Tallaght / Clondalkin to City Centre Core Bus Corridor Scheme

March 2023

Preliminary Design Report

BUS CONNECTS

SUSTAINABLE TRANSPORT FOR A BETTER CITY.

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List of Acronyms

Acronym	Definition
AVL	Dublin Bus Automatic Vehicle Location
BCPDGB	BusConnects Preliminary Design Guidance Booklet
BJTR	Bus Journey Time Report
br/bl DBC	brown/black Dublin Boulder Clay
CBC	Core Bus Corridor
CBR	California Bearing Ratio
CPO	Compulsory Purchase Order
DCC	Dublin City Council
DEHLG	Department of Environment, Heritage and Local Government
DETR UK	Department of Environment, Transport and the Regions UK
DLAM	Dublin Local Area Model
DM, DS	Do Minimum, Do Something
DMRB	TII's Design Manual for Roads and Bridges
DMURS	Design Manual for Urban Roads and Streets
DNO	Distribution Network Operator
DRA	Designers Risk Assessment
DTTAS	Department of Transport, Tourism and Sport
ED/ED's	Engineering Design/Engineering Designers
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMRA	Eastern and Midlands Region
EPR	Emerging Preferred Route
GDA	Greater Dublin Area
GDACNP	Greater Dublin Area Cycle Network Plan
GDRCoP,	Greater Dublin Regional Code of Practice
GDSDS	Greater Dublin Strategic Drainage Study
GIS	Geographical Information Systems
GT	Glacial Till
HGV	Heavy Goods Vehicle
HP	High Pressure
IW	Irish Water

Acronym	Definition
KFPA	Kerbs, Footways and Paved Areas
LED	Light Emitting Diode
LMST	Limestone
LP	Low Pressure
MASP	Metropolitan Area Strategic Plan
MCA	Multi-Criteria Assessment
MG	Made Ground
NCDWC	National Construction and Demolition Waste Council
NCM	National Cycle Manual
NDP	National Development Plan
NPF	National Planning Framework
NSS	National Spatial Strategy
NTA	National Transport Authority
OPW	Office of Public Works
PDR	Preliminary Design Report
PMG	Project Management Guidelines
PMSC	People Movement Signals Calculator
PRO	Preferred Route Option
ROCK	Bedrock
RSA	Road Safety Audit
RSESs	Regional Spatial and Economic Strategies
SDCC	South Dublin County Council
SDRAs	Strategic Development and Regeneration Areas
SSD	Stopping Sight Distances
SuDS	Sustainable Urban Drainage Systems
TII	Transport Infrastructure Ireland
TS	Topsoil
TSM	Traffic Sign Manual

Executive Summary

This Preliminary Design Report has been prepared for the Tallaght / Clondalkin to City Centre Core Bus Corridor and builds on the previous Feasibility and Options Reports for two Core Bus Corridors (CBCs) – namely the Greenhills to City Centre CBC and the Clondalkin to Drimnagh CBC - and the Preferred Route Options Report for the Tallaght/Clondalkin to City Centre scheme.

This report summarises the project background and the need for the scheme in the context of National and Local Planning Policy, summarises the existing physical conditions and documents the surveys undertaken in developing the design.

The report also details the preliminary design, sets out traffic management proposals and outlines the traffic modelling undertaken and the outputs from the junction modelling.

The land use and acquisition requirements are summarised in this report, along with details of affected landowners and property owners, and proposed accommodation works.

The report concludes that the design of the Tallaght/Clondalkin to City Centre Core Bus Corridor scheme wholly achieves the scheme objectives. In doing so, it fulfils the aim of providing enhanced walking, cycling and bus infrastructure on a key access corridor in the Dublin region, enabling the delivery of efficient, safe, and integrated sustainable transport movement along the corridor.

1 Introduction and Description

1.1 Introduction

BusConnects is the National Transport Authority's (NTA) programme to improve bus and sustainable transport services. It is a key part of the Government's polices to improve public transport and address climate change. The NTA established a dedicated BusConnects Infrastructure team, the BusConnects Infrastructure team, to advance the planning and construction of the BusConnects Dublin - Core Bus Corridors Infrastructure Works (herein after called the 'CBC Infrastructure Works'). It comprises an inhouse team including technical and communications resources and external service providers procured from time-to-time to assist the internal team in the planning and design of the twelve Proposed Schemes.

The CBC Infrastructure Works involves the development of continuous bus priority infrastructure and improved pedestrian and cycling facilities on twelve radial core bus corridors in the Greater Dublin Area (GDA), across the local authority jurisdictions of Dublin City Council (DCC), South Dublin County Council (SDCC), Dún Laoghaire-Rathdown County Council (DLRCC), Fingal County Council (FCC), and Wicklow County Council (WCC). Overall, the CBC Infrastructure Works encompasses the delivery of approximately 230 km of dedicated bus lanes and 200 km of cycle tracks along twelve stand-alone Core Bus Corridors Schemes.

The Tallaght / Clondalkin to City Centre Core Bus Corridor of the CBC Infrastructure Works (herein after called the 'Proposed Scheme') measures approximately 15.5 km from end to end.

The Proposed Scheme will be comprised of two main alignments in terms of the route it follows, namely from Tallaght to the City Centre and from Clondalkin to Drimnagh.

The Tallaght to City Centre section commences at the junction of Old Blessington Road/ Cookstown Way and is routed along Belgard Square West, Belgard Square North, Belgard Square East, Old Blessington Road to the junction of the R819 Greenhills Road and Bancroft Park. From here the Proposed Scheme is routed along the R819 Greenhills Road to Walkinstown Roundabout and includes three new sections of road at Birchview Avenue/Treepark Road, Calmount Avenue and Calmount Road. From Walkinstown Roundabout the CBC is routed along the R819 Walkinstown Road to the junction with the R110 Long Mile Road / Drimnagh Road. From here the Proposed Scheme is routed along the R110 to the junction of Dean Street and Patrick Street via Drimnagh Road, Crumlin Road, Dolphins Barn, Cork Street, St Luke's Avenue and Dean St. From here the Proposed Scheme is routed along the R137 via Patrick Street to the junction at Winetavern Street and Christchurch Place where the Proposed Scheme terminates within the City Centre. The Proposed Scheme includes an offline cycle facility between Walkinstown Roundabout and Parnell Road (Grand Canal) which provides a more direct route towards the city via Bunting Road, Kildare Road and Clogher Road.

The Clondalkin to Drimnagh section commences at the junction of the R134 New Nangor Road and Woodford Walk and is routed along the R134 New Nangor Road, the R810 Naas Road, the R112 Walkinstown Avenue and the R110 Long Mile Road to the junction of the R819 Walkinstown Road and Drimnagh Road where meets the route of the Tallaght to City Centre Section.

The Proposed Scheme will require a number of significant structures, bridges, gantries, retaining walls and switch back ramps as described in Section 8 of this report.

Refer to Figure 1-1 for overall layout of the Proposed Scheme.

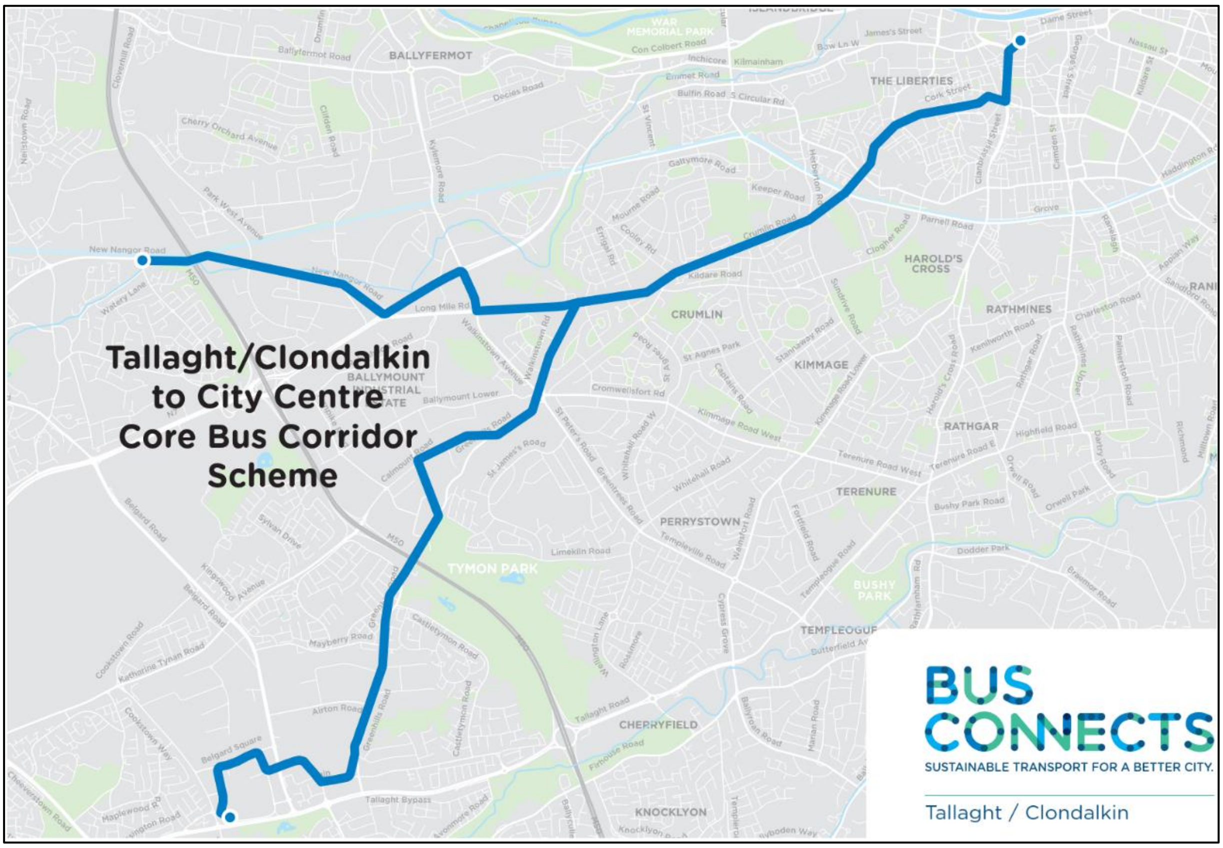

Figure 1-1: Proposed Scheme Route Overview

1.2 Scheme Aim and Objectives

The aim of the Proposed Scheme is to provide enhanced walking, cycling and bus infrastructure along this key access corridor in the south west Dublin region, which will enable and deliver efficient, safe, and integrated sustainable transport movement along the corridor.

In accordance with the CBC Infrastructure Works the Proposed Scheme objectives are to:

- Enhance the capacity and potential of the public transport system by improving bus speeds, reliability and punctuality through the provision of bus lanes and other measures to provide priority to bus movement over general traffic movements;
- Enhance the potential for cycling by providing safe infrastructure for cycling, segregated from general traffic wherever practicable;
- Support the delivery of an efficient, low carbon and climate resilient public transport service, which supports the achievement of Ireland's emission reduction targets;
- Enable compact growth, regeneration opportunities and more effective use of land in Dublin, for present and future generations, through the provision of safe and efficient sustainable transport networks;
- Improve accessibility to jobs, education and other social and economic opportunities through the provision of improved sustainable connectivity and integration with other public transport services; and
- Ensure that the public realm is carefully considered in the design and development of the transport infrastructure and seek to enhance key urban focal points where appropriate and feasible.

1.3 Project Background

The Transport Strategy for the Greater Dublin Area 2016 – 2035 sets out a network of the bus corridors forming the "Core Bus Network" for the Dublin region. Sixteen indicative radial Core Bus Corridors

(CBCs) were initially identified for redevelopment. This is shown in Figure 1-2, below (extract from Transport Strategy for the Greater Dublin Area 2016-2035).

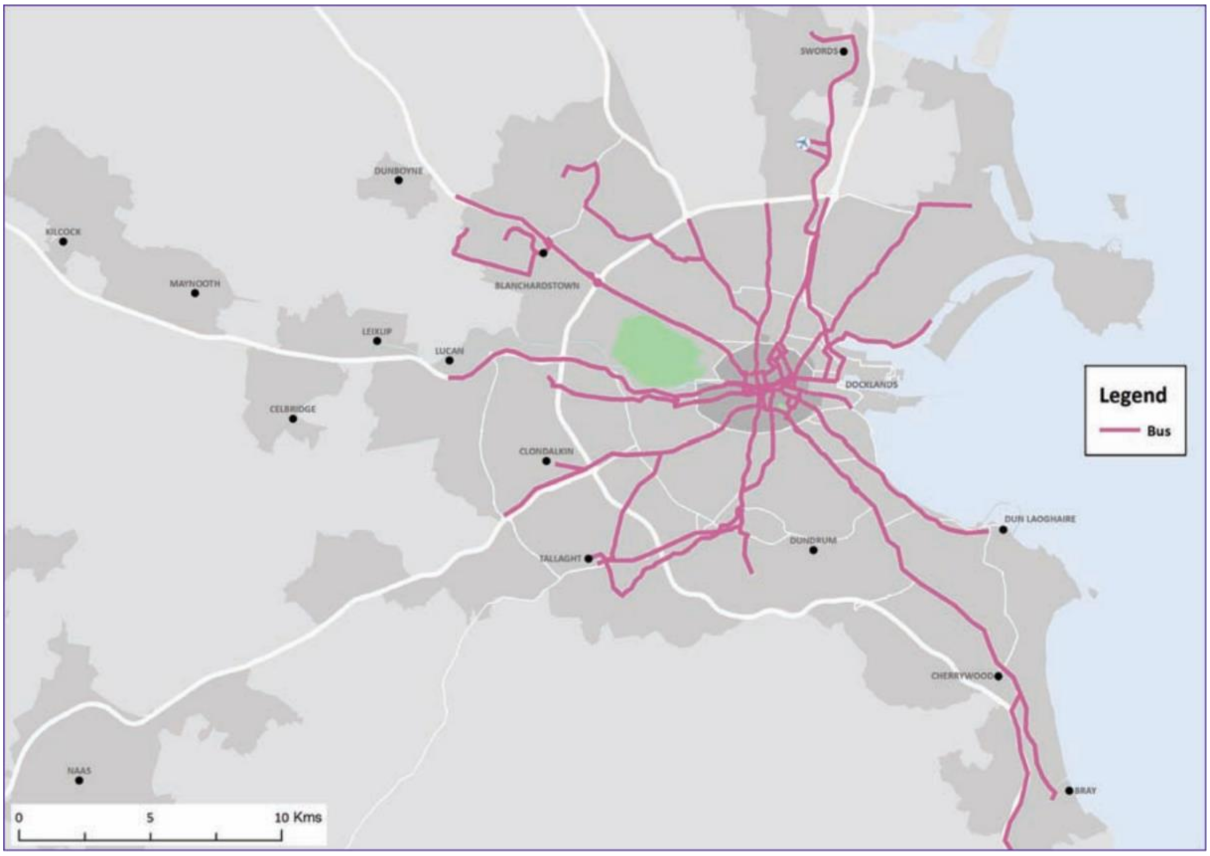

Figure 1-2: 2035 Core Bus Network – Radial Corridors

Collectively, these corridors currently have dedicated bus lanes along less than one third of their combined lengths which means that for most of the journey, buses as well as cyclists are competing for space with general traffic. This means that bus services are directly impacted by the increasing levels of congestion. This results in delayed buses and unreliable journey times for passengers. Following the completion of the Feasibility and Options studies, sixteen radial corridors were taken forward.

In June 2018, the NTA published the Core Bus Corridors Project Report. The report was a discussion document outlining proposals for the delivery of a CBC network across Dublin. The Proposed Scheme is identified in this document as forming part of the Radial Core Bus Network, designated as Tallaght / Clondalkin to City Centre CBC.

In the context of the proposed planning applications for the CBC Infrastructure Works, the initial sixteen radial CBCs have been grouped as twelve individual Schemes. The twelve Schemes that will be the subject of separate applications to An Bord Pleanála for approval are listed below:

- Clongriffin to City Centre Core Bus Corridor Scheme;
- Swords to City Centre Core Bus Corridor Scheme;
- Ballymun / Finglas to City Centre Core Bus Corridor Scheme;
- Blanchardstown to City Centre Core Bus Corridor Scheme;
- Lucan to City Centre Core Bus Corridor Scheme;
- Liffey Valley to City Centre Core Bus Corridor Scheme;
- Tallaght / Clondalkin to City Centre Core Bus Corridor Scheme;
- Kimmage to City Centre Core Bus Corridor Scheme;
- Templeogue / Rathfarnham to City Centre Core Bus Corridor Scheme;
- Bray to City Centre Core Bus Corridor Scheme;

- Belfield / Blackrock to City Centre Core Bus Corridor Scheme; and
- Ringsend to City Centre Core Bus Corridor Scheme.

The twelve radial routes that form the CBC Infrastructure works is shown within Figure 1-3.

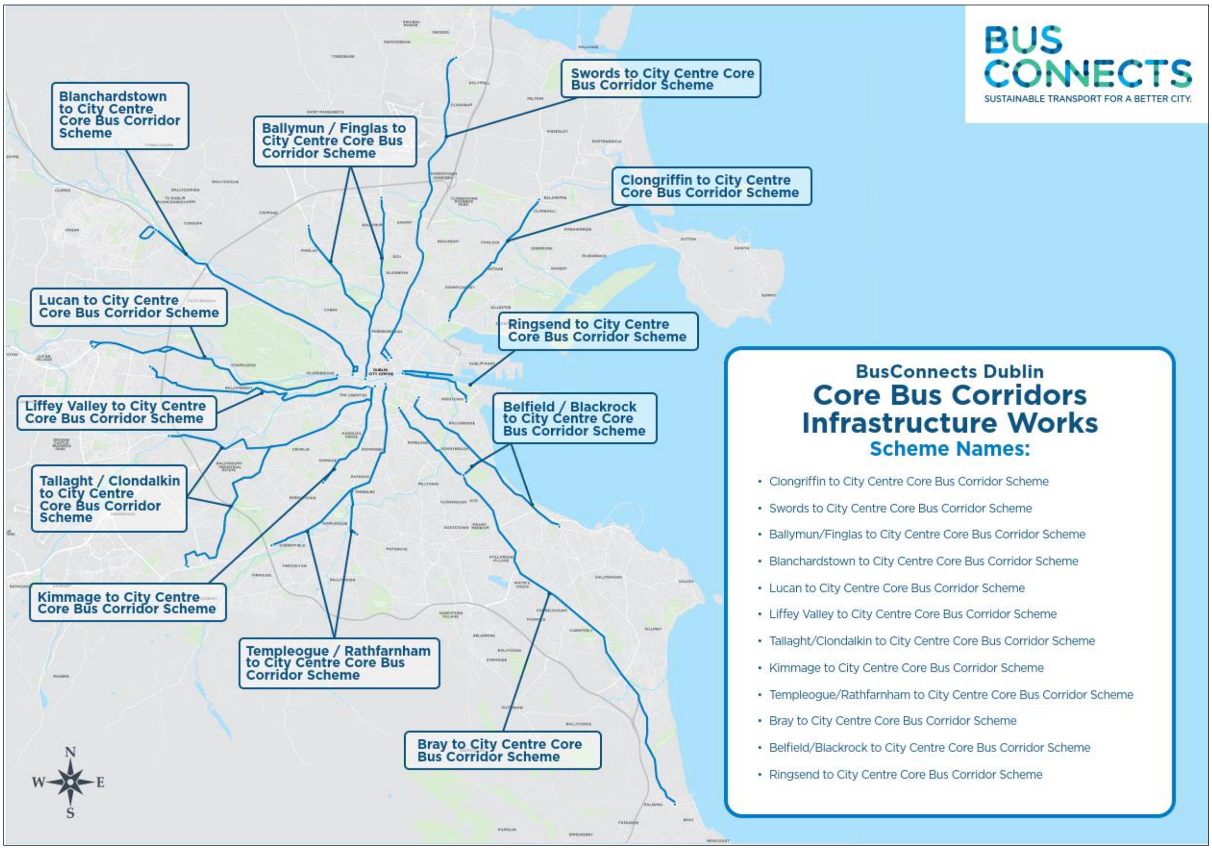

Figure 1-3: BusConnects Radial CBC Network

1.4 Proposed Construction Procurement Method

All of the design-related documentation and background design information should be included with the tender documentation as part of the specification of the Works Requirements. Usually, this includes the definitive Project Brief and all of the documents that have contributed to it, including the Feasibility Studies / Preliminary Reports, Output Specifications, Functional Requirements etc. It also includes any prescriptive drawings and specifications that have been developed in detail sufficient for statutory approval purposes.

Consequently, the design information presented in this report ensures that the objectives of the Proposed Scheme are met, in accordance with current design standards and guidance documents. It further ensures that sufficient land will be acquired during the Compulsory Purchase Order (CPO) process in order to construct the Proposed Scheme and fulfil the design requirements.

Future design stages will be constrained by the requirement to adhere to the design requirements, to incorporate the mitigation specified in the Environmental Impact Assessment Report (EIAR) and to utilise the available land for its construction and any proposed design modifications will require NTA review and acceptance prior to implementation into the Proposed Scheme design.

During preliminary design development, designer's risk assessments were undertaken, details of these are included in Appendix A Designer’s Risk Assessment

1.5 Stakeholder Consultation

Throughout the development of the design there has been extensive stakeholder consultation including three rounds of non-statutory public consultation which have taken place over the following dates:

- 26th February 2019 to 31st May 2019 - Consultation on Emerging Preferred Route for the Greenhills to City Centre CBC (Tallaght to City Centre section of the Proposed Scheme);
- 23rd January 2019 to the 30th April 2019 - Consultation on Emerging Preferred Route for the Clondalkin to Drimnagh section of the Proposed Scheme;
- 4th March 2020 - 17th April 2020 - Consultation on Preferred Route Option; and
- 4th November 2020 - 16th December 2020 - Consultation on Preferred Route Option.

Refer to the Greenhills to City Centre Core Bus Corridor and Clondalkin to Drimnagh Core Bus Corridor Preferred Route Option Second and Third Public Consultation Submissions Summary Reports for information on the non-statutory consultations at the link below.

https://busconnects.ie/initiatives/core-bus-corridors/background-information/consultation-submission-reports

Consultation with the principal project stakeholders (i.e. South Dublin County Council (SDCC), Dublin City Council (DCC), Transport Infrastructure Ireland (TII), statutory undertakers/utility companies) has taken place to date in order to:

- Inform the scheme development process at particular locations;
- Identify constraints and opportunities within the study area, scheme corridor and route options considered;
- Further refine the scheme objectives;
- Discuss potential mitigation measures and options; and
- Identify planning requirements, conditions and implications with respect to the proposed scheme design measures.

Specific scheme requirements have been discussed and agreed during workshops, with the Local Authorities, and meetings, at Steering Group and Programme level. The BusConnects Infrastructure team has taken cognisance of any specific requirements and recommendations emerging from this process when exploring feasible scheme options and preparing the preliminary design.

In addition to the principal project stakeholders, consultations have taken place with:

- Representative groups;
- Chartered land owners (i.e. owners of lands at any specific locations); and
- Directly impacted landowners.

1.6 Audit of the Existing Situations

The following surveys and desktop studies have been conducted to inform the preliminary design of the Proposed Scheme.

- Problem Identification Audit;
- Accessibility Audit;
- Road Infrastructure Audit;
- Existing Pavement Inspection Audit;
- Existing Structures Study;
- Existing Route Collision Analysis;
- Private Landings Study;

- Baseline Tree Survey;
- Cycle Journey Time Study;
- Phase 1 Utility Survey;
- Bus Stop Study;
- Traffic Surveys (JTC, ATC, pedestrian & cyclist counts);
- Parking Study; and
- Bus Journey Time Study.

These surveys have been supplemented with secondary record data including; utility record information, Office of Public Works (OPW) Catchment Flood Risk Assessment and Management (CFRAM) Flood Models, Irish Water (IW) drainage models and existing traffic signal data from DCC & SDCC.

A number of environmental surveys have also been carried out by the Environmental Impact Assessment (EIA) team. Refer to the Environmental Impact Assessment Report for further information.

1.7 Purpose of the Preliminary Design Report

The purpose of the Preliminary Design Report (PDR) is to outline the design intent of the Proposed Scheme and to support the Compulsory Purchase Order (CPO) documentation and Environmental Impact Assessment Report (EIAR) which form part of the Planning Application to An Bord Pleanála. In particular, the PDR outlines the following:

- Sets out the context for the Proposed Scheme, the justification for the Proposed Scheme, the basis for selecting the proposed scheme improvements, and the design criteria;
- Describes the elements of the Proposed Scheme listed in the preliminary design drawings;
- Summarises the existing physical conditions, addressing, in particular, ground conditions in general and particularly in areas of new construction, existing pavement quality, tree survey information, utility information, road traffic information including existing bus patterns, bus stop usage, traffic signal system, and other relevant information;
- Details and summarises the surveys and studies undertaken in developing the design,
- Sets out traffic management proposals, i.e. permanent changes required as part of the Proposed Scheme (and associated traffic modelling);
- Provides details of the traffic modelling undertaken along the route and the outputs from junction modelling undertaken;
- Summarises the land use and land acquisition requirements, includes details of affected landowners and property owners, and provides details of proposed accommodation works;
- Sets out particular considerations in the context of the urban landscape of the Proposed Scheme, and the criteria influencing the associated design; and
- Sets out the benefits of the Proposed Scheme.

1.8 Preliminary Design Drawings

A set of preliminary design drawings have been prepared to convey the scheme design principles for each discipline and should be read in conjunction with this PDR. The following table provides a description of the drawings and relevant design content displayed in each of the series as applicable for the scheme. The drawings have been included in Appendix B Preliminary Design Drawings for reference.

Table 1-1: Preliminary Design Drawings

Drawing Series Volume Code	Drawing Series Description / Scale	Design Content
SPW_KP/SPW_ZZ	Site Location Map (1:12500@ A1) & Site Location Plans (1:2500@A1)	Defines the full extent of the works & planning red line boundary. Outlines the scheme chainage structure and provides context for the locality of adjacent Schemes and other notable locations along the route.
SPW_BW	Fencing and Boundary Treatment Plans (1:500@A1)	To be read in conjunction with the GEO_GA General Arrangement series and GEO_CS Typical Cross Section series. Provides an indication of the locations for the proposed boundary modification works along the route.
GEO_GA	General Arrangement Plans (1:500 @ A1)	Displays information for conveying the overarching scheme design intent , providing information on the proposed pedestrian/cycle/ bus/traffic regime, indicative ultimate tree arrangement (existing trees retained & proposed trees), bus stop/shelter locations, key heritage feature locations, parking and loading arrangements, turn bans, side road treatments in addition to identification of specific items of note to the scheme (structures or significant features which may be further described on other drawing series)
GEO_CS	Typical Cross Sections (1:50 @ A1)	To be read in conjunction with the GEO_GA General Arrangement series. Provides an indication of the proposed cross section works in comparison to the existing road geometry. Indicative pavement/kerbing, boundary treatments and key street furniture are also provided for context.
GEO_HV	Mainline Plan and Profile Drawings (1:500@A1)	To be read in conjunction with the GEO_GA General Arrangement series. Provides an indication of the proposed modification works to the mainline vertical alignment with supplementary information on earthworks/retaining walls and other notable structures along the route (as required).
ENV_LA	Landscaping General Arrangement Plans (1:500@A1)	Provides information relating to urban realm and landscaping proposals including: identification of trees to be removed resulting from the arborist assessments, proposed tree/planting regime, proposed footway surface finishes, locations of proposed Sustainable (Urban) Drainage Systems (SuDS) features and proposed boundary treatment and key street furniture notes.
DNG_RD	Proposed Surface Water Drainage Plans (1:500@A1)	Displays information for conveying the design intent for the drainage portion of the works including identification of SuDS measures, requirements for peak discharge management measures (attenuation/detention/flow control) where applicable, catchment assessments and proposed notable trunk network modifications and outline design for the proposed drainage discharge strategy along the route.
UTL_UC	Combined Existing Utilities Record Plans (1:500@A1)	Displays information regarding existing statutory undertakers records along the length of the scheme with the proposed scheme features shown as background information for context.
UTL_UD	Irish Water Foul Sewer Alteration Plans (1:500@A1)	Provides an indication of the existing trunk foul sewer network and proposed indicative modification/diversion works (where identified) along the route. The existing and proposed kerb lines have been displayed for scheme context.
UTL_UW	Irish Water Potable Water Alteration Plans (1:500@A1)	Provides an indication of the existing trunk potable water network and proposed indicative modification/diversion works (where identified) along the route. The existing and proposed kerb lines have been displayed for scheme context.

Drawing Series Volume Code	Drawing Series Description / Scale	Design Content
UTL_UE	ESB Asset Alteration Plans (1:500@A1)	Provides an indication of the existing trunk electrical network (above and below ground) and proposed indicative modification/diversion works (where identified) along the route. The existing and proposed kerb lines have been displayed for scheme context.
UTL_UL	Telecommunications Asset Alteration Plans (1:500@A1)	Provides an indication of the existing trunk telecommunications network and proposed indicative modification/diversion works (where identified) along the route. The existing and proposed kerb lines have been displayed for scheme context.
UTL_UG	Gas Networks Ireland Asset Alteration Plans (1:500@A1)	Provides an indication of the existing trunk gas network and proposed indicative modification/diversion works (where identified) along the route. The existing and proposed kerb lines have been displayed for scheme context.
LHT_RL	Street Lighting Plans (1:500@A1)	Provides an indication of the proposed modification works to the existing street lighting infrastructure along the route in addition to identification of any key heritage light column features.
TSM_SJ	Junction System Design Plans (1:250@A1)	Provides a more detailed overview of the proposed junction arrangements for pedestrians, cyclists, buses and general traffic with an indication of the proposed junction staging and associated signal head arrangements for key signalised junctions/signalised crossings along the route.
TSM_GA	Traffic Signs and Road Markings Plans (1:500@A1)	Provides an indication of the proposed signage (information/directional/regulatory) design requirements and the design intent for the proposed lane marking arrangements along the route.
PAV_PV	Pavement Treatment Plans (1:500@A1)	Provides an indication of the proposed pavement treatment works along the length of the route
STR_GA	Bridges and Retaining Structures (Varies)	Provides additional details relating to proposed bridge structure/underpass and gantry works in addition to structural retaining walls along the route.
BLD_ZZ	Bus Interchange (Varies)	Provides additional details relating to proposed bus interchange details including architectural layouts and site elevations and sections.

It should be noted that a significant volume of other drawings and sketches have also been prepared as required to facilitate the design development process. The information shown on the PDR drawings has been deemed sufficient for the purposes of conveying the design intent of the Proposed Scheme in addition to outlining the extent of works in conjunction with the planning red line boundary extents and CPO documentation.

The planning red line boundary has been displayed on the Site Location Plans in drawing series SPW_ZZ as designated by the solid red line 'SITE EXTENTS'. For clarity the various discipline general arrangement drawing series have been displayed with the permanent extent of works boundary line as designated by the solid red line 'SITE BOUNDARY LINE'. Where construction access or accommodation works are required to facilitate the permanent works, this has been displayed by the dashed red line 'TEMPORARY LAND ACQUISITION'. Construction site compounds outside the 'SITE BOUNDARY LINE' are also captured within the dashed red line 'TEMPORARY LAND ACQUISITION'.

It is noted that the contractor will be restricted to what works can be carried out in the dashed red line areas i.e. to be limited to access and or accommodation works only. Storage of materials/stockpiling and/or temporary traffic management proposals will not be permitted for extended periods of time in these areas unless otherwise agreed with landowners and the NTA.

Full details of the compulsory land acquisition required to construct the scheme are provided on the various deposit maps, server maps and associated CPO schedules/documentation for the Proposed Scheme as part of the statutory application documentation.

1.9 Report Structure

The structure for the remainder of this report is set out as follows:

- Chapter 2:
- Policy Context and Design Standards – This chapter briefly identifies the policies and overview of the approach taken for application of design standards which have been applied to the preliminary design.
- Chapter 3: The Proposed Scheme – This chapter provides an overview of the design intent at various locations along the Proposed Scheme, providing a description of the route in more detailed subsections. An outline of the key interactions with other infrastructure projects is also provided.
- Chapter 4: Preliminary Design – This chapter provides an overview of the key design parameters used for the geometric designs and more detailed descriptions of the design elements for pedestrians, cyclists and buses.
- Chapter 5: Junction Design – The junction design methodology and modelling process is set out for all key junctions along the length of the route in this chapter
- Chapter 6: Ground Investigation and Ground Conditions – This chapter provides an overview of the ground investigation process and existing ground conditions
- Chapter 7: Pavement, Kerbs, Footways and Paved Areas Pavement – This chapter gives an overview of the existing pavement situation and proposed pavement design for the scheme
- Chapter 8: Structures – In this chapter an overview of the structures strategy is provided, along with a summary of principal and minor structures, retaining walls and embankments, where applicable.
- Chapter 9: Drainage, Hydrology and Flood Risk – This chapter is an overview of the drainage strategy includes descriptions of existing watercourses and culverts alongside a summary of the drainage design for each catchment along the scheme, including the consideration of drainage at structures and the maximisation of SuDS features
- Chapter 10: Services and Utilities – This chapter shows the Utilities design strategy documents surveys undertaken to date, identifies conflicts and recommends a number of diversions
- Chapter 11: Waste Quantities – This chapter provides an overview of the waste quantities for the Proposed Scheme.
- Chapter 12: Traffic Signs, Lighting and Communications – In this chapter the design strategy for traffic signs, road markings, lighting and communications equipment is outlined, alongside descriptions of how these elements can be maintained and monitored safety and securely
- Chapter 13: Land Use and Accommodation Works **–** This chapter outlines land use and acquisition requirements, affected land and property owners, and proposed accommodation works
- Chapter 14: Landscape and Urban Realm – This chapter is an overview of the landscape and urban realm design strategy focussing on the existing trees and proposed mitigation
- Chapter 15: Scheme Benefits / How we are Achieving the Objectives – In this chapter benefits provided by the scheme are summarised against the scheme objectives.
- Appendices – Various appendices and background information as referenced throughout the report.

2 Policy Context and Design Standards

2.1 Policy Context

The following national, regional and local policies have been reviewed and considered in the development of the Proposed Scheme:

- Project Ireland 2040 – National Planning Framework;
- Department of Transport: Statement of Strategy (2016 - 2019);
- Smarter Travel: A Sustainable Transport Future (2009 – 2020);
- National Cycle Policy Framework (2009 - 2020);
- Road Safety Strategy (2013 – 2020);
- Building on Recovery: Infrastructure and Capital Investment (2016 - 2021);
- The Sustainable Development Goals National Implementation Plan (2018-2020);
- Climate Action Plan (2019);
- Eastern & Midland Regional Assembly, Regional Spatial & Economic Strategy (2019-2031);
- Transport Strategy for the Greater Dublin Area (2016-2035);
- Greater Dublin Area Cycle Network Plan (2013);
- South Dublin County Council Development Plan (2016-2022);
- South Dublin County Council Development Plan (2022-2028);
- Dublin City Council Development Plan (2016-2022);
- Tallaght Town Centre Local Area Plan 2020 (SDCC);
- The Liberties Local Area Plan 2009 (DCC);
- The Liberties Greening Strategy 2015 (DCC);
- Dolphins Barn Public Realm Improvement Plan 2018 (DCC);
- Park West – Cherry Orchard Local Area Plan 2019 (DCC);
- Variation No.3 Zoning Objective Amendment on Lands at Ballymount/ Naas Road 2019 (SDCC) and;
- Naas Road Lands Local Area Plan 2013 (DCC).

For further information on how the Proposed Scheme meets the policies outlined above refer to the Tallaght / Clondalkin to City Centre Core Bus Corridor Planning Compliance Report.

2.2 Design Standards

Design standards applied on the Proposed Scheme are stated within the applicable chapters of this report. In addition to national design standards the CBC Infrastructure Works has developed the BusConnects Preliminary Design Guidance Booklet (BCPDGB - included in Appendix O), its purpose is to provide guidance for the various design teams involved in CBC Infrastructure Works, to ensure a consistent design approach across the twelve Proposed Schemes.

The BCPDGB complements existing guidance documents relating to the design of urban streets, bus facilities, cycle facilities and urban realm. A non-exhaustive list of these guidelines is as follows:

- The Design Manual for Urban Roads and Streets (DMURS);
- The National Cycle Manual (NCM);

- TII Publications;
- The Traffic Signs Manual (TSM);
- Guidance on the use of Tactile Paving;
- Building for Everyone: A Universal Design Approach, and
- Greater Dublin Strategic Drainage Study (GDSDS).

The BCPDGB focuses on the engineering geometry and Proposed Scheme operation. It is recognised that the Proposed Scheme is being planned and designed within the context of an existing city, with known constraints. The BCPDGB provides guidance, however a more flexible approach to the design of the Proposed Scheme, utilising engineering judgement, may be necessary in some locations due to these constraints.

Where it has been necessary to deviate from the parameters set out in the relevant national design standards or design guidance, these deviations, relaxations and departures have been noted within Section 7.

3 The Proposed Scheme

3.1 Proposed Scheme Description

3.1.1 Introduction

The Proposed Scheme is approximately 15.5 km long and consists of two main alignments. It runs primarily from Tallaght to the City Centre, with Clondalkin to Drimnagh forming a secondary alignment. From Walkinstown Roundabout to Parnell Road (Grand Canal), where it is not practicable to provide segregated cycle facilities along the main corridor due to site constraints, an additional offline cycling facility of approximately 3.9 km in length provides a more direct route towards the city centre. The General Arrangement drawings within Appendix B Preliminary Design Drawings show the extent of the infrastructure proposed to deliver the Proposed Scheme.

The Proposed Scheme Description has been broken into six sections; the Tallaght to City Centre section of the Proposed Scheme has been split into four sub-sections and the Clondalkin to Drimnagh section has been split into two sub-sections to align with the previous Options and Feasibility Reports, as well as the Preferred Route Options Reports.

- Section 1: Tallaght to Ballymount;
- Section 2: Ballymount to Crumlin;
- Section 3: Crumlin to Grand Canal;
- Section 4: Grand Canal to Christchurch;
- Section 5: Woodford Walk (R113) / New Nangor Road (R134) to Long Mile Road (R110) / Naas Road (R810) / New Nangor Road (R134) junction; and
- Section 6: Long Mile Road / Naas Road / New Nangor Road junction to Drimnagh.

The works contained within each of these sections are described accordingly.

3.1.2 Section 1: Tallaght to Ballymount

The Proposed Scheme commences at the junction of Old Blessington Road/ Cookstown Way to facilitate access to the proposed bus interchange on Belgard Square West. General traffic will also be permitted to access the Square Shopping Centre from this junction via Belgard Square South as Belgard Square West is restricted to buses, cyclists and other authorised vehicles. Bus traffic across Old Blessington Road will be controlled by signal-controlled priority maintaining a similar arrangement to the existing scenario for orbital services heading towards the bus interchange.

It is proposed to change the existing Belgard Square South roundabout to a fully signalised junction with improved pedestrian facilities. The section of Belgard Square West from Belgard South to Old Blessington Road and immediately north of Old Blessington Road is proposed to be a bus only route and will no longer be a through-route for general traffic. A bus interchange will be developed on Belgard Square West which will allow for interchange with the red line Luas and serve as the terminus for several buses including the A3, F1, D5 spine routes, W2, W4, W6, S6 orbital routes and 71, 85, L44 local routes. This will also act as the focal point for other through bus routes in the area. Access to Tallaght Cross West / Broadfield Hall and neighbouring developments will still be permitted from via Belgard Square North and the northern section of Belgard Square West.

The proposed Tallaght Bus Interchange will greatly improve transport links to the area and cater for greater public access. It will become an important new focal point in the community. The interchange is an “island” type layout with four sedum green roofs to soften the view from local apartments above. It will have eight independently usable alighting/boarding bays with an inbound bus layby for buses passing through the interchange. Pedestrian movement by passengers and shoppers is accommodated within and across the interchange island. The Bus Interchange design will require land take and will integrate with the adjacent shopping centre, the proposed South Dublin County Council (SDCC) public realm development and wider Tallaght area.

It is proposed to change the roundabout junction on Belgard Square North at the Tallaght Hospital Entrance to a fully signalised junction to accommodate new bus, cycle and pedestrian facilities. The roundabout junction at Belgard Square East will also be replaced with new signalised junction arrangements. It is proposed to upgrade the existing cycle facilities and associated junctions on Belgard Square North to provide segregated cycle tracks to and from Tallaght Hospital. This proposed amendment may impact on the existing trees and shrubs along Belgard Square North and require localised land acquisition on a currently undeveloped site. The recently constructed signalised junction at the Cookstown Link Road and right-turn filter lane on Belgard Square North will be accommodated in the Proposed Scheme.

From Belgard Square East the route continues via Blessington Road and Main Street to Greenhills Road. To avoid traffic congestion on Greenhills Road it is proposed for buses to use the Old Greenhills Road alignment and create a new bus only junction at the location of the existing cul-de-sac opposite Bancroft Park Road, to facilitate bus only turn movements to Greenhills Road (R819). This will aid the bus in avoiding congestion at the Main Street/ Greenhills Road (R819) junction. Stone paving will be used in the area and localised planting will be implemented to retain the character of the existing cul-de-sac treatment.

Between the Old Greenhills Road and the junction with Mayberry Road, along the Greenhills Road (R819), it is intended to provide one bus lane, one traffic lane and a cycle track in each direction. Raised table side entry treatments and protected junctions have been proposed along this section where practical to improve pedestrian and cycle facilities. To accommodate this road cross section, it is proposed to acquire additional land on both the west and east side of the existing Greenhills Road (R819). A bus gate has been proposed along this section to minimise impacts to the existing mature trees and the stone wall on the western verge north of the TUD entrance on Greenhills Road (R819). The Airton Road/Greenhills Road (R819) junction has been upgraded to provide improved facilities for buses, cyclists and pedestrians.

To improve the operation of the existing junction and minimise land take, it is proposed to introduce a southbound right turn ban from the Greenhills Road (R819) to the entrance to Harvey Norman/Costa carpark and a northbound right turn ban from the Greenhills Road (R819) to Hibernian Industrial Estate. Southbound access to Harvey Norman/Costa car park via Greenhills Road (R819) will be maintained via the entrance off Airton Road. Northbound access to Hibernian Industrial Estate will be achieved via the entrance opposite Broomhill Road.

A low height retaining wall will be required to the south of Broomhill Road to accommodate the proposed road boundary cross section.

Between Mayberry Road and Tymon Lane, it is proposed to reconfigure the local road network. SDCC had previously identified this section of Greenhills Road for upgrade through the provision of new roads under their current County Development Plan and received Part 8 Planning Approval in 2007. The Proposed Scheme seeks to align with the principles of the Part 8 scheme with a significantly reduced cross section that caters for sustainable modes only (i.e. bus/cycling/pedestrian) to minimise impacts on the adjacent properties and surrounding environment. General traffic will remain on the existing Greenhills Road. Bus Priority signalling will be used to prioritise bus movements in the outbound direction via the new approximately 620m long sustainable link road that will run parallel to Birchview Avenue and Treepark Road. Inbound D5 spine services and X47 services from Castletymon Road will also be provided with a priority bus only link that adjoins the new link road. As part of the proposal, improved cycling facilities including new two-way cycling and pedestrian links will be incorporated to improve access to Tymon Park and surrounding amenities. Significant new landscaping and SUDs enhancements will also be provided in these areas.

As outlined in the GDA Cycle Network Plan, this Section of the corridor will provide access with the proposed secondary routes SO6 and 9C at Belgard Square South /Belgard Square West and aligns with primary route SO5 on the Blessington Road and primary route 8B on Greenhills Road (R819). The proposed Dodder Greenway can be accessed at Tymon Park south of the R819/M50 overbridge.

3.1.3 Section 2: Ballymount to Crumlin

The existing M50 bridge crossing will be retained. Two new single span pedestrian/cycle bridges are proposed to be located adjacent to the existing bridge to maintain priority for buses on the existing bridge and to provide high quality cycle/pedestrian facilities over the M50 in both directions. The pedestrian/cycle bridges will be steel warren truss type structures and positioned immediately parallel to the existing structure. Additional land acquisition on both sides of the M50 will be required to facilitate the construction of the pedestrian/cycle bridges.

Two sustainable link roads will be constructed in the Ballymount area due to the existing width constraints within the existing Greenhills Road (R819) to the east of the M50. The existing Ballymount Road Upper connection to Greenhills Road will be closed to vehicular traffic and a new 220m long link road to the south of Ballymount Avenue will provide a connection to Greenhills Road (R819). New retaining walls and earth embankments will be required at this location to facilitate the new road construction. It is proposed to widen the existing Ballymount Avenue and Calmount Road for dedicated bus and cycle tracks and connect Calmount Road to Greenhills Road. The existing Greenhills Road (R819) will be retained for local access and cycling facilitities with a cul-de-sac treatment to the northern end where a new approximately 250m long sustainable transport link road will be constructed in the green area to the east of Calmount Road. New retaining walls and earth embankments will be required at this location to facilitate the new road construction. To maintain access for local businesses along the Greenhills Road (R819) in this area a small roundabout will be constructed with a new approximately 90m long link road to connect Greenhills Road with Calmount Avenue which generally aligns to the principles of the SDCC Part 8 schemes for the area. Accessible ramps and stairs will be provided to mitigate against the step gradient on Calmount Avenue where it joins to Greenhills Road.

Between Calmount Road and Walkinstown Roundabout, it is proposed to maintain one bus lane, one traffic lane and a cycle track inbound with one traffic lane and a cycle track outbound along the Greenhills Road (R819).

The layout of Walkinstown Roundabout has been designed to provide enhanced cycle and pedestrian connectivity around this busy junction as well as improving safety for pedestrians, cyclists, bus and general traffic. A two-way segregated cycle track has been proposed around the junction to allow cyclists to adopt the most direct route around the roundabout (i.e both directions) and to reduce interactions with motor vehicles. Parallel pedestrian/cyclist raised table crossings have been implemented on all arms to improve pedestrian and cyclist safety. Set back crossings have been used on all arms to promote pedestrian/cyclist desire lines with consideration for vehicle exit lane storage off the roundabout. Cycle detection loops have also been implemented on the two-way segments on approach to the crossings to help promote cycling journey time efficiencies and minimise delays for cyclists crossing multiple arms of the junction. The number of general traffic entry lanes/flares, circulation lanes and angle of entry have been reconfigured to promote safer vehicle movements. Landscaping proposals and revised parking arrangements are also proposed to enhance the area. City-bound cyclists will be directed to the offline cycle route along Bunting Road and St. Mary's Road providing a more direct route linking Walkinstown Roundabout with Kildare Road.

As outlined in the GDA Cycle Network Plan, this Section of the corridor will align with primary route 8B on the R819 M50 overbridge as far as Tymon Park entrance and secondary route 8A on Ballymount Avenue, Calmount Road and Greenhills Road (R819) to Walkinstown Roundabout.

3.1.4 Section 3: Crumlin to Grand Canal

On Walkinstown Road (R819) between Walkinstown Roundabout and the Long Mile Road (R110), it is proposed to provide one bus lane and one general traffic lane in each direction with minimum landtake impacting properties on Walkinstown Road (R819) maintaining sufficient front driveway boundary setback lengths for a car to be parked. To accommodate this cross-section land acquisition will be required along the Walkinstown Road (R819). Land acquisition is proposed on the western side of the Walkinstown Road (R819) between Walkinstown Roundabout and Kilnamanagh Road. Between Kilnamanagh Road and Long Mile Road (R110), land acquisition is proposed on the eastern side of Walkinstown Road (R819). It is proposed to introduce a southbound right turn ban for general traffic from Walkinstown Road (R819) to Kilnamanagh Road to improve the efficiency of the junction and minimise bus delays. Kilnamanagh Road will remain accessible from the Walkinstown Road (R819) via Walkinstown Drive. It is also proposed to introduce a right turn ban for northbound right turning traffic from the Walkinstown Road (R819) to the southern entrance of the SuperValu supermarket (Walkinstown Shopping centre) during peak hours to improve the operation of the junction and reduce bus delays. Entry to the shopping centre will be possible via the alternative car park entrance.

City-bound cyclists will have an alternative segregated cycle route along Bunting Road (GDA Cycle Route 8A) and St. Marys Road providing a more direct route linking Walkinstown Roundabout with Kildare Road.

It is proposed to upgrade the junction at Drimnagh Road (R110) / Walkinstown Road (R819) to enhance pedestrian and cycling facilities. To improve the safety of cycle facilities and reduce vehicle speeds the existing left turn slip lane to the Walkinstown Road (R819) has been removed and additional planting and urban realm enhancements have been proposed. Proposals for parking adjacent to shop frontage on the Long Mile Road (R110) has been revised, with the existing perpendicular parking converted to a parallel parking layout. To accommodate the proposed revised grading arrangements for the junction a retaining wall structure has been proposed to the northern side of the Drimnagh Road(R110) at the interface with Slievebloom Park cul-de-sac.

On Drimnagh Road (R110) it is proposed to maintain one bus lane, one general traffic lane and one cycle track in each direction. The junction at Kildare Road, St. Mary's Road and Drimnagh Road has been revised to provide improved cycle and pedestrian facilities. This will provide improved cycle connectivity between the Drimnagh Road (R110) and the proposed offline cycle route via Kildare Road.

On Crumlin Road (R110) bus priority will be maintained by incorporating Signal Controlled Priority and managing the flow of traffic in both directions along the Crumlin Road (R110). Widening of the road corridor here for dedicated bus and traffic lanes in both directions is not feasible due to the size of the front gardens and gradient constraints between the road level and front doors. The proposed arrangement requires the closure of Clonard Road and Bangor Drive for direct access onto Crumlin Road to facilitate traffic management within this portion of the Crumlin Road (R110) such that bus priority can be maintained, one-way access from the Crumlin Road (R110) onto Clonard Road and Bangor Drive will be possible. Egress and access for Bangor Drive and Clonard Road can be achieved via Windmill Road and Old County Road.

Due to width restrictions in the area of Crumlin Road (R110) there is insufficient space to provide dedicated cycle facilities. Therefore, it is proposed to provide an alternative cycle route along Kildare Road and Clogher Road.

The alternative cycle route will include segregated cycle tracks over most of its length either through the addition of kerbs to the existing cycle lanes or the construction of new kerbed cycle tracks. On Clogher Road, between Sundrive Road and Kildare Road, the narrow cross-section prevents the provision of dedicated cycle facilities therefore it is proposed to provide a bus/cycle gate at the junction of Clogher Road/ Sundrive Road to reduce the amount of traffic on this road and making it suitable for designation as a Quiet Street.

At the Crumlin Road / Herberton Road / Sundrive Road junction, it is proposed to modify the existing layout and kerb alignments to provide improved pedestrian crossing facilities. On Crumlin Road (R110) between Herberton Road and Dolphin Road it is proposed to maintain one bus lane and one general traffic lane in each direction. There is insufficient road width on this section to provide dedicated cycle tracks, with the proposed cycle route along Clogher Road providing an alternative route.

On Crumlin Road (R110) between Cooley Road and Dolphin Road the posted speed limit will be reduced to 30 kph from 50 kph with raised tables installed at side road junctions to improve pedestrian accessibility. At the Crumlin Road (R110) junction with Dolphin Road / Parnell Road (R111) on-road cycle lanes will be provided within the fully signalised junction, existing right turn bans will be maintained.

As outlined in the GDA Cycle Network Plan, this Section of the corridor will provide access to secondary routes SO3 (R818 Cromwellsfort Road), SO4 (St. Peter's Road (R112) and Walkinstown Avenue (R112)) and 7E (Ballymount Road Lower). It will align with secondary route 8A on Bunting Road, secondary route 8C on Long Mile Road (R110), Drimnagh Road (R110), Kildare Road and Clogher Road as far as Parnell Road (R111) / Grand Canal primary route SO1 / N10. Junctions within this section will be upgraded to provide enhanced cycle facilities where feasible.

3.1.5 Section 4: Grand Canal to Christchurch

Between Dolphin Road and South Circular Road (R811), it is intended to provide one bus lane, one general traffic lane and one cycle track in each direction along the R110. The proposed South Circular

Road junction design takes into account the Dolphins Barn Public Realm improvement plan that is being implemented by DCC.

Between South Circular Road (R110) and Ardee Street it is proposed to have one bus lane, one general traffic lane and one cycle track in each direction. It is also intended to upgrade the Ardee Street junction with improved pedestrian facilities. It is proposed to modify the Kevin Street / Dean Street junction to facilitate improved cycle facilities. Bus priority from St. Luke's Avenue will be maintained with through Signal Controlled Priority as there is insufficient road corridor width on Dean Street to provide continuous bus lanes.

The Dean Street/Patrick Street junction will be upgraded to provide enhanced cycling and pedestrian facilities with the conversion of the existing left turn slip lane on the north western corner of the junction to a cycle bypass facility to provide efficiencies for left turning cyclists on the corridor. A controlled crossing will be implemented to manage the pedestrian and cyclist interaction at the cycle bypass.

The future proposed Kimmage to City Centre Core Bus Corridor scheme will also join the route here on the southern arm via New Street. The design proposals allow for connection to both the existing arrangement and the future proposed arrangement under the Kimmage Scheme.

Between Dean Street and Bride Road it is proposed to have one bus lane, one general traffic lane and one cycle track in each direction, between Bride Road and Christchurch Place it is proposed to have one bus lane and one cycle track in each direction with two traffic lanes inbound and one traffic lane outbound.

The Proposed Scheme terminates at the junction of Christchurch Place and Winetavern Street where the Proposed Scheme ties into the DCC contra flow bus lane arrangement, providing connectivity to and from the Quays.

The future proposed Liffey Valley to City Centre Core Bus Corridor scheme will also join the route here on the western arm via High Street. The design proposals allow for connection to both the existing arrangement and the future proposed arrangement under the Liffey Valley Scheme.

As outlined in the GDA Cycle Network Plan, this Section of the corridor will align with primary route 8 on R110 Dolphin's Barn Street, Cork Street and St. Luke's Avenue and link with primary route 7 at R108 High Street and Christchurch Place. It will align with secondary route 9B on R137 Patrick Street and Nicholas Street. Junctions within this section will be upgraded to provide enhanced cycle facilities where feasible.

3.1.6 Section 5: Woodford Walk (R113) / New Nangor Road (R134) to Long Mile Road (R110) / Naas Road (R810) / New Nangor Road (R134) junction

The junction at Woodford Walk / New Nangor Road (R134) will be upgraded with removal of the existing left turn slip lanes, provision of enhanced cycling and pedestrian facilities and improved connectivity to the existing Grand Canal Greenway including the removal of the existing kissing gate.

Between Woodford Walk / New Nangor Road (R134) junction and the approach to the M50 overbridge a bus lane, general traffic lane and cycle track will be provided in both directions. A continuous footway will be provided along the outbound side of the New Nangor Road (R134). On the inbound side of the New Nangor Road (R134), no footway is proposed beyond the Woodford Walk junction as pedestrians will be directed to the parallel Grand Canal Greenway.

It is proposed to widen the existing R134 carriageway at the M50 bridge to provide a three-lane arrangement. A continuous inbound bus lane has been proposed to mitigate against any potential queuing that may occur from the upgraded Riverview Business Park junction. Bus priority on the outbound bus lane is facilitated by a bus priority signal on the approach to the M50 overbridge. The inbound footway on the New Nangor Road (R134) is reintroduced on the approach to the Nangor Road Business Park junction with a new pedestrian and cycle link connection to the Grand Canal Greenway to the east of the M50 overbridge.

Between the New Nangor Road (R134) /Riverview Business Park junction and New Nangor Road (R134) /Killeen Road junction it is proposed to widen the existing R134 carriageway to accommodate enhanced bus, cycle and pedestrian facilities along the corridor. This will require localised land acquisition on both the southern and northern boundaries to the existing carriageway. Localised modifications to the Cammock river headwall at the New Nangor Road (R134) /Oak Road junction will also be required.

The existing roundabouts and junctions along this portion of the New Nangor Road (R134) will be upgraded to cycle protected signalised junctions with the provision of large segregation islands proposed where practicable in consideration of the heavy goods vehicle movements in the area. Removal of left turn slip lanes and improved pedestrian crossing facilities are also proposed.

Raised table crossings are proposed at the interface of the existing HGV entrances (Diageo Baileys and Toyota Ireland) on the northern side of the New Nangor Road (R134) to improve the existing crossing arrangements.

At the Killeen Road junction the existing outbound bus bypass facility will be modified to accommodate the revised junction arrangements. A new two-way cycle facility will provide connection to the proposed cycle bridge at the New Nangor Road (R134) / Naas Road (R810) junction and also linking to the proposed two-way cycle track on the northern side of the Naas Road (R810), thus enhancing the accessibility of the existing Killeen Road cycle tracks that link to the Grand Canal Greenway and Park West whilst also reducing the need for cycle crossings on the R134. A proposed inbound right turn ban from the New Nangor Road (R134) towards Killeen Road will be implemented to facilitate bus priority in this section through lane reallocation. Alternative access to Killeen Road from the New Nangor Road (R134) is available via Willow Road / Knockmitten Lane. The existing peak hour right turn ban from Killeen Road to the New Nangor Road (R134) is proposed to be retained with the provision of inbound bus signals to allow for continuous bus priority during the right turn movements from Killeen Road.

Between Killeen Road junction and the Naas Road (R810) junction land acquisition and new retaining walls will be required along the northern boundary to facilitate enhanced bus, cycle, and pedestrian infrastructure.

At the New Nangor Road (R134) /Naas Road (R810) junction a new pedestrian and cycling bridge with accessible ramps and stairs on all approaches to the junction has been proposed to provide increased pedestrian and cycling safety, permeability and accessibility at this junction. This will require land acquisition and boundary treatment on the periphery of the existing road boundary to accommodate the proposed bridge and ancillary ramp structures. A proposed continuous inbound bus lane with dedicated left turn bypass facility will provide enhanced bus priority between the New Nangor Road (R134) and the Naas Road (R810). This will require land acquisition and boundary modifications including new retaining structures in conjunction with the new bridge access ramps and steps. A new bus lane is proposed within the junction for the outbound buses heading towards New Nangor Road (R134) to improve bus priority along the corridor. As a result, the general traffic lane allocation from the Long Mile Road (R110) will be revised to two straight ahead lanes towards the New Nangor Road (R134) and two left turn lanes towards the Naas Road (R810).

As outlined in the GDA Cycle Network Plan, this Section of the corridor aligns with the proposed Primary Route 7B / N10 until cyclists re-join New Nangor Road beyond the M50 overbridge. The route also aligns with Secondary Route 8C2 along its extents.

3.1.7 Section 6: Long Mile Road / Naas Road / New Nangor Road junction to Drimnagh

The Proposed Scheme is routed along the Naas Road (R810) until the junction with Walkinstown Avenue (R112), generally maintaining the existing lane provision of one bus lane and two traffic lanes in each direction with a proposed segregated two way cycle track on the inbound direction and segregated one way cycle track on the outbound direction. The existing left turn slip lane towards the Kylemore Road (R112) is to be removed and the inbound left turn movement will be banned, with traffic diverted via Old Naas Road/John F Kennedy Drive in order to access Kylemore Road (R112). This arrangement allows for improved bus facilities and passenger interchange with the Kylemore Luas Stop. Right turning buses from Naas Road (R810) towards Walkinstown Avenue (R112) will have a layby bus stop with a bus priority signal to complete the right turn movement through the junction. Through services/coaches along the Naas Road (R810) will have a layby bus stop adjacent to the Old Naas Road junction. An inline bus stop for the corridor spine services and offline layby bus stop for coaches is provided on the outbound section of the Naas Road (R810). Localised land acquisition and widening will be required to accommodate the arrangement for the outbound bus stops.

The junction of Naas Road (R810)/ Walkinstown Avenue (R112) is being reconfigured to provide enhanced pedestrian and cyclist facilities. Existing pedestrian routes are maintained along Naas Road with raised table crossings at key entrances along this section of the corridor to improve pedestrian priority.

From the Naas Road (R810) the Proposed Scheme is routed along the Walkinstown Avenue (R112), with one bus lane, one general traffic lane, cycle track and footpath in each direction. A grass verge is provided to segregate the outbound cycle track from the carriageway and to retain the existing mature trees along this section of the corridor. Land acquisition will be required on the eastern boundary to accommodate the revised cross section.

The junction of Walkinstown Avenue (R112) / Long Mile Road (R110) is being reconfigured to provide enhanced pedestrian and cyclist facilities. The westbound approach to the junction on Long Mile Road is also being altered, with a bus gate being provided for improved priority for right turning buses into Walkinstown Avenue.

The existing bus and traffic lane provision is generally maintained along the Long Mile Road (R110) until the junction with Slievebloom Park, at which point this section of the Proposed Scheme joins the Tallaght section. The junction with Slievebloom Park is proposed to be upgraded to a signalised junction with improved pedestrian and cycle facilities. Existing footway provisions have largely been maintained, with raised tables proposed at side roads and new raised crossing proposed adjacent to schools in order to improve pedestrian accessibility and safety. Cycle tracks are provided in both directions.

As outlined in the GDA Cycle Network Plan, this Section of the corridor aligns with the proposed Secondary Route 7D. the proposed Secondary Route S04 and the proposed Secondary Route 8C.

3.2 Associated Infrastructure Projects and Developments

3.2.1 Introduction

The Proposed Scheme will interface with the following major infrastructure projects or developments that are under construction or proposed.

3.2.2 Mobility Hub Pocket Park, Tallaght

SDCC intend to construct a public realm pocket park on the Old Blessington Road between the proposed Tallaght Bus Interchange and The Square Shopping Centre Car Park (Figure 3-1, below). To facilitate this, the Proposed Scheme will provide a design to interface with this Pocket Park to maintain pedestrian access across the Pocket Park and to maintain vehicular access to the Square Shopping Centre car park from the Old Blessington Road.

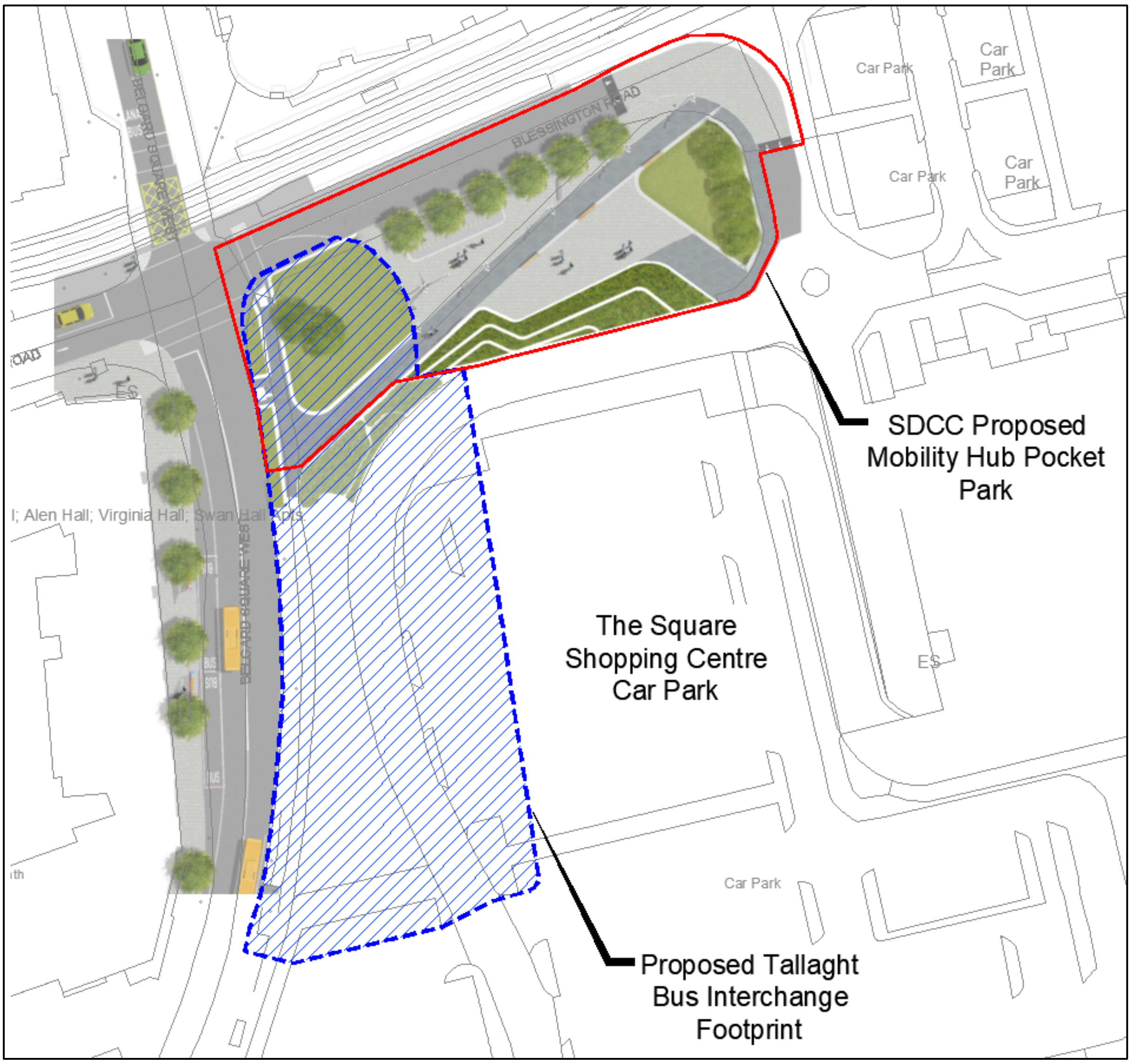

Figure 3-1: Proposed SDCC Mobility Hub Pocket Park

3.2.3 Dolphins Barn Public Realm Improvement Plan

Dolphins Barn Public Realm Improvement Plan (Figure 3-2 below) is being developed by DCC as one of a number of initiatives underway to revitalise the Dolphins Barn area.

Figure 3-2: Overview of Proposed Dolphin's Barn Public Realm Improvement

The aim of the project is to create an enhanced public realm providing a sense of identity and a coherent vision for the environmental and physical development of Dolphin's Barn Village with the following objectives:

- The creation of a pedestrian friendly public realm
- A material strategy that binds the diverse finishes together
- Architectural proposals which look to strengthen the sense of edge to the broad street of Dolphins Barn.
- A spatial strategy which looks to unify the existing linear pocket park and Church Park and in so doing make both more accessible.

3.2.4 Winetavern Street Contra-Flow Bus Lane

Dublin City Council have recently constructed an inbound contra-flow bus lane on Winetavern Street / St. Michael's Hill (Figure 3-3 below).

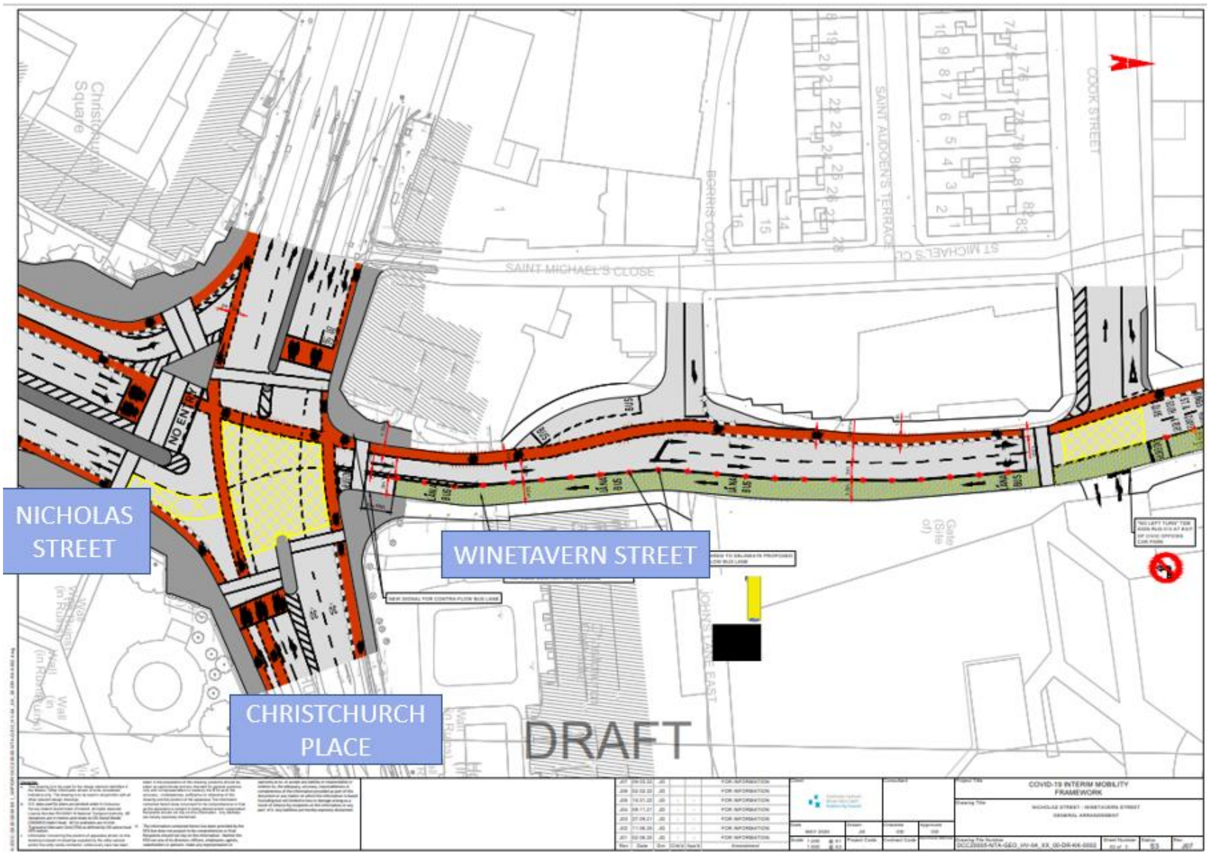

Figure 3-3: Proposed Contra-Flow Bus Lane Winetavern Street

This contra-flow bus lane allows buses to travel directly from the Quays to Clanbrassil Street. This will provide a new, fast connection for buses travelling to the south west of the city, as well as providing another routing alternative for bus services currently using the Dame Street corridor.

3.2.5 Greenhills Road / Airton Road Development

Proposed mixed use development at the former Gallaher's cigarette factory site at the junction of Airton Road and Greenhills Road, Dublin 24. A 502 apartment development with vehicular access from Greenhills Road and Airton Road accessed off Ballymount Avenue and Calmount Road.

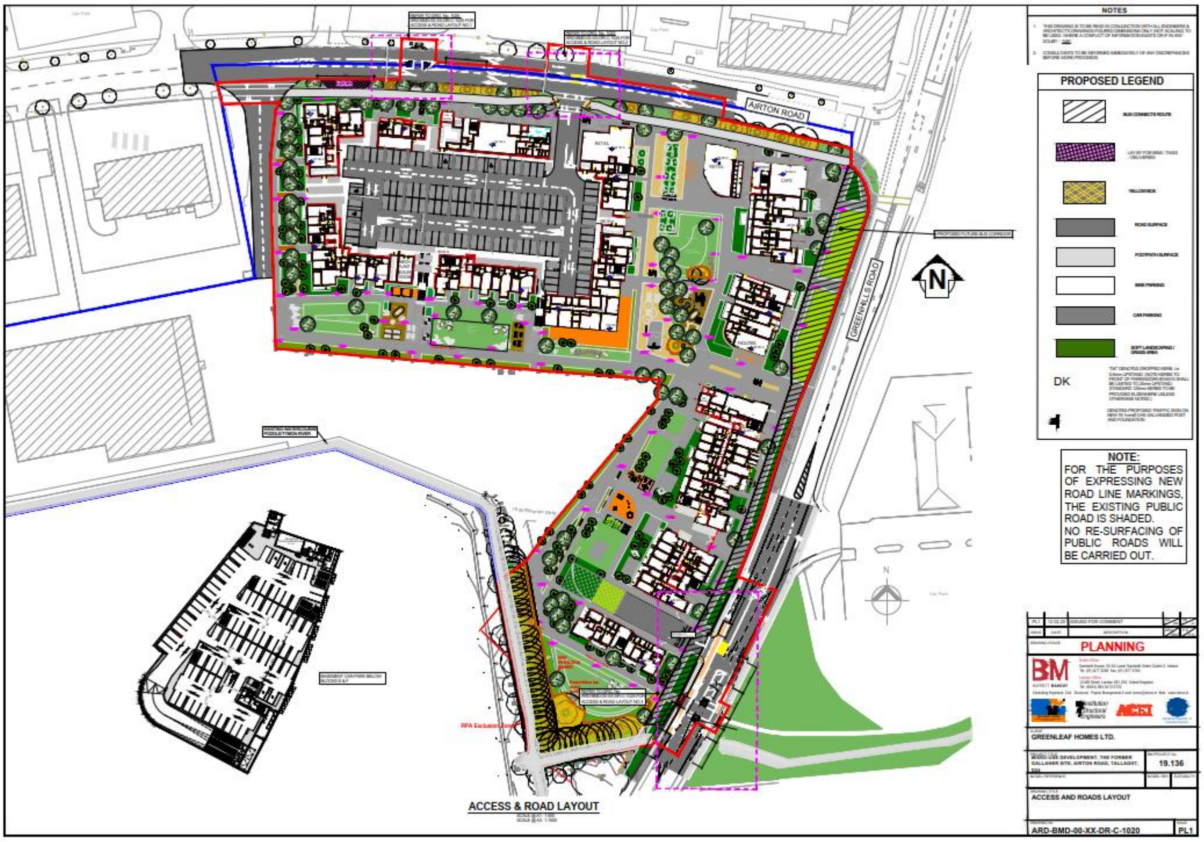

Figure 3-4: Mixed Use Development, Airton Road, Tallaght, Dublin D24.

3.2.6 Calmount Road / Ballymount Avenue Development

A mixed use Warehousing / Logistics, Office and Café / Restaurant Development at Calmount Road / Ballymount Avenue, Dublin 12

Figure 3-5: Mixed Use Development, Calmount Road / Ballymount Avenue, Dublin D12.

3.2.7 Mixed Use Development (Southwest Gate) on Walkinstown Avenue

Mixed use development comprising of residential units, commercial units and a hotel east of Walkinstown Avenue and the Naas Road.

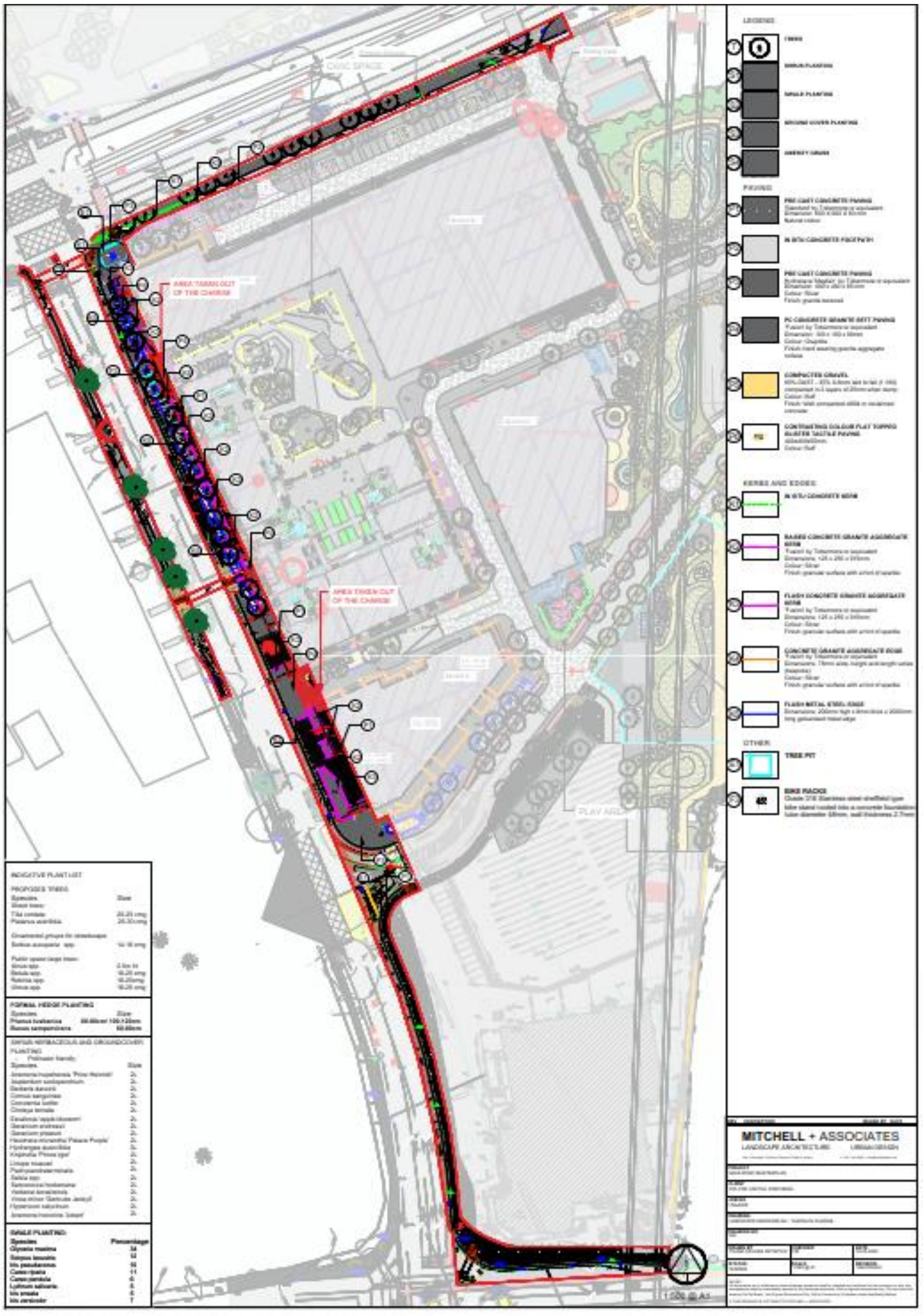

Figure 3-6: Mixed Use Development, Naas Road / Walkinstown Avenue.

3.3 Integration with other Core Bus Corridor Schemes

3.3.1 Introduction

As part of the Preliminary Design of the Proposed Scheme, consideration has been given to the potential coordination required in relation to other Proposed Schemes within the BusConnects CBC Infrastructure Works where relevant. In this regard this section outlines potential interactions of the Proposed Scheme with adjacent scheme(s) and identifies any procedures within the construction strategies that may be required in order to account for various sequencing scenarios in the construction of the schemes.

The Proposed Scheme runs between the proposed Liffey Valley to City Centre Core Bus Corridor Scheme and the proposed Kimmage to City Centre Core Bus Corridor Scheme, with connections to the two schemes at High Street and New Street South respectively.

The BCID Infrastructure Team has coordinated the Proposed Schemes designs to ensure a holistic design has been achieved, so that each scheme can be implemented, and integrated, regardless of the sequencing of their construction.

3.3.2 Kimmage to City Centre Core Bus Corridor

Figure 3-7 shows an extract of the preliminary design of the Proposed Scheme at the New Street South / Patrick Street junction, which ties in with the existing layout.

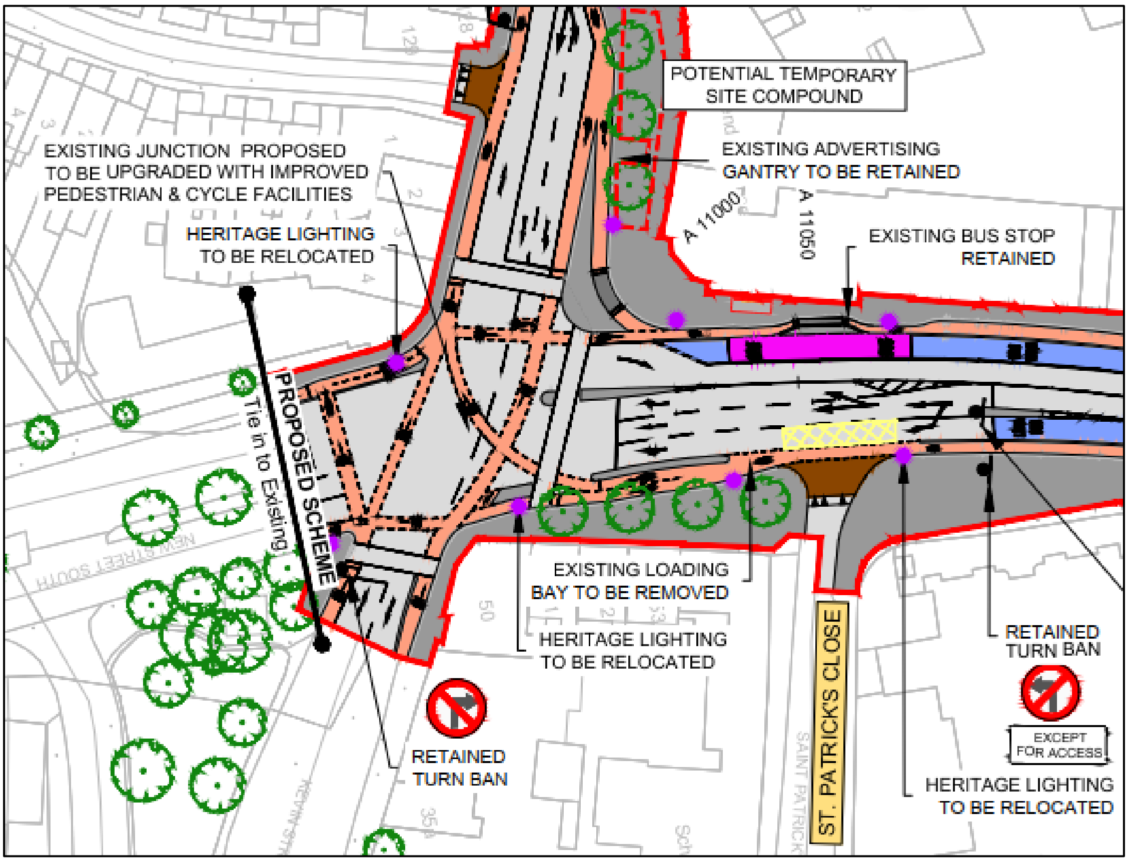

Figure 3-7: Preliminary Design of the Proposed Scheme Tie-in with the Existing Layout

The Proposed Scheme intends to tie-in with the Kimmage Scheme at the New Street South / Patrick Street in order to provide continuity of bus lanes and cycle tracks between the Proposed Scheme and the Kimmage Scheme. Figure 3-8 shows an indicative coordinated design of the expected overall arrangement in a scenario in which both schemes have been implemented.

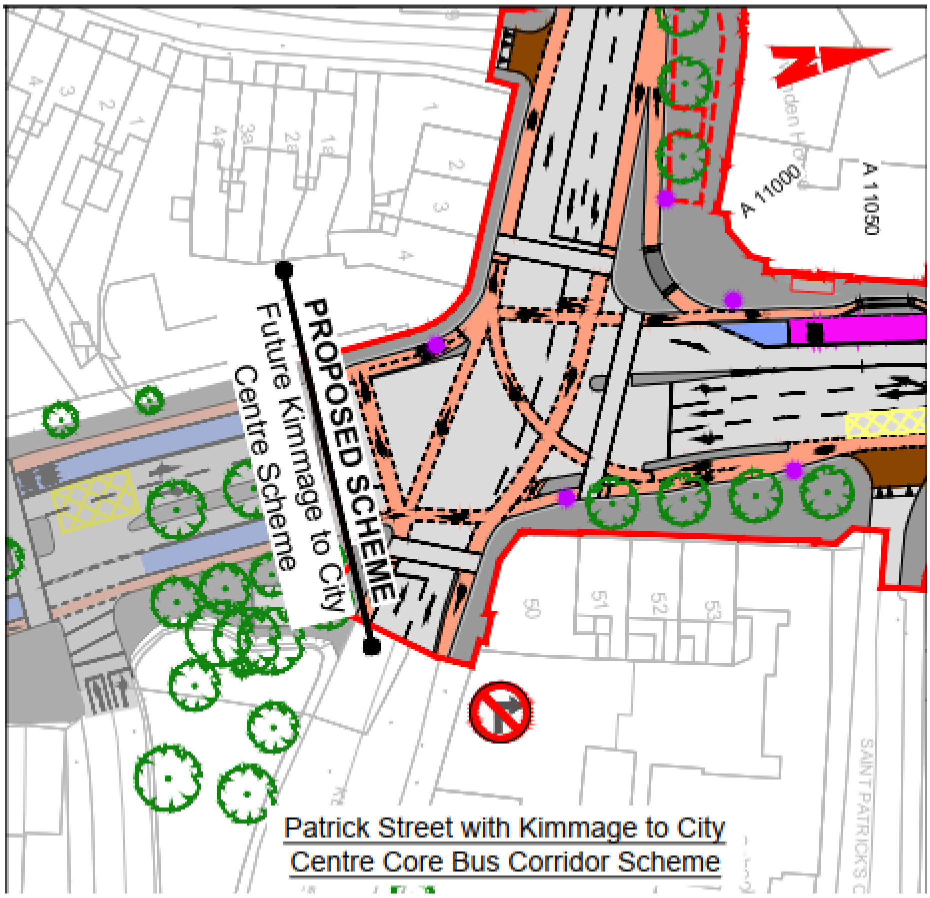

Figure 3-8: Preliminary Design of the Proposed Scheme Tie-in with the Kimmage Scheme

Table 3-1 presents a matrix of potential interactions and impacts associated with various potential sequencing scenarios in relation to construction and operation of both schemes.

Table 3-1: Matrix of Potential Interactions and Impacts Associated with Different Sequencing Scenarios

	Kimmage Scheme: Not Yet Commenced	Kimmage Scheme: Under Construction	Kimmage Scheme: Completed
Proposed Scheme: Not Yet Commenced	N/A	Construction of the Kimmage Scheme will be carried out in accordance with the Construction Strategy within that scheme's planning application, without any potential interaction with works associated with the Proposed Scheme.	The Kimmage Scheme shall be in full operation, designed in accordance with its planning application which will allow for the Tallaght/Clondalkin Scheme to tie in at a future date.
Proposed Scheme: Under Construction	Construction of the Proposed Scheme shall be carried out in accordance with the Construction Strategy within that scheme's planning application, without any potential interaction with works associated with the Kimmage Scheme.	It is not envisaged that both schemes will be under construction at the same time at this location.	The Kimmage Scheme will have been completed and the Proposed Scheme will tie into the revised layout on the New Street South / Patrick Street junction which will provide bus lane and cycle track continuity between the two schemes.

	Kimmage Scheme: Not Yet Commenced	Kimmage Scheme: Under Construction	Kimmage Scheme: Completed
Proposed Scheme: Completed	The Proposed Scheme shall be in full operation, designed in accordance with its planning application which will allow for the Kimmage Scheme to tie in at a future date.	The Proposed Scheme will be completed and the Kimmage Scheme will tie into the revised layout on the New Street South / Patrick Street junction. The proposed bus lane and cycle lane connections to the Kimmage Scheme will be implemented.	The arrangement will be as per Figure 3-2.

3.3.3 Liffey Valley to City Centre Core Bus Corridor

Figure 3-9 shows an extract of the preliminary design of the Proposed Scheme at the High Street / Nicholas Street junction, which ties in with the existing layout.

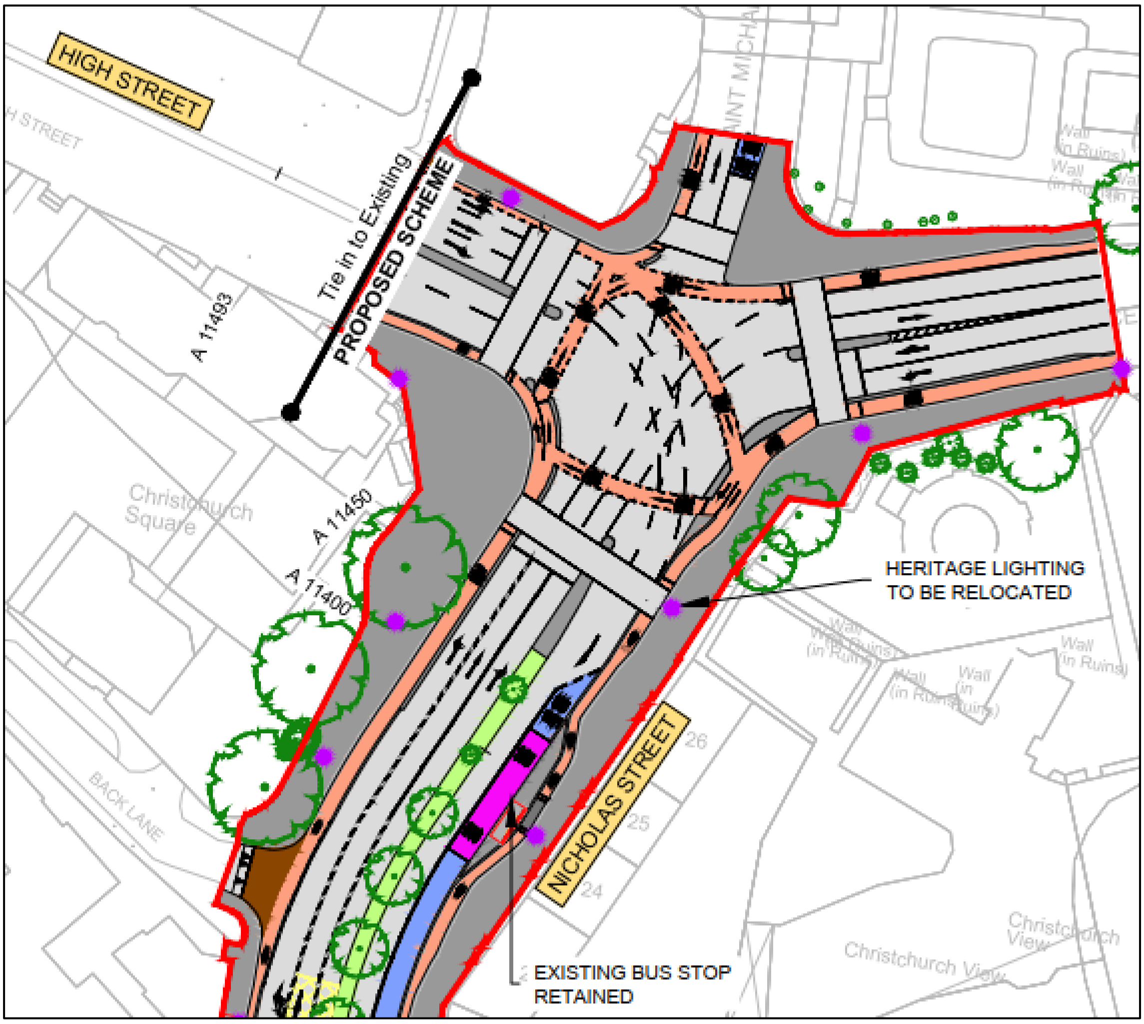

Figure 3-9: Preliminary Design of the Proposed Scheme Tie-in with the Existing Layout

The Proposed Scheme intends to tie-in with the Liffey Valley Scheme at the High Street / Nicholas Street in order to provide continuity of bus lanes and cycle tracks between the Proposed Scheme and the Liffey Valley Scheme. Figure 3-2 shows an indicative coordinated design of the expected overall arrangement in a scenario in which both schemes have been implemented.

