locations (Part 3)

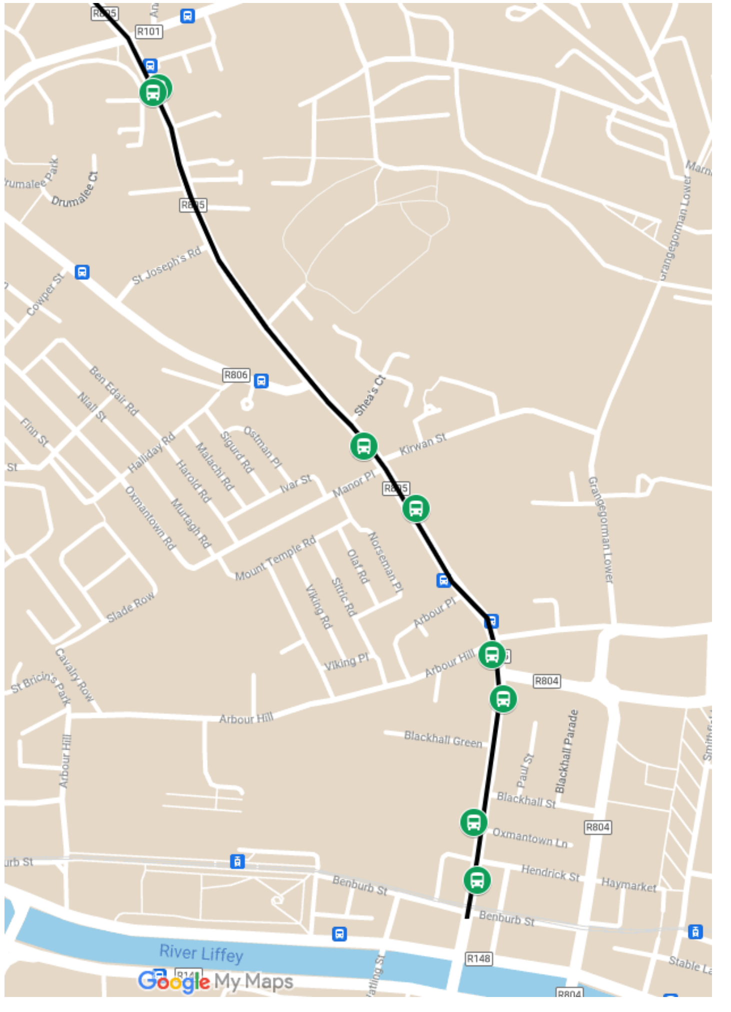