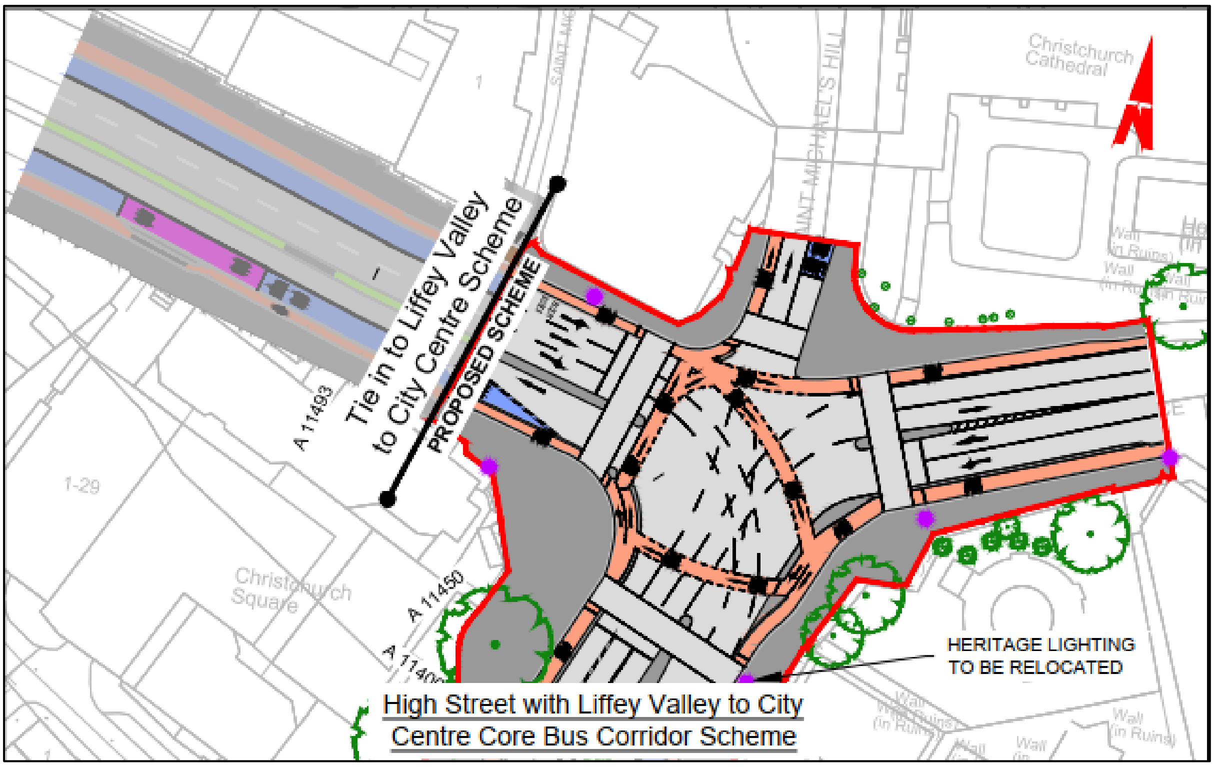

Figure 3-10: Preliminary Design of the Proposed Scheme Tie-in with the Liffey Valley Scheme

Table 3-2 presents a matrix of potential interactions and impacts associated with various potential sequencing scenarios in relation to construction and operation of both schemes.

Table 3-2: Matrix of Potential Interactions and Impacts Associated with Different Sequencing Scenarios

	Liffey Valley Scheme: Not Yet Commenced	Liffey Valley Scheme: Under Construction	Liffey Valley Scheme: Completed
Proposed Scheme: Not Yet Commenced	N/A	Construction of the Liffey Valley Scheme will be carried out in accordance with the Construction Strategy within that scheme's planning application, without any potential interaction with works associated with the Proposed Scheme.	The Liffey Valley Scheme shall be in full operation, designed in accordance with its planning application which will allow for the Tallaght/Clondalkin Scheme to tie in at a future date.
Proposed Scheme: Under Construction	Construction of the Proposed Scheme shall be carried out in accordance with the Construction Strategy within that scheme's planning application, without any potential interaction with works	It is not envisaged that both schemes will be under construction at the same time at this location.	The Liffey Valley Scheme will have been completed and the Proposed Scheme will tie into the revised layout on High Street which will provide bus lane and cycle track continuity between the two schemes.

	Liffey Valley Scheme: Not Yet Commenced	Liffey Valley Scheme: Under Construction	Liffey Valley Scheme: Completed
	associated with the Liffey Valley Scheme.		
Proposed Scheme: Completed	The Proposed Scheme shall be in full operation, designed in accordance with its planning application which will allow for the Liffey Valley Scheme to tie in at a future date.	The Proposed Scheme will be completed and the Liffey Valley Scheme will tie into the revised layout on High Street. The proposed bus lane and cycle lane connections to the Liffey Valley Scheme will be implemented.	The arrangement will be as per Figure 3-4.

4 Preliminary Design

4.1 Principal Geometric Parameters

As a safety improvement, junction improvement and traffic management scheme within an urban area, the Proposed Scheme has generally been designed to urban standards in accordance with the Design Manual for Urban Roads and Streets (DMURS), published by the Department of Transport, Tourism and Sport and the Department of Environment, Community and Local Government in 2013.

DMURS provides guidance in the design of urban roads and streets. DMURS recognises the challenges of fully applying its standards on schemes that involve the retrofitting of new facilities to existing streets, as is the case for the Proposed Scheme.

The design philosophy adopted for routes has applied a balanced and integrated approach to road and street design by applying as far as practicable the four design principles of DMURS, i.e. with respect to connected networks; multi-functional streets; pedestrian focus; and multidisciplinary approach.

In addition to DMURS, criteria from other documents have been considered to provide the most appropriate design application including the National Cycle Manual, the Transport Infrastructure Ireland (TII) Design Manual for Roads and Bridges (DMRB), Building for Everyone: A Universal Design Approach and the BCPDGB.

A number of published design standards and guides have been utilised to inform the geometrical design of the Proposed Scheme, as listed below:

- TII's Design Manual for Roads and Bridges (DMRB)
- Design Manual for Urban Roads and Streets (DMURS)
- National Cycle Manual (NCM)
- Traffic Sign Manual (TSM)
- Traffic Management Guidelines (TMG)
- NDA's Building for Everyone: A Universal Design Approach
- Guidance on the use of Tactile Paving
- Construction Standards for Road and Street Works in DCC; and
- BusConnects Preliminary Design Guidance Booklet (BCPDGB) – See Appendix O Preliminary Design Guidance Booklet

Table 4-1 details the key design parameters which have been generally adopted to inform the Proposed Scheme design layout. The table describes the relevant geometric features set out in order of functional geometrical requirements for each road user including pedestrians (footways), cyclists (cycle tracks), bus lanes, general traffic lanes, junctions and parking/loading areas. In designing the geometrical elements of the Proposed Scheme, a balanced approach to the requirements for each of the road functions from a people movement perspective is needed, noting that the aim of the Proposed Scheme is to provide enhanced walking, cycling and bus infrastructure. It should be noted that the development of the urban realm proposals along the corridor have also informed the key geometrical layouts for the Proposed Scheme which are further discussed in Chapter 14.

Table 4-1: BusConnects Key Design Parameters

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(/s)
All	Road Type	The Proposed Scheme and adjoining street network function in line with DMURS (60km/hr or less)	Varies – Scheme wide	Arterial Link / Link Street / Local Streets	DMURS (Figure 3.3)
Footway	Footway Widths	Nominal footway widths in low pedestrian activity areas and pinch point areas.	Varies – Scheme wide	• 2m desirable minimum width • 1.8m minimum nominal width (low pedestrian activity area or localised restrictions) • 1.2m absolute minimum width at pinch points (e.g. trees over 2m length)	NDA[1] (Section 1.5.1) DMURS (Figure 4.34)
		Nominal footway widths in moderate – high pedestrian activity areas		• 2.5m-3m desirable width (moderate to high pedestrian activity area) • 3m-4m desirable width (high pedestrian activity area)	NDA[1] (Section 1.5.1) DMURS (Figure 4.34)
	Footway Longitudinal Gradient	New road sections or new offline footways		• 0.5% (1 in 200) absolute minimum • 3% (1 in 33) desirable maximum • 5% (1 in 20) absolute maximum (where constrained by road geometry and other factors)	DMURS (Section 4.4.6)
		Existing footways with localised adjustments		• Generally in line with existing site constraints to a maximum of 5% (1 in 20) gradient with no less than 0.5% (1 in 200)	DMURS (Section 4.4.6)
		Ramp gradients – Urban Realm		• Nominal gradient of 1 in 25 with landings at maximum 19m intervals and routes with a gradient of 1 in 33 should have landings at no more than 25m intervals with linear interpolation between gradients as required • Desirable max gradient 1 in 20 with 0.45m max rise over 9m length between landings	NDA[1] (Section 1.5.2)

[1] National Disability Authority: *Building for Everyone: A Universal Design Approach - External environment and approach*

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(/s)
		Ramp gradients – Bridge Structures		• Desirable max gradient 1 in 20 with 2.5m max rise between landings • Absolute max 1 in 15 – 1 in 12 with 0.65m max rise between landings where 1 in 20 is not practical)	DN-STR-03005 (Section 6.9, 6.14, 6.15)
	Footway Crossfall Gradient	Fully reconstructed road sections or new offline footways		• 1 in 50 nominal gradient	NDA[1] (Section 1.5.1.1)
		Existing footways with localised adjustments		• Generally in line with existing site constraints to a maximum of 3.3% (1 in 33) gradient with no less than 1.5% (1 in 65)	DN-PAV-03026 (Table 2.3)
Cycle Track	Cycle Track Width	Optimum cycle track width (two abreast cycling): single-direction, with-flow, raised-adjacent cycle track		• 2m desirable minimum width	BCPDGB (Section 5)
		Minimum cycle track (single file cycling): single-direction, with-flow, raised-adjacent cycle		• 1.5m minimum width • 1m absolute minimum width at constrained island bus stop locations. • Using the NCM width calculator, reduction of these desirable minimum widths can be considered on a case-by-case basis, with due cognisance of the volume of cyclists anticipated to use the route as well as the level of service required.	BCPDGB (Section 5.3, 11.2)
		Two-way cycle track (single file cycling)		• 3.25m desirable minimum cycle track with additional desirable minimum 0.5m buffer & absolute minimum 0.3m buffer	BCPDGB (Section 5.3)
		Pedestrian priority zone areas (pedestrian and cyclist) for constrained locations		• 3m minimum width	NCM 1.9.3
	Horizontal Curvature	Minimum horizontal radius (General Alignment)	20 km/h	• 10m radius (urban areas)	NCM 4.10.3
			30 km/h	• 20m	NCM 4.10.3
			40 km/h	• 25m	NCM 4.10.3

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(/s)
		Minimum horizontal radius (Island Bus Stops)		• 4m radius (Entry deflection radius) • 6m radius (Exit deflection radius)	BCPDGB (Figure 34)
		Nominal deflection – Parking & Loading Bays		• 1 in 3 horizontal taper at cycle protected parking	BCPDGB (Figure 12)
		Nominal deflection – Island Bus Stops		• 1 in 1.5 horizontal taper at Island Bus Stops	BCPDGB (Figure 34)
	Longitudinal Gradient	Acceptable gradient range		• 0.5% to 5.0% (1:200 to 1:20)	NCM 5.2.3.4
	Ramps	Transition to cycle track to carriageway		• 60mm drop at 1:20 gradient (2.4m long)	NCM 4.10
		Transition from carriageway to Pedestrian Priority Zone		• 120mm at 1:20 gradient (4.8m long)	NCM 4.10
		Transition from cycle track to Pedestrian Priority Zone		• 60mm rise at 1:20 gradient (2.4m long)	NCM 4.10
	Crossfall Gradient	Acceptable gradient range		• 1.25% to 2.5% (1:80 to 1:40)	NCM 5.2.3.4
Bus Lane	Shared Bus/Cycle Lane	Lane widths (collector/link roads – low speed) in constrained environments	30-50 km/h	• 3m max width (consideration for cycle and bus (including taxis + other permitted vehicles) volumes required in addition to bus lane operation hours)	NCM 4.3.3
			60 km/h	• 3.0m width	NCM 4.3.3
	Nominal with flow Bus Lane Widths	Nominal lane widths adjacent to cycle track/footway	50 km/h	• 3m min width & lane widening as required by vehicle tracking assessment on tight bends	BCPDGB (Section 5.1)
			60 km/h	• 3.25m min width and lane widening as required by vehicle tracking assessment on tight bends	BCPDGB (Section 5.1)
			85 km/h	• 3.0m min width	BCPDGB (Section 5.1)
		Bus lanes adjacent to on street parking (no cycle track/footway)	30-50 km/h	• 3m min width with consideration for designated buffer zones and delineated parking areas	BCPDGB (Figure 12)
	Design Speed	Design speed for vehicles in bus lane along the Proposed Scheme	30-50 km/h	• See Table 4-1	DMURS (Section 4.1.1 & Table 4.1)
			60 km/h	• See Table 4-1	DMURS (Section 4.1.1 and Table 4.1)

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(/s)
	Visibility	Forward Visibility Stopping Sight Distance (SSD) (Buses & HGV vehicles).	30 km/h	• 24m	DMURS (Table 4.2)
			50 km/h	• 49m	DMURS (Table 4.2)
			60 km/h	• 65m	DMURS (Table 4.2)
	Headroom	Headroom vertical clearance for different structures		• Overbridges – 5.3m(new construction), 5.03m (maintained headroom) • Footbridges and sign/signal gantries – 5.7m (new construction), 5.41m (maintained headroom)	DN-GEO-03036 (Table 5.1)
Traffic Lane	Design Speed	Design speed for vehicles in general traffic lanes along the Proposed Scheme	30 km/h	• Local roads	DMURS (Section 4.1.1 & Table 4.1)
			50 km/h	• Link streets / Local streets	DMURS (Section 4.1.1 & Table 4.1)
			60 km/h	• Link streets / Local streets	DMURS (Section 4.1.1 & Table 4.1)
	Traffic Lane Width	Min carriageway lane width	30 km/h	• 3m min width & lane widening as required by vehicle tracking assessment on tight bends	BCPDGB (Section 5.1)
			50 km/h	• 3m min width & lane widening as required by vehicle tracking assessment on tight bends	
			60 km/h	• 3.25m min width	
	Visibility	Forward Visibility Stopping Sight Distance SSD (cars & smaller vehicles).	30 km/h	• 23m	DMURS (Table 4.2)
		Forward Visibility Stopping Sight Distance SSD (cars & smaller vehicles).	50 km/h	• 45m	DMURS (Table 4.2)
		Forward Visibility Stopping Sight Distance SSD (cars & smaller vehicles).	60 km/h	• 59m	DMURS (Table 4.2)
		Forward Visibility Stopping Sight Distance SSD (Buses & HGV vehicles).	30 km/h	• 24m	DMURS (Table 4.2)
		Forward Visibility Stopping Sight Distance SSD (Buses & HGV vehicles).	50 km/h	• 49m	DMURS (Table 4.2)

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(/s)
		Forward Visibility Stopping Sight Distance SSD (Buses & HGV vehicles).	60 km/h	• 65m	DMURS (Table 4.2)
		Visibility to regulatory signage	Up to 50 km/h	• 60m recommended clear	TSM (Table 5.1)
			60 to 80 km/h	• 75m (or 90m where greater prominence is required) recommended clear	
		Minimum clear visibility distance of gantry sign	60 km/h	• 300mm minimum clear visibility distance of gantry sign • Directional signage on the approach to a diverge should be located 1km and 0.5km upstream of the diverge as well as at the start of the nosing of the exit taper	TSM Table 2.3.1
	Horizontal Curvature	Minimum radius with adverse camber of 2.5%	30 km/h	• 26m	DMURS (Table 4.3)
			50 km/h	• 104m	
			60 km/h	• 178m	
	Vertical Curvature	Crest curve K value	30 km/h	• N/A	DMURS (Table 4.3)
			50 km/h	• 4.7	
			60 km/h	• 8.2	
		Sag curve K value	30 km/h	• 2.3	DMURS (Table 4.3)
			50 km/h	• 6.4	
			60 km/h	• 9.2	
	Longitudinal Gradient	Longitudinal gradient	30-60 km/h	• 0.5% minimum grade • 5% desirable maximum grade • 8.3% absolute maximum grade	DMURS (Section 4.4.6)
	Cross Fall	Cross-fall	30-80 km/h	• 2.5% nominal	DMURS (Section 4.4.6)

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(/s)
All Junctions	Visibility	Intra-junction visibility envelope	30-100 km/h	• 2.5m behind stop lines, inclusive of all signal heads	DN-GEO-03044 (TII DMRB TD50/04) Section 2.10 & 2.14. Figs 2/2 and 2/3.
		Priority junction side road visibility distance (safe gap stopping distance)	30 km/h	• X Value = 2.4m; Y Value = 24m SSD (Bus Routes)	DMURS (Figure 4.63)
			50 km/h	• X Value = 2.4m; Y Value = 49m SSD (Bus Routes)	DMURS (Figure 4.63 / Para 4.4.4 and 4.4.5)
			60 km/h	• X Value = 2.4m; Y Value = 65m SSD (Bus Routes)	
		Visibility to primary traffic signals	30 km/h	• 50m desirable min, 40m absolute min	TSM (Table 9.1)
			50 km/h	• 70m desirable min; 50m absolute min	
			60 km/h	• 90m desirable min, 70m absolute min	
	Corner Radii	Few larger vehicles (local streets)	Varies – scheme wide	• 1m -3m radius (subject to vehicle tracking assessment & balance of junction form/function)	DMURS (Section 4.4.3)
		Occasional larger vehicles including buses and rigid body trucks (between arterial and or link streets)		• 6m maximum radius (subject to vehicle tracking assessment & balance of junction form/function)	
		Occasional larger vehicles including buses and rigid body trucks (Arterial/Link to local streets)		• 4.5m – 6m radius (subject to vehicle tracking assessment & balance of junction form/function)	
		Frequent larger vehicles (industrial estates)		• 9m radius (subject to vehicle tracking assessment)	
	Pedestrian Crossings	Signalised crossing type/length *(subject to confirmation by traffic modelling and site constraints)*	Varies – scheme wide	• Preferred for all locations: Single stage direct crossing up to 19m length • Alternative for primary/distributor/dual carriageway roads: Two stage staggered crossings with ideally min 3m staggered offset refuge island (ideally stagger to face oncoming traffic) and ideally min 3m (2m absolute min) wide refuge island. • Alternative for primary/distributor/dual carriageway: Two stage crossing in straight crossing with 4m wide refuge island. • Alternative: Single stage direct crossing greater than 19m length (urban centres)	BCPDGB (Section 5) TMG (Section 10.7, Diagram 10.15) DMURS (Section 4.3.2)

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(/s)
		Signalised pedestrian/toucan crossing width		• Absolute minimum width 2m • Desirable minimum width 2.4m (4m to be considered for urban centres) • Toucan crossing width minimum 4m	TMG (Section 10.7) DMURS (Section 4.3.2)
Parking/Loading	On-street parking Dimensions	Accessible parking and child/parent parking	Varies – scheme wide	• 7m x 3.6m with appropriate drop kerb and tactile paving. • Cycle buffer zone (0.75m preferred)	NDA[1] (Figure 1.4)
		Parallel parking (Preferred Arrangement)		• 6m x 2.1m desirable minimum. • 6m x 2.4m preferred • Cycle buffer zone (0.75m preferred)	BCPDGB (Section 6) DMURS (Section 4.4.9)
		Angled parking		• 60 degree parking: 4.8m-5m x 2.4m @ 4.2m depth. • 45 degree parking: 4.8m-5m x 2.4m @ 3.6m depth	DMURS (Section 4.4.9)
		Perpendicular parking		• 4.8m – 5m x 2.4m desirable minimum. • Buffer zone (0.3m minimum)	DMURS (Section 4.4.9)
		Loading Bay (Parallel)		• 6m x 2.8m (large vans) • Cycle buffer zone (0.75m preferred)	DMURS (Section 4.4.9)

4.2 Mainline Cross-Section

Utilising Section 4.4.1 of DMURS and following consultation with the NTA, a design strategy was implanted to determine the appropriate cross-section for scheme, taking account of the design speed and nature of the locations.

Traffic lane widths will follow the guidance outlined in DMURS, with the preferred width of traffic lanes on CBC's being:

- 3.0m in areas with a posted speed limit <60km/h; and
- 3.25m in areas with a posted speed limit >60km/h.

Traffic lane widths of 2.75m are permissible but not desirable and only on roads with very low HGV percentage. In some locations these lane widths have been considered for auxiliary turning lanes where appropriate.

The desirable minimum width for a single direction, with flow, raised adjacent cycle track is 2.0m. Based on NCM this allows for overtaking within the cycle track. The minimum width is 1.5m. The desirable width for a 2-way cycle track is 3.25m with a 0.5m buffer between the cycle track and the carriageway. 2m is the desirable minimum width for footways with 1.2m being the minimum width at pinch points.

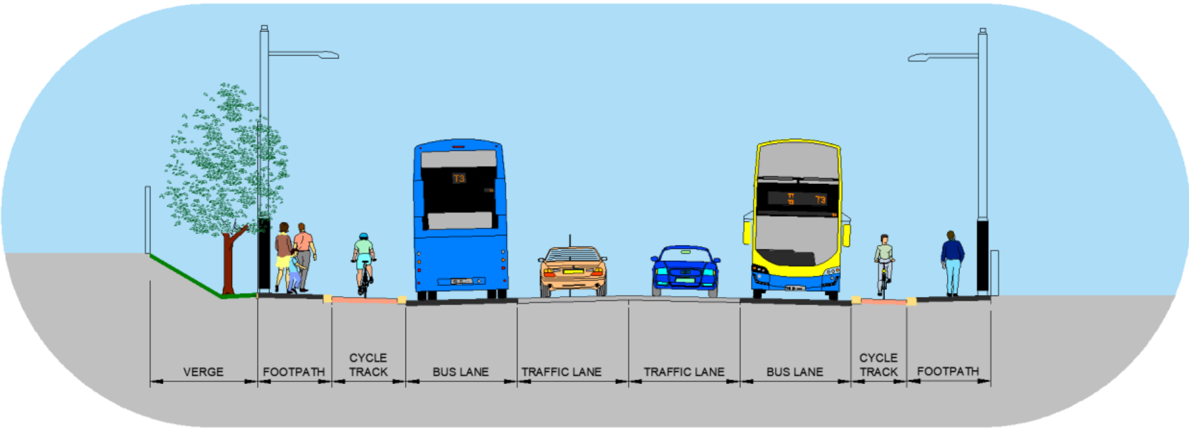

Figure 4-1: Typical CBC Cross Section Greenhills Road South of Mayberry Road

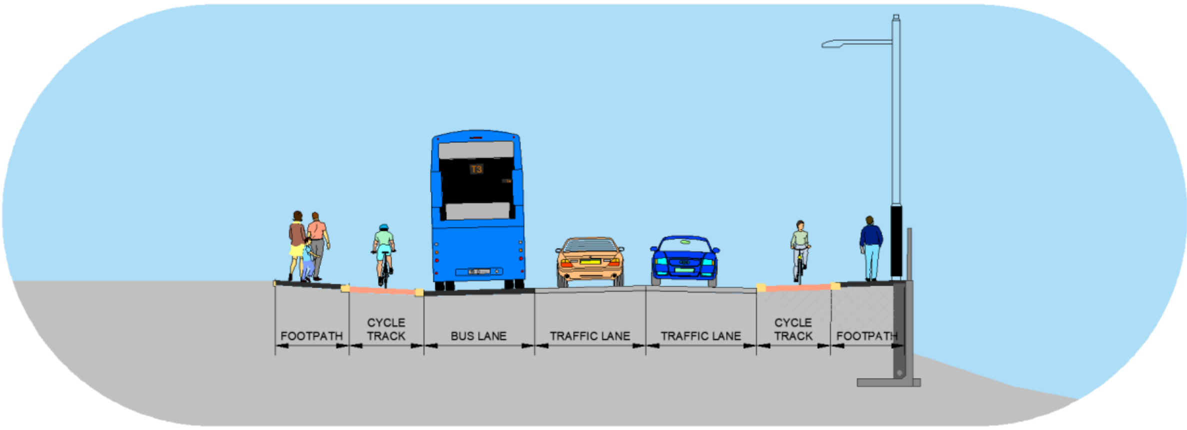

Figure 4-2: Typical CBC Cross Section Greenhills Road East of Calmount Road Tie-In

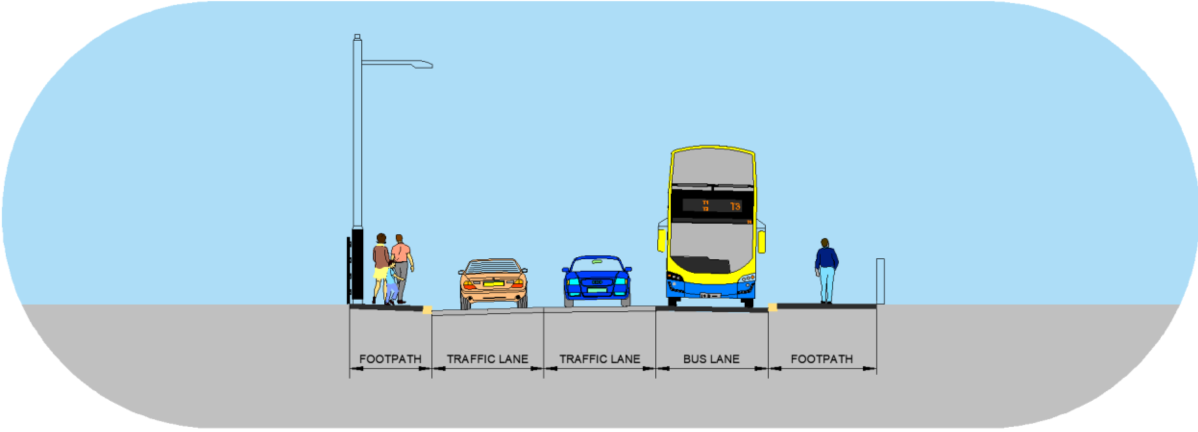

Figure 4-3: Typical CBC Cross Section Crumlin Road

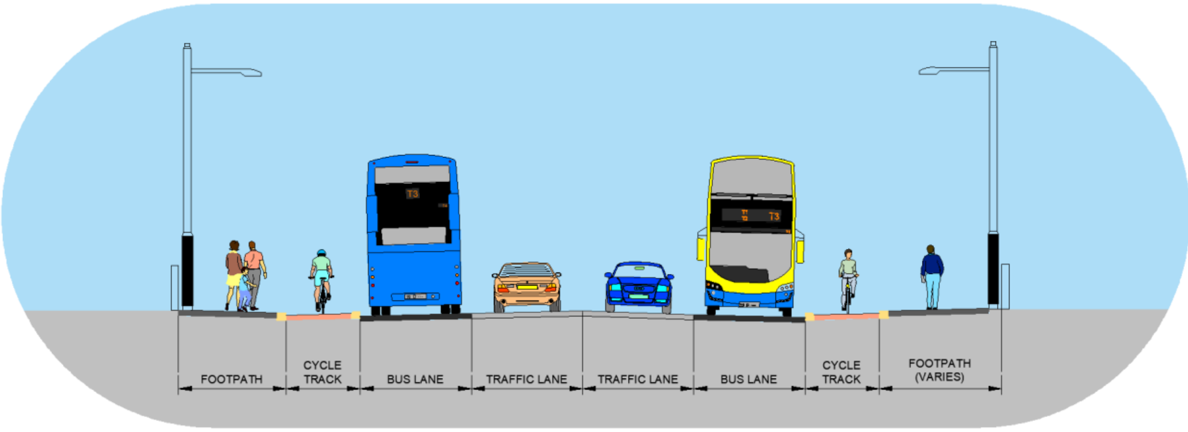

Figure 4-4: Typical CBC Cross Section St. Luke's Avenue

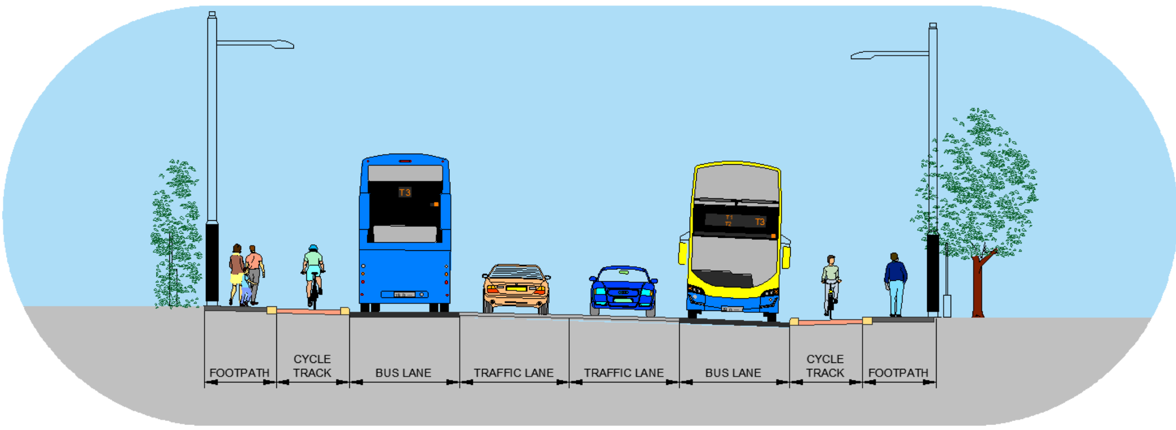

Figure 4-5: Typical CBC Cross Section New Nangor Road

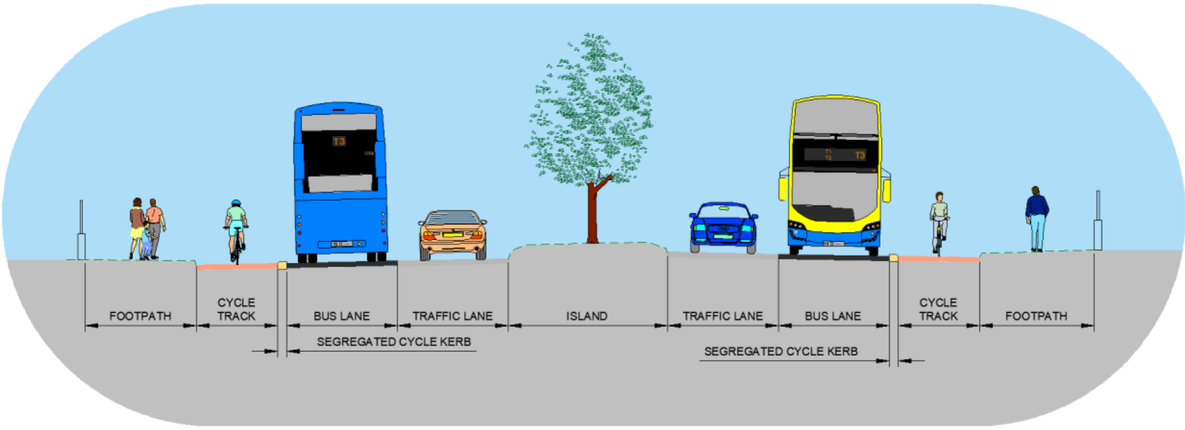

Figure 4-6: Typical CBC Cross Section Long Mile Road

A detailed scheme breakdown of the relevant existing and proposed road cross section elements is provided in Table 4-2. These tables provide information on the existing facilities for pedestrians, cyclists, bus lanes and general traffic lanes between junctions along the route. A detailed description of the existing and proposed junction arrangements is provided in Chapter 5. The table below is intended to provide supplementary information alongside the information presented on the General arrangement (GEO_GA), Typical Cross Sections (GEO_CS) and Pavement Treatment Plans (PAV_PV) available in Appendix B Preliminary Design Drawings.

In Table 4-2 the following design alignments are tabulated:

- Alignment A – Follows the main CBC route from Belgard Square West, Greenhills Road, Walkinstown Road, Drimnagh Road, Crumlin Road, Cork Street, St Luke's Avenue, Dean Street, Patrick Street;
- Alignment B – Greenhills Road - Greenhills Road/Old Greenhills Road to M50 overbridge;
- Alignment C – Greenhills Road – East of Ballymount Ave. and Calmount Road;
- Alignment D – Bunting Road;
- Alignments E – Kildare Road;
- Alignments F – New Nangor Road, Naas Road, Walkinstown Avenue, Long Mile Road;

Table 4-2: Proposed Scheme vs Existing Nominal Cross Section Widths

Chainage Reference	Existing Inbound Carriageway / Proposed Inbound Carriageway				Existing Outbound Carriageway / Proposed Outbound Carriageway				Existing Conditions Notes / Proposed Scheme Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
(Alignment A) Belgard Square West to Belgard Square North									
CH. A0 to CH. A400	2.0m – 8.0m	n/a	n/a	3.0m – 5.0m	1.8m – 4m	n/a	n/a	3.0m – 5.0m	No inbound/outbound bus lane or cycle tracks in the existing conditions. Roundabout at Ch. 0m.
	2.0m – 14.0m	n/a	3.0m	3.0m	2.0m – 12.0m	n/a	3.0m	3.0m – 3.5m	Existing roundabout at Ch. 0m converted to signalised junction, allowing for a larger footway. Loading area removed at Ch. 200 for larger footway. Bus Interchange and bus and cycle only lanes between Ch. A20m – A170m and A180m – A235m. Land take required for bus interchange.
(Alignment A) Belgard Square North to Belgard Square East									
CH. A400 to CH. A800	1.8m – 5.5m	1.5m – 1.8m Mainly non segregated	n/a	3.2m – 4.8m	1.8m – 11m	1.5m – 1.8m Mainly non segregated	n/a	3.2m - 7.1m	No inbound/outbound bus lane in the existing conditions. Cycle track on-road advisory Ch A420-A540, segregated Ch A560-A800 inbound, primarily on-road advisory on Belgard Square North outbound.
	2.0m – 4.2m	1.5m - 2m	3.0m	3.0m	1.8m – 6.5m	1.5m – 2.0m	3.0m	3.0m – 5.0m	Lane widths reduced and road widening into existing footway area to facilitate proposed inbound and outbound bus lanes & cycle track, partial bus lane outbound on Belgard Square North. Segregated cycle lanes.
(Alignment A) Belgard Square East									

Chainage Reference	Existing Inbound Carriageway Proposed Inbound Carriageway				Existing Outbound Carriageway Proposed Outbound Carriageway				Existing Conditions Notes Proposed Scheme Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
CH. A800 to CH. A950	2.0 – 4.0m	1.6m	n/a	4.2m	2.0 – 3.6m	1.5m	n/a	4.2m	No inbound/outbound bus lane in the existing conditions. Cycle track intermitted and poor-quality surface.
	2.0m – 5.5m	1.8m - 2m	3.5m	4.2m	2m – 8.0m	1.8m - 2m	3.5m	4.2m	Proposed inbound and outbound bus gate between Ch. 800 – 840. Segregated cycle lane. Footways reduced to facilitate improved cycle tracks.
(Alignment A) Blessington Road to Bus Gate									
CH. A950 to CH. A1250	2.0m – 4.0m	1.8m (two-way)	4m (bus gate only)	3.0m - 3.5m	1.5 – 5.0m	Shared with inbound "Zipway"	4m (bus gate only)	3.0m - 3.5m	No designated inbound or outbound bus lane between Ch. 950 – 1200. Segregated "Zipway" cycle track.
	2.2m – 8.0m	2.0m	3.2m - 4m (bus gate)	3.0m	1.8m – 11.0m	n/a	3.2m - 4m (bus gate)	3.0m	One inbound and one outbound traffic lane converted to bus lane between Ch. 950 – 1050. Blessington Road Junction left slip removed. Inbound kerb line adjusted at Ch. 950 – 1050 to allow for bus lane. Segregated "Zipway" cycle track retained.
(Alignment A) Blessington Road to Main Road									
CH. A1250 to CH. A1550	1.8m – 5.0m	n/a	n/a	3.0m – 3.5	1.8m – 10.0m	n/a	n/a	3.0m – 4.5m	No inbound or outbound bus lane or cycle track.
	1.8m – 5.0m	n/a	n/a	3.0m – 3.5	1.8m – 10.0m	n/a	n/a	3.0m – 4.5m	Bus only right turn from Main Road. No inbound or outbound bus lane or cycle track. (Largely matching existing).

Chainage Reference	Existing Inbound Carriageway Proposed Inbound Carriageway				Existing Outbound Carriageway Proposed Outbound Carriageway				Existing Conditions Notes Proposed Scheme Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
(Alignment A) Main Road - Old Greenhills Road									
CH. A1550 to CH. B1950	1.1m – 4.5m	n/a	n/a	2.2m-3.5m	1.4m – 7.0m	n/a	n/a	2.2m-3.7m	Narrow existing pavement widths on Old Greenhills Road. No inbound or outbound bus lane or cycle track
	1.1m – 4.5m	n/a	n/a	3.0m-4.0m	1.4m – 7.0m	n/a	n/a	3.0m-4.5m	Matching existing except for proposed extension of Old Greenhills Road to accommodate bus only access to Greenhills Road.
(Alignment A) Greenhills Road - Old Greenhills Road to Airton Road Junction									
CH. A1950 to CH. A2450	2.0 – 10m	1.5m – 2.0m	n/a	3.4 – 4.5m	2.0 – 3.0m	1.5m – 2.0m	n/a	3.4 – 4.5m	No inbound or outbound bus lanes. Off-road cycle/ped facilities (shared footway with white line segregation). ASL on Airton Road.
	1.8m – 4.0m	1.5m – 2.0m	3.0m	3.0m	1.8m – 5.2m	1.5m – 2.0m	3.0m	3.0m	Tie-in with upgraded TUD junction Ch A2100. Land take Ch. A2150 – A2450 to facilitate proposed bus lanes inbound and outbound. Dedicated left turn lane from Greenhills Road to Airton Road. Cycle track Ch A1950 – A2080 as per existing. Fully segregated cycle tracks Ch A2150 -A2450.
(Alignment A) Greenhills Road - Airton Road Junction to Mayberry Road									
CH. A2450 to CH. A2950	1.2m – 2.5m	1.5m	n/a	2.1m – 3.3m	1.5m – 2.0m	1.5m	n/a	2.2m – 3.0m	No inbound or outbound bus lanes. Southbound ASL on Greenhills Road at Airton Road Junction and Hibernian Industrial Estate junction. Suboptimum cycle facilities (advisory cycle track with white line segregation).

Chainage Reference	Existing Inbound Carriageway Proposed Inbound Carriageway				Existing Outbound Carriageway Proposed Outbound Carriageway				Existing Conditions Notes Proposed Scheme Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
	2.0m	2.0m	3.0m	3.0m	1.8m – 3.9m	1.5m – 2m	3.0m	3.0m	Land take required to facilitate proposed bus lanes inbound and outbound. Retained reconstructed ramp structure and embankment at Ch A2500 inbound. Fully segregated cycle lanes.
(Alignment A) Greenhills Road – 150m Section of Road North of Mayberry Road									
CH. A2950 to CH. A3100	1.2m – 2.0m	1.2m - 1.5m	n/a	2.6m – 3.3m	n/a	1.5m	n/a	1.6m – 3.4m	No inbound or outbound bus lanes. Suboptimum cycle facilities (advisory cycle track with white line segregation).
	2m	2m	3m	3m	2m	2m	3m	3m	Land take required to facilitate proposed bus lanes and improved cycle and ped facilities. Fully segregated cycle lanes.
(Alignment A) Sustainable Link Route - Mayberry Road to Tymon Lane									
CH. A3100 to CH. A3650	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Green area
	2.0m	1.6m - 2.0m	3.0m	n/a	n/a	1.6m	3.0m	n/a	Inbound and outbound bus lanes with two-way cycle tracks
(Alignment B) Greenhills Road - Greenhills Road/Old Greenhills Road to M50 overbridge									
CH. B0 to CH. B551	1.5m	1.2m - 1.5m	n/a	3.0m – 3.2m	1.5- 6.0m	1.5m	n/a	3.0m – 3.2m	No inbound or outbound bus lanes. Advisory cycle track with white line segregation.

Chainage Reference	Existing Inbound Carriageway Proposed Inbound Carriageway				Existing Outbound Carriageway Proposed Outbound Carriageway				Existing Conditions Notes Proposed Scheme Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
	2.0m (Ch B170 – B430)	2.0m	n/a	3.0m	2.0m – 3.7m	2.0m	n/a	3.0m	Fully segregated inbound and outbound cycle lanes.
(Alignment A) Greenhills Road - M50 overbridge									
CH. A3650 to CH. A3800	1.8m – 2.8m	1.5m	n/a	3.0m	1.3m – 2.8m	1.5m	n/a	3.0m	No inbound or outbound bus lanes. Advisory cycle track with white line segregation. M50 road and footway overbridge.
	2.0m	2.0m - 2.65m	3.0m	2.9m – 3.0m	2.0m	2.0m - 2.65m	3.0m	2.9m – 3.0m	Proposed bus lanes inbound and outbound. Segregated cycle tracks. Two new pedestrian and cycle track bridge over M50 motorway. Existing road bridge for general traffic and bus lanes.
(Alignment A) Greenhills Road - M50 overbridge to Ballymount Ave									
CH. A3800 to CH. A4200	1.5m -3.5m	1.5m	n/a	2.2m -3.0m	1.3m -3.5m	1.5m	n/a	2.2m - 3.0m	No inbound or outbound bus lanes. Advisory cycle track with white line segregation.
	2.0m	2.0m	3.0m	3.0m	2m	2.0m	3.0m	3.0m	Land take required for proposed bus lanes. Proposed bus lanes inbound and outbound. Segregated cycle track.
(Alignment C) Greenhills Road – East of Ballymount Ave. and Calmount Road									

Chainage Reference	Existing Inbound Carriageway Proposed Inbound Carriageway				Existing Outbound Carriageway Proposed Outbound Carriageway				Existing Conditions Notes Proposed Scheme Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
CH. C0 to CH. C890	1.0m – 2.5m	1.3m – 1.5m	n/a	2.5m – 3.0m	1.25m – 1.5m (Ch C0 – C130, Ch C275 – C470 and Ch C610 – C760).	1.4m – 1.5m	n/a	2.5m – 3.0m	No inbound or outbound bus lanes. Advisory cycle track inbound and outbound with white line segregation. Priority junction at Ch C425 to shopping centre and industrial estate.
	1.0m – 2.5m	1.3m - 1.5m	n/a	2.6m – 3.0m	1.25m – 2.0m (Ch C0 – C130, Ch C275 – C470 and Ch C610 – C760).	1.4m - 1.5m	n/a	2.5m – 3.0m	No inbound or outbound bus lanes. Advisory cycle track inbound and outbound with white line segregation. Largely matching existing. Proposed roundabout junction and new link road connecting Calmount Avenue to Greenhills Road and shopping centre/industrial estate.
(Alignment A) Ballymount Avenue to Calmount Road									
CH. 4200 to CH. A4650	1.8m - 2.0m	n/a	n/a	3.7m - 3.9m	n/a	n/a	n/a	3.7m - 3.9m	No inbound or outbound bus lanes, nor cycle track. Footway on western side only, with 2.5m verge separating footway from road. Roundabout at Calmount Road junction.
	2.0m	2.0m	3.0m	3.0m	1.8m - 2.0m	1.8m - 2.0m	3.0m	3.0m	Land take required for proposed bus lanes and segregated cycle tracks inbound and outbound. Additional footway on eastern side. Roundabout converted to signalised junction, including additional lane for straight and left turning vehicles.

Chainage Reference	Existing Inbound Carriageway Proposed Inbound Carriageway				Existing Outbound Carriageway Proposed Outbound Carriageway				Existing Conditions Notes Proposed Scheme Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
(Alignment A) Calmount Road									
CH. A4650 to CH. A5500	2.0m	n/a	n/a	3.8m – 4.8m	2.0m – 2.5m	n/a	n/a	4.2m – 4.5m	No inbound or outbound bus lanes, nor cycle track. Footway both sides segregated from road with grass verge.
	1.8m – 3.5m	1.5m – 2.0m	3.0m	3.0m	2.0m – 2.2m	1.5m – 2.0m	3.0m	3.0m	Road width reduced to 3.0m and land take required for proposed priority junction access to Ballymount Business Centre. Bus lanes and segregated cycle tracks inbound and outbound.
(Alignment A) Greenhills Road - to Walkinstown Roundabout									
CH. A5500 to CH. A5850	1.3m – 4.5m	1.4m - 1.5m	n/a	2.5m – 3.6m	1.8m – 8.4m (non-continuous)	1.5m – 1.8m	n/a	2.7m – 4.0m	No inbound or outbound bus lanes. Advisory cycle track inbound and outbound with white line segregation. Full inbound footway and partial outbound footway.
	1.8m – 3.5m	1.5m - 2.0m	3.0m	3.0m	1.8m – 5.0m	1.5m-2.0m	n/a	3.0m	Land take required for proposed road cross-section, inbound bus lane and segregated inbound and outbound cycle tracks. Retaining walls required.
(Alignment A) Walkinstown Roundabout									
CH. A5850 to CH. A6000	Varies	n/a	n/a	2.6m – 5.0m	Varies	n/a	n/a	2.6m – 5.0m	3-lane central roundabout with 6 access arms, no cycle tracks or bus lanes.

Chainage Reference	Existing Inbound Carriageway Proposed Inbound Carriageway				Existing Outbound Carriageway Proposed Outbound Carriageway				Existing Conditions Notes Proposed Scheme Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
	Varies	1.5m – 2.0m	n/a	3.0m – 4.25m	Varies	1.5m – 2.0m	n/a	3.0m – 4.25m	2-lane central roundabout with 6 access arms and gyratory 2-way cycle tracks, no bus lanes.
(Alignment A) Walkinstown Road									
CH. A6000 to CH. A6750	2.1m – 3.3m	n/a	3.5m (Ch A6570 – A6750)	3.0m – 4.0m	1.8m – 4.5m	n/a	3.0m (Ch A6000 – A6050)	3.2m – 4.2m	Inbound bus lane on approach to Long Mile Road junction and outbound bus lane on approach to Walkinstown Roundabout only. No cycle tracks, wide general traffic lanes.
	1.8m – 3.0m	n/a	3.0m	3.0m	1.8m – 3.5m	n/a	3.0m	3.0m	Proposed inbound and outbound bus lanes, general traffic lanes reduced to 3.0m lane widths. Landtake required Ch A6022 – Ch A6390 inbound and Ch A6410 – Ch A6720 outbound.
(Alignment A) Long Mile Road - Drimnagh Road to end of parking on southern side									
CH. F4090 to CH. F4226 and CH. A6750 to CH. A6920	1.3m – 4.5m	1.4m (Ch A6810 – A6870)	3.0m - 3.5m (Ch F4115 – F4190 and Ch A6880 – A6920)	2.5m – 4.2m	1.5m – 7.1m	n/a	3.5m (Ch F4090 – F4170 and Ch A6880 - 6920)	3.0m - 3.6m	No outbound cycle track, partial advisory inbound cycle lane with white line segregation. Inbound and outbound bus lanes interrupted through junction.
	1.8m – 2.8m	1.5m – 2.0m	3.0m	2.75m – 3.0m	1.8m – 9.5m	1.5m – 2.0m	3.0m	3.0m	Proposed inbound and outbound bus lanes and segregated cycle tracks. Relocated and reconstructed retaining wall. Removal of left turn slip onto Walkinstown Road. Reconfiguration of central traffic islands.

Chainage Reference	Existing Inbound Carriageway Proposed Inbound Carriageway				Existing Outbound Carriageway Proposed Outbound Carriageway				Existing Conditions Notes Proposed Scheme Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
(Alignment A) Drimnagh Road - End of parking on southern side to Errigal Road									
CH. A6920 to CH. A7250	2.2m – 2.8m	1.25m (Ch A7150 – A7210)	3.0m – 3.5m	3.2m – 4.2m	2.5m – 3.0m	1.3m – 1.4m (Ch A7180 – A7215)	3.0m - 3.3m	3.0m – 3.3m	Inbound and outbound bus lanes, partial advisory cycle lanes with white line segregation.
	1.8m – 2.6m	1.5m - 2.0m	3.0m	3.0m	2.0m – 3.4m	2.0m	3.0m	3.0m	Proposed inbound and outbound bus lanes and segregated cycle tracks.
(Alignment A) Drimnagh Road - Errigal Road to Kildare Road									
CH. A7250 to CH. A7500	2.6m – 4.2m	n/a	3.3m – 3.7m	2.8mm – 3.3m	2.5m – 3.6m	n/a	3.3m – 3.5m	2.75m – 3.3m	Inbound and outbound bus lanes, no cycle tracks.
	1.8m – 2.8m	1.5m – 2.0m	3.0m	3.0m	2.0m – 4.5m	2.0m	3.0m	3.0m	Proposed inbound and outbound bus lanes and segregated cycle tracks.
(Alignment A) Drimnagh Road - Kildare Road to Cooley Road									
CH. A7500 to CH. A7650	3.0m	1.5m (Ch A7550 – 77590)	3.0m – 3.2m	3.0m - 3.3m	1.9m – 5.0m	1.3m - 1.5m	3.5m – 3.7m	2.75m – 3.5m	Bus lanes inbound and outbound. Partial advisory cycle lane inbound with white line segregation. Outbound advisory cycle lane with white line segregation. Taxi rank inbound. Off-street car parking.

Chainage Reference	Existing Inbound Carriageway Proposed Inbound Carriageway				Existing Outbound Carriageway Proposed Outbound Carriageway				Existing Conditions Notes Proposed Scheme Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
	2.0m – 4.0m	1.5m – 2.0m	3.0m	3.0m	2.0m – 5.0m	1.5m - 2.0m	3.0m	3.0m	Inbound and outbound bus lanes and segregated cycle tracks. Left turn slip lane removed from Drimnagh Road to Kildare Road. Retained inbound Taxi rank and off-street parking.
(Alignment A) Crumlin Road - Cooley Road to Raphoe Road									
CH. A7650 to CH. A7870	2.0 – 2.5m	1.3m – 1.5m (Ch A7700 – A7790)	2.9m - 3.0m (Ch A7630 – A7690)	2.9m – 3.5m	2.2m – 2.6m	1.2m – 1.5m	n/a	2.7m – 3.2m	Short section of inbound bus lane, no outbound bus lane. Inbound and outbound cycle lanes with white line segregation.
	1.8m – 3.4m	n/a	3.0m	3.0m	2.0m – 5.0m	2.0m (Ch A7650 – A7690)	3.0m	3.0m	Landtake required inbound for proposed bus lane and bus gate. Inbound and outbound bus lanes. Short section of outbound segregated cycle track only.
(Alignment A) Crumlin Road - Raphoe Road to Guinness Rugby Club									
CH. A7870 to CH. A8250	2.0m – 2.7m	1.5m	n/a	3.0m	2.4m – 3.6m	1.5m	n/a	3.0m	Inbound and outbound cycle lanes with white line segregation. No bus lanes.
	2.0m – 2.7m	n/a	n/a	3.0m	2.0m – 3.6m	n/a	3.0m	3.0m	Outbound bus lane only. No cycle tracks
(Alignment A) Crumlin Road - Guinness Rugby Club to Crumlin Health Centre									

Chainage Reference	Existing Inbound Carriageway Proposed Inbound Carriageway				Existing Outbound Carriageway Proposed Outbound Carriageway				Existing Conditions Notes Proposed Scheme Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
CH. A8250 to CH. A8600	2.1m – 4.3m	1.5m	n/a	2.8m - 3.0m	2.5m – 2.9m	1.4m - 1.5m	n/a	2.8m - 3.0m	Inbound and outbound cycle lanes with white line segregation. No bus lanes.
	2.0m – 4.5m	n/a	3.0m	3.0m	2.0m – 4.0m	n/a	n/a	3.0m	Inbound bus lane. Outbound bus lane Ch A8250 – A8280 only. No cycle tracks.
(Alignment A) Crumlin Road - Crumlin Health Centre to Herberton Road Junction									
CH. A8600 to CH. A8850	2.2m – 6.2m	1.25m - 1.5m	3.0m (Ch A8680 – A8810)	3.0m – 3.2m	1.6m – 3.4m	1.5m	n/a	3.0 – 5.2 m	Inbound and outbound cycle lanes with white line segregation. Inbound bus lane only.
	2.2m – 7.0m	n/a	3.0m	3.0m	1.8m – 4.5m	n/a	3.0m	3.0m	Inbound and outbound bus lanes. Outbound bus gate. Land take required on southern side to facilitate proposed bus lanes.
(Alignment A) Crumlin Road - Herberton Road Junction to Dolphin Barn Junction									
CH. A8850 to CH. A9250	2.0m – 5.0m	n/a	3.0m	3.0m	2.0m – 3.2m	n/a	3.0m	3.0m	Inbound and outbound bus lanes. No cycle track.
	2.0m – 5.0m	1.5m – 2.0m (Ch A8850 – A8940 and approach to Dolphin Road)	3.0m	3.0m	2.0m – 3.2m	1.5m - 2.0m (Ch A 8850 – A8930 and Ch A9220 – A9250)	3.0m	3.0m	Inbound and outbound bus lanes. Cycle lanes through junctions either end. Largely matching existing.

Chainage Reference	Existing Inbound Carriageway Proposed Inbound Carriageway				Existing Outbound Carriageway Proposed Outbound Carriageway				Existing Conditions Notes Proposed Scheme Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
(Alignment A) Dolphin Barn - Dolphin Barn Junction to South Circular Road Junction									
CH. A9250 to CH. A9500	2.4m – 3.2m	1.0m – 1.3m	2.2m – 2.5m	3.0m	2.0m – 3.2m	1.2m – 1.4m (Ch A9280 – A9360)	3.0m (Ch A9360 – A9430)	3.0m - 6.8m	Inbound advisory cycle lane with white line segregation, partial outbound cycle lane with white line segregation. Inbound bus lane and partial outbound bus lane.
	1.8m – 3.2m	1.5m	3.0m	3.0m – 3.5m	2.0 – 4.0m	1.5m - 2.0m	3.0m	3.0m	Central reserve island maintained Ch A9300 – A9415. Removal of single outbound traffic lane to facilitate outbound bus lane and segregated cycle track. Inbound and outbound bus and segregated cycle tracks. Outbound left turn slip lane on South Circular Road removed. Integration with proposed Dolphin's Barn Public Realm Improvement Plan.
(Alignment A) Dolphin Barn/Cork Street - South Circular Road Junction to Cameron Street									
CH. A9500 to CH. A9900	2.6m – 8.2m	1.25m – 1.4m	3.0m	3.0m – 3.4m	2.0m – 4.4m	1.25m	3.0m	3.3m	Inbound and outbound bus lanes. Inbound and outbound advisory cycle lanes with white line segregation.
	2.2m – 6.8m	2.0m	3.0m	3.0m	2.0m – 4.4m	1.5m - 2.0m	3.0m	3.0m	Inbound and outbound bus lanes and segregated cycle tracks. Integration with proposed Dolphin's Barn Public Realm Improvement Plan.
(Alignment A) Cork Street - Cameron Street to Ardee Street Junction									

Chainage Reference	Existing Inbound Carriageway Proposed Inbound Carriageway				Existing Outbound Carriageway Proposed Outbound Carriageway				Existing Conditions Notes Proposed Scheme Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
CH. A9900 to CH. A10500	2.0m – 5.5m	1.25m - 1.4m	3.0m	3.0m - 3.3m	1.5m – 5.0m	1.5m	3.0m	3.0m - 3.3m	Inbound and outbound bus lanes. Inbound and outbound advisory cycle lanes with white line segregation.
	2.0m – 5.5m	1.5m – 2.0m	3.0m	3.0m	3.0m – 5.0m	1.5m – 1.8m	3.0m	3.0m	Inbound and outbound bus lanes and segregated cycle tracks.
(Alignment A) St Luke's Ave - Ardee Street Junction to Dean Street									
CH. A10500 to CH. A10850	3.0m – 8.0m	1.25m	3.0m	3.0m - 3.5m	2.7m – 4.5m	1.25m	3.0m	3.0m – 3.2m	Inbound and outbound bus lanes. Inbound and outbound cycle lanes with white line segregation.
	2.5m – 8.0m	1.5m	3.0m – 3.4m	3.0m – 3.4m	2.3m – 4.5m	1.5m	3.0m	3.0m – 3.2m	Inbound and outbound bus lanes and segregated cycle tracks.
(Alignment A) Dean Street									
CH. A10850 to CH. A11000	1.7m – 8.5m	1.5m	n/a	2.8m – 3.3m	2.0m – 3.5m	1.5m	n/a	2.2m – 3.9m	No inbound and outbound bus lane. Inbound and outbound cycle lanes with white line segregation.
	1.7m – 10m	1.5m - 2.0m	n/a	3.0m	1.8m – 4.0m	1.5m - 2.0m	n/a	3.0m – 4.2m	No inbound and outbound bus lanes. Inbound and outbound segregated cycle tracks. Left turn slip lane from Dean Street to Patrick Street removed.
(Alignment A) Patrick Street									

Chainage Reference	Existing Inbound Carriageway Proposed Inbound Carriageway				Existing Outbound Carriageway Proposed Outbound Carriageway				Existing Conditions Notes Proposed Scheme Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
CH. A11000 to CH. A11500	1.6m – 8.0m	1.1m – 1.5m	2.6m – 3.1m	2.8m – 3.3m	2.5m – 11.0m	1.3m - 1.5m	n/a	2.5m - 3.0m	Inbound bus lane Ch A11070 – A11280, no outbound bus lane. Inbound cycle track partially advisory/mandatory with white line marking and section without white line marking. Outbound advisory cycle lane with white line marking.
	1.5m – 9.0m	1.5m - 2.0m	3.0m	3.0m	2.0m – 10.5m	1.5m - 2.0m	3.0m	3.0m	Inbound and outbound bus lanes. Inbound and outbound segregated cycle tracks, cycle track widths reduced locally to allow existing heritage lighting poles remain in place where practicable.
(Alignment D) Bunting Road									
CH. D0 to CH. D1330	2.6m – 12.5m	1.0m – 1.5m	n/a	2.4m – 3.5m	1.1m – 7.0m	1.0m – 1.5m	n/a	2.6m – 3.6m	No outbound and inbound bus lane. Outbound advisory cycle lane Ch D70 – D1130, mandatory cycle lane Ch D1130 - D1325 with white line marking. Inbound advisory cycle lane with white line marking. Traffic calming speed humps.
	2.7m – 10.5m	1.5m - 2.0m	n/a	2.75m - 3.25m	1.1m – 9.5m	1.5m - 2.0m	n/a	2.75m - 3.25m	No inbound and outbound bus lane. Inbound and outbound segregated cycle tracks. Traffic calming speed humps.
(Alignment E) Kildare Road									
CH. E0 to CH. E550	1.7m – 4.8m	n/a	n/a	3.8m – 4.9m	2.7m – 3.6m	n/a	n/a	4.2m – 5.3m	No outbound and inbound bus lane or cycle track. Traffic calming speed humps.

Chainage Reference	Existing Inbound Carriageway Proposed Inbound Carriageway				Existing Outbound Carriageway Proposed Outbound Carriageway				Existing Conditions Notes Proposed Scheme Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
	1.7m – 3.5m	1.5m - 2.0m	n/a	3.0m	1.9m – 3.7m	1.5m - 2.0m	n/a	3.0m	No inbound and outbound bus lane. Proposed segregated cycle track both directions. Traffic calming speed humps and proposed outbound parallel parking.
(Alignment E) Kildare Road – Clogher Road									
CH. E550 to CH. E2440	2.0m – 4.8m	n/a	n/a	2.5m – 4.7m	1.8m – 4.6m	n/a	n/a	2.4m – 5.1m	No outbound and inbound bus lane or cycle track. Traffic calming speed humps.
	1.4m – 4.6m	1.5m – 1.8m	n/a	2.65m - 3.25m	2.4m – 4.8m	1.5m – 1.8m	n/a	2.65m - 3.25m	No inbound and outbound bus lane. Proposed segregated cycle track both directions with shared cycle /traffic lanes on Clogher Road between Saul Road and Sundrive Road.
(Alignment F) New Nangor Road to M50 Overbridge									
CH. F-40 to CH. F450	1.2m	n/a	3.3m	1x 3.3m lane	1.2m - 1.8m	n/a	3.3m	1x 3.3m lane	No inbound/outbound cycle tracks in the existing conditions. Suboptimum footway width. No inbound or outbound bus lane under M50 bridge.
	3.8m (existing greenway)	2.0m	3.0m	1x 3.0m lane (5.5m before taper)	2.0m – 8.0m (typically 2m but widens at junction)	2.0m	3.0m	1x 3.0m lane	Narrow inbound footway removed and pedestrians to use existing greenway. Lanes reduced to 3m to facilitate additional inbound and outbound cycle track and 2m wide outbound footway. Inbound bus lane under M50 bridge.
(Alignment F) New Nangor Road - M50 Overbridge to Riverview Business Park Junction									

Chainage Reference	Existing Inbound Carriageway Proposed Inbound Carriageway				Existing Outbound Carriageway Proposed Outbound Carriageway				Existing Conditions Notes Proposed Scheme Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
CH. F450 to CH. F750	1.8m – 2.0m	n/a	3.3m	1x 3.2m lane	1.8m – 2.0m	n/a	3.2m	1x 3.3m – 5.5m lane	No inbound/outbound cycle tracks in the existing conditions. Road marking 1.0m buffer strip between outbound bus lane and traffic lane as well as between opposing traffic lanes.
	2.0m – 5.0m (typically 2m but widens at junction)	2.0m	3.0m	1x 3.2m lane	2.0m	2.0m	3.0m	1x 3.2m lane	Lane widths reduced and road widening into existing footway area to facilitate proposed inbound and outbound cycle track. Segregated cycle lane. Inbound footway starts from Ch. 600.
(Alignment F) New Nangor Road. Riverview Business Park Junction – Park West Ave Junction									
CH. F750 to CH. F1000	1.8m – 2.4m	n/a	3.3m	1x 2.8m-3.3m lane 1x 2.8m lane between Ch. 950-1000	1.8m – 2.0m	n/a	3.3m	1x 3.3m – 5.5m lane	No inbound/outbound bus lane in the existing conditions. Left slip from New Nangor road to Park West Avenue.
	1.8m – 8.5m	1.25m - 2.0m	3.0m	1x 3.0m lane 1x 3.0m right turn lane	1.8m – 4.0m	1.25m-2.0m	3.0m	1x 3.0m lane 1x 3.0m right turn lane	Segregated cycle lane, which tapers to 1.25m across bus stop. Priority bus signal across junction. Additional traffic lanes for right turning vehicles at both junctions inbound and outbound. Left slip removed.
(Alignment F) New Nangor Road. Park West Ave Junction – Willow Road Junction									

Chainage Reference	Existing Inbound Carriageway / Proposed Inbound Carriageway				Existing Outbound Carriageway / Proposed Outbound Carriageway				Existing Conditions Notes / Proposed Scheme Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
CH. F1000 to CH. F1400	1.4m	n/a	3.3m	1x 3.3m-6.0m lane	1.4m	n/a	3.3m	1x 3.3m lane 1x 3.0m lane between Ch. 1000-1100	No inbound or outbound cycle track. Bus lane starts at Ch. 1100m. Suboptimum footway width.
	1.8m – 7.25m	1.2m – 2.0m	3.0m	1x 3.0m lane	1.8m – 2.5m	3.0m	3.0m	1x 3.0m lane	Land take on southern side between Ch. 1000 – 1370 and lane widths reduced to 3m to facilitate inbound and outbound cycle track. Proposed right turn lane onto Willow Road. Proposed retaining wall between Ch. 1160 – 1300.
(Alignment F) New Nangor Road. Willow Road Junction – Killeen Road Junction									
CH. F1400 to CH. F1700	1.5-2.0	n/a	3.2m	1x 3.5m lane	1.5-1.8	n/a	3.2m	1x 3.5m lane	No inbound or outbound cycle track. Intermittent bus lane. Mainly suboptimum footway width.
	1.8m – 2.0m	1.25m – 2.0m	3.0m	1x 3.0m lane	1.8m – 3.4m	1.25m – 2.0m	3.0m	1x 3.0m lane	Lane widths reduced to 3m to facilitate inbound and outbound cycle tracks and larger footway.
(Alignment F) New Nangor Road. Killeen Road Junction – Naas Road									
CH. F1700 to CH. F2000	1.25m – 2.2m	n/a	3.0m – 3.3m	1x 3.5m – 4.0m lane 1x 3.3m lane between Ch. 1750 - 1880	1.25m – 1.5m	n/a	3.0m – 3.3m	1x 3.5m – 4.5m lane 1x 3.3m lane between Ch. 1750 - 1880	No inbound or outbound cycle track. Intermittent bus lane. Mainly suboptimum footway width.

Chainage Reference	Existing Inbound Carriageway Proposed Inbound Carriageway				Existing Outbound Carriageway Proposed Outbound Carriageway				Existing Conditions Notes Proposed Scheme Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
	1.8m – 2.5m	3.5m	3.0m	1x 3.0m lane	1.8m – 2.3	1.25m - 3.5m	3.0m	1x 3.0m lane (2x 3.0m lanes between CH. 1700 – 1880)	Land take required on inbound side between Ch. 1750-1860 & 1900-2270 and outbound side between Ch. 1800-2040. Lane widths reduced to 3m to facilitate inbound and outbound cycle tracks and larger footway. Both directional cycle track on inbound side and mainly one directional on outbound side. 1.25m cycle track across bus stop. Retaining walls north and south of road between Ch. 1900-2200 and Ch. 1970-2030 respectively.
(Alignment F) Naas Road Junction									
CH. F2000 to CH. F2350	1.5m - 2.0m	n/a	n/a	Max. of 5x 3.2m – 3.8m lanes	1.5m - 2.0m	n/a	n/a	Max. of 5x 3.2m – 3.8m lanes	No inbound or outbound cycle track or bus lane. Mainly suboptimum footway width.
	2.0m – 4.0m	3.5m	3.0m	Max. of 4x 3.0m - lanes between CH. 2180 – 2300	1.8m – 4.8m	2.0m	3.0m - 3.5m	Max. of 5x 3.0m - lanes between CH. 2300 – 2350 2x 3.3m lanes at roundabout	Land take required around all arms of junction. Inbound and outbound cycle track. Both directional cycle track on inbound side and mainly one directional on outbound side. Proposed 4 armed NMU overbridge. Bus lane inbound and bus lane generated outbound on roundabout. Retaining wall on inbound side between Ch. 1900-2200 and southern side of junction between approx. Ch. 2230 – 2260.
(Alignment F) Naas Road – Walkinstown Avenue									
CH. F2350 to CH. F2950	1.5m – 2.2m	1.5m	3.0m - 3.65m	3 x 3.0m-3.5 lane (3 lanes taper to 2 at Ch. 2440)	1.25m – 2.0m	1.35m	3.2m	2x 3.0m – 3.5m lanes	Intermitted inbound and outbound bus lane. Segregated inbound cycle track, suboptimum and non-segregated outbound cycle track.

Chainage Reference	Existing Inbound Carriageway Proposed Inbound Carriageway				Existing Outbound Carriageway Proposed Outbound Carriageway				Existing Conditions Notes Proposed Scheme Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
	2.0m – 2.8m	2.0m - 3.5m	3.0m	3 x 3.0m lane (3 lanes taper to 2 at Ch. 2440)	1.8m – 2.8m	1.5m – 2.0m	3.0m	1x 3.0m-5.5m lane 1x 3.0m lane	Land take and retaining wall on southern side between Ch. 2890-2960. Inbound and outbound cycle track. Both directional cycle track on inbound side. Slip road from John F Kennedy Drive to Naas Road stopped up. Inbound and outbound bus lane.
(Alignment F) Walkinstown Avenue – Long Mile Road									
CH. F2950 to CH. F3350	1.8m	n/a	n/a	1x 3.5m-6.0m lane which tapers to 3x 2.5m lanes at Ch. 3250	1.8m	n/a	n/a	1x 3.3m-6.0m lane which tapers to 2x 3.3m lanes at Ch. 2870	No inbound or outbound bus lane or cycle track. Large single traffic lanes than taper on approach to junctions and split to multiple lanes.
	2.0m	2.0m	3.0m	1x 3.0m – 5.5m lane 1x 3.0m right turn lane	2.2m	1.8m	3.0m	1x 3.0m lane	Land take required between Ch. 3020 – 3335m on western side to facilitate proposed inbound and outbound cycle track and inbound and outbound bus lane.
(Alignment F) Long Mile Road – Tallaght (Greenhills) tie-in									
CH. F3350 to CH. F4080	1.5m – 3.65m	1.6m	3.3m	1x 2.65m - 3.5m lane	1.6m – 5.5m	2.0	2.8m – 3.2m	1x 2.8m – 3.6m lane	Inbound and outbound bus lane. Non segregated cycle track both directions.

Chainage Reference	Existing Inbound Carriageway Proposed Inbound Carriageway				Existing Outbound Carriageway Proposed Outbound Carriageway				Existing Conditions Notes Proposed Scheme Notes
	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Footway Width (m)	Cycle Lane/ Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	
	1.3m – 5.8m	1.25m – 2.5m	3.0m	1x 2.8m - 3.0m lane	1.3m – 6.2m	1.25m - 2.25m	3.0m – 4.7m	3x 3m lanes between CH. 3370 – 3410. 2x 3m lanes between CH. 3410 – 3500 1x 3m-5.5m lanes between CH. 3500 – 4080	Inbound and outbound cycle track and inbound and outbound bus lane. Narrow footway widths isolated and required for right turn jugs. Sub 3.0m lanes on slips for right turning vehicles.

4.3 Design Speed

The design speed to which the horizontal and vertical alignment of the Proposed Scheme has been governed by DMURS and the guidance provided by the DTTAS in the document Guidelines for Setting and Managing Speed Limits in Ireland.

As outlined in DMURS '*Design Speed is the maximum speed at which it is envisaged/intended that the majority of vehicles will travel under normal conditions*' for the urban road sections. DMURS recommends that "*in most cases the posted or intended speed limit should be aligned with the design speed"and* that the design speed of a road or street must not be "*up designed*" so that it is higher than the posted speed limit. DMURS sets out that designers *"must balance speed management, the values of place and reasonable expectations of appropriate speed according to context and function"*.

Consideration for selection of an appropriate design speed is undertaken in light of the "Function and Importance of Movement" and "Context" of the street network, as explained further in DMURS Section 3.2. The "Design Speed Selection Matrix" as shown in below is also used to inform the appropriate design speed, extracted from DMURS Chapter 4.

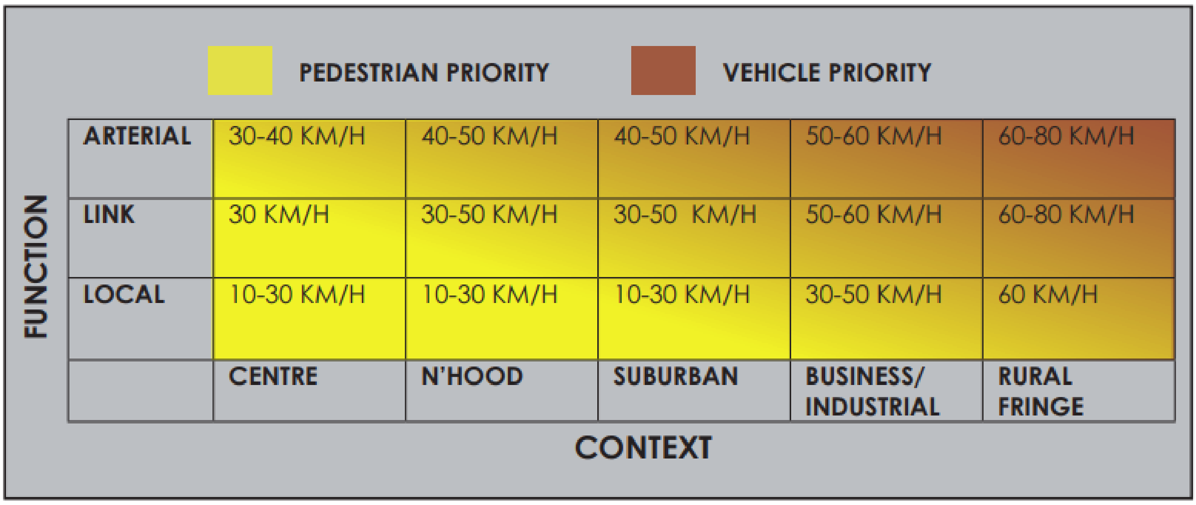

Figure 4-7: DMURS Design Speed Selection Matrix

The design speeds used for the existing and proposed mandatory speed limits on the Proposed Scheme are detailed in Table 4-3, below. Given the location of the scheme within industrial, suburban and urban areas (both residential and commercial) and with expected increases in the number of pedestrians and cyclists using the active transport infrastructure due to Covid-19 restrictions, DCC have proposed the introduction of Special Speed Limit Bye-Laws, subject to public consultation between the 2nd July and the 13th August 2020, which aims to reduce the default speed limit from 50km/h to 30km/h within the DCC boundaries.

Table 4-3: Existing and Proposed Design Speeds

Chainage reference	Road/Junction Name	DMURS Road Function	DMURS Place Context	Existing Speed Limit (km/h)	Proposed Design Speed (km/h)	Proposed Posted Speed Limit (km/h)
A0 to A180	Belgard Square West	Link	Centre	50	50	50
A180 to A1350	Belgard Square West / Belgard Square North / Belgard Square East / Blessington Road	Link	Business / Industrial	50	50	50
A1350 to A1800	Blessington Road / Main Road	Link	Centre	50	50	50
A1800 to A1980	Old Greenhills Road	Link	Centre	30	30	30

Chainage reference	Road/Junction Name	DMURS Road Function	DMURS Place Context	Existing Speed Limit (km/h)	Proposed Design Speed (km/h)	Proposed Posted Speed Limit (km/h)
A1980 to A2210	Greenhills Road R819	Arterial	Business / Industrial	50	50	50
A2210 to A3150	Greenhills Road R819	Arterial	Business / Industrial	60	50	50
A3150 to A3675	Greenhills Road (New)	Arterial	Neighbourhood	n/a	50	50
A3675 to A4150	Greenhills Road R819	Arterial	Business / Industrial	60	50	50
A4150 to A4360	Greenhills Road (New) / Ballymount Avenue	Arterial	Business / Industrial	n/a	50	50
A4360 to A5500	Ballymount Avenue / Calmount Road	Arterial	Business / Industrial	50	50	50
A5500 to A5740	Greenhills Road R819	Arterial	Business / Industrial	50	50	50
A5740 to A6000	Walkinstown Roundabout	Arterial	Centre	50	50	50
A6000 to A6700	Walkinstown Road R819	Arterial	Neighbourhood	50	50	50
A6700 to A6940	Long Mile Road / Drimnagh Road R110	Arterial	Centre	50	50	50
A6940 to A7630	Drimnagh Road / Crumlin Road R110	Arterial	Neighbourhood	50	50	50
A7630 to A9250	Crumlin Road R110	Arterial	Neighbourhood	50	50	30
A9250 to A11450	Dolphin's Barn / Cork Street / St. Luke's Avenue / Dean Street R110 / Patrick Street / Nicholas Street R137	Arterial	Centre	50	50	50
B0 to B520	Old Greenhills Road R819	Link	Neighbourhood	60	50	50
C0 to C914	Greenhills Road R819	Link	Business / Industrial	50	50	50
D0 to D1346	Bunting Road / St. Mary's Road	Link	Neighbourhood	30	30	30
E0 to E2440	Kildare Road / Clogher Road	Arterial	Neighbourhood	50	50	50
F -40 to F2950	New Nangor Road R134 and Naas Road R810 from Woodford Walk to Walkinstown Avenue R112	Arterial	Business / Industrial	60	60	60

Chainage reference	Road/Junction Name	DMURS Road Function	DMURS Place Context	Existing Speed Limit (km/h)	Proposed Design Speed (km/h)	Proposed Posted Speed Limit (km/h)
F2950 to F3020	Naas Road R810 / Walkinstown Avenue R112 junction	Arterial	Business / Industrial	50	60	60
F3020 to F3260	Walkinstown Avenue R112	Arterial	Business / Industrial	60	60	60
F3260 to F3380	Walkinstown Avenue R112 / Long Mile Road R110 junction	Arterial	Business / Industrial	50	50	50
F3380 to F3740	Long Mile Road R110	Arterial	Business / Industrial	60	60	60
F3740 to F4090	Long Mile Road R110	Arterial	Business / Industrial & Schools	50	50	50

4.4 Alignment Modelling Strategy

The 3D model design, including the horizontal and vertical alignments, 3D modelling corridors and the associated design features has been developed using the Autodesk Civil 3D software in accordance with the BCID BIM Execution Plan. The models have been developed for the purposes of informing the scheme extents and informing the preliminary design for the requirement for any significant earthworks/ retaining structures along the Proposed Scheme.

As part of the alignment design process, the horizontal and vertical design has been optimised to minimise impact to the existing road network and adjoining properties where feasible. Horizontal and vertical alignments have been developed to define the road centrelines for the proposed route layout while also taking cognisance of the existing road network. In terms of the horizontal alignments, due consideration has been given to aligning the centrelines as close to existing as practicable. However, the over-riding determining factor for locating the horizontal alignment is to ensure it is positioned in the centre of the proposed carriageway. This is ideally along a central lane marking on the carriageway, in order to minimise rideability issues for vehicles crossing the crown line.

In the case of developing the vertical alignment along the route, a refinement process has been undertaken to minimise impacts to the existing road network and develop the proposed carriageway levels as close to existing as practicable. In most circumstances however, due to a change in cross-section, due consideration is given to the resulting level difference at the outer extents of the carriageway, particularly through urban areas where a difference in existing and proposed footway levels will require additional temporary land-take to facilitate tie-in.

Existing ground levels have been determined using the existing ground model produced for the Proposed Scheme from the topographical survey. This existing ground model informs the differences in levels between proposed and existing along the route, while at junctions it is also used to determine dwell area gradients and lengths to facilitate junction realignment.

The developed alignment design sets parameters for development of other design elements such as drainage, determination of earthworks, utility/services placement etc.

4.5 Summary of Horizontal Alignment

Existing alignments and crossfalls along the Proposed Scheme have been generally retained wherever practical. DMURS provides the following guidance in relation to modifications of existing arterial and link road geometry:

- *Designers should avoid major changes in the alignment of Arterial and Link streets as these routes will generally need to be directional in order to efficiently link destinations.*
- *Major changes in horizontal alignment of Arterial and Link streets should be restricted to where required in response to the topography or constraints of a site.*

In some areas, minor adjustments will be required to the horizontal alignment to deliver the requisite width to ensure the provision of the necessary traffic lanes, bus lanes, cyclist and pedestrian facilities which would also allow the drainage of surface water into new/relocated road gullies.

In areas where road widening and minor changes to the horizontal alignment will not be practicable due to constraints (environmental, residential, geometrical etc.), new construction has been provided through greenfield areas to ensure the provision of continuity of design throughout the scheme.

In light of the above, the horizontal and vertical alignment of the mainline are generally as per the existing parameters and surveys. The alignment of the scheme is generally compatible with the selected design speed and associated safe SSD, notwithstanding that localised adjustments in the horizontal alignment at the locations below have been undertaken to facilitate the conversion of the existing Roundabouts to new signalised junctions.

- Ch A0, Belgard Square South / Belgard Square West junction – a change to the cross section width where the existing Belgard Square South roundabout will be changed to a fully signalised three-arm junction, the carriageway cross-section will be reduced resulting in an increase in pedestrian pavement and pedestrian crossings on all arms;
- Ch A400, Belgard Square West / Belgard Square North junction – a change to the cross section width where the existing roundabout will be changed to a fully signalised junction with new bus, cycle and pedestrian facilities. The central median islands on Cookstown Way, Belgard Square West and Belgard Square North arms and the existing central island softscaping will be removed;
- Ch A775, Belgard Square North / Belgard Square East junction – a change to the cross section width where the existing roundabout will be changed to a fully signalised junction with new bus, cycle and pedestrian facilities. The central median islands on Belgard Square North (East and West), Belgard Square East and the existing central island softscaping will be removed;
- Ch A4650, Ballymount Avenue / Calmount Road junction - a change to the cross section width where the existing roundabout will be changed to a fully signalised junction with new bus, cycle and pedestrian facilities. The central median islands on Calmount Road (East and West), Ballymount Avenue (North and South) and the existing central island softscaping will be removed; and
- Ch F750, New Nangor Road junction with Nangor Road Business Park and Riverview Business Park - a change to the cross section width where the existing roundabout will be changed to a fully signalised junction with new bus, cycle and pedestrian facilities. The central median islands on New Nangor Road (East and West), entrance to Nangor Road Business Park, entrance to Riverview Business Park and the existing central island softscaping will be removed.

At constrained locations, Signal Control Priority traffic signals are proposed as detailed in Section 4.13.3 to afford buses the priority ahead of other traffic on single lane road sections. In addition, alignment design adjustment is proposed at the following locations:

- Physical constraints preventing the desired cross section were encountered on Greenhills Road on approach to Walkinstown Roundabout and Crumlin Road between Chainages A7850m – A8600m. On Greenhills Road it is proposed to not provide a bus lane westbound until Chainage A5500m to facilitate the desired traffic lane, cycle track and footway widths. It is proposed to have a layby bus stop at Chainage A5700 to avoid traffic queuing. Traffic modelling has confirmed queuing lengths at the next junction will not have a significant impact on this.
- Crumlin Road is heavily constraint due to the proximity of the existing buildings and property boundaries. It is proposed to have additional bus lanes eastbound and westbound for sections and priority bus signals to facilitate improved bus flows. The existing cycle track will be removed to accommodate the extra bus lane, however, and while cyclists will be permitted to use the bus lane the majority are expected to use the alternative more direct cycle route along Kildare Road and Clogher Road which will include upgraded facilities for cyclists.

- It was not practicable to accommodate the standard cross section of footway and cycle track at the existing bridge carrying the M50 over the New Nangor Road. It has been proposed to omit the northern footway from the Woodford Walk junction to east of the M50 overbridge. To the north of New Nangor Road, a pedestrian connection to the Grand Canal Greenway is provided at the existing access point at the Woodford Walk junction. From here to the east of the M50 overbridge pedestrians can utilise the greenway where a new connection to the footway will be provided on the approach to the Riverview Business Park junction, thus connecting pedestrians on the greenway with the Riverview Business Park. To the south of the road, a continuous footway is provided to serve pedestrian movement from Clondalkin to the employment areas east of the M50. Pedestrians also have the option to cross at the pedestrian crossing at the Woodford Walk junction and use the footway along the south side of New Nangor Road.

4.6 Summary of Vertical Alignment

Due to the nature of the proposed design, i.e. the majority of the design proposals involve widening of the existing roadway in order to accommodate additional facilities, every effort has been made to ensure the longitudinal alignment adheres, as closely as practicable, to the existing arrangement.

DMURS defines the vertical alignment of a road as follows:

> *"A vertical alignment consists of a series of straight-line gradients that are connected by curves, usually parabolic curves. Vertical alignment is less of an issue on urban streets that carry traffic at moderate design speeds and changes in vertical alignment should be considered at the network level as a response to the topography of a site."*

Visibility concerns associated with adverse vertical crest and sag curves have not been identified on the Proposed Scheme due to the nature of the existing urban road network. Notwithstanding, the vertical alignment of the proposed road development has also been assessed to ensure hard standing areas have been designed above the minimum gradient of 0.5% to mitigate localised surface water ponding and facilitate surface run-off drainage measures.

In general, vertical alignments have been designed using the appropriate set of design guidelines/standards as outlined in Section 4.1. In areas of new road construction, including the proposed sustainable link bus route at Parkview and road reconfigurations at Castletymon Road, Ballymount Avenue, Calmount Road and Calmount Avenue, the overriding design factor used to determine the desirable minimum and maximum longitudinal gradients has been the comfort and safety of vulnerable road users. Technical Guidance Document Part M of the building regulations advises that access routes with a gradient of 1:20 or less are preferred. Therefore, a maximum gradient of 5% has been incorporated into the vertical design, wherever practicable, on streets where pedestrians are active. For the new section of Calmount Avenue a vertical alignment gradient of 7.2% is required due to the existing topography and to tie-in to existing levels at Calmount Avenue and Greenhills Road at the access road to Lidl retail unit.

4.7 Forward Visibility

Forward visibility is the distance along the street ahead of which a driver of a vehicle can see. The minimum level of forward visibility required along a street for a driver to stop safely, should an object enter its path, is based on the Stopping Sight Distances (SSD).

The SSD is the theoretical minimum forward sight distance required by a driver travelling at free speed (i.e. not influenced by other drivers) in order to stop the car when faced with an unexpected hazard on the carriageway. This is calculated as the total distance it takes the driver driving at the design speed to stop safely. It is measured along the centreline of the lane in which the vehicle is travelling, and a rule of thumb is that a driver sitting in a low vehicle (eye height 1.05m) must be able to see an object 0.26m high from the SSD distance, therefore:

SSD = perception distance + reaction distance + braking distance.

The SSD standards which have been applied to the proposed design, in accordance with the design guidance given within DMURS are shown on Table 4-4. The desirable minimum forward visibility requirements were achieved for the Proposed Scheme.

Table 4-4: SSD Design Standards

SSD STANDARDS

Design Speed (km/h)	SSD Standard (metres)
10	7
20	14
30	23
40	33
50	45
60	59

Forward Visibility

Design Speed (km/h)	SSD Standard (metres)
10	8
20	15
30	24
40	36
50	49
60	65

Forward Visibility on Bus Routes

An assessment of visibility at major and minor junctions has been completed along the route. In accordance with DMURS, the SSD parameters for relevant design speeds has been adopted as the Y-Distance visibility to be achieved while an X-Distance of 2.4m (reduced to 2.0m as a relaxation) has been implemented. An assessment of the junction visibility at accesses serving individual properties and single dwellings has been undertaken, ensuring that the existing visibility splay "X" and "Y" are maintained or improved.

In the absence of DMURS guidance with respect to visibility at signalised junctions, the principles and parameters of 'Junction Intervisibility' from DNGEO-03044 (The Geometric Layout of Signal-Controlled Junctions and Signalised Roundabouts) has been adopted as a benchmark to assess the intervisibility at all signalised junctions. As many of the junctions along the Proposed Scheme will involve retrofitting of the existing layout in an urban environment to provide additional NMU provisions in addition to the requirements to facilitate vehicle swept-paths, junction intervisibility will be impacted.

4.8 Corner Radii and Swept Path

In line with the Proposed Scheme objectives of improving facilities for walking and cycling, corner radii along the route are to be reduced where appropriate in order to lower the speed at which vehicles can turn corners and increase inter-visibility between users.

Junctions are where the actual and perceived risk to both cyclists and pedestrians are highest and usually represent the most uncomfortable parts of any journey. In order to provide a design whereby vehicles navigate through turns at a reduced speed, thereby reducing the risk of serious collisions, kerb and footway buildouts have been included on the majority of the designed junctions along the route thus adhering to design guidance given within the DMURS document where it is stated:

> *"Build-outs should be used on approaches to junctions and pedestrian crossings in order to tighten corner radii, reinforce visibility splays and reduce crossing distances."*

The corner radius in urban settings is often determined by swept path analysis. Whilst swept path analysis should be considered, the analysis may overestimate the amount of space needed and / or the speed at which the corner is taken. The design balanced the size of the corner radii with user needs, pedestrian and cyclist safety and the promotion of lower operating speeds. In general, on junctions between Arterial and/or Link streets a maximum corner radius of 6m was applied. 6m will generally allow larger vehicles, such as buses and rigid body trucks, to turn corners without crossing the centre line of the intersecting road. However, in areas where swept-path analysis has identified constrained areas and larger vehicles are anticipated to make up a higher portion of the usage (i.e. bus lanes, HGV service areas etc.) the corner radii has been increased to 8 or 10m to facilitate this.