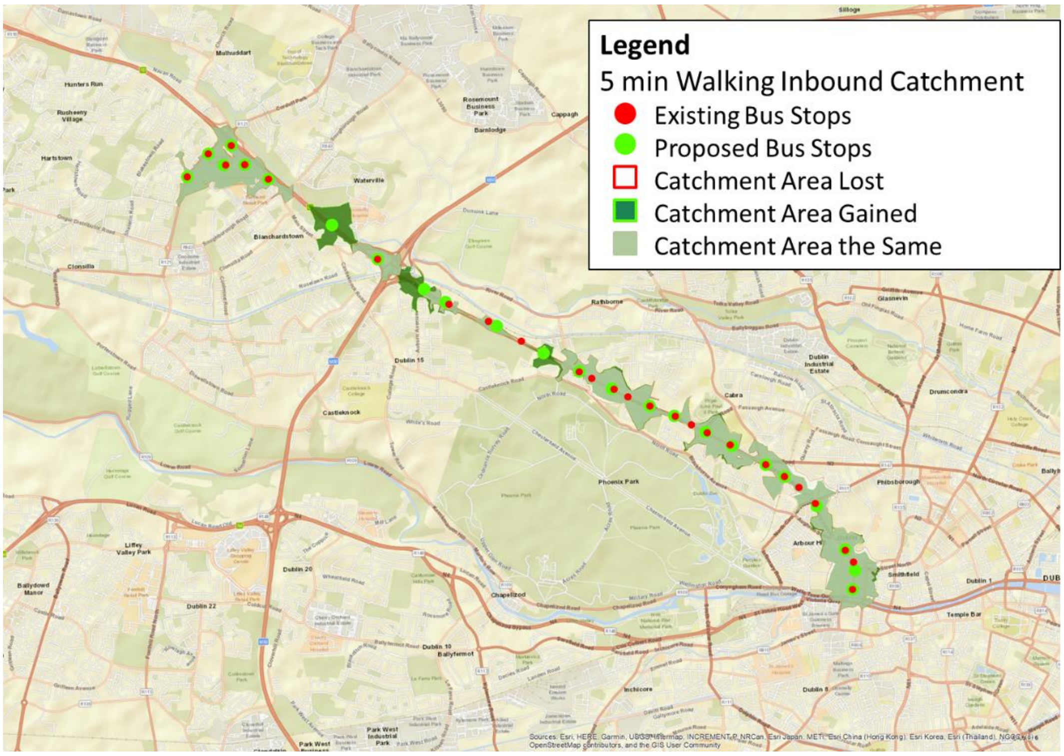
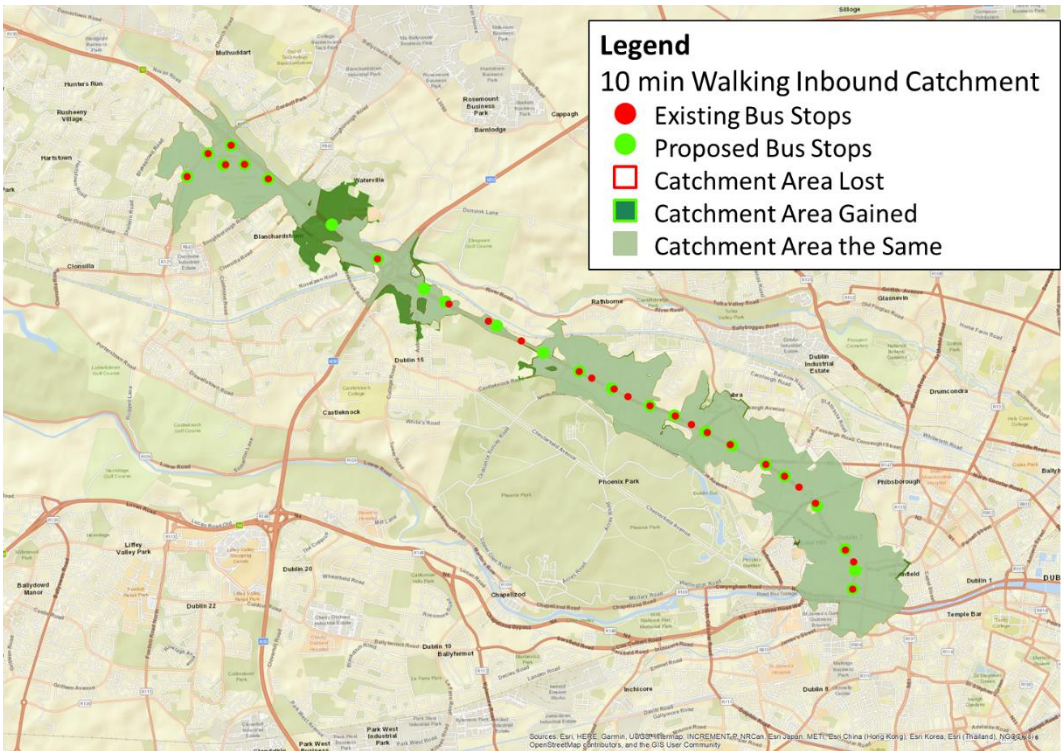


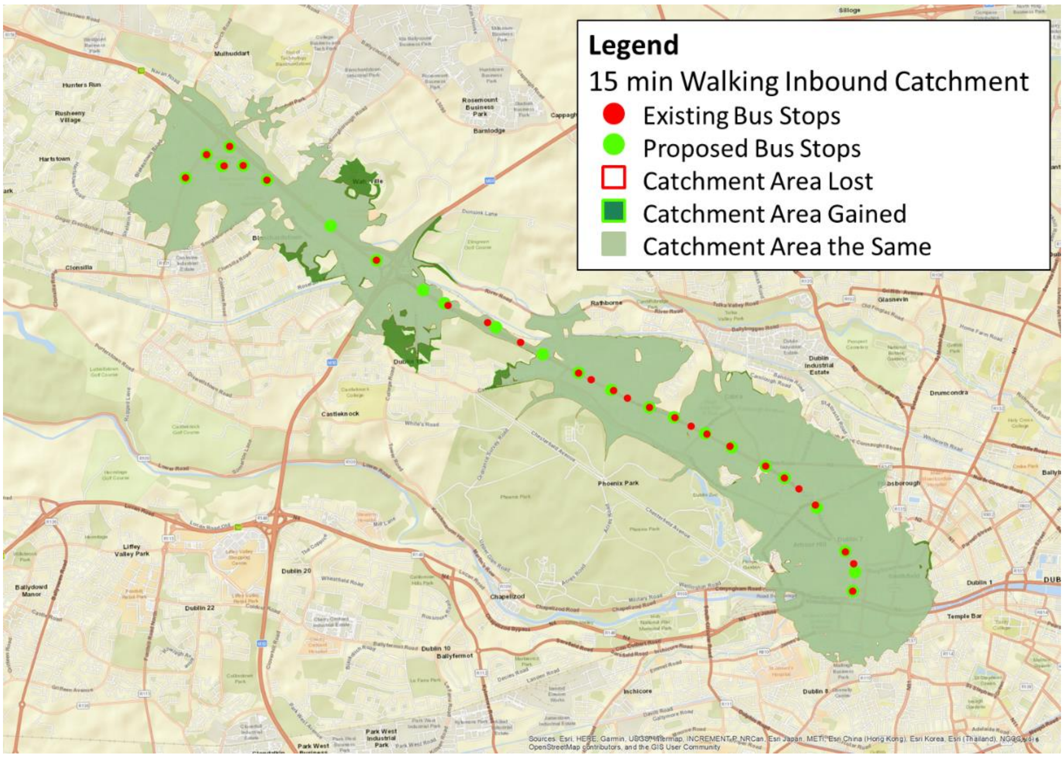
Figure C.6: Proposed Stop Locations (Part 3)