A suite of vehicles was collated for consideration in assessment of alignment/ junction designs and entrances to private properties as shown below in Figure 4-8.

Name	Width	Length	W/W Rad
'Standard' Articulated Bus	2.520	18.020	11.400
15m 6WS Luxury Coach	2.500	15.000	12.490
DB32 Fire Appliance	2.180	8.680	8.821
DB32 Private Car	1.715	4.223	6.207
DB32 Refuse Vehicle	2.400	7.900	10.323
Double Decker City Bus	2.520	10.704	10.856
Double Decker Regional Bus	2.550	14.145	12.150
FTA Design Articulated Vehicle (1998)	2.550	16.480	7.314
FTA Design Drawbar Vehicle (1998)	2.550	18.751	10.708
Low Entry Regional Commuter Bus	2.550	13.490	12.200
Rigid Truck	2.500	12.000	12.677
Single Deck City Bus	2.445	11.505	11.948
Single Deck Midi Bus	2.445	10.280	11.577

Figure 4-8: Standard Suite of Vehicles Used for Assessment of the Proposed Scheme

In general vehicle tracking/ swept path analysis was carried out using the following principles:

- DB32 Private Car – Analysis undertaken at impacted private residential properties/car parking areas;
- DB32 Refuse Vehicle – Analysis undertaken to ensure refuse vehicles can make turns in/out of all side roads and entries concerning residential/commercial properties;
- 12.2m Standard NTA Bus – Analysis undertaken along the main alignment of the route concerning bus lanes, including the bus interchange area and at junctions;
- Rigid Truck – Analysis undertaken along the main alignment of the route;
- 16.5m FTA Design Articulated Vehicle (1998) – Analysis undertaken along the regional roads of the Proposed Scheme.

At the following locations it was deemed appropriate to provide a setback stop line to facilitate turning movements at junctions:

- Ch A1800, Main Road / Old Greenhills Road junction;
- Ch A2540, Greenhills Road / Hibernian Industrial Estate junction;
- Ch A2950, Greenhills Road / Mayberry Road junction;
- Ch A6400, Walkinstown Road / Walkinstown Shopping Centre access;
- Ch 11450, Winetavern Street / Christchurch Place junction;
- Ch F750, New Nangor Road / Parkview Business Park junction;
- Ch F980, New Nangor Road /Park West Avenue junction; and
- Ch F3350, Walkinstown Avenue / Long Mile Road junction.

4.9 Kerbing

The kerbing type selected along the Proposed Scheme is primarily dependent upon the presence of a cycle track alongside the carriageway. Where cycle tracks will be present adjacent to the carriageway, the cycle track will be separated by the typical 250mm wide BusConnects kerb, which will have a 120mm upstand to the carriageway and a 60mm upstand to the cycle track (120mm upstand where cycle track is not raised) as shown in Figure 4-4.

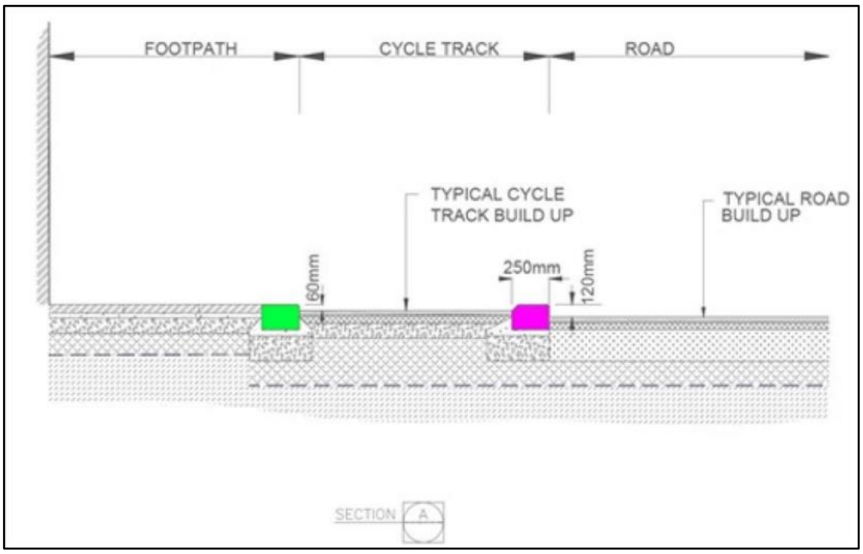

Figure 4-9: Typical Kerb Arrangement

Where this kerb will cross at an uncontrolled junction and at direct accesses, the Raised Table Priority Junction Treatment (Figure 4-10) will be implemented at the majority of locations. At these locations, the kerb will be lowered to a 60mm upstand while the cycle track will be raised throughout. At some locations, where it is necessary to retain the cycle track at carriageway level (e.g. due to cobblestone heritage feature), the kerb will transition to carriageway level and / or terminate as required.

At controlled and signalised junctions, the cycle track will be ramped down to the carriageway level and the kerb will be transitioned to carriageway level and terminated.

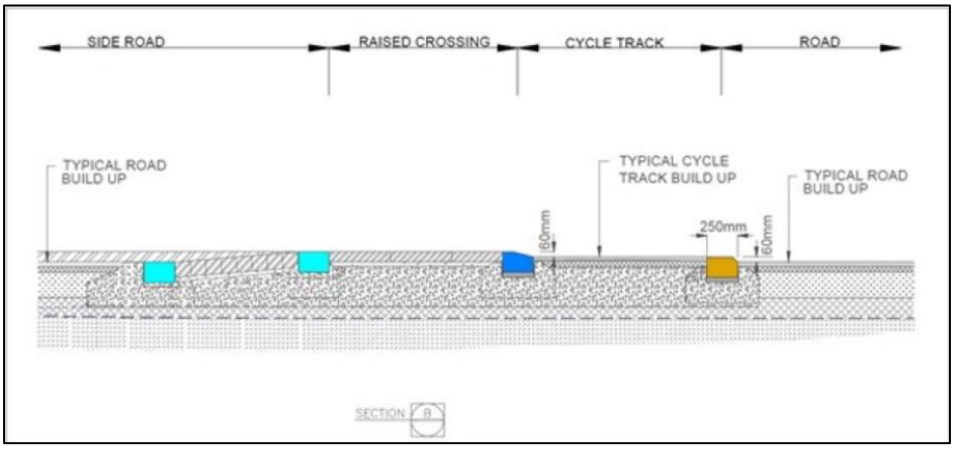

Figure 4-10: Kerb Treatment at Raised Table Priority Junction

At locations where a footpath will be located adjacent to a cycle track, a half battered kerb with a 60mm upstand is proposed. This 60mm high vertical kerb will be required to ensure that the kerb is properly detectable by visually impaired pedestrians using the footpath.

At locations where a cycle track is not present, and the footpath is adjacent to the carriageway, a standard 125mm upstand is proposed. Dropped and transition kerbs will be provided at driveways and pedestrian crossings.

Where levels and proposed carriageway cross-sections will not change across major overbridge structures along the Proposed Scheme, it is proposed to retain the existing kerb provisions.

4.10 Pedestrian Provision

4.10.1 Overview

DMURS defines the footway cross section by three distinct areas. The 'footway' area is designated as the main throughfare within the footway designated for pedestrian movement along the street. The 'verge' area provides an area that can be used for street furniture as well as an overflow area for pedestrian movement. In some circumstances the verge area can also provide a buffer for high-speed traffic, however for the majority of the Proposed Scheme a cycle track will perform a similar function for separation from motorised traffic. The 'strip' area is designated as a specific location for which retail/commercial/private premises may undertake certain outdoor activities including dining, stalls or outdoor seating etc. These areas often have specific licenses or agreements in place with the Council or have dedicated legal interests (private landings) over this area of the footway. The assessment of these areas is further discussed in Chapter 13.

Figure 4-11 below provides an extract from DMURS demonstrating the relevant components of the footway.

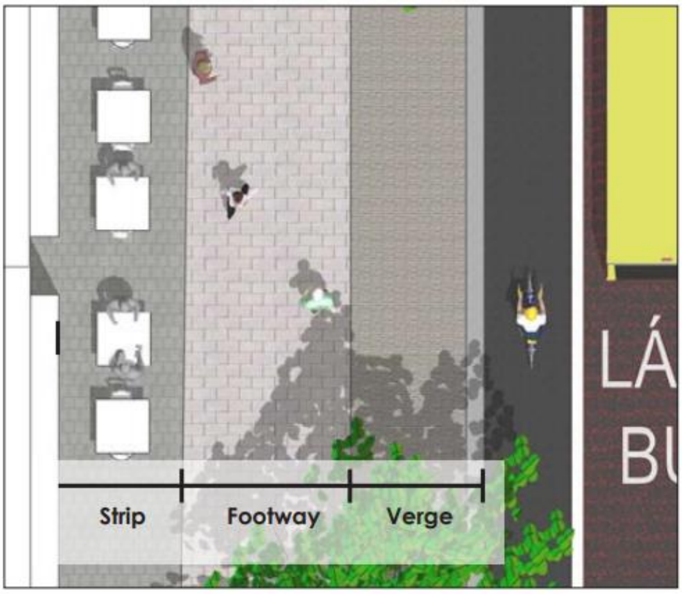

Figure 4-11: Key Components of the Footway

4.10.2 Footway Widths

The adopted footway design width parameters have been provided in Table 4-1.The desirable minimum footway width for the Proposed Scheme is 2m, where practicable, and an absolute minimum width of 1.8m has been adopted at constrained sections. This width should be increased in areas catering for significant pedestrian volumes where space permits or in areas where designated additional outdoor functionality has been determined to increase the overall footway regime.

At localised pinch points, Building for Everyone: A Universal Design Approach, defines acceptable minimum footway widths as being 1.2m wide over a 2m length of path.

In line with the Road User Hierarchy designated within DMURS, at pinch points, the width of the general traffic lane should be reduced first, then the width of the cycle track should be reduced before the width of the pedestrian footway is reduced. For the majority of the Proposed Scheme extents minimum lane widths have been adopted throughout.

Throughout the scheme, footway widths of 2m or wider have been proposed, with the exception of a limited number of stretches where a width of 1.8m or greater is proposed due to the presence of localised space constraints. The existing and Proposed Scheme nominal footway widths over the length of the corridor have been provided in Table 4-2.

4.10.3 Footway Crossfall

The adopted footway design crossfall parameters have been provided in Table 4-5. The footway crossfall is recommended to be 2% - 3.3% as per DN-PAV-03026.

Table 4-5: DN-PAV-03026, Figure 2.3 Geometric Parameters for Footways

Parameter	Recommended Limits	Extreme Limits
Longitudinal gradient (normally the same as adjacent highway)	1.25% to 5%	8% maximum*
Width	2m minimum	1.3m minimum
Crossfall	2% to 3.3%	1.5% minimum to 7% maximum at crossings

Note: *In some cases it may be necessary to construct a footway with a gradient of more than 8 per cent. Provision of a handrail is recommended if site constraints necessitate a gradient steeper than 10 per cent.

Building for Everyone: A Universal Design Approach recommends that crossfalls should ideally be limited to 1:50 or 2% gradient as steeper gradients can tend to misdirect prams, pushchairs and wheelchairs. This approach has been generally adopted to within the constraints of the existing footway extents.

In certain circumstances dictated by the constraints of existing land boundaries and (particularly at existing residential accesses) to minimise impacts to adjacent properties it has been necessary to deviate from these values in the proposed design. In most cases the maximum crossfall applied to footpath design is 4.0% over a short distance.

4.10.4 Longitudinal Gradient

The footway longitudinal gradient follows the gradient of the proposed carriageway. DN-PAV-03026, Table 2.3 shown in Table 4-1 recommends a longitudinal gradient of 1.25%-5%.

Similar to cycle tracks throughout the scheme, longitudinal gradients of footways are likely to be constrained by the longitudinal gradient of the adjacent carriageway with little scope to vary the footway separately. For the new section of Calmount Avenue where the carriageway vertical alignment gradient is 7.2%, the proposed footway longitudinal gradient is up to a maximum of 8.1% due to existing topography, to accommodate intermediate landings for pedestrians are provided. DMURS section 4.4.6 considers steeper footway gradients where it is states:

> *"In hilly terrain, steeper gradients may be required but regard must be had to the maximum gradient that most wheelchair users can negotiate of 8.3%, although this should be limited to shorter distances. A designer may need to consider mitigation measures, such as intermediate landings, to ensure that pedestrian routes are accessible."*

4.10.5 Pedestrian Crossings

The adopted pedestrian crossing design parameters have been provided in Table 4-1.Where practicable, DMURS recommends that designers provide pedestrian crossings that allow pedestrians to cross the street in a single, direct movement. To facilitate road users who cannot cross in a reasonable time, the desirable maximum crossing length without providing a refuge island is 18m. This may be increased to 19m as an absolute maximum. This is applicable at stand-alone pedestrian crossings as well as at junctions.

Refuge islands should be a minimum width of 2m. Larger refuge islands should be considered by designers in locations where the balance of place and movement is weighted towards vehicle movements, such as areas where the speed limit is 60kph or greater, in suburban areas or where there is an increased pedestrian safety risk due to particular traffic movements. Straight crossings can be provided through refuge islands only where the island is 4m wide or more. Islands of less than 4m in width should provide for staggered crossings.

Where space allows, crossing lengths can be minimised by accommodating a suitable landing area for pedestrians between the road carriageway and cycle track, with the cycle track crossing controlled by mini-zebra markings. This reduced pedestrian crossing distance will have the added benefit of improving overall junction performance due to reduced intergreen times.

Along the Proposed Scheme, pedestrian crossings varying from 2.4m and 4m in width have been incorporated throughout the design. Larger pedestrian crossing widths have been allocated in areas that are expected to accommodate a high number of non-motorised users.

At signalised junctions and standalone pedestrian crossings, the footway is to be ramped down to carriageway level to facilitate pedestrians who require an unobstructed crossing. At minor junctions, raised tables are provided to raise the road level up to footway level and facilitate unimpeded crossing. Tactile paving is provided at the mouth of each pedestrian crossing and is to be designed in accordance with standards. Audio units are to be provided on each traffic signal push button.

Formal crossing points are to be provided on the upstream side of bus stop islands, consisting of an on-demand signalised pedestrian crossing with appropriate tactile paving, push buttons and LED warning studs. A secondary informal crossing should be provided on the desire line on the downstream side of the island.

4.11 Accessibility for Mobility Impaired Users

The aim of the Proposed Scheme is to provide enhanced walking, cycling and bus infrastructure along the corridor. In achieving this aim, the Proposed Scheme has generally been developed in accordance with the principles of DMURS and Building for Everyone: A Universal Design Approach.

The following non exhaustive list of relevant standards and guidelines have informed the approach to Universal Design in developing the Proposed Scheme:

- Building for Everyone: A Universal Design Approach NDA CEUD;
- How Walkable is Your Town, 2015 NDA CEUD;
- Shared Space, Shared Surfaces and Home Zones from a Universal Design Approach for the Urban Environment in Ireland CEUD;
- Best Practice Guidelines, Designing Accessible Environments. Irish Wheelchair Association;
- DfT Inclusive Mobility;
- UK DfT Guidance on the use of tactile paving surfaces; and
- BS8300:2018 Volume 1 Design of an accessible and inclusive built environment. External Environment- code of practice

The Disability Act 2005 places a statutory obligation on public service providers to consider the needs of disabled people. A specialist consultant was engaged to undertake an Accessibility Audit of the existing environment and proposed draft preliminary design for the corridor. The Audit provided a description of the key accessibility features and potential barriers to disabled people based on the Universal Design standards of good practice listed above, noting the following seven Principles of Universal Design:

1. Equitable Use The design is useful and marketable to people with diverse abilities.
2. Flexibility in Use The design accommodates a wide range of individual preferences and abilities.

3. Simple and Intuitive Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
4. Perceptible Information The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
5. Tolerance for Error The design minimizes hazards and the adverse consequences of accidental or unintended actions.
6. Low Physical Effort The design can be used efficiently and comfortably and with a minimum of fatigue.
7. Size and Space for Approach and Use Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

The audit provided a description of the key accessibility features and potential barriers to mobility impaired people based on good practice and considered the following general design issues.

- Accessible Parking - On-street Disabled Parking Space layout should be to the appropriate standard, with dropped kerb access between the parking space and footpath;
- Access Routes on Footpaths - Width of footpaths should be clear of clutter, such as street furniture, and allow unimpeded access for the mobility impaired, and in doing so, meet the minimum standards for widths;
- Drainage - All footpaths should have sufficient cross-fall for drainage purposes but without affecting the ability of mobility-impaired people to move safely along the corridor;
- Guardrails - Guardrails should be located only where needed for safety purposes – and care should be taken not to create narrow spaces which create difficulties for movement;
- Pedestrian Crossing Points - Pedestrian crossing points should be laid out in accordance with standards and make it convenient and safe for mobility impaired users to negotiate crossing of carriageways;
- Controlled and Uncontrolled Crossings - Controlled and Uncontrolled Crossings should have tactile paving laid out correctly to provide tactile and visual assistance to mobility-impaired users approaching crossing points;
- Changes in Level - Any changes in level should be addressed in the design process to ensure that all changes in level, where practicable, comply with standards;
- Shared pedestrian/cyclist areas - Shared pedestrian/cyclist areas should be well laid out, with clear visual and tactile elements included, to ensure that these areas are safe for mobility-impaired users, pedestrians and cyclists;
- Surface Material - Footpath materials should be selected to ensure surfaces are free of undulations, with no trip hazards where there is a transition between surface materials – or where the Proposed Scheme ties into the existing infrastructure; and
- Street Furniture - All poles for signs and street lighting should be carefully located to minimise the effect on the safe and convenient passage of pedestrians and cyclists, with due cognisance to the safe movement of mobility impaired users.

A copy of the Audit has been provided in Appendix I Accessibility Audit. It should be noted that the audit was undertaken in the early design stages with the view to implementing any key measures identified as part of the design development process.

A detailed scheme breakdown of the relevant existing and proposed footways have been provided in Table 4-2. In achieving the enhanced pedestrian facilities there has been a concerted effort made to provide clear segregation of modes at key interaction points along the corridor which was highlighted as a potential mobility constraint in the Audit of the existing situation, particularly for people with vision impairments. In addressing one of the key aspects to segregation, the use of the 60mm set down kerb between the footway and the cycle track is of particular importance for guide dogs, whereby the use of white line segregation is not as effective for establishing a clear understanding of the change of pavement use and potential for cyclist/pedestrian interactions.

One of the other key areas that was focused on was the interaction between pedestrians, cyclists and buses at bus stops. The Proposed Scheme has implemented the use of island bus stops to manage the interaction between the various modes with the view to providing a balanced safe solution for all modes. This is further discussed in Section 4.13.

4.12 Cycling Provision

4.12.1 Overview

One of the core objectives of the Proposed Scheme is to provide segregated cycling facilities along the routes. Physical segregation ensures that cyclists are protected from motorised traffic as well as independent of vehicular congestion, thus improving cyclist safety and reliability of journey times for cyclists. Physical segregation can be provided in the form of vertical segregation, (e.g. raised kerbs), horizontal segregation, (e.g. parking/verge protected cycle tracks), or both.

The 'preferred cross-section template' developed for the CBC project consists of protected cycle tracks, providing vertical segregation from the carriageway to the cycle track and vertical segregation from the cycle track to the footway.

The principal source for guidance on the design of cycle facilities is the National Cycle Manual (NCM) published by the National Transport Authority.

The desirable minimum width for a single-direction, with-flow, raised-adjacent cycle track is 2.0m. This arrangement allows for two-abreast cycling. Based on the NCM width calculator, this allows for overtaking within the cycle track. The minimum width is 1.5m, which based on the NCM width calculator, allows for single file cycling. Localised narrowing of the cycle track below 1.5m may be necessary over very short distances to cater for local constraints (e.g. mature trees).

The desirable minimum width for a two-way cycle track is 3.25m. In addition to this, a buffer of 0.5m should be provided between the two-way cycle track and the carriageway. Using the NCM width calculator, reduction of these desirable minimum widths can be considered on a case-by-case basis, with due cognisance of the volume of cyclists anticipated to use the route as well as the level of service required.

The Proposed Scheme is approximately 15.5 km long with an additional offline cycle route of approximately 3.9 km. Overall the Proposed Scheme includes 35.8 km of new segregated cycle tracks and 2.7 km of non-segregated cycle lanes. The preliminary design drawings included within Appendix B Preliminary Design Drawings, show the improved extent of cycle provision, which is summarised below:

Tallaght to City Centre Section:

- 55% Existing cycle priority (outbound) (6% cycle track, 49% cycle lane)
- 58% Existing cycle priority (citybound) (7% cycle track, 51% cycle lane)
- 72% Proposed cycle priority mainline (outbound) (72% cycle track)
- 100% Proposed cycle priority alternate route/Quiet Street (outbound) (95% cycle track, 5% Quiet Street)
- 72% Proposed cycle priority mainline (citybound) (72% cycle track)
- 100% Proposed cycle priority alternate route/Quiet Street (citybound) (95% cycle track, 5% Quiet Street)

Clondalkin to Drimnagh Section:

- 41% Existing cycle priority (outbound) (14% Greenway cycle track, 27% cycle lane)
- 27% Existing cycle priority (citybound) (14% Greenway cycle track, 9% cycle track, 4% cycle lane)
- 100% Proposed cycle priority (outbound) (100% cycle track)
- 100% Proposed cycle priority (citybound) (100% cycle track)

4.12.2 Segregated Cycle Tracks

A Cycle Track is a segregated cycle facility which is physically segregated from the adjacent traffic lane and/or bus lane horizontally and/or vertically, as shown in Figure 4-12, below, taken from the BCPDGB.

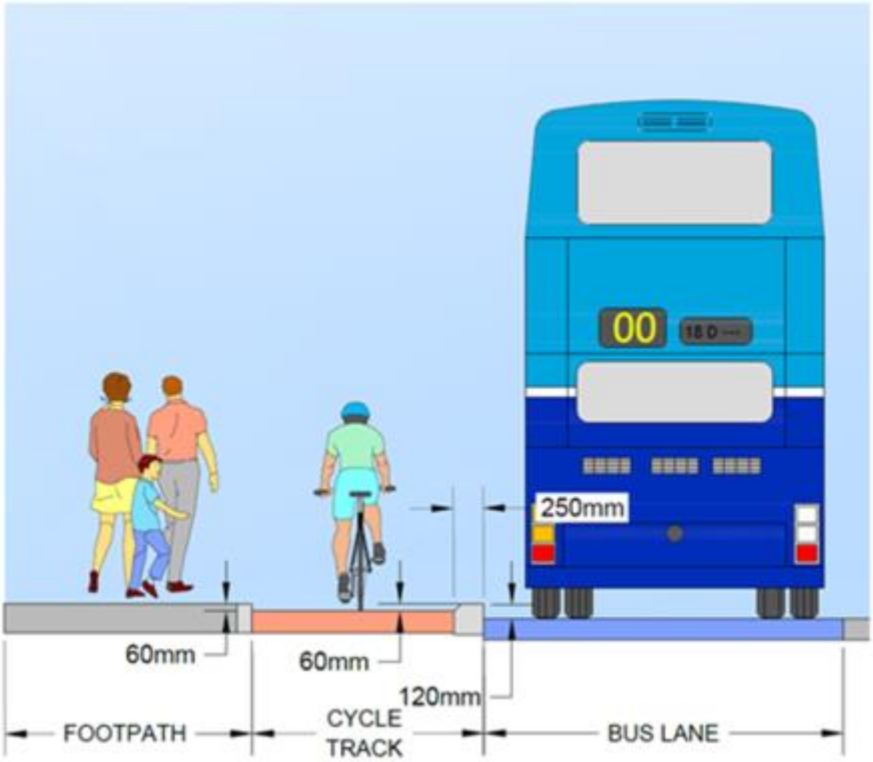

Figure 4-12: Fully Segregated Cycle Track

The desirable minimum width used throughout the Proposed Scheme for a single direction, with-flow, raised-adjacent cycle track is 2m. This is based on the National Cycle Manual (NCM) Width Calculator, and allows for overtaking within the cycle track. The minimum width is 1.5m, based on the NCM Width Calculator, allows for single file cycling. In addition, a full height 120mm upstand kerb between the carriageway and the cycle track should be provided (120mm kerb height on the bus lane side and 60mm kerb height on the cycle track side). This provides increased protection of the cycle track as well as allowing for side entry drainage systems where applicable.

Cycle track construction guidance is given in Section 5.6 of the NCM. The use of machine laid asphalt for cycle tracks has proven to be an effective way of providing a high level of service with a safe, smooth and continuous surface.

Wherever practicable, the Proposed Scheme design has endeavoured to incorporate segregated cycle tracks, and has done so in the following locations:

- Belgard Square North between Belgard Square East and Belgard Square West
- Belgard Square East between Belgard Square North and Blessington Road (existing segregated cycle track upgraded).
- Existing “Zipway” cycle track to be maintained on Blessington Road Ch A950 to Ch A1275
- Greenhills Road between Bancroft Park and TUD Access junction (existing segregated cycle track).
- Greenhills Road Ch A2150 (TUD Access junction) to Ch A3700 (M50 Bridge)
- Greenhills Road / Ballymount Avenue / Calmount Road Ch A3790 (M50 Bridge) to Ch A5840 (Walkinstown Roundabout).
- Long Mile Road Ch F4100 (Slievebloom Park) to F4200 (Walkinstown Road).
- Drimnagh Road Ch A6830 (Slievebloom Road) to A7600 (Cooley Road).
- Crumlin Road Ch A9280 (Dolphin Road / Parnell Road) to A9400 (South Circular Road).
- Dolphin’s Barn Street / Cork Street / St. Luke’s Avenue Ch A9570 (Reuben Street) to Ch A10850 (Dean Street).
- Dean Street Ch A10860 to Ch A10990 (Patrick Street).

- Patrick Street / Nicholas Street Ch A11030 to Ch A11420 (Christchurch Place).
- Bunting Road / St. Mary's Road Ch D20 to D1330.
- Kildare Road Ch E20 to E1150 (Saul Road).
- Clogher Road Ch E1410 (Sundrive Road) to Ch E2430 (Parnell Road).
- New Nangor Road / Naas Road Ch F50 (Woodford Walk) to Ch F2410.
- Naas Road / Ch F2670 to F2970 outbound.
- Walkinstown Avenue Ch F3000 to Ch F3280 inbound
- Walkinstown Avenue / Long Mile Road Ch F3280 to F4100.

4.12.3 Cycle Lane

Cycle lanes are designated lanes on the carriageway that are reserved either exclusively or primarily for the passage of cyclists. Standard cycle lanes include mandatory cycle lanes and advisory cycle lanes. Mandatory cycle lanes are marked by a continuous white line which prohibits motorised traffic from entering the lane, except for access. Parking is not permitted on mandatory cycle lanes. Mandatory cycle lanes are 24 hour unless time plated in which case they are no longer cycle lanes. Advisory cycle lanes are marked by a broken white line which allows motorised traffic to enter or cross the lane. They are used where a mandatory cycle lane leaves insufficient residual road space for traffic, and at junctions where traffic needs to turn across the cycle lane. Parking is not permitted on advisory cycle lanes other than for set down and loading. Advisory cycle lanes are 24 hour unless time plated.

Cycle tracks are the preferred cycling infrastructure proposed along the length of the Proposed Scheme. Where necessary the use of cycle lanes have been limited to the following locations typically along the route:

- Transitions to existing cycle lanes, typically on side roads of the main corridor alignment;
- At grade junction crossings; and
- For side road crossings where the cycle track is locally reduced to road level.

However, where segregated cycle tracks cannot be provided due to constraints or location, cycle lanes have been incorporated into the design at the following locations:

Tallaght to City Centre Section:

- Ch C15 to C100, inbound and outbound
- Ch C450 to C530, inbound and outbound

4.12.4 Offline Cycle Tracks

Offline cycle tracks are fully offset from the road carriageway by a grass verge, providing a greater level of protection and comfort to cycle users. Offline sections of cycle track are provided at the following locations:

Tallaght to City Centre Section:

- The westbound and eastbound cycle track over the M50 are proposed to have separate bridges from the traffic bridge Ch A3700 to Ch A3790).
- Two-way circulatory cycle track at Walkinstown Roundabout.
- Long Mile Road F4200 to A6820

Clondalkin to Drimnagh Section:

- Connections provided to the existing offline N10 Grand Canal Greenway at the New Nangor Road / Woodford Walk junction (Ch F40) and at the New Nangor M50 overbridge Ch F415 & Ch F550).

- Naas Road Ch F2340 to Ch F2960 inbound.
- Naas Road Ch F2420 to Ch F2670 outbound.
- Walkinstown Avenue Ch F3000 to Ch F3280 outbound.

4.12.5 Quite Street Treatment

Where the road widths cannot facilitate cyclists, without significant impact on bus priority, alternative cycle routes are explored for short distances away from the Proposed Scheme route.

Such offline options may include directing cyclists along streets with minimal general traffic, other than car users who live on the street. Guidance in this regard has been provided within the Preliminary Design Guidance Booklet for BusConnects Core Bus Corridors, which states:

> *"Diversions of proposed cycle facilities on to quieter parallel routes, to avoid localised narrowing of cycle tracks on the main CBC route, is to be considered in the context of the CBC route being listed as a primary cycle route as per the Greater Dublin Area Cycle Network Plan. These diversions, however, may also be considered where appropriate cycle facilities cannot be provided along the CBC route without significant impact."*

"Quiet Streets" were termed due to their low volume of general traffic and are deemed suitable for cyclists to share, without the need for segregated cycle tracks or painted cycle lanes. Anticipated Quiet Street treatments would include appropriate advisory signage for both road users and cyclists.

An alternative cycle route along Bunting Road, St. Mary's Road, Kildare Road and Clogher Road forms part of the Proposed Scheme, with a view to providing an alternative safe and more direct route for cyclists navigating between the Walkinstown Road roundabout and the Grand Canal cycle route at Parnell road, as opposed to cyclists using Drimnagh Road and Crumlin Road, where there is insufficient road width to provide dedicated cycle tracks. While cycle tracks are provided for the majority of this route, a Quiet Street Treatment is proposed for the section of Clogher Road between Saul Road and Sundrive Road.

4.12.6 Treatment of Constrained Areas

At some locations along the Proposed Scheme, standard width of cycleways cannot be achieved, and localised narrowing is required.

Details of these locations are provided below:

- Citybound between A1760 to A1780 – Reduced to 1.5m
- Citybound between A1950 to A2080 – Reduced to 1.5m
- Citybound between A2190 to A2220 – Reduced to 1.5m
- Citybound between A4700 to A4750 – Reduced to 1.5m
- Citybound between A4840 to A4890 – Reduced to 1.5m
- Citybound between A4890 to A5040 – Reduced to 1.75m
- Citybound between A5585 to A5625 – Reduced to 1.5m
- Citybound between F4115 to A6780 – Reduced to 1.5m
- Citybound between A6835 to A7215 – Reduced to 1.5m
- Citybound between A7285 to A7400 – Reduced to 1.5m
- Citybound between A7605 to A7625 – Reduced to 1.5m
- Citybound between A8860 to A8940 – Reduced to 1.5m
- Citybound between A9240 to A9505 – Reduced to 1.5m
- Citybound between A9880 to A10140 – Reduced to 1.5m

- Citybound between A10180 to A10360 – Reduced to 1.5m
- Citybound between A10360 to A10500 – Reduced to 1.75m
- Citybound between A10535 to A10930 – Reduced to 1.5m
- Citybound between A11090 to A11165 – Reduced to 1.75m
- Citybound between A11190 to A11205 – Reduced to 1.5m
- Citybound between A11315 to A11335 – Reduced to 1.25m
- Citybound between A11355 to A11365 – Reduced to 1.2m
- Citybound between C15 to C395 – Reduced to 1.5m
- Citybound between C480 to C880 – Reduced to 1.5m
- Citybound between D15 to D1080 – Reduced to 1.5m
- Citybound between E35 to E180 – Reduced to 1.5m
- Citybound between E500 to E545 – Reduced to 1.8m – 1.5m
- Citybound between F675 to F720 – Reduced to 1.75m
- Citybound between E750 to E1010 – Reduced to 1.6m
- Citybound between E1040 to E1110 – Reduced to 1.5m
- Citybound between E1405 to E2430 – Reduced to 1.5m
- Outbound between A525 to A605 – Reduced to 1.5m
- Outbound between A1950 to A2080 – Reduced to 1.5m
- Outbound between A2190 to A2220 – Reduced to 1.5m
- Outbound between A2815 to A2965 – Reduced to 1.5m
- Outbound between A4630 to A4790 – Reduced to 1.5m
- Outbound between A4910 to A4970 – Reduced to 1.75m
- Outbound between A5590 to A5645 – Reduced to 1.5m
- Outbound between F4150 to A6775 – Reduced to 1.5m
- Outbound between A7585 to A7630 – Reduced to 1.5m
- Outbound between A8850 to A8925 – Reduced to 1.5m
- Outbound between A9430 to A9515 – Reduced to 1.5m
- Outbound between A9875 to A10850 – Reduced to 1.5m
- Outbound between A11040 to A11370 – Reduced to 1.5m – 1.75m
- Outbound between C15 to C395 – Reduced to 1.5m
- Outbound between C480 to C780 – Reduced to 1.5m
- Outbound between D15 to D1120 – Reduced to 1.5m
- Outbound between E35 to E165 – Reduced to 1.5m
- Outbound between E540 to E1190 – Reduced to 1.5m
- Outbound between E1405 to E2430 – Reduced to 1.5m

- Outbound between F3210 to F3035 – Reduced to 1.5m
- Outbound between F2960 to F2865 – Reduced to 1.5m
- Outbound between F2410 to F2280 – Reduced to 1.5m

It is also noted that cycle tracks narrow to minimum 1.5m width to slow flow of cyclists when approaching mini-bus islands and 1m at the bus stop island.

4.12.7 Cycle Parking Provision

As noted in Section 4 bike racks will generally be provided, where practicable, at all island bus stops and key additional locations as noted in the Landscape drawings. In addition, although not included in the Proposed Scheme it is noted that new cycle parking is proposed as part of the new park immediately north east of the proposed bus interchange in Tallaght.

The existing cycle parking at the following locations will be retained:

- Belgard Square West (various locations);
- Tallaght Hospital entrance;
- Belgard Square North;
- Main Street;
- Walkinstown Roundabout;
- Walkinstown Road / Drimnagh Road junction;
- Drimnagh Road (various locations);
- Clonard Road;
- Cork Street (various locations);
- Dean Street;
- Patrick Street (various locations);
- Nicholas Street;
- St Mary's Road; and
- Long Mile Road.

To supplement the existing provision, new cycle stands will be provided at the following key locations:

- At all island bus stops along the length of the Proposed Scheme, where practicable;
- Walkinstown Roundabout (all arms); and
- Naas Road / Kylemore Road, in the vicinity of Kylemore Luas stop.

4.13 Bus Provision

4.13.1 Overview

One of the main objectives of the Proposed Scheme is to enhance the capacity and potential of the public transport system by improving bus speeds, reliability and punctuality through the provision of bus lanes and other measures to provide priority to bus movement over general traffic movements. The proposed bus provision is shown on the General Arrangement drawings within Appendix B Preliminary Design Drawings. This provision will increase the bus priority along both sections of the Proposed Scheme.

The Tallaght to City Centre Section is approximately 11.5 km long and the Clondalkin to Drimnagh Section is approximately 4.0 km long. The updated scheme design drawings show the improved extend of bus provisions as per below;

Tallaght to City Centre Section

- 18% Existing Bus Priority (Outbound)
- 23% Existing Bus Priority (Citybound)
- 93% Proposed Bus Priority (Outbound)
- 95% Proposed Bus Priority (Citybound)

Clondalkin to Drimnagh Section

- 43% Existing Bus Priority (Outbound)
- 59% Existing Bus Priority (Citybound)
- 100% Proposed Bus Priority (Outbound)
- 100% Proposed Bus Priority (Citybound)

4.13.2 Bus Priority

Bus priority for the Proposed Scheme is based on provision of a dedicated lane within the carriageway for the bus to travel unhindered by the general traffic along the road corridors between junctions. At junctions, bus lane provision can be provided up to the stop line wherein adaptive signalling solutions could request a green signal for buses or similarly a short, generally less than 20m section of shared bus/traffic lane in advance of the junction stop line can be provided and configured in a similar manner using adaptive signalling methods to communicate the arrival of a bus on approach to the junction. Both methods provide a high level of bus priority with the latter solution implemented where left turning traffic volumes are relatively low and/or scenarios where less stages/phases are more desirable for junction capacity and bus priority in a fixed time cycle approach where adaptive bus signalling solutions are not appropriate. This is further discussed in Chapter 5 and Chapter 11.

Where bus priority cannot be provided due to cross-section constraints, measures such as signal controlled priority and bus gates may be utilised to retain bus priority.

Over the majority of the route a 3m wide lane is provided for bus and other authorised vehicle use only. Larger lane widths are needed in some instances where the swept path of the bus needs more space.

4.13.3 Signal Controlled Priority

Signal Control Priority uses traffic signals to enable buses to get priority ahead of other traffic on single lane road sections, but it is only effective for short distances. This typically arises where the bus lane cannot continue due to obstructions on the roadway. An example might be where a road has pinch-points where it narrows due to existing buildings or structures that cannot be demolished to widen the road to make space for a bus lane. It works through the use of traffic signal controls (typically at junctions) where the bus lane and general traffic lane must merge ahead and share the road space for a short distance until the bus lane recommences downstream. The general traffic will be stopped at the signal to allow the bus to pass through the narrow section first and when the bus has passed the general traffic will then be allowed through the lights.

In considering signal-controlled priority it is necessary to look at the traffic implications both upstream and downstream of the area under consideration. For the signal-controlled priority to operate successfully, queues or tailbacks on the single (shared bus/traffic) lane portion, cannot be allowed to develop as this will result in delays on the bus service.

The paragraphs below present descriptions of the five locations where signal controlled priority provisions is included within the Proposed Scheme which result in buses and general traffic sharing a lane.

New Nangor Road Outbound

Signal control will be used on New Nangor Road westbound through the M50 overbridge. There is insufficient width through this existing structure to provide the desired cross section, and the signal control holds back general westbound traffic, facilitating continuous bus priority.

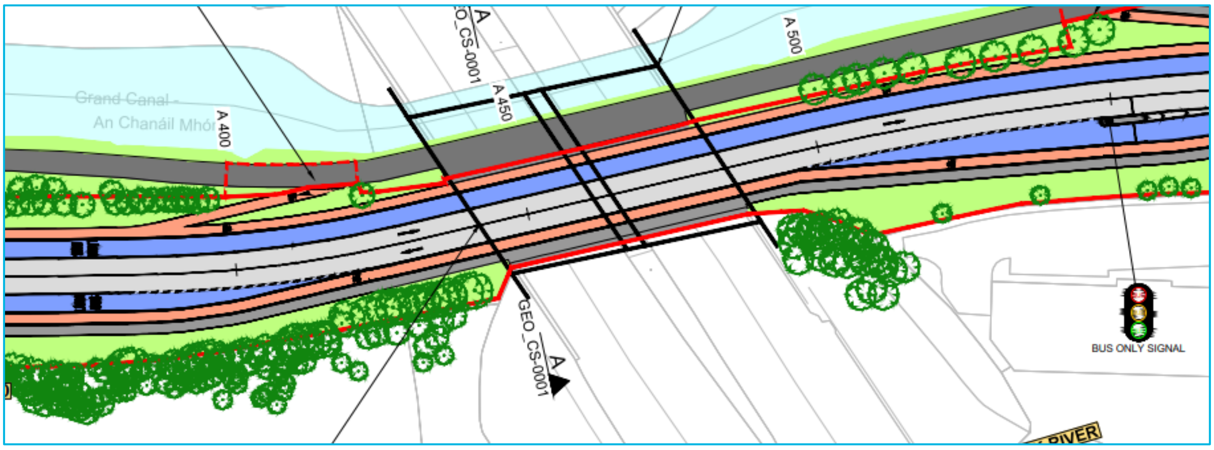

Figure 4-13: Signal Controlled Priority on New Nangor Road

Long Mile Road Outbound

Signal control has been used on the westbound Long Mile Road approach to the junction with Walkinstown Avenue in order to maintain bus priority for buses turning right. Traffic is held back in advance of the junction, allowing right turning buses to assume position in the right turning lane at the junction without obstruction from general traffic.

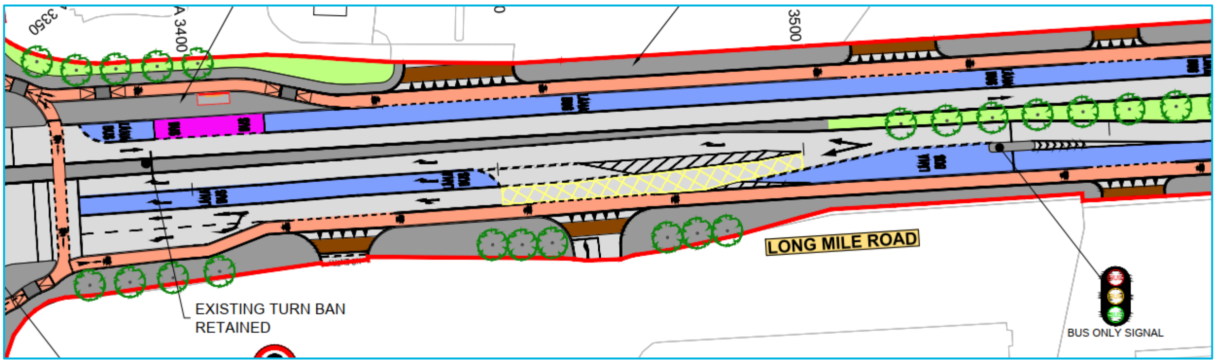

Figure 4-14: Signal Controlled Priority on Long Mile Road Tallaght (Greenhills) to City Centre Section

Greenhills Road Outbound

Signal control will be used on Greenhills Road outbound approach to the Old Greenhills Road in order to maintain bus priority for buses turning right. Traffic is held back westbound on Greenhills Road in advance of the bus priority signal, allowing buses to assume position without obstruction from general traffic.

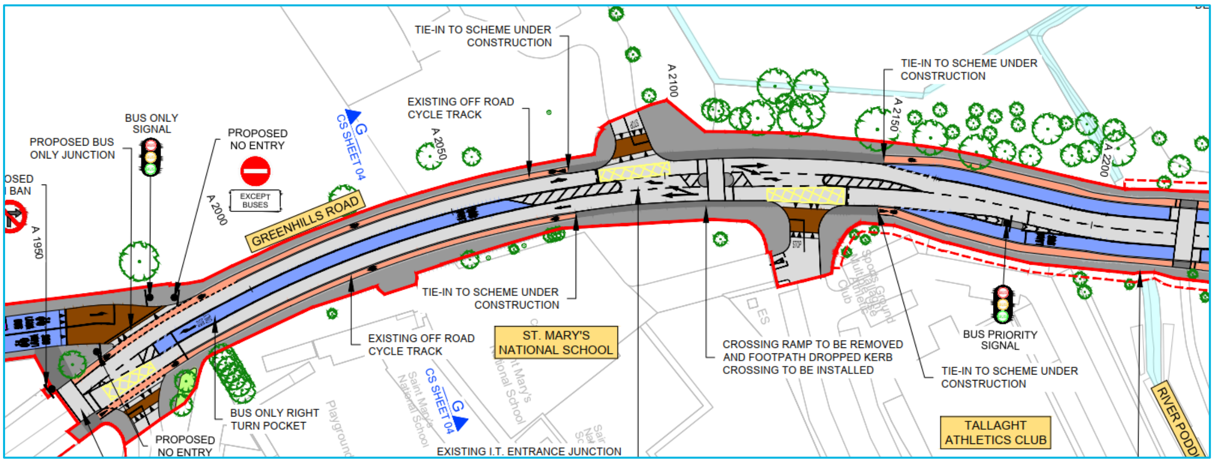

Figure 4-15:Signal Controlled Priority on Old Greenhills Road and Greenhills Road

Crumlin Road

Signal control will be used on Crumlin Road eastbound, approximately 40m before the junction with Raphoe Road, and westbound, approximately 100m before the junction with Ardagh Road. In both locations there is insufficient width along the existing Crumlin Road due to buildings to provide the desired cross section. The signal control holds back traffic, facilitating continuous bus priority.

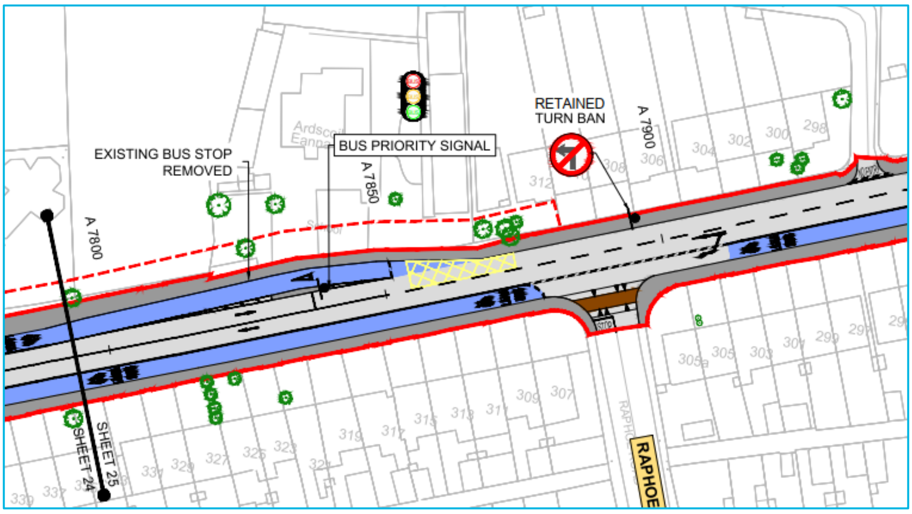

Figure 4-16:Signal Controlled Priority on Crumlin Road eastbound

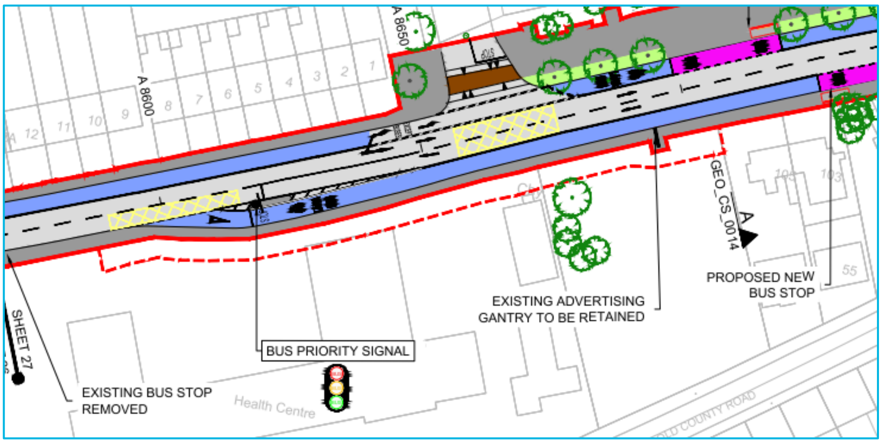

Figure 4-17: Signal Controlled Priority on Crumlin Road westbound

4.13.4Bus Gate

A Bus Gate is a sign-posted short length of stand-alone bus lane. This short length of road is restricted exclusively to buses, taxis and cyclists plus emergency vehicles. It facilitates bus priority by removing general through traffic along the overall road where the bus gate is located. General traffic will be directed by signage to divert away to other roads before they arrive at the Bus Gate.

The paragraphs below present descriptions of the seven locations where signal controlled priority provision is included.

Belgard Square West

On Belgard Square West bus gates are proposed either side of Old Blessington Road between Belgard Square South and Tallaght Cross West / Broadfield Hall to facilitate unhindered bus movements to / from the proposed Bus Interchange as.

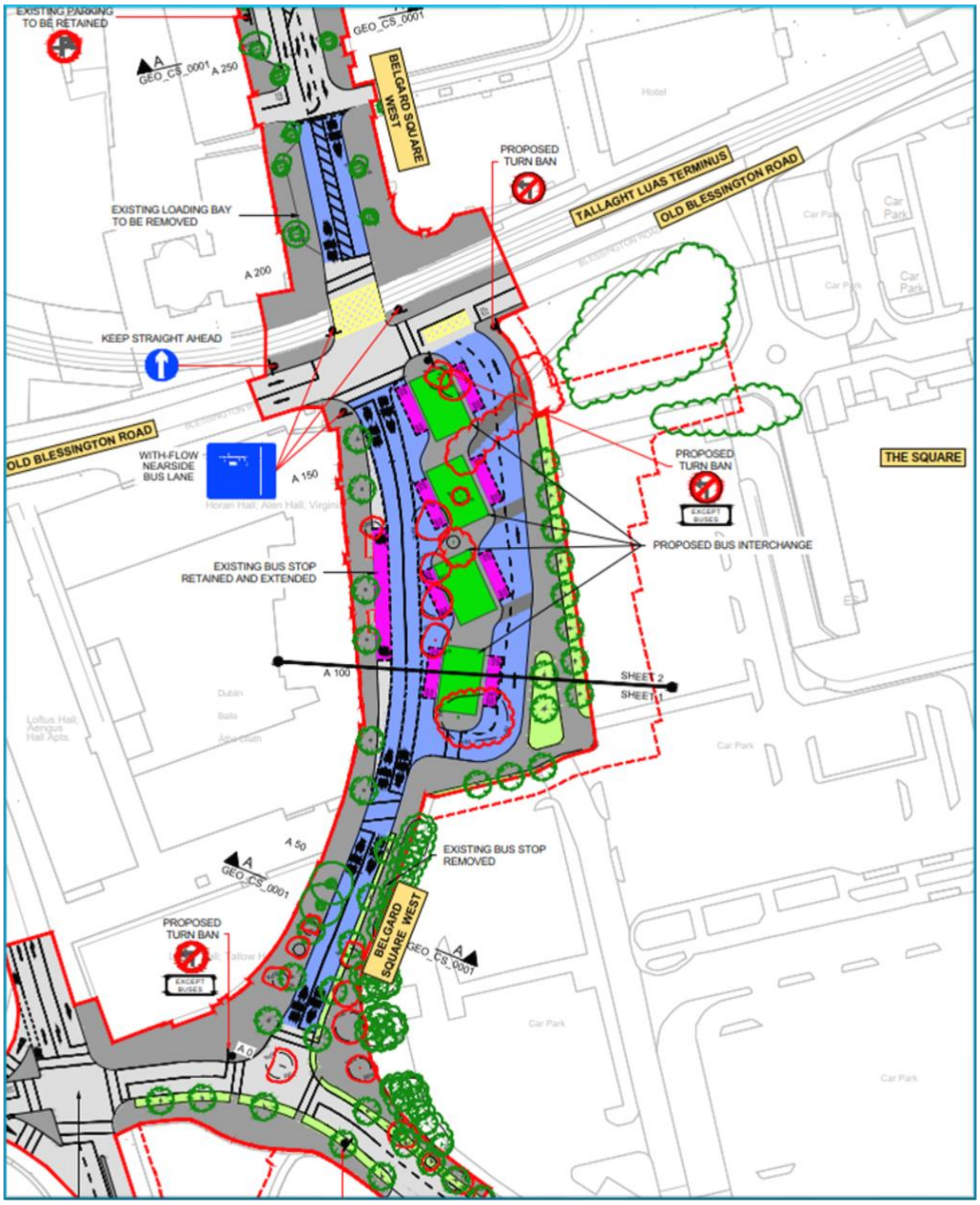

Figure 4-18: Proposed Bus Gate on Belgard Square West

Belgard Square East

On the northernmost section of Belgard Square East, approximately 40m in length approaching Belgard Square North, a bus gate is proposed to provide bus priority,.

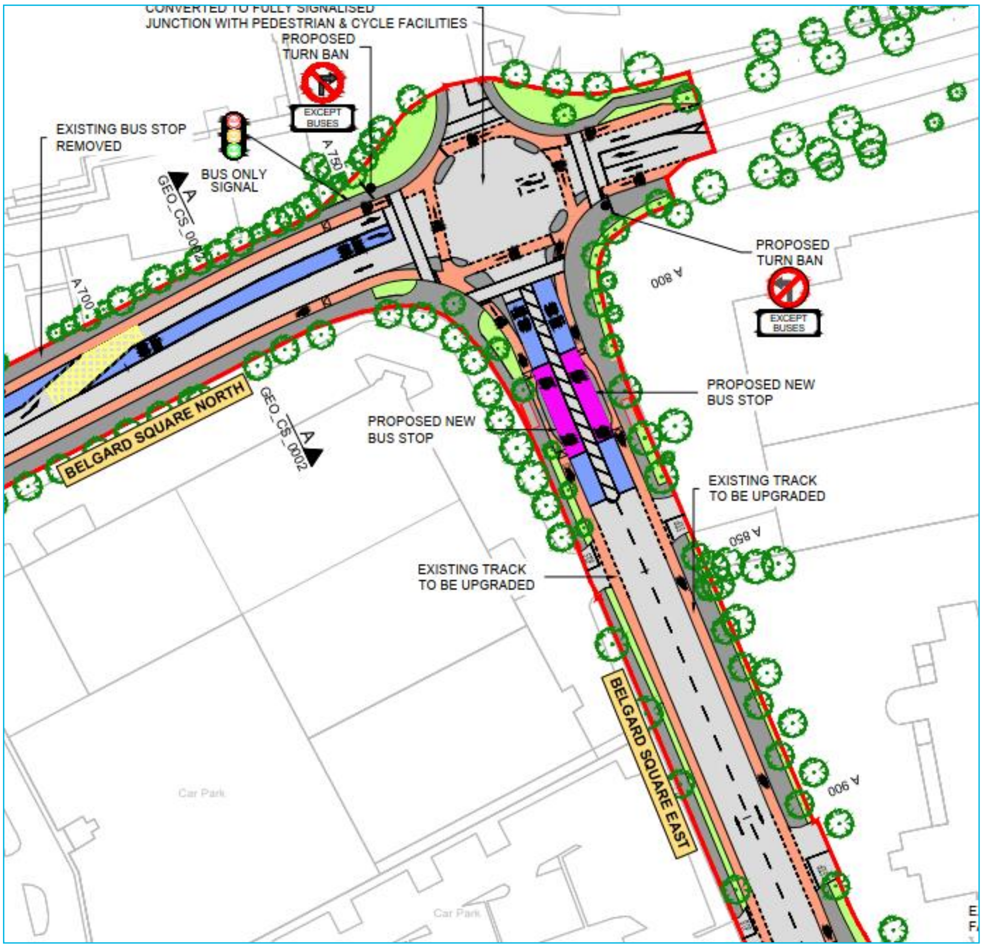

Figure 4-19: Proposed Bus Gate on Belgard Square East

Blessington Road

The existing Bus Gate on Blessington Road immediately east of the access to TUD will be maintained.

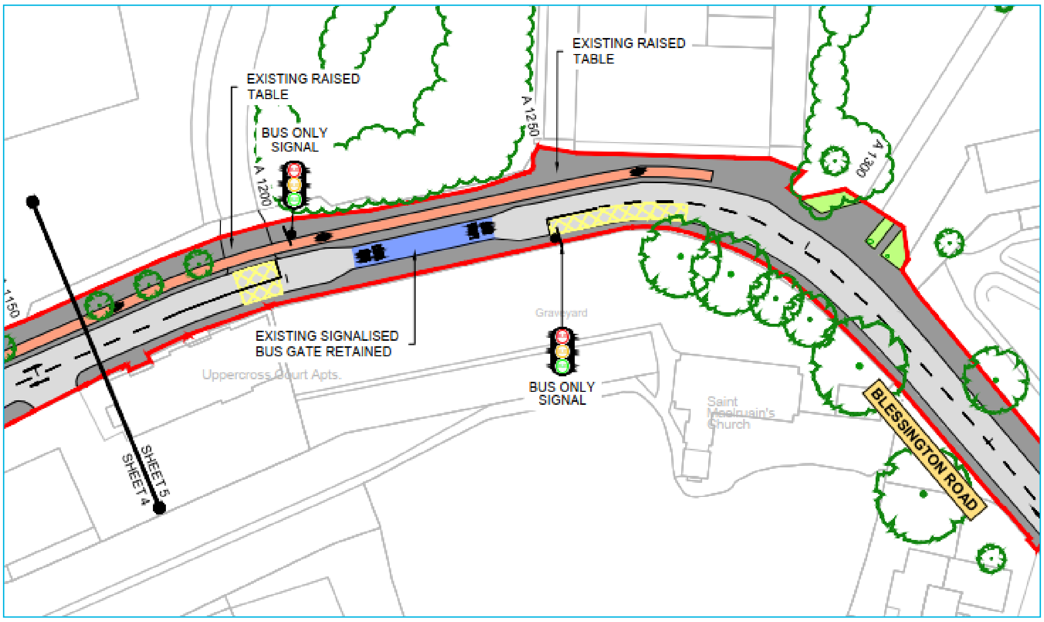

Figure 4-20: Existing Bus Gate on Blessington Road

Old Greenhills Road

On Old Greenhills Road / Greenhills Road Junction Tallaght a bus gate is proposed to allow buses to avoid potential traffic congestion on Greenhills Road at the junction with Main Road.

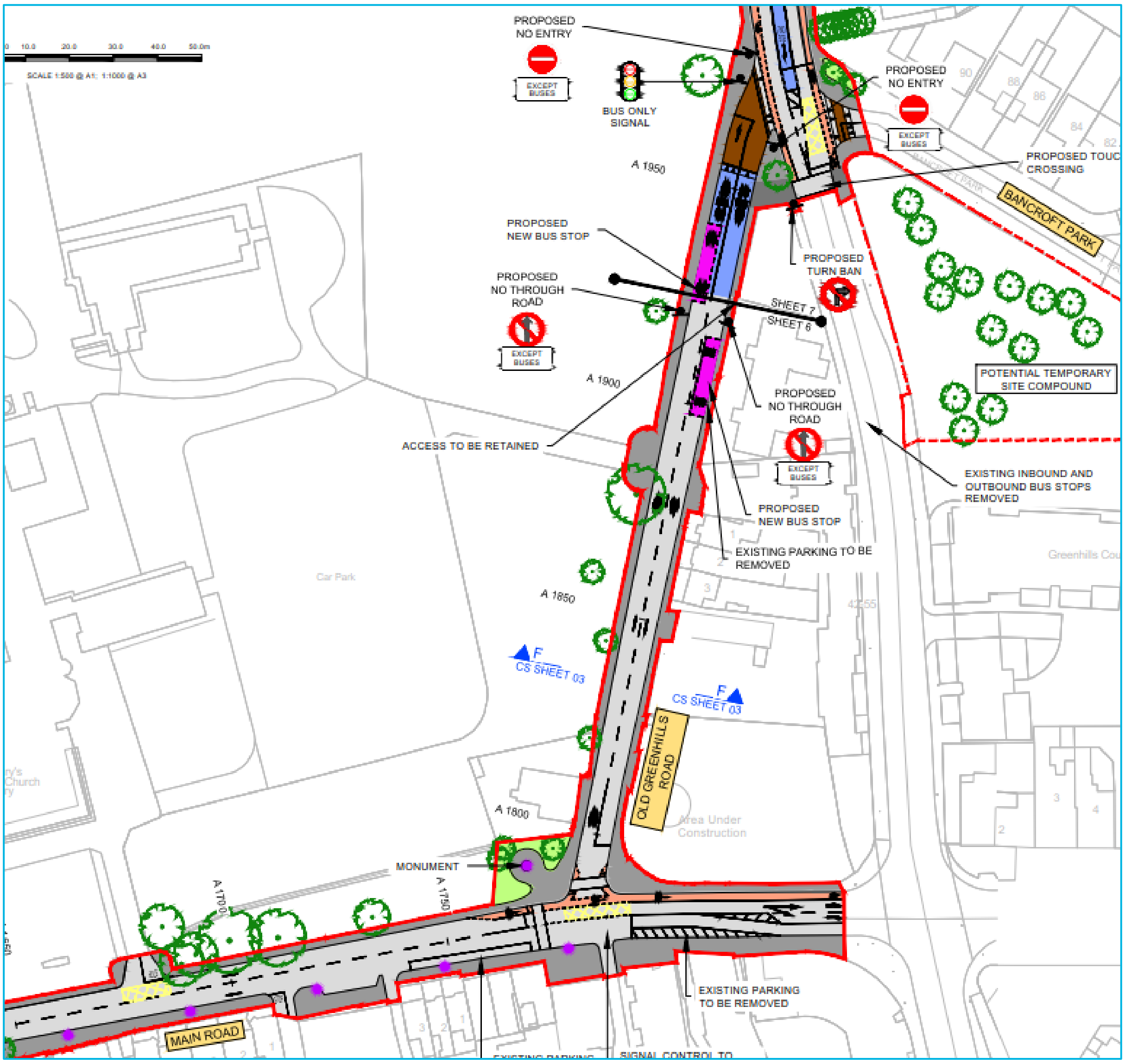

Figure 4-21: Proposed Bus Gate on Old Greenhills Road, Tallaght

Greenhills Road

Bus gates are included at either end of the sustainable transport link which is proposed between Greenhills Road and Birchview Avenue / Treepark Road.

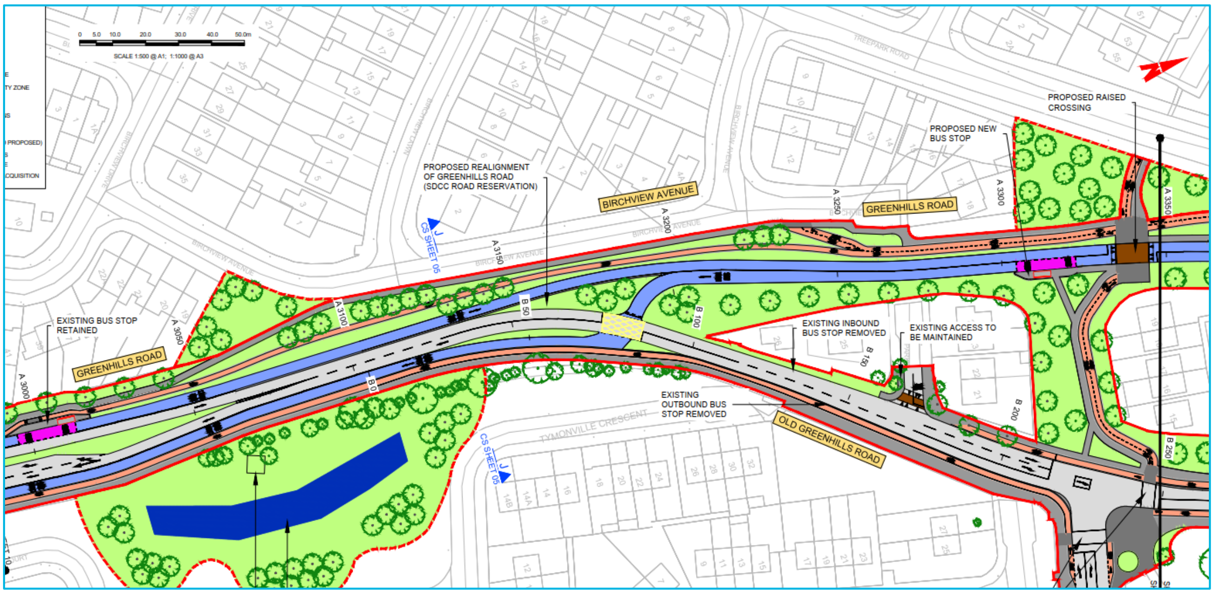

Figure 4-22: Proposed Bus Gate at Southern end of New Sustainable Transport Link

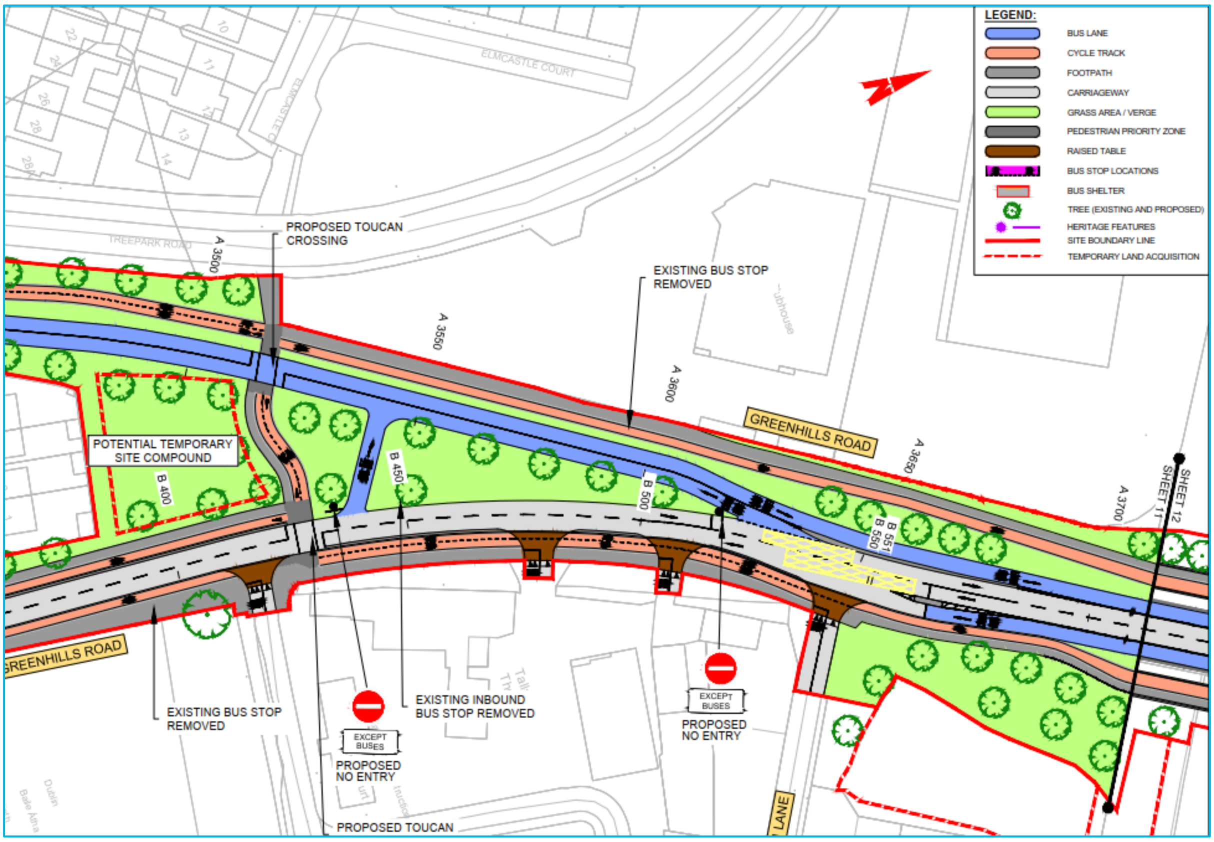

Figure 4-23: Proposed Bus Gate at Southern end of New Sustainable Transport Link

Clogher Road

On Clogher Road immediately west of the junction with Sundrive Road a bus gate is proposed to facilitate local bus services and a Quiet Street treatment for cycling on this narrow section of Clogher Road.

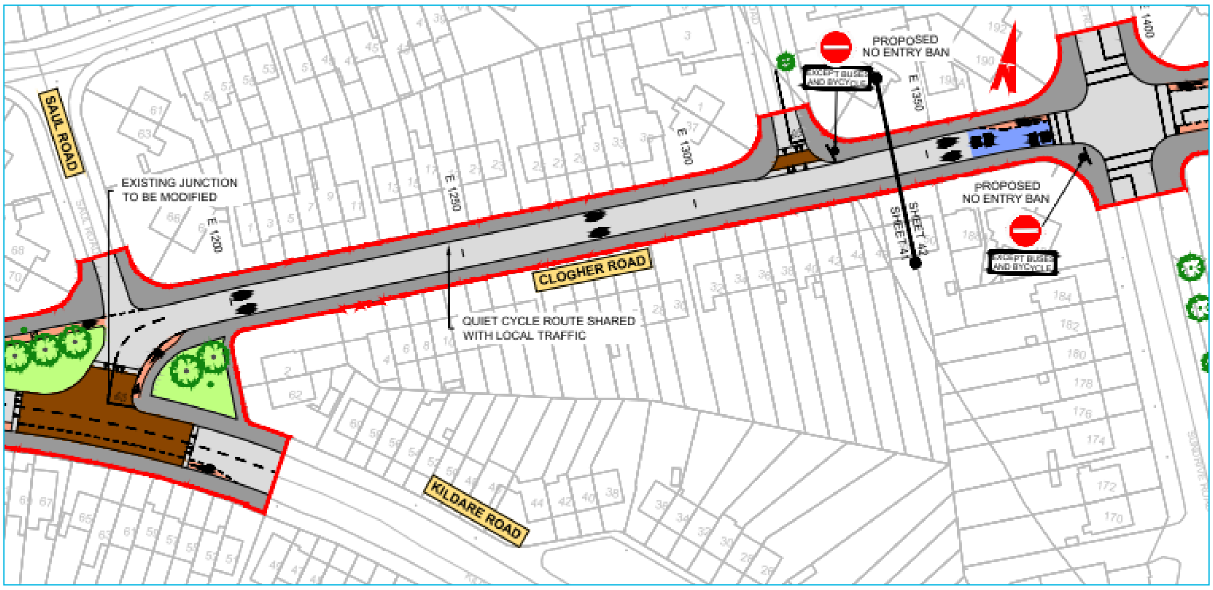

Figure 4-24: Proposed Bus Gate on Clogher Road

4.14 Bus Stops

4.14.1 Overview

The flow chart below outlines the process for examining each BusConnects Corridor and assessing and reporting on the bus stops along each route, as shown in Figure 4-25, below.

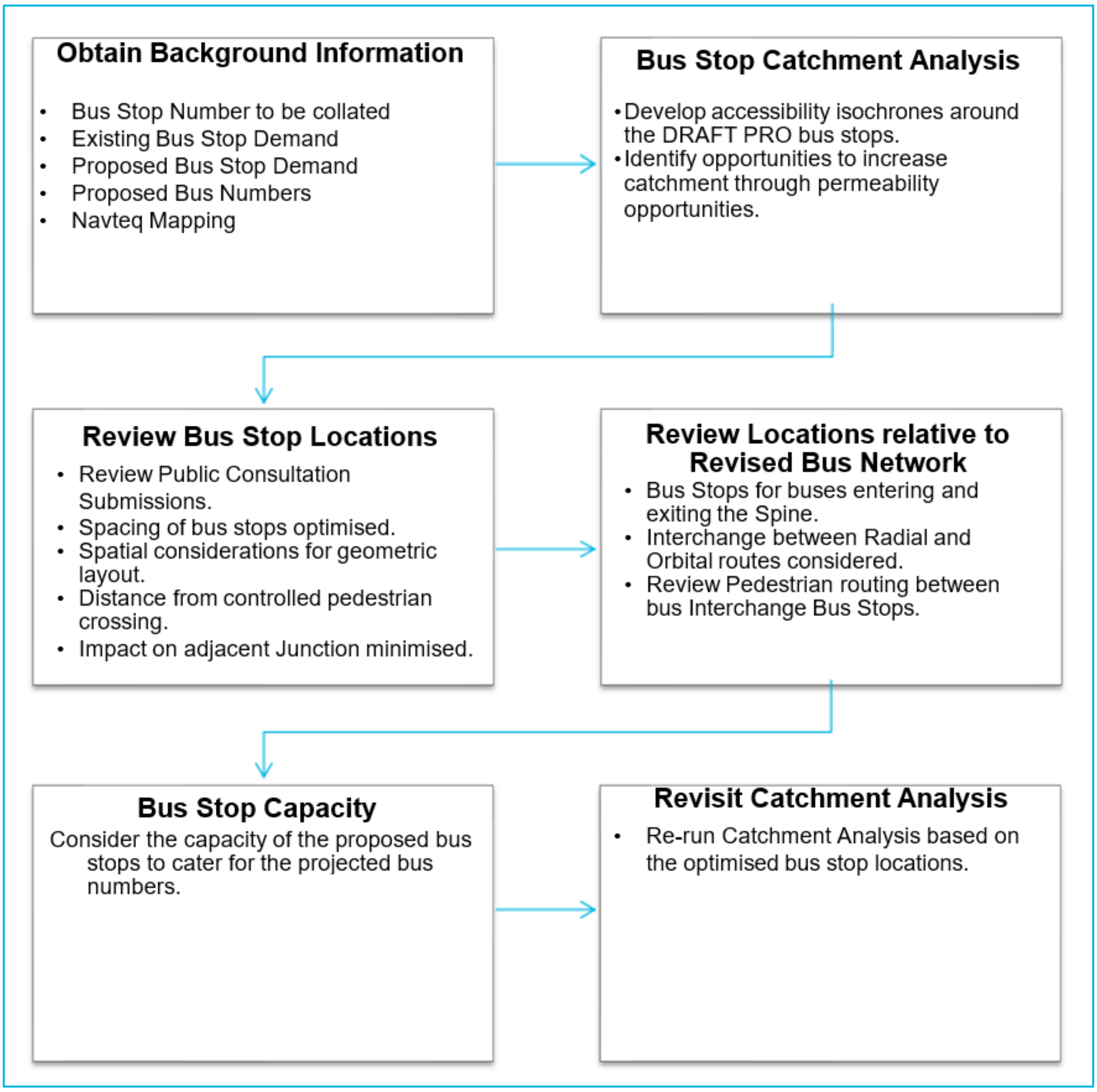

Figure 4-25: Bus Stop Location Assessment Process

The procedure for the assessment undertaken was set out in the Bus Stop Review Methodology document provided in Appendix H.1. Bus Stop Review Methodology.

The basic criteria for consideration when locating a bus stop are as follows:

- Driver waiting and passengers are clearly visible to each other;
- Located close to key 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.

The Core Bus Network Report concluded that increasing spacing between bus stops was part of the solution to reduce delays along the corridors. For BusConnects it is proposed that bus stops should be spaced approximately 400m apart on typical suburban sections on route, dropping to approximately 250m in urban centres. This spacing should be seen as recommended rather than an absolute minimum spacing.

It is important that bus stops are not located too far from pedestrian crossings as by nature pedestrians will take the quickest route. This may be hazardous and include jaywalking. Locations with no or indirect pedestrian crossings should be avoided, and their optimum placement should be a short distance from a controlled crossing point.

4.14.2 Bus Stop Summary

Table 4-6, below provides an overview of the key changes to the locations for bus stops along the Proposed Scheme. A more detailed breakdown of the bus stop review in addition to the catchment analysis outputs is provided in Appendix H.2. Bus Stop Review Analysis. Where specific feedback in relation to bus stops from the public consultation process has been provided this has been acknowledged in the assessment.

Table 4-6: Bus Stop Summary

Inbound							
Existing				Proposed			
No.	Bus Stop No.	Chainage	Distance between Stops (meters)	No.	Bus Stop No. / Location	Chainage	Distance between Stops (meters)
1	4348	A105	N/A	1	4348 &Tallaght Bus Interchange	A105	N/A
2	4646	A490	385	2	4646	A 490	385
3	4647	A690	200	3	New	A 820	330
4	4435	A1400	710	4	4435	A 1400	580
	2632	A1890 (Offline)	490		New	A 1935	535
5	2633	A 2480	590	5	2633	A 2470	535
6	2369	A 2980	500	6	2369	A 3000	530
7	2370	B 150	270	7	New	A 3360	360
8	2371	B 455	305	8	New	A 4250	890
9	2372	A 4065	510	9	New	A 4765	515
10	2373	C 310	440	10	New	A 5010	245
11	2377	A 5765	950	11	New	A 5370	360
12	2378	A 6030	265	12	2377	A 5765	395
13	2183	A 6450	420	13	2378	A 6030	265
14	2184	A 6620	170	14	2183	A 6450	420
15	2185	A 6770	150	15	2185	A 6790	340
16	1421	A 7275	505	16	1421	A 7275	485
17	1423	A 7345	70	17	1424	A 7550	275
18	7043	A 7395	50	18	2187	A 8265	715
19	1424	A 7550	155	19	2189	A 8710	445
20	2186	A 7855	305	20	1436	A 9015	305

Inbound							
Existing				Proposed			
No.	Bus Stop No.	Chainage	Distance between Stops (meters)	No.	Bus Stop No. / Location	Chainage	Distance between Stops (meters)
21	2187	A 8230	375	21	3952	A 9190	175
22	2188	A 8530	300	22	New	A 9525	335
23	2189	A 8740	210	23	4434	A 9780	255
24	1436	A 9015	275	24	2379	A 10120	340
25	3952	A 9180	165	25	2382	A 10590	470
26	2190	A 9350	170	26	5099	A 10750	160
27	4434	A 9780	430	27	2383	A 11050	300
28	2379	A 10160	380	28	New	A 11340	290
29	2380	A 10450	290				
30	2382	A 10590	140				
31	5099	A 10750	160				
32	2383	A 11050	300				
		Average Distance:	**343**			Average Distance:	**416**
33	6152	F40	N/A	x	Woodford Walk	x	N/A
34	6153	F660	620	1	6152	F0	N/A
35	6243	F1260	600	2	New	F900	900
36	6154	F1630	370	3	6243	F1335	435
37	6155	F2015	385	4	6154	F1615	280
38	1980	F2490	475	5	6155	F2085	470
39	1981	F2845	355	6	1981	F2845	760
40	2787	F3190	345	7	New	F2935	90
41	2181	F3480	290	8	2181	F3400	465
42	2182	F3750	270	9	2778	F3960	560
43	2778	F3960	210				
		Average Distance:	**392**			Average Distance:	**495**
Quietway							
1	2331	D1280	N/A	1	1397	E 230	N/A
2	1397	E 230	290	2	1398	E 475	245
3	1398	E 475	245	3	1399	E 795	320
4	1399	E 795	320	3	5148	E 1070	275
5	5148	E 1070	275	4	1402	E1445	375
6	1401	E 1260	190	5	1403	E 1900	455
7	1402	E 1445	185	6	1404	E2130	230
8	1403	E1900	455	7	1405	E 2370	240
9	1404	E2130	230				
10	1405	E 2370	240				
		Av. Distance:	**270**			Average Distance:	**357**

Outbound							
Existing				Proposed			
No.	Bus Stop No.	Chainage	Distance between Stops (meters)	No.	Bus Stop No. / Location	Chainage	Distance between Stops (meters)
1	4347	A50	N/A	1	Tallaght Bus Interchange	A125	N/A
2	4640	A510	460	2	4640	A520	395
3	4436	A1130	620	3	New	A820	300
4	2557	A1440	310	4	4436	A1130	310
5	2603	A1910 (Offline)	470	5	2557	A1440	310
6	4446	A2480	570	6	New	A1910	470
7	2601	A2865	385	7	4446	A2360	450
8	2340	B150	380	8	2601	A2850	490
9	2339	B395	245	9	2340	B150	400
10	2337	A3925	435	10	New	A4130	880
11	2336	C100	375	11	New	A4600	470
12	2335	C460	360	12	New	A4900	300
13	4662	C700	240	13	New	A5440	540
14	2334	A5710	505	14	2334	A5690	250
15	2333	A6000	290	15	2333	A6015	325
16	2332	A6355	355	16	2332	A6370	355
17	2103	A6500	145	17	New	A6705	335
18	2102	A6880	380	18	New	F4190	-
19	2101	A7430	550	19	2101	A7440	735
20	2099	A7550	120	20	2096	A8250	810
21	2097	A8060	510	21	New	A8735	485
22	2096	A8270	210	22	1409	A8950	215
23	2095	A8580	310	23	1407	A9180	230
24	1409	A8950	370	24	1406	A9420	240
25	1407	A9180	230	25	2094	A9670	250
26	1406	A9430	250	26	2315	A10120	450
27	2094	A9660	230	27	2313	A10590	470
28	2315	A10110	450	28	2312	A10810	220
29	2314	A10420	310	29	New	A11145	335
30	2313	A10590	170	30	2385	A11390	245
31	2312	A10810	220				
32	2385	A11390	580				
		Average Distance:	**356**			Average Distance:	**402**
33	6149	F650	N/A	1	New	F110	N/A
34	6147	F1260	610	2	New	F900	790
35	6146	F1630	370	3	6147	F1350	450
36	6145	F2015	385	4	6146	F1650	300

Outbound							
Existing				Proposed			
No.	Bus Stop No.	Chainage	Distance between Stops (meters)	No.	Bus Stop No. / Location	Chainage	Distance between Stops (meters)
37	1958	F2480	465	5	6145	F2150	500
38	1957	F2660	180	6	1956	F2885	735
39	1956	F2900	240	7	New	F2920	35
40	2780	F3110	210	8	New	F3285	365
41	2105	F3590	480	9	2727	F3900	615
42	2727	F3900	310				
43	2726	F4060	160				
		Average Distance:	**341**			Average Distance:	**474**
Quietway							
1	2317	D1130	N/A	1	2317	D1130	N/A
2	1396	E160	365	2	1396	E160	365
3	7414	E425	265	3	7414	E415	255
4	1442	E680	255	4	1442	E680	265
5	1441	E960	280	5	1441	E970	290
6	3356	E1110	150	6	3356	E1110	140
7	3355	E1320	210	7	1389	E1480	370
8	1389	E1480	160	8	1388	E1780	300
9	1388	E1780	300	9	1387	E2110	330
10	1387	E2110	330	10	1386	E2330	220
11	1386	E2330	220				
		Average Distance:	**254**			Average Distance:	**282**

4.14.3Island Bus Stops

The preferred bus stop arrangement for the Proposed Scheme is the island bus stop arrangement, Figure 34 of the BCPDGB, is shown below in Figure 4-26.

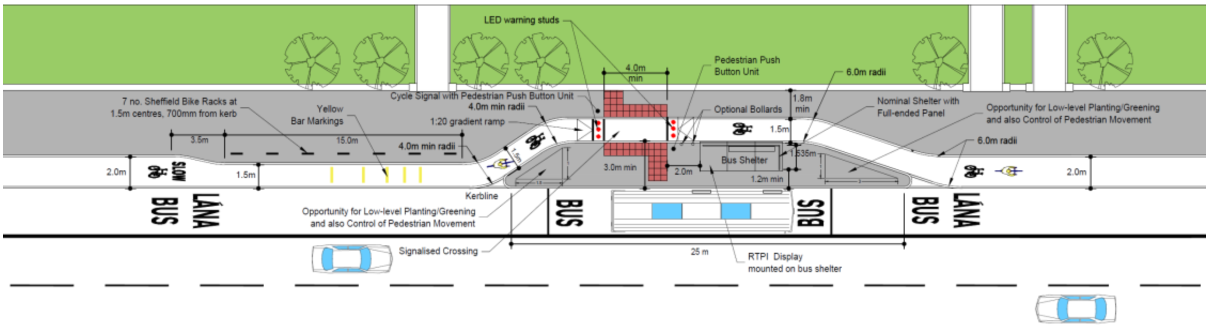

Figure 4-26: Example of an Island Bus Stop

This arrangement will reduce the potential for conflict between pedestrians, cyclists and stopping buses by deflecting cyclists behind the bus stop, thus creating an island area for boarding and alighting passengers. On approach to the bus stop island the cycle track is intentionally narrowed with yellow bar markings also used to promote a low speed single file cycling arrangement on approach to the bus stop. Similarly, a 1 in 1.5 typical cycle track deflection is implemented on the approach to the island to reduce speeds for cyclists on approach to the controlled pedestrian crossing point on the island. To address the potential pedestrian/cyclist conflict, a pedestrian priority crossing point is provided for pedestrians accessing the bus stop island area. At these locations a 'nested Pelican' sequence similar to what has been provided on the Grand Canal Cycle Route could be introduced so that visually impaired or partially sighted pedestrians may call for a fixed green signal when necessary and the cycle signal will change to red. Where the pedestrian call button has not been actuated the cyclists will be given a flashing amber signal to enforce the requirement to give way to passing pedestrians. A schematic outline of the nested pelican sequence is provided below in Figure 4-27. Audible tactile units could also be featured at the crossing points.

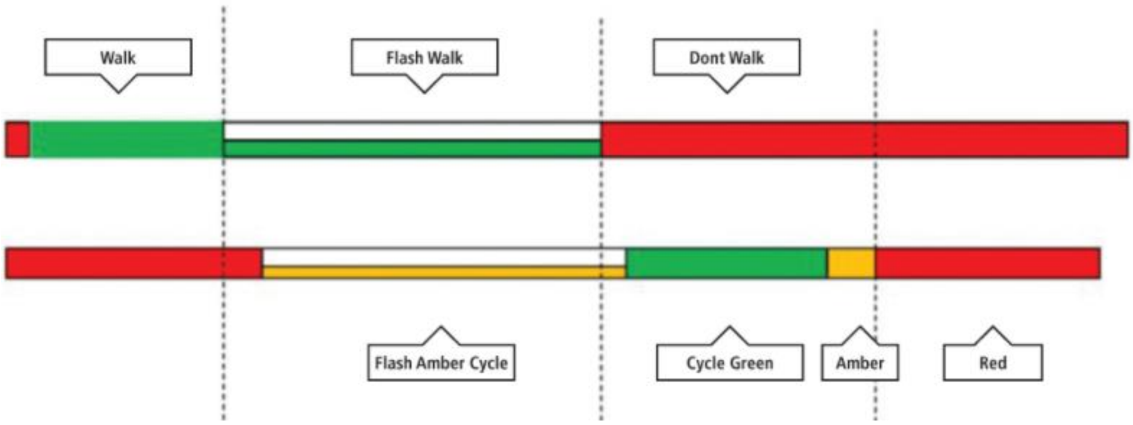

Figure 4-27: Example of Nested Pelican Sequence

A 1:20 ramp is provided on the cycle track to raise the cycle track to the level of the footway/island area onto a 4m wide crossing. Suitable tactile paving is also provided at the crossing point in addition a series of LED warning studs are provided at the crossing location which are actuated by bus detector loops in the bus lane. The exit taper for the bus stop has been nominated at 1 in 3 to provide for a gradual transition to the cycle track.

The desired minimum island width of 3m (2.4m absolute minimum) has been provided to accommodate the provision of a full end panel shelter and nominal length of 25m to accommodate a 19m typical bus cage arrangement and adjusted to suit the site constraints (e.g. between driveway entrances). The residual bus stop triangular island arrangements can also be used for areas of planting or SuDS as these areas are not intended for pedestrian circulation and will also help promote directing pedestrians towards the designated crossing point in addition to improving the passenger waiting area environment. Bike racks should also be located, where practicable, in the immediate vicinity as shown in Figure 4-28 to promote the use sustainable mode interchange at bus stops for longer distance trips.

Figure 4-28: Example Landscaping Arrangement at Island Bus Stops on Oxford Road Manchester (source: Google Street View 2021)

The island bus stop design is used for the majority of the bus stops along the Proposed Scheme, additional information on the island bus stop design principles can be found in the BCPDGB. Table 4-7, below, provides a summary of the proposed island bus stop locations.

Table 4-7: List of Island Bus Stops

Citybound/ Outbound	Bus Stop Name	Bus Stop No.	Chainage	Bus Stop Type
Citybound	Old Blessington Road, Tallaght Hospital	4646	A 490	Island Bus Stop (2.9m Island)
Citybound	Greenhills Road, Airton Road	2633	A 2470	Island Bus Stop (2.5m Island)
Citybound	Greenhills Road, Mayberry Road	2369	A 3000	Island Bus Stop (2.4m Island)
Citybound	Greenhills Road, Park View	New	A 3360	Island Bus Stop (2.4m Island)
Citybound	Ballymount Avenue	New	A 4250	Island Bus Stop (2.4m Island)
Citybound	Calmount Road, Ballymount Court	New	A 5370	Island Bus Stop (2.4m Island)
Citybound	Greenhills Road, Walkinstown Roundabout	2377	A 5765	Island Bus Stop (2.4m Island)
Citybound	Drimnagh Road, Crumlin Hospital	1424	A 7550	Island Bus Stop (2.4m Island)
Citybound	Cork Street, Marion Villas	2379	A 10120	Island Bus Stop (2.8m Island)
Citybound	Nangor Road Business Centre	New	F 900	Island Bus Stop (2.75m Island)
Citybound	Naas Road, Luas Kylemore	1981	F 2845	Island Bus Stop (2.8m Island)
Citybound	Naas Road, Luas Kylemore	New	F 2935	Island Bus Stop (2.7m Island)
Citybound	Long Mile Road, Walkinstown Avenue	2181	F 3400	Island Bus Stop (4.2m Island)
Citybound	Long Mile Road, Drimnagh Castle	2778	F 3960	Island Bus Stop (3.2m Island)
Outbound	Greenhills Road, Airton Road	4446	A 2360	Island Bus Stop (2.4m Island)
Outbound	Greenhills Road, Tymonville	2340	A 3310	Island Bus Stop (2.4m Island)
Outbound	Greenhills Road, Tibradden Drive	New	A 4130	Island Bus Stop (2.4m Island)
Outbound	Calmount Road, Ballymount Court	New	A 5440	Island Bus Stop (2.4m Island)
Outbound	Drimnagh Road, St. Mary's Road	2101	A 7440	Island Bus Stop (2.5m Island)
Outbound	Patrick Street, Back Avenue	2385	A 11390	Island Bus Stop (2.4m Island)

Citybound/ Outbound	Bus Stop Name	Bus Stop No.	Chainage	Bus Stop Type
Outbound	Kildare Road, Pearse Park	1396	E160	Island Bus Stop (Quietway)
Outbound	Kildare Road, Windmill Road	7414	E415	Island Bus Stop (Quietway)
Outbound	New Nangor Road, Riverview Business Centre	New	F 900	Island Bus Stop (2.4m Island)
Outbound	Nangor Road, Killeen Road	6145	F 2150	Island Bus Stop (2.4m Island)
Outbound	Naas Road, Luas Kylemore	1956	F 2885	Island Bus Stop (2.8m Island)
Outbound	Naas Road, Luas Kylemore	New	F 2920	Island Bus Stop (3.1m Island)
Outbound	Long Mile Road, Drimnagh Castle	2727	F 3900	Island Bus Stop (2.4m Island)

4.14.4 Shared Bus Stop Landing Zone

Where space constraints do not allow for an island bus stop, an option consisting of a shared bus stop landing zone will be considered. The principles of this arrangement are similar to those described in Section 4.14. The use of corduroy tactile paving on the cycle track is additional in this arrangement to help facilitate awareness and reduce speeds in lieu of the 1:1.5 deflection provision for the island bus stop. The cycle track will also be narrowed when level to the footway and tactile paving provided to minimise pedestrian/cyclist conflict. An example of a shared landing area bus stop is shown in Figure 4-29.

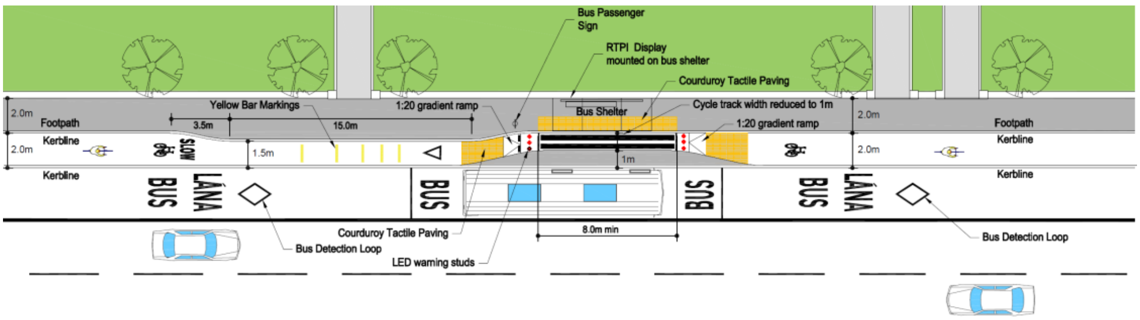

Figure 4-29: Example of a Shared Bus Stop Landing Zone

Shared bus stop landing zones are required in a number of locations along the Proposed Scheme due to localised space constraints. See Table 4-8, below, for the locations of bus stops of this type.

Table 4-8: List of Shared Landing Area Bus Stops

Citybound/ Outbound	Bus Stop Name	Bus Stop No.	Chainage	Bus Stop Type
Citybound	Belgard Square East	New	A 820	Shared Landing Bus Stop
Citybound	Calmount Road	New	A4765	Shared Landing Bus Stop

Citybound/ Outbound	Bus Stop Name	Bus Stop No.	Chainage	Bus Stop Type
Citybound	Calmount Road, Calmount Avenue	New	A5010	Shared Landing Bus Stop
Citybound	Crumlin Hospital	1421	A7275	Shared Landing Bus Stop
Citybound	Cork Street, Coombe Hospital	4434	A9780	Shared Landing Bus Stop
Citybound	St. Luke's Avenue, Brabazon Row	2382	A10590	Shared Landing Bus Stop
Citybound	St. Luke's Avenue, Newmarket Street	5099	A10750	Shared Landing Bus Stop
Citybound	Patrick Street, St. Patrick's Cathedral	2383	A11050	Shared Landing Bus Stop
Citybound	Nicholas Street, Ross Road	New	A11340	Shared Landing Bus Stop
Citybound	Nangor Road, Woodford Walk	6152	F 0	Shared Landing Bus Stop
Citybound	Nangor Road, Willow Road	6243	F 1335	Shared Landing Bus Stop
Citybound	Nangor Road, Knockmitten Lane	6154	F 1615	Shared Landing Bus Stop
Citybound	Nangor Road, Killeen Road	6155	F 2085	Shared Landing Bus Stop
Outbound	Old Blessington Road, Tallaght Hospital	4640	A 520	Shared Landing Bus Stop
Outbound	Belgard Square East	New	A 820	Shared Landing Bus Stop
Outbound	Greenhills Road, Mayberry Road	2601	A 2850	Shared Landing Bus Stop
Outbound	Ballymount Avenue	New	A 4600	Shared Landing Bus Stop
Outbound	Calmount Road, Calmount Avenue	New	A 4900	Shared Landing Bus Stop
Outbound	Greenhills Road, Mulcahy Keane	2334	A 5690	Shared Landing Bus Stop
Outbound	Long Mile Road, Slievebloom Park	New	F 4190	Shared Landing Bus Stop
Outbound	Dolphin's Barn, South Circular Road	1406	A 9420	Shared Landing Bus Stop
Outbound	Cork Street, Coombe Hospital	2094	A9670	Shared Landing Bus Stop
Outbound	Cork Street, Donore Avenue	2315	A 10120	Shared Landing Bus Stop
Outbound	St. Luke's Avenue, Ardee Court	2313	A 10590	Shared Landing Bus Stop
Outbound	St. Luke's Avenue, The Coombe	2312	A 10810	Shared Landing Bus Stop

Citybound/ Outbound	Bus Stop Name	Bus Stop No.	Chainage	Bus Stop Type
Outbound	Patrick Street, St. Patrick's Cathedral	New	A 11145	Shared Landing Bus Stop (No Shelter)
Outbound	New Nangor Road, Woodford Walk	New	F 110	Shared Landing Bus Stop
Outbound	Nangor Road, Willow Road	6147	F 1350	Shared Landing Bus Stop
Outbound	Nangor Road, Knockmitten Lane	6146	F 1650	Shared Landing Bus Stop
Outbound	Walkinston Avenue	New	F 3285	Shared Landing Bus Stop
Outbound	Kildare Road, Clonard Road	1442	E680	Shared Landing Bus Stop
Outbound	Kildare Road, Bangor Road	1441	E970	Shared Landing Bus Stop
Outbound	Clogher Road, Bangor Road	3356	E1110	Shared Landing Bus Stop
Outbound	Clogher Road, St. Bernadette's Church	1389	E1480	Shared Landing Bus Stop
Outbound	Clogher Road, Goldstone Court	1388	E1780	Shared Landing Bus Stop
Outbound	Clogher Road, Aughavanagh Road	1387	E2110	Shared Landing Bus Stop
Outbound	Clogher Road, Parnell Road	1386	E2330	Shared Landing Bus Stop
Quietway				
Citybound	St Mary's Road, Crumlin Bowling Club	2317	D 1130	Shared Landing Bus Stop
Citybound	Kildare Road, Pearse Park	1397	E230	Shared Landing Bus Stop
Citybound	Kildare Road, Windmill Road	1398	E 475	Shared Landing Bus Stop
Citybound	Kildare Road, Clonard Road	1399	E 795	Shared Landing Bus Stop
Citybound	Kildare Road, Bangor Road	5148	E 1070	Shared Landing Bus Stop
Citybound	Clogher Road, Sundrive Road	1402	E 1445	Shared Landing Bus Stop
Citybound	Clogher Road, Rutland Avenue	1403	E 1900	Shared Landing Bus Stop
Citybound	Clogher Road, Aughavanagh Road	1404	E 2130	Shared Landing Bus Stop
Citybound	Clogher Road, Parnell Road	1405	E 2370	Shared Landing Bus Stop

4.14.5 Inline Bus Stop

Inline bus stops are used on the Proposed Scheme where there are no adjacent cycling facilities provided and where the users departing the bus exit straight on the footway. Inline bus stops are provided at the following locations listed in Table 4-9.

Table 4-9: List of Inline Bus Stops Tallaght to City Centre Section

Citybound/ Outbound	Bus Stop Name	Bus Stop No.	Chainage	Bus Stop Type
Citybound	Tallaght Road, Tallaght Village	4435	A 1400	Inline Bus Stop
Citybound	Old Greenhills Road, Tallaght	New	A 1935	Inline Bus Stop
Citybound	Walkinstown Road, Walkinstown Drive	2378	A 6030	Inline Bus Stop
Citybound	Walkinstown Road, Shopping Centre	2183	A 6450	Inline Bus Stop
Citybound	Crumlin Road, Iveagh Grounds	2187	A 8265	Inline Bus Stop
Citybound	Crumlin Road, Crumlin Shopping Centre	2189	A 8710	Inline Bus Stop
Citybound	Crumlin Road, Herberton Road	1436	A 9015	Inline Bus Stop
Citybound	Crumlin Road, Dolphin Road	3952	A 9190	Inline Bus Stop
Citybound	Dolphin Barn Street	New	A 9525	Inline Bus Stop
Outbound	Blessington Road, Institute of Technology	4436	A1130	Inline Bus Stop
Outbound	Tallaght Village, Old Bawn Road	2557	A1440	Inline Bus Stop
Outbound	Old Greenhills Road, Tallaght	New	A1910	Inline Bus Stop
Outbound	Walkinstown Road, Walkinstown Roundabout	2333	A6015	Inline Bus Stop
Outbound	Walkinstown Road, Kilnamanagh Road	2332	A6370	Inline Bus Stop
Outbound	Walkinstown Road, Drimnagh Road	New	A6705	Inline Bus Stop
Outbound	Crumlin Road, Clonard Road	2096	A8250	Inline Bus Stop

Citybound/ Outbound	Bus Stop Name	Bus Stop No.	Chainage	Bus Stop Type
Outbound	Crumlin Road, Crumlin Shopping Centre	New	A8735	Inline Bus Stop
Outbound	Crumlin Road, Sundrive Road	1409	A8950	Inline Bus Stop
Outbound	Crumlin Road, Rutland Avenue	1407	A9180	Inline Bus Stop

4.14.6 Layby Bus Stops

Layby bus stops can provide an effective solution for coaches with long dwell times at bus stops. However as stated in the Preliminary Design Guidance Booklet for BusConnects; urban area bus stop laybys, when re-entering general traffic lanes, can present significant operational problems and negative impacts for bus users and should only be used where there are compelling safety or road capacity reasons.

An example of a layby landing zone bus stop arrangement is shown in Figure 4-30.

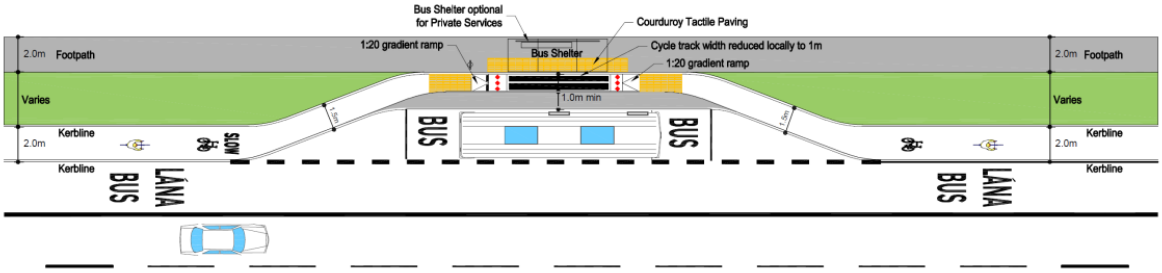

Figure 4-30: Example of a Layby Bus Stop

Layby bus stops are used on the Proposed Scheme at locations shown in Table 4-10 below.

Table 4-10: List of Layby Bus Stops

Citybound/ Outbound	Bus Stop Name	Bus Stop No.	Chainage	Bus Stop Type
Citybound	Old Blessington Road, The Square	4348	A 105	Layby Bus Stop
Citybound	Naas Road, Luas Kylemore	1981	F 2845	Layby Bus Stop
Citybound	Naas Road, Luas Kylemore	New	F 2935	Layby Bus Stop
Outbound	Greenhills Road, Mulcahy Keane	2334	A 5690	Layby Bus Stop
Outbound	Greenhills Road, Mulcahy Keane	New	F 2920	Layby Bus Stop

4.14.7 Bus Shelters

Bus shelters provide an important function in design of bus stops. The shelter will offer protection for people from poor weather, with lighting to help them feel more secure. Seating is provided to assist ambulant disabled and older passengers and accompanied with Real Time Passenger Information (RTPI) signage to provide information on the bus services. The locations of the bus shelters have been presented on the GEO_GA General Arrangement drawing series in Appendix B Preliminary Design Drawings.

The optimum configuration that provides maximum comfort and protection from the elements to the traveling public is the 3-Bay Reliance 'mark' configuration with full width roof. This shelter is a relatively new arrangement which has been developed by JCDecaux in conjunction with the NTA. The shelter consists mainly of a stainless-steel structure with toughened safety glass and extruded aluminium roof beams. Figure 4-31 below provides an example image of the preferred full end panel shelter arrangement. The desirable minimum footway/island widths required to accommodate the full end panel shelter is 3.3m with an absolute minimum width of 3m to facilitate a min. 1.2m clearance at the end panel for pedestrians. Alternative arrangements for more constrained footway widths are considered in the following sections.

Figure 4-31: Example of a 3-Bay Reliance Full End Panel Bus Shelter (Source: JCDecaux)

The cantilever shelter using full width roof and half end panel arrangement provides a second alternative solution for bus shelters in constrained footway locations. Figure 4-32 below provides an example of this type of shelter. Advertising panels in this arrangement are normally located on the back façade of the shelter compared to the full end panel arrangement. The desirable minimum footway/island widths required to accommodate the full end panel shelter is 2.75m with an absolute minimum width of 2.4m to facilitate a min. 1.2m clearance at the end panels for pedestrians.

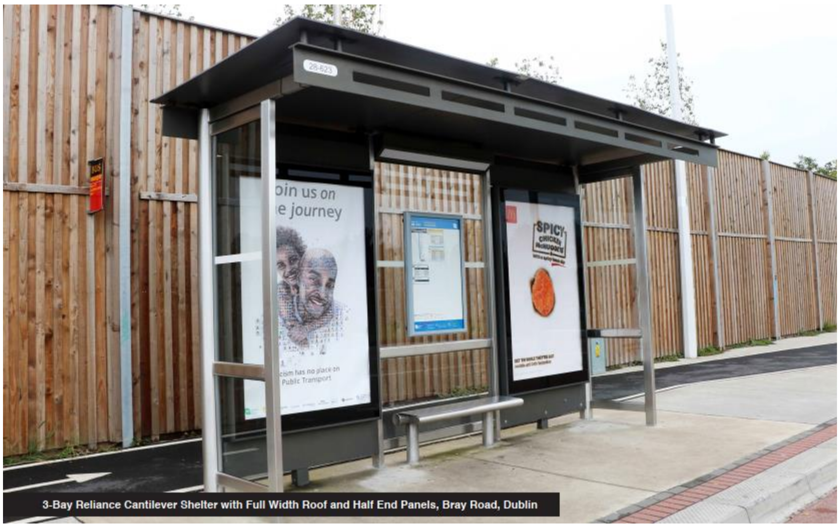

Figure 4-32: Example of a 3-Bay Reliance Cantilever Shelter with Full Width Roof and Half End Panels (Source: JCDecaux)

Two alternative narrow roof shelter configurations are also available which offer reduced protection against the elements compared to the full width roof arrangements. These shelter configurations are not preferred but do provide an alternative solution for particularly constrained locations where cycle track narrowing to min 1m width has already been considered and 2.4m widths cannot be achieved to facilitate the full width roof with half end panel shelter or for locations where the surrounding environment may offer protection against the elements. The desirable minimum footway widths for the narrow roof configuration are 2.75m (with end panel) and 2.1m (no end panel). The absolute minimum footway widths for these shelters are 2.4m (with end panel) and 1.8m (no end panel) to requirements for boarding and alighting passengers in consideration of wheelchair, pram, luggage and other such similar spatial requirements.

Figure 4-33: Example of a 3-Bay Reliance Cantilever Shelter with Narrow Roof Configuration with and without Half End Panels (Source: JCDecaux)

The siting of bus shelters also requires due consideration on a case by case basis. Ideally bus shelters should be located on the island bus stop boarding/alighting area where space permits. Where this is not feasible, the shelters should be located parallel to the island to the rear of the footway. Where bus shelters cannot be located directly on the dedicated island or parallel to the island due to spatial and or other constraints, they should ideally be located downstream of the stop area. This will inherently promote eye to eye contact between boarding passengers and oncoming cyclists and buses when signalling the bus and also improve the courtesy arrangement for segregation of boarding and alighting passengers. Examples from each of these scenarios are shown below.

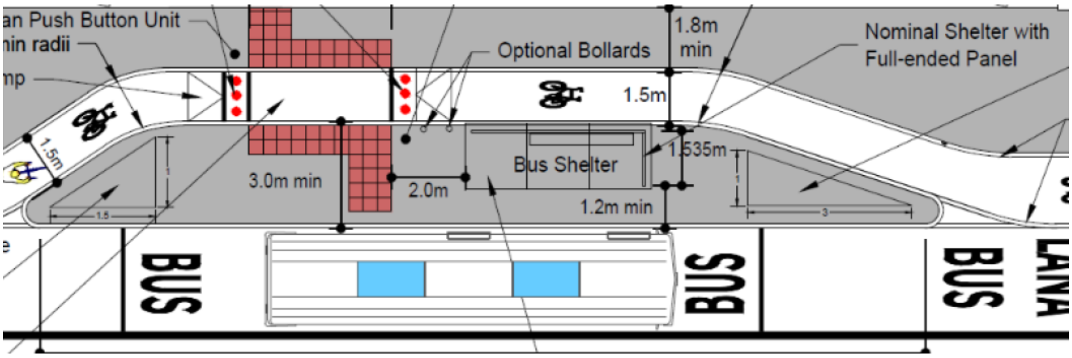

Figure 4-34: Preferred Shelter Location (On Island)

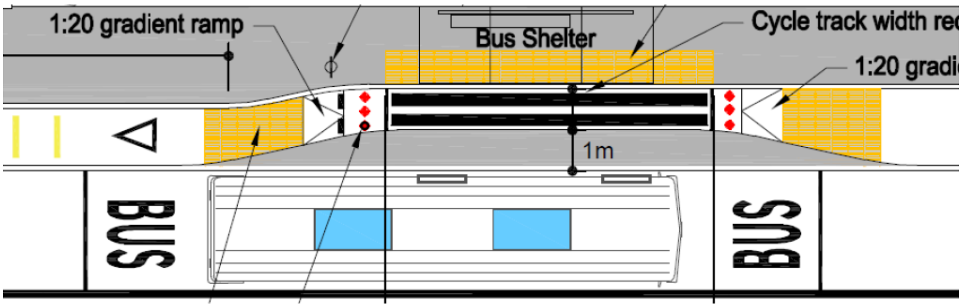

Figure 4-35: Alternative Shelter Location Back of Footway (Narrow Island with Adequate Footway Widths)

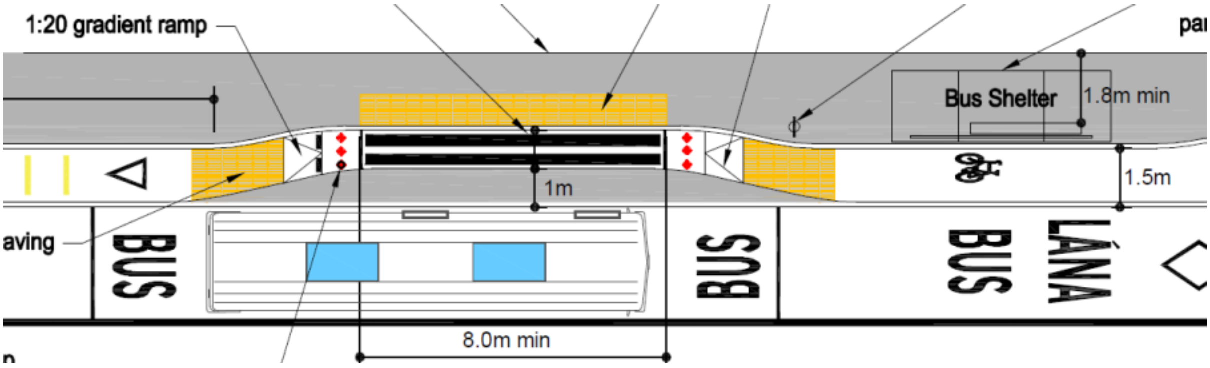

Figure 4-36: Alternative Shelter Location Downstream of Island (Narrow Island with Narrow Footway Widths at Landing Area)

4.15 Parking and Loading

4.15.1 Overview

As part of the ongoing assessment of existing conditions to support the development of the engineering design along the Proposed Scheme, a parking survey assessment was undertaken to assess the existing loading and parking arrangements and potential alternatives along the Proposed Scheme.

Appendix G Desktop Parking Studies provides the details of the Parking and Loading Report.

The report was prepared in the absence of parking survey data, which cannot be obtained due to ongoing movement restrictions as a result of the international Covid-19 pandemic, information was obtained by site visits and desktop studies. Quantification of the number of existing parking spaces and their potential removal along the scheme is a critically important task, as removal of parking without provision of viable replacement options may result in a reduction in the cross-sectional width of the design.

Below is an overview of the methodology in assessing the parking impacts along the Proposed Scheme:

- Review the existing parking arrangements on the road network or immediately adjacent to the proposed scheme;
- Assess the impacts associated with the current design proposals;
- Identify practicable mitigation measures / alternative parking arrangements;
- Analyse mitigation measure to inform the optimum recommendation; and
- Provide recommendations and residual parking impacts.

In assessing the Proposed Scheme the following parking/loading classifications were adopted:

- Designated Paid Parking;
- Permit Parking;
- Disabled Permit Parking;
- Loading/Unloading (in designated Loading Bays);
- Loading/Unloading (outside designated Loading Bays);
- Taxi Parking (Taxi Ranks);
- Commercial vehicles parked for display (car sales); and
- Illegal Parking

In addition to the above consideration for other parking usage/ behaviour has been analysed under the following classifications:

- Informal Parking: On-street parking in which spaces may or may not be marked and in which the Local Authority does not charge for use; and
- Adjacent Parking: Parking which is located in close proximity to the street. This parking includes free and pay parking and also highlights car parks which may be affected by future design proposals.

4.15.2 Summary of Parking Amendments

The locations for existing and proposed parking/loading modifications in line with the Proposed Scheme have been identified on the GEO_GA General Arrangement drawings in Appendix B Preliminary Design Drawings and further discussed in detail in the Parking Study Report Appendix G Desktop Parking Studies. The following table provides a summary of the key residual parking/loading impacted areas along the Proposed Scheme.

The proposed changes in parking provision are summarised in Table 4-11, below.

Table 4-11: Summary of Parking Amendments

Locality	Parking type	Existing Parking Provision	Proposed Parking Provision	Change
Belgard Square	Adjacent Parking	6000 approx.	5935 approx.	-65
	Loading Bay	0	3	3
Main Road / Old Greenhills Road	Designated Paid Parking	34	14	-20
	Disabled Permit Parking	2	1	-1
	Illegal Parking	2 approx.	0	-2 approx.
Greenhills Road – West of M50 Bridge	Adjacent Parking	920 approx.	908 approx.	-12
Calmount Road	Informal Parking	35	0	-35
Greenhills Road between Calmount Road and Walkinstown Roundabout	Illegal Parking	14 approx.	0	-14 approx.
	Adjacent Parking	450	389	-61
Walkinstown Roundabout	Illegal Parking	3	0	-3
	Informal Parking	30	28	-2
	Adjacent Parking	88	53	-35
	Taxi Parking	9	4	-5
Walkinstown Road	Illegal Parking	7 approx.	0	-7
	Adjacent Parking	281	254	-27
Drimnagh Road	Illegal Parking	17 approx.	0	-17 approx.
	Informal Parking	63	18	-45
Crumlin Road	Taxi Parking (Taxi Rank)	12	5	-7
	Illegal Parking	16 approx.	0	-16
	Informal parking	54	41	-13
	Adjacent Parking	983	981	-2
Dolphin's Barn/Cork Street/St. Luke's Avenue	Designated paid Parking	51	44	-7
	Illegal Parking	34 approx.	0	-34 approx.
	Adjacent Parking	317	305	-12
Dean Street / Patrick Street / Christchurch	Loading/Unloading (in designated Loading Bays)	10	9	-1
	Illegal Parking	4	0	-4
Bunting Road / St. Mary's Road / Kildare Road / Clogher Road	Illegal Parking	136 approx.	0	-136 approx.
	Informal Parking	111 approx.	67	-44 approx.
New Nangor Road between Willow Road and Naas Road junction	Informal Parking	7	0	-7
	Adjacent Parking	831 and 35 HGV approx.	821 and 31 HGV approx.	-10 and -4 HGV approx.
New Nangor Road / Naas Road / Long Mile Road junction	Adjacent Parking	857 and 157 HGV approx.	745 and 154 HGV	-112 and -3 HGV approx.
Naas Road and Walkinstown Avenue between New Nangor Road junction and Long Mile Road junction	Illegal Parking	6 approx.	0	-6 approx.
	Informal Parking	9 approx.	0	-9 approx.
Long Mile Road between Walkinstown Avenue junction and Slievebloom Park junction	Illegal Parking	20 approx.	0	-20 approx.
	Informal Parking	26 approx.	9	-17 approx.

4.15.3 Summary of Parking Impact

With BusConnects infrastructure in place, the impacts of the change in on-street parking have been considered and are itemised below (in summary);. Aspects of the Proposed Scheme and network proposals are expected to mitigate the reduction in parking by reducing reliance on private cars due to availability of an improved bus network with journey reliability, and by availability of improved cycling infrastructure. Other location specific measures are also summarised below.

- In the Belgard Square and Tallaght Village area, the existing car park serving The Square Shopping Centre will have its parking space capacity reduced by approximately 65 parking spaces. On Main Road and the Old Greenhills Road 17 designated parking spaces and 1 disabled permit parking bay will be lost.
- On Greenhills Road west of the M50 bridge the Proposed Scheme will affect existing parking at Westpark Fitness. where 12 adjacent car parking spaces will be removed.
- In the area east of the M50 bridge to the Walkinstown Roundabout there is a mixture of informal parking, illegal parking and adjacent parking affected by the proposed scheme. The informal parking on Calmount Road will be lost due to the requirement for inbound and outbound bus lanes at this location, the nature of the existing informal parking is unknown. The adjacent parking at DPD Depot, B & Q Quality Home Products and Parts for Cars will be reduced by approximately 61 spaces.
- At Walkinstown Roundabout the scheme will require the loss of 2 informal parking spaces and approximately 35 adjacent parking spaces.
- On Walkinstown Road the scheme will result in the loss of 42 customer car parking spaces at the SuperValu Shopping Centre, which will be mitigated by placing 15 parallel parking bays where the perpendicular parking spaces are lost.
- On Drimnagh Road and Crumlin Road the scheme will result in the loss of 7 Taxi Rank spaces, 58 informal parking spaces and 2 adjacent parking spaces. As mitigation for this loss of taxi parking spaces, it may be possible to provide taxi parking at the Crumlin Shopping Centre road frontage in consultation with stakeholders, the Crumlin Shopping Centre is currently being redeveloped.
- Between Dolphin's Barn and Christchurch Place the scheme will result in the loss of 7 designated parking spaces, 1 loading/unloading bay and 12 adjacent parking spaces.
- On the Quietway along Bunting Street, St. Mary's Road, Kildare Road and Clogher Road the proposed scheme will result in the loss of approximately 44 informal parking spaces. Mitigation for the loss of the existing 108 informal parking spaces is provided with 67 informal parking spaces on Kildare Road.
- On New Nangor Road the proposed scheme will result in the loss of 7 informal parking spaces and approximately 10 adjacent parking spaces. No mitigation is proposed for the loss of the 7 informal parking spaces at the New Nangor Road / Killeen Road junction as cars are parked on grass verge.
- At the New Nangor Road / Naas Road / Long Mile Road junction approximately 112 car parking and 3 HGV trailer spaces will be lost due to the proposed pedestrian / cycle bridge to be constructed over the junction as part of the scheme. As there appears to be sufficient existing adjacent parking space available at Woodies Naas Road and Hino/DHL properties no mitigation measures are proposed.
- On the Long Mile Road the proposed scheme will result in the loss of 17 informal parking spaces. Nine of the spaces being removed are associated with private commercial premises. No mitigation is proposed for the removal of four parking spaces at Walkinstown Parade as residences affected will still have available parking in the vicinity.

4.16 Turning Bans and Traffic Management Measures

Turning bans and other traffic management measures will be implemented on the route to direct traffic away from either the Proposed Scheme corridor (to maximise bus journey time reliability) or to limit use of side streets as a short-cut route by through traffic. All these measures are shown on the General Arrangement Drawings within Appendix B Preliminary Design Drawings.

For the southern end of the Proposed Scheme the existing speed limit on Belgard Square West is 50kph which continues through to the start of the Old Greenhills Road in Tallaght Village where an existing 30kph speed limit is posted. At the end of the Old Greenhills Road where the Greenhills Road (R819) intersects, the existing speed limit of 50kph is maintained as far as the Crumlin Road R110 at the junction of Cooley Road, where a reduced speed limit of 30kph is posted. This 30kph posted speed limit continues on the Crumlin Road R110 until the Grand Canal where the existing 50kph speed limit is maintained.

The Old Greenhills Road at Tymon Park will have the existing speed limit of 60kph reduced to a posted speed limit of 50kph. On Bunting Road, the existing 30kph speed limit will be maintained. On Kildare Road and Clogher Road the existing 50kph speed limit will be maintained.

On the New Nangor Road R134 at the Woodford Walk junction the existing 60kph speed limit is maintained as far as the Naas Road R810 / Walkinstown Avenue R112 junction. After this junction the existing 60kph speed limit on Walkinstown Avenue R112 is to be maintained as far as the Long Mile Road R110 junction where the existing 50kph speed limit is maintained. The 60kph speed limit on the Long Mile Road is maintained as far as Walkinstown Parade where the existing 50kph speed limit is maintained.

A summary of the turning bans and access restrictions along the route are shown in Table 4-12

Table 4-12: Summary of Turning Bans

Chainage	Minor Road	Major Road	Existing / Proposed	Turning Ban	Notes
A-50	Old Blessington Road	Cookstown Way	Existing	No right turn onto major road	Existing restrictions retained
A-50	Belgard Square South	Cookstown Way	Existing	No left turn onto minor road	Existing restrictions retained
A0	Belgard Square West (Bus Gate)	Belgard Square South	Proposed	No left turn onto minor road	Revised junction. Only buses allowed to exit major road turning left
A0	Belgard Square West (Bus Gate)	Belgard Square South	Proposed	No right turn onto minor road	Revised junction. Only buses allowed to exit major road turning right
A170	Tallaght Bus Interchange	Old Blessington Road	Proposed	No left turn onto Tallaght Bus Interchange	New Bus Interchange. Exit road only from Bus Interchange
A170	Belgard Square West (Bus Gate)	Old Blessington Road	Proposed	Bus Only left turn onto minor road both northbound and southbound	Existing left-turn restrictions revised to allow Bus Only left turn
A170	Belgard Square West (Bus Gate)	Old Blessington Road	Proposed	Bus Only right-turn onto minor road both northbound and southbound	Revised junction. Only buses allowed to exit major road turning left and right
A200	Belgard Square West (Bus Gate)	Old Blessington Road	Existing	No right turn and no left turn southbound onto major road	Existing restrictions retained
A750	Belgard Square North eastbound	Belgard Square East (Bus Gate)	Proposed	No right turn onto major road	Revised junction. Only buses allowed to exit minor road turning right

Chainage	Minor Road	Major Road	Existing / Proposed	Turning Ban	Notes
A790	Belgard Square North westbound	Belgard Square East (Bus Gate)	Proposed	No left turn onto major road	Revised junction. Only buses allowed to exit minor road turning left
A840	Commercial units access	Belgard Square East (Bus Gate)	Proposed	No left turn and no right turn for commercial units exiting	Revised egress with no left turn for unit on west side of major road and no right turn for unit on east side of major road exiting
A950	Belgard Square East	Blessington Road	Proposed	No right turn southbound onto major road	Revised junction. Turn ban used to regulate traffic flow
A950	Belgard Square East	Blessington Road	Existing	No right turn northbound onto major road	Existing restrictions retained
A1225	N/A	Blessington Road (Bus Gate)	Existing	Through route restricted to Bus Only	Existing restrictions retained
A1560	Blessington Road	Main Road Tallaght	Proposed	No right turn onto minor road	Revised junction. Only buses allowed to exit major road turning right
A1975	Old Greenhills Road (Bus Gate)	Greenhills Road	Proposed	Bus Only right-turn southbound onto minor road	Revised junction. Only Buses allowed to enter Old Greenhills Road
A2500	Hibernian Industrial Estate	Greenhills Road	Proposed	No right turn onto minor road	Revised junction. Turn ban used to regulate traffic flow
A2550	Harvey Norman Access Road	Greenhills Road	Proposed	No right turn onto minor road	Revised junction. Turn ban used to regulate traffic flow
A2750	Hibernian Industrial Estate	Greenhills Road	Proposed	No right turn onto major road	Revised junction. Turn ban used to regulate traffic flow
A3200	New Bus Route	Greenhills Road (Bus Gate)	Proposed	No right turn and no left turn onto bus route from major road	New junction
A3550	New Bus Route link road	Greenhills Road	Proposed	No access to bus route link road from major road and no left turn from bus route link road onto new bus route	New junctions
A3650	New Bus Route	Greenhills Road (Bus Gate)	Proposed	Bus only right turn onto bus route from major road	New junction
A3960	Ballymount Road Upper	Greenhills Road	Proposed	Junction closed to vehicular traffic	Revised junction. Ballymount Road Upper connection to Greenhills Road closed
A4200	Greenhills Road	Ballymount Avenue	Proposed	No right turn onto major road	Revised junction. Turn ban used to regulate traffic flow
D0	Bunting Road	Cromwellsfort Road	Proposed	No right turn onto minor road	Revised junction. Turn ban used to regulate traffic flow
A6390	Supervalu Walkinstown	Walkinstown Road	Proposed	No right turn onto car park (Peak Hours only)	Revised junction. Turn ban used to regulate traffic flow
A6420	Kilnamanagh Road	Walkinstown Road	Proposed	No right turn onto minor road (Except Buses)	Revised junction. Turn ban used to regulate traffic flow
A6740	Walkinstown Road	Long Mile Road	Existing	No left turn onto major road	Existing turn ban used to regulate traffic flow
A6810	Balfe Road	Drimnagh Road	Proposed	No right turn onto major road (Peak Hours)	Turn ban used to regulate traffic flow

Chainage	Minor Road	Major Road	Existing / Proposed	Turning Ban	Notes
A6810	Balfe Road	Drimnagh Road	Proposed	No right turn onto minor road	Turn ban used to regulate traffic flow
A6840	Slievebloom Road	Drimnagh Road	Proposed	No right turn onto major road (Peak Hours)	Turn ban used to regulate traffic flow
A7480	Kildare Road	Drimnagh Road	Existing	No right turn onto major road (Except Buses)	Existing turn ban used to regulate traffic flow
A7900	Rafters Lane	Crumlin Road	Existing	No left turn onto minor road	Existing turn ban used to regulate traffic flow
A7980	Rafters Lane	Crumlin Road	Existing	No right turn onto minor road	Existing turn ban used to regulate traffic flow
A8300	Clonard Road	Crumlin Road	Proposed	No right turn onto minor road	Turn ban used to regulate traffic flow
A8400	Bangor Drive	Crumlin Road	Proposed	No right turn onto minor road	Turn ban used to regulate traffic flow
A8920	Herberton Road	Crumlin Road	Proposed	No left turn onto major road	Turn ban used to regulate traffic flow
A9250	Dolphin Road	Crumlin Road	Existing	No left turn onto minor road	Existing turn ban used to regulate traffic flow
A9250	Parnell Road	Crumlin Road	Existing	No right turn onto minor road	Existing turn ban used to regulate traffic flow
A9270	Dolphin Road	Dolphin's Barn	Existing	No right turn onto minor road	Existing turn ban used to regulate traffic flow
A9270	Parnell Road	Dolphin's Barn	Existing	No left turn onto minor road	Existing turn ban used to regulate traffic flow
A10940	Francis Street	Dean Street	Proposed	No right turn onto major road	Turn ban used to regulate traffic flow
A10940	Francis Street	Dean Street	Existing	No left turn onto minor road	Existing Turn ban used to regulate traffic flow
A10950	Francis Street	Dean Street	Existing	No right turn onto minor road	Existing turn ban used to regulate traffic flow
A11000	Kevin Street Upper	Patrick Street	Existing	No right turn onto major road	Existing turn ban used to regulate traffic flow
A11000	Kevin Street Upper	New Street South	Existing	No left turn onto major road	Existing turn ban used to regulate traffic flow
A11060	St. Patrick's Close	Patrick Street	Existing	No left turn onto minor road (Except for Access)	Existing turn ban used to regulate traffic flow
A11200	Bull Alley Street	Patrick Street	Existing	No left turn onto minor road	Existing turn ban used to regulate traffic flow
A11290	Bride Road	Patrick Street	Existing	No left turn onto minor road	Existing No Entry used to regulate traffic flow
A11340	Ross Road	Nicholas Street	Existing	No left turn onto minor road except for access	Existing restrictions retained
E600	Cashel Road	Kildare Road	Proposed	No through route connection from Cashel Road west slip road	Revised junction, existing west slip road connection converted to Cul-de-Sac
E1360	Clogher Road (Bus Gate)	Sundrive Road	Proposed	No through route (Except Buses and Bicycle)	No Entry used to regulate traffic flow
E1380	Clogher Road (Bus Gate)	Sundrive Road	Proposed	No northbound left turn onto minor Road (Except Buses and Bicycle)	No Entry used to regulate traffic flow
E1380	Clogher Road (Bus Gate)	Sundrive Road	Proposed	No southbound right turn onto minor Road (Except Buses and Bicycle)	No Entry used to regulate traffic flow
F1800	Killeen Road	New Nangor Road	Proposed	No right turn onto minor road	Turn ban used to regulate traffic flow

Chainage	Minor Road	Major Road	Existing / Proposed	Turning Ban	Notes
F1820	Killeen Road	New Nangor Road	Existing	No right turn onto major road (Peak Hour)	Existing turn ban used to regulate traffic flow
F2220	New Nangor Road	Naas Road	Existing	No right turn onto major road	Existing turn ban used to confirm traffic lane direction for access to New Nangor Road
F2220	New Nangor Road	Naas Road	Existing	No left turn onto minor road	Existing turn ban used to confirm traffic lane direction for access to Naas Road
F2250	Long Mile Road	Naas Road	Existing	No right turn onto major road	Existing turn ban used to confirm traffic lane direction for merge lane
F2250	Long Mile Road	Naas Road	Existing	No right turn onto major road	Existing turn ban used to confirm traffic lane direction for access to New Nangor Road
F2800	Old Naas Road	Naas Road	Proposed	No left turn on to major road	Turn ban used to regulate traffic flow
F2950	Kylemore Road	Naas Road	Proposed	No left turn onto minor road	Turn ban used to regulate traffic flow
F2980	Kylemore Road	Naas Road	Existing	No right turn onto major road	Existing turn ban used to regulate traffic flow
F3000	Walkinstown Avenue	Naas Road	Proposed	No right turn onto major road	Turn ban used to regulate traffic flow

4.17 Deviations from Standards

4.17.1 Overview

The design has been developed in accordance with the standards and guidance listed within Section 4.1. However, in some circumstances it has been necessary to digress from the desirable minimum geometric parameters identified. A schedule of identified deviations relating to the individual aspects of Road Geometry is included within Appendix C Deviations from Standards.

4.17.2 DMURS Design Compliance Statement

The Proposed Scheme has been designed in line with the principles and guidance outlined within the DMURS 2019. The scheme proposals have been developed in direct response to the aims and objectives of the as set out in Section 1.2 which have common synergies with the Core Design Principles of DMURS.

The adopted design approach successfully achieves the appropriate balance between the functional requirements of different network users whilst enhancing the sense of place. The implementation of enhanced pedestrian, cycling and bus infrastructure actively manages movement by offering real modal and route choices in a low speed high-quality mixed-use self-regulating environment. Specific attributes of the Proposed Scheme design which contribute to achieving this DMURS objective include;

- Prioritising pedestrians and cyclists through the implementation of designated footways, and cycle tracks and limiting vehicles' speed through the use of tight kerb radii on all internal junctions within the development;
- Provision of cycle protected junctions will control speed at which vehicles can travel through the junction and incorporates tight kerb radii to limit vehicles' speed but also allow occasional larger vehicles to manoeuvre safely through the junction, while also reducing pedestrian crossing distances;
- The inclusion of new and enhanced pedestrian crossing facilities will promote increased pedestrian activity along the scheme, providing safe desire lines for pedestrians to/from all directions. The

Proposed Scheme also removes the existing lengthy uncontrolled crossings and the associated safety risks that they present to pedestrians at these vehicle dominated locations;

- Introduction of designated cycle protected parking along the scheme will improve the interaction between parked vehicles, pedestrians and cyclists; and
- The implementation of traffic calming measures and side entry treatments promote pedestrian activity on the junction side arms.

The scheme proposals are the outcome of an integrated urban design and landscaping strategy to enhance the function and place for the surrounding area and thereby facilitating a safer environment for pedestrians and cyclists.

The design has been progressed in accordance with the design standards within Section 4.1 as far as practicable, but in some instances, it has been necessary to deviate away from these. A schedule of identified deviations relating to the road geometry, alongside those identified for other technical design elements, is included within Appendix C Deviations from Standards.

4.18 Road Safety and Road User Audit

Road Safety Audits (RSA) have been undertaken at various stages throughout the design development process. The TII GE-STY-01024 document provides an outline of the typical stages for road safety audits and further noted below as follows:

- **Stage F**: Route selection, prior to route choice;
- **Stage 1**: Completion of preliminary design prior to land acquisition procedures;
- **Stage 2**: Completion of detailed design, prior to tender of construction contract. In the case of Design and Build contracts, a Stage 2 audit shall be completed prior to construction taking place;
- **Stage 1 & 2**: Completion of detailed design, prior to tender of construction contract, for small schemes where only one design stage audit is appropriate;
- **Stage 3**: Completion of construction (prior to opening of the scheme, or part of the scheme to traffic wherever practicable); and
- **Stage 4**: Early operation at 2 to 4 months' post road opening with live traffic.

In line with the above a Stage 1 RSA was undertaken as part of the EPR selection process and a Stage 1 RSA was undertaken as part of the preliminary design development. Both RSAs have been included in Appendix M Road Safety Audits, complete with the proposed designer's responses.

The Stage 1 RSA was reviewed in light of the scheme development and had identified various elements of the EPR scheme that were subsequentially improved with design development, including the introduction of cycle protected junctions, tie ins for cycle infrastructure on side roads and buffer zones for parking and pedestrian segregation measures.

The Stage 1 RSA represents the response of an independent audit team to various aspects of the scheme. The recommendations contained within the document are the opinions of the audit team and are intended as a guide to the designers on how the scheme as constructed can be improved to address issues of road safety.

5 Junction Design

5.1 Overview of Transport Modelling Strategy

The design and modelling of junctions has been an iterative process to optimise the number of people that can pass through each junction, with priority given to pedestrian, cycle and bus movements.

The design for each junction within the Proposed Scheme was developed to meet the underlying objectives of the project and to align with the geometric parameters set out in Section 4.1 in conjunction with the junction operation principles described in the BCPDGB. Various traffic modelling tools were used to assess the impact of the proposals on a local, corridor and surrounding road network level which is further described in Section 5.4.

A traffic impact assessment has been undertaken for the Proposed Scheme in order to determine the predicted magnitude of impact Proposed Scheme measures may have against the likely receiving environment. The impact assessments have been carried out using the following scenarios:

- Do Minimum' (DM)– This scenario represents the likely conditions of the road network with all major committed transportation schemes in place that will impact on the use of public transport and private car, without the Proposed Scheme; and
- Do Something' (DS) – This scenario represents the likely conditions of the road network with all major committed transportation schemes in place that will impact on the use of public transport and private car, with the Proposed Scheme (i.e. the 'DM' scenario with the addition of the Proposed Scheme).

Both scenarios above comprised of an assessment at opening year (2028) and opening year +15 years (2043). In developing the design proposals for the Proposed Scheme, the 2028 year flows were determined to provide the higher volume of traffic flows for the most part and as such has been generally adopted as the design case scenario for junction development.

Where design flows from the 2028 DS model were not deemed appropriate for a specific location the flows associated with the DM and or base 2019 survey flows have been considered. Similarly, the final junction designs have been supplemented with additional cycle volumes to ensure a minimum 10% cycle mode share in terms of people movement at each junction can be achieved in line with the National Cycle Policy Framework (NCPF).

5.2 Overview of Junction Design

The purpose of traffic signals is to regulate movements safely with allocation of priority in line with transportation policy. For the Proposed Scheme, a key policy is to ensure appropriate capacity and reliability for the bus services so as to maximise the overall throughput of people in an efficient manner. The junctions will provide safe and convenient crossing facilities for pedestrians with as little delay as practicable. Particular provisions are required for the protection of cyclists from turning traffic, as well as ensuring suitable capacity for a rapidly increasing demand by this mode.

The design of signalised junctions, or series of junctions, as part of the Proposed Scheme has been approached on a case-by-case basis. There have been a number of components of the design development process that have influenced the preliminary junction designs including:

- The junction operational and geometrical principles described in the BCPDGB;
- Integration of pedestrian and cycle movements at junctions;
- Geometrical junction design for optimal layouts for pedestrians, cyclists and bus priority whilst minimising general traffic dispersion where practicable;
- PMSC to inform junction staging and design development;
- LINSIG junction modelling to assess junction design performance and refinement;

- Micro-Sim modelling to assess and refine bus priority designs; and
- Cyclist quantification.

5.3 Junction Geometry Design

5.3.1 Pedestrians

The junction design approach is to minimise delay for pedestrians at junctions, whilst ensuring high quality infrastructure to ensure pedestrians of all ages including vulnerable users can cross in a safe and convenient manner. Pedestrian crossings have been placed as close to pedestrian desire lines as practicable. Where pedestrians are required to cross a cycle track, this is proposed to be controlled by traffic signals to manage potential conflicts.

The preferred arrangement for pedestrians at junctions is to have a wrap around pedestrian signal stage at the start of the cycle. In some instances, this has not been feasible i.e. due to crossing distances and the associated intergreen time for pedestrians to safely clear the junction. A “walk with traffic” system is therefore proposed at certain junctions, in particular where refuge islands have been introduced for a two-stage pedestrian crossing. At these locations, controlled crossing for pedestrians is provided across part of the junction, whilst some of the traffic movements that are now in conflict with the pedestrian movement, are allowed to run at the same time. This facility has the advantage to allowing pedestrians to cross during the cycle whilst having less effect on traffic capacity.

The Proposed Scheme will enhance pedestrian crossing facilities, in particular all existing left turn slip lanes have been removed, and wherever practicable straight through crossings have been provided. In these instances, the cycle times have been increased to balance the proposed new pedestrian infrastructure with the competing demands for bus, cyclists and general traffic as shown in Table 5-1. The proposed new infrastructure will assist to reduce pedestrian crossing distances thus reducing crossing times and improving the overall crossing experience at the junctions for pedestrians.

Table 5-1: Do Minimum and Do Something Cycle Times

Junction	DM Cycle Time (seconds)	DS Cycle Time (seconds)
Woodford Walk-New Nangor Rd	110	120
Riverview BP-New Nangor Rd	Existing Roundabout	120
Oak Rd – New Nangor Rd	120	120
Willow Rd – New Nangor Rd	60	100
L1014 Killeen Rd	120	120
L1013 Killeen Rd	75	120
Nangor-Naas-Long Mile Rd	130	90
John F Kennedy – Old Naas Rd	Not coded in SATURN	90
Naas Rd – Walkinstown Avenue	130	130
Walkinstown-Long Mile	120	120
Walkinstown Parade	Unsignalised Junction	90
Cookstown Way	100	110
Belgard Sq S-Belgard Sq W	Roundabout	110
Old Blessington Rd-Belgard W	90	75
Belgard Square North-West	Roundabout	120
Belgard Sq N-Library-Draft	Not coded in DM	120
Belgard Square North-East	Roundabout	120
Blessington-Belgard Square E	81	120
Blessington Rd-Belgard Rd	120	120

Junction	DM Cycle Time (seconds)	DS Cycle Time (seconds)
Old Bawn Rd-Blessington Rd	90	75
Old Greenhills Rd-Main St	Not coded in DM	90
Old GH Rd-GH Rd-Bancroft	100	90
Airton Rd-Greenhills Rd	102	120
Hibernian Ind. Estate-Greenhills Road	75	120
Mayberry Rd-Greenhills Road	83	100
Castletymon Rd (West)	85	100
Castletymon Rd (East)	Not coded in DM	100
Ballymount Avenue	Roundabout	120
Calmount Avenue-Calmount Rd	Not coded in DM	90
Walkinstown Roundabout (Arcady)	Roundabout	Roundabout
Kilnamanagh Rd	75	90
Slievebloom Park-Long Mile	Priority junction	120
Walkinstsown Rd – Long Mile Rd	117	120
Drimnag-Errigal Rd	100	120
St.Mary's-Kildare Rd	100	120
Crumlin-Cooley Rd	120	120
Sundrive Rd_Clogher Rd	98	120
Sundrive Rd_Crumlin Rd	120	120
Crumlin Rd – Dolphin Rd	120	90
SCR Dolphins	117	120
Donore – Marrowbone Lane	Priority junction	120
Ardee St-Luke Av	115	100
The Coombe – St Luke's Ave	115	110
Patrick Street – Dean Street	117	120
Bride Road	90	100
Christchurch-Nicholas	85	120

5.3.2 Cyclists

The provision for cyclists at junctions is a critical factor in managing conflict and providing safe junctions for all road users. The primary conflict for cyclists is with left turning traffic.

Based on international best practice, the preferred layout for signalised junctions is the "Protected Junction", which provides physical kerb build outs to protect cyclists at junctions. The key design features and considerations relating to this junction type are listed below:

- The traffic signal arrangement removes any uncontrolled conflict between pedestrians and cyclists, assigning clear priority to all users at different stages within a traffic cycle;
- Kerbed corner islands should be provided to force turning vehicles into a wide turn and remove the risk of vehicles cutting into the cycle route at the corner, which is a cause of serious accidents at junctions. The raised islands create a protective ring for cyclists navigating the junction, improving safety for right turning cyclists
- Cycle tracks that are protected behind parking or loading bays return to run along the edge of the carriageway approaching the junction. Consideration has been given to remove any parking or loading located immediately at junctions to enhance visibility between motorists and cyclists;

- The cycle track is typically ramped down to carriageway level on approach to the junction and proceeds to a forward stop line. A secondary cycle stop line is also proposed at an advanced location to the vehicular stop line at a number of junctions to cater for right turning cyclists, which also places the cyclists within view of traffic waiting at the junction. Cycle signals will control the movement of cyclists including the second stage movement i.e. right turners; and
- Cyclist and pedestrian crossings have been kept as close as practicable to the mainline desire line. However pedestrian and cyclist crossings are to be separated where feasible, in this instances 2-3m separation should be provided between crossings. This is to ensure motorists infer a clear differentiation between cycle lane crossing through the junction and the pedestrian crossing across the same arm, which will be controlled separately for the most part.

In certain junctions an orbital cycle track is provided i.e. at the Long mile Road / Walkinstown Avenue junction. At these locations, controlled crossing points are proposed to allow pedestrians to cross the cycle track. Left turning cyclists can effectively bypass the junction, while giving way to pedestrian crossings as well as cyclists already on the orbital cycle track.

In some instances, constraints in respect of physical space and junction configuration has meant that protected junctions have not been incorporated into the design of a signalised junction. In these instances, this has been limited to minor signalised junctions where left turning movements by general traffic is projected to be low and cyclists desire line is projected to be straight through the junction.

5.3.3 Bus Priority

The scheme incorporates four different types of bus priority design which have been outlined in the BCPDGB and referred to as Junction Types 1-4. The subsections below provide an overview of each junction type design and the principles for applying all or part of the junction type layouts for the Proposed Scheme design.

5.3.3.1 Junction Type 1

Junction Type 1, as described in Section 7.4.1 of BCPDGB, comprises a dedicated bus lane on both inbound and outbound direction continues up to the junction stop line. Due to space constraints, general traffic travelling both straight ahead and turning left is restricted to one lane. Junction Type 1 is typically chosen for the following reasons:

- Volume of left turning vehicles greater than 100 PCUs per hour; and
- Urban setting, no space available for dedicated left turning lane / pocket.

In this instance, mainline cyclists proceed with the bus phase. The bus lane gets red, allowing the general traffic lane to proceed. If the volume of turning vehicles is greater than 150 PCUs, then the cyclists should also be held on red whilst the general traffic proceeds on green. For turning volumes between 100 – 150 PCUs per hour, the mainline cyclists can still proceed with general traffic left turners from the mainline will be controlled by a flashing amber arrow.

An example of Junction Type 1 applied to the Proposed Scheme at Greenhills Road / Hibernian Industrial Estate Road is shown in Figure 5-1 below.

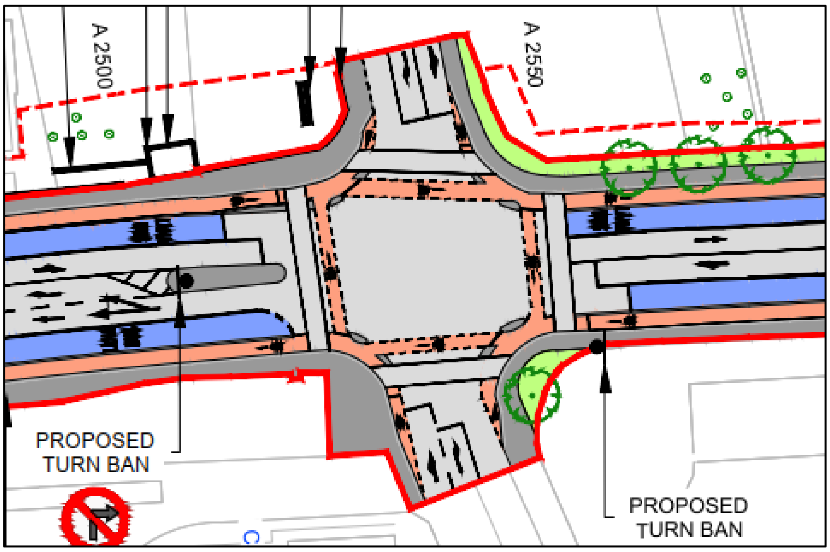

Figure 5-1: Junction Type 1, Proposed Greenhills Road / Hibernian Industrial Estate junction

5.3.3.2 Junction Type 2

Junction Type 2, as described in Section 7.4.2 of BCPDGB, comprises a signalised junction in a suburban context where there is room for additional lanes. A dedicated bus lane in both inbound and outbound directions continue up to the junction stop line. At approximately 30m back from the stop line there is a yellow box to allow left turners to cross the bus lane to enter a dedicated left turn pocket, where space permits. Junction Type 2 has been chosen for the following reasons:

- Suburban setting where space is available for a dedicated left turning lane / pocket; and
- High volume of left turning traffic which can be controlled separately with exiting traffic from side roads.

In this instance, left turners are held and mainline cyclists proceed with the bus phases. Mainline cyclists can proceed also with the straight-ahead general traffic if left turners are held. If the volume of left tuners traffic is less than 150 PCUs per hour, the mainline cyclists could still proceed when left turners from the left-turn pocket are given a flashing amber arrow. Alternatively, the left turners could go whilst the side road traffic proceeds, in which case, the mainline cyclists will be held on red.

Figure 5-2: Junction Type 2 (Inbound), Proposed Greenhills Road / Mayberry Road junction

5.3.3.3 Junction Type 3

Junction Type 3, as described in Section 7.4.3 of BCPDGB, illustrates a signalised junciton where the inbound and outbound bus lane terminates just short of the junction to allow left turners to turn left from a short left turn pocket in front of the bus lane. Buses can continue straight ahead from this pocket where a receiving bus lane is proposed. A Junction Type 3 is chosen for the following reasons:

- Volume of left turning vehicles is less than 100 PCUs per hour; and
- Urban setting, no space available for a dedicated left turning lane / pocket.

In this instance, mainline buses and general traffic (including left turners) from the mainline proceed together, but before they do, mainline cyclists are given an 'early start' of approxiately 5 seconds (minimum of 3 seconds) to minimise any conflict with left turners. When this early start is complete, the mainline cyclists can still proceed, assuming turning volumes are less than 100 PCUs per hour. Left turners from the left turn pocket are given a flashing amber.

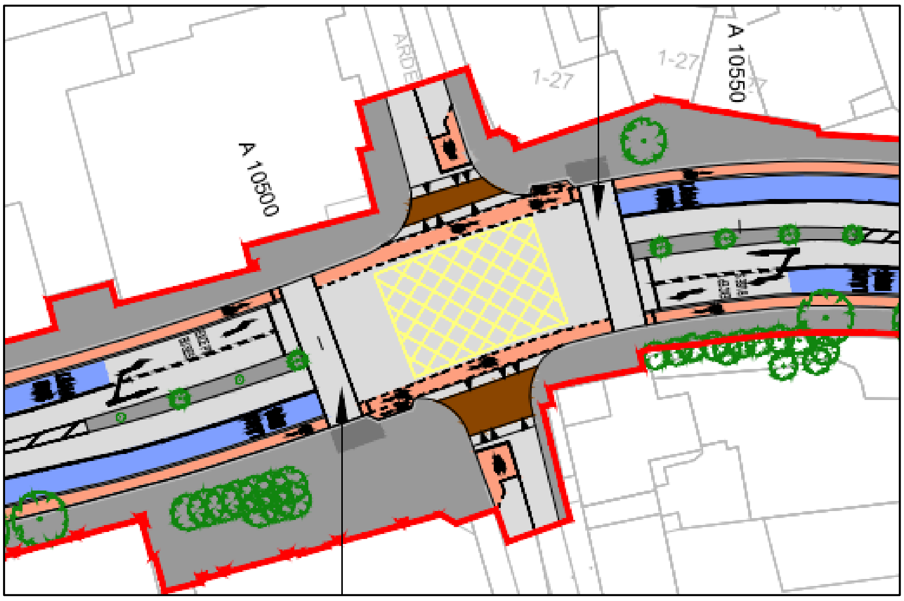

Figure 5-3: Junction Type 3, Proposed Cork Street / Ardee Street junction

5.3.3.4 Junction Type 4

Junction Type 4, as described in Section 7.4.4 of BCPDGB, illustrates a signalised junction with an inbound and outbound bus lane, but also positions the pedestrian crossings on the inside of the cycle lanes across the arms of the junction. Pedestrian crossing distances are minimised as a result. Signalised pedestrian crossings are proposed across the cycle tracks to allow pedestrians to cross from the footway to the pedestrian crossing landing areas, thus avoiding uncontrolled pedestrian – cyclist conflict. The key design features and considerations relating to this junction type are as follows:

- An orbital cycle track is provided, with controlled crossing points to allow pedestrians to cross to large islands within a central signal-controlled area;
- Left turning cyclists can effectively bypass the junction, while giving way to pedestrians crossing as well as cyclists already on the orbital cycle track; and
- Signal controlled pedestrian crossing distances are reduced when compared to traditional junction layouts, due to the face that pedestrians cross the cycle track in a separate signalised movement. Pedestrian crossings are also close to the pedestrian desire line. However, the number of crossings for pedestrians is increased as pedestrians must cross the cycle track to access the central signal controlled area.

Junction Type 4 is chosen for the following reasons:

- Volume of left-turning vehicles less than 100 PCUs per hour;

- High incidence of HGV movements e.g., at industrial estates or where two major regional roads meet;
- Suburban setting; no space available for a dedicated left-turning lane/pocket; and,
- Low pedestrian volumes.

In this instance, mainline buses and left turning from the mainline proceed together. Depending on the prevailing site conditions, mainline cyclists can proceed with left-turners from the mainline (who are controlled with a flashing amber arrow) or cyclists can be held on red until it is time to share a full pedestrian 'wrap around' stage where all vehicular traffic is held and the green man is activated across all arms of the junction. The use of 'early start' stages for cyclists will have to be considered in the context of the proposed signalised pedestrian crossings across the cycle tracks, which have the potential to halt the progression of cyclists if demand-activated.

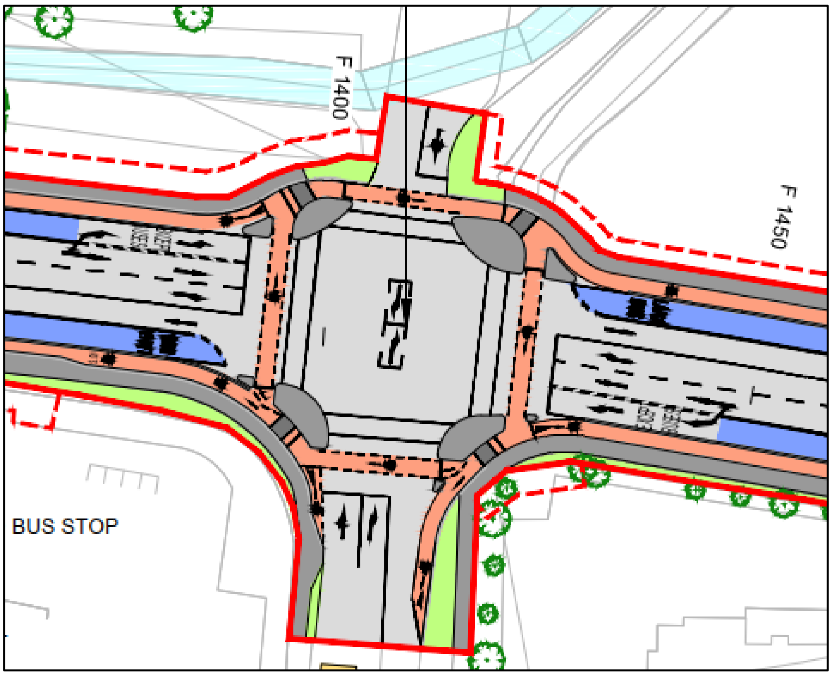

Figure 5-4: Junction Type 4, Proposed New Nangor Road / Willow Road junction

5.3.4 Staging and Phasing

The optimum staging for each junction will be determined by the required junction operational parameters and local site conditions. One of the key considerations in the design of signalised junctions is the conflict between left turning traffic and buses, cyclists and pedestrians continuing along the main corridor. The following presents an overview of the design of junction staging, a junction specific assessment can be found in Appendix L Junction Design Report.

- Cyclists travelling through the junction across the side road will run with straight ahead traffic movements, including buses in a dedicated bus lane;
- A short early start will enable cyclists to advance before general traffic. The amount of green given to cyclists is subject to junction dimensions and signal operation. A 5 second early start has been proposed on the main arms of the majority of junctions, with 3 seconds minimum at certain junctions;
- Cycle movements crossing a side road can run simultaneously with the bus stage in the same direction, so long as it is not permitted to turn left from the bus lane in this scenario; and
- Cycle movements at junctions are to be controlled by cycle signal aspects where there is an advance stop line ahead of the traffic signals including for hook turns at the far side of the side street crossing. Additional cycle signals have been provided for right turning cyclists.

5.3.5 Junction Design Summary

A detailed junction assessment has been undertaken in line with the principles described previously. The following summary tables, Table 5-2 and Table 5-3, provide an overview of the key design principles adopted at each junction location. More detailed information for each junction location can be found in Appendix L Junction Design Report.

Table 5-2: Overview of Major Junctions

No.	Junction	Key Design Notes
1	Belgard Square South / Belgard Square West	Existing roundabout junction proposed to be replaced with a signalised junction with the introduction of Bus only restriction for Belgard Square West to facilitate Tallaght Bus Interchange.
2	Belgard Square West / Belgard Square North	Junction Type 3 on Belgard Square North. Existing roundabout junction proposed to be removed with dedicated pedestrian and cycle crossings.
3	Belgard Square North / Belgard Square East	Junction Type 1 and Junction Type 2 layout. Existing roundabout junction proposed to be removed with dedicated pedestrian and cycle crossings. Bus only access to Belgard Square East.
4	Greenhills Road / Airton Road	Junction Type 1 and Junction Type 2 layout with dedicated pedestrian and cycle crossings. Bus priority inbound and outbound along CBC proposed.
5	Greenhills Road / Hibernian Industrial Estate / Harvey Norman Access	Junction Type 1 layout with dedicated pedestrian and cycle crossings. Bus priority inbound and outbound along CBC proposed.
6	Greenhills Road / Mayberry Road	Junction Type 1 and Junction Type 2 layout with dedicated pedestrian and cycle crossings. Bus priority inbound and outbound along CBC proposed.
7	Greenhills Road / Castletymon Link Road	Proposed new road alignment with bus priority inbound and toucan road crossing.
8	Ballymount Avenue / Calmount Road	Junction Type 4 layout with dedicated pedestrian and cycle crossings. Bus priority inbound and outbound along CBC proposed. Existing roundabout junction proposed to be removed with dedicated pedestrian and cycle crossings.
9	Walkinstown Roundabout	Existing junction upgraded with dedicated pedestrian and cycle crossings on all arms. Proposed 2 lane roundabout traffic to replace existing 3 lane roundabout layout.
10	Long Mile Road / Walkinstown Road	Existing junction upgraded with dedicated pedestrian and cycle crossings. Existing left-turn slip road removed, Bus priority inbound and outbound along CBC proposed.
11	Drimnagh Road / Kildare Road	Junction Type 4 with bus priority up to the stop line. Existing junction upgraded with dedicated pedestrian and cycle crossings. Bus priority inbound and outbound along CBC proposed.
12	Crumlin Road / Herberton Road / Sundrive Road	Existing junction upgraded with bus priority inbound. Left turn slip lanes removed.
13	Crumlin Road / Dolphin Road / Parnell Road	Junction Type 1 layout with dedicated pedestrian and cycle facilities. Bus priority inbound and outbound along CBC proposed.
14	Dolphins Barn / South Circular Road	Existing junction upgraded to accommodate proposed Dolphin’s Barn Public Realm Improvement Scheme.
15	St. Luke’s Avenue / Dean Street	Junction Type 1 layout inbound with dedicated pedestrian and cycle facilities. Bus priority inbound along proposed CBC proposed.
16	Dean Street / Patrick Street	Existing junction upgraded with dedicated pedestrian and cycle crossings. Left-turn slip lane onto Patrick Street removed.
17	Nicholas Street / Christchurch Place	Existing junction upgraded with dedicated pedestrian and cycle crossings.
18	New Nangor Road / Woodford Walk	Junction Type 3 outbound with bus priority on New Nangor Road inbound and outbound. Removal of left-turn slip lane from Woodford Walk and protected cycle lanes.

No.	Junction	Key Design Notes
19	New Nangor Road / Nangor Road Business Park / Riverview Business Park	Junction Type 4 layout with dedicated pedestrian and cycle crossings. Bus priority inbound and outbound along CBC proposed. Removal of existing roundabout junction.
20	New Nangor Road / Park West Avenue / Oak Road	Junction Type 4 layout with dedicated pedestrian and cycle crossings. Bus priority inbound and outbound along CBC proposed.
21	New Nangor Road / Willow Road	Junction Type 4 layout with dedicated pedestrian and cycle crossings. Bus priority inbound and outbound along CBC proposed.
22	New Nangor Road / Killeen Road	Junction Type 4 and Junction Type 2 layout with dedicated pedestrian and cycle crossings. Bus priority inbound and outbound along CBC proposed.
23	Naas Road / New Nangor Road / Long Mile Road	Upgraded existing junction with dedicated cycle and pedestrian crossings via overbridge. Bus priority inbound and outbound along CBC proposed.
24	Naas Road / Kylemore Road / Walkinstown Avenue	Junction Type 1 layout with dedicated pedestrian and cycle crossings. Existing left-turn from Naas Road onto Kylemore Road removed. Bus priority inbound and outbound along CBC proposed.
25	Long Mile Road / Walkinstown Avenue	Junction Type 1 and Junction Type 3 layout with dedicated pedestrian and cycle crossings. Bus priority inbound and outbound along CBC proposed.

Table 5-3: Overview of Moderate Junctions

No.	Junction	Key Design Notes
1	Cookstown Way / Belgard Square South	Right-turn vehicular access proposed to be permitted from Cookstown Way to Belgard Square South to facilitate access to The Square Shopping Centre replacing existing right-turn ban at this location
2	Belgard Square West / Old Blessington Road	Existing signalised junction reconfigured for proposed bus only access onto Belgard Square West inbound and outbound.
3	Belgard Square North / Cookstown Link Road	Junction reconfigured to accommodate recently constructed Cookstown Link Road.
4	Belgard Square East / Blessington Road	Proposed bus priority outbound on Blessington Road.
5	Blessington Road / Belgard Road	Proposed bus priority inbound on Blessington Road. Proposed Toucan road crossing linking cycle tracks on Belgard Road and Blessington Road.
6	Blessington Road / Main Road Tallaght	Existing signalised junction reconfigured to provide proposed bus only right turn on Main Road.
7	Main Road Tallaght / Old Greenhills Road	No current pedestrian crossing facilities. Proposed signalised priority junction with pedestrian crossing on Old Greenhills Road.
8	Greenhills Road / Old Greenhills Road / Bancroft Park	Proposed opening of junction at Old Greenhills Road / Greenhills Road to bus only movements. Raised table side entry treatment proposed and no right turn onto Greenhills Road, no right turn onto Bancroft Park.
9	Greenhills Road / TUD Access Road / St. Mary's National School	Junction reconfigured to accommodate recently constructed TUD Access junction.
10	Greenhills Road / Broomhill Road	No current pedestrian crossing facilities, raised table side entry treatment proposed.
11	Greenhills Road / Hibernian Industrial Estate	No current pedestrian crossing facilities, raised table side entry treatment proposed.
12	Old Greenhills Road / Castletymon Road	Existing signalised priority junction. Proposed junction reconfiguration to include new Castletymon Link Road with cycle tracks and Toucan crossing.
13	Old Greenhills Road / Temple Woods	Existing dropped kerb pedestrian crossing facilities, raised table side entry treatment proposed.
14	Greenhills Road / Ballymount Road Upper	Junction closed, access to Ballymount Road Upper via proposed Ballymount Avenue link road.
15	Ballymount Avenue / Greenhills Road	Proposed side entry treatment at new Ballymount Avenue link road junction.

No.	Junction	Key Design Notes
16	Ballymount Avenue / Ballymount Avenue Link Road	No current pedestrian crossing facilities, raised table side entry treatment proposed.
17	Calmount Road / Calmount Avenue	Priority junction. Proposed signalised junction with pedestrian and cycle facilities. Inbound and outbound bus lanes.
18	Walkinstown Road / Kilnamanagh Road	Signalised crossroad junction with pedestrian crossing facilities. Proposed peak hour right turn ban to Shopping Centre and 24hr right turn ban to Kilnamanagh Road except buses.
19	Long Mile Road / Slievebloom Park	Existing priority junction, no current pedestrian crossing facilities. Signalised junction with raised entry treatment proposed.
20	Drimnagh Road / Balfe Road	Existing signalised junction with pedestrian crossing, raised table side entry treatment with right turn bans onto Balfe Road (24hr) and Drimnagh Road (peak hour) proposed.
21	Drimnagh Road Slievebloom Road	Existing signalised junction with pedestrian crossing, raised table side entry treatment with right turn ban onto Drimnagh Road (peak hour) proposed.
22	Crumlin Road / Errigal Road	Existing signalised junction with pedestrian crossing maintained.
23	Crumlin Road / Cooley Road	Existing signalised junction maintained.
24	Cork Street / Marrowbone Lane	Signalised junction with pedestrian crossing, raised table side entry treatment proposed.
25	Cork Street / Donore Avenue	Signalised junction with pedestrian crossing, raised table side entry treatment proposed.
26	Cork Street / Ardee Street	Existing signalised junction. Junction reconfiguration with Toucan crossings and raised table side entry proposed.
27	Patrick Street / Bull Alley Street	Existing signalised junction with dedicated outbound bus lane and improved cycle facilities proposed.
28	Patrick Street / Bride Road	Existing signalised junction with dedicated inbound and outbound bus lanes, improved cycle facilities and raised table side entry treatment proposed.
29	Bunting Road / Cromwellsfort Road	Existing dropped kerb pedestrian crossing facilities. Signalised raised table pedestrian and cycle crossing with no right turn onto Bunting Road proposed.
30	Kildare Road / Windmill Road	Existing signalised junction. Raised table signalised junction proposed
31	Kildare Road / Bangor Road	Existing signalised junction. Raised table signalised junction proposed
32	Clogher Road / Sundrive Road	Existing signalised junction. Bus Only access to Clogher Road west proposed.
33	New Nangor Road / Killeen Road	Existing signalised junction upgraded. Existing pedestrian crossing and right-turn ban maintained with two-way cycle crossing proposed.
34	Long Mile Road / Walkinstown Parade	Existing dropped kerb pedestrian crossing facilities proposed to be replaced with signalised junction.

5.3.5.1 Minor and Priority Junctions

Table 5-4: Overview of Minor Junctions

No.	Junction	Key Design Notes
1	Old Greenhills Road / 21-25 Park View	No current pedestrian crossing facilities. Proposed bus only restriction on Old Greenhills Road, no right turn onto Old Greenhills Road. Inbound cycle lane relocated onto proposed Greenhills Road alignment.
2	Old Greenhills Road / 10-20 Park View	No current pedestrian crossing facilities. Inbound cycle lane relocated onto proposed Greenhills Road alignment.
3	Old Greenhills Road / 1-9 Park View	No current pedestrian crossing facilities. Inbound cycle lane relocated onto proposed Greenhills Road alignment.
4	Greenhills Road / Tallaght Theatre	No current pedestrian crossing facilities, raised table side entry treatment proposed.

No.	Junction	Key Design Notes
5	Greenhills Road / Boyle Sports	No current pedestrian crossing facilities, raised table side entry treatment proposed.
6	Greenhills Road / Tymon Lane	No current pedestrian crossing facilities, raised table side entry treatment proposed.
7	Greenhills Road / Tallaght Truck Dismantlers	No current pedestrian crossing facilities, raised table side entry treatment proposed.
8	Greenhills Road / Tymon Park	No current pedestrian crossing facilities, raised table side entry treatment proposed.
9	Calmount Road / Ballymount Court Business Centre	Proposed uncontrolled priority junction with outbound right-turn ghost island on Calmount Road.
10	Greenhills Road / Greenhills Industrial Estate	No current pedestrian crossing facilities, raised table side entry treatment proposed.
11	Greenhills Road / Mulcahy Keane Industrial Estate	No current pedestrian crossing facilities
12	Walkinstown Road / Walkinstown Drive	Existing raised table pedestrian crossing facilities, Stop priority junction proposed.
13	Walkinstown Road / Thomas Moore Road	Existing raised table pedestrian crossing facilities. Stop priority junction proposed.
14	Walkinstown Road / Walkinstown Shopping Centre	No current pedestrian crossing facilities, Stop priority junction proposed.
15	Drimnagh Road / St. Mary’s Drive	Existing raised table, raised table side entry treatment proposed.
16	Crumlin Road / Crumlin Park	Existing raised table, raised table side entry treatment proposed.
17	Crumlin Road / Rafters Road	Existing dropped kerb pedestrian crossing facilities, raised table side entry treatment proposed.
18	Crumlin Road / Raphoe Road	Existing raised table, raised table side entry treatment proposed.
19	Crumlin Road / Rafters Lane	Existing No Entry priority junction maintained.
20	Crumlin Road / Iveagh Gardens	Existing raised table pedestrian crossing facilities, raised table side entry treatment proposed.
21	Crumlin Road / Windmill Road	Existing raised table/dropped kerb pedestrian crossing facilities, raised table side entry treatment proposed.
22	Crumlin Road / Clonard Road	Existing dropped kerb pedestrian crossing facilities, raised platform and one-way access with no right turn to Clonard Road proposed.
23	Crumlin Road / Bangor Drive	Existing dropped kerb pedestrian crossing facilities, raised platform and one-way access with no right turn to Bangor Drive proposed.
24	Crumlin Road / Ardagh Road	Existing raised table, raised table side entry treatment proposed.
25	Crumlin Road / Crumlin Shopping Centre West Access	No current pedestrian crossing facilities, raised table side entry treatment proposed.
26	Crumlin Road / Crumlin Shopping Centre East Access	Zebra pedestrian crossing facilities, raised table side entry treatment proposed.
27	Crumlin Road / Old County Road	Existing dropped kerb pedestrian crossing facilities, raised table side entry treatment proposed.
28	Crumlin Road / Rutland Avenue	Existing raised table, raised table side entry treatment proposed.
29	Dolphin’s Barn / St. James’s Terrace	Existing raised table, raised table side entry treatment proposed.
30	Dolphin’s Barn / An Carnan	No current pedestrian crossing facilities, raised table side entry treatment proposed.
31	Dolphin’s Barn / Rehoboth Place	Existing priority junction with raised table and tactile paving maintained.
32	Dolphin’s Barn / Reuben Street	Existing dropped kerb pedestrian crossing facilities, raised table side entry treatment proposed.
33	Dolphin’s Barn / Reilly’s Avenue	Existing priority junction maintained.
34	Dolphin’s Barn Street / Emerald Square	Existing raised table and tactile paving pedestrian crossing facilities, raised table side entry treatment proposed.

No.	Junction	Key Design Notes
35	Cork Street / Cameron Street	No current pedestrian crossing facilities, raised table side entry treatment proposed.
36	Cork Street / Brickfield Lane	Existing raised table and tactile paving pedestrian crossing facilities, raised table side entry treatment proposed.
37	Cork Street / Ormond Street	Existing raised table and tactile paving pedestrian crossing facilities, raised table side entry treatment proposed.
38	Cork Street / Robinson's Court	Existing raised table and tactile paving pedestrian crossing facilities, raised table side entry treatment proposed.
39	St. Luke's Avenue / Brabazon Place	Existing raised table and tactile paving pedestrian crossing facilities, raised table side entry treatment proposed.
40	Dean Street / Convent School/Hyatt Hotel	Raised table side entry treatment proposed.
41	Dean Street / Francis Street	Existing dropped kerb pedestrian crossing facilities, raised table side entry treatment and Francis Street one-way with no right turn onto Dean Street proposed.
42	Dean Street / New Row South	Existing dropped kerb pedestrian crossing facilities, raised table side entry treatment proposed.
43	Patrick Street / St. Patrick's Close	Existing dropped kerb pedestrian crossing facilities, raised table side entry treatment proposed.
44	Patrick Street / Dillon Place South	Existing dropped kerb pedestrian crossing facilities, raised table side entry treatment proposed.
45	Nicholas Street / Ross Road	Existing dropped kerb pedestrian crossing facilities, raised table side entry treatment proposed.
46	Nicholas Street / Back Lane	Existing raised table and tactile paving pedestrian crossing facilities, raised table side entry treatment proposed.
47	Bunting Road / Wallace Road	Existing dropped kerb pedestrian crossing facilities, raised table side entry treatment proposed.
48	Bunting Road / Harty Avenue	Existing dropped kerb pedestrian crossing facilities, raised table side entry treatment proposed.
49	Bunting Road / Balfe Road	Existing dropped kerb pedestrian crossing facilities, raised table side entry treatment proposed.
50	Bunting Road / St. Agnes Road	Existing dropped kerb pedestrian crossing facilities, raised table side entry treatment proposed.
51	Bunting Road / Fernvale Drive	Existing dropped kerb pedestrian crossing facilities, raised table side entry treatment proposed.
52	Kildare Road / Kildare Park	Existing dropped kerb pedestrian crossing facilities, raised table side entry treatment proposed.
53	Kildare Road / Cashel Road	No current pedestrian crossing facilities, raised table side entry treatment and slip road removal proposed.
54	Kildare Road / Clonard Road	Existing roundabout junction, raised table priority junction proposed.
55	Kildare Road / Kildare Road	Existing dropped kerb pedestrian crossing facilities, raised table side entry treatment proposed.
56	Kildare Road / Monasterboice Road	Existing dropped kerb pedestrian crossing facilities, raised table side entry treatment proposed.
57	Kildare Road / Clogher Road	No current pedestrian crossing facilities, raised table junction treatment proposed.
58	Clogher Road / Saul Road	No current pedestrian crossing facilities, narrowing of junction entry proposed.
59	Clogher Road / Slane Road	Existing dropped kerb pedestrian crossing facilities, raised table side entry treatment proposed.
60	Clogher Road / Clogher Road	Existing dropped kerb pedestrian crossing facilities, raised table junction treatment proposed.
61	Clogher Road / Rutland Avenue	Existing priority junction with signalised pedestrian crossing east of junction. Raised table treatment junction with signalised pedestrian crossing south of junction proposed.
62	Clogher Road / Aughavannagh Road	No current pedestrian crossing facilities, raised table junction treatment proposed.
63	Naas Road / Robinhood Road	No current pedestrian crossing facilities, raised table junction treatment proposed.

No.	Junction	Key Design Notes
64	Naas Road / John F Kennedy Drive / Old Naas Road	Proposed raised table controlled crossing on John F Kennedy Drive, Vehicular access from John F Kennedy Drive / Old Naas Road onto Naas Road removed.

5.3.5.2 Roundabouts

Table 5-5: Overview of Roundabouts

No.	Junction	Key Design Notes
1	Greenhills Road / Calmount Avenue Extension	Existing uncontrolled priority junction without pedestrian crossing facilities. Proposed roundabout with raised table pedestrian Zebra crossings on all arms.

5.4 Junction Modelling

5.4.1 Overview

Junction modelling was undertaken to enable understanding of the likely impact of the Proposed Scheme on traffic operation on the surrounding road network. The focus of the assessment was to ensure bus priority was maximised, whilst ensuring the overall movement of people through the junctions was maximised in particular via sustainable modes i.e. walking and cycling, whilst mitigating and resulting adverse traffic impacts.

The traffic modelling steps can be summarised as follows and further discussed in the subsequent sections:

- **People Movement Calculator Assessment:** The draft designs were assessed using a high level PMSC to provide a preliminary understanding of the typical green time proportion for each mode and provided an initial input for the Local Area Model (LAM) modelling which was further refined using LinSig and Microsimulation tools.
- **Saturn Modelling – LAM:** The proposed scheme design and traffic signal operation was assessed within the LAM which is a subset model of the NTA's Eastern Regional Model (ERM). The LAM outputs provided projected traffic flows for the DS Operational Year for the peak periods. In addition, traffic dispersion plots were provided, comparing the DS vs the DM to identify where any traffic dispersion is likely to occur off the Proposed Scheme;
- **Design Optimisation:** The proposed junction designs and signal timings were optimised in LinSig, in order to maximise people movement through the corridor and to minimise traffic dispersion off the corridor. Where performance issues such as poor overall capacity, inefficient stage green allocation or specific queues were identified, the junction layout was reviewed and a suitable mitigation or design solution was applied;
- **Iterative process:** The optimised junction designs and signal timings were fed back into the LAM and the above steps were repeated as part of an iterative process until a suitable level of dispersion was achieved;
- **LinSig and Microsimulation:** The optimised LinSig timings were used to inform the microsimulation model developed for the Proposed Scheme. The micro simulation assisted to support the junction designs and traffic control strategies and provided journey time information. The junction designs and signal timings were further optimised where necessary as a result of the microsimulation modelling; and
- **Final Iterations:** As part of the iterative process the optimised junction designs and signal timings were fed back into the LAM and the above steps were repeated to inform the final design and signal timings. Final LinSig junction models were undertaken using the final flows and supplemented with projected cycle flows to accommodate a minimum 10% cycle mode share in terms of people movement at each junction.

Figure 5-5 illustrates an overview of the traffic modelling process for the proposed scheme.

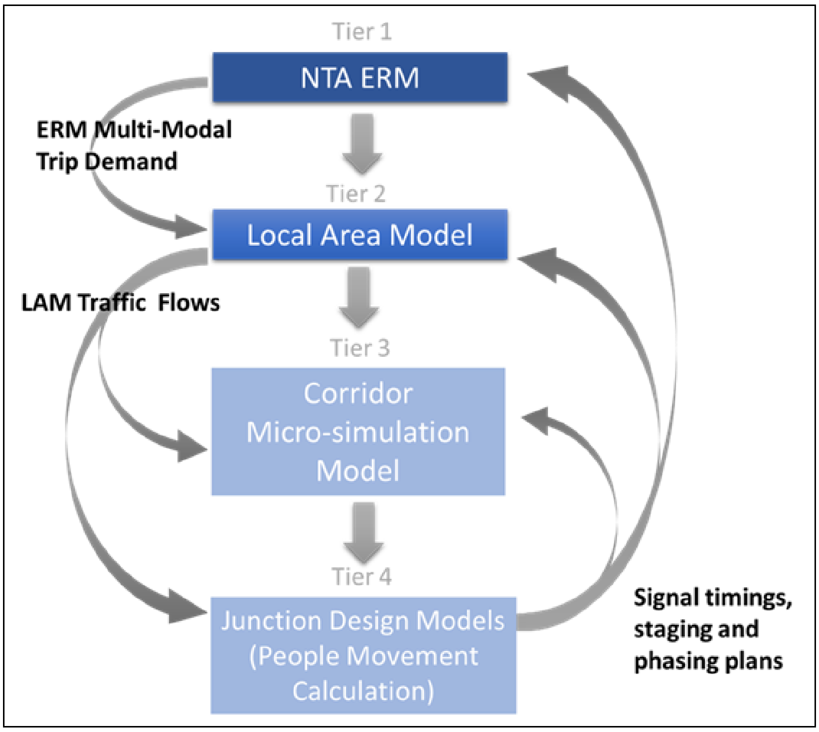

Figure 5-5: Proposed Scheme Traffic Modelling Hierarchy

5.4.2 People Movement

An assessment has been carried out to determine the potential people movement the proposed scheme will generate. This adopts a policy led approach to the design of junctions, which prioritises the people movement and maximisation of sustainable modes i.e. walking, cycling and bus in advance of the consideration and management of general traffic movements at junctions. The outputs of the calculator provide an estimate of people movement per mode per junction and the respective percentage mode share. Figure 5-6, illustrates the People Movement Formulae.

People Movement Formulae	
Cyclists	$\sum(\frac{Green\ Time}{headway})(\frac{3600}{Cycle\ Time})(\frac{CT\ Width}{1.5})$
Buses	$\sum(No.of\ Buses)(Occupancy)(Direction)$
General Traffic	$\sum LinSig\ PCU\ Capacity\ Outputs$
Pedestrians	$\sum(Green\ Time)(\frac{Walking\ Speed}{Ped.Walking\ Buffer})(\frac{Crossing\ Width}{2})(\frac{3600}{Cycle\ Time})(No.Crossing\ Points)$

Figure 5-6: People Movement Formulae

The emerging proposed designs were inputted to the PMSC tool, which produced initial people movement outputs and indicative green times per mode. The results provided an initial starting point to facilitate a review of the junction designs, where necessary pedestrian, cyclist and bus infrastructure was optimised accordingly to facilitate additional capacity. The revised designs were then added into the LAM to facilitate traffic modelling.

The LAM outputs provided traffic flows for the operational year (2028) and operational year +15 (2043). The traffic flows were fed into the LinSig models to facilitate a detailed analysis of the proposed junction operation. The LinSig and DLAM analysis required multiple traffic modelling iterations to arrive at a balanced solution for prioritising sustainable modes and minimising traffic dispersion. The people movement results were also revaluated during the iteration process, the results were also used to inform the projected number of cyclists in the operational year, as discussed in the following section.

5.4.3 Local Area Model

As noted previously, the Proposed Scheme design and traffic signal operation was assessed within the LAM. The LAM outputs provided projected traffic flows for the DS Operational Year 2028 and Future Year 2043 for the respective AM and PM peak periods. In addition, traffic dispersion plots were produced, comparing the DS vs the DM to identify where any occurred onto the adjoining road network, and where necessary to review and apply traffic management, to retain traffic on the corridor and to minimise dispersion at inappropriate locations.

The results of the LAM were used to inform the proposed junction designs and optimise signal timings, in order to maximise people movement through the corridor and to minimise traffic dispersion off the corridor. Where performance issues such as poor overall capacity, inefficient stage green allocation or specific queues were identified, the junction layout was reviewed, and a suitable mitigation or design solution was applied.

To demonstrate the benefits of this iterative process,

Figure 5-7 illustrates an initial 2028 AM distribution plot, whilst

Figure 5-8 illustrates a final iterated distribution plot.

Figure 5-7 illustrates more significant traffic dispersion onto the surrounding road network, whilst the refined

Figure 5-8 demonstrates a more optimised Proposed Scheme, where traffic dispersion has been minimised without compromising the sustainable modes.