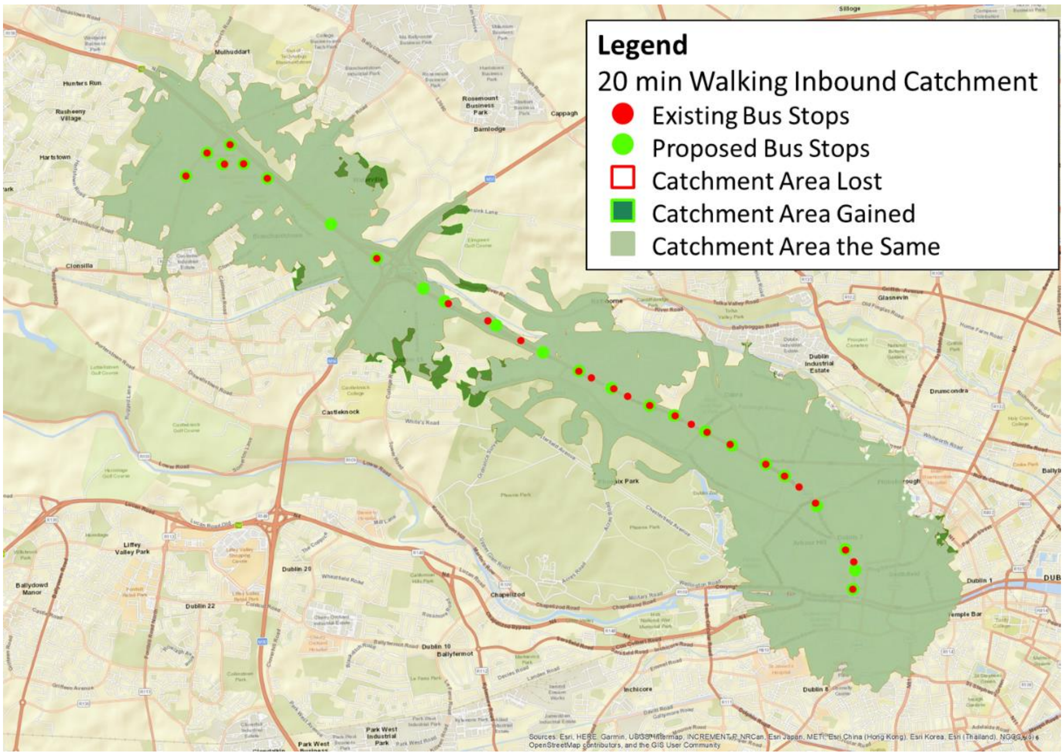
Appendix D

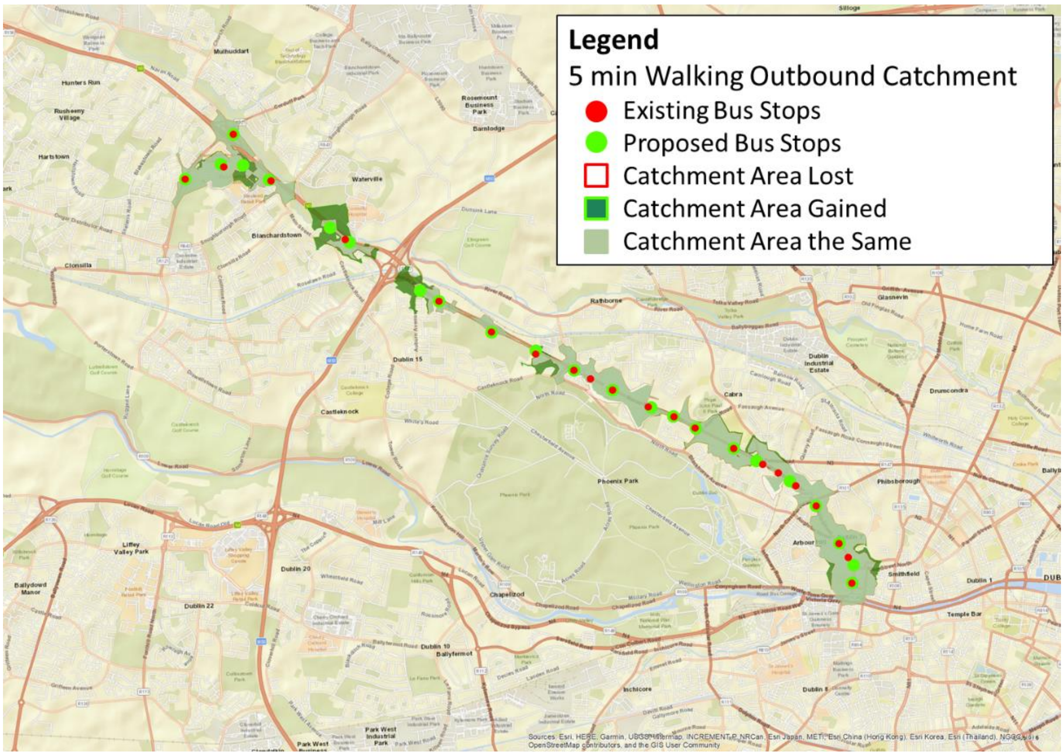
Overlap Maps

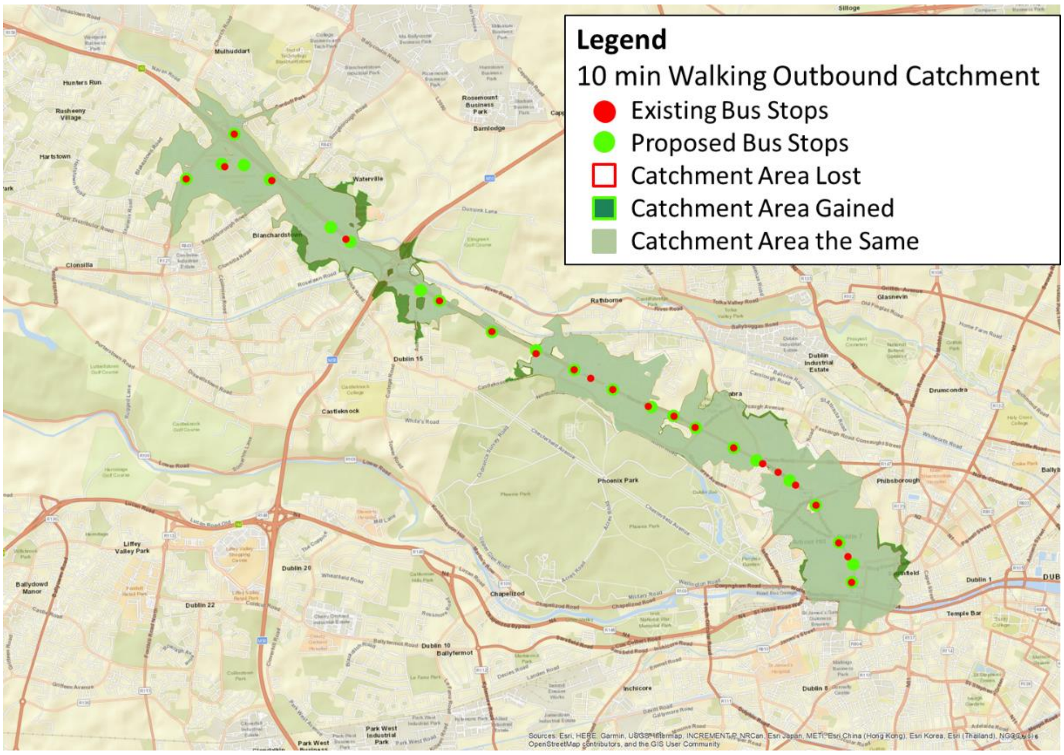

Legend
5 min Walking Inbound Catchment
Existing Bus Stops
Proposed Bus Stops
Catchment Area Lost