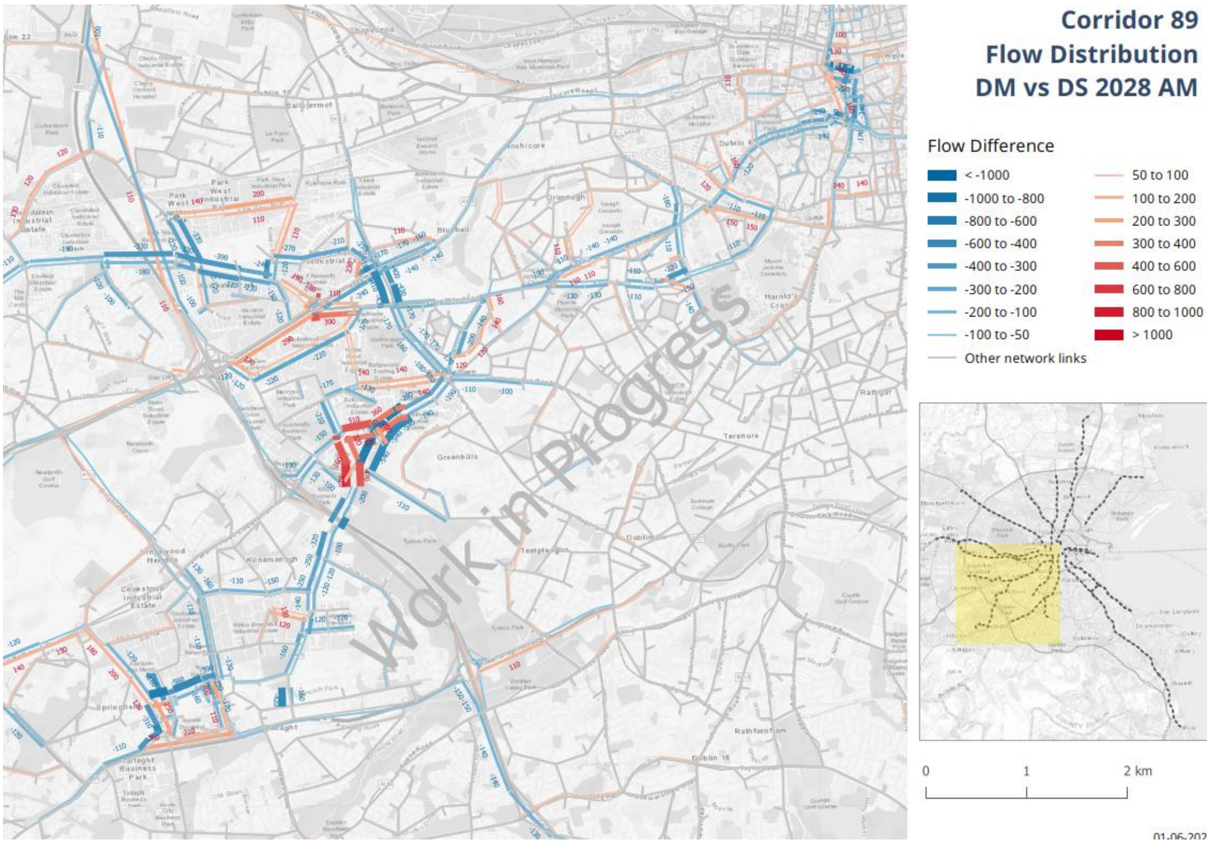

Figure 5-7: An Initial 2028 AM Peak DLAM Distribution Plot

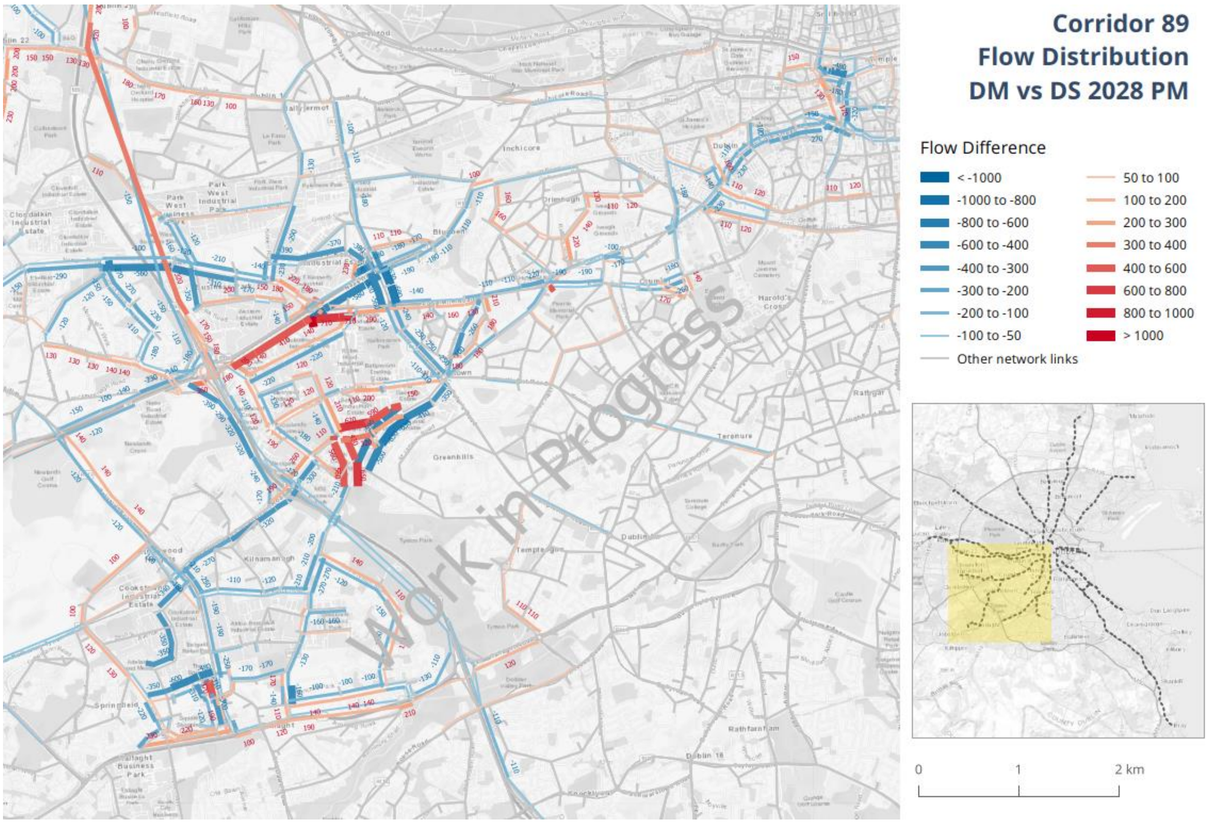

Figure 5-8: Optimised and Iterated 2028 AM Peak DLAM Distribution Plot

5.4.4 LinSig Modelling

Detailed junction modelling analysis using LinSig 3.2.40 was undertaken on the emerging design proposals at each signalised junction until the DLAM model iterations had been concluded and a final preliminary design was achieved. The LinSig modelling adopted the future year traffic flows from the Saturn DLAM model runs for the DS scenario for the Opening Year 2028.

5.4.4.1 LinSig Assumptions

The following LinSig assumptions were applied in the modelling

Cycle Time

- 120s (max) cycle time permitted.

Pedestrian

- Green Time: 6s minimum green time for pedestrians; and
- Intergreen: based on a walking speed of 1.2m per second plus a 2 second safety buffer.

Cyclist

- Cruise speed: 15km/h or 4.16m per second;
- Cyclist early start: 5s on the majority main CBC arms, with 3s minimum. On the side roads of junctions, 3s cyclist early start; and
- Modelled cyclist flows based on cycle quantification exercise.

5.4.4.2 Cycle Quantification

The vision of the National Cycle Policy Framework (NCPF) is that “10% of all trips will be by bike”.

Each junction along the Proposed Scheme has been designed to be consistent with the above objective to accommodate a minimum 10% cycle mode share in terms of people movement at each junction. This will mean that in practice the junctions should be designed to have capacity to provide for at least the existing levels of cycling demand or levels of cycling that provide for a minimum 10% mode share in future years (whichever is the greater).

A cycle demand quantification assessment was undertaken in order to identify projected cycling demand in the Opening Year (2028) to inform the design of cycle facilities at each junction along the Proposed Scheme in line with the NCPF. The level of cycle demand informs the level of priority and the requirements for geometric design for cyclists. This also has implications for the green time allocation to be provided for cycle movements modelled in LinSig and then in turn in VISSIM.

The cycle demand calculation illustrated in Figure 5-6 is based on the capacity provided rather than being informed by existing or modelled future year cycling numbers. It was noted that using the maximum pedestrian capacity calculation skewed the mode share calculations therefore the existing pedestrian counts plus an uplift factor of 20% has been applied.

The calculation accounts for the green time provided in a typical signal cycle, the number of cycles within the hour and an assumption on headway between cyclists. The calculation also considers the capacity benefit of wider lane provision, whereby cyclists can overtake each other with greater widths.

Using the cycle quantification and people movement spreadsheet the following checks were undertaken to ensure cycle demand is catered for at an appropriate level and that each of the criteria is satisfied:

- A minimum 10% cycle mode share is provided for when summing people movement across all arms (including side roads);
- The calculated cycle capacity (calculated from above) exceeds existing cycling flow; and
- If the calculated mode share of 10% is less than the existing flow. The minimum target is the existing flow plus design buffer level of 20%

To quantify the cycle demand numbers for input into LinSig, the following approach was applied:

- Cycle Design Target demand for the junction calculated based on achieving the above criteria (10% of total people movement at junction or existing plus 20% buffer);
- This Design Target total for whole junction is distributed across turning movements based on existing observed 2019 survey data for cycling;
- A minimum turning demand of 10 cyclists per hour to be allowed for;
- Cycle demand turning flows input to LinSig models with green times and phasing and staging plans adjusted as appropriate; and
- Resulting LinSig models provided for input to VISSIM models which will model the same cycling flows.

Table 5-6 presents a summary of the projected number of cyclists per junction identified as a design target and a total number of cyclists modelled in LinSig per junction.

Table 5-6:Cyclist People Movement Quantification

Junction Name	Cycle Quantification (Number of Cyclists)			
	2028 AM Peak Hour		2028 PM Peak Hour	
	Design Target	Total Modelled	Design Target	Total Modelled
Woodford Walk-New Nangor Rd	237	300	300	410
Riverview BP-New Nangor Rd	285	490	306	460
Oak Rd – New Nangor Rd	263	530	278	480
Willow Rd – New Nangor Rd	216	500	254	450
L1014 Killeen Rd	253	530	286	510
L1013 Killeen Rd	224	520	267	480
Nangor-Naas-Long Mile Rd	884	920	857	860
John F Kennedy – Old Naas Rd	109	160	65	110
Naas Rd – Walkinstown Avenue	453	720	375	6204

Junction Name	Cycle Quantification (Number of Cyclists)			
	2028 AM Peak Hour		2028 PM Peak Hour	
	Design Target	Total Modelled	Design Target	Total Modelled
Walkinstown-Long Mile	509	770	498	610
Walkinstown Parade	413	540	379	530
Cookstown Way	250	269	100	138
Belgard Sq. S-Belgard Sq. W	50	65	50	82
Old Blessington Rd-Belgard W	200	216	50	96
Belgard Square North-West	448	570	425	520
Belgard Sq. N-Library-Draft	400	440	420	450
Belgard Square North-East	385	530	348	490
Blessington-Belgard Square E	283	440	273	410
Blessington Rd-Belgard Rd	385	480	413	490
Old Bawn Rd-Blessington Rd	60	73	60	87
Old Greenhills Rd-Main St	153	220	150	160
Old GH Rd-GH Rd-Bancroft	155	350	170	350
Airton Rd-Greenhills Rd	140	480	140	450
Hibernian Ind. Estate-Greenhills Road	149	480	150	470
Mayberry Rd-Greenhills Road	238	490	220	460
Castletymon Rd (West)	197	320	175	200
Castletymon Rd (East)	224	350	225	275
Ballymount Avenue	296	590	310	570
Calmount Avenue-Calmount Rd	239	500	240	500
Walkinstown Roundabout (Arcady)	500	660	500	680
Kilnamanagh Rd	266	520	237	550
Slievebloom Park-Long Mile	454	560	394	470
Walkinstsown Rd – Long Mile Rd	640	710	632	770
Drimnagh-Errigal Rd	558	790	565	750
St. Mary's-Kildare Rd	507	620	496	630
Crumlin-Cooley Rd	447	540	456	570
Sundrive Rd_Clogher Rd	310	340	335	340
Sundrive Rd_Crumlin Rd	510	540	530	570
Crumlin Rd – Dolphin Rd	530	680	510	730
SCR Dolphins	550	670	537	710
Donore – Marrowbone Lane	411	690	395	710
Ardee St-Luke Av	439	720	427	760
The Coombe – St Luke's Ave	454	700	447	770
Patrick Street – Dean Street	1,017	1,170	969	1,050
Bride Road	562	800	530	850
Christchurch-Nicholas	929	1000	920	1,020

5.4.4.3 LinSig Results

Table 5-7, provides an overview of the LinSig junction analysis results. The Junction Design Report in Appendix L provides details of LinSig junction modelling outputs. It is noted that the LinSig models produced provide a basis for finalising junction designs, but that implementation of the proposed junctions will require detailed signal controller specifications and associated phasing plans to be produced.

Table 5-7:Proposed Scheme Signalised Junctions

No	Junction Name	Cycle Time (Seconds)		Practical Reserve Capacity (%)	
		DM	DS	AM Peak Hour	PM Peak Hour
1	Woodford Walk-New Nangor Rd	110	120	60.2	83
2	Riverview BP-New Nangor Rd	Existing roundabout	120	30.4	40.7
3	Oak Rd – New Nangor Rd	120	120	-20.9	-13.2
4	Willow Rd – New Nangor Rd	60	120	81.5	57.6
5	L1014 Killeen Rd	120	120	50.9	10.6
6	L1013 Killeen Rd	75	120	67.4	55.3
7	Nangor-Naas-Long Mile Rd	130	90	30.6	25.7
8	John F Kennedy – Old Naas Rd	existing unsignalised junction	90	32.2	136.5
9	Naas Rd – Walkinstown Avenue	130	130	8.9	15
10	Walkinstown-Long Mile	120	120	-27.9	-7.2
11	Walkinstown Parade	existing unsignalised junction	100	19.4	47.7
12	Cookstown Way	100	110	78.9	33.8
13	Belgard Sq. S-Belgard Sq. W	existing roundabout	110	12	9.2
14	Old Blessington Rd-Belgard W	90	75	26.4	26.4
15	Belgard Square North-West	existing roundabout	120	45.5	3.1
16	Belgard Sq. N-Library-Draft	existing unsignalised junction	120	52.6	31.5
17	Belgard Square North-East	existing roundabout	120	66.3	80.7
18	Blessington-Belgard Square E	81	120	49.1	8.1
19	Blessington Rd-Belgard Rd	120	120	34.1	-9.1
20	Old Bawn Rd-Blessington Rd	90	75	235	194
21	Old Greenhills Rd-Main St	existing unsignalised junction	90	101	127
22	Old GH Rd-GH Rd-Bancroft	100	90	87.1	136
23	Airton Rd-Greenhills Rd	102	120	85.4	118.3
24	Hibernian Ind. Estate-Greenhills Road	75	120	82.3	114.7
25	Mayberry Rd-Greenhills Road	83	100	6.8	16.4
26	Castletymon Rd (West)	85	90	19.8	20.8
27	Castletymon Rd (East)	existing unsignalised junction	90	4.6	24.3
28	Ballymount Avenue	existing roundabout	120	-4.7	2.4
29	Calmount Avenue-Calmount Rd	existing unsignalised junction	90	27.2	26.9
30	Walkinstown Roundabout (Arcady)	existing roundabout	n/a	14%	9%
31	Kilnamanagh Rd	75	90	160	158
32	Slievebloom Park-Long Mile	existing unsignalised junction	120	29.9	44.3
33	Walkinstsown Rd – Long Mile Rd	117	120	31.9	37.7
34	Drimnagh-Errigal Rd	100	120	51.1	57.7

No	Junction Name	Cycle Time (Seconds)		Practical Reserve Capacity (%)	
		DM	DS	AM Peak Hour	PM Peak Hour
35	St. Mary's-Kildare Rd	100	120	17.2	6.7
36	Crumlin-Cooley Rd	120	120	17.7	11
37	Sundrive Rd_Clogher Rd	98	120	-25	-43
38	Sundrive Rd_Crumlin Rd	120	120	-34.9	-5.7
39	Crumlin Rd – Dolphin Rd	120	90	9.7	-39.5
40	SCR Dolphins	117	120	-1.7	37.5
41	Donore – Marrowbone Lane	existing unsignalised junction	120	-2.8	5.9
42	Ardee St-Luke Av	115	100	65.9	65.9
43	The Coombe – St Luke's Ave	115	110	131.9	134.4
44	Patrick Street – Dean Street	117	120	-41.2	-23.7
45	Bride Road	90	100	49.2	91
46	Christchurch-Nicholas	85	120	-27	-15.7

Overall, the junction analyses show that all junctions along the corridor have feasible and functional signal staging plans which will ensure that buses will be able to proceed along the corridor with delays minimised, and that high quality crossing facilities are provided for cyclists and pedestrians.

6 Ground Investigation and Ground Conditions

6.1 Introduction and Desktop Review

The following sections provide a summary of the desk study and commentary on the findings of ground investigations that have been undertaken for the Proposed Scheme. A summary of factual data, which has been gathered for the scheme, is provided with interpretation of design parameters and should be read in accordance with the following documents located in Appendix E **Ground Investigation Reports**.

- Preliminary Sources Study Report (PSSR): Bus Connects Corridor Route 08: Clondalkin to Drimnagh and Route 09: Tallaght (Greenhills) to City Centre, dated December 2019 , which has been located in Appendix E.1.
- Ground Investigation Report (GIR) Tallaght/Clondalkin to City Centre CBC 0809, dated December 2020 , which has been located in Appendix E.2.

The above documents were generally prepared in accordance with the procedures set out in TII Managing Geotechnical Risk DN-ERW-03083.

The results of the factual investigation are also included in Appendix E **Ground Investigation Reports**:

- Report No: 20-0399D Bus Connects Route 9 Tallaght/Clondalkin to City Centre – Ground Investigation, dated December 2020 , which has been located in Appendix E.3.
- Report No: 20-0399C Bus Connects Route 8 Tallaght/Clondalkin to City Centre – Ground Investigation, dated December 2020 , which has been located in Appendix E.4.

Considering the guidance in IS EN 1997-1, it is considered that Geotechnical Category 2 is currently the most appropriate for the Proposed Scheme.

6.2 Summary of Ground Investigation Contract

The ground investigation is split into different phases of investigation. The initial phase was concerned with carrying out test holes at key locations to inform the design and to facilitate the planning phase of the project. It is anticipated that additional ground investigation, generally conforming to guidelines of EC7, will be carried out at later date.

The following is a summary of the geotechnical considerations along the Proposed Scheme.

6.3 Ground Investigation

6.3.1 Field Investigation

Two project specific ground investigations have been undertaken to date:

- Bus Connects Route 9 Tallaght/Clondalkin to City Centre conducted between 29th September and 29th October 2020.
- Bus Connects Route 8 Tallaght/Clondalkin to City Centre conducted between 13th and 22nd October 2020.

In general, the ground investigations utilised the following exploratory techniques:

- Cable percussion (CP) boring sunk using shell and auger techniques. This technique was used to investigate the superficial ground conditions, undertaking in-situ testing and taking undisturbed and disturbed samples for geotechnical/geochemical laboratory testing. Typically, CP boreholes were terminated on encountering refusal on very dense/stiff soils, boulders or weathered bedrock, or at a predefined depth based on the design and construction requirements for the proposed structure/earthwork.
- Rotary drilling both with and without core recovery. Generally, when using rotary drilling within soils, Standard Penetration Tests (SPTs) are undertaken at regular intervals below the depth attained by the CP boring.
  - Rotary drilling without core recovery (RO) was typically used to identify rockhead level and extend CP boreholes to rockhead when the CP could not advance due to obstructions (i.e. very dense/stiff soils or boulders).
  - Rotary drilling with core recovery (RC) was typically used in soils to extend CP boreholes beyond obstructions (i.e. very dense/stiff soils or boulders), where more soil information was required than would be recovered by RO methods. The use of a geotechnical wireline triple tube core barrel S-size (“Geobor”) allowed recovery of good quality (Class 1) samples.
  - RC was typically used in rock to provide information on the rock (i.e. lithology, discontinuities, strength, etc.) and recover core samples suitable for laboratory testing.
- Groundwater monitoring standpipes, installed to identify groundwater levels, provide water samples for geochemical testing and monitor groundwater flow.
- Machine excavated trial pits sunk to identify the near surface ground conditions and, at specific locations, to identify whether there was any archaeological significance. Disturbed samples and, where contamination was suspected, environmental samples were recovered from the trial pits to allow for geotechnical and geochemical testing. In-situ hand vane testing was also carried out in suitable cohesive soils. Dynamic Cone Penetrometers (DCPs) were carried out adjacent to trial pits to provide a profile of penetration with depth and to a derive a California Bearing Ratio (CBR) value.
- Window sampling boreholes at locations, which were unsuitable to access by means of CP rigs, RC rigs or excavators; the window sampling rig was smaller and easier to mobilise to difficult locations. The window sampler was used to identify superficial ground conditions, taking disturbed samples for geotechnical/ geochemical testing and carrying out SPTs. Typically, the window sampling boreholes were terminated on very dense/stiff soils or on possible boulders or bedrock.

The investigation is summarised in the following sections.

6.3.1.1 Tallaght to City Centre Section September 2020 Investigation

Site operations, which were conducted between 13th and 22nd October 2020, comprised:

- Four boreholes (R8-CPGS01-R8-CPGS04) were put down by a combination of light cable percussion boring using a Dando 2000 rig and rotary follow-on drilling techniques with core recovery in bedrock using a truck mounted Berretta T44 rotary drilling rig.
- A groundwater monitoring standpipe was installed in R8-CPGS02 and R8-CPGS04.

6.3.1.2 Clondalkin to Drimnagh Section September 2020 Investigation

Site operations, which were conducted between 29th September and 29th October 2020, comprised:

- Fourteen boreholes (R9CP01-R9CP13) were put down to completion in minimum 200mm diameter using a Dando 2000 light cable percussion boring rig. R9CP13A was terminated due to encountering an old tank and removed to a new position at R9CP13.
- Four boreholes (R9CPGS01-R9CPGS04) were put down by a combination of light cable percussion boring and rotary follow-on drilling techniques using a truck mounted Beretta T44 rotary drilling rig with core recovery in overburden and bedrock.
- One borehole (R9WS01) was put down to completion by light percussion boring techniques using a Dando Terrier dynamic sampling rig.

- Eleven trial pits (R9TP01–R9TP11) were excavated using a 3t tracked excavator or JCB3CX fitted with a 600mm wide bucket, to a maximum depth of 4.20m.
- A groundwater monitoring standpipe was installed in R9CP02, R9CP04, R9CP05, R9CP06, R9CP08, R9CP11, R9CPGS01 and R9CPGS04.

6.3.2 Geotechnical Laboratory Testing

A range of geotechnical, geochemical and contamination testing was undertaken on samples of soil, rock, groundwater recovered during the ground investigation.

The Ground Investigation Factual Report provides the laboratory test results/reports and details of the testing methods.

Soils tests, undertaken as part of the ground investigation, include the following:

- Classification tests: moisture content, Atterberg Limits, and particle size distribution by wet sieving and sedimentation.
- Compaction related tests: MCV and CBR at natural moisture content.
- Shear strength (total stress): unconsolidated undrained, single stage triaxial tests on nominal 100mm diameter specimens prepared from U100 and Geobor core samples.

Rock tests, undertaken as part of the ground investigations, are detailed below:

- Point load strength tests.
- Uniaxial compressive strength (UCS) tests.

The following chemical tests were undertaken:

- pH.
- Water soluble sulfate content.
- Acid soluble sulfate content.
- Total sulphur content.

A suite of contamination testing was scheduled on selected soil and water samples recovered at various locations along the proposed scheme. The full lists of tests and the test results are included in the Ground Investigation Factual Report.

6.4 Soils and Geology

6.4.1 Quaternary Sediments

A review of the route's underlying geology was completed using available data derived from the GSI spatial data viewer and indicate the routes are underlain by the following deposits:

Made Ground

The majority of the route is mantled by deposits of Made Ground.

Alluvium Deposits

Undifferentiated Alluvium associated with the River Camac and, although not shown on the mapping, there is potentially alluvium associated with the River Poddle.

Glaciofluvial Deposits

Deposit of glaciofluvial sand and gravel, located in the Greenhills area. Deposits are described as being derived chiefly from Carboniferous limestone.

Till Deposits

The route is generally underlain by Glacial Till deposits known colloquially as Dublin Boulder Clay. Deposits are described as being derived chiefly from Carboniferous limestone.

6.4.2 Bedrock

The GSI Bedrock Geology map (scale 1:100,000) indicates the site is underlain by the Lucan Formation comprising of dark-grey, argillaceous, cherty, specular micrites and shales, with horizons of graded, skeletal limestones containing ooids and other shallow water grains.

6.4.2.1 Tallaght to City Centre Section

Grey weathered Limestone. (Driller's description) was found in R9CPGS03 from 10 – 10.5 m bgl.

Medium strong very thinly bedded dark grey argillaceous Limestone was encountered in R9CPGS01-04 to completion depth.

A 2 m thick, medium strong thinly laminated black Mudstone was encountered in R9CPGS04 from 11.05 to 13.05 m bgl.

The rock is generally described as partially weathered, leading to closer fracture spacing with probably slightly reduced strength. Full descriptions are available in the borehole logs.

Table 6-1 presents a summary of geotechnical and soil/rock chemistry parameters encountered within the rock units in the Tallaght to City Centre Section.

Table 6-1: Summary of geotechnical laboratory and in-situ results on Bedrock in the Tallaght to City Centre Section

Geotechnical Property	Unit	No. Tests	Min Value	Mean Value	Max Value
Rock Strength					
Uniaxial Compressive Strength	Mpa	2	39	57.3	75.6
Point Load Index	Mpa	43	0.1	1.36	3.60
Discontinuities					
Fracture Index	Nr/m	5	10	16.6	21
Chemistry					
pH		2	9.1	9.15	9.2
Water soluble sulfate	%	2	<0.010		

6.4.2.2 Clondalkin to Drimnagh Section

Limestone was encountered at depths ranging from 4.50m in R8-CPGS01- R8-CPGS03 to 6.00m in R8-CPGS04. The limestone was typically described as medium strong.

R8-CPGS-03 encountered soft becoming firm brown sandy gravelly Clay infill from 9.65 m bgl to termination depth at 10 m bgl.

Full descriptions are available in the borehole logs.

Table 6-2 presents a summary of geotechnical and soil/rock chemistry parameters encountered within the rock units in the Clondalkin to Drimnagh Section.

Table 6-2: Summary of geotechnical laboratory and in-situ results on Bedrock in the Clondalkin to Drimnagh Section

Geotechnical Property	Unit	No. Tests	Min Value	Mean Value	Max Value
Rock Strength					
Uniaxial Compressive Strength	Mpa	14	72.8	90.1	08
Point Load Index	Mpa	20	2.1	3.08	4.40
Discontinuities					
Fracture Index	Nr/m	18	3	10.7	21
Chemistry					

pH	%	4	8.8	8.95	9.2
Water soluble sulfate	%	4	< 0.010*	NA	0.059

*One sample less than limit of detection

6.5 Ground Summary and Material Properties

6.5.1 Overview

The following lithologies have been assigned to the ground types encountered in the ground investigations:

- Topsoil (TS)
- Made Ground/Highway Fill (MG)
- Glacial Till (GT) deposits –subdivided into brown Dublin boulder Clay (br DBC), and black Dublin boulder clay (bl DBC).
- Sand and Gravel deposits (S&G) – typically glaciofluvial deposits
- Glacial Clay (GC)
- Bedrock (ROCK) – subdivided into Limestone (LMST) and Mudstone (MDST)

Table 6-3 summarises the ground conditions encountered in the Tallaght to City Centre Section in approximate lithological order.

Table 6-3: Tallaght to City Centre Section Summary of soil units encountered

Stratum	Depth to Top of Stratum (m bgl)	Level at Top of Stratum (m AOD)	Thickness (m)
Topsoil	0	101.7 to 64.16	0.10 to 0.6
Made Ground	0	87.89 to 52.22	0.4 to 6.5*
Brown Dublin Boulder Clay	0.3 to 7.5	101.38 to 53.04	0.3 to 4*
Black Dublin Boulder Clay	3 to 7.8	84.89 to 50.37	0.2 to 4*
Sands and Gravels	0.5 to10.5	73 to 50.72	0.55 to 8.05*
Glacial Clay	1.6 to 4.7	55.01 to 52.29	0 to 2*
Mudstone	11.05	62.02	2
Limestone	10.5 to 13.05	57.07 to 54.38	2.95 to 5.50**

**not proven in all test holes*
***not proven*

Table 6-4 summarises the ground conditions encountered in the Clondalkin to Drimnagh Section in approximate lithological order.

Table 6-4: Clondalkin to Drimnagh Section Summary of soil units encountered

Stratum	Depth to Top of Stratum (m bgl)	Level at Top of Stratum (m AOD)	Thickness (m)
Made Ground	0	48.19 to 46.53	0.6 to 1.2
Brown Dublin Boulder Clay	0.6 to 0.7	46.48 to 45.83	1.3 to 1.9
Black Dublin Boulder Clay	1.2 to 2.5	46.99 to 44.53	1.8 to 3.5
Limestone	4.3 to 5.5	43.89 to 41.03	5.35 to 6.5**

***not proven*

The strata of each exploratory hole shown on the geotechnical long sections have been assigned to one of the above lithologies by considering:

- strata descriptions and laboratory test results;
- published geology and interpreted geomorphology; and

- topography in the area.

The following sections of the report describe the general nature of the identified lithologies and the primary locations where they have been identified in the ground investigations.

6.5.2 Topsoil

Topsoil was encountered in exploratory holes along the route, with approximate thickness summarised in Table 6-5. All topsoil was encountered at ground surface.

Table 6-5: Occurrences of Topsoil

Testhole	Topsoil Thickness (mm)
R9CP02	10
R9CP03	40
R9CP04	20
R9CPGS01	30
R9CPGS02	20
R9CPGS03	20
R9CPGS04	10
R9TP01	30
R9TP02	30
R9TP04	30
R9TP06	10
R9TP07	30
R9WS01	60

6.5.3 Made Ground

Made ground is present in various areas along the length of the routes. Highway fill is associated with existing roads or areas of hard standing; it typically comprises general fill of reworked clay/silt/sands and selected fills formed by silty sandy gravels.

Reworked sandy gravelly clay/silt or sandy clayey gravel or gravelly silty sand fill was encountered at all locations except R9CP04, R9CP07, R9CP09, R9CP11, R9CP12, R9CPGS01 and R9TP02 to a maximum depth of 6.50m in R9CPGS02. Varying amounts of red brick, wood, plastic, cloth, glass, rubber, carpet, ceramics and concrete were encountered across the site concentrated in R9CP05, R9TP05 and R9TP06.

The main occurrences encountered in exploratory holes along the route, with approximate chainage are summarised in Table 6-6.

Table 6-6: Occurrences of Made Ground

Approximate Chainage	Test hole	Depth range (m bgl)	Thickness (m)	Description
A 605	R9TP01	0.3 – 2	1.7	MADE GROUND: Stiff greyish brown slightly sandy gravelly CLAY with low cobble content.
A 622	R9TP02	0.3 – 2.4	2.1	Stiff brown slightly sandy slightly gravelly CLAY with low cobble content.
A 2375	R9TP03	0 – 0.9	0.9	0 – 0.1 m bgl : MADE GROUND: Grey rounded coarse GRAVEL. 0.1 – 0.35 m bgl: MADE GROUND:

Approximate Chainage	Test hole	Depth range (m bgl)	Thickness (m)	Description
				Greyish brown very sandy very silty subangular fine to coarse GRAVEL of mixed lithologies. 0.35 – 0.9 m bgl: MADE GROUND: Dark grey sandy subangular fine to coarse GRAVEL of limestone with high cobble content.
A 2635	R9CP01	0 – 0.4	0.4	MADE GROUND: Soft brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
A 2882	R9CP02	0.1 – 0.4	0.3	0.1- 0.4 m bgl: MADE GROUND: Grey angular fine to coarse GRAVEL. 0.4 – 1.3 m bgl: MADE GROUND: Firm brownish grey sandy gravelly CLAY
A 3055	R9CP03	0.4 – 2	1.6	MADE GROUND: Firm brown sandy gravelly CLAY.
A 3125	R9TP04	0.3 – 1.1	0.8	0.3 – 1.1 m bgl: MADE GROUND: Stiff brown slightly sandy slightly gravelly CLAY with low cobble content and fragments of red brick. 1.1 – 1.7 m bgl: MADE GROUND: Stiff yellowish brown slightly sandy slightly gravelly CLAY with fragments of red brick
A 3355	R9TP05	0 – 1.8	1.8	MADE GROUND: Firm brown slightly sandy slightly gravelly CLAY with medium cobble content and fragments of red brick and wood and pieces of rubber and carpet.
A 3631	R9TP06	0.1 – 0.2	0.95	0.1- 0.2 m bgl: MADE GROUND: Firm orangish brown slightly sandy slightly gravelly CLAY. 0.2- 1.05 m bgl: MADE GROUND: Stiff greyish brown slightly sandy gravelly CLAY with medium cobble and boulder content and fragments of concrete, red brick and pieces of rubber tubes.
A 3680	R9CPGS01	0.3 – 6	5.7	Possible Made Ground: Firm to stiff brown slightly sandy slightly gravelly CLAY with low cobble content.
A 3685	R9CPGS02	0.2 – 6.5	6.3	0.2 – 2.4 m bgl: MADE GROUND: Firm brown sandy gravelly CLAY. 2.4 – 5 m bgl: MADE GROUND: Firm becoming stiff brownish grey sandy gravelly CLAY. 5 – 6.3 m bgl: MADE GROUND: Firm brown sandy gravelly CLAY with fragments of red brick. (Driller's description)
A 3800	R9CPGS04	0.1 – 0.3	1.3	0.1 – 0.3 m bgl: MADE GROUND: Grey angular fine to coarse GRAVEL 0.3 – 1.3 m bgl: MADE GROUND: Firm brownish sandy gravelly CLAY.
A 3800	R9CPGS03	0.2 – 2	1.8	MADE GROUND: Firm brown sandy gravelly CLAY. Sand is fine to coarse.
A 3975	R9TP07	0.3 – 1.8	1.5	MADE GROUND: Firm brown slightly sandy slightly gravelly silty CLAY with medium cobble and boulder content and pieces of red brick and concrete.
A 4245	R9CP05	0 – 4.8	4.8	MADE GROUND: Soft becoming firm brown sandy gravelly CLAY with fragments of wood and pieces of cloth and plastic.

Approximate Chainage	Test hole	Depth range (m bgl)	Thickness (m)	Description
A 4340	R9TP08	0 – 0.55	0.55	MADE GROUND: Stiff brown slightly sandy gravelly CLAY.
A 4555	R9WS01	0.6 – 1.2	0.6	MADE GROUND: Soft brown sandy gravelly SILT with concrete fragments.
A 5345	R9CP08	0 – 2.4	2.4	0 – 0.2 m bgl: MADE GROUND: Grey angular fine to coarse GRAVEL 0.2 – 2.4 m bgl: MADE GROUND: Soft to firm brown sandy gravelly CLAY.
A 5366	R9TP10	0 – 0.8	0.8	0 – 0.55 m bgl: MADE GROUND: Firm brown slightly sandy slightly gravelly CLAY with fragments of red brick. 0.55 – 0.8 m bgl: MADE GROUND: Soft yellowish brown slightly sandy slightly gravelly CLAY.
A 5402	R9TP11	0 – 1.6	1.6	0 – 0.9 m bgl: MADE GROUND: Stiff brown slightly sandy slightly gravelly CLAY. 0.9 – 1.6 m bgl: MADE GROUND: Stiff yellowish brown slightly sandy slightly gravelly CLAY and fragments of ceramic.
A 5413	R9CP10	0 – 1.4	1.4	0 – 0.2 m bgl: MADE GROUND: Grey angular fine to coarse GRAVEL 0.2 – 1.4 m bgl: MADE GROUND: Soft to firm brown sandy gravelly CLAY.
A 5504	R9CP09	0 – 0.4	0.4	0 – 0.2 m bgl: BITMAC 0.2 – 0.4 m bgl: MADE GROUND: Grey angular fine to coarse GRAVEL.
A 5617	R9CP12	0 – 0.5	0.5	0 – 0.2 m bgl: BITMAC 0.2 – 0.5 m bgl: MADE GROUND: Grey angular fine to coarse GRAVEL
A 5636	R9CP11	0.2 – 0.4	0.2	MADE GROUND: Grey angular fine to coarse GRAVEL
A 5737	R9CP13	0 – 1.2	1.2	0 – 0.1 m bgl: BITMAC 0.1 – 0.3 m bgl: MADE GROUND: Grey angular fine to coarse GRAVEL 0.3 – 1.2 MADE GROUND: Soft to firm brown sandy gravelly CLAY
C 425	R9CP06	0 – 4	4	0 – 0.1 m bgl: MADE GROUND: Grey sandy slightly clayey subangular fine to coarse GRAVEL of mixed lithologies. 0.2 – 2 m bgl: MADE GROUND: Firm becoming stiff dark brownish black sandy gravelly CLAY. 2 – 4 m bgl: MADE GROUND: Firm brown sandy gravelly CLAY.
C 475	R9TP09	0 – 2.20	2.20	0 – 0. 15 m bgl: MADE GROUND: Grey sandy very silty subangular fine to coarse GRAVEL of limestone. 0.15 – 0.25 m bgl: MADE GROUND: Light yellowish brown slightly sandy clayey subangular fine to coarse GRAVEL of mudstone. 0.25 – 0.35 m bgl: MADE GROUND: Brown very sandy very clayey subangular to subrounded fine to coarse GRAVEL of mixed lithologies. 0.35 – 0.45 m bgl: MADE GROUND: Dark

Approximate Chainage	Test hole	Depth range (m bgl)	Thickness (m)	Description
				brown very gravelly very silty fine to coarse SAND 0.45 – 2.2 m bgl: MADE GROUND: Greyish brown slightly sandy gravelly CLAY with high cobble content and fragments of glass and red brick.
C 885	R9CP07	0 – 0.5	0.5	0 – 0.2 m bgl: BITMAC 0.2 – 0.5 m bgl: MADE GROUND: Grey angular fine to coarse GRAVEL.
Naas Road Bridge	R8-CPGS01	0 – 1.2	1.2	0 – 0.1 m bgl: MADE GROUND: Paving brick 0.1 – 0.3 m bgl: CONCRETE 0.3 – 0.5 m bgl: BITMAC 0.5 – 0.7 m bgl: MADE GROUND: Grey angular fine to coarse GRAVEL 0.7 – 1.2 m bgl: MADE GROUND: Grey sandy silty subangular fine to coarse GRAVEL of mixed lithologies.
Naas Road Bridge	R8-CPGS02	0 – 0.1	0.1	0 – 0.1 m bgl: MADE GROUND: Paving brick 0.1–0.4m bgl: CONCRETE 0.4 – 0.6 m bgl: BITMAC 0.6 – 1 m bgl: CONCRETE 1 – 1.2 m bgl: MADE GROUND: Grey angular fine to coarse GRAVEL of mixed lithologies
Naas Road Bridge	R8-CPGS03	0 – 0.6	0.6	0 – 0.1 m bgl MADE GROUND: Paving brick 0.1 – 0.3 m bgl : CONCRETE 0.3 – 0.6 m bgl: MADE GROUND: Grey slightly sandy angular fine to coarse GRAVEL
Naas Road Bridge	R8-CPGS04	0 – 0.7	0.7	0.1 – 0.1 m bgl: MADE GROUND: Paving brick 0.1 – 0.3 m bgl: Concrete 0.3 – 0.7 m bgl: MADE GROUND: Grey angular fine to coarse GRAVEL.

Table 6-7 presents a summary of geotechnical and soil/rock chemistry parameters encountered within the soil unit in the Tallaght to City Centre Section.

Table 6-7: Summary of Geotechnical Laboratory and in-situ results on Made Ground

Geotechnical Property	Unit	No. Tests	Min Value	Mean Value	Max Value
Particle Size Distribution					
Clay	%	3	5	7	8
Silt			17	18.7	21
Fines		6	10	24.7	37
Sand			9	32.25	52.5
Gravel			18.5	40.9	68
Cobbles			0	2.16	13
Atterberg Limits					
Moisture Content	%	27	5.9	15.25	22
Liquid Limit (LL)	%	16	21	30.5	44
Plastic Limit (PL)			14	19.25	29
Plasticity Index (PI)			1	11.25	19
Compaction related					
MCV		2	5.7	8.2	10.6
California Bearing Ratio	%	1		0.41	

Geotechnical Property	Unit	No. Tests	Min Value	Mean Value	Max Value
Shear strength (total stress)					
In-situ hand vane, peak cu	kPa	24	50	132.5	201
UU Triaxial test, cu		1		148	
In situ tests					
Standard Penetration Test		17	8	13	23
Soil Chemistry					
pH		23	8.2	8.82	11.3
Water soluble sulfate	g/l	19	<0.010*	NA	1.5
Acid soluble sulfate	%	7	0.02	0.315	1.9
Total sulphur	%	7	0.013	0.165	0.77

** Six samples less than limit of detection*

In the Clondalkin to Drimnagh Section, all boreholes encountered paving brick at ground level. Beneath this were both bitmac and concrete of varying thickness likely representing old road surfaces. Concrete was encountered to a maximum depth of 1.00m in R8-CPGS01 and R8-CPGS02. Sub-base, comprising approximately 200 to 300mm of crushed rock aggregate fill, was encountered beneath the paved surface

6.5.4 Glacial Till

The Glacial Till is typical of the drift cover in much of the Dublin area, comprising boulder clay, a lodgement till deposited during the last ice age, about 10,000 years ago. Farrell et al. (1995) made the distinction between the 'Brown Boulder Clay' and the 'Black Boulder Clay', stating that the Brown Boulder Clay was a weathering product of the Black Boulder Clay, and is broadly similar to it in terms of particle size distribution.

The Brown Dublin Boulder Clay generally consists of sandy gravelly silt/clay with low to medium cobble content; occasionally soft to firm to 0.5 m; typically, firm / firm to stiff to maximum of about 3 m.

The black Dublin Boulder clay is found underlying the brown Dublin Boulder Clay and consists of generally stiff / very stiff / sandy gravelly silt/clay; high cobble content and occasional boulders are typical below 2.0m bgl.

For the purposes of interpretation, where a very stiff brown slightly sandy slightly gravelly Clay was encountered underlying the very stiff black Dublin Boulder clay it was still classified as the black Dublin Boulder Clay for interpretation and presentation purposes.

In the Tallaght to City Centre Section, Glacial till deposits were typically encountered in the majority of the test holes with Glacial till deposits being more prominent in test holes south of Greenhills Bridge. Soft glacial deposits were encountered in R9CP05, R9CP08, and R9CP10. The upper 0.5 m can be frequently softened (degraded) by weathering or water action. Below the weathered zone, these deposits generally become stiffer with increasing depth, representing unweathered soil. The presence of groundwater within lenses of soil with higher coarse-grained content also leads to softening in the till; consequently zones of degraded till were encountered below unweathered till.

The following table presents a summary of geotechnical and soil/rock chemistry parameters encountered within the soil unit in the Tallaght to City Centre Section:

Table 6-8: Summary of geotechnical laboratory and in-situ results on Glacial Till - Tallaght to City Centre Section

Geotechnical Property	Unit	No. Tests	Min Value	Mean Value	Max Value
Particle Size Distribution					
Clay	%	4	4	8.75	22
Silt			19	25.5	31
Sand		6	21	37.3	55

Geotechnical Property	Unit	No. Tests	Min Value	Mean Value	Max Value
Gravel			16	26.7	41
Cobbles			0	1	6
Atterberg Limits					
Moisture Content	%	32	7.5	14	33
Liquid Limit (LL)	%	11	23	31.2	43
Plastic Limit (PL)		11	17	19.4	24
Plasticity Index (PI)		11	6	11.8	19
Compaction					
MCV		1	3	3	3
California Bearing Ratio	%	1	0.5	0.5	0.5
Shear strength (total stress)					
In-situ hand vane, peak cu	kPa	6	124	171.5	201
UU Triaxial test, cu		6	59	94.3	129
Laboratory Vane		2	11	16	21
SPT, cu (br DBC)		22	36	133.6	300
SPT, cu (bl DBC)		12	144	255.5	300
In-situ tests					
Standard Penetration Test (br DBC) blows per 300 mm		22	6	22.3	50
Standard Penetration Test (bl DBC) blows per 300 mm		12	24	42.5	50
Soil Chemistry					
pH		7	8.3	8.85	10.1
Water soluble sulfate	g/l	5	< 0.010*	NA	0.12
Acid soluble sulfate	%	1	0.055		
Total sulphur	%	1	0.065		

In the Clondalkin to Drimnagh Section Glacial Till deposits were encountered in all test holes with the stiffness increasing from firm to stiff/very stiff with increasing depth.

The following table presents a summary of geotechnical and soil/rock chemistry parameters encountered within the soil unit in the Clondalkin to Drimnagh Section:

Table 6-9: Summary of geotechnical laboratory and in-situ results on Glacial Till - Clondalkin to Drimnagh Section

Geotechnical Property	Unit	No. Tests	Min Value	Mean Value	Max Value
Particle Size Distribution					
Clay	%	1	7.2	7.2	7.2
Silt			16.6	16.6	16.6
Sand			17.4	17.4	17.4
Gravel			58.8	58.8	58.8
Cobbles			0	0	0
Atterberg Limits					
Moisture Content	%	14	0.79	9.74	21
Liquid Limit (LL)	%	3	36	37.33	39
Plastic Limit (PL)			19	19	19
Plasticity Index (PI)			17	18.33	20
In-situ tests					
Standard Penetration Test blows per 300 mm		13	13	44	50
Shear strength (total stress)					
UU Triaxial test, cu	kPa	1	122		
SPT, cu		13	78	265	300

Geotechnical Property	Unit	No. Tests	Min Value	Mean Value	Max Value
Soil Chemistry					
pH		4	8.4	8.825	9.6
Water soluble sulfate	g/l	4	< 0.010		0.36

6.5.5 Alluvium Deposits

Although not encountered in the 2020 investigations, there is the possibility for alluvial soil along the route at locations adjacent to the River Camac and River Poddle.

These are recent deposits of waterborne clay, silt, sand and gravel deposited close to watercourses, with the nature of the soil varying laterally and with depth. For the purpose of classification, alluvial deposits are generally split into two types:

- Cohesive (fine grained) alluvium: deposits mainly comprising silts and clays, sometimes peaty/organic, which were frequently soft in consistency.
- Granular (coarse grained) alluvium: deposits mainly comprising sands and gravels, occasionally with low cobble content, and frequently of loose relative density.

In many cases, the alluvial clays and silts are inter-bedded with alluvial sands or gravels.

6.5.6 Sand and Gravels

These deposits were not encountered in the Clondalkin to Drimnagh Section.

In the Tallaght to City Centre Section, glaciofluvial deposits of typically medium dense to dense sands and gravels interspersed with layers of sandy gravelly clay or silt were generally encountered along Greenhills Road from approximately Greenhills Bridge to the extent of the investigation approaching Walkinstown Roundabout.

Greenhills Road is located near the Greenhills Esker, a ridge of sediment deposited by a stream that ran under, over, or within a glacier. Eskers can contain a wide variety of materials, with coarse-grained soils generally prevalent.

Associated sands and gravels along the Greenhills Road, northeast of the esker, are probably part of an associated ice marginal fan. The sands and gravels within the feature are comprised chiefly of limestone clasts.

The area to both side of Greenhills Road was historically mined for Sand and Gravel.

The following table presents a summary of geotechnical and soil/rock chemistry parameters encountered within the soil unit in the Tallaght to City Centre Section.

Table 6-10: Summary of Soil/Rock Chemistry - Tallaght to City Centre Section

Geotechnical Property	Unit	No. Tests	Min Value	Mean Value	Max Value
Particle Size Distribution					
Clay	%	6	2	3.3	5
Silt			13	22.7	32
Fines		17	2	15.7	37
Sand			6	34.5	82
Gravel			2	46.5	78
Cobbles			0	3.2	17
In-situ tests					
Standard Penetration Test	blows per 300 mm	31	10	22	50
Soil Chemistry					

Geotechnical Property	Unit	No. Tests	Min Value	Mean Value	Max Value
pH		3	8.7	8.83	9

6.5.7 Glacial Clay

This deposit was not encountered in the Clondalkin to Drimnagh Section.

In the Tallaght to City Centre Section, Glacial Clay deposits were found in R9TP10 and R9TP11 near the Greenhills Esker and are described as deposits of stiff brown CLAY with lenses of brown fine to medium SAND of approximate 2 m thickness. It is possible these deposits were also encountered in RPCP12 and R9CP13 based on the similar descriptions and close proximity.

It is possible these layers are the result of deposition from a historical glacial river near the extents of the esker.

The following table presents a summary of geotechnical and soil/rock chemistry parameters encountered within the soil unit in the Tallaght to City Centre Section.

Table 6-11: Summary of Geotechnical Laboratory and in-situ results on Glacial Clays

Geotechnical Property	Unit	No. Tests	Min Value	Mean Value	Max Value
Particle Size Distribution					
Clay	%	3	4	16	39
Silt			25	45.7	62
Sand			11	27.3	41
Gravel			1	11.3	30
Cobbles			0	0	0
Atterberg Limits					
Moisture Content	%	4	20	24.75	28
Liquid Limit (LL)	%	3	25	31.3	43
Plastic Limit (PL)			17	19.3	21
Plasticity Index (PI)			5	12	23
In-situ tests					
Standard Penetration Test		1	10	10	10

6.6 Groundwater

6.6.1 Groundwater Monitoring

The results of groundwater monitoring are as follows:

Table 6-12: **Results of Groundwater Monitoring**

Section	Testhole	Standpipe Depth	Slotted Screen Range (m bgl)	Response Zone	Water Level 19-11-2020
Tallaght	R9-CP02	2.92	1 – 3	1- 1.3 m bgl : Made Ground : reworked boulder clay 1.3 – 3 m bgl: Granular deposits	1.16
Tallaght	R9-CP04	3	1 – 3	Glacial Till	Bung Jammed unable to open
Tallaght	R9-CP05	7.25	4.8 – 7.5	Sand and Gravel deposits	Dry
Tallaght	R9-CP06	5.96	3 – 6	3- 4 m bgl : Made Ground : reworked boulder clay 4 – 6 m bgl: Granular deposits	Dry

Section	Testhole	Standpipe Depth	Slotted Screen Range (m bgl)	Response Zone	Water Level 19-11-2020
Tallaght	R9-CP08	4.45	1 – 4.6	1- 2.4 m bgl : Made Ground : reworked boulder clay 2.4 – 4.6 bgl: Glacial Till	4.1
Tallaght	R9-CP11	4.05	1.3 – 3.8	Granular deposits	3.28
Tallaght	R9-CPGS01	12	6 – 12	6 – 10 m bgl : Glacial Till deposits 10- 12 m bgl : Granular deposits	8
Tallaght	R9-CPGS04	11.04	6 – 11.05	6- 9.4 and 10.5 – 11 m bgl : Granular deposits 9.4 – 10.5 m bgl : Glacial Till deposits	8.92
Clondalkin	R8-CPGS02	4.6	1 – 4.3	Glacial Till	3.29
Clondalkin	R8-CPGS04	5.16	1 – 5.5	Glacial Till	2.53

6.6.2 Groundwater Strikes

The results of groundwater strikes are as follows:

Table 6-13: Results of Water Strikes

Section	Testhole	Water Strike	Casing to (m)	Time (min)	Rose to (m)	Remarks
Tallaght	R9CP01	5	5			Slow seepage at 5.00 m
Tallaght	R9CP08	4.1	4.1	20	4	Slow seepage at 4.10 m
Tallaght	R9CP13	2				Seepage at 2 m
Tallaght	R9CPGS01	9	9			Strike at 9.0 m
Tallaght	R9CPGS02	9				Strike at 9.0 m
Tallaght	R9CPGS03	9				Strike at 9.0 m
Tallaght	R9CPGS04	9				Strike at 9.0 m
Tallaght	RPTP05	1.6				Rapid water strike at 1.60 m
Clondalkin	R8-CPGS01	4.3	4.3			Strike at 4.30 m
Clondalkin	R8-CPGS02	3.4				Strike at 3.40 m
Clondalkin	R8-CPGS02	3.6	3.6	20	3.5	Slow seepage at 3.60 m
Clondalkin	R8-CPGS03	4.2				Strike at 4.20 m
Clondalkin	R8-CPGS04	3.5				Strike at 3.5 m

6.7 Contaminated Land

Both former and present industrial land use may have resulted in the presence, along the proposed route corridor, of potentially toxic or other hazardous material, which may pose a threat to human health, controlled waters or other sensitive receptors.

The Preliminary Sources Study Report (PSSR) collected information on potentially contaminative land use within the route corridor.

Instances of made ground are recorded in section 6.5.3

Contamination testing was undertaken on Made Ground encountered during the 2020 investigation and consisted of the following:

- Rialta Suite
- Suite E soil samples

6.7.1.1 Summary from PSSR

EPA mapping indicates the following facilities along the route:

- IPPC Facility: surrendered IEL along Greenhills Road near intersection of Airton Road
- IPPC Facility: Plateco ZN Limited, Mulcahy Keane Estate, Dublin 12, Dublin
- IPPC Facility: B.G. Flexible Packaging Limited, South Circular Road, Dolphin's Barn, Dublin 8, Dublin
- Waste Transfer Station: Ballymount Baling Station
- Waste Transfer Station: Keywaste Management Limited, Greenhills Road
- Waste Transfer Station: Lawlor Brothers Waste Disposal Limited, JFK Industrial Estate, Naas Road

Historic mills are located at the following locations:

- Corner of Vauxhall Avenue and Dolphin's Barn St.
- North of the River Camac at the intersection of Killen Road and Nangor Road.

There is one petrol station recorded along the Clondalkin to Drimnagh Section on the Naas Road (R810).

There are four petrol stations located throughout the Tallaght to City Centre Section: one on Greenhills Road opposite Broomhills Road junction, one on Greenhills Road at the Ballymount Road Upper junction, one directly to the east of the Crumlin Road (R110) / Windmill Road Junction, and one directly to the west of Dolphin's Barn Bridge. There is a vehicle scrap yard at the north east end of Calmount Road, Tallaght Truck Dismantlers on Greenhills Road north-east of the M50 overbridge and an area recorded as comprising various shipping containers and miscellaneous debris is located at the southern end of Calmount Avenue.

Historical report GSI reference 2691, which involved a site to be developed at a major baled waste depot along Greenhills Road, states:

"An area of mixed domestic\commercial fill was found in the corner of the site bounded by the distributor road and the Greenhills Road. This probably represents unauthorised dumping into a former gravel pit."

The report also states:

"The site is in the main reasonably level but lying some 3 to 4 metres below the Greenhills Road, with a steep embankment from the Greenhills Road to the actual development site."

Another report, GSI reference 115 which was at a proposed industrial estate in Greenhills Road, encountered made ground consisting of paper, timber, rubble, etc. extending to a maximum depth of 4.60m bgl.

The historical maps show the area of Greenhills Road north of the M50 was an Esker previously quarried for Sand and Gravel. It is possible that this was infilled with waste material after quarrying operations ceased.

Report 778 along Patricks Street describes waste fill associated with the possible filling of the River Poddle.

6.7.1.2 2020 Geo-environmental Testing Results Summary

Samples for geo-environmental testing were taken from made ground along the proposed route. Made ground, containing anthropogenic material, was recorded at a number of locations and included varying amounts of red brick, wood, plastic, cloth, glass, rubber, carpet, ceramics and concrete were encountered across the site, and concentrated in R9CP05, R9TP05 and R9TP06.

The following samples were tested.

Table 6-14: Summary of Samples Tested

Test hole	Sample Type	Depth
R9CP01	Soil	0.50
R9CP04	Soil	1.50

R9CP05	Soil	1.50
R9CP06	Soil	1.00
R9CP08	Soil	1.50
R9CPGS02	Soil	2.00
R9TP04	Soil	1.50
R9TP05	Soil	1.00
R9TP06	Soil	0.50
R9TP07	Soil	0.50
R9TP08	Soil	0.50
R9TP09	Soil	1.00
R9TP09	Soil	2.00
R9TP11	Soil	1.00
R9CP02	Water	1.16*
R9CP08	Water	4.1*
R9CP11	Water	3.28*
R9CPGS01	Water	8*
R9CPGS04	Water	8.92*

**water level at time of sampling*

The following table summarise the soil laboratory test results:

Table 6-15: Summary of Soil Geo-environmental Test Results

Determinant	Unit	No. of samples	Minimum Concentration	Maximum Concentration
Organics		No.	Min	Max
Total Organic Carbon		4	0.51	3.3
Organic Matter	%	8	<0.4	19
Mineral Oil & TPH				
Mineral Oil	mg/kg	8	<10	<10
Total Petroleum Hydrocarbons (by IR)	mg/kg	4	<10	860
Aliphatic TPH >C5-C6	mg/kg	4	< 1.0	0
Aliphatic TPH >C6-C8	mg/kg	4	< 1.0	0
Aliphatic TPH >C8-C10	mg/kg	4	< 1.0	6.2
Aliphatic TPH >C10-C12	mg/kg	4	< 1.0	2.3
Aliphatic TPH >C12-C16	mg/kg	4	< 1.0	1.4
Aliphatic TPH >C16-C21	mg/kg	4	< 1.0	1.2
Aliphatic TPH >C21-C35	mg/kg	4	< 1.0	11
Aliphatic TPH >C35-C44	mg/kg	4	< 1.0	1.9
Total Aliphatic Hydrocarbons	mg/kg	4	< 5.0	24
Aromatic TPH >C5-C7	mg/kg	4	< 1.0	0
Aromatic TPH >C7-C8	mg/kg	4	< 1.0	0
Aromatic TPH >C8-C10	mg/kg	4	< 1.0	1.2
Aromatic TPH >C10-C12	mg/kg	4	< 1.0	1.3
Aromatic TPH >C12-C16	mg/kg	4	< 1.0	2.2
Aromatic TPH >C16-C21	mg/kg	4	< 1.0	5.3
Aromatic TPH >C21-C35	mg/kg	4	< 1.0	57
Aromatic TPH >C35-C44	mg/kg	4	< 1.0	3.7
Total Aromatic Hydrocarbons	mg/kg	4	< 5.0	71
Total Petroleum Hydrocarbons	mg/kg	4	< 10	94
BTEX & MTBE				
Benzene	µg/kg	4	< 1.0	< 1.0
Toluene	µg/kg	4	< 1.0	< 1.0
Ethylbenzene	µg/kg	4	< 1.0	< 1.0

Determinant	Unit	No. of samples	Minimum Concentration	Maximum Concentration
m & p-Xylene	µg/kg	4	< 1.0	< 1.0
o-Xylene	µg/kg	4	< 1.0	< 1.0
Methyl Tert-Butyl Ether	µg/kg	4	< 1.0	< 1.0
PAH				
Naphthalene	mg/kg	12	<0.1	0.32
Acenaphthylene	mg/kg	12	<0.1	0.33
Acenaphthene	mg/kg	12	<0.1	1.3
Fluorene	mg/kg	12	<0.1	1.4
Phenanthrene	mg/kg	12	<0.1	7.7
Anthracene	mg/kg	12	<0.1	2.7
Fluoranthene	mg/kg	12	<0.1	11
Pyrene	mg/kg	12	<0.1	10
Benz(a)anthracene	mg/kg	12	<0.1	4.9
Chrysene	mg/kg	12	<0.1	4.3
Benzo(a) pyrene	mg/kg	12	<0.1	5.3
Indeno(1,2,3-c,d)pyrene	mg/kg	12	<0.1	3.2
Dibenz(a,h)anthracene	mg/kg	12	<0.1	1.9
Benzo(g,h,i)perylene	mg/kg	12	<0.1	3.1
Benzo(b)fluoranthene	mg/kg	8	<0.1	6.2
Benzo(k)fluoranthene	mg/kg	8	<0.1	2.8
PAHs (Sum of total)	mg/kg	12	<2	66
SVOC				
Coronene	mg/kg	12	<0.1	<0.1
PCB				
PCB 28	mg/kg	4	< 0.010	< 0.010
PCB 52	mg/kg	4	< 0.010	< 0.010
PCB 90+101	mg/kg	4	< 0.010	< 0.010
PCB 118	mg/kg	4	< 0.010	< 0.010
PCB 153	mg/kg	4	< 0.010	< 0.010
PCB 138	mg/kg	4	< 0.010	< 0.010
PCB 180	mg/kg	4	< 0.010	< 0.010
Total PCBs (7 Congeners)	mg/kg	4	< 0.10	< 0.10
Phenolics				
nonchlorinated phenols	mg/kg	12	<0.3	<0.3
Metals				
Arsenic	mg/kg	12	15	86
Antimony	mg/kg	4	<2	3.8
Barium	mg/kg	4	53	350
Boron	mg/kg	12	<0.4	1.7
Cadmium	mg/kg	12	<0.1	2.5
Chromium (III+VI)	mg/kg	12	6.8	81
Chromium (Trivalent)	mg/kg	4	15	17
Chromium (Hexavalent)	mg/kg	4	<0.5	<0.5
Copper	mg/kg	12	17	280
Lead	mg/kg	12	19	710
Mercury	mg/kg	12	<0.1	0.51
Molybdenum	mg/kg	4	<0.2	4.6
Nickel	mg/kg	12	27	120
Selenium	mg/kg	4	<0.2	0.54
Zinc	mg/kg	12	49	570
Inorganic				

Determinant	Unit	No. of samples	Minimum Concentration	Maximum Concentration
Cyanide Total	mg/kg	12	<0.5	<0.5
Moisture	%	12	6.5	23
Sulphate (soluble)	g/L	12	<0.01	1.2
pH (Lab)	pH_Units	12	8.2	9.3
Asbestos				
Asbestos		12	NAD	NAD

The following table summarise the water geo-environmental laboratory test results:

Table 6-16: Summary of Water Geo-environmental Test Results

Determinant	Unit	No. of samples	Minimum Concentration	Maximum Concentration
Organics				
Total Organic Carbon	mg/l	5	85	120
Mineral Oil & TPH				
Mineral Oil	µg/l	5	<10	<10
Total TPH >C6-C40	µg/l	5	<10	<10
PAH				
Naphthalene	µg/l	5	<0.10	<0.10
Acenaphthylene	µg/l	5	<0.10	<0.10
Acenaphthene	µg/l	5	<0.10	<0.10
Fluorene	µg/l	5	<0.10	<0.10
Phenanthrene	µg/l	5	<0.10	<0.10
Anthracene	µg/l	5	<0.10	<0.10
Fluoranthene	µg/l	5	<0.10	<0.10
Pyrene	µg/l	5	<0.10	<0.10
Benzo[a]anthracene	µg/l	5	<0.10	<0.10
Chrysene	µg/l	5	<0.10	<0.10
Benzo[b]fluoranthene	µg/l	5	<0.10	<0.10
Benzo[k]fluoranthene	µg/l	5	<0.10	<0.10
Benzo[a]pyrene	µg/l	5	<0.10	<0.10
Indeno(1,2,3-c,d)Pyrene	µg/l	5	<0.10	<0.10
Dibenz(a,h)Anthracene	µg/l	5	<0.10	<0.10
Benzo[g,h,i]perylene	µg/l	5	<0.10	<0.10
Total Of 16 PAH's	µg/l	5	<2.0	<2.0
Metals				
Arsenic (Dissolved)	µg/l	5	<1.0	<1.0
Boron (Dissolved)	µg/l	5	23	170
Barium (Dissolved)	µg/l	5	61	73
Cadmium (Dissolved)	µg/l	5	<0.080	0.32
Copper (Dissolved)	µg/l	5	<1.0	2.3
Iron (Dissolved)	µg/l	5	290	500
Mercury (Dissolved)	µg/l	5	<0.50	<0.50
Manganese (Dissolved)	µg/l	5	9.4	300
Molybdenum (Dissolved)	µg/l	5	1.1	3.6
Nickel (Dissolved)	µg/l	5	<1.0	14
Lead (Dissolved)	µg/l	5	<1.0	<1.0
Antimony (Dissolved)	µg/l	5	<1.0	<1.0
Selenium (Dissolved)	µg/l	5	<1.0	11
Zinc (Dissolved)	µg/l	5	2.3	8.1

Determinant	Unit	No. of samples	Minimum Concentration	Maximum Concentration
Chromium (Trivalent)	µg/l	5	[B] < 20	[B] < 20
Chromium (Hexavalent)	µg/l	5	[B] < 20	[B] < 20
Inorganic				
pH		5	7.6	8.2
Electrical Conductivity	µS/cm	5	640	1200
Ammonia (Free) as N	mg/l	5	<0.050	<0.050
Nitrite as N	mg/l	5	<0.010	0.3
Nitrate as N	mg/l	5	<0.50	8.3
Phosphorus (Total)	mg/l	5	<0.020	<0.020
Phosphate as P	mg/l	5	<0.050	<0.050
Nitrogen (Total)	mg/l	5	<5.0	16
Calcium	mg/l	5	73	160
Magnesium	mg/l	5	7.7	29
Sodium	mg/l	5	25	56
Total Hardness as CaCO3	mg/l	5	250	520

No Contamination testing was undertaken along the Clondalkin to Drimnagh Section.

6.8 Overview of Soil Classification

Engineering Fill will be required on this project for the construction of embankments and backfill to retaining structures.

The primary types of fill materials (classified in accordance with Table 6-1 and Table 6-2 of TII Specification for Road Works (CC-SPW-00600 series) that will be required include the following:

- General Granular Fill (Class 1)
- General Cohesive Fill (Class 2) – consisting of fine–grained Glacial Till of adequate remoulded undrained shear strength.
- Selected uniformly graded granular material (Class 6C) – for use as a starter layer if required.
- Selected granular fill (Class 6F1/6F2/6F3): capping.
- Selected granular fill (Class 6N1) –for use as a fill to structures.
- Selected granular fill (Class 6N2) –for use as a fill below structures.
- Selected granular fill (Class 6I/J) –for use as a fill to reinforced earth and anchored earth.

6.8.1 Re-use

Reuse of topsoil and excavated material within the Proposed Scheme is proposed, where practicable.

6.8.1.1 Topsoil

Topsoil stripped as part of earthworks will likely classify as Class 5A material.

6.8.1.2 Glacial Till

Glacial Till with a minimum remoulded shear strength of 50 kPa will generally be acceptable as Class 2 general fill.

Laboratory California Bearing Ratio (CBR) testing of silty boulder clay soils can often provide unexpectedly low results, often attributed to dilatancy, migration of water from granular lenses, or excess pore water pressures within the remoulded specimen following its preparation. Moisture Condition Value (MCV) test data at the site investigation stage can also frequently underestimate the acceptability of Class 2 materials.

In-situ CBR results obtained from Dynamic Cone Penetrometer (DCP) testing in trial pits and measured Standard Penetration Tests (SPT) from the boreholes available in the Ground Investigation Factual Reports may provide more realistic predictions of the in-situ soil stiffness.

For SPT values in glacial till, a multiplier has been applied on SPT values to convert to an appropriate c_u value as follows:

$$Cu = f_1 \times N_{60}$$

Guidance on the value of f_1 is provided by Stroud & Butler (1975) who related the parameter to the soil plasticity index. A value of 5.5 – 6 could be used for f_1 which is consistent with the typical plasticity indices of the glacial till encountered across the site. This would indicate, allowing for some reduction of strength on remoulding, that an SPT blow count in excess of about 10 blows per 300 mm would provide an acceptable remoulded shear strength of 50 kPa.

Glacial till with a remoulded shear strength of less than 50 kPa may be suitable as Class 4 landscaping fill if sufficient stiffness to allow placement and light compaction.

Unacceptable Class U1 cohesive glacial till can also be treated with lime modification to improve to Class 2 general fill.

6.8.1.3 Sand and Gravels

Sands and Gravels on the route are typically associated with Greenhills Road north of the M50.

The material will generally classify as Class 1 granular fill; however, there may be some instances when the fines are in excess of the 15% limit.

6.9 Hydrogeology

6.9.1 Aquifer Classification

According to the GSI Groundwater Resources (Aquifer) map, the Lucan Formation, which predominantly underlies the site, is classified as a Locally Important Aquifers (LI). These formations are moderately productive only in local zones.

Most of the soil permeability across the route and surrounding area is classified as low. The Greenhills Road area would be considered high subsoil permeability.

The site does not lie within a Group Scheme or Public Supply Source Protection Area.

More detailed information is provided in the Preliminary Sources Study Report (PSSR) Route 8: Clondalkin to Drimnagh and Route 9: Greenhills to City Centre, dated December 2019, see Appendix E **Ground Investigation Reports**.

6.9.2 Groundwater Vulnerability

The GSI National Groundwater Vulnerability map indicates that the groundwater vulnerability is variable. The route is generally "Low" to "High" with "Extreme" pockets also encountered.

More detailed information is provided in the Preliminary Sources Study Report (PSSR) Route 8: Clondalkin to Drimnagh and Route 9: Greenhills to City Centre, dated December 2019, see Appendix E **Ground Investigation Reports**.

6.9.3 Karst Landforms

According to the GSI Groundwater Karst Data map there are no karst features recorded within 1 km of the route.

More detailed information is provided in Appendix E.1 Preliminary Sources Study Report (PSSR): Bus Connects Corridor Route 08: Clondalkin to Drimnagh and Route 09: Tallaght (Greenhills) to City Centre, dated December 2019.

6.10 Preliminary Engineering Assessment

6.10.1 Embankments

Refer to Appendix E.1 Preliminary Sources Study Report (PSSR): Bus Connects Corridor Route 08: Clondalkin to Drimnagh and Route 09: Tallaght (Greenhills) to City Centre, dated December 2019.

6.10.2 Cuttings

Refer to Appendix E.1 Preliminary Sources Study Report (PSSR): Bus Connects Corridor Route 08: Clondalkin to Drimnagh and Route 09: Tallaght (Greenhills) to City Centre, dated December 2019.

6.10.3 Pavement Design

Refer to Appendix E.1 Preliminary Sources Study Report (PSSR): Bus Connects Corridor Route 08: Clondalkin to Drimnagh and Route 09: Tallaght (Greenhills) to City Centre, dated December 2019.

7 Pavement, Kerbs, Footways and Paved Areas Pavement

7.1 Pavement

7.1.1 Introduction

This section identifies the proposed pavement strategy, setting out the design development considerations for the pavement works in current and future design stages. It also outlines the key elements for consideration for future testing requirements, and considerations for the use of recycled aggregates in the detailed design stage.

7.1.2 Overview of Pavement

The road pavement design for the Proposed Scheme considers rehabilitation of the existing road pavement and new road pavement construction resulting from road widening or changes in geometry along the scheme extents. The details of the preliminary pavement design can be found on the PAV_PV Pavement Treatment Plans and GEO_CS Typical Cross Section drawing series in Appendix B. It should be noted that the pavement boxing shown on the typical cross section series has been shown indicatively only for the purposes of demonstrating areas of full depth reconstruction.

The nature of the works associated with the Proposed Scheme is to generally widen the existing carriageway or reallocate existing road space to facilitate bus and cycle infrastructure. Existing footways and existing traffic lanes will also be impacted by the works. In general, all existing footways will be required to be removed and reinstated resulting from the realignment / widening works. Similarly, existing traffic lanes may be required to undergo pavement rehabilitation due to existing defects or pavement reconstruction works due to road realignment works or a pavement inlay / overlay treatment due to lane marking reallocation.

For the purposes of the pavement assessment the future bus flows and base 2019 traffic flows have been adopted as a reasonable worst-case scenario to inform the new pavement loading criteria for a 40-year design life.

Existing pavement asset testing information provided by the Road Management Office (RMO) has been assessed to provide an understanding of the existing pavement performance and quality. This data has been reviewed against high quality aerial photography, Google Street View imagery (2019), and site imagery, to correlate the data against visual defects.

The preliminary design of pavement assets is based on the following standards:

- DN-PAV-03021 (Dec. 2010) – Pavement and Foundation Design;
- DN-PAV-03023 (Jun. 2020) – Surfacing Materials for New and Maintenance Construction for use in Ireland;
- AM-PAV-06050 (Mar. 2020) – Pavement Assessment, Repair and Renewal Principles;
- PE-SMG-02002 (Dec. 2010) – Traffic Assessment;
- CC-SPW-00600 (Mar. 2013) – Specification for Road Works Series 600 – Earthworks;
- CC-SPW-00700 (Jan. 2016) – Specification for Road Works Series 700 – Road Pavements – General;
- CC-SPW-00800 (Mar. 2013) – Specification for Road Works Series 800 – Road Pavements – Unbound and Cement Bound Mixtures; and
- CC-SPW-00900 (Sep. 2017) – Specification for Road Works Series 900 – Road Pavements – Bituminous Materials.

The different pavement assets are designed taking consideration of:

- Traffic loads;
- Changes in road geometry;
- Existing pavement construction build-up;
- Existing pavement condition;
- Landscape Architect's requirements; and
- The impact of other assets such as drainage, utilities, and structures.

7.1.3 Design Constraints

7.1.3.1 Traffic Loading Considerations

The requirements for the design life of the pavement works are set out in PE-SMG-02002 and DN-PAV-03021 for new pavement construction and AM-PAV-06050 for pavement strengthening measures. The design life for different pavement scenarios are shown below.

Table 7-1: Pavement Design Criteria

Pavement Type	Design criteria
New build, widening, full reconstruction	• 40 year 'long life' pavement to max 80msa
Structural strengthening of the existing pavement	• 20-year design life

Current Traffic Count data (Traffic Count Data 2019-2020) has been used to understand the current traffic loads that are currently operational on the road network. A representation of surveyed traffic counts along the proposed scheme is displayed below in Figure 7-1, Figure 7-2, and Figure 7-3.

Figure 7-1: 2019- 2020 AADF – Proposed Scheme (Tallaght to Walkinstown Roundabout)

Figure 7-2: 2019 – 2020 AADF – Proposed Scheme (Walkinstown Roundabout to City Centre)

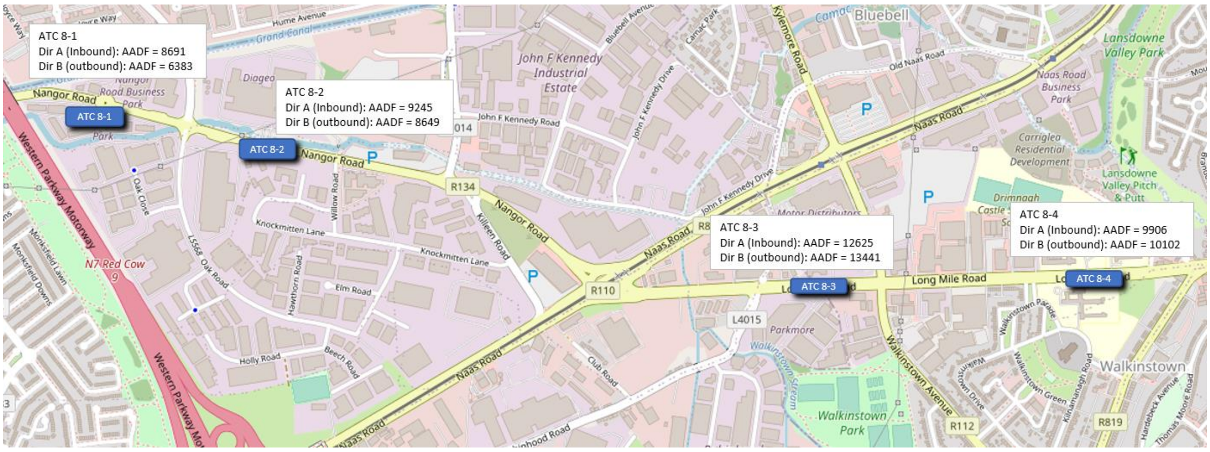

Figure 7-3: 2019 – 2020 AADF – Proposed Scheme (Clondalkin to Drimnagh)

Based on surveyed flows Table 7-2, below gives the estimated design msa for 20-year (rehabilitation) & 40-year (widening / new construction) design periods for the Proposed Scheme. Based on the Bus Network redesign, the forecast bus frequency of 45 buses per hour equates to 30 msa for a 40-year design life in accordance with the relevant design standard as shown below.

Table 7-2: Estimated Design Traffic ranges for Tallaght / Clondalkin to City Centre Proposed Scheme.

	Design Life	
Section	20 Years	40 Years
Tallaght to City Centre	2 to 23 msa	4 to 46 msa
Clondalkin to Drimnagh	8 to 13 msa	15 to 26 msa
Note: “msa” stands for million standard axles.		

Table 7-3: Bus Frequencies & associated msa for 40 year design life

Bus Frequency/ hour	Proposed Scheme	Traffic Loading Million standard axles (msa)
15		10
30		20
45	45	30
60	60	40

Locations of new highway pavement are predominantly anticipated to be at areas of widening for bus lane pavement and for the new bus lane route between Parkview and Birchview Avenue/Treepark Road. The standard DCC flexible pavement design specification for Bus Corridors is detailed in the Construction Standards for Roads and Street Works (CSRSW) in Dublin City Council and is presented below in Figure 7-4. The design allows for Hot Rolled Asphalt (HRA) or Stone Mastic Asphalt (SMA) surface course but specifies 40/60 pen asphalt concrete binder and base materials providing structural capacity to support 80msa traffic load. Whilst this detail is noted to cater above the future anticipated traffic loading in some areas, adopting this detail will provide a more robust pavement solution which could result in lower potential for maintenance / rehabilitation, and thus reducing the future potential for delays to the bus services along the Proposed Scheme.

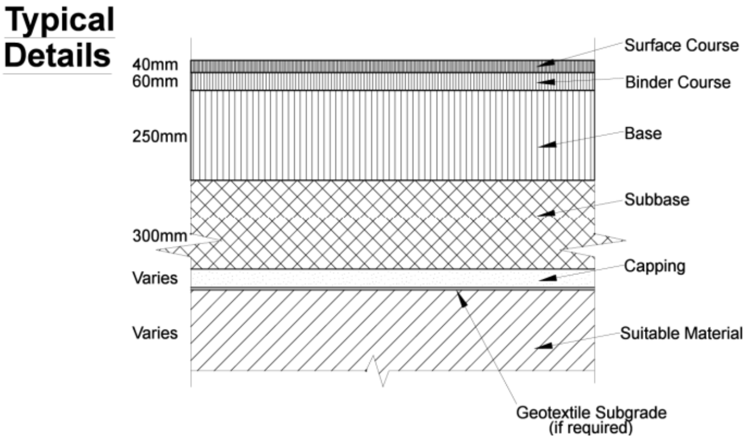

Figure 7-4: DCC Construction Standards for Roads and Street Works – Bus Corridor – Asphalt Road (Indicative 80msa Design)

Where it is considered uneconomical to provide a standard design for particular low traffic scenarios, such as non bus routes / Quiet Streets, alternate design thickness, based upon different base material and design traffic, should be designed in accordance with DN-PAV-03021 (as per CSRSW requirements for design in accordance with the NRA Design Manual for Roads and Bridges).

Other specific areas for consideration along the Proposed Scheme are noted below:

- Bus stops (on- and off-line);
- Tallaght Bus Interchange;
- Loading / Unloading areas for delivery vehicles;
- Off-line parking areas;
- Driveways; and
- Traffic calming features.

7.1.3.2 Geometry Considerations

The Proposed Scheme is proposed to be constructed on existing pavement assets, within constrained urbanised environments. It is therefore essential for the preliminary pavement design to consider the current road geometry and how it is proposed to be amended for the purpose of the Proposed Scheme.

The following road geometry changes expected to have an impact on the preliminary pavement design are:

- Pavement Widening;
- Pavement Narrowing;
- Horizontal realignment leading to relocation of pavement longitudinal joints (in relation to location of wheel tracks);
- Increase in vertical alignment;
- Decrease in vertical alignment;
- Impact on utilities and services trenches;
- Relocation of traffic islands; and
- Any combination of the above.

7.1.3.2.1 Pavement Widening

Widening is about extending transversely a rehabilitated existing pavement ensuring that the pavement structure shall be consistent from kerb to kerb and drainage paths are being maintained. It is therefore essential to understand what the existing pavement construction and condition is, as well as how it will be rehabilitated, before finalising the design of any widening.

It is proposed that any widening will be the full width of any proposed new lane, be it a cycle lane, a bus lane, or a general traffic lane. The widened lane shall be tied to the existing pavement as per transverse and longitudinal joint details CC-SCD-00704 – Pavement – Longitudinal Joint Between New Construction and Existing Road (Dec. 2010) and CC-SCD-00703 – Pavement – Transverse Joint Between New Construction and Existing Road (Sep. 2010).

7.1.3.2.2 Pavement Narrowing

Narrowing the pavement is the least disturbing geometrical change. Attention should however be given to the location of longitudinal joints in the existing pavement if the alignment of the traffic lanes is being shifted one way or the other. No longitudinal joint should be located in the wheel tracks.

It is proposed for any narrowing to be limited, in terms of excavation, to the area between the existing and the proposed kerblines.

7.1.3.2.3 Horizontal Realignment

Usually combined with a widening or a narrowing, a change in lanes alignment will result in the relocation of wheel tracks on the transverse profile of the pavement. If it leads to the relocation of the wheel tracks above an existing pavement joint, pavement works are required to prevent accelerated deterioration. Those pavement works could consist of the relocation of longitudinal joints in the binder and surface courses, by renewal of both layers. A geotextile would also be installed on top of the longitudinal joint in the base course to delay reflective cracking.

7.1.3.2.4 Increase in Vertical Alignment

Where the vertical alignment is proposed to be increased, the do-minimum treatment would be removal of the existing surface course before overlaying to the new finish level. In some instances, poor condition of the underlying layers may lead to deeper rehabilitation works. The use of regulating layers and materials is likely to be required.

7.1.3.2.5 Decrease in Vertical Alignment

Where the vertical alignment is proposed to be decreased, the do-minimum treatment would require the pavement to be cold milled down to the proposed finished level of the binder course, as a minimum. If the bond between the layer being cold milled into and the underlying layer is weak, (i.e. the planer removed the material down to the interface at some locations), cold milling should be extended to this interface. In some instances, poor condition of the underlying layers may lead to deeper rehabilitation works. The use of regulating layers and materials is likely to be required.

7.1.3.2.6 Pavement Works over Existing Utilities

Where the proposed works require new or modified utilities and drainage infrastructure, their depth or cover will require consideration with the proposed pavement profile. Typically, new utilities are installed below the structural pavement layers to facilitate an even load distribution onto the assets, however in many cases the depth of existing services will not be sufficiently deep enough to fall beneath the structural pavement layers and may require protection, diversion or a modified pavement design.

7.1.3.2.7 Relocation of Traffic Islands

Existing traffic islands to be relocated or removed should be fully excavated and may require a full depth pavement construction in trafficked areas, while proposed traffic islands may use the existing pavement as foundation where appropriate.

7.1.3.3 Existing Pavement Considerations

7.1.3.3.1 Construction

As the Proposed Scheme is proposed to be constructed on existing pavement assets, it is essential to gather intelligence on those existing assets in terms of construction build-up and condition.

No as-built data was available to confirm existing pavement construction for the Proposed Scheme; however, for non-national routes the Road Maintenance Office (RMO) pavement asset database generally includes details of more recent rehabilitation and resurfacing works [data as of 2019] including the following:

- "Surface Inventory Material Type": this provides information on which type of surface material or treatment is present;
- "Completed Pavement Interventions": this provides the location of where the carriageway has been resealed, surface restored, structurally overlaid, fully reconstructed or if a different treatment has been applied as Table 7-4, below [data as of 2019]; and
- "Planned Pavement Interventions": this provides the location of where the carriageway is planned to undergo routine maintenance, surface restoration or full depth reconstruction as per table below [data as of 2019].

Table 7-4: Lengths of Completed and Planned Interventions on Local Authorities' networks

Pavement Interventions (in linear metres)	
Completed	**Planned**
Surface restoration: 1760m in 2015, and 2200m in 2017.	Surface restoration: 1400m for 2020, and 1080m for 2021.

The surface materials and treatments recorded on the Proposed Scheme are a mix of Hot Rolled Asphalt (HRA) and Stone Mastic Asphalt (SMA) with some localised Surface Dressing (SD).

Local Pavement Asset Managers have also been contacted to establish if tar contaminated materials have been encountered on previous projects in the area. No known issues were identified; notwithstanding future testing will need to be undertaken to confirm the presence of tar contaminated materials.

7.1.3.3.2 Condition

As noted above, data from the RMO has been retrieved to assess the existing pavement condition. The data provided comprises limited network level survey data of non-national routes, including road surface measurements and limited visual condition surveys. This surface characteristics and visual condition data has been reviewed to give an indicative assessment of the pavement structural condition and to inform estimated high-level treatments.

For the sections of the Proposed Scheme running on the network of non-national routes, access to the RMO data sets was granted and Dublin City Council (DCC) provided their Road Condition Index data. The following datasets were made available in early 2020:

- **Sideway-Force Coefficient Routine Investigation Machine (SCRIM)** data: Characteristic Skid Coefficient (CSC);
- **Pavement Surface Condition Index (PSCI)**: PSCI giving an idea of general pavement condition from the analysis of surface observed defects;
- **Road Surface Profiler (RSP)** data: International Roughness Index, Mean Profile Depth, and Rutting Depth and Longitudinal Profile Variance; and
- **Road Condition Index (RCI) Scanner** (DCC only): RCI giving an indication of general pavement condition from the analysis of surface observed defects.

The pavement surface condition is directly assessed while the pavement structural condition is indirectly estimated. The structural condition of the pavement can only be reported on and assessed from indirect condition indicators taken from the surface of the pavement: rut depth, International Roughness Index (IRI) and Longitudinal Profile Variance (LPV). This initial assessment of these indicators of the pavement structural condition has been used to inform estimated high-level treatments at this preliminary design stage. At detailed design stage with additional pavement condition information available from further testing, assessment of pavement structural capacity can be accurately estimated, and residual life determined for existing and rehabilitated pavements along the Proposed Scheme.

The following are the key findings of the initial pavement quality assessment and proposed treatment interventions for this preliminary design stage.

SCRIM data: Characteristic Skid Coefficient (CSC)

Where SCRIM data is available and processed to provide a Characteristic SCRIM Coefficient (CSC), preliminary strengthening designs have considered the following treatments, as a minimum, based upon measured SCRIM values categories:

- "GREEN" – (Very Good & Good) Good Condition (CSC >0.5) – Do nothing
- "LIGHT GREEN" – Good Condition (CSC 0.45 – 0.5) – Do nothing
- "YELLOW" – (Fair) Some deterioration (CSC 0.4 – 0.45) – Retexturing treatment – Shot-blasting
- "AMBER" – (Poor) Some deterioration (CSC 0.35 – 0.4) – Retexturing treatment – Shot-blasting
- "RED" – (Very Poor) Poor condition (CSC <0.35) – 40mm Asphalt Surface Course

The extents of the proposed treatment interventions are illustrated on drawing series BCIDA-ACM-PAV_PV-0809_XX_00-DR-CR-9001 in Appendix B.