Catchment Area Gained
Catchment Area the Same

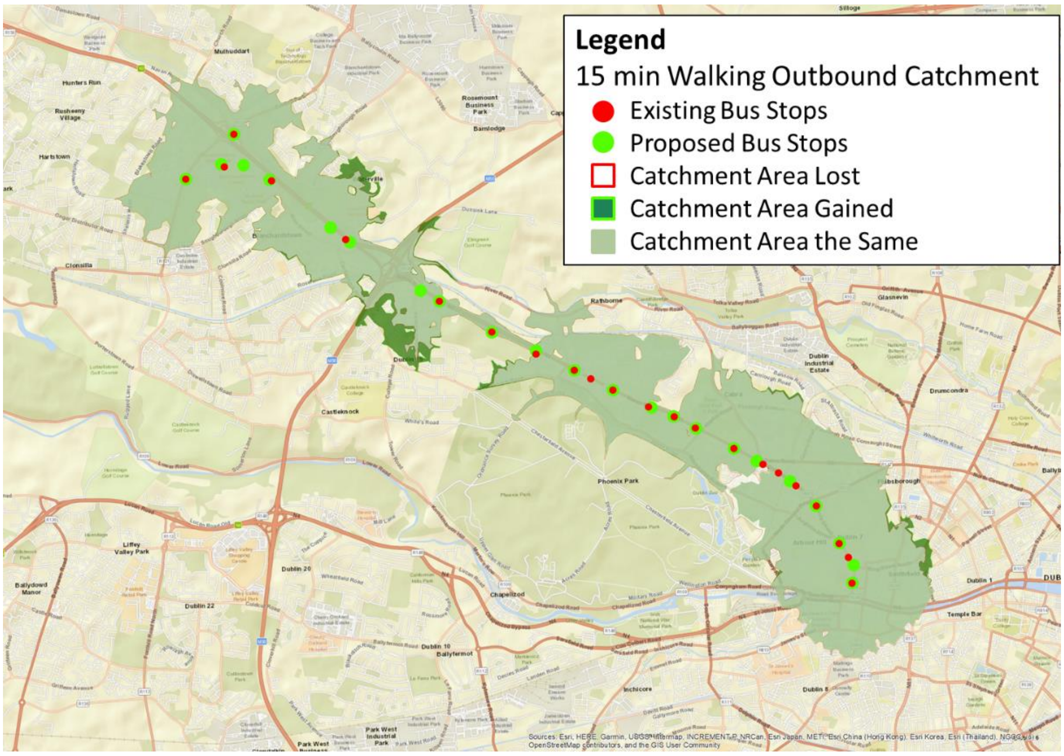

Legend
10 min Walking Inbound Catchment
Existing Bus Stops
Proposed Bus Stops
Catchment Area Lost
Catchment Area Gained
Catchment Area the Same

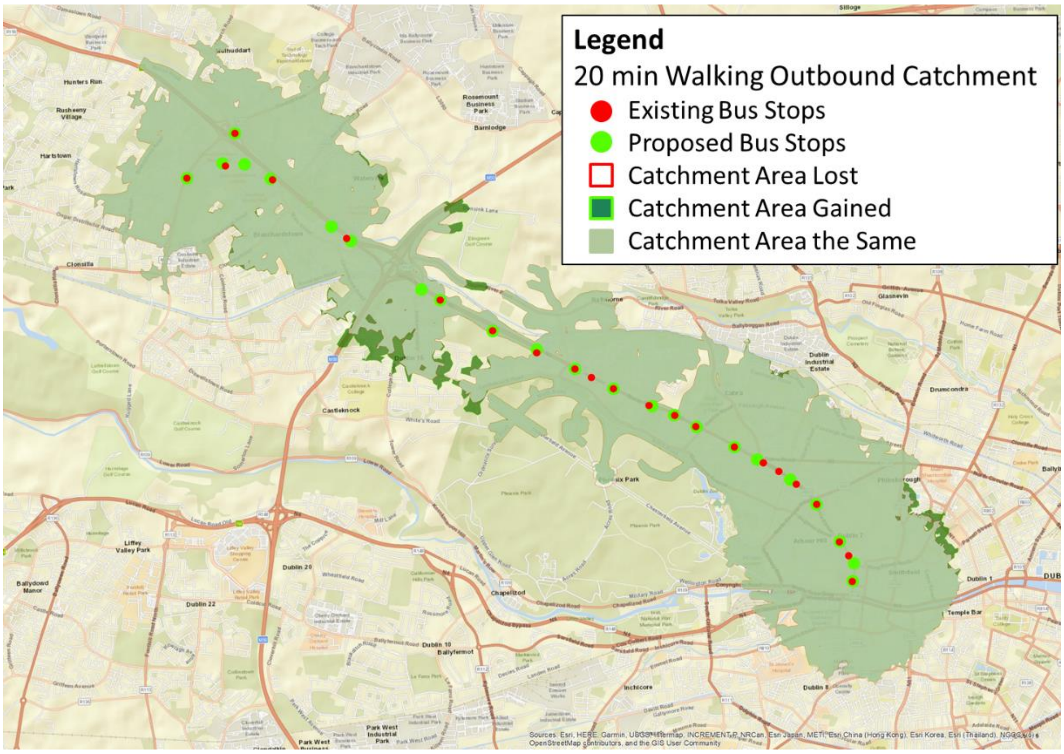

Legend
15 min Walking Inbound Catchment
Existing Bus Stops
Proposed Bus Stops
Catchment Area Lost
Catchment Area Gained
Catchment Area the Same


Legend
20 min Walking Inbound Catchment
Existing Bus Stops
Proposed Bus Stops
Catchment Area Lost
Catchment Area Gained
Catchment Area the Same


Legend
5 min Walking Outbound Catchment
Existing Bus Stops
Proposed Bus Stops
Catchment Area Lost
Catchment Area Gained
Catchment Area the Same


Legend
10 min Walking Outbound Catchment
Existing Bus Stops
Proposed Bus Stops
Catchment Area Lost
Catchment Area Gained
Catchment Area the Same


Legend
15 min Walking Outbound Catchment
Existing Bus Stops
Proposed Bus Stops
Catchment Area Lost
Catchment Area Gained
Catchment Area the Same


Legend
20 min Walking Outbound Catchment
Existing Bus Stops
Proposed Bus Stops
Catchment Area Lost
Catchment Area Gained
Catchment Area the Same