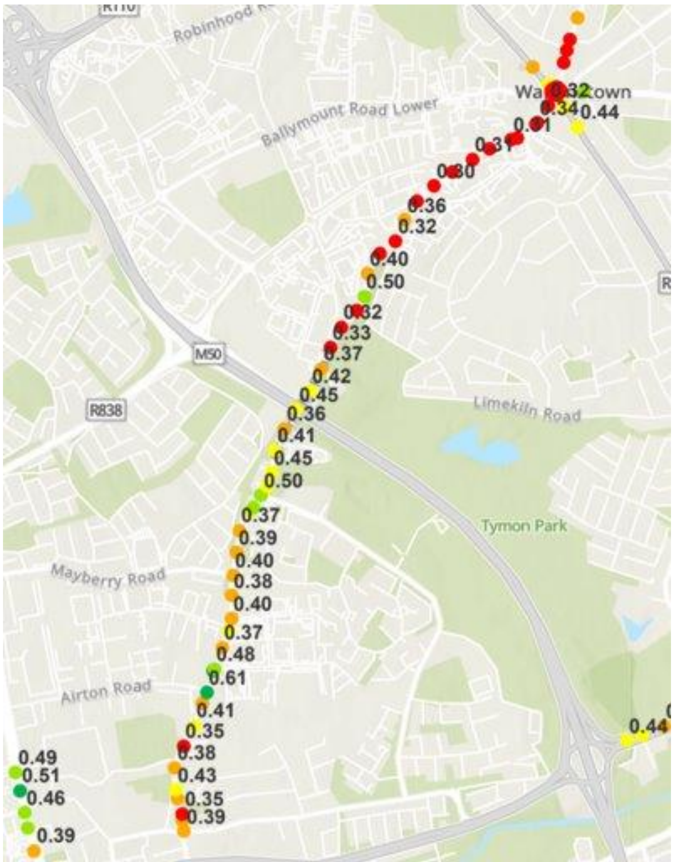

Figure 7-5: Corrected SCRIM Conditions for Proposed Scheme (Tallaght to Walkinstown Road) Source: ArcGIS RMO MapRoad (2019 DCC pavement surveys) – Esri UK, Esri, HERE, Garmin, METI/NASA, USGS mapping

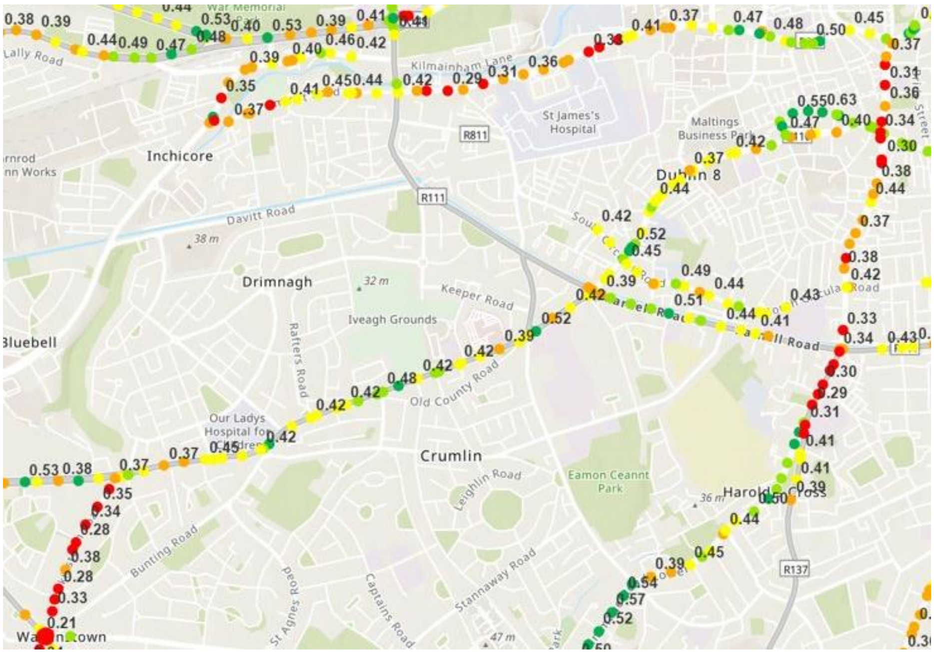

Figure 7-6: Corrected SCRIM Conditions for Proposed Scheme (Walkinstown Road to City Centre). Source: ArcGIS RMO MapRoad (2019 DCC pavement surveys) – Esri UK, Esri, HERE, Garmin, METI/NASA, USGS mapping

The SCRIM assessment for the section of the Proposed Scheme from Tallaght to the City Centre (Figure 7-5 and Figure 7-6) indicates that retexturing treatment or replacement of the surface course (40mm SMA) may be required along the vast majority of the Tallaght to City Centre Section as they have been categorised as ‘Amber’ or ‘Red’. Areas categorised as ‘Green’ are located at intermittent locations throughout the sections along the route and require no modifications. This will be reviewed during the site investigation stage to determine if the apparently low CSC values result from a loss of texture or material.

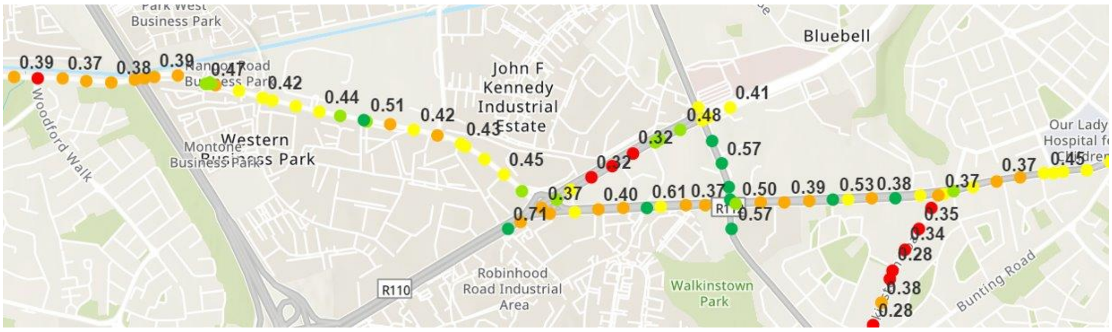

Figure 7-7: Corrected SCRIM Conditions for Proposed Scheme (Clondalkin to Drimnagh). Source: ArcGIS RMO MapRoad (2019 DCC pavement surveys) – Esri UK, Esri, HERE, Garmin, METI/NASA, USGS mapping

The SCRIM assessment for the section of the Proposed Scheme from Clondalkin to Drimnagh (Figure 7-7) indicates that retexturing treatment or replacement of the surface course (40mm SMA) may be required along intermittent sections of New Nangor Road, Naas Road and Long Mile Road, as these have been categorised as ‘Amber’ or ‘Red’.

Pavement Surface Condition Index (PSCI)

Where PSCI data is available, preliminary strengthening designs have been proposed for lengths of the existing carriageway pavements based upon the PSCI condition category. Preliminary strengthening designs based upon the PSCI categories are as follows:

- PSCI 9-10 – Routine Maintenance – Do nothing
- PSCI 7-8 – Resealing & Restoration of Skid Resistance – Shot-blasting

- PSCI 5-6 – Surface Restoration – 40mm Asphalt Surface Course plane and replace
- PSCI 3-4 – Structural Overlay / Inlay – 150mm Asphalt Inlay
- PSCI 1-2 – Road Reconstruction – 250-350mm Asphalt Inlay

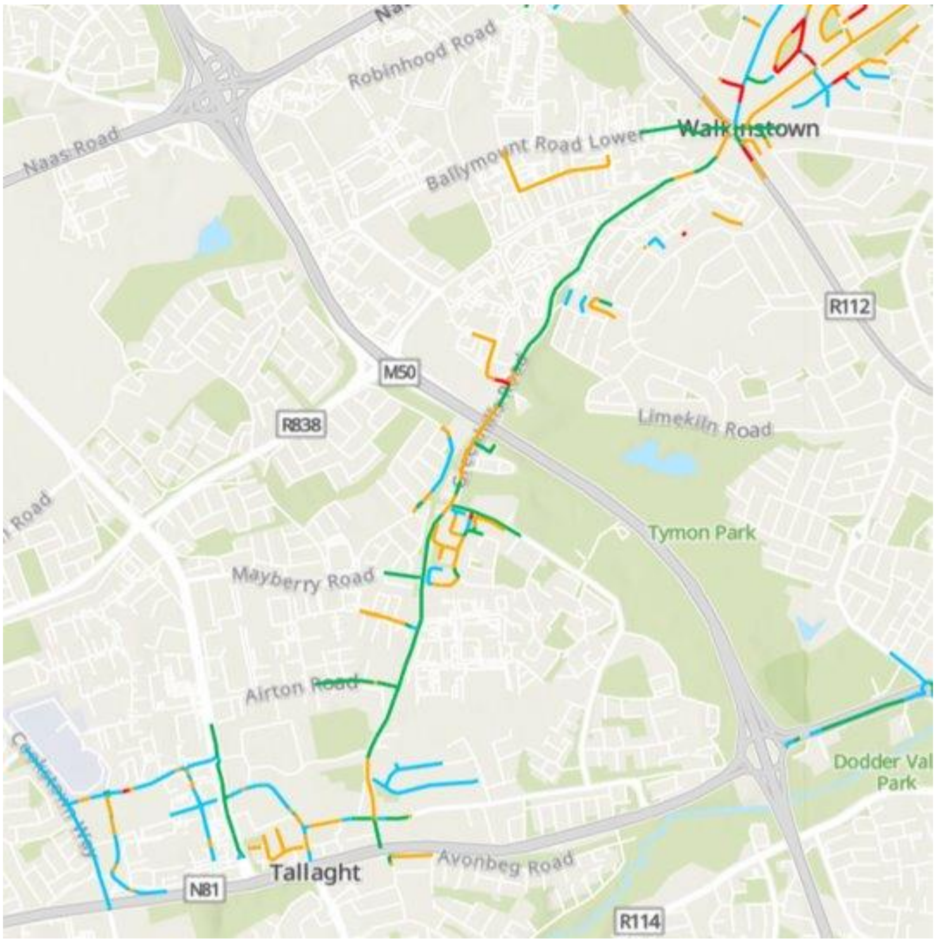

Figure 7-8: PSCI survey for the Proposed Scheme (Tallaght to Walkinstown Road)

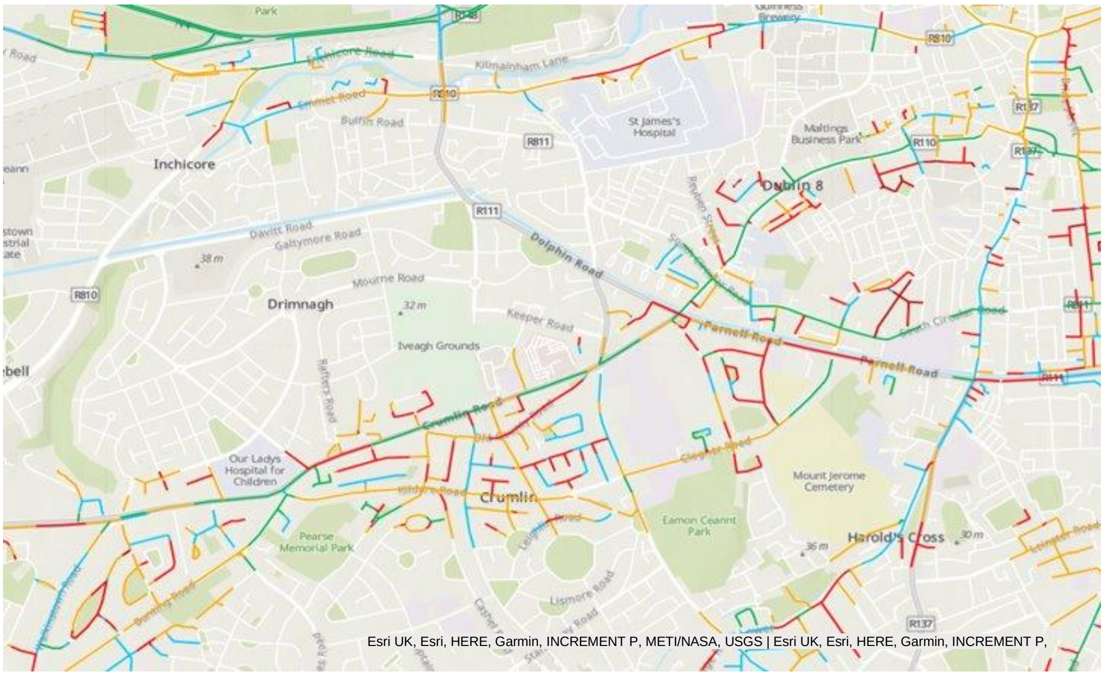

Figure 7-9: PSCI survey for the Proposed Scheme (Walkinstown Road to City Centre)

The PSCI survey for the section of the Proposed Scheme from Tallaght to the City Centre (Figure 7-8 & Figure 7-9) shows the majority of the route is in generally good condition falling between the 'Overall PSCI Rating' of 7-10. However, the PSCI data indicates that there are some localised areas of the route with moderate defects located along Bunting Road, Kildare Road, Clogher Road, Greenhills Road (from Old Greenhills Road junction to Parkview bypass junction), and Greenhills Road (from M50 to Calmount Road junction). There are also areas of the route in poor / distressed condition along Belgard Road, Crumlin Road (Cooley Road to Rafter Lane), South Circular Road and Walkinstown Road.

The PSCI data was cross checked at problem areas with high quality aerial photography and Google street view imagery (2019), and site imagery to further investigate the received data. See examples below showing defects which corroborate with the PSCI data received.

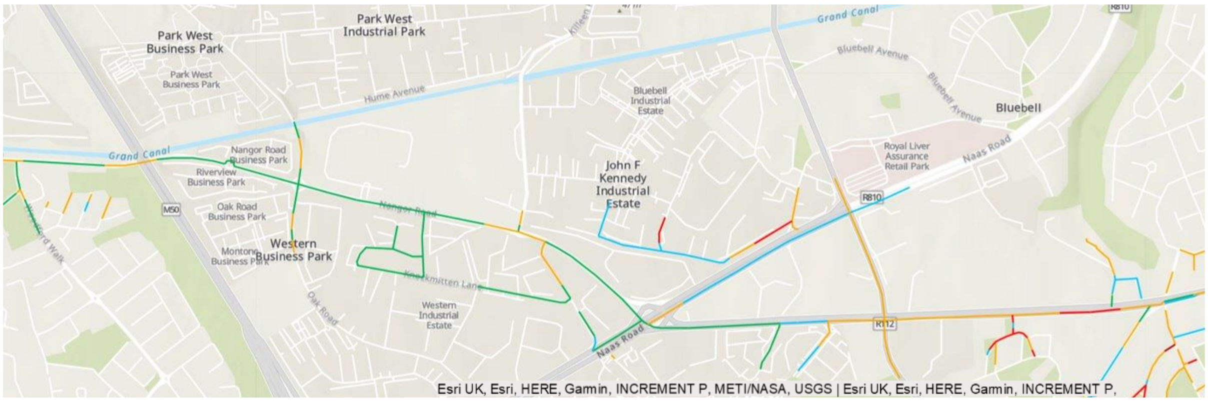

Figure 7-10: PSCI survey for the Proposed Scheme (Clondalkin to Drimnagh)

The PSCI survey for the section of the Proposed Scheme from Clondalkin to Drimnagh (Figure 7-10) shows the majority of the route is in generally good condition falling between the 'Overall PSCI Rating' of 7-10. However, the PSCI data indicates that there are some localised areas of the route with moderate defects located on Naas Road and stretches of New Nangor Road. There appears to be no areas of the route in poor / distressed condition.

Figure 7-11: Localised Poor Road Pavement Condition at Kildare Road / Windmill Road Junction ©2018 Google Maps

Figure 7-12: Localised Poor Road Pavement Condition at Walkinstown Road / Walkinstown Drive Junction ©2019 Google Maps

Figure 7-13: Moderate Road Pavement Condition at Nangor Road / Knockmitten Lane Junction with some ravelling around reinstatement works and joints ©2019 Google Maps

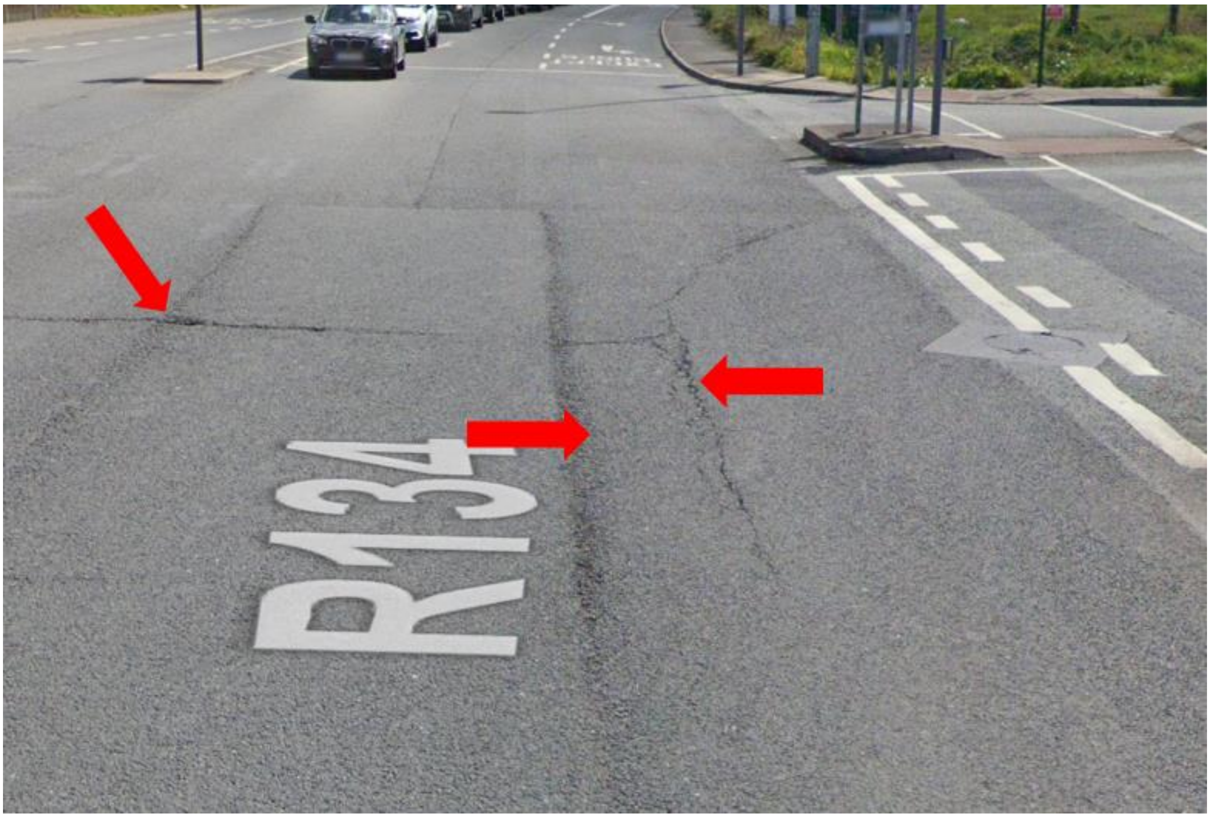

Figure 7-14: Moderate Road Pavement Condition at Nangor Road / Knockmitten Lane ©2019 Google Maps

Road Condition Index (RCI) Scanner

Where RCI scanner data is available, preliminary strengthening designs have been proposed for lengths of the existing carriageway pavements based upon the RCI condition category. Preliminary strengthening designs based upon the RCI categories are as follows:

- "GREEN" Generally good condition (<40) – Do nothing
- "Yellow" Some deterioration is apparent (Fair), (≥40 and <80) – Plan investigation soon
- "AMBER" – Some deterioration is apparent (Poor), (≥80 and <100) – Pavement Strengthening, 150mm Asphalt Inlay
- "RED" – Poor overall condition (≥100) – Full Reconstruction, 250-350mm Asphalt Inlay

The SCANNER survey for the section of the Proposed Scheme from Tallaght to City Centre (Figure 7-15 and Figure 7-16) indicates that the pavement is generally classified as good along the Tallaght to City Centre Section, however survey data isn't available from Belgrave Square to Walkinstown Roundabout. Very few areas along the route appear to be in poor condition with localised areas of poor condition identified along Crumlin Road, Kildare Road and Clogher Road.

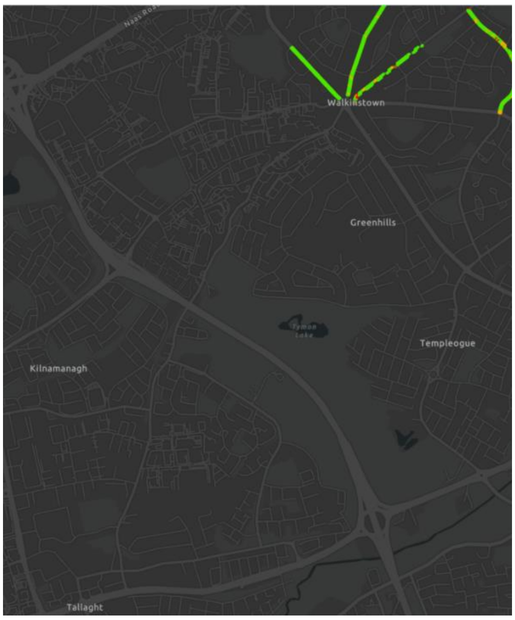

Figure 7-15: Road Condition Indicator for the Proposed Scheme (Tallaght to Walkinstown Ave / St. Peter's Road)

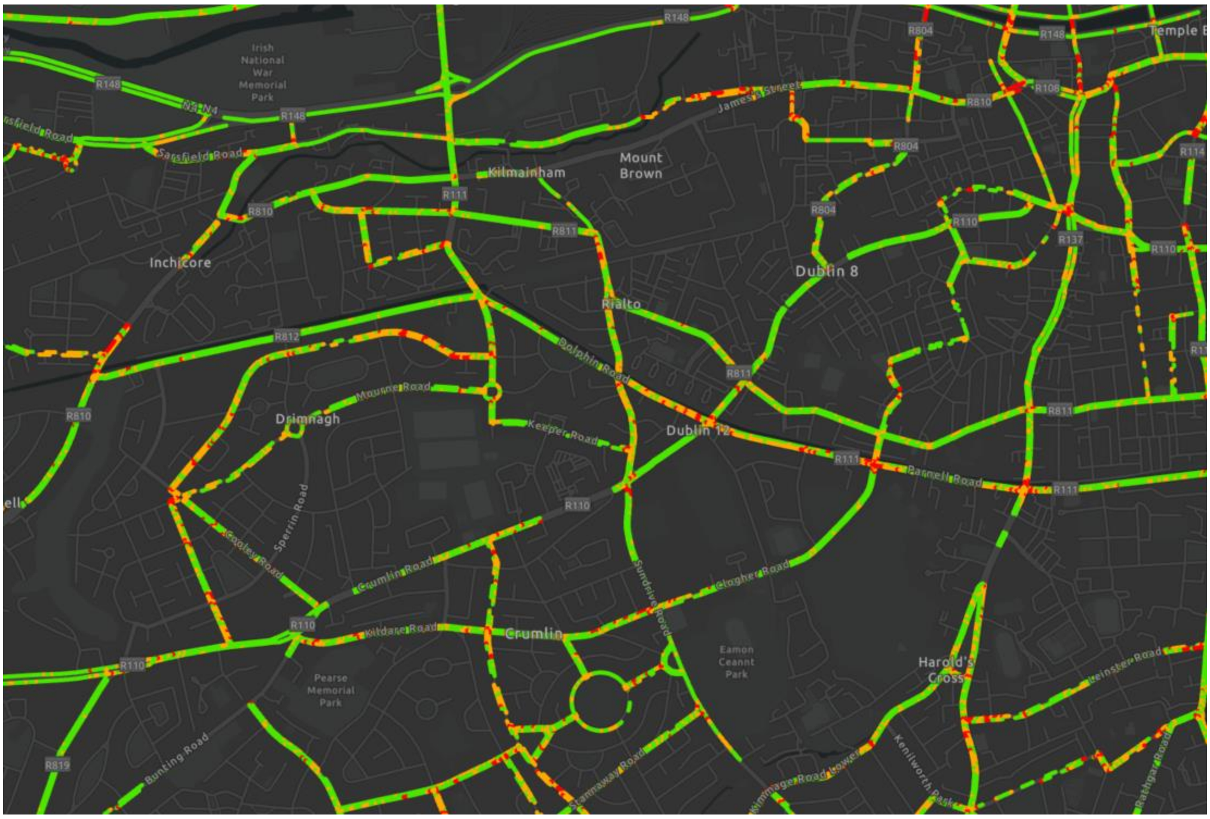

Figure 7-16: Road Condition Indicator for the Proposed Scheme (Walkinstown Ave / St. Peter's Road to City Centre)

The RCI scanner survey for the section of the Proposed Scheme from Clondalkin to Drimnagh (Figure 7-17) isn't available along the majority of the scheme, however, from the data that is available it indicates that the pavement is generally classified as good along the Clondalkin to Drimnagh Section. Very few areas along the route appear to be in poor condition with localised areas of poor condition identified at the Naas Road / Kylemore Road / Walkinstown Avenue junction, and Walkinstown Avenue / Long Mile Road junction.

Figure 7-17: Road Condition Index for the Proposed Scheme (Clondalkin to Drimnagh). Source shown

Summary of Assessment

The RCI and PSCI values have been combined in ArcGIS and analysed in Microsoft Access to establish the most onerous rating and avoid double counting of areas requiring intervention. From this assessment (Table 7-5 and Table 7-6) the overall pavement quality for the length of the route was established. Along sections of the route where there are multiple lanes, the poorest graded lane was used in the assessment.

The assessment describes the pavement condition being in one of four categories: red (poor), amber (moderate / poor), yellow (moderate / good) and green (good), which will determine the proposed treatment intervention.

Table 7-5:Preliminary Overall Pavement Quality Assessment of Pavement works for Tallaght (Greenhills) to City Centre (Both Directions)

Section	Length	Pavement Quality								
	(both sides)	Red		Amber		Yellow		Green		NA
	(m)	Length (m)	%	Length (m)	%	Length (m)	%	Length (m)	%	
Belgard Square West South section (up to junction with Old Blessington Road)	980	0	0	0	0	70	7	850	87	60
Belgard Square West North section (from junction with Old Blessington Road to Cookstown Road)	532	0	0	0	0	202	38	302	57	28
Belgard Square North	1064	0	0	58	5	196	18	762	72	48
Belgard Square East	830	0	0	0	0	0	0	830	100	0
Blessington Road (up to junction with Main Street)	956	0	0	0	0	196	21	760	79	0
Main Street	500	0	0	0	0	300	60	200	40	0
Old Greenhills Road	536	0	0	0	0	198	36	338	63	0
Greenhills Road (From Old Greenhills Road junction to Parkview bypass junction)	2286	0	0	0	0	0	0	2286	100	0
Old Greenhills Road @ Parkview bypass	1170	0	0	0	0	360	30	810	69	0
Greenhills Road (from M50 to Calmount Road junction)	2624	0	0	0	0	400	15	2224	84	0
Calmount Road	865	0	0	0	0	0	0	0	0	865
Greenhills Road (from Calmount Road tie into Walkinstown Roundabout)	1106	0	0	0	0	460	41	646	58	0
Walkinstown Road	1612	0	0	260	16	290	18	1062	65	0
Bunting Road	1150	80	7	82	7	866	75	122	10	0
Drimnagh Road (from Walkinstown Road junction to junction with Bunting Road)	1612	80	5	132	8	478	30	922	57	0
Crumlin Road (from junction with Bunting Road/Kildare Road to Parnell Road)	2994	262	9	366	12	914	30	1452	48	0
Dolphins Barn (from junction with Parnell Road to junction with Marrowbone Lane)	2074	128	6	182	9	288	14	1476	71	0
Cork Street (from junction with Marrowbone Lane to Junction with Ardee Street)	844	40	4	40	4	96	11	668	79	0
St Luke's Avenue (From junction with Ardee Street to junction with The Coombe)	676	40	6	40	6	76	11	520	77	0
The Coombe (from junction with St Luke's Avenue to junction with New St. South/Patrick Street)	166	0	0	42	25	124	75	0	0	0
Patrick Street (from junction with The Coombe to Brides Road)	296	58	20	8	3	230	77	0	0	0
Nicholas Street (from Brides Road to Christchurch)	426	20	5	20	5	386	91	0	0	0
Kildare Road	2230	314	14	260	12	1656	74	0	0	0
Clogher Road	2888	242	8	182	6	1806	63	658	23	0

A summary of the overall assessment in Figure 7-18 indicates just 10% of the pavement on the route needs further intervention than resurfacing [noting appreciable lengths with no data].

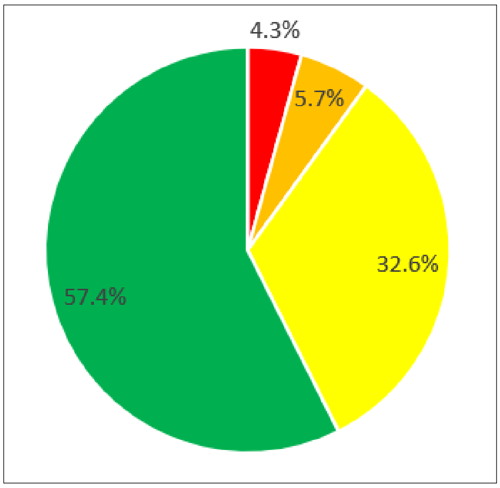

Figure 7-18: Summary of Overall Preliminary Pavement Quality Assessment – Key: red (poor), amber (moderate / poor), yellow (moderate / good) and green (good) – (Tallaght to City Centre)

Table 7-6: Preliminary Overall Pavement Quality Assessment of Pavement works for Proposed Scheme (Clondalkin to Drimnagh – Both Directions)

Section	Length	Pavement Quality								
	(both sides)	Red		Amber		Yellow		Green		No data
	(m)	Length (m)	%	Length (m)	%	Length (m)	%	Length	%	(m)
New Nangor Road (Woodford Walk to Naas Road/Long Mile Road)										
Woodford Walk to Oak Road	2014	0	0	0	0	624	31	1390	69	0
Oak Road to Killeen Road	1476	0	0	0	0	214	14	1262	86	0
Killeen Road to Naas Road	1200	0	0	0	0	178	15	1022	85	0
Naas Road	740	60	8	26	4	378	51	276	37	0
Walkinstown Avenue	330	28	8	0	0	0	0	0	0	302
Long Mile Road	1760	20	1	180	10	1560	89	0	0	0

A summary of the overall assessment in Figure 7-19 indicates just 4.4% of the pavement on the route needs further intervention than resurfacing [noting appreciable lengths with no data].

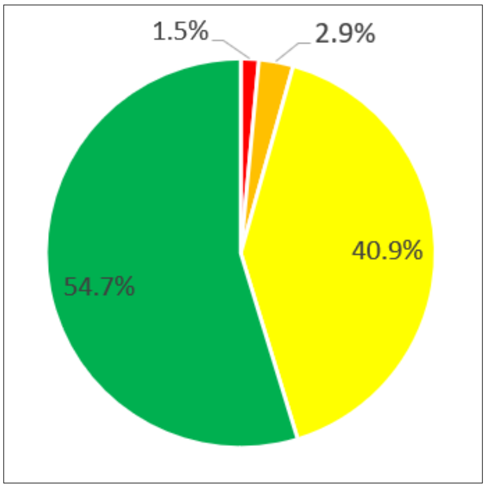

Figure 7-19: Summary of Overall Preliminary Pavement Quality Assessment – Key: red (poor), amber (moderate / poor), yellow (moderate / good) and green (good) – (Clondalkin to Drimnagh – Both Directions)

7.1.3.4 Required Complementary Surveys

Whilst the information provided by the RMO has been useful for the purposes of providing an indication of the existing pavement condition there are other elements that would need to be confirmed with more detailed testing such as the pavement structural condition and subgrade condition. The additional condition data requirements, including surveys, will be required for future design stages to develop and implement pavement rehabilitation strategies. Those requirements shall be in line with AM-PAV-06050 (Mar. 2020).

As part of the future testing regime a Ground Penetration Radar (GPR) survey is to be procured. Cores will be taken at regular intervals to allow for the calibration of the GPR against the extracted pavement layers. Such survey would generate the following datasets essential for the pavement design:

- Depth of unbound granular materials;
- Depth of rigid materials (concrete);
- Depth of bituminous materials;
- Detailed pavement build-up (number of layers and their associated thicknesses – bound materials only);
- Condition of the bound materials;
- Condition of the interlayer bonds;
- Condition of the foundation layer(s) through the use of Dynamic Cone Penetrometer (DCP) testing; and
- Likely presence of tar contaminated materials.

To greater understand the pavement structural condition and more accurately determine strengthening requirements in terms of extents and depth, additional surveys will be required for the detailed pavement design. These should include both non-intrusive and intrusive testing in addition to those proposed to inform pavement construction. The pavement surveys which are recommended to be undertaken to inform the existing pavement structural condition are as follows:

- Falling Weight Deflectometer including back-analysis and residual life calculations, and
- Laboratory materials testing.

7.1.4 Pavement Design

7.1.4.1 Pavement Materials

During future design stages, the selection of appropriate pavement materials should be made with the following considerations:

- Pavement structure most appropriate and compatible with existing pavement; (i.e. Fully flexible vs. Flexible Composite vs. Rigid pavement);
- Materials most appropriate for noise, permeability, colour, texture, etc; and
- Materials lifecycle which provide the best value in terms of environmental impact, durability, maintainability, repairability, recyclability, cost.

Specific materials should be selected for specific loading areas. Concrete (rigid) pavements, particularly if proposed at bus stops may prove impractical for these works due to long curing times and the need to remain untrafficked until sufficient strength gain has been achieved. For such reasons, concrete pavements at on-line bus stops are likely to be difficult to accommodate without delaying the construction programme. However, off-line bus stops, and bus interchanges where buses are likely to remain stationary for longer periods of time and thus benefit from rigid construction, could more feasibly be concrete pavements without causing delay to construction. This will need to be reviewed during future detailed design.

The ambition in terms of pavement materials is to reuse or recycle all the excavated materials. The specification of materials and processes with a reduced environmental impact should be prioritised.

The choice of surfacing materials has been discussed with the Landscape Architect, in particular in potential development opportunity areas.

If it is considered uneconomical to provide a standard subbase thickness for all pavement locations (i.e. due to variable subgrade strength) alternate design thickness can be designed in accordance with TII Publication DN-PAV-03021 "Pavement & Foundation Design" December 2010. DN-PAV-03021 should be consulted with regards to allowable subbase materials in case of use of high stiffness asphalt base, where bound support layer is best practice to support the additional compactive effort required to lay the 'stiff' asphalt and to help ensure required material performance.

Table 7-7: Foundation Designs – Fully Flexible Pavement with EME2 base (Foundation Class 3)

Subgrade Long Term Design CBR (%)	Single Foundation Layer (DN-PAV-03021 Fig. 5.1)
2.5	340mm CBGM C8/10
3	320mm CBGM C8/10
4	290mm CBGM C8/10
5	280mm CBGM C8/10
8	230mm CBGM C8/10
10	210mm CBGM C8/10
15	200mm CBGM C8/10

Table 7-7 Notes:

Subbase to be Cement Bound Granular Mixture (CBGM) to Clause 821 or 822 of the NRA Specification for Road Works (MCDRW1) achieving at least the strength class C8/10 when tested in accordance with Clause 825 of MCDRW1

EME2 denotes Enrobe à Module Elevé asphalt
CBR denotes California Bearing Ratio

Design should consider drainage continuity with adjacent pavement. However, this information is not currently available generally and so this should be reviewed at detailed design stage once localised pavement construction build-up is confirmed.

Longitudinal tie-in details for the widening designs should be undertaken in accordance with the appropriate NRA Standard Construction Details (ref. CC-SCD-00704 December 2010) as shown in Figure 7-20.This shows the requirements for longitudinal offsetting of the joints at each individual layer.

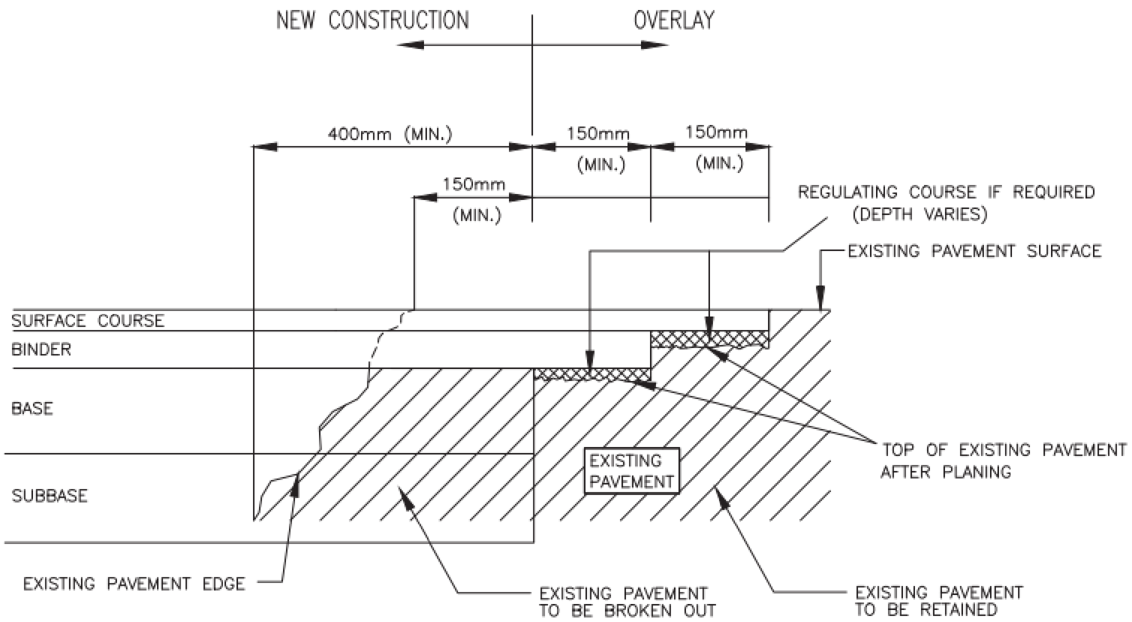

Figure 7-20: TII – Typical Road Section Longitudinal Tie-in with Existing Road

In addition to the requirements of the example standard detail, care should be taken to avoid locating surface joints within wheel track zones to help minimise damage and required maintenance.

Where greater traffic volumes are expected and where it is considered uneconomical to provide a standard design for particular low traffic scenarios, alternate design thickness, based upon different base material and design traffic should be designed in accordance with DN-PAV-03021 (as per CSRSW requirements for design in accordance with the NRA Design Manual for Roads and Bridges).

Design thickness for the pavement options and materials provided in DN-PAV-03021 are presented below in Table 7-8, for a range of design traffic which will cover the variable traffic volumes along the bus lanes.

Table 7-8: Pavement Design Thickness for New Construction – Design Thickness for Planning Application highlighted

Design Traffic (msa)	Fully Flexible Design Min. Asphalt Thickness (mm)[5]			Flexible Composite Design Min. Asphalt / CGBM Thickness (mm)[5]	Rigid Design – Min. Concrete Thickness (mm)	
	AC 40/60	AC 70/100	EME2[1]	AC 40/60 + C12/15[2]	URC[3]	CRCP[4] with 30mm As Surface
1	200	200	200	100 + 150	150	230
2	200	210	200	100 + 150	150	230
3	210	230	200	100 + 150	150	230
4	220	240	200	110 + 150	160	230
5	230	250	200	120 + 150	165	230
10	250	280	200	140 + 150	190	230
20	280	320	220	150 + 150	215	230
30	300	340	240	160 + 170	235	230
40	310	350	240	170 + 170	250	230
50	320	370	250	180 + 180	260	230
60	340	370	260	180 + 180	270	230
70	340	380	260	180 + 180	275	230
80	350	390	270	180 + 190	285	230

Table 7-8 Notes:

1. EME2 asphalt pavement requires a Class 3 Foundation performance
2. CBGM comprises CBGM 1 grading envelope Category G2 (strength class C12/15 with Crushed Aggregate (crushed gravel not permitted). Flexible composite design assumes Foundation Class 2.
3. URC comprise strength class C32/40 with design based upon assumption of mean 28-day compressive cube strength of 50 N/mm2 as per requirements of TRL Report RR87 (1987), with Class 3 foundation performance. Design assumes untied shoulder to concrete.
4. CRCP comprise strength class C32/40 with 5.0Mpa design concrete flexural strength and crushed rock aggregate, with Class 2 foundation performance. Design thickness is increased by 30mm to account likely lack of 1m edge strip or tied shoulder in urban environment.
5. Total thicknesses of asphalt shown include the thickness of the surface course. Binder and base asphalt materials to be design or performance mixtures.

Msa denotes Million Standard Axles

AC 40/60 denotes Asphalt Concrete with 40/60 Pen Bitumen
AC 70/100 denotes Asphalt Concrete with 70/100 Pen Bitumen
EME2 denotes Enrobe à Module Elevé asphalt
CBGM denotes Cement Bound Granular Mixture
C8/10 denotes Concrete Class C8/10
URC denotes Unreinforced (Jointed) Concrete
CRCP denoted Continuously Reinforced Concrete Pavement
design thicknesses are rounded to the nearest 10mm as per requirements of DN-PAV-03021

7.1.4.2 Pavement Strategy

7.1.4.2.1 New Pavement and Bus Interchange Strategy

New pavement is proposed for the new bus route alignment at Parkview between Mayberry Road junction on Greenhills Road and the Greenhills Road M50 overbridge. The proposed pavement design will be as outlined in section 7.1.3.1.

A bus interchange is proposed on Belgard Square West at The Square, Tallaght. This location will be trafficked by a large volume of buses. Slow moving, stationary, vibrating and manoeuvring buses are extremely damaging to both the pavement surface and the pavement structure. Fully flexible (bituminous mixtures) and flexible composite (bituminous mixtures on a hydraulically bound base) pavement structure are unlikely to provide a durable and low maintenance option for this location. It is therefore proposed for the pavement to be rigid (concrete) at that location. Rigid pavements do not rut, are highly resistant to scuffing and oil dropping, requiring limited maintenance, for example at joints.

7.1.4.2.2 Pavement Rehabilitation Strategy

At specimen design stage, the pavement strategy will be revisited to develop options for:

- Areas to be widened or fully reconstructed; and
- Areas to be rehabilitated (do minimum, intermediary strategies, fully reconstruct).

As noted in 7.1.3.4 an appropriate testing regime will be undertaken at specimen design stage. The successful Contractor will undertake further testing as deemed required by the findings of the testing regime, and to satisfy any specific requirements for the design.

In order to estimate the waste quantities and the carbon emissions from the Proposed Scheme pavement works, the following assumptions were made:

- Where full depth reconstruction is anticipated (e.g. widening, traffic island relocation), a conservative fully flexible pavement design is assumed: 350mm of bituminous mixtures on top of 150mm of subbase material and 400mm of capping material; and
- Where the existing pavement is anticipated to only require rehabilitation, are informed by the most onerous of the PSCI or RCI:
- Fully Flexible Carriageway
    - Green & Yellow condition: No action (but may need to be reprofiled / resurfaced for proposed works);
    - Amber condition: Pavement Strengthening – 150mm asphalt Inlay required; and
    - Red condition: Full pavement reconstruction – 250-350mm asphalt Inlay (+ 150mm subbase + 400mm capping as required).
- Rigid Carriageway
    - PSCI ≥ 5: no works, and
    - PSCI ≤ 4: 200mm Concrete Inlay.

Preliminary pavement drawings detailing the extents of the proposed treatment interventions are illustrated on drawing series BCIDA-ACM-PAV_PV-0809_XX_00-DR-CR-9001 included in Appendix B Preliminary Design Drawings. Detailed general arrangement cross section drawings have also been prepared; however, these show a simplified pavement arrangement. The reader should refer to typical

TII standard pavement edge and tie-in details like Figure 7-20 above, and the BusConnects Design Guide for more detailed insight to the proposed tie-in and edge of pavement proposals.

The above pavement strengthening proposals are based upon provision of a new surface and binder course layer to help remove any surface defects and provide some additional strengthening to the pavement. The 150mm inlay can typically be installed in one night shift, with lengths of treatment limited by the time available. The full reconstruction treatment assumes the expected fully flexible pavement thickness range (accounting for expected variation in design traffic and existing construction thickness) which would be required to remove all failed bound pavement materials which can no longer provide sufficient structural capacity to the vehicular trafficking. As noted above, the preliminary design full reconstruction thicknesses are based upon the DCC Bus Route specification (for new construction).

It should be noted that there is risk of underestimating strengthening requirements in the absence of additional testing. Additional testing may identify extents of 'Green' condition pavement that may be fatigued and require strengthening to meet future trafficking. Additionally, the later any future strengthening works are undertaken the greater the risk that these earlier assumptions underestimate the pavement fatigue and damage at time of the works.

All proposed treatments will be subject to confirmation and refinement by Ground Investigation and additional pavement survey works during future detailed design, where defect causation, pavement construction and thickness, structural capacity and foundation performance are confirmed. This is essential if a specific design life is to be provided for the pavement.

The risk of tar contaminated material presence in the existing pavement is expected to be mitigated with the delivery of the GPR survey through the testing of the calibrating cores for tar. Ideally, where any tar bound materials are located at depth in the pavement, the design should consider the potential to leave them in situ. In the absence of core logging and testing for presence of Polyaromatic Hydrocarbons (PAH), pavement rehabilitation cannot consider reducing inlay depths to prevent tar bound layer excavation. As such, there is a risk that tar bound materials may be identified later and excavated, requiring material classification (as inert or hazardous), and potential costly disposal as hazardous waste.

7.1.4.3 Opportunities for Innovation

Innovative materials and processes delivering enhanced environmental, social and financial benefits are being promoted in the ongoing pavement design process.

7.1.4.4 Reuse and Recycling Considerations

Opportunities for reuse and recycling of secondary materials have and should also continue to be identified and quantified throughout the Specimen Design process.

Current opportunities include but are not limited to:

- Where practicable, incorporation of minimum 20% of reclaimed asphalt into new base and binder layers of the pavement;
- Excavated capping layer material to be reused as new capping material if compliant with current standards; and
- Excavated subbase layer material to be reused as new subbase material if compliant with current standards.

Developments in standards and design codes, the capacity of the Irish market to deliver, and the programming of the individual schemes and collective programming schedule, are key elements that will inform the final reuse and recycling proposals to be adopted in the development of the tender design strategy.

To generate likely waste volumes for the planning application a waste calculator has been developed for the Proposed Scheme and is detailed in Section 11. It quantifies and classifies the likely material types in accordance with TII GE-ENV-01101 and the European Waste Catalogue waste codes, and where possible breaks down into the likely TII material specification to establish an understanding of the volume of materials that could potentially be reused / recycled.

7.2 Kerbs, Footways and Paved Areas

7.2.1 Overview of Kerbs, Footways and Paved Areas

This section covers the preliminary design for the kerbs, footways, and paved areas (KFPA) assets:

- Kerbs;
- Footways (concrete, bituminous and paved); and
- Cycle tracks.

For the Proposed Scheme, two pavement networks are being considered, the primary and the secondary networks. The primary network refers to the bus corridor under consideration while the secondary network refers to the roads impacted by the re-routing of existing traffic from the proposed scheme to the nearby road network.

The preliminary design of KFPA assets is based on the following standards:

- DN-PAV-03021 (Dec. 2010) – Pavement and Foundation Design;
- DN-PAV-03026 (Jan. 2005) – Footway Design;
- Construction Standards for Road and Street Works in Dublin City Council (May 2016) – Revision 1;
- PE-SMG-02002 (Dec. 2010) – Traffic Assessment;
- CC-SPW-00600 (Mar. 2013) – Specification for Road Works Series 600 – Earthworks;
- CC-SPW-00700 (Jan. 2016) – Specification for Road Works Series 700 – Road Pavements – General;
- CC-SPW-00800 (Mar. 2013) – Specification for Road Works Series 800 – Road Pavements – Unbound and Cement Bound Mixtures;
- CC-SPW-00900 (Sep. 2017) – Specification for Road Works Series 900 – Road Pavements – Bituminous Materials;
- CC-SPW-01000 (Mar. 2013) – Specification for Road Works Series 1000 – Road Pavements – Concrete Materials;
- CC-SPW-01100 (Feb. 2012) – Specification for Road Works Series 1100 – Kerbs, Footways and Paved Areas; and
- BS 7533 series of standards (1999 – 2021) – Pavement Constructed with Clay, Concrete or Natural Stone paving Units.

The different KFPA assets are designed taking consideration of:

- Traffic loads;
- Changes in road geometry;
- Existing KFPA construction build-up;
- Existing KFPA condition;
- Landscape Architect’s requirements; and
- The impact of other assets such as drainage, utilities, and structures.

New cycleway and cycle track pavements should be designed considering the requirements of the BCPDGB. This booklet notes that reference should be made to the guidance provided in the National Cycle Manual (NCM) with regards to cycleway and cycle track design and materials selection. This is in line with DCC CSRSW requirements.

7.2.2 Design Constraints

7.2.2.1 Traffic Loading Considerations

Depending on the expected traffic characteristics (volumes, pedestrian versus vehicular) and the proposed surface material, the Design Traffic may be categorised slightly differently as illustrated on Figure 7-21.

For bituminous footways and cycle tracks, the Design Traffic will be calculated in accordance with PE-SMG-02002 (Dec. 2010) and categorised as per DN-PAV-03026 (Jan. 2005), if the Design Traffic is below 50,000 standard axles over their lifetime (40 years).

For concrete footways, the Design Traffic will be calculated in accordance with PE-SMG-02002 (Dec. 2010) for a 40-year design life.

For paved footways, the Design Traffic will be calculated in accordance with PE-SMG-02002 (Dec. 2010) and categorised as per BS 7533 series.

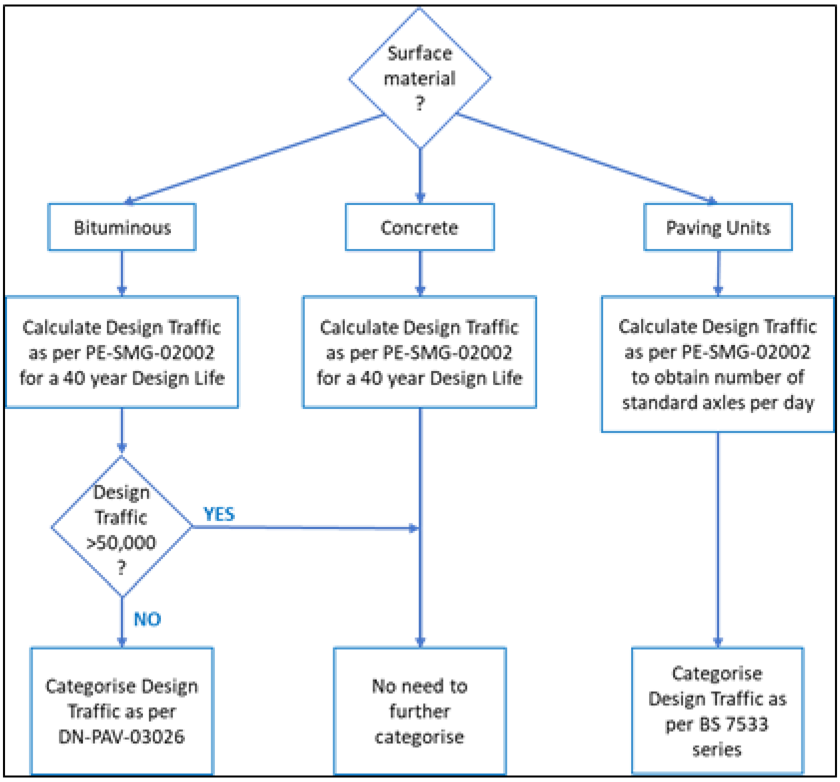

Figure 7-21: Traffic Design and Categorisation for KFPA

7.2.2.2 Geometry Considerations

For the planning application the preliminary design has estimated where the full depth footway or cycle track reconstruction is required. It has assumed full depth carriageway construction at cycle lanes. At Specimen Design stage, the 3D geometry model will be further analysed to identify footways and segregated cycle tracks requiring full depth reconstruction and those that can be maintained in place.

7.2.2.3 Existing Pavement Condition Considerations

For the footways and cycle tracks that will be fully reconstructed, the design of the foundation will be based on an assumed Design CBR of 2.5%, the minimum permitted value as per Clause 3.23 of DN-PAV-03021 (Dec. 2010).

If some existing footways and cycle tracks are proposed to be maintained (no impact from utilities etc), their condition will be assessed visually before proposing any potential rehabilitation works.

7.2.3 Pavement Design

7.2.3.1 Pavement Materials

The selection of appropriate pavement materials should be undertaken with the following considerations:

- Pavement structure most appropriate and compatible with existing pavement; (i.e. Fully flexible vs. Flexible Composite vs. Rigid pavement);
- Materials most appropriate for noise, permeability, colour, texture, etc; and
- Materials lifecycle which provide the best value in terms of environmental impact, durability, maintainability, repairability, recyclability, cost.

Specific materials should be selected for specific loading areas.

The ambition in terms of pavement materials is to reuse or recycle all the excavated materials where practicable. The specification of materials and processes with a reduced environmental impact should be prioritised.

At preliminary design stage the choice of surfacing materials has been discussed with the Landscape Architect, in particular in Potential Development Opportunity areas. The Landscape Architect's design will be considered at Specimen Design stage to identify the choice of surfacing materials which will in turn dictate the choice of materials used for the underlying footpath and segregated cycle track structure.

For bituminous footways and cycle tracks, the bituminous layer(s) should make use of as much recycled material as practicable. Low Energy Bound Mixtures (LEBM) should be considered as an alternative to the conventional Asphalt Concrete (AC), Hot Rolled Asphalt (HRA) and Stone Mastic Asphalt (SMA) mixtures.

As per Section 5.5 of the BCPDGB, in order to provide a visual differentiation between the carriageway and cycle tracks and cycle lanes, it is proposed that all cycle tracks and cycle lanes are to have red coloured epoxy type surfacing, or red coloured HRA, or similar in accordance with the National Cycle Manual.

7.2.3.2 Pavement Structures

Selection of pavement and foundation construction types for footways and cycle tracks will be influenced by existing adjacent pavement construction, existing utilities, drainage continuity and ease of pavement tie-in, and will be reviewed at pre-tender design stage when more information would be expected to be available with additional survey work undertaken.

Where subgrade conditions are identified as being poor, based upon geotechnical investigation, consideration should be given to provision of geogrids to stiffen the foundation and to aid transition between pavements at widening.

7.2.3.3 Opportunities for Innovation

Innovative materials and processes delivering enhanced environmental, social and financial benefits are being promoted in the ongoing pavement design process.

7.2.3.4 Reuse and Recycling Considerations

Opportunities for reuse and recycling of secondary materials have and should continue to be identified and quantified throughout the Specimen Design process.

Current opportunities include but are not limited to:

- Excavated capping layer material to be reused as new capping material if compliant with current standards;
- Excavated subbase layer material to be reused as new subbase material if compliant with current standards;
- Up to 50% of capping and subbase materials can be substituted with reclaimed asphalt;

- Concrete base to paved areas to make use of recycled aggregate, recycled concrete aggregate, and more sustainable hydraulic binders (e.g. CEM III/A);
- Concrete footways to also make use of more sustainable hydraulic binders;
- Jointing and bedding mortars used in the construction of paved areas may contain recycled materials; and
- Aggregate for base / binder layer for cycle tracks should be 100% Reclaimed Asphalt (Low Energy Bound Material – LEBM).

As noted in Section 7.1.4.4, a waste calculator has been developed for the Proposed Scheme and is detailed in Section 11.

8 Structures

8.1 Overview of Structures Strategy

There are several existing and proposed structures along the Proposed Scheme. The structures vary in form and complexity and are detailed below.

Where the route interfaces an existing structure a visual inspection has been carried out to identify the current condition of the structure and any repair/maintenance works required. In some cases, a visual inspection was not possible due to access issues. Where alterations to the existing carriageway lines, kerbs lines and verge widths are proposed a Stage 1 Structural Assessment has been carried out to ensure the structural capacity can withstand the revised arrangement.

Where new bridge structures are proposed the preliminary design has been prepared in accordance with the requirements in TII DN-STR-03001 Technical acceptance of Structures on Motorways and Other National Roads. This includes Structures File Notes, Outline Structures Reports, Structures Options Reports and Preliminary Design Reports as required.

8.2 Summary of Existing Structures

The Proposed Scheme interfaces six existing structures from its starting point in Tallaght/Clondalkin to its terminus in the city centre. A full list of structures including coordinates, Local Authority, and proposed works are listed below. Further information on each structure can be found within the Structures File Note prepared for the scheme included within Appendix F Structural Survey Report**.**

Table 8-1:Existing Structures along the Proposed Scheme

Location	Co-ordinates	Local Authority	Comment
Greenhills Road Culvert (Poddle River)	709532.000 728098.000	SDCC	Structure not impacted
Ballymount Avenue Culvert (Tributary of Robinhood Stream)	710083.812 730200.855	SDCC	Structure not impacted
Calmount Road Culvert (Tributary of Robinhood Stream)	710162.363 730477.103	SDCC	Structure not impacted
Greenhills Road, M50 Bridge SD-M50-013	709981.615 729536.932	SDCC	Carriageway rearrangement proposed. In addition, two new pedestrian and cycle bridges proposed, one either side of the existing overbridge.
Dolphin's Barn, Grand Canal bridge	713678.980 732685.593	DCC	Structure not impacted
New Nangor Road, Unknown Culvert (Tributary of River Cammock)	707643.622 732113.814	SDCC	Structure not impacted
New Nangor Road, Unknown Culvert (Tributary of River Cammock)	707794.846 732109.375	SDCC	Structure not impacted
New Nangor Road M50 overbridge	708071.318 732116.470	SDCC	Structure not impacted
New Nangor Road Oak Road Culvert	708581.275 732053.407	SDCC	Span less than 1.5m, widening proposals covered under separate contract.
Naas Road Culvert (Walkinstown Stream)	709971.246 731773.198	SDCC	Structure not impacted

8.3 Summary of Principal Structures

There are two proposed principal structures on the Proposed Scheme, summarised Table 8-2 below.

Table 8-2:Proposed Principal Bridge Structures along the Proposed Scheme

Location	Co-ordinates	Local Authority	Comment
ST01 Greenhills Road Pedestrian and Cycle Bridges	709981.615 729536.932	SDCC	Two bridges, one either side of the existing road bridge over the M50. Both bridges single span fully through warren trusses.
ST02 Naas Road Pedestrian and Cycle Bridge	709,646.023, 731,736.535	SDCC	Central span plus four arterial link span pedestrian and cycle bridge over the Naas Road / Long Mile Road Junction. All spans are single span fully through warren trusses

The PDR prepared in accordance with Phase 4 of DN-STR-03001 for each principal structure has been included in Appendix F Structural Survey Report. A short summary of each structure has been provided below for reference.

8.4 ST01 Greenhills Road Pedestrian and Cycle Bridges

ST01 Greenhills Road Pedestrian and Cycle Bridges will be formed of two new pedestrian/cycle bridges located adjacent to the existing Greenhills Road Bridge spanning the M50. The new bridges will provide dedicated facilities for pedestrians and cyclists travelling in both directions along Greenhills Road. Traffic and bus lanes will be accommodated on the existing Greenhills Road Bridge. The new bridges will span 48.55m over the M50 carriageway. The width of the new pedestrian/cycle bridges will be 4.65m wide providing a 2.65m segregated cycle track and 2m pedestrian footpath. A minimum internal vertical clearance of 2.7m will be provided along the length of the bridges.

The structures will span the M50 with no skew and have a constant longitudinal gradient falling from the western to the eastern support. The warren truss will be designed with a full through construction where the structure is built up around the deck. This is a light and economical form of construction and works well with longer spans. The warren truss also reduces the structural depth of the bridge, allowing the 5.7m clearance envelope to the carriageway to be achieved.

The bridges will be designed with circular steel structural hollow sections as the main top and bottom chords and as the secondary members. The top chord will act in compression and the bottom chord is in tension under downward loading and the two chords are braced by the diagonal members. The diagonal members create a series of triangles which are inherently rigid shapes thus reducing the sag that occurs in comparison to a simply supported beam. In theory a truss design uses pinned joints between members to eliminate any restraint to free rotation and thus preventing the creation of any internal bending moments. This results in the components of the truss only being imparted with axial forces, compression and tension. In axial loading the force is carried equally by each part of the member, enabling the designer to maximise the efficiency of the truss members and create a lightweight structure.

A steel plate deck will be provided along the length of the bottom cord. The steel deck will be finished with an anti-skid surfacing. Both new bridges will be supported on two reinforced concrete full height abutments constructed in-situ within the embankments on either side of the M50 carriageway. The south abutment will be set back 2.60m from the edge of the M50 northbound carriageway with the face of the north abutment set back 4.20m from the edge of the south bound carriageway. A safety barrier will be incorporated between the face of abutments and the edge of both the north and south bound carriageway. This is to remove the potential of impact loading on abutments. No central supports will be required within the M50 central median for either bridge. It is envisaged that due to the structural form and material, the use of bridge bearings and expansion joints will be required for both new pedestrian/cycle bridges. The choice of a through truss offers the advantage of providing a built-in, fully contained pedestrian parapet railing supported via the vertical bracing members.

In addition to construction of the new pedestrian/cycle bridge the carriageway layout on the existing Greenhills Road bridge will also be altered with all pedestrians and cyclists diverted away from the existing bridge to the new bridges. The current arrangement across the existing bridge is as follows: 2m footpath, 4.5m carriageway with shared cycle facilities in each direction and 2m footpath. The altered carriageway layout will see the removal of existing footpaths and shared areas. The revised bridge cross section will be as follows: 0.6m raised verge, 3m bus lane, 2.9m traffic lane, 2.9m traffic lane, 3m bus lane and 0.6m raised verge. A Stage 1 Structural Assessment has been carried out in accordance with AM-STR-06056. The assessment has confirmed that the new proposed carriageway layout passes for 30 units of HA and HB loading and provides a similar load rating to that of the existing carriageway layout.

8.5 ST02 Naas Road Pedestrian and Cycle Bridge

ST02 Naas Road Pedestrian and Cycle bridge will be a five-span fully through warren truss structure. The bridge is formed of a central span (55.5m) over the Naas Road and Red Line Luas and four arterial spans (ranging from 42.1m to 46.1m) spanning the outer corners of the junction. The bridge location and articulation has been developed with the aim of providing the optimal pedestrian link between the four corners of the Naas Road / Long Mile Road junction. The central span has been designed as single span over the main carriageways of the Naas Road and the Luas Red Line. The arterial link spans have also been designed as single spans to each corner of the junction. The support locations have been chosen with consideration of the sightlines of vehicles on approach and through the junction. The impact on traffic in an already congested junction during construction was also a factor in determining the optimum support locations.

The bridge will be formed in painted structural steel, supported on braced steel supports located in the concrete islands to the north and south of the Naas Road. All spans will be fully articulated on a combination of pot, guided and fixed bearings allowing for expansion and contraction, and mitigating against excessive stresses in the supports. The truss will be designed with full-through construction where the superstructure is built up around the deck. Where required, a steel mesh will be fitted to the vertical and horizontal bracing to create a fully enclosed superstructure.

The north and south supports of the central span will consist of three steel piers in a triangular arrangement, diagonally braced for lateral stiffness and supported on insitu concrete piled foundations. The arterial spans will be supported at these central supports and span to end supports formed from a pair of braced steel columns.

Painted steel access ramps and stairs will be supported off landing structures at the end supports of each arterial span. The ramps will be formed of a ladder beam structure and will vary in overall length from 119m to 136m. The ramps will be designed in accordance with the requirements set out in DN-STR-03005. Thus, landings of 2m in length will be provided at equal intervals along the length of the ramp and at maximum vertical rises of 2.5m. The ramps will also incorporate a 1-in-20 fall from the proposed bridge deck level to proposed finished footpath levels. Approach steps shall also be provided to arterial structure; these steps shall be formed in painted structural steel. The stairs shall be detailed in accordance with DN-STR-03005 to ensure that 2.5m long landings shall be provided at a maximum spacing of every 13 risers. The riser height will be a maximum of 150mm with a tread length of between 300mm and 350mm.

8.6 Summary of Minor Structures

No minor structures are proposed on the Proposed Scheme.

8.7 Summary of Retaining Walls

There are five retaining walls on the Proposed Scheme, summarised in the table below.

Table 8-3: Existing Retaining Walls along the Proposed Scheme

Location	Co-ordinates	Local Authority	Comment
RW01 Calmount Road Retaining Wall	710,754.565, 730,696.050	SDCC	RW01 is required along the eastbound carriageway of the proposed alignment connecting the existing Calmount Road with Greenhills Road. The retaining walls will retain the earthworks embankment required as part of this proposed alignment. The wall will be approximately 229m in length with a maximum retained height of 7.6m and will be formed using reinforced earth composed of reinforcing straps and precast concrete panels.
RW02 Calmount Road Retaining Wall	710,853.130, 730,710.350	SDCC	RW02 is required along the westbound carriageway of the proposed alignment connecting the existing Calmount Road with Greenhills Road. The retaining walls will retain the earthworks embankment required as part of this proposed alignment. The wall will be approximately 151.4m in length with a maximum retained height of 3.3m and will be formed using reinforced earth composed of reinforcing straps and precast concrete panels.
RW03 Long Mile Road Retaining Wall	711,363.699, 731,741.457	DCC	Long Mille Road Retaining Wall will be located along the eastbound carriageway of the road at the junction with Walkinstown road and will create a new boundary line between the Slievebloom Park housing estate and Long Mile Road. The wall will be 63.9m in length with a maximum retained height of 1.5m. The wall will be formed of a gravity retaining wall.
RW04 Naas Road Retaining Wall	709,646.023, 731,736.535	SDCC	RW04 will be located along the southbound carriageways of New Nangor Road (R134) at its junction with the Naas Road (R810). The wall is required to retain widened fill material to accommodate the approach stairs and ramp to ST02 Naas Road Pedestrian and Cycle Bridge. The wall will be 277.6m in length with a maximum retained height of 4.5m. The wall will be formed of a gravity retaining wall.
RW05 Naas Road Retaining Wall	709,663.327, 731,633.766	SDCC	RW05 will be located along the eastbound carriageways of New Nangor Road (R134) at its junction with the Naas Road (R810). The wall is required to retain widened fill material to accommodate the approach stairs and ramp to ST02 Naas Road Pedestrian and Cycle Bridge. The wall will be 90.0m in length with a maximum retained height of 1.5m. The wall will be formed of a gravity retaining wall.

The PDR prepared in accordance with Phase 4 of DN-STR-03001 for each retaining wall has been included in Appendix F Structural Survey Report

8.8 Summary of Miscellaneous Structures

Table 8-4: Existing Miscellaneous Structures along the Proposed Scheme

Location	Co-ordinates	Local Authority	Comment
Greenhills Road / Airton Road junction outbound Advertising Sign	709602.044 E, 728233.678 N	SDCC	Existing advertising unit to be relocated
Greenhills Road, Kilnamanagh Tymon Primary Care Centre Retaining Wall and Access Ramp	709612.43 5E, 728364.476 N	SDCC	Structure to be demolished and reconstructed to accommodate reconfigured bus stop
Drimnagh Road near outbound bus stop at Drimnagh Road / St. Mary's Road / Kildare Road junction	712056.200 E, 731842.942 N	DCC	Existing advertising unit to be relocated
Crumlin Road outbound opposite Crumlin Shopping Centre	713187.925 E, 732359.168 N	DCC	Existing advertising sign not impacted

8.9 Tallaght Bus Interchange

The proposed Bus Interchange at Belgard Square West / The Square Shopping Centre Tallaght will provide four new covered waiting areas located centrally, serving four bus stops either side of the waiting area. Curved sedum green roof structures above the waiting areas are linked with lower horizontal canopies for continuous shelter throughout the waiting area platform. Recessed LED downlighting and concealed LED display lighting is recessed curved canopies. Glazing provides shelter and passenger comfort at the waiting areas. The proposed interchange is located between the Luas Red Line Tallaght Stop to the north, and The Square Tallaght Shopping Centre to the east.

The curved and horizontal roof canopies will have sealed red cedar soffits with powder coated apex, verge and waiting area gable clad walls. The waiting area paving will be granite and electronic notice boards, real time display and advertisement screens will be integrated and recessed into the walls.

The canopy roof structure will be supported with inclined painted steel circular columns up to glulam beams. The column base connections consist of high-quality concrete plinths which will also provide additional seating.

To the east of the interchange a planted raised wall feature will provide a soft interface with the shopping centre car park with lighting features placed at key locations for orientation across the interchange space and link to the proposed public plaza north-east of the Bus Interchange.

Refer to Tallaght Bus Interchange Architectural Design Statement in Appendix P and Buildings / Landscape Architecture drawing series in Appendix B for further information.

9 Drainage, Hydrology and Flood Risk

9.1 Overview of Drainage Strategy

The drainage preliminary design was developed following consultation with the relevant Local Authority and Irish Water where applicable. The strategy and design parameters to be adopted throughout BusConnects is summarised in the Drainage Design Basis included in Appendix K.

The design basis statement was developed whilst taking the Greater Dublin Greater Dublin Regional Code of Practice (GDRCoP), Greater Dublin Strategic Drainage Study (GDSDS), Planning requirements of Local Authorities within the Dublin region, Transport Infrastructure Ireland (TII) requirements and international best practices such as CIRIA The SuDS Manual (C753).

The principal objectives of drainage design are as follows:

- To drain surface water from existing and proposed pavement areas throughout the BusConnects development and maintain the existing standard of service;
- To maintain existing runoff rates from existing and newly paved surfaces using Sustainable Urban Drainage Systems (SuDS); and
- To minimise the impact of the runoff from the roadways on the surrounding environment using SuDS, silt traps and/or oil/petrol interceptors. The drainage system should ensure that surface water drains from existing and new pavement areas be limited by the capacity of the existing highway drainage network.

No drainage features like gullies or manholes are to be located at, or any ponding will be allowed to occur at, pedestrian cross-walk locations or at bus stop locations. Where any such drainage features currently exist at such locations they will be relocated.

Drainage of newly paved areas will include SuDS measures to treat and attenuate any additional runoff. These measures will ensure that there is:

- No increase in existing runoff rates from newly paved areas, and
- Appropriate treatment to ensure runoff quality.

A hierarchical approach to the selection of SuDS measures has been adopted with 'Source' type measures e.g. tree pits implemented in preference to catchment type measures e.g. attenuation tanks. Further details of the SuDS hierarchy are provided in Drainage Design Basis.

9.2 Existing Watercourses and Culverts

9.2.1 Tallaght to City Centre Section

The location of existing watercourses and culverts have been identified using OS Mapping (https://osi.ie/). All watercourses are culverted beneath the existing highway. Stage 1 and 2 Flood Risk Assessments have been completed on the preliminary design and are summarised in Section 9.7. The Proposed Scheme crosses the following watercourses:

Table 9-1: Existing Watercourses and Culverts crossing the Proposed Scheme

Watercourse	Chainage	Crossing Detail
Tymon River (Poddle River)	A2210	Culvert
Tributary of Robinhood Stream	A4480	Culvert
Tributary of Robinhood Stream	A4850	Culvert
Tributary of the River Camac	F0 - F50	Culvert
Tributary of the River Camac	F175	Culvert
River Camac	F980	Culvert
Walkinstown Stream	F2500	Box Culvert

9.3 Existing Drainage Description

9.3.1 Introduction

Based on the information received from Irish Water the Proposed Scheme is served by both surface water and combined drainage networks. The surface water drainage system is managed by the local authority whilst the combined sewer systems are managed by Irish Water. Flows are typically collected in standard gully grates and routed via a gravity network to outfall points. There are no SuDS/attenuation measures on the existing drainage networks to treat or attenuate runoff from the existing highway.

9.3.2 Tallaght to City Centre Section

The existing drainage network along this section of the Proposed Scheme can be split into nineteen catchment areas based on topography and the existing pipe network supplied by Irish Water. The approximate catchment areas, existing sewer networks, outfalls, and watercourses are shown on the existing catchment drawings, refer to drawings BCIDA-ACM-DNG-RD-0809_XX_00-DR-CD-1001 to BCIDA-ACM-DNG-RD-0809_XX_00-DR-CD-1004 in Appendix B.

The catchments are summarised below:

Table 9-2: Summary of Existing Catchments along the Tallaght to City Centre Section

Existing Catchment Reference	Chainage	Approx. Drainage Catchment Area (km^2)	Existing Network Type	Existing Outfalls
9.12	A0 – A800	0.441	Surface Water (Storm)	Network outfalls to the Whitestown Stream
9.11	A800 – A2000	0.297	Surface Water (Storm)	Network outfalls to the Whitestown Stream
9.10	A2000 – A2210	0.260	Surface Water (Storm)	Network outfalls to the Poddle River
9.9	A2210 – A2550	0.241	Surface Water (Storm)	Network outfalls to the Poddle River
9.8	A2550 – A2770	0.589	Surface Water (Storm)	Network outfalls to the Poddle River
9.7	A2770 – A3630	0.759	Surface Water (Storm)	Unknown – assumed to be Poddle River
9.6	A3670 – A5535 & C75 – C914	1.10	Surface Water (Storm)	Network outfalls to Robinhood Stream – Cammock River - Liffey
9.5	A5535 – A7400 & D0 – D1060	3.02	Surface Water (Storm)	Network outfalls to the Poddle River
9.4	A7400 – A7800 & D1060 - D1346	0.253	Surface Water (Storm)	Network outfalls to the Poddle River
9.3	A8975 - A9275 & E0 - E2447	1.81	Surface Water (Storm) & Combined	Network outfalls to the Combined Sewer on Parnell Road
9.2	A7800 – A9275	1.48	Surface Water (Storm) & Combined	Network outfalls to the Combined Sewer on Dolphin Road
9.1	A9275 – A11438	2.39	Surface Water (Storm) & Combined	Network outfalls to the Combined Sewer on Dean Street
8.1	Not applicable for reporting as entirely upstream of proposal			
8.2	F0 – F615	0.867	Surface Water (Storm)	Network outfalls to the Cammock River - Liffey
8.3	F615 – F1500	0.636	Surface Water (Storm)	Network outfalls to the Cammock River - Liffey
8.4	F1500 – F1980	0.309	Surface Water (Storm)	Network outfalls to the Cammock River - Liffey
8.5	F1980 – F2750	0.643	Surface Water (Storm)	Network outfalls to the Cammock River - Liffey
8.6	F2750 – F3330	0.466	Surface Water (Storm)	Network outfalls to the Cammock River - Liffey
8.7	F2200 – F2350 (Long Mile Road)	0.134	Surface Water (Storm)	Network outfalls to the Cammock River - Liffey

Existing Catchment Reference	Chainage	Approx. Drainage Catchment Area (km^2)	Existing Network Type	Existing Outfalls
9.5	F3330 – F4226	3.02	Surface Water (Storm)	Network outfalls to the Cammock River - Liffey

9.4 Overview of Impacts of Proposed Works on Drainage / Runoff

Whilst in some areas the proposed development increases the impermeable areas, additional permeable areas are also provided by the softening of public realm along the routes. The drainage design aims to sustain flow levels within the existing pipe network after a rainfall event by controlling the discharge rate within each catchment. Flows will be controlled by the implementation of SuDS techniques. One of the principal objectives of the road drainage system is to minimise the impact of the runoff from the roadways on the surrounding environment via the position of: filter drains, swales, bio retention areas, tree pits, oil/petrol interceptors, silt traps and attenuation features if necessary. The welfare of pedestrians and cyclists is a high priority in the consideration of the drainage system design.

The proposed surface water drainage works are shown on drawings BCIDA-ACM-DNG_RD-0809_00-DR-CD-0001 to 0056 in Appendix B.

Table 9-3 provides information of the proposed additional catchments (new paved areas) against the proposed permeable areas (current paved areas to become grassed).

Each catchment area has been broken down into sub-catchments in order to define the change in impermeable surface area as a result of the proposed scheme. Where there is a net increase in impermeable surface area, a form of attenuation will be required prior to discharge. Where there is no net change or net decrease, then no form of attenuation will be required prior to discharge. A summary list of the sub-catchments, the associated chainage, and impermeable surface area differential is given below. Note, permeability factors have been applied to the impermeable and permeable areas. These factors are described in the Design Basis Statement and are required due to the difference in the calculated runoff rate from an impermeable surface, such as a road, when compared with a permeable surface, such as a verge. The following tables contain a column entitled “Net change” which take account of the applicable permeability factors and the change of use from impermeable to permeable areas and vice versa.

Table 9-3: Summary of Increased Permeable and Impermeable Areas for Tallaght to City Centre Section

Existing Catchment Reference	Chainage	Road Corridor Area (m^2)	Change of use to Impermeable Areas (m^2)	Change of use to Permeable Areas (m^2)	*Net Change (m^2)	Percentage Change (%)
9.12	A0 – A800	8855	1668	570	1353	16.7%
9.11	A800 – A2000	24981	0	0	0	0%
9.10	A2000 – A2210	1736	0	0	0	0%
9.9	A2210 – A2550	5583	1654	154	1454	26%
9.8	A2550 – A2770	3672	1927	0	1427	38.9%
9.7	A2770 – A3630 & B0 – B520	9380	12296	2746	19847	211%
9.6	A3670 – A5535 & C75 – C914	47317	22020	2827	13555	28.6%
9.5	A5535 – A7400 & D0 – D1060	81327	1469	2292	-576	-0.7%
9.4	A7400 – A7800 & D1060 -D1346	16628	48	115	-47	-0.3%
9.3	A8975 - A9275 & E0 - E2447	63798	0	615	-431	-0.7%

Existing Catchment Reference	Chainage	Road Corridor Area (m^2)	Change of use to Impermeable Areas (m^2)	Change of use to Permeable Areas (m^2)	*Net Change (m^2)	Percentage Change (%)
9.2	A7800 – A9275	27632	435	403	22	0.1%
9.1	A9275 – A11438	55364	55	277	155	0.28%
8.1	Not applicable for reporting as entirely upstream of proposal					
8.2	F0 – F615	13168	1344	390	668	5.1%
8.3	F615 – F1500	20979	4928	246	3277	15.6%
8.4	F1500 – F1980	11738	2189	107	1457	12.4%
8.5	F1980 – F2750	39188	5583	1864	3434	8.8%
8.6	F2750 – F3330	16743	2438	242	1537	9.2%
8.7	F2200 – F2350 (Long Mile Road)	2913	1189	0	833	28.6%
9.5	F3330 – F4226	24739	125	758	-443	-1.8%

9.5 Preliminary Drainage Design

9.5.1 Overview

The existing drainage network will be maintained and used as the main discharge point for the new drainage system. The purpose of the design will be to replicate the existing situation. Existing gully connections will be used where practicable. Where new multiple gully connections discharge to a combined sewer are required, a new surface water pipe will be provided where practicable and connected to the combined sewer as per Irish Water requirements.

The following drainage systems were considered for the Proposed Scheme where new paved areas are proposed:

- **Sealed Drainage (SD)** comprises narrow profile gullies and sealed pipes. They will collect, convey, and discharge runoff. The narrow profile gullies will be located within the kerb line mostly between the cycle track and bus lane and/or the footway and the cycle track depending on the highway profile, but with the location of the bicycle and/or bus wheel-track in mind for cycling safety and ride-quality purposes.
- **Grass Surface Water Channels, Swales, and Bio Retention Areas/Rain Gardens (SW/RG)** are provided as road edge/footway edge drainage collection systems. They will provide treatment and can provide attenuation if required. A filter drain can be laid below the swales to keep the swale dry during low return period rainfall events.
- **Filter Drains (FD)** are provided as road edge channels. These comprise a perforated pipe with granular surround and are designed to convey, attenuate, and treat runoff prior to discharge.
- **Soakaways and Infiltration Trenches (SO/IT)** are provided for small catchments where ground conditions permit and are designed to discharge into the adjacent ground.
- **Tree pits (TP)** are provided in close proximity to the road, where practicable. These receive flows from the sealed pipe network and are designed to convey, attenuate, and treat runoff prior to discharge.
- **Attenuation Tanks/Oversized Pipes (AT/OSP) –** Where there is insufficient attenuation volume provided by the proposed SuDS drainage measures, hard attenuation measures such as concrete tanks and/or oversize pipes can be provided to meet the required attenuation volume.

9.5.2 Summary of Surface Water Drainage

The proposed drainage types for the Proposed Scheme are listed in Table 9-4.

Table 9-4: Summary of Proposed Surface Water Infrastructure for Tallaght to City Centre Section

Existing Catchment Reference	Chainage	Drainage Type
Asset Owner/Location: Irish Water/South Dublin City Council		
9.12	A0-A800	Existing drainage, Sealed drainage, oversized pipes, tree pits, green roofs, filter drains
9.11	A800-A2000	Existing drainage
9.10	A2000-A2210	Existing drainage, sealed drainage
9.9	A2210 – A2550	Existing drainage, Sealed drainage, oversized pipes
9.8	A2550 – A2770	Existing drainage, Sealed drainage, oversized pipes,
9.7	A2770 – A3630	Existing drainage, Sealed drainage, tree pits, filter drains, bioretention area, oversized pipes
9.6	A3630 – A5535 & C71 – C914	Existing drainage, Sealed drainage, bioretention area, oversized pipes
9.5	A5535 – A5900	Existing drainage, Sealed drainage, oversized pipes
Asset Owner/Location: Irish Water/Dublin City Council		
9.5 (continued)	A5900 - A7400 & D0 – D1060	Existing drainage, Sealed drainage, oversized pipes
9.4	A7400 – A7800 & D1060 – D1346	Existing drainage
9.3	A8975 - A9275 & E0 – E2447	Existing drainage
9.2	A7800 - A9275	Existing drainage, sealed drainage, oversized pipes
9.1	A9275 – A11438	Existing drainage, sealed drainage, oversized pipes
Asset Owner/Location: Irish Water/South Dublin City Council		
8.1	Not applicable for reporting as entirely upstream of proposal	
8.2	F0 to F615	Existing drainage, Sealed drainage, oversized pipes, soakaways, filter drains
8.3	F615 to F1500	Existing drainage, Sealed drainage, bioretention area, tree pits, oversized pipes, filter drains
8.4	F1500 to F1980	Existing drainage, sealed drainage, bioretention areas, oversized pipes, filter drains, tree pits
8.5	F1980 to F2750	Existing drainage, Sealed drainage, bioretention area, oversized pipes, filter drains
Asset Owner/Location: Irish Water/Dublin City Council		
8.6	F2750 to F3330	Existing drainage, Sealed drainage, bioretention area, oversized pipes, soakaway, filter drains
8.7	F22000 to F2350 (Long Mile Road)	Existing drainage, Sealed drainage, oversized pipes
9.5	F3330 – F4226	Existing drainage, Sealed drainage, bioretention area

9.5.3 Summary of Attenuation Features, SuDS, and Outfalls

Where practicable, and in new areas of public realm gained as part of the design, sustainable drainage system is considered in the form of rain gardens, bioretention areas, filter drains, swales, tree pits, permeable paving, etc. SuDS will also be considered in existing areas where practicable.

The attenuation measures for the Proposed Scheme are summarised for each catchment within Table 9-5 below. Attenuation volumes have been estimated using Micro drainage software and are based on factored impermeable areas and the Permitted Discharge for a 1 in 30-year return period plus 20% climate change.

Table 9-5: Summary of Proposed Attenuation Features, SuDS and Outfalls for Tallaght to City Centre Section

Chainage	Existing Catchment Reference	Approx. Impermeable Surface Area		Permitted Discharge (l/sec)	Possible SUDS Solution / Attenuation Measure	Catchment Outfall
		Existing (m^2)	Additional (m^2)			
Asset Owner/Location: Irish Water/South Dublin City Council						
A0-A25 RHS	9.12.1	917	39	12	Oversized pipes & bioretention areas, Approx. Attenuated Volume 3-12m^3	Discharge into existing drainage network DN1050. Existing drainage network outfalls to the Whitestown Stream.
A0-A25 LHS	9.12.2	78	0	N/A	N/A	Discharge into existing drainage network DN225. Existing drainage network outfalls to the Whitestown Stream.
A25-A175 RHS	9.12.3	2580	1269	35	Oversized Pipes & Green Roofs, Approx. Attenuated Volume 21-58m^3	Discharge into existing drainage network DN1050. Existing drainage network outfalls to the Whitestown Stream.
A25-A175 LHS	9.12.4	1149	0	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Existing drainage network outfalls to the Whitestown Stream.
A400-A500 LHS	9.12.5	1411	18	19.1	Oversized Pipes, Approx. Attenuated Volume 4-18m^3	Discharge into existing drainage network DN unknown. Existing drainage network outfalls to the Whitestown Stream.
A400-A500 RHS	9.12.6	1140	0	N/A	N/A	Discharge into existing drainage network DN unknown. Existing drainage network outfalls to the Whitestown Stream.
A500-A800	9.12.7	1580	155	30	Oversized pipes, Approx. Attenuated Volume 0.5-16m^3	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Existing drainage network outfalls to the Whitestown Stream.
A820-A2000	9.11.1	24981	-62	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Existing drainage network outfalls to the Whitestown Stream.
A2000-A2100	9.10.1	649	0	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and

Chainage	Existing Catchment Reference	Approx. Impermeable Surface Area		Permitted Discharge (l/sec)	Possible SUDS Solution / Attenuation Measure	Catchment Outfall
		Existing (m²)	Additional (m²)			
						connected to existing surface water network. Existing drainage network outfalls to the Poddle River.
A2100-A2210	9.10.2	1087	0	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Existing drainage network outfalls to the Poddle River.
A2210-A2440 RHS	9.9.1	1143	767	15.6	Oversized Pipes, Approx. Attenuated Volume 13-31m³	Discharge into existing drainage network DN1050. Existing drainage network outfalls to the Poddle River.
A2225-A2440 LHS	9.9.2	2784	106	37.7	Oversized Pipes, Approx. Attenuated Volume 8-36m³	Discharge into existing drainage network DN1050. Existing drainage network outfalls to the Poddle River.
A2440-A2525 RHS	9.9.3	836	284	15.2	Oversized Pipes, Approx. Attenuated Volume 3-14m³	Discharge into existing drainage network DN1050. Existing drainage network outfalls to the Poddle River.
A2450-A2525 LHS	9.9.4	809	297	12.9	Oversized Pipes, Approx. Attenuated Volume 4-15m³	Discharge into existing drainage network DN750. Existing drainage network outfalls to the Poddle River.
A2550-A2780 RHS & A2610-A2720 LHS	9.8.1	3152	1168	42.9	Oversized Pipes, Approx. Attenuated Volume 22-64m³	Discharge into existing drainage network DN225. Existing drainage network outfalls to the Poddle River.
A2540-A2610 LHS	9.8.2	520	259	7.1	Oversized Pipes, Approx. Attenuated Volume 0-2m³	Discharge into existing drainage network DN750. Existing drainage network outfalls to the Poddle River.
A2780 - A3100	9.7.1	4365	2065	68	Bioretention Area, Approx. Attenuated Volume 69-157m³	Discharge into existing drainage network DN225. Existing drainage network outfalls to Unknown (assumed Poddle River)
A3125-A3360 LHS	9.7.2	0	2262	2	Oversized pipes, Bioretention Areas, Approx. Attenuated Volume 74-122m³	Discharge into existing drainage network DN225. Existing drainage network outfalls to Unknown (assumed Poddle River)
A3180-A3480	9.7.3	0	1037	2	Oversized Pipes,	Discharge into existing drainage network

Chainage	Existing Catchment Reference	Approx. Impermeable Surface Area		Permitted Discharge (l/sec)	Possible SUDS Solution / Attenuation Measure	Catchment Outfall
		Existing (m^2)	Additional (m^2)			
					Bioretention Areas, Approx. Attenuated Volume 29-49m^3	DN225. Existing drainage network outfalls to Unknown (assumed Poddle River)
A3360-A3750 LHS	9.7.4	0	3130	2	Oversized Pipes, Bioretention Areas, Approx. Attenuated Volume 168-272m^3	Discharge into existing drainage network DN Unknown. Existing drainage network outfalls to Unknown (assumed Poddle River)
A3340 (Cycleway / Footway)	9.7.5	0	423	2	Oversized Pipes, Bioretention Areas, Approx. Attenuated Volume 7-13m^3	Discharge into existing drainage network DN225. Existing drainage network outfalls to Unknown (assumed Poddle River)
A3480– A3620 RHS	9.7.6	0	421	2	Oversized Pipes, Approx. Attenuated Volume 7-13m^3	Discharge into existing drainage network DN Unknown. Existing drainage network outfalls to Unknown (assumed Poddle River)
B100–B200 LHS	9.7.7	475	-61	N/A	N/A	Discharge into existing drainage network DN225. Existing drainage network outfalls to Unknown (assumed Poddle River)
B0-B435	9.7.8	3450	813	81	Oversized Pipes, Approx. Attenuated Volume 23-90m^3	Discharge into existing drainage network DN225. Existing drainage network outfalls to Unknown (assumed Poddle River)
B435-B450 LHS	9.7.9	0	151	2	Oversized Pipes, Approx, Attenuated Volume 2.5-5.5m^3	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Discharge into existing drainage network DN225. Existing drainage network outfalls to Unknown (assumed Poddle River)
B435-B550	9.7.10	1090	53	2	Oversized Pipes, Approx, Attenuated Volume 2.5-5.5m^3	Discharge into existing drainage network DN unknown. Existing drainage network outfalls to Unknown (assumed Poddle River)
A3670-A3760 RHS	9.6.1	0	383	2	Oversized Pipes, bioretention areas,	Discharge into existing drainage network DN unknown. Existing drainage network outfalls to Robinhood

Chainage	Existing Catchment Reference	Approx. Impermeable Surface Area		Permitted Discharge (l/sec)	Possible SUDS Solution / Attenuation Measure	Catchment Outfall
		Existing (m^2)	Additional (m^2)			
					Approx. Attenuated Volume 4-8m^3	Stream – Cammock River - Liffey
A3790-3925 N	9.6.2	1823	305	20	Oversized Pipes, Approx. Attenuated Volume 0-0.1m^3	Discharge to existing stormwater network DN unknown. Catchment outfall unknown.
A3925-A4050 N	9.6.3	1251	-198	N/A	N/A	Existing gullies to be replaced with narrow profile gullies, relocated to new kerbline, and connected to existing surface water network. Catchment outfall unknown. To be verified on site.
A3750-A4050 S	9.6.4	2911	1128	16.9	Oversized Pipes, Approx. Attenuated Volume 2.3-14m^3	Discharge to existing stormwater network DN unknown. Catchment outfall unknown.
A4060-A4375 N	9.6.5	3705	1511	15.0	Oversized Pipes, Approx. Attenuated Volume 22-46m^3	Discharge to existing stormwater network DN 1500. Catchment ultimately outfalls to the Robinhood Stream – Cammock River – Liffey
A4375-A4475 S	9.6.6	236	165	2.0	Oversized Pipes, Approx. Attenuated Volume 1.6-3.9m^3	Discharge to existing stormwater network DN 1500. Catchment ultimately outfalls to the Robinhood Stream – Cammock River – Liffey
A40600-A4500 S	9.6.7	4503	2455	24.8	Oversized Pipes, Approx. Attenuated Volume 39-81m^3	Discharge to existing stormwater network DN 1350. Catchment ultimately outfalls to the Robinhood Stream – Cammock River – Liffey
A4520-A4850 S	9.6.8	3670	1021	29.2	Oversized Pipes, Approx. Attenuated Volume 0-7.2m^3	Discharge to existing stormwater network DN Unknown. Catchment ultimately outfalls to the Robinhood Stream – Cammock River – Liffey
A4490-A4850 N	9.6.9	5853	1222	60.0	Oversized Pipes, Approx. Attenuated Volume 0-10m^3	Discharge to existing stormwater network DN Unknown. Catchment ultimately outfalls to the Robinhood Stream – Cammock River – Liffey
A4860-A4950 S	9.6.10	1076	235	10.1	Oversized Pipes, Approx. Attenuated Volume 4.6-14m^3	Discharge to existing stormwater network DN Unknown. Catchment ultimately outfalls to the Robinhood Stream – Cammock River – Liffey
A4520-A4850 S	9.6.11	750	203	6.3	Oversized Pipes, Approx. Attenuated	Discharge to existing stormwater network DN Unknown. Catchment ultimately outfalls to the Robinhood Stream – Cammock River – Liffey

Chainage	Existing Catchment Reference	Approx. Impermeable Surface Area		Permitted Discharge (l/sec)	Possible SUDS Solution / Attenuation Measure	Catchment Outfall
		Existing (m^2)	Additional (m^2)			
					Volume 3.6-9.9m^3	
A5025-A5110 S	9.6.12	764	213	6.3	Oversized Pipes, Approx. Attenuated Volume 3.7-10m^3	Discharge to existing stormwater network DN Unknown. Catchment ultimately outfalls to the Robinhood Stream – Cammock River – Liffey.
A5110-A5160 S	9.6.13	576	149	4.9	Oversized Pipes, Approx. Attenuated Volume 2.7-7.6m^3	Discharge to existing stormwater network DN Unknown. Catchment ultimately outfalls to the Robinhood Stream – Cammock River – Liffey
A5160-A5470 S	9.6.14	1019	1876	9.0	Oversized Pipes, Approx. Attenuated Volume 33-63m^3	Discharge to existing stormwater network DN Unknown. Catchment ultimately outfalls to the Robinhood Stream – Cammock River – Liffey
A4850-A4950 N	9.6.15	320	300	9.1	Oversized Pipes, Approx. Attenuated Volume 5.4-15m^3	Discharge to existing stormwater network DN Unknown. Catchment ultimately outfalls to the Robinhood Stream – Cammock River – Liffey
A4950-A5510 N	9.6.16	5679	2312	26.9	Oversized Pipes, Approx. Attenuated Volume 23-55m^3	Discharge to existing stormwater network DN Unknown. Catchment ultimately outfalls to the Robinhood Stream – Cammock River – Liffey
C75-C350	9.6.17	3308	0	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the Robinhood Stream – Cammock River – Liffey
C350-C470 S	9.6.18	1747	-384	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the Robinhood Stream – Cammock River – Liffey
C375-C450 (NW Bound) S	9.6.19	907	448	3.1	Oversized Pipes, Approx. Attenuated Volume 8-16m^3	Discharge to existing stormwater network DN unknown. Catchment outfall unknown.
C375-C450 (NW Bound) N	9.6.20	746	444.5	2.1	Bioretention Area, Approx. Attenuated Volume 7.2-14m^3	Discharge to existing stormwater network DN unknown. Catchment outfall unknown.

Chainage	Existing Catchment Reference	Approx. Impermeable Surface Area		Permitted Discharge (l/sec)	Possible SUDS Solution / Attenuation Measure	Catchment Outfall
		Existing (m^2)	Additional (m^2)			
C470-C914	9.6.21	5709	-456	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the Robinhood Stream – Cammock River – Liffey
A5350	9.6.22	771	227	2.1	Oversized Pipes, Approx. Attenuated Volume 0m^3	Discharge to existing stormwater network DN unknown. Catchment outfall unknown.
A5660-A5835 S	9.5.1	1310	85	16.1	Oversized Pipes Approx. Attenuated Volume 3.7-16m^3	Discharge to existing stormwater network DN 225. Catchment ultimately outfalls to the Poddle River
A5500-A5650 S	9.5.2	1544	563	11.6	Oversized Pipes, Approx. Attenuated Volume 9.4-23m^3	Discharge to existing stormwater network DN 150. Catchment ultimately outfalls to the Poddle River
A5575-A5820 N	9.5.6	2688	0	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the Poddle River
Asset Owner/Location: Irish Water/South Dublin City Council and Dublin City Council						
A5835-A6050	9.5.3	9965	-1051	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the Poddle River
Asset Owner/Location: Irish Water/Dublin City Council						
A6050-6330 N	9.5.4	2437	298	29.0	Approx. Attenuated Volume 8.2-32m^3	Discharge to existing stormwater network DN 525. Catchment ultimately outfalls to the Poddle River
A6550-A6690 S	9.5.5	119	84	2	Approx. Attenuated Volume 0m^3	Discharge to existing stormwater network DN 525. Catchment ultimately outfalls to the Poddle River
A6050-A6550 S	9.5.7	5868	0	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately

Chainage	Existing Catchment Reference	Approx. Impermeable Surface Area		Permitted Discharge (l/sec)	Possible SUDS Solution / Attenuation Measure	Catchment Outfall
		Existing (m^2)	Additional (m^2)			
						outfalls to the Poddle River
A6380-A6690 N	9.5.8	3764	0	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the Poddle River
A6690-A7400 N & S	9.5.9	21492	-554	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the Poddle River
D0-D640	9.5.10	20401	0	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the Poddle River
D640-D1060	9.5.11	11742	0	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the Poddle River
A7400-A7700 N	9.4.1	7322	0	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the Poddle River
A7400-A7800 S	9.4.2	2692	-46.9	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the Poddle River
D1060-D1346	9.4.3	6614	0	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the Poddle River
A8975-A9350 N	9.3.1	3134	0	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated

Chainage	Existing Catchment Reference	Approx. Impermeable Surface Area		Permitted Discharge (l/sec)	Possible SUDS Solution / Attenuation Measure	Catchment Outfall
		Existing (m^2)	Additional (m^2)			
						to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the combined sewer on Parnell Road
A8975-A9350 S	9.3.2	4463	0	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the combined sewer on Parnell Road
E0-E1400	9.3.3	25050	-431	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the combined sewer on Parnell Road
E1400-E1850	9.3.4	9712	0	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the combined sewer on Parnell Road
E1850-E2050	9.3.5	7710	0	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the combined sewer on Parnell Road
E2050-E2447	9.3.6	13729	0	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the combined sewer on Parnell Road
A7700-A7800 N	9.2.1	226	124	2.2	Oversized pipes, Approx. Attenuated Volume 0-1.2m^3	Discharge to existing stormwater network DN 300. Catchment ultimately outfalls to the combined sewer on Dolphin Road
A8240-A8325 N	9.2.2	143	101	2	Oversized pipes, Approx. Attenuated Volume 1.7-4.1m^3	Discharge to existing stormwater network DN 300. Catchment ultimately outfalls to the combined sewer on Dolphin Road
A8610-A8700 S	9.2.3	666	81	4.9	Oversized pipes, Approx. Attenuated Volume 0m^3	Discharge to existing stormwater network DN 300. Catchment ultimately outfalls to the

Chainage	Existing Catchment Reference	Approx. Impermeable Surface Area		Permitted Discharge (l/sec)	Possible SUDS Solution / Attenuation Measure	Catchment Outfall
		Existing (m²)	Additional (m²)			
						combined sewer on Dolphin Road
A7800-A8560 S	9.2.4	6035	-70	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the combined sewer on Dolphin Road
A7865-A8175 N	9.2.5	2440	0	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the combined sewer on Dolphin Road
A8325-A9350 N	9.2.6	10861	-212	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the combined sewer on Dolphin Road
A8700-A9350 S	9.2.7	7261	0	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the combined sewer on Dolphin Road
A9350-A1100 N & S	9.1.1	42156	-176	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the combined sewer on Dean Street
A11100-A11200 N & S	9.1.2	5756	0	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the combined sewer on Dean Street
A11200-A11450 N & S	9.1.3	5986	0	N/A	N/A	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to the combined sewer on Dean Street
A11413-A11438 R	9.1.4	1467	22	2	Oversized pipes,	Discharge to existing stormwater network DN 300. Catchment

Chainage	Existing Catchment Reference	Approx. Impermeable Surface Area		Permitted Discharge (l/sec)	Possible SUDS Solution / Attenuation Measure	Catchment Outfall
		Existing (m^2)	Additional (m^2)			
					Approx. Attenuated Volume 0-0.1m³	ultimately outfalls to the combined sewer on Dean Street
Asset Owner/Location: Irish Water/South Dublin City Council						
F0 - F40	8.2.1	1787	-4.5	N/A	Approx. Attenuated Volume 0m³	Existing gullies to be replaced with narrow profile gullies, relocated to new kerbline, and connected to existing surface water network. Catchment ultimately outfalls to Cammock River - Liffey.
Woodford Walk	8.2.2	1132	7.6	2.0	Approx. Attenuated Volume 0m³	Assumed existing stormwater network has capacity for nominal additional runoff. Existing gullies to be replaced with narrow profile gullies, relocated to new kerbline, and connected to existing surface water network. Catchment ultimately outfalls to Cammock River - Liffey.
F40 - F230 N	8.2.3	2071	34	2.0	Approx. Attenuated Volume 0m³	Over the edge drainage utilised. Assumed existing stormwater network has capacity for nominal additional runoff. Existing gullies to be replaced with narrow profile gullies, relocated to new kerbline, and connected to existing surface water network. Catchment ultimately outfalls to Cammock River - Liffey..
F40 - F230 S	8.2.4	1709	162	Rate of Infiltration	Soakaways, Approx. Attenuated Volume TBD	Discharge to intermittent soakaways.
F230 - F430 N	8.2.5	2114	139	11.5	Filter drains, Approx. Attenuated Volume 3.5-13.0m³	Over the edge drainage into filter drains utilised. Discharge to existing surface water network DN unknown. Catchment ultimately outfalls to the Cammock River - Liffey.
F230 - F370 S	8.2.6A	1321	86	Rate of Infiltration	Soakaways, Approx. Attenuated Volume TBD	Discharge to intermittent soakaways.
F370 – F430 S	8.2.6B		49	3.0	Oversized Pipe, Approx. Attenuated Volume 1.1 – 3.7m³	Discharge to existing stormwater network DN unknown. Catchment ultimately outfalls to the Cammock River - Liffey.
F430 - F480	8.2.7	636	1	2.0	N/A	Assumed existing stormwater network has capacity for nominal

Chainage	Existing Catchment Reference	Approx. Impermeable Surface Area		Permitted Discharge (l/sec)	Possible SUDS Solution / Attenuation Measure	Catchment Outfall
		Existing (m^2)	Additional (m^2)			
						additional runoff. Existing gullies to be replaced with narrow profile gullies relocated to new kerbline and connected to existing surface water network. Catchment ultimately outfalls to Cammock River - Liffey.
F480 -F600 N	8.2.8	501	-27	N/A	N/A	Discharge to existing stormwater network DN unknown. Catchment ultimately outfalls to Cammock River - Liffey.
F480 - F600 S	8.2.9	1897	221	11.8	Tree pits & Filter drains, Approx. Attenuated Volume 4.3-15m^3	Discharge to existing stormwater network DN unknown. Catchment ultimately outfalls to the Cammock River - Liffey.
F600 - F720 N	8.3.1	569	219	5.5	Oversized Pipes, Approx. Attenuated Volume 3.8 – 9.7m^3	Discharge to existing stormwater network DN unknown. Catchment ultimately outfalls to the Cammock River - Liffey.
F600 - F720 S	8.3.2	1976	83	3.2	Tree pits & Filter drains, Approx. Attenuated Volume 1.6-4.7m^3	Discharge to existing stormwater network DN unknown. Catchment ultimately outfalls to the Cammock River - Liffey.
F720-F1000 N	8.3.4	3954	508	31.3	Filter drains, Tree pits & Bioretention areas, Approx. Attenuated Volume 11-39m^3	Discharge to existing stormwater network DN unknown. Catchment ultimately outfalls to the Cammock River - Liffey.
F720-F1000 S	8.3.5	4354	611	40.7	Oversized Pipe, Tree pits, Bioretention areas & Filter drains, Approx. Attenuated Volume 14-49m^3	Discharge to existing stormwater network DN unknown. Catchment ultimately outfalls to the Cammock River - Liffey.
F1000-F1190 S	8.3.7A	3597	428	4.7	Oversized Pipes & Tree pits, Approx. Attenuated Volume 6.9-15.0m^3	Discharge to existing stormwater network DN 300. Catchment ultimately outfalls to the Cammock River - Liffey.
F1000-F1030N	8.3.7C		41	7.2	Oversized Pipes, Approx. Attenuated Volume 1.7-7.3m^3	Discharge to existing stormwater network DN 225 Catchment ultimately outfalls to the Cammock River - Liffey.
F1030-F1130N	8.3.7B		87	3.8	Oversized Pipes, Approx. Attenuated	Discharge to existing stormwater network DN 300. Catchment

Chainage	Existing Catchment Reference	Approx. Impermeable Surface Area		Permitted Discharge (l/sec)	Possible SUDS Solution / Attenuation Measure	Catchment Outfall
		Existing (m^2)	Additional (m^2)			
					Volume 1.8 – 5.3m^3	ultimately outfalls to the Cammock River - Liffey
F1130-F1190 N	8.3.7D		38	3.8	Oversized Pipes, Approx. Attenuated Volume 1.1 – 4.2m^3	Discharge to existing stormwater network DN 300. Catchment ultimately outfalls to the Cammock River - Liffey.
F1190-F1280 N	8.3.8A	2854	65	3.5	Oversized Pipes, Approx. Attenuated Volume 1.3 – 4.5m^3	Discharge to existing stormwater network DN 225. Catchment ultimately outfalls to the Cammock River - Liffey.
F1280-F1350 N	8.3.8B		153	8.0	Oversized Pipes, Compensatory Bioretention Area & Filter Drains, Approx. Attenuated Volume 8.1-16m^3	Discharge to existing stormwater network DN 225. Catchment ultimately outfalls to the Cammock River - Liffey.
F1190-F1350 S	8.3.9A	611	389	5.5	Oversized Pipes, Approx. Attenuated Volume 6.3-14m^3	Discharge to existing stormwater network DN 450. Catchment ultimately outfalls to the Cammock River - Liffey.
F1350-F1500 S	8.3.9B		222	10.3	Oversized Pipes, Approx. Attenuated Volume 4.5-14m^3	Discharge to existing stormwater network DN 450. Catchment ultimately outfalls to the Cammock River - Liffey.
F1350-F1410 N	8.3.10A	3065	190	11.7	Oversized Pipes, Approx. Attenuated Volume 4.2-14m^3	Discharge to existing stormwater network DN 225. Catchment ultimately outfalls to the Cammock River - Liffey.
F1410-F1500 N	8.3.10B		243	11.9	Oversized Pipes, Approx. Attenuated Volume 5-16m^3	Discharge to existing stormwater network DN unknown. Catchment ultimately outfalls to the Cammock River - Liffey.
F1500-F1720 N	8.4.1	2160	316	10.9	Filter drain & Bioretention area, Approx. Attenuated Volume 5.9-17m^3	Discharge to existing stormwater network DN 900. Catchment ultimately outfalls to the Cammock River - Liffey.
F1500-F1630 S	8.4.2B	2124	117	8.3	Oversized Pipes, Approx. Attenuated Volume 2.8-10m^3	Discharge to existing stormwater network DN 900. Catchment ultimately outfalls to the Cammock River - Liffey.
F1630-F1700 S	8.4.2A		43	4.3	Oversized Pipes, Approx. Attenuated Volume 1.2-4.8m^3	Discharge to existing stormwater network DN 900.

Chainage	Existing Catchment Reference	Approx. Impermeable Surface Area		Permitted Discharge (l/sec)	Possible SUDS Solution / Attenuation Measure	Catchment Outfall
		Existing (m^2)	Additional (m^2)			
						Catchment ultimately outfalls to the Cammock River - Liffey.
F1720-F1980 N	8.4.3	1597	490	17.7	Oversized Pipes, Filter drain, & Bioretention area, Approx. Attenuated Volume 9.1-26m^3	Discharge to existing stormwater network DN 900. Catchment ultimately outfalls to the Cammock River - Liffey.
F1700-F1980 S	8.4.4	5258	459	16.1	Oversized Pipes, Tree pits, Filter Drains & Bioretention area, Approx. Attenuated Volume 8.5-24m^3	Discharge to existing stormwater network DN unknown. Catchment ultimately outfalls to the Cammock River - Liffey.
Killeen Road – Jct at F1720 W	8.4.5	600	33	2.0	N/A, Approx. Attenuated Volume 0m^3	Assumed existing stormwater network has capacity for nominal additional runoff. Existing gullies to be replaced with narrow profile gullies relocated to new kerb line and connected to existing surface water network. Catchment ultimately outfalls to Cammock River - Liffey.
F1980-F2400 N	8.5.1	8182	1891	43.3	Oversized Pipes, Approx. Attenuated Volume 32-80m^3	Discharge to existing stormwater network DN 600. Catchment ultimately outfalls to the Cammock River - Liffey.
F1980-F220 S	8.5.2	5639	1297	24.7	Oversized Pipes, Approx. Attenuated Volume 22-51m^3	Discharge to existing stormwater network DN 600. Catchment ultimately outfalls to the Cammock River - Liffey.
F2240	8.5.3	3124	85	2.7	Bioretention area, Approx. Attenuated Volume 1.5-4.2m^3	Discharge to existing stormwater network DN 450. Catchment ultimately outfalls to the Cammock River - Liffey.
F2300-F2350 S	8.5.4	3847	329	6.2	Oversized Pipes, Approx. Attenuated Volume 5.4-13m^3	Discharge to existing stormwater network DN 450. Catchment ultimately outfalls to the Cammock River - Liffey.
F2400-F2700 N	8.5.5B-H	10796	-33	N/A	Filter drains, Approx. Attenuated Volume N/A m^3	Discharge to existing stormwater network RG2700x1800. Catchment ultimately outfalls to Cammock River - Liffey.

Chainage	Existing Catchment Reference	Approx. Impermeable Surface Area		Permitted Discharge (l/sec)	Possible SUDS Solution / Attenuation Measure	Catchment Outfall
		Existing (m^2)	Additional (m^2)			
F2700-F2850 N	8.5.5A		224	13.9	Oversized Pipes, Approx. Attenuated Volume 5.1-17m^3	Discharge to existing stormwater network DN 600. Catchment ultimately outfalls to Cammock River - Liffey.
F2400-F2750 S	8.5.6	7599	-358	N/A	Bioretention areas, Approx. Attenuated Volume N/A (compensatory bioretention area)	Existing gullies to be replaced with narrow profile gullies relocated to new kerbline, and connected to existing surface water network. Catchment ultimately outfalls to Cammock River - Liffey.
F2250 S	8.7.1	1179	803	9.9	Oversized Pipes, Approx. Attenuated Volume 13-28m^3	Discharge to existing stormwater network DN 300. Catchment ultimately outfalls to the Walkinstown Stream.
F2260 S	8.7.2	1733	30	2.0	N/A, Approx. Attenuated Volume 0m^3	Assumed existing stormwater network has capacity for nominal additional runoff. Existing gullies to be replaced with narrow profile gullies, relocated to new kerbline, and connected to existing surface water network. Catchment ultimately outfalls to the Walkinstown Stream.
Asset Owner/Location: Irish Water/Dublin City Council						
F2750-F2850 S	8.6.1	1790	196	Rate of Infiltration	Soakaway, Approx. Attenuated Volume TBD	Discharge to soakaway.
F2850-F2880 S	8.6.2D	6034	109	5.7	Oversized Pipe, Approx. Attenuated Volume 2.3-7.5m^3	Discharge to existing stormwater network DN 225. Catchment ultimately outfalls to Cammock River - Liffey.
F2880 S – F3010 W	8.6.2C		314	4.3	Oversized Pipe, Approx. Attenuated Volume 5.2-11m^3	Discharge to existing stormwater network DN 225. Catchment ultimately outfalls to Cammock River - Liffey.
F3010-F3040 W	8.6.2A		-9	N/A	N/A, Approx. Attenuated Volume N/A	Existing gullies to be replaced with narrow profile gullies, relocated to new kerbline, and connected to existing surface water network. Catchment ultimately outfalls to Cammock River - Liffey.
F3040-F3080 W	8.6.2G		56	2.0	Oversized Pipe, Approx. Attenuated	Discharge to existing stormwater network DN 225.

Chainage	Existing Catchment Reference	Approx. Impermeable Surface Area		Permitted Discharge (l/sec)	Possible SUDS Solution / Attenuation Measure	Catchment Outfall
		Existing (m^2)	Additional (m^2)			
					Volume 0.3-1.6m^3	Catchment ultimately outfalls to Cammock River - Liffey.
F3080-F3125 W	8.6.2F		54	2.0	Oversized Pipe, Approx. Attenuated Volume 0.5-2.1m^3	Discharge to existing stormwater network DN 225. Catchment ultimately outfalls to Cammock River - Liffey.
F3125-F3230 W	8.6.2E		50	3.0	Oversized Pipe, Approx. Attenuated Volume 1.1-3.7m^3	Discharge to existing stormwater network DN 225. Catchment ultimately outfalls to Cammock River - Liffey.
F3230-F3290 W	8.6.2H		85	2.0	Oversized Pipe, Approx. Attenuated Volume 1.4-3.6m^3	Discharge to existing stormwater network DN 225. Catchment ultimately outfalls to Cammock River - Liffey.
F3220-F3290 E	8.6.2B		109	2.2	Oversized Pipe, Approx. Attenuated Volume 1.8-4.4m^3	Discharge to existing stormwater network DN 225. Catchment ultimately outfalls to Cammock River - Liffey.
F2850-F3000 N	8.6.3	5190	81	11.4	Oversized Pipes, Approx. Attenuated Volume 2.8-12m^3	Discharge to existing stormwater network DN 225. Catchment ultimately outfalls to Cammock River - Liffey.
F3000-F3220 E	8.6.4	2857	336	8.0	Oversized Pipes, Approx. Attenuated Volume 5.7-14m^3	Discharge to existing stormwater network DN 300. Catchment ultimately outfalls to Cammock River - Liffey.
F3290-F3330 W	8.6.5	536	58	2.1	Oversized Pipes, Approx. Attenuated Volume 1.1-3.1m^3	Discharge to existing stormwater network DN 225. Catchment ultimately outfalls to Cammock River - Liffey.
F3290-F3330 E	8.6.6	336	97	2.0	Oversized Pipes, Approx. Attenuated Volume 1.6-3.5m^3	Discharge to existing stormwater network DN 225. Catchment ultimately outfalls to Cammock River - Liffey.
F3330-F3420 N	9.5.11	1385	-88	N/A	N/A Approx. Attenuated Volume N/A	Discharge to existing stormwater network DN 225. Catchment ultimately outfalls to Cammock River - Liffey.
F3330-F4020 S	9.5.12	9660	-108	N/A	N/A, Approx. Attenuated Volume N/A	Assumed existing stormwater network has capacity for nominal additional runoff. Existing gullies to be replaced with narrow profile gullies, relocated to new kerbline and

Chainage	Existing Catchment Reference	Approx. Impermeable Surface Area		Permitted Discharge (l/sec)	Possible SUDS Solution / Attenuation Measure	Catchment Outfall
		Existing (m^2)	Additional (m^2)			
						connected to existing surface water network. Catchment ultimately outfalls to Camac River.
F3420-F4100 N	9.5.13	9473	-210	N/A	N/A, Approx. Attenuated Volume N/A	Assumed existing stormwater network has capacity for nominal additional runoff. Existing gullies to be replaced with narrow profile gullies, relocated to new kerbline, and connected to existing surface water network. Catchment ultimately outfalls to Cammock River - Liffey.
F4020-F4100 S	9.5.14	727	0	N/A	N/A, Approx. Attenuated Volume N/A	Discharge to existing stormwater network DN 225. Catchment ultimately outfalls to Cammock River - Liffey.
West of F3330 N	9.5.15	1915	-38	N/A	Bioretention area, Approx. Attenuated Volume N/A (compensatory bioretention area)	Assumed existing stormwater network has capacity for nominal additional runoff. Existing gullies to be replaced with narrow profile gullies, relocated to new kerbline, and connected to existing surface water network. Catchment ultimately outfalls to Cammock River - Liffey
West of F3330 S	9.5.16	1579	0	N/A	N/A, Approx. Attenuated Volume N/A	Assumed existing stormwater network has capacity for nominal additional runoff. Existing gullies to be replaced with narrow profile gullies, relocated to new kerbline, and connected to existing surface water network. Catchment ultimately outfalls to Cammock River - Liffey.

9.6 Drainage at Bridge Structures

There are no new bridge structures in the Proposed Scheme that require special surface water management techniques.

9.7 Flood Risk

9.7.1 Overview

Flood risk assessment (FRA) has been prepared as part of the planning application for the Proposed Scheme.

The Stage 1 FRA is a high-level study of the scheme to identify flood risks to the Proposed Scheme and any potential flooding issues arising due to the project. The FRA informs the planning process and identify whether a further Stage 2 FRA is required.

The FRA includes the following:

- Confirmation of the sources of flooding which may affect the site;
- A qualitative assessment of the risk of flooding to the site and to adjacent sites as a result of construction of the proposed development,
- Review of the availability and adequacy of existing information,
- Identification of possible measures which could mitigate the flood risk to acceptable levels, and;
- Areas for further investigation (Stage 2 FRA) if required.

(Refer to Appendix N Flood Risk Assessment for Site Specific Flood Risk Assessment Tallaght / Clondalkin to City Centre)

9.7.2 Flood Risk Assessment

There are a number of historic flood events are noted in the vicinity of the Proposed Scheme. The Proposed Scheme is largely on existing roads and will result in minimal additional paved areas and will therefore not increase the risk of these events reoccurring compared to the current scenario.

No tidal flood risk has been identified to the proposed schemes together with no risk of coastal flooding to the site in the present, or future climate change scenario.

The groundwater vulnerability varies along the Proposed Scheme. As most of the Proposed Scheme is on existing roads with no known flooding specifically due to groundwater, it is not expected that this risk will increase with the construction of the Proposed Scheme. In order to accurately assess the site-specific risk of groundwater flooding, a geotechnical site investigation will be carried out as part of the final design in order to confirm the groundwater conditions along the Proposed Scheme.

There are sections of the proposed schemes where there is a risk of fluvial flooding. These are:

Tallaght to City Centre Section:

- Area 1: Section at Dolphins Barn on the R110 lies within Flood Zone A (1 in 100-year fluvial flood extents),
- Area 2: Section on Clogher Road near St. Kevin's College lies within Flood Zone A (1 in 100-year fluvial flood extents),
- Area 3: Section at the junction between R110 and R137 (near St. Patrick's Cathedral lies within Flood Zone A (1 in 100-year fluvial flood extents),
- The rest of the route is at low risk of flooding from rivers and the coast and is therefore located within Flood Zone C.

Clondalkin to Drimnagh Section:

- Area 1: Section at the Fox-and-Geese lies within Flood Zone A (1 in 100-year fluvial flood extents),
- Area 2: Section at Drimnagh lies within Flood Zone A (1 in 100-year fluvial flood extents),

- The rest of the route is at low risk of flooding from rivers and the coast and is therefore located within Flood Zone C.

The risk of pluvial flooding along most of the Proposed Scheme is considered to be medium.

The above risks exist in the current scenario and will be reduced as a result of the Proposed Scheme, as where new surface water sewers are being proposed along the development, these networks shall be designed to provide attenuation for return period of up to 30 years where practicable. This would be an improvement on the existing historical drainage network infrastructure and will reduce the overall risk of pluvial flooding. New drainage infrastructure will be provided including Sustainable (Urban) Drainage Systems (SuDS) such as rain gardens, swales, and tree pits where practicable. These SuDS features will provide source control measures and reduce the risk of pluvial flooding.

10 Services and Utilities

10.1 Overview of Utilities Design Strategy

Utility records from all providers were sought at an early stage of the scheme design. These records combined with topographic survey records, GPR Survey, walk over inspections and desktop analysis of the proposed scheme identified areas of risk to existing assets. Where risk was initially identified to high value assets, such as high voltage ESB cables, high pressure gas mains and trunk water mains, a review was undertaken to ascertain if the risk could be mitigated by amending the highways design whilst still meeting the objectives of the scheme. Some areas of conflict were designed out at this stage; however, some remained and had to be accommodated within the overall scheme design.

10.1.1 Record Information

Available utility records were submitted by service providers and reviewed along the Proposed Scheme. These records have assisted with informing the scheme design. Utility records were received from the following service providers:

- Irish Water;
- Gas Networks Ireland (GNI);
- Electricity Supply Bord (ESB);
- Eir;
- Virgin Media;
- BT;
- Vodafone;
- Enet;
- South Dublin County Council; and
- Dublin City County Council.

10.1.2 Phase 1 Utility Survey

A targeted utility survey to PAS 128A, including GPR, was commissioned by the NTA to investigate areas where there is risk identified to existing high value assets such as high voltage ESB cables, high pressure gas mains and trunk water mains due to the proposed carriageway alignment. Some areas where there is a high concentration of utility diversions proposed were also surveyed to ensure that adequate spacing is available for relocation of assets. The results of the utility survey have been reviewed to confirm the adequacy of design provisions made with respect to diversion proposals. Additionally, a more extensive utility survey will be completed to inform the detailed design phase of the Proposed Scheme.

10.1.3 Consultation with Utility Service Providers

Consultation with all relevant utility service providers was undertaken to evaluate the impact of the Proposed Scheme on existing utilities.

Based on records and topographical survey that was available, utility diversions and areas where protection measures might be required were identified. These potential impacts were documented on a set of consultation drawings and a technical note was prepared for each utility company.

Consultation meetings were held with ESB, GNI, Irish Water and Eir. The Proposed Scheme proposals were also outlined to them and scenarios where utility infrastructure might be impacted by the Proposed Scheme were discussed.

10.2 Overview of Service Diversions

The construction of the Proposed Scheme will result in conflicts with several existing utility assets.

These conflicts have been identified, and preliminary consultation has been undertaken with the relevant service providers so that the conflict can be resolved by relocating or diverting the services where necessary and protecting in-situ where appropriate.

The principal statutory and other service providers affected are:

- ESB;
- Irish Water (water and public sewer);
- GNI; and
- Telecommunication Services – Eir, Virgin Media, eNet and BT.

In addition to the above, it will be necessary to relocate and upgrade some of the existing public lighting and traffic signalling network and equipment along the extents of the Proposed Scheme.

The services conflicts and the associated diversions will need to be considered in the design and construction of the Proposed Scheme. The design considerations have been taken into account as much as practicable at this stage, but it is likely that design modifications will be required at detailed design stage when further site investigations have taken place.

During construction, it will be necessary to maintain supply to certain services. This will require the retention and protection of existing utility supplies until such time as permanent diversions can be commissioned, or alternatively the construction of temporary diversions to facilitate completion of the works including the permanent diversion of services. The sequence of works must also take into account the need to liaise with service providers and, subject to their availability to carry out diversions, staging of the works may be necessary.

The service diversions required for this development are discussed in the following paragraphs. The locations of all known services from records provided from the service providers are shown on Combined Utility Drawings (See Appendix B Preliminary Design Drawings) Table 10-1 provides a summary of the service data received to date.

Table 10-1:Service Data Received Summary

Service Type	Data Available	Comments	Date Received
High Pressure (HP) Gas	Yes	No network present for sheets 1-27, 29-43, 45-50 & 54-56 TBC by Utility Investigation Survey.	15/10/2019
Medium Pressure (MP) Gas	Partial	No data available for sheets 5, 15, 20-23, 25, 26, 34, 36 & 39-44, 45, 51, 54 & 55.	15/10/2019
Low Pressure (LP) Gas	Partial	No data available for sheets 4, 6-9, 12, 14, 16, 17 & 40 – 50.	15/10/2019

Service Type	Data Available	Comments	Date Received
Telco Duct	Yes	No network present for sheets 1, 3-8, 13, 15-18, 20-23, 31-3, 39-43 & 54-56 TBC by Utility Investigation Survey.	15/10/2019
Foul Sewer (FS)	Yes	Data is available for all sheets.	15/10/2019, 26/03/2020
HV Electricity	Yes	No network present for sheets 5-7, 9, 15, 17, 18, 20-22, 26, 27, 35-37, 49-52 & 55-56. TBC by Utility Investigation Survey.	15/10/2019
MV Electricity	Partial	No data available for sheets 15 & 41-43. TBC by Utility Investigation Survey.	15/10/2019
LV Electricity	Partial	No data available for sheets 41-46, 48, 49, 51 & 53. TBC by Utility Investigation Survey.	15/10/2019
IW Water Network (WN)	Yes	No data available for sheets 45-46.	15/10/2019, 26/03/2020
IW Abandoned Lines	Yes	No network present for sheets 1-5, 7-26 & 28-46, 48-50, 52, 55 & 56 TBC by Utility Investigation Survey.	15/10/2019, 26/03/2020

10.3 Summary of Recommended Diversions

10.3.1 Gas Networks Ireland

No impacts to high pressure gas mains have been identified. There are five locations where GNI medium pressure gas mains require a diversion and eight locations where GNI low pressure gas mains require a diversion along the scheme Table 10-2, below outlines potential diversions of ESB services, and these are illustrated on drawing series BCIDC-ACM-UTL-UG-0809_XX_00-DR-CU-9001 in Appendix B Preliminary Design Drawings

Table 10-2: GNI Asset Diversions

Ref. no.	Utility Provider	Chainage	Asset Impacted	Description of Works
R09-LP-G3-AA	GNI	BCIDA-ACM-ULT_UG-0809_XX_00-DR-CU-0003/0004	Low Pressure Gas Network	360m Diversion to GNI Specification

R09-MP-G7-A	GNI	BCIDA-ACM-ULT_UG-0809_XX_00-DR-CU-0007	Medium Pressure Gas Network	55m Diversion to GNI Specification
R09-MP-G8-A-1	GNI	BCIDA-ACM-ULT_UG-0809_XX_00-DR-CU-0008	Medium Pressure Gas Network	75m Diversion to GNI Specification
R09-MP-G9-A-3	GNI	BCIDA-ACM-ULT_UG-0809_XX_00-DR-CU-0009	Medium Pressure Gas Network	40m Diversion to GNI Specification
R09-MP-G14-A	GNI	BCIDA-ACM-ULT_UG-0809_XX_00-DR-CU-0014/0016	Medium Pressure Gas Network	155m Diversion to GNI Specification
R09-LP-G19-K	GNI	BCIDA-ACM-ULT_UG-0809_XX_00-DR-CU-0018	Low Pressure Gas Network	75m Diversion to GNI Specification
R09-LP-G20-E	GNI	BCIDA-ACM-ULT_UG-0809_XX_00-DR-CU-0019/0020	Low Pressure Gas Network	360m Diversion to GNI Specification
R09-LP-G20-F	GNI	BCIDA-ACM-ULT_UG-0809_XX_00-DR-CU-0021	Low Pressure Gas Network	140m Diversion to GNI Specification
R09-LP-G21-F	GNI	BCIDA-ACM-ULT_UG-0809_XX_00-DR-CU-0021	Low Pressure Gas Network	270m Diversion to GNI Specification
R09-LP-G24-J	GNI	BCIDA-ACM-ULT_UG-0809_XX_00-DR-CU-0024/0025	Low Pressure Gas Network	200m Diversion to GNI Specification
R09-LP-G26-G	GNI	BCIDA-ACM-ULT_UG-0809_XX_00-DR-CU-0026	Low Pressure Gas Network	82m Diversion to GNI Specification
R08-MP-G5-I	GNI	BCIDA-ACM-ULT_UG-0809_XX_00-DR-CU-0048/0049	Medium Pressure Gas Network	135m Diversion to GNI Specification
R08-LP-G7-BB	GNI	BCIDA-ACM-ULT_UG-0809_XX_00-DR-CU-0051	Low Pressure Gas Network	35m Diversion to GNI Specification
R08-LP-G10-L	GNI	BCIDA-ACM-ULT_UG-0809_XX_00-DR-CU-0054	Low Pressure Gas Network	60m Diversion to GNI Specification

10.3.2 ESB

One section of high voltage underground cable requires a diversion. Fourteen sections of medium voltage cables and twenty-five sections of low voltage cables require diversions along the length of the route as well as the local relocation of a substation Table 10-3, below outlines potential diversions of ESB services, and these are illustrated on drawing series BCIDC-ACM-UTL-UE-0809_XX_00-DR-CU-9001 in Appendix B Preliminary Design Drawings

Table 10-3: ESB Asset Diversions

Ref. no.	Utility Provider	Drawing	Asset Impacted	Description of Works
R09-UG-MV-E3-J	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0003	Medium Voltage Underground ESB Electricity	44m Diversion Required to ESB Specification
R09-UG-HV-E3-F	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0003	High Voltage Underground ESB Electricity	120m Diversion Required to ESB Specification
R09-UG-MV-E3-D, E3-D-1, E4-C & E4-D	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0003/0004	Medium Voltage Underground ESB Electricity	340m Diversion Required to ESB Specification

Ref. no.	Utility Provider	Drawing	Asset Impacted	Description of Works
R09-UG-MV-E8-B	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0008	Medium Voltage Underground ESB Electricity	112m Diversion Required to ESB Specification
R09-UG-LV-E8-L	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0008	Low Voltage Underground ESB Electricity	114m Diversion Required to ESB Specification
R09-UG-LV-E8-L-1	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0008	Low Voltage Underground ESB Electricity	12m Diversion (Including Mini Pillar Relocation) Required to ESB Specification
R09-UG-MV-E8-AA	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0009	Medium Voltage Underground ESB Electricity	25m Diversion Required to ESB Specification
R09-UG-LV-E9-TT	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0009	Low Voltage Underground ESB Electricity	1m Diversion (including mini pillar relocation) Required to ESB Specification
R09-OH-LV-E12-F	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0012	Low Voltage Overhead ESB Electricity	127m Diversion Required to ESB Specification
R09-UG-LV-E14-N	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0014	Low Voltage Underground ESB Electricity	120m Diversion Required to ESB Specification
R09-UG-MV-E14-B	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0014	Medium Voltage Underground ESB Electricity	90m Diversion Required to ESB Specification
R09-UG-MV-E16-BB	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0016	Medium Voltage Underground ESB Electricity	26m Diversion Required to ESB Specification
R09-OH-LV-E17-I	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0018	Low Voltage Overhead ESB Electricity	240m Diversion Required to ESB Specification
R09-UG-MV-E17-B	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0018	Medium Voltage Underground ESB Electricity	165m Diversion Required to ESB Specification
R09-OH-LV-E18-AA	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0018	Low Voltage Overhead ESB Electricity	95m Diversion Required to ESB Specification
R09-OH-LV-E18-HH	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0018	Low Voltage Overhead ESB Electricity	30m Diversion Required to ESB Specification
R09-OH-LV-E18-I	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0018	Low Voltage Overhead ESB Electricity	127m Diversion Required to ESB Specification
R09-UG-MV-E18-C	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0018	Medium Voltage Underground ESB Electricity	55m Diversion Required to ESB Specification

Ref. no.	Utility Provider	Drawing	Asset Impacted	Description of Works
R09-OH-LV-E19-Y	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0019	Low Voltage Overhead ESB Electricity	120m Diversion Required to ESB Specification
R09-OH-LV-E19-XX	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0019	Low Voltage Overhead ESB Electricity	95m Diversion Required to ESB Specification
R09-OH-LV-E19-GG	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0019	Low Voltage Overhead ESB Electricity	Pole Relocation Required to ESB Specification
R09-OH-LV-E19-JJ	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0019	Low Voltage Overhead ESB Electricity	20m Diversion Required to ESB Specification
R09-OH-LV-E19-PP	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0019	Low Voltage Overhead ESB Electricity	Pole Relocation Required to ESB Specification
R09-OH-LV-E19-HH	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0019	Low Voltage Overhead ESB Electricity	Pole Relocation Required to ESB Specification
R09-OH-LV-E19-Z	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0019	Low Voltage Overhead ESB Electricity	Pole Relocation Required to ESB Specification
R09-UG-MV-E20-A	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0019/0020	Medium Voltage Underground ESB Electricity	75m Diversion Required to ESB Specification
R09-OH-LV-E20-G	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0019/0020	Low Voltage Overhead ESB Electricity	390m Diversion Required to ESB Specification
R09-OH-LV-E21-G & E21-L	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0021/0022	Low Voltage Overhead ESB Electricity	340m Diversion Required to ESB Specification
R09-UG-LV-E24-XX	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0024	Low Voltage Underground ESB Electricity	10m Diversion Required to ESB Specification
R09-OH-LV-E24-L	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0024/0025	Low Voltage Overhead ESB Electricity	200m Diversion Required to ESB Specification
R09-UG-LV-E24-W	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0024/0025	Low Voltage Underground ESB Electricity	170m Diversion Required to ESB Specification
R09-UG-MV-E24-XX	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0024/0025	Medium Voltage Underground ESB Electricity	170m Diversion Required to ESB Specification
R09-OH-LV-E26-I	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0026	Low Voltage Overhead ESB Electricity	135m Diversion Required to ESB Specification

Ref. no.	Utility Provider	Drawing	Asset Impacted	Description of Works
R09-UG-LV-E26-K	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0026	Low Voltage Underground ESB Electricity	30m Diversion Required to ESB Specification
R09-IVEAGH GROUNDS SUBSTATION	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0026	Substation ESB Electricity	To Be Relocated Locally
R09-UG-MV-E26-A	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0026	Medium Voltage Underground ESB Electricity	115m Diversion Required to ESB Specification
R09-OH-LV-E27-XX	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0027	Low Voltage Overhead ESB Electricity	90m Diversion Required to ESB Specification
R09-UG-LV-E27-YY	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0027	Low Voltage Underground ESB Electricity	80m Diversion Required to ESB Specification
R09-UG-MV-E27-U	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0027	Medium Voltage Underground ESB Electricity	126m Diversion Required to ESB Specification
R06-UG-MV-E3-D	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0047	Medium Voltage Underground ESB Electricity	10m Extension Required to ESB Specification
R08-OH-MV-E7-VV	ESB	BCIDA-ACM-ULT_UE-0809_XX_00-DR-CU-0051	Medium Voltage Overhead ESB Electricity	65m Extension Required to ESB Specification

10.3.3 Irish Water

Based on the information available to date, no conflicts occur along with foul sewer mains. however, there are twenty-four sections of water mains along the route where diversions are required. Table 10-4, below outlines potential diversions of Irish Water watermain services, and these are illustrated on drawing series BCIDC-ACM-UTL-UW-0809_XX_00-DR-CU-9001 in Appendix B Preliminary Design Drawings

Table 10-4: Irish Water Watermain Asset Diversions/Protections

Clash Ref:	Utility Provider	Drawing	Asset Impacted	Description of Works
R09-W2-H	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0001/0002	Water Network DN160mm moPVC	132m Ductile Iron Diversion to Irish Water Specification
R09-W2-L	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0002	Water Network DN160mm moPVC	60m Ductile Iron Diversion to Irish Water Specification
R09-W3-K	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0003	Water Network DN160mm moPVC	36m Ductile Iron Diversion to Irish Water Specification
R09-W3-K-1	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0003	Water Network DN150mm UPVC	92m Ductile Iron Diversion to Irish Water Specification
R09-W7-AA	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0007	Water Network DN304mm AC / DN300mm DI	60m Ductile Iron Diversion to Irish Water Specification

Clash Ref:	Utility Provider	Drawing	Asset Impacted	Description of Works
R09-W8-F	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0008	Water Network DN160mm moPVC	50m Ductile Iron Diversion to Irish Water Specification
R09-W8-E	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0008	Water Network DN160mm moPVC	50m Ductile Iron Diversion to Irish Water Specification
R09-W8-D	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0008	Water Network DN304mm AC / DN300mm DI	158m Ductile Iron Diversion to Irish Water Specification
R09-W9-E-1	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0009	Water Network DN228.6mm PVC	30m Ductile Iron Diversion to Irish Water Specification
R09-W10-AA	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0010	Water Network DN101mm moPVC	90m Ductile Iron Diversion to Irish Water Specification
R09-W11-H	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0011	Water Network DN101mm moPVC	70m Ductile Iron Diversion to Irish Water Specification
R09-W12-C	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0011/0012	Water Network DN101mm moPVC	300m Ductile Iron Diversion to Irish Water Specification
R09-W12-D	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0012	Water Network DN304mm AC	35m Ductile Iron Diversion to Irish Water Specification
R09-W12-C-1	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0012	Water Network DN101mm moPVC	8m Ductile Iron Diversion to Irish Water Specification
R09-W13-E	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0013	Water Network DN101mm CI	66m Ductile Iron Diversion to Irish Water Specification
R09-W15-A	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0015	Water Network DN101mm CI	75m Ductile Iron Diversion to Irish Water Specification
R09-W18-E	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0018	Water Network DN101mm CI	120m Ductile Iron Diversion to Irish Water Specification
R09-W18-H	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0018/0019	Water Network DN152.4mm UPVC	225m Ductile Iron Diversion to Irish Water Specification
R09-W20-B	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0020/0021	Water Network DN152.4mm CI	420m Ductile Iron Diversion to Irish Water Specification
R09-W24-E	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0024/0025	Water Network DN101mm CI	190m Ductile Iron Diversion to Irish Water Specification
R09-W26-D	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0026	Water Network DN101.6mm CI	185m Ductile Iron Diversion to Irish Water Specification
R08-W5-D-1	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0049	Water Network DN152.4mm moPVC	160m Ductile Iron Diversion to Irish Water Specification
R08-W9-L-1	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0053	Water Network DN228.6mm AC	15m Ductile Iron Diversion to Irish Water Specification
R08-W10-O	IW	BCIDA-ACM-ULT_UW-0809_XX_00-DR-CU-0054	Water Network DN228.6mm AC	50m Ductile Iron Diversion to Irish Water Specification

10.3.4 Telecommunications

There are forty-five locations along the route where conflicts with telecommunications infrastructure have been identified and diversions are required. below outlines potential Table 10-5, diversions of telecommunications infrastructure, and these are illustrated on drawing series BCIDC-ACM-UTL-UL-0809_XX_00-DR-CU-9001 in Appendix B Preliminary Design Drawings

Table 10-5: Telecommunications Asset Diversions

Clash Ref:	Utility Provider	Drawing	Asset Impacted	Description of Works
R09-ER2-U	Eir Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0001/0002	9 No. x 100mm ducts 40M 2 No. x 100mm ducts 60M	100m Diversion Including Chamber Relocations
R09-ER2-U & ER2-U-1	Eir Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0002	9 No. x 100mm ducts	8m Diversion Including Chamber Relocations
R09-ER2-U & ER2-U-2	Eir Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0002	9 No. x 100mm ducts	30m Diversion Including Chamber Relocations
R09-VM3-S	Virgin Media Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0003/0004	2 No. x 100mm ducts	125m Diversion Including Chamber Relocations
R09-ER3-U	Eir Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0003/0004	4 No. x 100mm ducts	225m Diversion Including Chamber Relocations
R09-ER8-T	Eir Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0008	6 No. x 100mm ducts	105m Diversion Including Chamber Relocations
R09-VM8-P	Virgin Media Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0008/0009		170m Diversion Including Chamber Relocations
R09-ENET11-R	ENET Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0011		245m Diversion Including Chamber Relocations
R09-ER11-Z	Eir Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0011	24 No. x 100mm ducts	70m Diversion Including Chamber Relocations
R09-VM12-J	Virgin Media Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0012/0013	12 No. x 100mm ducts	160m Diversion Including Chamber Relocations
R09-ER12-N	Eir Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0012/0013	6 No. x 100mm ducts	320m Diversion Including Chamber Relocations
R09-ER14-W	Eir Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0014	2 No. x 100mm ducts	100m Diversion Including Chamber Relocations
R09-GNI14-R	GNI Telco Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0014		35m Diversion Including Chamber Relocations
R09-VM14-S	Virgin Media Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0014	4 No. x 100mm ducts	30m Diversion Including Chamber Relocations
R09-ER14-X	Eir Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0014	4 No. x 100mm ducts	140m Diversion Including Chamber Relocations
R09-VM14-T	Virgin Media Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0014		145m Diversion Including Chamber Relocations

Clash Ref:	Utility Provider	Drawing	Asset Impacted	Description of Works
R09-ER15-C	Eir Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0015	16 No. x 100mm ducts 6 No. x 100mm ducts 3 No. x 100mm ducts	155m Diversion Including Chamber Relocations
R09-ER18-N	Eir Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0018	5 No. x 100mm ducts	70m Diversion Including Chamber Relocations
R09-ER18-B, ER18-L, ER18-M & ER18-N	Eir Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0018	1 No. x 100mm ducts 16 No. x 100mm ducts 6 No. x 100mm ducts 4 No. x 100mm ducts	330m Diversion Including Chamber Relocations
R09-ER19-N, ER19-N-2, ER19-AK, ER19-AL, ER19-AN & ER19-N	Eir Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0018/0019	16 No. x 100mm ducts 6 No. x 100mm ducts 4 No. x 100mm ducts	130m Diversion Including Chamber Relocations
R09-ER19-AO	Eir Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0019	4 No. x 100mm ducts	25m Diversion Including Chamber Relocations
R09-VM19-AH	Virgin Media Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0019	4 No. x 100mm ducts	45m Diversion Including Chamber Relocations
R09-ER19-L-2	Eir Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0018/0019	1 No. x 100mm ducts 16 No. x 100mm ducts	120m Diversion Including Chamber Relocations
R09-ER19-L	Eir Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0019/0020		50m Diversion Including Chamber Relocations
R09-ER19-AP	Eir Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0019	3 No. x 100mm ducts	60m Diversion Including Chamber Relocations
R09-ER18-AM-1, ER19-K & ER20-M	Eir Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0020	6 No. x 100mm ducts	375m Diversion Including Chamber Relocations
R09-ER20-L-4, ER20-L-4-1 & ER20-K	Eir Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0020/0021	2 No. x 100mm ducts	530m Diversion Including Chamber Relocations
R09-VM20-I	Virgin Media Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0020		160m Diversion Including Chamber Relocations
R09-ER21-L-1 & ER21-J	Eir Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0021	2 No. x 100mm ducts	100m Diversion Including Chamber Relocations
R09-ER21-L-1	Eir Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0020	2 No. x 100mm ducts	55m Diversion Including Chamber Relocations
R09-ER27-AH	Eir Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0027		90m Diversion Including Chamber Relocation
R09-ER27-AG	Eir Existing	BCIDA-ACM-ULT_UL-0809_XX_00-DR-CU-0027	1 No. x 100mm ducts	140m Diversion Including Chamber Relocation

Clash Ref:	Utility Provider	Drawing	Asset Impacted	Description of Works
R08-VM2-L	Virgin Media Existing	BCIDA-ACM-ULT_UL-0008_XX_00-DR-CU-0046		105m Diversion Including Chamber Relocations
R08-GNI-T2-B	GNI Telco Existing	BCIDA-ACM-ULT_UL-0008_XX_00-DR-CU-0046		120m Diversion Including Chamber Relocations
R08-EN3-K	ENET Existing	BCIDA-ACM-ULT_UL-0008_XX_00-DR-CU-0047		87m Diversion Including Chamber Relocations
R08-ER5-L & R08-ER5-L-1	Eir Existing	BCIDA-ACM-ULT_UL-0008_XX_00-DR-CU-0049	1 No. x 100mm ducts 4 No. x 100mm ducts	112m Diversion Including Chamber Relocations
R08-ER5-M	Eir Existing	BCIDA-ACM-ULT_UL-0008_XX_00-DR-CU-0049	4 No. x 100mm ducts	95m Diversion Including Chamber Relocations
R08-ER5-O & ER5-N	Eir Existing	BCIDA-ACM-ULT_UL-0008_XX_00-DR-CU-0049/0050	4 No. x 100mm ducts 4 No. x 100mm ducts	65m Diversion Including Chamber Relocations
R08-VM7-Y	Virgin Media Existing	BCIDA-ACM-ULT_UL-0008_XX_00-DR-CU-0051		105m Diversion Including Chamber Relocations
R08-GNI7-T6-A	GNI Telco Existing	BCIDA-ACM-ULT_UL-0008_XX_00-DR-CU-0051	4 No. x 100mm ducts	105m Diversion Including Chamber Relocations
R08-ER6-N5, ER6-N, ER6-AC & ER6-AB	Eir Existing	BCIDA-ACM-ULT_UL-0008_XX_00-DR-CU-0051	4 No. x 100mm ducts	105m Diversion Including Chamber Relocations
R08-GNI-T7-RR	GNI Telco Existing	BCIDA-ACM-ULT_UL-0008_XX_00-DR-CU-0051	4 No. x 100mm ducts	20m Diversion Including Chamber Relocations
R08-ER9-V	Eir Existing	BCIDA-ACM-ULT_UL-0008_XX_00-DR-CU-0053	4 No. x 100mm ducts	25m Diversion Including Chamber Relocations
R08-ER9-U	Eir Existing	BCIDA-ACM-ULT_UL-0008_XX_00-DR-CU-0053	6 No. x 100mm ducts	150m Diversion Including Chamber Relocations
R08-ER9-U	Eir Existing	BCIDA-ACM-ULT_UL-0008_XX_00-DR-CU-0054	6 No. x 100mm ducts	150m Diversion Including Chamber Relocations

11 Waste Quantities

11.1 Overview of Waste

The majority of the waste arisings from the construction of the Proposed Scheme are likely to accumulate from excavation related activities resulting from road widening and drainage/utility works in addition to proposed public domain street works. A waste calculator was developed for the Proposed Scheme to quantify and classify the likely material types in accordance with TII GE-ENV-01101 and the European Waste Catalogue waste codes. The waste quantities associated with soil and stones (waste code 17 06 02) were further broken down into the likely TII material specification to establish an understanding of the volume of materials that could potentially be reused/recycled. In developing the waste estimate quantities, a number of assumptions were required to undertake the assessment which have been outlined in Section 11.2.

Due to the nature of the works in an urban environment there are limited opportunities to provide a cut/fill balance of materials that could be more readily accommodated on a greenfield project where earthworks embankments/ bunds are more common. Material from the existing pavement layers could be sent to a suitable recovery facility for recycling and reuse as recycled aggregate material in the industry. The existing made ground material will need to be tested for quality and contamination and could potentially be sent to a suitable soil recovery facility also for reuse as general fill or general landscape fill material in the industry under the provisions of Article 28. Similarly, alternative sites could be identified under the provisions of Article 27 for material re-use during future design stages. No such suitable sites have been identified for the Proposed Scheme during the preliminary design phase.

Future design stages will undertake additional site investigations to inform the detailed pavement design and associated excavation quantity assessment. Various mitigations could be considered during the design and construction works to offset the net volume of material that will be sent off site to a soil recovery facility including stockpiling of existing subbase, capping layer and topsoil material on site for direct reuse in the proposed works (subject to quality testing, construction sequencing and material availability versus demand given the intermittent nature of the streetworks). Similarly, there are potentially other opportunities within the proposed pavement design/construction to further offset the net volume of natural aggregate material requirements through consideration for the use of recycled aggregates and reclaimed asphalt material. Suitable recycled aggregates and appropriate site won material could be implemented in the proposed road base/binder layers, subbase layers under footway/cycle tracks, and capping layer material within the road pavement. Adopting these mitigations in the proposed designs may have significant benefits in offsetting the overall quantity of natural aggregate materials requirements and could potentially realise up to a significant volume of recycled/reused aggregates to improve the overall sustainability of the Proposed Scheme.

Waste arisings from street furniture, trees and materials from within the public domain (17 01 02 Bricks, 17 04 07 Mixed metals, 17 02 03 Plastic, 17 02 01 wood, 17 02 02 Glass) are also likely to result from the nature of the works. These materials will need to be segregated by waste classification on site and sent to a suitable recovery facility for recycling. The principles of prevention and minimisation will be further considered in detailed design/construction stages through value engineering, substitution or reuse of materials, and effective methods or control systems (e.g. just in time deliveries/ effective spoil management) so that waste production is minimised.

11.2 Waste Calculation Assumptions

The following tables provide an overview of the various material weights that have been applied in consideration of the overall materials waste estimate quantities for the Proposed Scheme.

Table 11-1: Street Furniture Unit Weights

Item	Material	Assumed Nominal Weight	Notes
Timber arising from trees	Timber/ Wood	150 kg per tree	Average value per tree across the scheme length.
Vegetation (e.g. hedges, shrubs, leaves and branches)	Organic	N/A	Organic material from hedges, shrubs, leaves and branches have not been quantified.
Walls	Masonry/ Bricks	1.5m height 0.3m width	Nominal assumed dimensions for purposes of assessment
Gates	Metal	100 kg/unit	Nominal assumed average weight per gate over scheme
Metal railings	Metal	15 kg/m	Nominal assumed average weight per railing over scheme
Fencing	Metal	40 kg/m	Nominal assumed average weight per railing over scheme
Traffic signals	Metal	68 kg/ 4m pole 15kg per traffic signal head Assumed two heads per pole	Source: Siemens Helios General Handbook Issue 18. Nominal assumed average scenario per signal over scheme length
	Plastic	9 kg	
Traffic signs	Metal	20kg/ 3m pole 0.75 m sign height 0.01 m pole thickness	Nominal assumed average scenario per traffic sign over scheme length
Lighting poles	Metal	100 kg per 8m pole	Nominal assumed average scenario over scheme length
ESB/EIR poles	Timber/wood	250 kg per 9m pole	Nominal assumed average scenario over scheme length
Bus stops	Plastic	365 kg per bus stop	JCDecaux and NTA (2017) Reliance Bus Shelter information
	Metal	2400 kg per bus stop	JCDecaux and NTA (2017) Reliance Bus Shelter information
	Glass	54 kg per bus stop	JCDecaux and NTA (2017) Reliance Bus Shelter information
Litter bins	Metal	60 kg per bin	Omos specification. Nominal assumed average scenario over scheme length
Safety barrier	Metal	20 kg/m	Nominal assumed average scenario over scheme length

Item	Material	Assumed Nominal Weight	Notes
Cabinets	Metal	85 kg	ESB (2008). National Code of Practice for Customer Interface 4th Edition. Available online: https://www.esbnetworks.ie/docs/default-source/publications/national-code-of-practice.pdf (Accessed on 6 May 2021)
Benches	Metal	32kg	Lost Art (2016). Benches: Product information operation and maintenance instructions. Available online: https://www.lostart.co.uk/pdf/lost-art-limited-product-information.pdf (Accessed on 6 May 2021)
	Wood	8kg	
Cameras	Metal	35 kg	2b Security Systems (2021) PTZ-7000 Long range IP PTZ camera. Available online: https://www.2bsecurity.com/product/long-range-ptz-camera/ (Accessed on 6 May 2021)
Overhead gantry (steel)	Metal	7000 in per m^3	TII (nb). CC- SCD- 01804-02. Available online:https://www.tiipublications.ie/library/CC-SCD-01804-02.pdf (Accessed on 6 May 2021) TII (nb). CC- SCD- 0180-02. Available online:https://www.tiipublications.ie/library/CC-SCD-01805-02.pdf (Accessed on 6 May 2021)
Cast iron bollard	Metal	50 kg	Furnitubes (2013) Cast Iron Bollards: Product Brochure. Available online: https://www.furnitubes.com/uploads/assets/brochures-2013/furnitubes-e-008-01-13-cast-iron-bollard-brochure.pdf (Accessed on 6 May 2021)
Non assigned bollard	Metal	40kg	Furnitubes (2013) Cast Iron Bollards: Product Brochure. Available online: https://www.furnitubes.com/uploads/assets/brochures-2013/furnitubes-e-008-01-13-cast-iron-bollard-brochure.pdf (Accessed on 6 May 2021)
Stainless steel bollard	Metal	30kg	Furnitubes (2013) Cast Iron Bollards: Product Brochure. Available online: https://www.furnitubes.com/uploads/assets/brochures-2013/furnitubes-e-008-01-13-cast-iron-bollard-brochure.pdf (Accessed on 6 May 2021)
Vehicle restraint bollard	Metal	130 kg	Furnitubes (2013) Cast Iron Bollards: Product Brochure. Available online: https://www.furnitubes.com/uploads/assets/brochures-2013/furnitubes-e-008-01-13-cast-iron-bollard-brochure.pdf (Accessed on 6 May 2021)
Bike railings/hand rails	Metal	16 kg	Dublin City Council (2016) Construction Standards for Road and Street Works in Dublin City Council

Item	Material	Assumed Nominal Weight	Notes
Gully grates	Metal	40 kg	Pam Saint- Gobain (2016). Ductile Iron Access Covers and Gratings: Product selection and specification guide. Available online: https://www.saint-gobain-pam.co.uk/sites/pamline_uk/files/access_covers_and_gratings_product_guide_0.pdf (Accessed on 6 May 2021) Greater Dublin Region (2012) Greater Dublin Regional Code of Practice for Drainage works. Available online: (https://www.sdcc.ie/en/download-it/guidelines/greater-dublin-regional-code-of-practice-for-drainage.pdf (Accessed on 6 May 2021)
Chamber covers and frame	Metal	0.112 tonnes	Pam Saint- Gobain (2016). Ductile Iron Access Covers and Gratings: Product selection and specification guide. Available online: https://www.saint-gobain-pam.co.uk/sites/pamline_uk/files/access_covers_and_gratings_product_guide_0.pdf (Accessed on 6 May 2021) Greater Dublin Region (2012) Greater Dublin Regional Code of Practice for Drainage works. Available online: (https://www.sdcc.ie/en/download-it/guidelines/greater-dublin-regional-code-of-practice-for-drainage.pdf (Accessed on 6 May 2021)
Manholes	Metal	0.04 tonnes	Pam Saint- Gobain (2016). Ductile Iron Access Covers and Gratings: Product selection and specification guide. Available online: https://www.saint-gobain-pam.co.uk/sites/pamline_uk/files/access_covers_and_gratings_product_guide_0.pdf (Accessed on 6 May 2021) Greater Dublin Region (2012) Greater Dublin Regional Code of Practice for Drainage works. Available online: https://www.sdcc.ie/en/download-it/guidelines/greater-dublin-regional-code-of-practice-for-drainage.pdf (Accessed on 6 May 2021)

Table 11-2: In-situ Pavement and Earthworks Densities

Material	Densities (tonnes/m3)	Notes
Soil	2.2	Professional judgement (Dublin boulder clay), laboratory testing - Nominal assumed average scenario over scheme length
Bitumen containing material	2.4	Professional judgement (Engineering designers) - Nominal assumed average scenario over scheme length
Concrete	2.4	Professional experience and (Bath Inventory - Version 2.0 (2011)) - Nominal assumed average scenario over scheme length
Granite	2.7	https://pubs.usgs.gov/of/1983/0808/report.pdf - Nominal assumed average scenario over scheme length

Material	Densities (tonnes/m3)	Notes
Paving stones (assumed concrete or natural stone)	2.4	Professional judgement (Engineering Designers) Nominal assumed average scenario over scheme length
Granular material	1.6	Nominal assumed average scenario over scheme length

Table 11-3: Utilities Material Excavation Assumptions

Asset type	Assumed nominal average trench width (m)	Assumed material spec. (TII)	Assumed nominal average trench depth under pavement layer (m)	Notes
Drainage pipe bedding excavation assessment (assumed at 1.2m cover i.e obvert at 0.35m under capping layer of road)	0.9	Class 2/4/U1 cohesive subgrade material	1.25	Irish Water (2020) Water Infrastructure Standard Details: Connections and Developer Services. Available online: https://www.water.ie/connections/Water-Standard-Details.pdf (Accessed on 6 May 2021)
Foul sewer pipe bedding excavation assessment (assumed at 1.2m cover i.e obvert at 0.35m under capping layer of road)	0.9	Class 2/4/U1 cohesive subgrade material	1.25	Irish Water (2020) Water Infrastructure Standard Details: Connections and Developer Services. Available online: https://www.water.ie/connections/Water-Standard-Details.pdf (Accessed on 6 May 2021)
Potable water pipe bedding excavation assessment (assumed at 1.2m cover i.e obvert at 0.35m under capping layer of road)	0.9	Class 2/4/U1 cohesive subgrade material	1.25	Irish Water (2020) Water Infrastructure Standard Details: Connections and Developer Services. Available online: https://www.water.ie/connections/Water-Standard-Details.pdf (Accessed on 6 May 2021)
Road pavement excavation (extra over in addition to road widening allowances e.g transverse trenching)	0.9	Bitumen (surface+binder and base)	0.35	Irish Water (2020) Water Infrastructure Standard Details: Connections and Developer Services. Available online: https://www.water.ie/connections/Water-Standard-Details.pdf (Accessed on 6 May 2021)
		Class 1/2 granular subbase material	0.3	Irish Water (2020) Water Infrastructure Standard Details: Connections and Developer Services. Available online: https://www.water.ie/connections/Water-Standard-Details.pdf (Accessed on 6 May 2021)

Asset type	Assumed nominal average trench width (m)	Assumed material spec. (TII)	Assumed nominal average trench depth under pavement layer (m)	Notes
		Class 6 granular capping material	0.2	Irish Water (2020) Water Infrastructure Standard Details: Connections and Developer Services. Available online: https://www.water.ie/connections/Water-Standard-Details.pdf (Accessed on 6 May 2021)
Electric/power bedding excavation assessment (assumed at 0.75m cover under footway i.e obvert at 0.55m under subbase layer of footway/cycletrack)	0.05	Class 2/4/U1 cohesive subgrade material	0.925	ESB (2008) Standard Specification for ESB MV/LV Network Duction (Minimum Standards). Available online: https://www.esbnetworks.ie/docs/default-source/publications/summary-of-standard-specification-for-esb-networks-mvlv-ducting.pdf?sfvrsn=f34b33f0_4 (Accessed on 6 May 2021)
Comms bedding excavation assessment (assumed at 0.75m cover under footway i.e obvert at 0.55m subbase layer of footway)	0.5	Class 2/4/U1 cohesive subgrade material	0.925	ESB (2008) Standard Specification for ESB MV/LV Network Duction (Minimum Standards). Available online: https://www.esbnetworks.ie/docs/default-source/publications/summary-of-standard-specification-for-esb-networks-mvlv-ducting.pdf?sfvrsn=f34b33f0_4 (Accessed on 6 May 2021)
Street lighting/comms/traffic excavation assessment (assumed at 0.6m cover under footway i.e obvert at 0.4m subbase layer of footway)	0.5	Class 2/4/U1 cohesive subgrade material	0.56	South Dublin County Council (2016) Public Lighting Specification. Available online: https://www.sdcc.ie/en/services/transport/public-lighting/sdcc-public-lighting-specification.pdf (Accessed on 6 May 2021)
Gas Excavation Assessment (assumed at 0.6m cover i.e obvert at 0.4m under subbase layer of footway)	0.45	Class 2/4/U1 Cohesive subgrade material	0.7	Gas Network Ireland (2018) Guidelines for Designers and Builders- Industrial and Commercial (Non-domestic) Sites. Available online: https://www.gasnetworks.ie/Guidelines-for-Designers-and-Builders-Industrial-and-Commercial-Sites.pdf (Accessed 6 May 2021)

Table 11-4: Footway and Road Widening Excavation Assumptions

Layer	Assumed Layer thickness (m)	Assumed material spec. (TII)
Footway surface treatment due to all works (remove and replace)	0.1	Concrete
Full Depth construction (FDC) new pavement depth	0.85	As per DCC standard bus corridor detail with 200mm capping assumed.
Footway sub-layer excavation due to FDC widening (material under footway)	0.1	Granular material- Class 1/2 granular subbase material
	0.75	Soil and stones- Class 2/4/U1 cohesive subgrade material
Verge and sub-layer excavation due to FDC widening (material under verge)	0.3	Soil and stones- Class 5 topsoil material
	0.55	Soil and stones- Class 4/U1 cohesive subgrade material
Verge and sub-layer excavation due to footway widening (material under verge)	0.3	Soil and stones- Class 5 topsoil material
	0	Soil and stones- Class 4/U1 cohesive subgrade material
Road surface treatment due to road markings and utilities trench reinstatement (mill & re-sheet)	0.05	Bitumen containing material - bitumen (surface)
Road sub-layer excavation due to FDC (material under road)	0.3	Bitumen containing material - bitumen (binder and base)
	0.3	Class 1/2 granular subbase material
	0.2	Granular material - Class 6 granular capping material
	0	Soil and stones- Class 2/4/U1 cohesive subgrade material

11.3 Waste Estimate Summary

The majority of the waste arisings from the construction of the Proposed Scheme are likely to accumulate from excavation related activities resulting from road widening and drainage/utility works in addition to proposed public domain street works.

It is estimated that an order of magnitude of 253,000 Tonnes of pavement and made ground material (17 01 01 Concrete/ 17 06 02 non-hazardous bituminous mixture/17 05 04 - Soil and stones (non-contaminated)) will be excavated as part of the works, refer to Table 11-5. Due to the nature of the works in an urban environment there are limited opportunities to provide a cut/fill balance of materials that could be more readily accommodated on a greenfield project where earthworks embankments / bunds are more common. Material from the existing pavement layers could be sent to a suitable recovery facility for recycling and reuse as recycled aggregate material in the industry as further described below. The existing made ground material will need to be tested for quality and contamination and could potentially to be sent to a suitable soil recovery facility also for reuse as general fill or general landscape fill material in the industry under the provisions of Article 28. There are no known Article 27 sites available at the time of planning for the site however this could also be considered for reuse of material arisings from the project at a later date.

Potentially up to 100% of concrete and asphalt material could be sent to a suitable aggregate recovery facility for recycling. Under TII specification crushed concrete material could be used in selected granular fill material under Series 600 for Earthworks (6A,6B,6C,6F, 6G,6H,6I, 6M, 6N) or as Type A Clause 803 unbound subbase material under Series 800 for Road Pavements. Similarly, TII specification allows for use of recycled bituminous planings to be used in capping material and 803 subbase material type A (for use under bituminous footway) in addition to LEBM pavements for roads with <5MSA or consideration in offline cycle track base material.

Potentially up to 90% of excavated subbase material and capping material could be reused as subbase material under footways and cycle track (subject to quality testing). It is assumed that potentially 10% of this material will contain excessive cohesive material during the excavation process (unsuitable for direct reuse). The 10% excess material would likely be sent to a suitable recovery facility as general fill or landscape fill material (Class 2/4 material) depending on excavation methods employed by the contractor and existing ground conditions.

Future design stage will undertake additional site investigations to inform the detailed pavement design and associated excavation quantity assessment. Various mitigations could be considered during the design and construction works to offset the net volume of material that will be sent off site to a soil recovery facility including stockpiling of existing subbase, capping layer and topsoil material on site for direct reuse in the proposed works (subject to quality testing, construction sequencing and material availability versus demand given the intermittent nature of the street works). Similarly, there are potentially other opportunities within the proposed pavement design/construction to further offset the net volume of natural aggregate material requirements through consideration for the use of recycled aggregates and reclaimed asphalt material. Suitable recycled aggregates and appropriate site won material could be implemented in the proposed road base/binder layers, subbase layers under footway/cycle tracks, and capping layer material within the road pavement. Adopting these mitigations in the proposed designs may have significant benefits in offsetting the overall quantity of natural aggregate materials requirements and could potentially realise up to 45,000 tonnes of recycled/reused aggregates to improve the overall sustainability of the Proposed Scheme.

It is estimated that an order of magnitude of 4,764 (3,734 + 1,030) Tonnes of waste arisings from street furniture, trees and materials from within the public domain (17 01 02 Bricks, 17 04 07 Mixed metals, 17 02 03 Plastic, 17 02 01 wood, 17 02 02 Glass) are also likely to result from the nature of the works. These materials will need to be segregated by waste classification on site and sent to a suitable recovery facility for recycling. The principles of prevention and minimisation will be further considered in detailed design/construction stages through value engineering, substitution or reused of materials, and effective methods or control systems (e.g just in time deliveries/ effective spoil management) so that waste production is minimised.

Table 11-5: Summary of Excavation Material Type and Quantities

Materials from C&D Sources	Approximate Waste and Material Quantity (Tonnes)
Concrete, bricks, tiles and similar	17,000 (Tallaght) + 5,000 (Clondalkin)
Bituminous mixtures	41,000 (Tallaght) + 16,000 (Clondalkin)
Soil and stone	135,000 (Tallaght) + 39,000 (Clondalkin)
TOTAL	**253,000**

12 Traffic Signs, Lighting and Communications

12.1 Traffic Signs and Road Marking

Signage and road markings will be provided along the extents of the proposed scheme to clearly communicate information, regulatory and safety messages to the road user. In addition, the existing lighting and communication equipment along the route has been reviewed and proposals developed to upgrade where necessary. Refer to the preliminary design drawings contained within Appendix B Preliminary Design Drawings for Traffic Signs and Road Markings Drawings and Lighting Drawings.

12.2 Traffic Sign Strategy

A preliminary traffic sign design has been undertaken to identify the requirements of the Proposed Scheme, whilst allowing for further design optimisation at the detailed design phase. A combination of information, regulatory and warning signs have been assessed taking consideration of key destinations/centres; intersections/decision points; built and natural environment; other modes of traffic; visibility of signs and viewing angles; space available for signs; existing street furniture infrastructure; existing signs. In line with DMURS, the signage proposals have been kept to the minimum requirements of the Traffic Signs Manual (TSM) to avoid sign congestion within the Proposed Scheme corridor.

Prior to assessing the requirements for individual signs, a review was carried out on the impact that proposed traffic restrictions and changes to the road layout will have on the key traffic routes in the vicinity of the Proposed Scheme.

A review of the existing regulatory and warning signs in the vicinity of the route was carried out to identify unnecessary repetitive and redundant signage to be removed. This includes rationalising signage structures by better utilising individual sign poles and clustering signage together on a single pole.

12.3 Traffic Signage and Road Marking

12.3.1 Traffic Signage General

A preliminary assessment was undertaken which involved an assessment of major road traffic signage, including requirements for all information signs (TSM Chapter 2), regulatory signs (TSM Chapter 5), warning signs (TSM Chapter 6), and road markings (TSM Chapter 7).

As stated in TSM Chapter 1, in urban areas the obstruction caused by posts located in narrow pedestrian footways should be minimised, ensuring that pedestrian and cycle access is unimpeded by any such signage infrastructure. Therefore, where practicable, signs are to be placed on single poles, or larger signs will be cantilevered from a post at the back of the footway using H-frames where necessary. Passively safe posts will be introduced where practicable to eliminate the need for vehicle restraint systems.

12.3.2 Gantry Signage

Existing gantry sign on the Naas Road Ch F2518 is not impacted by the Proposed Scheme. The original concept design and its development through preliminary design did not identify the requirement for any new gantry signage.

12.3.3 Road Marking

A preliminary design of road markings has been undertaken in accordance with TSM Chapter 7. Refer to the preliminary design drawings contained within Appendix B Preliminary Design Drawings for details. This exercise also included the preliminary road marking design of the following items:

- Bus lanes are provided along the Proposed Scheme and will be marked accordingly.

- Cycle tracks have been provided along the scheme. The pavement will be marked according to best practice guidelines such as DMURS and the NCM with particular attention given to junctions. Advance Stacking Locations (ASLs) have been designed predominantly on the minor side roads, where practicable, to provide a safer passage for cyclists at signal-controlled junction for straight ahead or right turn movements; and

Pedestrian crossings have been incorporated throughout the design to connect the network of proposed and existing footways. Wider pedestrian crossings have been provided in locations expected to accommodate a high number of pedestrians.

12.4 Public Lighting

12.4.1 Overview

A high-level review of the existing lighting provision along the extent of the route has been carried out to understand the impact of the proposed scheme on lighting columns and associated infrastructure. A number of existing columns are proposed to be relocated or replaced to accommodate the Proposed Scheme, as shown on the preliminary design drawings within Appendix B Preliminary Design Drawings

12.4.2 Existing Lighting

Light emitting diode (LED) lanterns will be the light source for any new or relocated public lighting provided.

The lighting design will involve works on functional, heritage and contemporary lighting installations on a broad spectrum of lighting infrastructure along the Proposed Scheme. This shall include, but not exclusively, luminaires supplied by underground and overhead cable installations and those located on ESB infrastructure.

In locations where road widening and/or additional space in the road margin is required, it is proposed that the public lighting columns shall be replaced and relocated to the rear of the footway to eliminate conflict with pedestrians, and the existing removed once the new facility is operational.

Where significant alterations are proposed to the existing carriageways, the existing public lighting arrangement shall be reviewed to ensure that the current standard of public lighting is maintained or improved. The New lighting requirement will be determined by BCID lighting design in accordance with the standards and best practice. To determine whether existing public lighting is to be improved / relocated or where new public lighting is required, an inspection shall be carried out to identify any new column locations required for particular sections of the Proposed Scheme.

For existing columns that have specific aesthetic requirements, the intent for the replacement of such columns will include:

- Replacing the existing heritage columns and brackets with identical replica columns and brackets;
- Replacing existing luminaires with approved LED heritage luminaires; and
- Ensuring that the electrical installation is compliant with standards detailed in Section 12.4

12.4.3 New Lighting

All new public lighting shall be designed and installed in accordance with the specific lighting and electrical items set out the following National Standards and guides, including but not limited to:

- Local Authority Guidance Specifications
- EN 13201: 2014 Road Lighting (all sections);
- ET211:2003 ‘Code of Practice for Public Lighting Installations in Residential Areas’
- BS 5489-1 ‘Code of practice for the design of road lighting’
- Volume 1 - NRA Specification for Road Works, Series 1300 & 1400;
- Volume 4 - NRA Road Construction Details, Series 1300 & 1400;

- IS EN 40 – Lighting Columns; and
- Institution of Lighting Professionals "GN01 Guidance Notes for Reduction of Obtrusive Light"

All new lighting shall aim to minimise the affects of obtrusive light at night and reduce visual impact during daylight. Lighting schemes shall comply with the 'Guidance notes for the Reduction of Light Pollution' issued by the Institution of Lighting Professionals (ILP).

12.4.4 Lighting at Stops

The design shall include for the provision of lighting in covered areas, open areas and passenger waiting areas.
The location of the lighting column shall be dictated by light spread of fittings to give the necessary level of illumination (the columns at stops provide clearance for buses).

12.5 Traffic Monitoring Cameras

12.5.1 Overview

A network of digital cameras is proposed to be introduced at key locations on the Proposed Scheme. These cameras will enable the monitoring of traffic flows along the route and provide rapid identification of any events that are causing, or are likely to cause, disruption to bus services on the route and to road users in general.

This preliminary design assumes the use of high-definition (1080p or greater) digital cameras with a digital communications network providing transmission of video and camera monitoring/control functionality.

Additionally, a mains power source will be required at each location where a camera is installed. Further details of the requirements for power and data communications are provided below. The cameras may be fixed position or pan, tilt and zoom (PTZ) depending on the most suitable option for a given location as well as general operational preferences for fixed or PTZ.

The requirement for cameras along the Proposed Scheme and the exact locations for these cameras will be determined at detailed design stage. The initial design assumption has been for the installation of camera(s) at each traffic signal junction although it is possible that not all such junctions will require a camera and there may also be situations where a camera is required between junctions. However, the design approach outlined below applies irrespective of the camera location or the number of cameras at any given location. The proposed junction signal camera locations are shown on the Junction Systems Design drawings within Appendix B.

12.5.2 Camera Positioning and Mounting

The precise position of a camera at each selected location will be considered on a site-by-site basis to ensure the optimum view of the road network in the vicinity of the site. In some cases there may be a requirement for more than one camera at a location in order to obtain the required view.

The method of mounting the camera and the height at which it is mounted depends to a large extent on this position. Thus, for example, it may be possible to mount a camera on a traffic signal post (which may require a height extension to that post) or on a street lighting column. If neither of these options is feasible then it will be necessary to consider installation of a dedicated mounting post for the camera. Whichever of these mounting arrangements is used, the camera will typically be mounted at a height between 5m and 10m, with most cameras being mounted at around 6m, although again this depends largely on the scene required to be monitored at each location. Refer to Table 8-4 for existing CCTV Mast relocation listing.

Where a site requires installation of a new mounting post then consideration will be given to using a "tilt-down" post design. This will provide for easier access to the camera for maintenance operatives and will avoid the need for operatives to work at height. However, there may be space restrictions (e.g. other street furniture, nearby trees, walls and buildings) that prevent the safe operation of a tilt-down pole, in which case a "static" post will be proposed. Whichever type of new post is used, where practicable, the design will assume that the post will be mounted in a NAL-type post, or similar, socket installed at footway floor level. This will provide for easier installation as well as replacement, for example where the pole has been damaged and structurally compromised.

12.5.3 Housing of Camera Power and Communication Equipment

The requirements for power and data communications described below require installation of a cabinet and/or feeder pillar to house the termination and control equipment for power and data communications services and for any other camera control equipment that may be needed. Where a camera is located at a traffic signal junction, consideration was initially given to housing the camera power, data comms and camera control equipment within the traffic signal controller cabinet. However, this could lead to practical difficulties in terms of access for maintenance where the traffic signals maintenance provider, the camera maintenance provider and the comms network operator will all require access to the cabinet. This could also lead to operational problems, for example if a camera maintenance operative inadvertently affects traffic signal control by disabling mains power to the cabinet, or if a signals maintenance operative disables camera or comms operation in the same manner.

It was therefore considered appropriate to assume the installation of a separate cabinet for camera equipment from that of the traffic signal control equipment. However, at each traffic signal junction where a camera is installed, consideration will be given to providing a duct between the traffic signal control cabinet and the camera equipment/comms cabinet to allow the connection of the traffic signal control equipment to the data communications network (further details of which are provided below). This would avoid the need for installation of a dedicated comms cabinet for the traffic signal control equipment.

There are sections of the Proposed Scheme where camera locations at or between junctions may be closely spaced. In such cases consideration will be given to using one camera equipment/comms cabinet to serve both camera locations in order to reduce installation costs and minimize the presence of street furniture. This may require positioning the cabinet (and its power supply) between junctions or running ducting from one junction to another. The exact requirement for this will be investigated on a location-specific basis at detailed design stage. In all cases the consideration of the siting of such roadside equipment shall prioritize the access for pedestrians and cyclists in the area and the aesthetics of the street urban landscape.

12.5.4 Camera Power Supply

Modern digital cameras use a low voltage (ELV) supply - typically 12V, 24V or 48V - provided either from a dedicated mains power adapter (converting mains voltage to the required ELV) or a power-over-ethernet (PoE) injector, a device that provides the low voltage over the same cabling (Ethernet) as the data communications for the camera. PoE is generally preferred as it only requires a single cable for both power and communications. In both cases the adapter/injector is located either in the base of the camera mounting post or in a cabinet at the camera location, as described above. Wherever it is located, a mains power supply is required for it.

One advantage of mounting a camera on a street lighting column is that there is a mains power supply readily available such that, subject to availability of space, the camera power adapter may be installed in the lighting column base and connected at that point to the mains supply. There is still, however, a need for a connection from the camera to the data comms network service as described below even though power need not then be provided via the Ethernet connection to this service.

12.5.5 Data Communications

It is increasingly common for operations centres that use digital cameras to require at least high definition (HD) quality (1080p resolution) video images. To achieve this, each camera requires a high bandwidth connection, preferably with a data download speed of 10Mbits/sec or higher. This connection is normally provided at the camera site either as a “private” connection (i.e. provided by the service owner/operator) or by a commercial service such as Eir or Virgin Media. In either case, this connection is normally terminated at a data comms cabinet installed at the camera location, as described above.

For the purpose of this design, it has been assumed that that a new private optical fibre network will be installed along the length of the Proposed Scheme which will pass through each site where a camera is to be located, where practicable existing ducting will be utilised. This will require a duct chamber at each camera location to connect the main optical fibre duct network to the camera equipment/comms cabinet. The cabinet will need to be of a design to allow installation of the required optical fibre termination equipment in addition to any camera power/control equipment and mains power supply. The number of items of equipment, and the space and power supply requirements for it, will vary according to the type of service provided. However, it will require at least one mains supply point in the cabinet, and possibly up to three such points. A standard design for this cabinet will be produced at detailed design stage.

Alternatively, each junction could contain a wireless connection to nearby optical fibre (or copper) backhaul point. However, this would require a detailed (site-by-site) understanding of requirements to determine lines-of sight, equipment mounting options/limitations, etc. both at the junction and at the optical fibre/copper backhaul point. The initial approach will therefore be to assume direct connection of each camera to the main optical fibre network and any additional requirement for wireless communication will be considered on a site-by-site basis if it is considered more appropriate to do so rather than using a direct optical fibre/copper connection.

12.5.6 Camera Ducting and Cabling Requirements

Ducting will be required to link the camera equipment/comms cabinet to the camera at each location. Where the camera is located at a traffic signal junction, the ducting used for connecting the traffic signals can be used wherever practicable and if necessary, additional ducting will then be included in order to link the traffic signal ducting to the camera equipment/comms cabinet and to the camera itself.

As mentioned above, Ethernet cabling is most often used to connect the camera to the comms service and this cable may or may not also carry power to the camera. It is generally accepted that an Ethernet cable run of up to 100m between the cabinet and camera is acceptable but beyond this signal degradation can lead to comms issues. In such cases a PoE signal extender can be introduced into the cable run. This does not need any additional power supply as it draws the power it needs from the PoE input in the cable. These devices can be cascaded along the Ethernet cable run to extend the cable distance considerably although it is sensible to coincide the location of these units with duct chambers for ease of installation and to allow for maintenance access. The detailed design stage will consider the need for this approach on a site-by-site basis where there are cable runs in excess of 100m.

12.6 Real-Time Passenger Information

12.6.1 Overview

The design for the Proposed Scheme includes the provision of RTPI at all of the bus stops. This will comprise a “live” display identifying the estimated arrival time of each bus at the stop.

This will require a flag-type display on a dedicated mounting post, as illustrated below.

Figure 12-1: Flag Type Display

12.6.2 RTPI Display Positioning and Mounting

The RTPI display, where present, is typically located adjacent to the shelter on the same side as approaching buses so that people waiting at the stop can simultaneously view both the display and the oncoming buses.

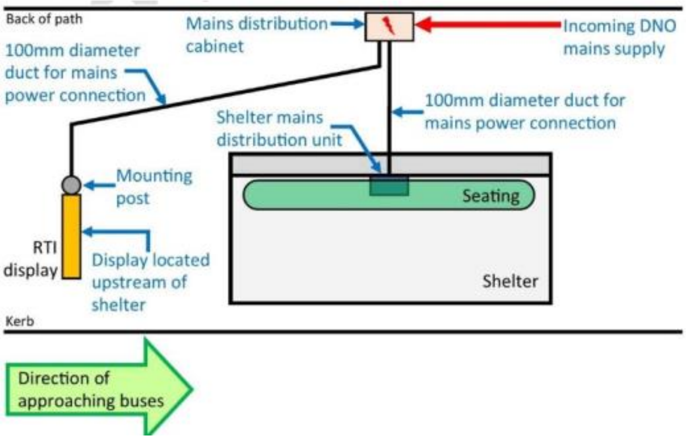

Figure 12-2: Typical Layout for Bus Stop with RTPI Display

The display is often placed around 4-5m from the shelter to maintain pedestrian access to the shelter while also enabling a clear view of the display from within the shelter. However, although this is considered the optimum position for a display, the precise location of it will be dictated by other site-based factors such as pedestrian and cyclist access (both to/from the stop and for those passing by) as well as requirements for other bus stop facilities such as waste bins, cycle storage and signage. Other physical restrictions (e.g. narrow footway, other street furniture, walls and buildings) may also influence the exact location of the display at each stop.

In any case, where an RTPI display is to be installed, the detailed design will assume that the mounting post for the display will be located in a NAL-type, or similar, post socket installed at footway floor level. As for the cameras, this will provide for easier installation as well as replacement, for example where the pole has been damaged and structurally compromised.

12.6.3 Power Supply for RTPI Display and Bus Shelter

The stand-alone design of the proposed RTPI display means that a physical link between the display and the bus shelter is not required. However, the display will nonetheless require a connection to a mains power supply. This can be shared with the supply to the bus shelter, as shown in Figure 12-2 from a mains distribution cabinet or feeder pillar located at the bus stop, where the mains service provider Distribution Network Operator (DNO) will terminate its incoming connection. This cabinet /pillar will provide mains power to both the RTPI display and the shelter, assuming the bus shelter needs a mains power supply.

The bus shelter will commonly include a mains power distribution unit for all of the equipment in the shelter that requires mains power - usually lighting and/or advertising. Most often this distribution unit is located under the seating although it can vary according to the shelter design. The shelter installer will provide a connection from this unit to the cabinet/pillar containing the mains power supply for the bus stop, as shown in Figure 12-2**.**

12.6.4 Data Communications for RTPI Display

The majority of RTPI systems currently in operation now use the mobile phone (GPRS/3G/4G) network as the method of data communication between each display and the central (“back office”) bus location/passenger information system. This comprises a small mobile network comms device (including the SIM card) installed within the RTPI display housing. It is assumed for the purpose of this design that such connectivity will be used for provision of RTPI on the Proposed Scheme, with the mains power for the display - as described above – also providing power for this comms device. In this case no ducting will be required for data comms at the bus stop and the only physical connection to the display (i.e. ducting and cabling) will therefore be as described above for mains power.

12.7 Roadside Variable Message Signs

Consideration was also given to the inclusion of roadside Variable Message Signs (VMS) to provide traffic information to road users. However, it has been confirmed that VMS is not considered a requirement for this route and therefore such signage is not currently included in the design for the Proposed Scheme.

12.8 Maintenance

Maintenance of signs, lighting and communication infrastructure has been considered and allowed for as part of the design process.

12.9 Traffic Signals

12.9.1 Overview

The Preliminary design shows the proposed locations of above ground and underground infrastructure. This is included in the Junction Systems Design drawings in Appendix B.

12.9.2 Above Ground Infrastructure

12.9.2.1 Traffic Signal Poles

All traffic signal equipment is designed in accordance with Chapter 9 (Traffic Signals) of the TSM. Traffic signal modelling, including LinSig models, determines the phasing and staging of the traffic signals which determines the design and positioning of the traffic signal heads. The TSM clearly defines the requirements and positioning of traffic signal heads, detection equipment, and associated traffic signal poles.

Traffic signal poles typically come in two lengths, 3m and 6m (as measured from the ground), or single or double height poles. Single height poles will be predominantly used on the Proposed Scheme to mount traffic signal heads, push button units, and other equipment. Double height poles will be used at locations where additional visibility of the signals is required by the motorist, e.g. high-speed approaches.

Where existing traffic signal poles do not provide for a sufficient field of view for above ground detection devices, additional traffic signal poles will be erected to mount that detection equipment.

12.9.2.2 Cantilever Traffic Signal Poles

Cantilever poles will be installed on multi-lane approaches where there is a potential for a high sided vehicle, including buses, to block the clear visibility of the primary traffic signal of vehicles in the outer lanes. They will also be installed at locations where a median island is not available to mount a second primary, required to control separate streams on a particular arm of a junction.

Cantilever poles may also be used to provide a mounting structure for secondary signals, where a median is not available and a position on opposing primary pole is outside the required line of sight.

12.9.2.3 Roadside Cabinets

Most equipment locations will require a roadside cabinet to house and protect electronic, electrical and communications equipment. Due to health and safety, design, space, operational and maintenance constraints it is often necessary to separate these cabinets in accordance with their function, including:

- Traffic signal control cabinets;
- Fibre breakout cabinets; and
- Electricity supply metering, mini and micro pillars.

Cabinets are positioned to allow for ease of access by maintenance personnel and to minimise their impact on the receiving environment. When accessing cabinets, maintenance personnel will require a clear view of the associated equipment and of approaching vehicles, pedestrians, and cyclists. Cabinets are often position at the back of footways, to minimise the impact on the effective width of the footway. In all cases the consideration of the siting of such roadside equipment shall prioritize the access for pedestrians and cyclists in the area and the aesthetics of the street urban landscape. They are often clustered together at a junction to minimise the amount of cabling between cabinets and to allow maintenance personnel to quickly shift operations from one cabinet to another.

12.9.3 Under Ground Infrastructure

12.9.3.1 Ducts

Where practicable, existing chambers and ducting will be reused, each device, mounting structure, and cabinet will have associated underground infrastructure including ducts for:

- Power cables – installed equipment will require a power supply to function, this is facilitated by a ducting connection between the electricity supply point and equipment location. This connection is normally a single power supply duct;
- Communication cables – to facilitate the provision of fibre optic cable along the Proposed Scheme it will be necessary to provide a telecommunication ducting network consisting of two communication ducts, with chambers at 180m centres, along one side of the carriageway. This longitudinal ducting will be continuous along the length of the Proposed Scheme, with local duct spurs to connect to cabinets and devices; and
- Device cables – devices will require cabling between field equipment and control equipment. For example, a ring of six ducts will be provided at each junction to allow for cabling between the traffic signal controller and the traffic signal poles. It is necessary when designing the ducting provision that sufficient spare capacity is provided to allow for changes to the field equipment, deployment of additional equipment, or damage to the ducting provision.

12.9.3.2 Chambers

Chambers will be required at the termination points of ducts, at regular intervals along ducts (180m), at changes in direction, and at breakout points for devices. The position of chambers will be designed to be away from carriageways, pedestrian and cycle desire lines, and tactile paving. It is important when positioning chambers that they can be accessed in a safe manner, without the need, where practicable, for extensive traffic and pedestrian management. Where practicable, existing chambers will be reused.

Individual chambers will be designed and sized with consideration given to the number of ducts and cables that will be routed through the chamber, and the need to provide maintenance loops of cables within the chambers. Unless prior agreement is in place, chambers will not be shared between users.

12.9.3.3 Foundations

All cabinets, poles and mounting structures will require a foundation or mounting frame to be constructed to allow for their installation. It is envisaged that for traffic signal poles, 5m -8m CCTV poles, cantilever signal poles and other lightweight mounting structures that retention sockets will be installed to allow for the easy installation, maintenance and replacement of structures.

For larger structures, such a high CCTV masts, bespoke mass concrete foundations will be designed for incorporation into the works. Cabinet mountings will be designed and constructed in accordance with the manufactures and local authorities' standard details, including the incorporation of required vaults, chambers, earthing rods and mats.

12.9.4 Traffic Signal Priority

12.9.4.1 Overview

Further to the information discussed in Section 4.13 and Section 5.3.3 it is the intention to provide specific detection for buses located a sufficient distance from the junction to allow the traffic signal junctions to respond efficiently to the requested bus priority request. There will be further back up loop or other above ground detection provided to ensure that all vehicles permitted to use the lane will be detected although these would be standard non-priority demands.

The automatic vehicle locating (AVL) system is configured to detect when buses pass defined georeferenced locations or zones. When a bus enters these zones, a demand will be passed to the traffic signalling system. The current system capability allows this to be achieved either using local or network-based communications where the site is controlled using an overarching urban traffic control (UTC) system.

The system provided can interface with all of the junctions along the corridor, and where required other parts of the network. This will require utilising an existing, or updated version, AVL system that communicates both with the Central Dublin Sydney Coordinated Adaptive Traffic System (SCATS), in an updated version of the Dublin Public Transport Interface Module (DPTIM) SCATS centralised priority system. Options for local control include direct from optical sensors or using an AVL system interface.

The Proposed Scheme will operate on a service headway approach rather than on specific timetabled service pattern. To support this the AVL priority will need to be developed to provide priority inputs for those services that fall within the defined headway, with others receiving standard inputs. The detailed approach for implementing priority differs somewhat between the various control system, however the general principle applied is as follows whereby three levels of priority are possible as shown in Table 12-1

Table 12-1: Levels of Bus Priority

Level of Priority	Normal actions
Low	Add Phase extensions for buses arriving at the end of green.
Medium	Truncation of all non-priority phases to minimum values. Bonus green compensation for all truncated phases during following cycle, where appropriate. Phase extensions for buses arriving at the end of green.
High	Truncation of the non-priority stage to minimum value. Immediate insertion of bus priority stage. Bonus green compensation for all truncated phases during following cycle, where appropriate. Phase extensions for buses arriving at the end of green.

It is proposed that priority will be achieved using either demand dependent bus phases that can appear within the normal cyclic operation, or by configuring some stages to be conditional demand types that would not appear when priority is being demanded. This will achieve the high level of priority without losing the overall coordination and compensation times that are needed to balance the time needed for the skipped stages.

As discussed in Chapter 5, the junction designs for the Proposed Scheme comprise predominately of Junction Types 1, 3 and 4. These junction types facilitate general traffic and bus through movements travelling in unison. This therefore gives BusConnects a high degree of flexibility regarding the level of bus priority applied at the respective junctions along the Proposed Scheme.

12.9.4.2 Infrastructure

Public Transport Priority will be provided through a number of passive and active means. The means of passive priority are discussed Section 4.12 in and are based on the design of the geometry, signing and road markings of the junctions. These include measures such as bus gates and bus lanes. active priority will be facilitated through the detection of the public transport vehicle and communicating their presence to the traffic signal controller for the implementation of measures on site.

The local authorities utilise different controllers and adaptive urban traffic control systems. The systems can operate in several modes including adaptive, linked, vehicle actuated, scheduled plans and fixed time modes. DCC use SCATS traffic signal controllers.

Detection will be based on the use of several different technologies, working in concert to provide comprehensive detection solutions. The detection types will include:

- Embedded Inductive loop detectors – induction detectors will be cut into the road surface at discrete positions around the junction to detect vehicles approaching, or departing from, the junction. The position and number of detectors will be dependent on the lane configuration and the type of traffic signal controller at the junctions;
- Specialised induction detectors can be utilised to detect cyclists on particular approaches to junctions. These detectors use a concentrated induction pattern to detect the passage of cyclists; and
- These embedded induction detectors will require ducting, chambers, and carriageway loop pots, to route the cables associated with the detector to the traffic signal controller.

Above ground detection, including:

- Optical detection – where it is impractical to install embedded inductive loop detectors into the carriageway, optical detection may be installed. Using these devices, a virtual detector is set up in the field of view that trigger alerts to the traffic signal controller. Optical detectors are generally installed on existing traffic signal poles, or cantilever traffic signal masts, to provide a clear view of the approach. Additional poles may need to be installed to provide the optimum field of view for particular approaches; and
- Radar detection – Radar detection is used for pedestrian crossings, pedestrian wait areas, and cycle detection. Similar to the optical detection, virtual detection zones are set up in the radar field of view that trigger alerts to the traffic signal controller. Radar detectors are generally installed on existing traffic signal poles, or cantilever traffic signal masts, to provide a clear view of the approach. Additional poles may need to be installed to provide the optimum field of view for particular approaches.

Push button units (PBU) will be installed on traffic signal poles at pedestrian and cycle crossing points to allow the user to manually alert the traffic signal controller of their presence. The use of on crossing detection can also be configured at key locations to extend pedestrian crossing phases, where necessary.

Additional inputs from the AVL system and dedicated short range communications (DSRC) devices can be provided to notify the Traffic Signal Controller of the presence of particular vehicles.

The traffic signal controllers will detect the presence of vehicles, including identification of particular vehicles classes, and use this data to determine the timing to be applied to the junction in the current and upcoming cycles, including the provision of priority to particular traffic signal phases as programmed into the traffic signal plans.

12.9.5 Communication

Communications will be used to connect on-street devices with the traffic control rooms. The communications will take the form of:

Fibre optic cable network:

- All local authorities operate fibre optic cable networks. It is envisaged that each of these networks will be extended along the length of the Proposed Scheme to provide high bandwidth/low latency communication to traffic signal controllers, CCTV cameras, and other apparatus deployed on the Proposed Scheme;
- Longitudinal ducting, provisionally two communications ducts, shall be provided along the length of the Proposed Scheme with access chambers at 180m centres; and
- Fibre breakout cabinets will be provided at each traffic signal controller, or CCTV camera.

Microwave wireless point-to-point links - Where it is not practicable to install ducting for fibre optic cable, or there is a need to provide a high bandwidth/low latency communication to a remote site or cell, point-to-point microwave communications will be provided to facilitate the communications link.

Cellular subscriber networks (3G/4G/5G) - Cellular communications will be provided to low bandwidth devices such as RTPI and VMS.

12.10 Safety and Security

12.10.1.1 CCTV

CCTV poles will be placed at positions, within the junction, to minimise the impact of solar glare, and to maximise the field of view of the CCTV. The requirement for CCTV along the Proposed Scheme route and the exact locations for these cameras will be determined at detailed design stage. The locations of CCTV have been indicated in the system design drawing for planning purposes. The initial design assumption has been for the installation of camera(s) at each traffic signal junction although it is possible that not all such junctions will require a camera and there may also be situations where a camera is required between junctions. However, the design approach adopted applies irrespective of the camera location or the number of cameras at any given location.

12.10.1.2 Bus Stops

The requirement for a pleasant, safe and secure environment for passengers waiting at Stops and undertaking their journeys is a key component of the proposed public transport service. This is facilitated by the provision of:

- RTPI – each stop will be provided with RTPI showing the estimated time of arrival of subsequent buses; and
- Public lighting – each stop will have public lighting designed to ensure the safe operation of the stops in all lighting conditions and to enhance the sense of security at the stops.

12.11 Maintenance

All traffic signal, CCTV, and communications equipment shall be designed and located to be accessed and maintained frequently. All equipment shall be accessible without disrupting pedestrian, bicycle, or vehicle traffic and without the use of special equipment.

Apparatus will be designed and located to allow for easy access and the safe maintenance of the Proposed Scheme into the future. This will include the provision of:

- Use of retention sockets, where applicable, for the erection of traffic signal, CCTV, above ground detection, and other equipment mounting poles to allow for the ease of installation, maintenance and replacement;
- The use of lightweight equipment poles, where appropriate, such as cantilever signal poles. Consideration will be given to the selection of products that allow for maintenance activities to be undertaken from ground level, such as tilt down poles or poles with wind-down mechanisms;
- Placement of poles and retention sockets within 7m of chambers to provide ease of installation and replacement of cables;
- Locating chambers away from pedestrian desire lines, and areas of tactile paving. This is to provide for a reduced impact of Traffic Management;
- On longitudinal duct runs, chambers to be placed at 180m centres to allow for the ease of installation and replacement of cables;
- Safe areas to be provided for the access and parking of maintenance vehicles; and
- Locating controller, and other cabinets in positions that allow for safe access and clear visibility of the operation of the junction.

13 Land Use and Accommodation Works

13.1 Summary of Land Use

13.1.1 Overview

The land use along the Proposed Scheme comprises a mix of residential and commercial properties. The various land uses are described in the sections below. The following is a description of the land use along the Proposed Scheme.

Tallaght to Ballymount

The Proposed Scheme commences south-west of the Square shopping centre in Tallaght. The Proposed Bus Interchange is immediately south of the existing Luas Terminus and will result in the loss of some of the adjacent retail car parking, The route follows the existing road corridor around Belgard Square West, North and East, where the adjacent land use is predominantly commercial. No land acquisition is proposed along this section. The route then runs along Blessington Road, Main Street and Old Greenhills Road on the northern edge of Tallaght village; again the route is contained within the extents of the existing road corridor.

The route joins the Greenhills Road at its junction with Bancroft Park and utilises the existing road corridor where it is bounded by TU Dublin to the west and St Mary's National School to the east. North of this location land acquisition is required on both sides of the road from adjacent commercial sites as far as the Hibernian Industrial Estate in order to provide bus lanes and cycle tracks in each direction. North of this junction land acquisition is required along the western side of Greenhills Road as far as Mayberry Road from the grassed areas in front of the commercial properties.

Between Mayberry Road and the M50 the Proposed Scheme passes through the public green space between Birchview Avenue / Treepark Road residential areas and Parkview residential roads. The existing Greenhills Road either side of the junction with Castletymon Road remains largely unchanged by the proposals.

Temporary land take is required within this section to facilitate:

- A construction compound at the junction of Blessington Road and the N81 Tallaght Bypass;
- Amendments to the western periphery of the Tallaght Shopping Centre car park;
- A construction compound on the grassed area at Bancroft Park;
- The construction of new boundary walls / fences to the various adjacent commercial properties from which land is acquired; and
- A construction compound adjacent to Tymon Lane and the M50 which will be used for the two new pedestrian and cyclist bridges that will cross the M50.

Ballymount to Crumlin

This section of the proposed Scheme runs predominantly through industrial estates with commercial premises on both sides. East of the M50 the scheme initially follows the Greenhills Road with a strip of land required from Tymon Park. The route then turns north via a new road link to meet Ballymount Avenue. Land acquisition is required for this new link. The Proposed Scheme then runs along Ballymount Avenue and Calmount Road, with lands required from the grassed area fronting a commercial building on the western side of the road immediately before the junction with Calmount Road.

A second new link road is proposed between Calmount Avenue and the Greenhills Road, which requires landtake and provides a connection to the Lidl retail store. Finally, a third new link road is proposed to extend Calmount Road eastwards to connect with the Greenhills Road. To facilitate this new connection land acquisition is required from the adjacent commercial premises on the northern side of the green area. The route then follows the Greenhills Road as far as Walkinstown Roundabout, where the adjacent land use changes from commercial to predominantly established residential properties. Some land acquisition is required from commercial premises on the south side of the road.

Temporary land take is required within this section to facilitate:

- The construction of new boundary walls / hedge to the boundary of Tymon Park, and
- A construction compound adjacent to Tymon Lane and the M50 which will be used for the construction of the two new pedestrian and cyclist bridges that will cross the M50.

Crumlin to Grand Canal

From Walkinstown Roundabout the Proposed Scheme follows Walkinstown Road to the junction with Long Mile Road / Drimnagh Road. Land acquisition is required for the full length of Walkinstown Road, predominantly from the front gardens of residential properties. The lands to be acquired are initially on the western side of the road, switching to the east side of the road at the junction with Kilnamanagh Road. Immediately north of this junction lands are required form the car park of the Walkinstown shopping centre, and beyond that land is required from the front gardens of residential properties.

The Proposed Scheme then runs along Drimnagh Road and Crumlin Road as far as the Grand Canal. The land use here is mixed residential, commercial, educational and recreational. The scheme is predominantly contained within the existing road corridor along this section, with three relatively short sections of land acquisition from recreational, derelict and publicly owned land.

Between Walkinstown Roundabout and the Grand Canal a parallel cycle route is proposed along Bunting Road, St Mary's Road, Kildare Road and Clogher Road. No land acquisition is required along this section of the scheme.

Temporary land take is required within this section to facilitate:

- The construction of new boundary walls the various adjacent properties from which land is acquired;
- A construction compound on the western edge of Bunting Park;
- A construction compound in the green space adjacent to Rafters Road; and
- A construction compound adjacent to the green space at Dolphin's Barn.

Grand Canal to Christchurch

This section of the Proposed Scheme runs along Dolphins barn, passing the Coombe University Hospital, and then runs along Cork Street, St Luke's Avenue, Dean Street, Patrick Street and Nicholas Street, before ending at Christchurch. The adjacent land use is a mix of residential, commercial and community lands typical of Dublin city centre. No permanent or temporary land acquisition is required along this section of the scheme.

Fonthill Road South to Naas Road

This section of the Proposed Scheme runs along the New Nangor Road, commencing at the junction with Woodford Walk. The adjacent land use is a mix of business parks and large commercial sites. Permanent land acquisition is required from a number of the adjacent sites on both sides of the road as far as the Naas Road junction.

At the New Nangor Road / Naas Road / Long Mile Road junction, permanent land acquisition is required from the commercial premises on all four quadrants of the junction to facilitate the proposed pedestrian and cyclists bridges.

Temporary land take is required within this section to facilitate:

- The construction of new boundary walls / fences for the various adjacent properties from which land is acquired;

- A construction compound between New Nangor Road and Killeen Road; and
- A construction compound on the south side of the Long Mile Road which will be used for the construction associated with the new pedestrian and cyclist bridges.

Naas Road to Drimnagh

The Proposed Scheme follows the Naas Road as far as the Kylemore Road junction from where it then runs along Walkinstown Avenue to the Long Mile Road. the adjacent land use comprises large commercial units along this section and some permanent land acquisition is required from the properties on the south-west side of the Kylemore Road junction and on the full length of the eastern side of Walkinstown Avenue. The land use adjacent to this section of the route predominantly comprises large commercial units, with four large educational establishments at the eastern end of Long Mile Road, namely Drimnagh Castle Primary and Secondary Schools and Assumption Primary and Secondary schools. No land acquisition is required along the Long Mile Road.

Temporary land take is required within this section to facilitate:

- The construction of new boundary walls / fences for the various adjacent properties from which land is acquired.

13.2 Summary of Compulsory Land Acquisition

The extent of the impact due to the Proposed Scheme on a landowner's holding is shown on the Compulsory Purchase Order Deposit Maps.

In total approximately 56.3ha. of land will be required to be permanently acquired to construct the Proposed Scheme, of which approximately 52.9ha is currently in public ownership. There will also be an additional 6.4ha of temporary land required to allow for construction of boundary treatment, planting, construction compounds and surface tie in work. This includes approximately 2.5ha currently in public ownership..

The list of properties that are impacted by the Proposed Scheme are summarised below in Table 13-1.

From the outset of the design of the Proposed Scheme every effort was made to avoid compulsory land acquisition. However, there are a number of public and private lands that are necessary for the construction of the proposed road development and to secure the many benefits for the Proposed Scheme. Reference should be made to the CPO Documents' prepared as part of the planning application.

13.3 Summary of Impacted Properties

The determination of the lands to be acquired for purposes of constructing the Proposed Scheme was as a result of an iterative design process, including non-statutory public consultation and detailed engagement with potentially impacted owners and occupiers.

The list of landowners/properties that are affected by the Proposed Scheme are summarised below.

Table 13-1: List of Landowners

Reference	Address	Proposed Works
001/07.1O.04	Green area between Old Blessington Road / N81	Temporary site compound
002/07.1O.01	The Square Shopping Centre, Tallaght.	Construction of Bus Interchange
003/07.1A.01	Green space at Blessington Rd / Belgard Square West junction	Construction of Bus Interchange

Reference	Address	Proposed Works
004/07.1A.05	Tallaght University Hospital Entrance at Belgard Square North	Construction of signalised junction
005/07.1B.01	Lands north of Belgard Square North at Cookstown Link Road junction	Road widening and boundary construction
006/07.1B.03	SDCC Offices Car park entrance Belgard Square North	Road widening
007/07.1B.04	Entrance to The Square Industrial Complex, Belgard Square North	Road widening
008/07.1C.02	Entrance to The Square Industrial Complex, Belgard Square East	Road widening
009/07.1C.03	Entrance to ABB, Belgard Square East	Road widening
010/07.2O.05	Green area between Greenhills Road and Bancroft Park	Temporary site compound
011/07.2O.03	Westpark Fitness Centre, Greenhills Road	Road widening and boundary construction
012/07.2O.04	Green space at River Poddle, Greenhills Road	Road widening and boundary construction
013/07.2A.01	Development Site at Airton Road	Road widening and boundary construction
014/07.2A.02	Greenhills Retail Park, Greenhills Road, Dublin 24	Road widening
015/07.2A.03	Kilnamanagh Tymon Primary Care Centre, Greenhills Road	Road widening and access ramp reconstruction
016/07.2A.04	Green area north of River Poddle and east of Greenhills Road	Road widening and temporary site compound
017/07.2A.05	Astro Park, Greenhills Road	Road widening
018/07.2A.06	SHD Site, Greenhills Road	Road widening and boundary construction
019/07.2B.01	Harvey Norman Retail Park, Greenhills Road	Road widening
020/07.2B.02	Valeo Foods Ltd., Broomhill Road	Road widening and boundary construction
021/07.2B.03	Cross Rental Services, Broomhill Road	Road widening and boundary construction
022/07.2C.01	Roadside Green Area South of Mayberry Road	Road widening

Reference	Address	Proposed Works
023/07.2C.02	Green Area East of Birchview Avenue	New road construction and temporary site compound
024/07.2C.04	Green Area West of Tymonville Crescent	SUDS provision and boundary construction
025/07.3O.01	Green Area East of Treepark Road	New road construction and temporary site compound
026/07.3O.02	Green Area between Greenhills Road and Parkview (North)	Road widening
027/07.3A.02	Green Area between Treepark Road and Greenhills Road	New road construction
028/07.3A.01	Green Area North of Tymon Lane	Road Widening and temporary site compound
029/07.3A.03	Greenhills Road Bridge over M50	New pedestrian / cycle bridge structures.
030/07.3A.04	Green area at Tallaght Truck Dismantlers / Greenhills Road	Road widening
031/07.3B.01	Tallaght Truck Dismantlers, Greenhills Road	Road widening
032/07.3B.02	Tallaght Pigeon Racing Club, Greenhills Road	Road widening
032/07.3B.03	SDCC Tymon Park, Greenhills Road	Road widening and boundary construction
033/07.3B.04	Greenhills Road west roadside verge north of M50	Road widening
034/07.3B.05	Entrance to Greenhills Lodge, Greenhills Road	Road widening
035/07.3B.06	Grass Verge north of Greenhills Lodge, Greenhills Road	Road widening
036/07.3C.01	SDCC Tymon Park, Greenhills Road	Road widening and boundary construction
037/07.3C.03	Plot Between Greenhills Road and Ballymount Avenue	New road construction
038/07.4O.03	Plot Between Greenhills Road and Ballymount Avenue	New road construction
039/07.4O.04	Ballymount Recycling Centre, Ballymount Avenue	New road and boundary construction

Reference	Address	Proposed Works
040/07.4O.02	Kelliher Electrical, Ballymount Avenue	Road widening and boundary construction
041/07.4A.05	M50 Business Park, Ballymount Road Upper	Road widening and boundary construction
042/07.5A.01	Green area west of Calmount Avenue/Greenhills Road junction	Link road, boundary wall and junction construction
043/07.5A.02	Calmount Avenue/Greenhills Road adjacent green area	Link road, boundary wall and junction construction
044/07.5A.03	Calmount Avenue	Link road construction
045/07.5A.04	SDCC Ballymount Depot, Calmount Avenue	Link road construction
046/07.5A.05	SDCC Ballymount Depot, Calmount Avenue	Link road construction
047/07.4B.02	Calmount Business Park plot east of Calmount Avenue	Link road construction
048/07.6O.01	Plot Between Calmount Road and Greenhills Road	Road extension and retaining wall construction
049/07.6O.07	Sunbury Industrial Estate, Ballymount Road Lower	Access road and retaining wall construction
050/07.6O.08	Ballymount Court Business Centre, Greenhills Road	Access road and retaining wall construction
051/07.6O.02	Ballymount Court Business Centre, Greenhills Road	Road extension and retaining wall construction
052/07.6O.04	Greenhills Ind. Est., Greenhills Road	Road extension and retaining wall construction
053/07.6A.01	Greenhills Ind. Est., Greenhills Road	Road widening and retaining wall construction
054/07.6A.02	Chadwicks Yard, Greenhills Ind. Est., Greenhills Road	Road widening and retaining wall construction
055/07.6A.03	B & G Ltd., Greenhills Road	Road widening and retaining wall construction
056/07.6A.04	Mulcahy Keane Estate, Greenhills Road	Road widening and retaining wall construction
057/07.6A.09	Fullers Café & Deli, Greenhills Road	Road widening
058/07.6A.14	Smiths Building Supplies, Greenhills Road	Road widening

Reference	Address	Proposed Works
059/07.6A.11	Fullers Café & Deli Car Wash, Greenhills Road	Road widening
060/07.6A.13	Greenhills Industrial Estate Access Road, Greenhills Road	Road widening
061/07.6A.05	Hardstanding outside 21 Greenhills Road	Road widening
062/07.6A.06	Hardstanding outside 19 Greenhills Road	Road widening
063/07.6A.07	Hardstanding outside 17 Greenhills Road	Road widening
064/07.6A.08	Hardstanding outside 15 Greenhills Road	Road widening
065/07.6B.02	Hardstanding outside 11A Greenhills Road	Road widening
066/07.6B.03	Hardstanding outside 11 Greenhills Road	Road widening
067/07.6B.04	Hardstanding outside 9 Greenhills Road	Road widening
068/07.6B.05	Hardstanding outside 7 Greenhills Road	Road widening
069/07.6B.06	Hardstanding outside 5 Greenhills Road	Road widening
070/07.6B.07	Hardstanding outside 3 Greenhills Road	Road widening
071/07.6B.01	Hardstanding 10 / 12 Greenhills Road	Cycle track, footway and hardscaping
072/07.6B.09	Car Park opposite The Cherry Tree Public House, Walkinstown Cross	Car Park, cycle track, footway and Landscaping
073/07.6B.12	Car Park between Cromwellsfort Road and Saint Peter's Road, Walkinstown Roundabout	Car Park, cycle track and Landscaping
074/07.6B.14	Hardstanding in Front of 8 Greenhills Road	Cycle track andfootway
075/07.6B.15	Hardstanding in Front of 2 Greenhills Road	Cycle track and footway

Reference	Address	Proposed Works
076/07.6B.16	Hardstanding in Front of 1A Ballymount Road Lower	Cycle track and footway
077/07.6B.17	Hardstanding in Front of 6 Greenhills Road	Cycle track and footway
078/07.6B.18	Hardstanding in Front of 8 /10 Greenhills Road	Cycle track and footway
079/07.7O.22	Hardstanding adjacent to 174 Walkinstown Road	Cycle track and footway
080/07.7O.28	Hardstanding adjacent to 172 Walkinstown Road	Cycle track and footway
081/07.7O.25	Hardstanding in front of Ladbrokes Walkinstown Road	Cycle track and footway
082/07.7O.26	Hardstanding in front of Kestral Public House Walkinstown Road	Cycle track and footway
083/07.7O.27	Footway in front of Kestral Public House Bunting Road	Cycle track and footway
084/07.7O.01	156 Walkinstown Road	Road widening
085/07.7O.02	154 Walkinstown Road	Road widening
086/07.7O.03	152 Walkinstown Road	Road widening
087/07.7O.04	150 Walkinstown Road	Road widening
088/07.7O.05	148 Walkinstown Road	Road widening
089/07.7O.06	146 Walkinstown Road	Road widening
090/07.7O.07	142 Walkinstown Road	Road widening
091/07.7O.08	140 Walkinstown Road	Road widening
092/07.7O.09	138 Walkinstown Road	Road widening
093/07.7O.10	136A Walkinstown Road	Road widening

Reference	Address	Proposed Works
094/07.7O.11	136 Walkinstown Road	Road widening
095/07.7O.12	134 Walkinstown Road	Road widening
096/07.7O.13	132 Walkinstown Road	Road widening
097/07.7O.14	130 Walkinstown Road	Road widening
098/07.7O.15	128 Walkinstown Road	Road widening
099/07.7O.16	126 Walkinstown Road	Road widening
100/07.7O.17	124 Walkinstown Road	Road widening
101/07.7O.18	Lane between 122 & 124 Walkinstown Road	Road widening
102/07.7O.19	122 Walkinstown Road	Road widening
103/07.7O.20	120 Walkinstown Road	Road widening
104/07.7A.01	118 Walkinstown Road	Road widening
105/07.7A.02	116 Walkinstown Road	Road widening
106/07.7A.03	114 Walkinstown Road	Road widening
107/07.7A.04	112 Walkinstown Road	Road widening
108/07.7A.05	110 Walkinstown Road	Road widening
109/07.7A.06	108 Walkinstown Road	Road widening
110/07.7A.07	106 Walkinstown Road	Road widening
111/07.7A.08	104 Walkinstown Road	Road widening

Reference	Address	Proposed Works
112/07.7A.09	102 Walkinstown Road	Road widening
113/07.7A.10	100 Walkinstown Road	Road widening
114/07.7A.11	98 Walkinstown Road	Road widening
115/07.7A.12	96 Walkinstown Road	Road widening
116/07.7A.13	94 Walkinstown Road	Road widening
117/07.7A.14	92 Walkinstown Road	Road widening
118/07.7A.15	90 Walkinstown Road	Road widening
119/07.7A.16	Walkinstown Mall, 80-88 Walkinstown Road	Road widening
120/07.7A.17	SuperValu Shopping Centre Walkinstown Road	Road widening
121/07.7A.18	47 Walkinstown Road	Road widening
122/07.7A.19	45 Walkinstown Road	Road widening
123/07.7B.01	43 Walkinstown Road	Road widening
124/07.7B.02	41 Walkinstown Road	Road widening
125/07.7B.03	39 Walkinstown Road	Road widening
126/07.7B.04	37 Walkinstown Road	Road widening
127/07.7B.05	35 Walkinstown Road	Road widening
128/07.7B.06	33 Walkinstown Road	Road widening
129/07.7B.07	31 Walkinstown Road	Road widening

Reference	Address	Proposed Works
130/07.7B.08	29 Walkinstown Road	Road widening
131/07.7B.09	27 Walkinstown Road	Road widening
132/07.7B.10	25 Walkinstown Road	Road widening
133/07.7B.11	23 Walkinstown Road	Road widening
134/07.7B.12	21 Walkinstown Road	Road widening
135/07.7B.13	19 Walkinstown Road	Road widening
136/07.7B.14	17 Walkinstown Road	Road widening
137/07.7B.15	15 Walkinstown Road	Road widening
138/07.7B.16	13 Walkinstown Road	Road widening
139/07.7B.17	11 Walkinstown Road	Road widening
140/07.7B.18	9 Walkinstown Road	Road widening
141/07.7B.19	Laneway between 9 Walkinstown Road and Car Park	Road widening
142/07.7B.20	Car park at 7 Walkinstown Road	Road widening
143/07.7B.24	Slievebloom Park Cul-de-Sac / Drimnagh Road	Road widening and retaining wall construction
144/07.7B.21	Green Area Between Landsdowne Valley and Slievebloom Park	Road widening and retaining wall construction
145/07.8A.19	Car Park at 8-12 Saint Mary's Road	Cycle track
146/07.8A.20	Green Area at Crumlin Road / Kildare Road	Road widening / bus stop
147/07.7A.20	Bunting Park	Temporary site compound

Reference	Address	Proposed Works
148/07.8B.01	Green space at Crumlin Road / Rafters Road	Road widening
149/07.8B.02	SHD 314/318 Crumlin Road	Road widening
150/07.8B.32	Hardstanding/Road Frontage 320 Crumlin Road	Road widening
151/07.9A.31	Iveagh Grounds, 196-246 Crumlin Road	Road widening
7152/07.9B.01	HSE Health Centre, 57 Old County Road	Road widening
153/07.9B.02	Green space between HSE Health Centre and 105 Crumlin Road	Road widening
154/07.11O.08	Green Area at Junction of Crumlin Road / Parnell Road	Landscaping
155/07.11O.09	Access Road Between Rutland Avenue and Parnell Road	Temporary Site compound
156/07.11A.05	Hardstanding/Car Park at Dolphins Barn / Sth. Circular Road junction	Hardscaping
157/07.11B.02	Hardstanding at Coombe Hospital, Dolphins Barn Street	Hardscaping
158/07.12C.02	Hardstanding at Ovenden House, Dean Street	Cycle track and hardscaping
159/07.12C.01	Footway at 50Patrick Street	Cycle track and footway
160/07A.1A.01	Green area, New Nangor Road, west of M50 Overbridge	Cycle track link
161/07A.1B.01	Green area, New Nangor Road, east of M50 Overbridge	Cycle track and footway link
162/07A.1C.01	Access to Nangor Road Business Park. New Nangor Road	Road junction widening
163/07A.1C.02	Access to Riverview Business Park. New Nangor Road	Road junction widening
164/07A.1D.01	Plot at Riverview Business Park, New Nangor Road	Road widening
165/07A.1D.07	Cammock River Bank, South of New Nangor Road	Road widening

Reference	Address	Proposed Works
166/07A.1D.02	Plot at Oak Road Business Park, New Nangor Road	Road widening
167/07A.1D.03	An Post, Dublin Mails Centre, New Nangor Road	Road widening
168/07A.1D.04	Industrial Unit at New Nangor Road	Road widening
169/07A.1D.05	Industrial Unit at New Nangor Road	Road widening
170/07A.1E.04	Plot at Western Industrial Estate, New Nangor Road	Road widening
171/07A.1E.01	Diageo Baileys Global Supply, Nangor House, New Nangor Road	Road widening
172/07A.1E.02	Toyota Material Handling, Killeen Road	Road widening
173/07A.1E.03	Westland Business Park, New Nangor Road	Road widening
174/07A.1E.05	Entrance to Toyota Ireland, New Nangor Road	Road widening
175/07A.2O.01	Harris Industrial Complex, Naas Road	Road widening
176/07A.2O.02	Plot at Junction Of Killeen Road / New Nangor Road	Road widening
177/07A.2O.03	Green Area between New Nangor and Killeen Road (South)	Road widening and temporary site compound
178/07A.2A.02	Green area between New Nangor and Killeen Road (South)	Temporary Site Compound
179/07A.2A.01	Harris Industrial Complex, Naas Road	Road widening and bridge structure
180/07A.2B.01	Harris Industrial Complex, Naas Road	Road widening and bridge structure
181/07A.2B.02	Woodies Naas Road	Road widening and bridge structure
182/07A.2B.03	Former Electrolux Building, Long Mile Road	Road widening, bridge structure and temporary site compound
183/07A.2B.04	Harris Group Plot, Long Mile Road	Road widening, bridge structure and temporary site compound

Reference	Address	Proposed Works
184/07A.2B.05	Maxol, The Huntsman Service Station, Long Mile Road	Road widening and bridge structure
185/07A.2B.07	Entrance to Harris Industrial Complex, Naas Road	Road widening
186/	Luas Light Rail Line, Naas Road	Road signage and pedestrian crossing removal
187/07A.3O.01	Motor Distributors Limited, Walkinstown Avenue	Road widening
188/07A.3O.02	Mixed use development site, Walkinstown Avenue	Road widening
189/07A.3O.03	Mixed use development site, Walkinstown Avenue	Road widening
190/	Luas Light Rail Line, Old Blessington Road	Road signage

13.4 Demolition

It is envisaged that demolition works will be limited to the demolition of boundary walls along the Proposed Scheme.

The demolition works shall be in accordance with the specific demolition items set out the following National Standards and guides:

- I.S EN 1991-1-6:2005 – Actions on Structures: General Actions – Actions During Execution (Including National Annex);
- BS 6187:2011 – Code of practice for full and partial demolition;
- BS 5228 – Code of practice for noise and vibration control on construction and open sites – Part 1: Noise; and
- BS 5228 – Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration.

All reasonable precautions to prevent pollution of the site, works and the general environment including streams and waterways shall be taken. All demolition waste shall be segregated and, where practicable, sent for recycling. This shall be in accordance with guidelines as set out by the National Construction and Demolition Waste Council (NCDWC).

A waste management plan following guidelines as set out by the NCDWC shall be produced outlining the proposals with respect to waste recycling, segregation and details of landfill proposals with target percentage of each element. The following legislation shall be noted:

- Protection of the Environment Act 2003;
- Waste Management (Amendment) Act 2001;
- Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste;
- EU Council Decision on Waste Acceptance (2003/33/EC);

- WMA Amendment Act (#2) 2001;
- Protection of the Environment Act No. 27 2003; and
- Best practice Guidelines on the preparation of Waste Management Plans for Construction and Demolition Waste.

13.5 Summary of Accommodation Works and Boundary Treatment

The locations for proposed new boundary treatments along the Proposed Scheme have been provided in Table 13-1 and also shown on the SPW_BW Fencing and Boundary Treatment Plans located in Appendix B Preliminary Design Drawings.

For boundary treatment requirements the following criteria has been used to calculate the area of temporary land take needed during construction:

- Walls - Typically 2m working room offset for temporary land take;
- Fences - Typically 2m offset for temporary land take;
- Significant retaining walls – Site specific but where lands available typically 15m offset for temporary land take; and
- Specific structures (bridges etc) – Site specific temporary land take based of available lands for pedestrian/cycle bridges and associated support structures at New Nangor Road/Naas Road/Long Mile Road junction and Greenhills Road / M50 overbridge.

To maintain the character and setting of the Proposed Scheme, the approach to undertaking the new boundary treatment works along the corridor is replacement on a ‘like for like’ basis in terms of material selection and general aesthetics unless otherwise noted on the drawings.

Modifications to driveways and entrances will be in line with DCC’s *Parking Cars in Front Gardens Advisory Booklet.* The basic dimensions to accommodate the footprint of a car in the front garden are 3m x 5m and a vehicular opening would typically be between 2.5m and 3.6m in width though this may need to be widened to allow for sightlines and manoeuvrability.

Existing gates will be reused where practicable however considerations will be required for the use of bifold/roller gates to mitigate impacts on parking in driveways.

14 Landscape and Urban Realm

14.1 Overview of Landscape and Urban Realm

Urban Realm refers to the everyday street spaces that are used by people to shop, socialise, play, and use for activities such as walking, exercise or to commute to/from work. The Urban Realm encompasses all streets, squares, junctions, and other rights-of-way, whether in residential, commercial or civic use. When well designed and laid out with care in a community setting, it enhances the everyday lives of residents and those passing through. It typically relates to all open-air parts of the built environment where the public has free access. It would include seating, trees, planting and other aspects to enhance the experience for all.

Successful urban realms or public open space tend to have certain characteristics.

- They have a distinct identity;
- They are safe and pleasant;
- They are easy to move through; and
- They are welcoming.

The following are the key policy and strategy documents that have been considered as guidance in developing the proposals for the BusConnects landscape and urban realm proposals.

BusConnects Dublin – Urban Realm Concept Designs

The following document BusConnects Dublin – Urban Realm Concept Designs, https://busconnects.ie/media/2089/busconnects-urban-realm-concept-designs.pdf was used as guidance in developing the proposals. The NTA published this document to present and describe outline objectives for enhancing the public realm of the Core Bus Corridors for walking, cycling and bus infrastructure. The analysis and the design principles set out in this section of the report relate directly to the following objectives;

- Enhance the capacity and potential of the public transport system;
- Enhance the potential for cycling;
- Support the delivery of an efficient, low carbon and climate resilient public transport service;
- Enable compact growth, regeneration opportunities and more effective use of land;
- Improve accessibility to jobs, education and other social and economic opportunities; and
- Ensure that the public realm is carefully considered in the design and development of the transport infrastructure and seek to enhance key urban focal points where appropriate and feasible.

Dublin City Development Plan 2016-2022

Section 9, Sustainable Environmental Infrastructure states in Policy SI18 a requirement to use SuDS in all new developments where appropriate, as set out in the Greater Dublin Regional Code of Practice (GDRCoP).

Section 10.5.6 Biodiversity, states in Objective GIO24 a requirement to support the implementation of the Dublin City Biodiversity Action Plan 2015-2020.

Section 10.5.7 Trees. The Dublin City Tree Strategy provides the vision and direction for long-term planning, planting, protection and maintenance of trees, hedgerows and woodlands within Dublin City. Objective GIO28 states the need to identify opportunities for new tree planting.

Dublin City Tree Strategy 2016-2020

A set of policies for the long-term promotion and management of public trees in Dublin. “Within the city, trees clean the air, provide natural flood defences, mask noise and promote a general sense of wellbeing”.

Dublin City Biodiversity Action Plan 2015-2020

Covers all areas of the city, including roadsides and footways and reflects the Strategic Objectives of Ireland's National Biodiversity Plan (Actions for Biodiversity 2011-2016)

- Strengthen the knowledge base of decision makers to protect species and habitats;
- Strengthen the effectiveness of collaboration between all stakeholders for the conservation of biodiversity in the greater Dublin region;
- Enhance opportunities for biodiversity conservation through green infrastructure and promote ecosystem services in appropriate locations throughout the city; and
- Develop greater awareness and understanding of biodiversity and identify opportunities for engagement with communities and interest groups.

14.2 Consultation with Local Authority

Consultation has taken place with DCC and SDCC throughout the design process. Stakeholders and statutory bodies including the OPW have been consulted through the process as well as through the

Public Consultations and various scheme presentations.

14.3 Landscape and Character Analysis

The landscape and urban realm proposals are derived from analysis of the existing urban realm, including existing character, any heritage features, existing boundaries, existing vegetation and tree planting, and existing materials. The BusConnects Dublin – Public Realm Assessment was undertaken as guidance in developing the proposals. For each section of the route, the team took a broad overview of building style, extents of vegetation and tree cover was undertaken, the predominant mixes of paving types, appearance of lighting features, fencing, walls, and street furniture was considered. The purpose of this analysis was to assess the existing character of the area and how the BusConnects Infrastructure Dublin proposals may alter this. The outcome of the analysis allowed the urban realm design team to consider appropriate enhancement opportunities along the route. The enhancement opportunities include key nodal 'Potential Development Opportunities' (PDO) which focus on locally upgrading the quality of the paving materials, extending planting, decluttering of streetscape and general placemaking along the route. These areas are further discussed in Section 14.7.

Where practicable, a SuDS approach will be taken to assist with drainage along the route. SuDS principles will be used as much as practicable to deal with run-off at, or close to, the surface where rainfall lands.

14.4 Arboricultural Survey

14.4.1 Scope of Assessment

An Arboricultural Impact Assessment Report identifies the trees, groups of trees, or hedgerows that may be impacted by the Proposed Scheme, along with suitable mitigation measures, as appropriate. The Tree Protection Plan identified trees to be removed, and the Arboricultural Method Statement sets out how retained trees are to be successfully protected. A copy of the report has been provided in Appendix D and the inputs from the report have been incorporated in the Landscaping Drawings in Appendix B.

The assessment was informed by an extensive tree survey prepared by John Morris Arboricultural Consultancy (JMAC) (ref: 20-092-03), based on the requirements of BS5837:2012 Trees in relation to design demolition and construction – Recommendations (BS5837).

The Arboricultural Impact Assessment sets out the likely principal direct and indirect impacts of the Proposed Scheme on the trees on or immediately adjacent to the Site, and suitable mitigation measures to allow for the successful retention of significant trees, or to compensate for trees to be removed, where appropriate. Trees which are 75mm in diameter (at 1.5m) or larger have been included within the survey as well as formally planted smaller trees within the highway (to reflect recent highway planting schemes). The tree survey considers all trees with the potential to be impacted by the scheme (those with a canopy or Root Protection Area (RPA) which could incur into the Site).

The report considered the following:

- Description of the site/route and summary of the trees surveyed;
- Summary of any statutory or non-statutory designations affecting trees within the survey area;
- A brief summary of trees to be removed;
- Outline guidance for the design team and any key considerations, or issues which need to be addressed;
- Schedule of surveyed trees and key;
- Recommendations for tree works and incursions related to the Proposed Scheme; and
- Tree Constraints Plans.

14.5 Hardscape

14.5.1 Design Principles

In the development of the preliminary design proposal, the following elements were analysed and considered:

- The character of each section including building typologies, uses, scale, pedestrian environment, landmarks, landscape character and any other relevant place attributes;
- Assessment of the scheme proposals and any impacts to the local setting that may need mitigation; and
- Preparation of conceptual public realm design responses for each section that are in keeping with the local character and in line with the objectives, in particular, ensure that the public realm is carefully considered in the design and development of the transport infrastructure and seek to enhance key urban focal points where appropriate and feasible.

14.5.2 Typical Material Typologies

Through the process of developing the Preliminary Designs, a typology and palette of proposed materials was developed to create a consistent design response for various sections of the routes. The proposed materials were based on the existing landscape character, existing materials and historical materials while also identifying areas for betterment through the use of higher quality surface materials.

The proposed material typologies employed in the preliminary design are described as:

- **Poured in situ concrete pavement.** -Used extensively on existing footways. Concrete pavements can be laid without a kerb, can have neatly trowelled edges and textured surface for a clean, durable, slip resistant surface;
- **Asphalt footway.** -Widely used on existing footways and will tie in with other sections of public realm. Laid with a road kerb, can have a smooth finish or textured aggregate surface, provides a strong flexible slip resistant surface. Opportunities to retain good quality kerbs have been explored and tie-in points considered;
- **Precast concrete unit paving.** -Either concrete paving slabs or concrete block, there is a very wide variety of sizes and colours available to provide an enhanced public realm. The use/reuse of granite kerbs where appropriate will further enhance the public realm. This type of material use is mostly employed in non-inner-city public realm enhancements;
- **Natural stone paving**. - Employed for high quality urban realm areas, mostly in city centre locations. This typology represents natural stone surface treatments such as granite and are used to create enhanced public spaces for major urban realm interventions;
- **Stone or Concrete setts**. - Proposed for distinguishing pedestrian crossing points either on raised table or at road level.

- **Self-binding gravel**. - Proposed for pedestrian paths set away from the road expected to see less traffic. Used for natural areas, for example, paths through wildflower meadows. They provide a defined informal route as an alternative to asphalt or concrete; and
- **No change.** - In addition to areas with proposed material changes, there were also areas identified where no change in materials would be required. For example, where pavement has recently been laid and is in good condition. The design also explores opportunities where good quality kerbs such as granite kerbs could be relaid in the same location, which would have both cost and sustainability advantages.

Other design responses include:

- **Boundary treatments** to both commercial and residential properties. Opportunity exists to take the best examples of existing boundary treatment and reinstate them, while improving other sections of the road frontage;
- **Tree pit enhancements** will be undertaken, using materials such as self-binding gravel. Consideration has also been given to the construction of tree pits to include in-ground root protection systems to improve both the vitality of the trees and the life span of the pavements; and
- **Street furniture** is mostly confined to replacing or relocating existing furniture, at locations where there is potential development opportunities there is the prospect to provide additional street furniture where it would most enhance communal spaces.

14.6 Softscape

14.6.1 Tree Protection and Proposed Planting

The first priority of the landscape strategy is to protect existing trees along the route. Where practicable, the initial conservation of existing biodiversity has been considered. The arboricultural survey identified the quality of existing trees. The information was overlaid on the proposed routes to inform the design process. The impact of roadworks will be minimised near existing trees by utilising no-dig construction techniques. Review and re-design of the alignment and extent of proposals through sensitive areas has minimised the loss of high-quality trees.

The following key areas were identified as potential conflicts and the road layout was reconfigured to preserve the trees.

- **Greenhills Road A3050 – A3200**

  Road widening requires the removal of existing trees along the western side of the road, but ensures protection of the eastern row of trees.

- **Dolphins Barn Chainage A9300 – A9400**

  Existing tree-lined central median maintained by adapting footway and cycle track widths.

- **Cork Street Chainage A9900 – A10350**

  Existing kerbline maintained with adjusted cycle track widths to maintain existing trees where practicable.

- **St. Luke's Avenue Chainage A10790 – A10830**

  Existing median with reduced width to maintain existing trees where practicable.

- **Bunting Road / St Mary's Road Chainage D80 – D1250**

  Cycle track width minimised to maintain existing trees where practicable.

- **Kildare Road / Clogher Road Chainage E780 – E2420**

  Cycle track width minimised to maintain existing trees where practicable.

- **Long Mile Road Chainage F3500 – F4100**

The existing planted central island is maintained as much as practicable but some existing tree loss will be necessary due to provision of the cycle track, new trees are proposed to mitigate this existing tree loss.

14.6.2 Tree Loss and Proposed Planting

Despite the best efforts to protect trees, especially trees of a mature and significant stature there will be inevitable impacts on local trees. In total it is estimated that there will be 720 trees lost, refer to Table 14-1 below. This loss has been addressed through mitigation and replanting efforts as outlined in the planting strategy (Section 14.6.3) below resulting in a substantial tree planting plan with a net increase of 328 additional semi-mature trees along the Proposed Scheme.

Table 14-1: Summary of Trees Retained, Removed and Proposed as part of the Proposed Scheme.

Retained Trees	Removed Trees	Proposed Trees	Total Trees in Development
Total retained in development	Total identified tree numbers lost	Street trees planted	Proposed Scheme
3023	**720**	**1048**	**4071**

14.6.3 Planting Strategy

The planting strategy has been developed to meet the objectives of the Proposed Scheme and the needs of the Dublin City Tree Strategy and the Dublin Biodiversity Action Plan. To have an influence on the local environment to improve amongst others; air quality, stormwater runoff, health and well-being; and habitat provision.

- Where practicable the initial conservation of existing biodiversity has been considered. The Arboricultural Survey identified the quality of existing trees. The information was overlaid on the proposed routes to inform the design process;
- Opportunities have been identified to enhance biodiversity through green infrastructure;
- Promote the role of street trees planting consistent with the recommendations of the Dublin City Tree Strategy; and
- Develop the role of SuDS opportunities within the scheme in coordination with the drainage engineers. (Refer the Drainage, Hydrology and Flood Risk section of this report).

14.6.4 Typical Planting Typologies

Several typologies were developed to address the above issues. Details of the proposed tree species and planting regime are provided on the ENV_LA Landscaping General Arrangement Drawings in Appendix B Preliminary Design Drawings. Additional information on suitable plant species is also provided in Section 14.7.2.

New Street Trees - Large canopy trees with 4.5m clear stem planted in urban tree pit systems allow for protection of the soil structure and good root development.

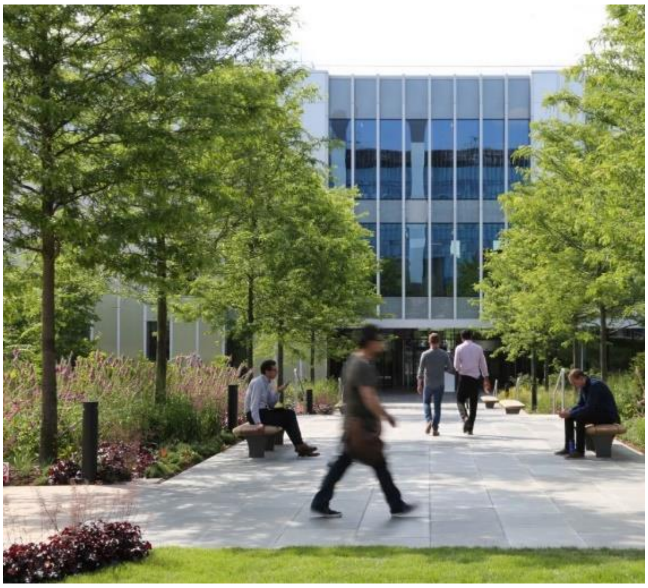

Figure 14-1 Tillia Cordata (Semi Mature Tree) and Semi Mature Street Trees

- **Central Median Screen Planting** - Combination of tree and shrub planting can reduce headlight glare where appropriate and add a corridor of planting.

Figure 14-2: Long Mile Road Existing Planting to Median

Figure 14-3: Patrick Street Existing Dense Planting to Median

- **Replacement Planting to Boundaries** - Direct replacement of trees and hedgerows lost to road widening, or the introduction of hedgerows to soften fence lines. Reconsider the species to be planted for long term sustainability, disease resistance and enhanced biodiversity.

Figure 14-4: Replacement of Boundaries (for example Adjacent to Dublin Mails Centre on New Nangor Road)

- **Native Planting / Tree Planting (Woodland Copses)** - Opportunity for small clusters of planting exist in spaces not readily accessible at junctions or wider verges. Promote native trees with understorey planting, long grass and swathes of bulbs.

Figure 14-5: Woodland Copses

- **Ornamental or Formal Planting** - Small landscape interventions at local community spaces, opportunity for combinations of street trees, raised beds, seating and more formal planting arrangements exist at certain intervals and are often picked up as potential development opportunities.

Figure 14-6: Example of Potential Development Opportunity at Christchurch

- **Residential Boundary Planting** - Residential boundaries vary greatly along the Proposed Scheme, and mitigation will largely replace like with like, but an opportunity exists to consider introduction of new green infrastructure in hedgerows and boundary trees. With greater opportunity for ornamental planting thus increasing the opportunity for greater biodiversity and support of pollinators.

Figure 14-7: Residential Boundaries Replaced with Like for Like Hedgerows

- **Commercial Boundary Planting** - Commercial boundaries vary greatly; however, they are mostly of robust nature, concerned more with security than visual appearance. Therefore, they offer great opportunity for introduction of new green infrastructure in hedgerows and boundary trees. They can offer an immediate visual improvement to the appearance of many areas and likewise provide opportunity for improved biodiversity.

Figure 14-8: Commercial Boundaries Provide Opportunities for New Tree Planting and Hedgerows

14.7 Proposed Urban Realm Design

14.7.1 Overview

The Urban Realm design is presented at 1:500 scale on combined hard and soft landscaping general arrangement drawing layout plans presented on the ENV_LA landscaping general arrangement series in Appendix B Separate (illustrative) drawings will be provided below to further illustrate proposals for Potential Development Opportunities (PDO) areas, (placemaking, enhancement opportunities). Tallaght to City Centre Section

This section commences at Tallaght shopping centre and is routed via Tallaght Main Road which will join the Greenhills Road at a new junction. It is then routed via Greenhills Road and Walkinstown Road to the junction with Long Mile Road. It continues along Crumlin Road and Cork Street where it connects to Patrick Street and terminates at Christchurch Place. Segregated cycle facilities are proposed along Bunting Road, Kildare Road and Clogher Road to link into the Grand Canal cycle route at Parnell Road.

14.7.1.1 Section 1: Tallaght to Ballymount

Existing Character: This is a mixture of commercial/retail/office areas with access to Tallaght University Hospital and Technology University Dublin Tallaght. The Tallaght area is characterised by modern tall office buildings and broad tree lined streets. The area is generally well cared for with grass verges and manicured hedges. The street trees are a dominant feature of the townscape character that link the areas of public open space at Tallaght University, the Hospital and the large parklands along the N61 and the Dodder River.

Proposed Design: The first section commences at the existing roundabout junction on Belgard Square South. The main landscaping intervention along this section of the route is the proposed Tallaght Interchange. The proposals include a new plaza space with bus shelters incorporated into sculptural canopies. The new plaza and interchange open space will greatly improve transport links to the area and cater for greater public access. It will become an important new connecting space within the local urban realm, tree and shrub planting will increase biodiversity in the area while creating a pleasant interface with the surrounding context (Figure 14-9 and Figure 14-10 below).

Figure 14-9: Sketch Scheme for Design Intent - Tallaght Bus Interchange

Figure 14-10: Sketch Scheme Urban Realm Improvement - Tallaght Bus Interchange

The route from Belgard Square will utilise existing road infrastructure allowing for retention of existing tree planting and public realm enhancements in the form or replacement planting at some areas along the route.

Between the Old Greenhills Road and the junction with Mayberry Road, and along the Greenhills Road, it is proposed to utilise land take on both the west and east side of the existing Greenhills Road. This will require replacement tree planting but also gives opportunity to introduce potential SuDS interventions along this section of the route

An extensive tree planting scheme is proposed along the entire route to provide a more consistent level of tree cover that will enhance the visual appearance of the route and increase the local biodiversity values. Key enhancements will include a new sustainable link road at Parkview and the creation of new public realm links, an extensive SuDS attenuation area at Tymonville Crescent planted with native species adaptable to wetland conditions and surrounded by native woodland trees in small clusters to provide a new landscaped parkland that will resemble the existing tree belt retained on the eastern side of Greenhills Road, and enhancement of the green infrastructure through new tree planting and development of meadow grass areas.

14.7.1.2 Section 2: Ballymount to Crumlin

Existing Character: The character of the landscape between Ballymount and Crumlin varies greatly from section to section. From the Greenhills Road eastern boundary with Tymon Park offers extensive views to the south and east. Travelling to the north the road is in enclosed with mature vegetation before it opens out to an industrial area defined by boundary walls and fences. The character on Bunting Road is a broad tree-lined residential street, in direct contrast to the commercial premises of Greenhills Road.

Proposed Design: The new connection to Greenhills Road through Ballymount Industrial Estate provides an opportunity for public realm enhancement utilising SuDS features, new tree planting, shrub and meadow grass areas to enhance the local biodiversity value and create localised public open spaces along the route.

Walkinstown Roundabout will be enhanced with new planting, and a redefined public realm with cycle facilities.

14.7.1.3 Section 3: Crumlin to Grand Canal

Existing Character: A combination of residential properties and retail units. The streetscape is generally a wide asphalt road with poured concrete pavements. There are few roadside planted areas in the vicinity of Rafters Road, Iveagh Gardens and Old County Road/Sundrive Road. The townscape character is largely residential with hubs of commercial premises at the major junctions. Housing dates back to the 1950s and 1960s with trees and vegetation mostly associated with private premises. Small pockets of green space are most notable at St James Gate Football grounds, the junction of Old County Road and at Loretto College.

Bunting Road and St Mary's Road are wide tree lined residential streets. The housing is typically of the 1950's to the 1970's and the road layouts and street trees will be of a similar age. The mature trees now provide a key characteristic of the townscape.

Kildare Road and Clogher Road are residential areas with asphalt road and poured concrete pavements, with tree lined streets between Sundrive Road and Parnell Road. The trees are a key characteristic of the neighbourhood giving the sense of a leafy suburb.

Proposed Design:

Road widening to accommodate the bus lanes on Walkinstown Road will result in the loss of existing trees. The loss of trees will be limited to one side of the street in order to ensure tress on the opposite side are protected.

The junction of Walkinstown Road and Long Mile Road is reconfigured creating a new public open space with new mature trees and raised planter with seating opportunities. (Figure 14-11 below). This is a significant improvement on what is currently a very wide junction dominated by traffic. Redefining the junction as open space with significant tree planting, and seating areas will provide a local landmark when journeying through Walkinstown

Figure 14-11: Sketch Scheme for Design Intent – Long Mile Road and Walkinstown Road Junction

The increased tree planting with underplanting adds to the biodiversity of this area. (Figure 14-12 below)

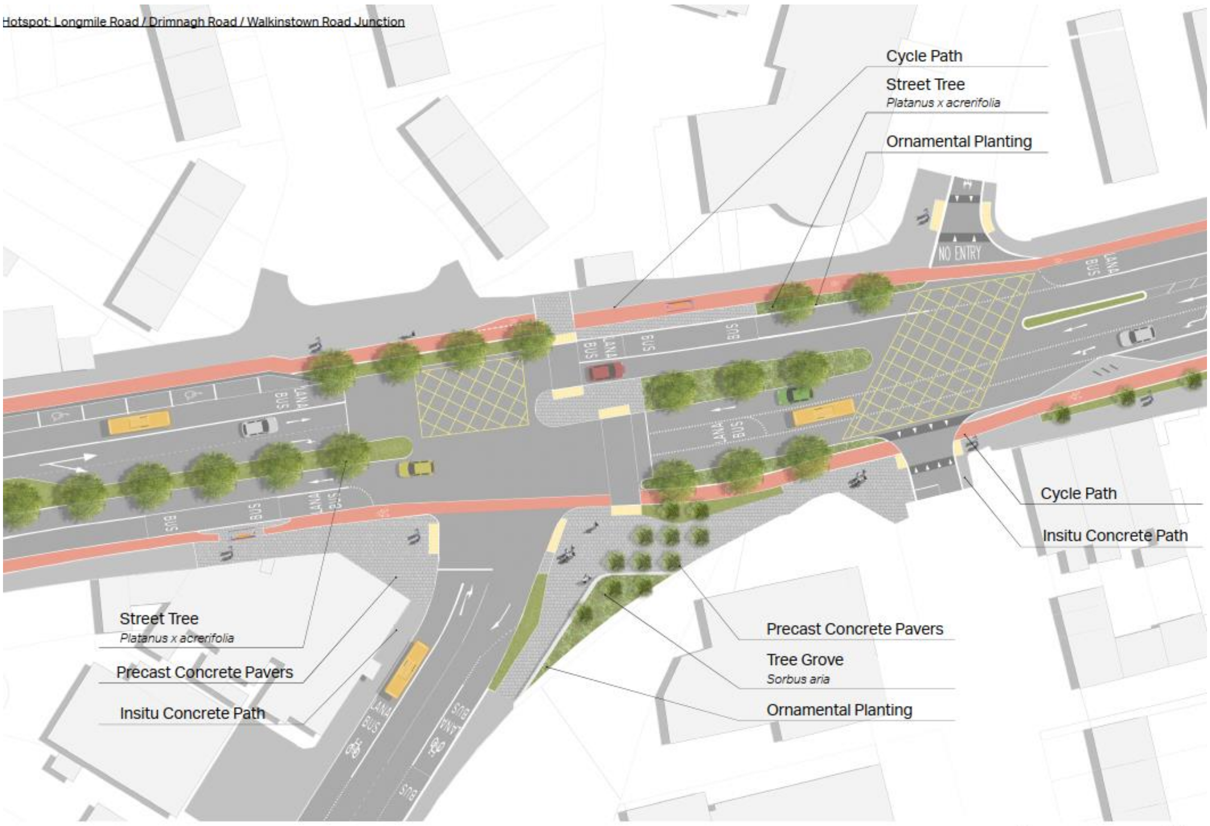

Figure 14-12: Long Mile Road and Walkinstown Road Junction Hot Spot

Other than the hedge boundary at St. James GAA, there are almost no street trees along Crumlin Road. The opportunity to provide pedestrian spaces at the junctions of Bangor Drive and Clonard Road will create small interventions conveniently located at small retail clusters. It will enhance the wider area providing pedestrian focal points along the Crumlin Road with mature tree planting in an otherwise vehicle dominated landscape. On the Crumlin Road between Herberton Road and Grand Canal / Parnell Road there are limited opportunities for public realm with street tree planting proposed at points to improve the streetscape at points taking advantage of existing green open space (Figure 14-13 below).

Figure 14-13: Sketch Scheme for Design Intent - Brickfield Drive

Upgraded public space at Bangor Road and Clonard Road create public realm space. Tree planting will enhance the streetscape on Crumlin Road and define the streetscape. Understory planting will enhance biodiversity opportunities (Figure 14-14 below).

Figure 14-14: Clonard Road and Bangor Drive Development Opportunity

On Bunting Road and St. Mary's Road the tree lined street will be preserved by using no dig methods to lay the cycle track under the tree canopies.

On Kildare Road and Clogher Road the trees will be retained by using a no-dig technique to lay the cycle track below the tree canopies. Where approximately 20 existing trees will be lost on Kildare Road, these will be replaced by offset planting at the new proposed green areas at Kildare Road/Cashel Road junction and Kildare Road/Clogher Road junction.

14.7.1.4 Section 4: Grand Canal to Christchurch

Existing Character: A combination of residential properties and retail/commercial units. The streetscape is generally a wide asphalt road with poured concrete pavements. From the Grand Canal and to Cork Street the urban character intensifies and changes from residential to tall apartment blocks and commercial properties. The density of the buildings increases with little street planting or vegetation. The urban character is dominated by the wide vehicular streetscape with pedestrians confined to relatively narrow walkways. The lack of vegetation and the softening and shading effect it can have in the high density-built areas is noticeable.

Proposed Design: A new landscaped area is proposed on the south eastern corner of the junction with South Circular Road to improve the urban realm aspects of the junction area whilst also improving safety. Integrating new tree planting with existing planting within the median and a public realm space on the area currently used for car parking will give definition to the public realm and enhance the junction further.

Along Cork Street, new street tree planting is proposed to enhance the existing planting with understory planting also proposed to some existing trees. This will allow the street trees along the street to create links with existing greenspaces such as Weaver Park giving a more connected public realm.

Between Dean Street Junction and Christchurch Place, it is proposed to maintain the central median and retain the existing trees, some of which are mature. Additional crossing points will be added to improve the permeability of this busy tourist area.

Realignment of the junction at Christchurch Place/Winetavern Street/High Street will increase pavement width and improve pedestrian accessibility and frontage at the Peace Park to the south, and Christ

Church Cathedral to the north. Public realm proposals in this area will use high quality materials and will respond to the adjacent public realm of Christchurch and Peace Park.

Upgraded public space through expansion of the pedestrian areas gives more clarity to the overall space and use of high quality materials keeps in with the heritage of the surrounding area. Integration of the area into the existing context defines the Christchurch Place junction within the city fabric. Paving interventions will link spaces surrounding the junction, such as the Christchurch cathedral grounds and Peace Park, with better definition on crossing points for pedestrians creating a more unified feel to the overall junction (Figure 14-15 below).

Figure 14-15: Christchurch Place Development Opportunity

14.7.1.5 Section 5 : Outer Ring Road (R136) to Woodford Walk

For Section 1 it was concluded that the existing high quality of bus infrastructure within the area, as well as modest potential for development leading to increased demand for public transport, meant that there was limited benefit to be had in starting the route within this area. Therefore, it was decided to omit Section 1 of the route between R136 Outer Ring and Woodford Walk.

For Section 1 it was concluded that the existing high quality of bus infrastructure within the area, as well as modest potential for development leading to increased demand for public transport, meant that there was limited benefit to be had in starting the route within this area. Therefore, it was decided to omit Section 1 of the route between R136 Outer Ring and Woodford Walk.

14.7.1.6 Section 6: Woodford Walk / New Nangor Road to Naas Road

Existing Character: Largely commercial area of Dublin with large commercial complexes and fenced parking lots. The general character is functionary with emphasis on secure fencing, wide asphalt roads and poured concrete pavements. Tree planting along the majority of road boundaries provides much needed greenery.

Proposed Design: Existing left turn slip lanes at the Woodford Walk/New Nangor Road junction are to be removed. This has provided additional space for a small urban realm intervention that incorporates a raised planter with new tree/shrub planting, seated walls and new concrete paving. The new paving areas will help strengthen the pedestrian connections between the new bus stop locations and the entrance to the N10 Grand Canal Greenway walkway.

New tree planting along New Nangor Road will replace the existing boulders that align adjacent to the carriageway which will soften the character of the area whilst defining and protecting the existing boundaries.

Cycle tracks will be provided on both sides of the carriageway the length of New Nangor Road, with cyclists able to join the cycle track at Woodford Walk from either the carriageway or the N10 Grand Canal Greenway. Additional cyclist connections to the Greenway from the north of New Nangor Road are provided at the M50 overbridge. This route aligns with the proposed Primary Route 7B/N10 until cyclists re-join New Nangor Road beyond the M50 overbridge. To accommodate these new connections there will be sections of trees to be removed. These will be substituted with new green verges and new tree planting where practicable.

Junctions at the entrance to commercial properties along New Nangor Road will be improved where practicable. Additional tree planting and new concrete paving will help formalise these entrances whilst softening their character. Potential for SuDS interventions has been identified within a number of green verges along this section of New Nangor Road.

Due to carriageway width being increased along the interface with Western Business Park there are a number of existing trees that will need to be removed. These will be replaced with new tree planting to re-define this boundary.

At the entrance to Diago Baileys there will be a section of existing hedgerow to be removed to accommodate the new carriageway design. New hedgerow planting is proposed in addition to some additional tree planting to ensure this interface is maintained.

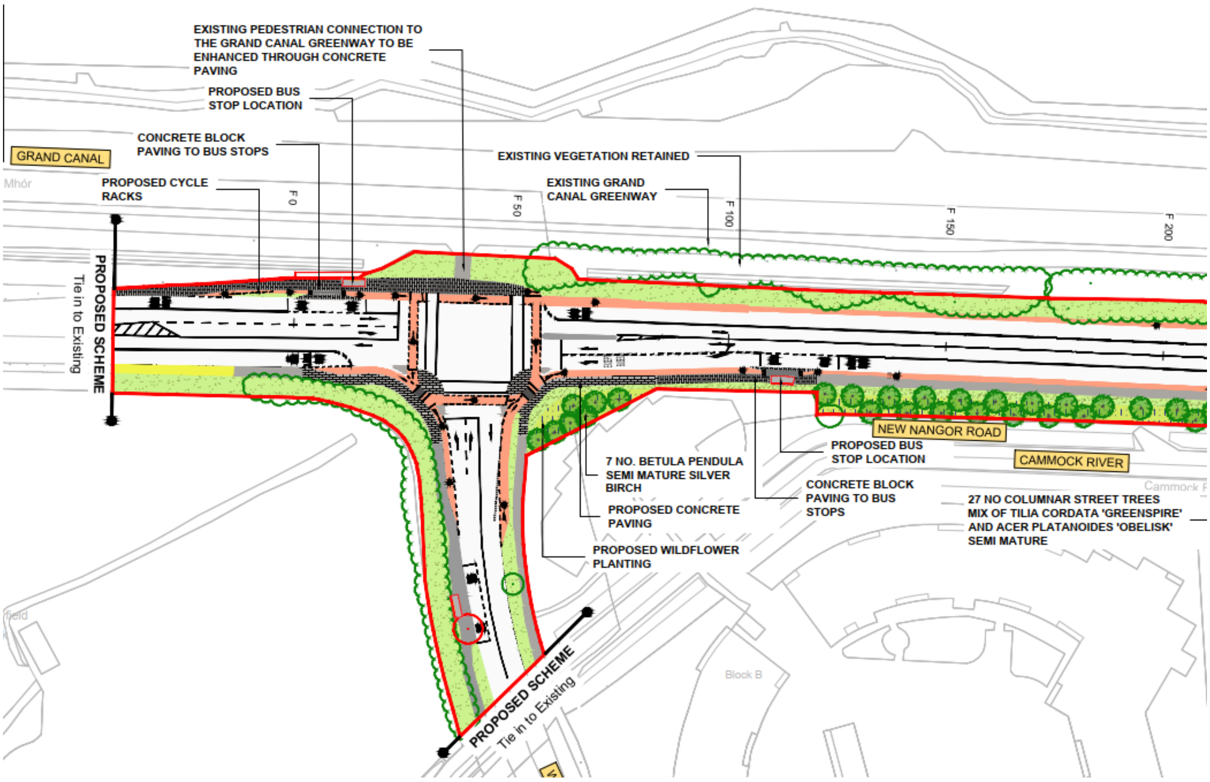

Figure 14-16: Urban Realm Proposals at Junction of Woodland Walk and New Nangor Road Connecting with Grand Canal Greenway

14.7.1.7 Section 3: Long Mile Road / Naas Road / New Nangor Road junction to Drimnagh

Existing Character: A large and very busy multi-lane signalised roundabout type junction at Naas Road / New Nangor Road / Long Mile Road forming the centrepiece of large industrial area in southwest Dublin incorporating LUAS light rail through the centre extending along Naas Road commercial area to junction with Walkinstown Avenue. Walkinstown Avenue and Long Mile Road is a largely commercial area with commercial complexes, two schools and fenced parking lots. The general character is functionary with emphasis on secure fencing, wide asphalt roads and poured concrete pavements. Tree planted medians and road boundaries are intermittently provided along this section.

Proposed Design: At the New Nangor Road / Naas Road / Long Mile junction a pedestrian and cyclist footbridge is proposed.

The existing left turn slip lane at Kylemore Road is to be removed, with traffic diverted via Old Naas Road (a short distance upstream) in order to access Kylemore Road. This arrangement allows for improved bus facilities, interchange with Kylemore Luas Station and opportunities for additional tree planting.

A two-way cycle track is provided along the north side of Naas Road with a verge to segregate the cycle track from the carriageway provided where practicable. A one-way westbound cycle track is provided along the south side of Naas Road with a verge to segregate the cycle track from the carriageway provided where practicable.

Along Walkinstown Avenue cycle tracks and footways are provided both north and southbound, with a verge provided to segregate the cycle track from the carriageway along the northbound carriageway from the MDL site entrance to the Naas Road junction. This verge allows for the retention of existing mature trees along Walkinstown Avenue.

Figure 14-17: Sketch Scheme for Design Intent - Long Mile Road Cycle Track and Enhanced Planting Within Medians

The junction of Walkinstown Avenue is being reconfigured to provide enhanced pedestrian and cyclist facilities. Additional footway widths across the junction have created opportunities for new tree planting to help soften the character of the area and create a more pedestrian friendly environment.

Figure 14-18: Sketch Scheme for Design Intent - New Pedestrian Crossing on Long Mile Road

Proposed raised table crossing paved in concrete pavers to match adjacent footways will improve driver awareness and increase pedestrian safety and connectivity at key crossing locations.

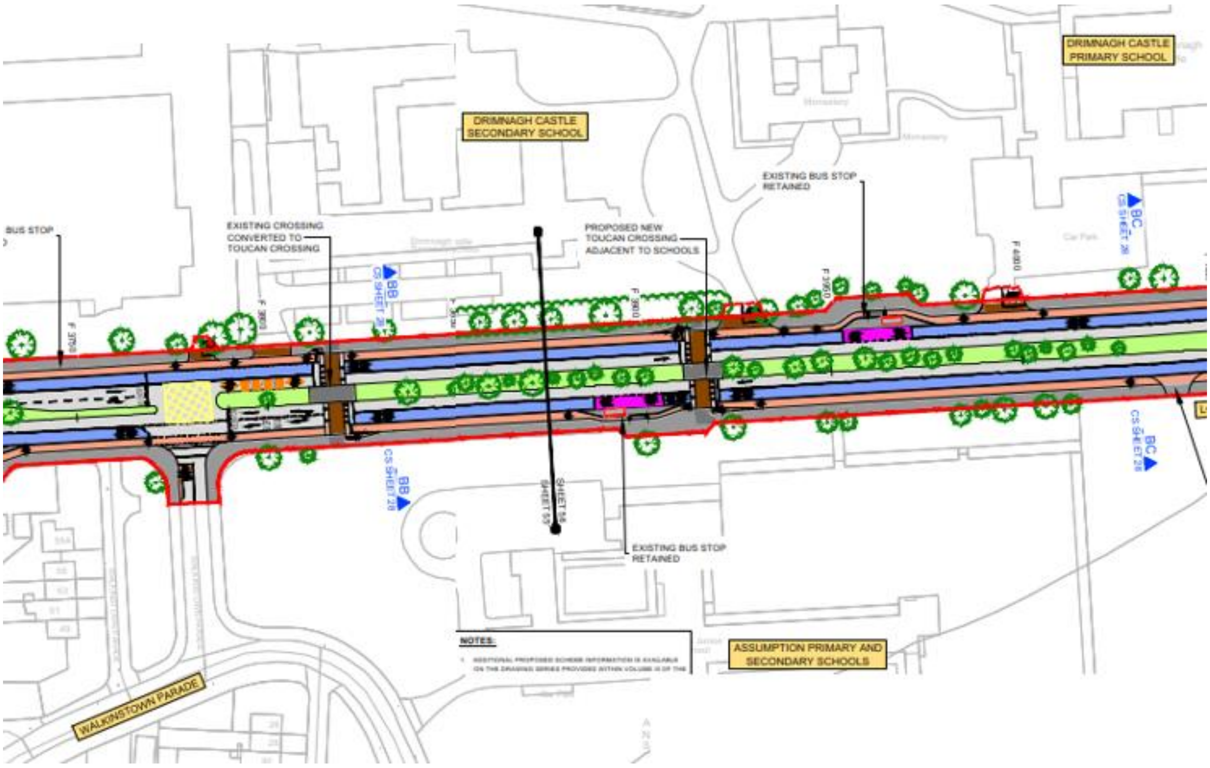

Figure 14-19: Pedestrian Crossing Improvements at Schools Located along Long Mile Road

14.7.2 Selection of Plant Species

The selection of appropriate species has considered planting suitable for wildlife, visual diversity, plant form and function. Specific trees with poor track record in the urban environment, or that are prone to disease and not suitable for urban realm projects, have been avoided.

Trees that are not suitable for urban realm environments are listed and in Table 14-2 below. Trees, shrub / hedging, climbers and other planting species suitable for urban realm environment with benefit for wildlife are shown in Table 14-3, Table 14-4, Table 14-5 and

Table 14-6 below.

Table 14-2: List of Trees Not Suitable for Urban Realm Environment

Latin Name	Common Name	Notes
Prunus serralata	Japanese Cherry	Unless it is planted in a 3m wide grass verge
Acer platanoides	Norway maple	Unless it is planted in a 2m wide grass verge minimum
Acer saccharinum	Silver maple	Brittleness
Fraxinus spp.	Ash	Dieback Disease
Quercus species	Oak	Must be local origin (Ireland) and not imported due to Processionary Moth issue.
Acer pseudoplatanus	Sycamore	Unless it is planted in large grass verge
Aesculus hippocastanum	Chestnut	Leaf miners and bleeding cankers diseases.

Table 14-3: Trees with Benefit for Wildlife

Latin name	Common name	Benefit
Semi mature (25-40cm girth)		
Acer x freemanii 'Autumn Blaze'	Freeman Maple	Attractive to a number of invertebrates.
Acer platanoides 'Obselisk'	Columnar Norway Maple	Attractive to a number of invertebrates and fruits are eaten by small mammals.
Betula pendula	Silver Birch	Excellent for insects and to attract insect-eating birds. Catkins are a good food source for a variety of birds.
Liriodendron tulipifera Fastigiata	Upright tulip Tree	Tree that attracts bees and butterflies.
Prunus avium 'Plena'	Cherry Tree	Berries provide a valuable food source for birds.
Sorbus aucuparia 'Asplenifolia'	Rowan / Mountain Ash	Attractive to a number of invertebrates and berries are eaten by birds.
Tilia cordata 'Greenspire'	Small-leaved lime	Attractive to pollinators.
Standard (16-18cm girth)		
Betula pendula	Silver Birch	Excellent for insects and to attract insect-eating birds. Catkins are a

		good food source for a variety of birds.
Prunus avium 'Plena'	Cherry Tree	Berries provide a valuable food source for birds.
Sorbus aucuparia	Rowan / Mountain Ash	Attractive to a number of invertebrates and berries are eaten by birds.
Quercus robur	Oak	Attractive to a range of invertebrates and are important for insect eating birds. Acorns are eaten by a variety of birds and mammals.
Fagus sylvatica	Beech	Attractive to a number of invertebrates.

Table 14-4: Shrub and Hedging Species with Benefit for Wildlife

Latin name	Common name	Benefit
Buxus sempervirens	Common Box	Attractive to pollinators. Can provide a dense nesting cover.
Ceanothus species	Lilac Bush	Provide nectar and pollen for butterflies, bees and other pollinators in their dense flower clusters in spring.
Cornus sanguinea	Dogwood	The flowers produce a scent that is attractive to many species of invertebrates. The berries are eaten by some species of birds.
Corylus avellana	Hazel	Reddish-brown nuts in a green husk are seen on hazel in the late summer and autumn; but these are generally eaten quickly by birds and mammals.
Crataegus monogyna	Hawthorn	Provides a source of nectar and berries providing food for birds including thrushes. If allowed to grow dense it will provide good nesting opportunities for birds.
Euonymus europaeus	Spindle	Spindle produces flowers that provide a good source of food for bees and other insects. The fruits attract aphids which in turn attract insect-eating birds.
Hebe species	Hebe	Most species of Hebe provide nectar and are visited by several species of bees.
Hypericum androsaemum	Tutsan	Flowers attract insects especially bees while the berries are eaten by birds and small mammals.
Ilex aquifolium	Holly	The berries are greatly enjoyed by birds and mammals. Holly also

		plays a crucial part in the life cycle of the beautiful butterfly the holly blue, which lays eggs on holly leaves in spring and is a frequent visitor to gardens in town. Requires male and female plants to produce berries.
Lavandula angustifolia	English Lavender	This plant is much favoured by bees for the nectar and pollen whilst the seeds attract birds.
Ligustrum vulgare	Privet	Wild privet is the preferred choice for wildlife and may provide nesting sites for blackbirds and other species. Left to grow a little less tidily than many gardeners allow, the structure will become more open and also offer nesting opportunities for many more species. Good for bees and butterflies.
Mahonia species	Mahonia	Flowering occurs in autumn, winter and early spring benefiting winter-active pollinators (like bumblebees or some hoverflies). Flowers produce abundant nectar. Berries are eaten by birds.
Pyracantha coccinea	Scarlett Firethorn	Very valuable to birds as a source of food and as a nesting site. Also, a good security plant due to the thorns.
Rosa species	Roses	Provides nectar for bees and butterflies. Hips are valuable for small birds and mammals.
Salix aegyptiaca	Musk Willow	Winter-flowering shrub pollinated by bees and other insects.
Sambucus nigra	Common Elder	Provides flowers for insects and berries for birds.
Sarcococca confusa	Sweet Box	Flowering in winter, followed by black berries eaten by birds.
Thymus species	Thyme	The rose-purple flowers grow in long, whorled, upright spikes and are very attractive to bees, hoverflies and butterflies.
Viburnum spp	Viburnum	Excellent for attracting hoverflies and are a good source of nectar for bees. The shiny berries provide a food source for birds and mammals alike.

Table 14-5: Climbers with Benefit for Wildlife

Latin name	Common name	Benefit
Clematis vitalba	Clematis ‘Old Man’s Beard’	Provides nectar for bee and butterflies.

Hedera helix	Ivy	Provides a late nectar source and cover / hibernating sites for many species of invertebrates.
Humulus lupulus	Hop	Provides nectar for bee and butterflies.
Jasminus officinale	Summer Jasmine	Night-scented. The scent from jasmine at night can attract bats.
Lonicera periclymenum	Honeysuckle	The flowers of the Honeysuckle attract night flying moths and other insects which in turn can provide food for bats. Honeysuckle can provide nest sites for small garden bird species while the bark is often used in nest building by species including the House Sparrow.

Table 14-6: Other Planting Species with Benefit for Wildlife

Latin name	Common name	Benefit
Abelia chinensis	Bee Bush or Chinese Abelia	Attractive to pollinators. Flowering in October.
Ajuga reptans	Bugle	Bugle is excellent for ground cover under shrubs since it prefers semi-shade and is attractive to a wide range of insects.
Anemone nemorosa	Wood Anemone	Provides a good early source of pollen and nectar for bees and other insects.
Armeria maritima	Thrift, Sea Pink	Attractive to pollinators.
Aster novi-belgii	Michaelmas Daisy	Attractive to a range of bees, butterflies, moths and birds.
Aubrieta deltoidea	Purple Rock-cress	Provides a good early food source for bees and adds colour to edges of flower beds, prefers full sunlight.
Bergenia purpurascens	Elephant’s Ear or Purple Bergenia	Attractive to pollinators.
Campanula glomerata	Clustered Bellflower	Attractive to pollinators.
Conopodium majus	Pignut	Attractive to pollinators.
Crocus tommasinianus	Early Crocus	As a winter-flowering, provides a good early source of pollen and nectar for bees and other insects.
Cynoglossum officinale	Hound’s Tongue	Attractive to pollinators.
Digitalis purpurea	Foxglove	Attractive to pollinators.
Filipendula vulgaris	Dropwort	Attractive to pollinators.
Galanthus nivalis	Common Snowdrop	As a winter-flowering, provides a good early source of pollen and nectar for bees and other insects.
Hyacinthoides non-scripta	Bluebell	Provides a source of pollen and nectar for bees and other insects. Ensure that suppliers do not provide either Spanish bluebell or the hybrid between this and bluebell (or any other hybrids) and have not stripped native bluebells from the wild.
Hypericum perforatum	Perforate St John’s Wort	Attractive to pollinators.

Lathyrus pratensis	Meadow Vetchling	Attractive to pollinators.
Leucanthemum vulgare	Ox-eye Daisy	Attractive to pollinators.
Linaria vulgaris	Common Toadflax	Attractive to pollinators.
Lunaria biennis	Honesty	Attractive to butterflies.
Malva moschata	Musk Mallow	Attractive to pollinators.
Matthiola longipetala	Night-scented Stock	Night-scented emits a pleasant scent in the evening and through the night attracting night-flying pollinators and insects and therefore bats.
Monarda didyma	Bergamot	Provides a good source of pollen and nectar.
Nicotiana	Tobacco Plant	Attractive to night pollinators like moths (beneficial for bats).
Oenothera biennis	Evening Primrose	Particularly attractive to night flying insects (therefore can attract bats).
Persicaria bistorta	Common Bistort	Attractive to pollinators.
Rudbeckia hirta	Black-eyed Susan	Attractive to pollinators. Flowering in October.
Silene vulgaris	Bladder Campion	Attractive to pollinators.
Thalictrum flavum	Meadow Rue	Attractive to pollinators.
Viola riviniana	Dog Violet	Flowers from April to June and is attractive to bees and other insects.

The tree planting schedule for the Proposed Scheme is shown in Table 14-7.

Table 14-7: Tree Planting Schedule

Scientific name	Common names	Specification	Size Girth	Comments	Qty.
Pyrus calleryana 'Chanticleer'	Callery pear	Semi-Mature	20-25cm girth	Single stem tree, 4.50-5.50m height, 2.2m clear stem, 4 x transplanted, 2m wide. Rootball, under ground guyed planted in cellular root management system	67
Gleditsia triacanthos	Honey Locust	Semi-Mature	20-25cm girth	Single stem tree, 4.50-5.50m height, 2.2m clear stem, 4 x transplanted, 2m wide. Rootball, under ground guyed planted in cellular root management system	28
Gleditsia triacanthos	Honey Locust	Mature	30+ cm	Single stem tree, 5.50-6.50m height, 2.5m clear stem, 4 x transplanted, 2m wide. Rootball, under ground guyed planted in cellular root management system	9
Betula pendula	Silver birch	Semi-Mature	20-25cm girth	Single stem tree, 4.50-5.50m height, 2.2m clear stem, 4 x transplanted, 2m wide. Rootball, under ground guyed planted in cellular root management system	94
Betula pendula	Silver birch	Selected Standard	10-12cm girth	Single stem tree, 3.00-3.50m height, 1.75 - 2.0m clear stem, 1.8m wide. Rootballed double staked planted in softworks with 2.0m diametre backfilled treepit.	8
Betula pendula	Silver birch	Heavy Standard	12-14cm girth	Single stem tree, 3.00-3.50m height, 1.75 - 2.0m clear stem, 1.8m wide. Rootballed double staked planted in softworks with 2.0m diametre backfilled treepit.	34
Betula pubescens	Downy birch	Semi-Mature	20-25cm girth	Single stem tree, 4.50-5.50m height, 2.2m clear stem, 4 x transplanted, 2m wide. Rootball, under ground guyed planted in cellular root management system	48
Betula pubescens	Downy birch	Heavy Standard	12-14cm girth	Single stem tree, 3.00-3.50m height, 1.75 - 2.0m clear stem, 1.8m wide. Rootballed double staked planted in softworks with 2.0m diametre backfilled treepit.	51
Amelanchier arborea 'Robin Hill'	Serviceberry	Semi-Mature	20-25cm girth	Single stem tree, 4.50-5.50m height, 2.2m clear stem, 4 x transplanted, 2m wide. Rootball, under ground guyed planted in cellular root management system	8

Fagus sylvatica	Beech	Heavy Standard	12-14cm girth	Single stem tree, 3.00-3.50m height, 1.75 - 2.0m clear stem, 1.8m wide. Rootballed double staked planted in softworks with 2.0m diametre backfilled treepit.	5
Sorbus intermedia 'Brouwers'	Swedish Whitebeam	Semi-Mature	20-25cm girth	Single stem tree, 4.50-5.50m height, 2.2m clear stem, 4 x transplanted, 2m wide. Rootball, under ground guyed planted in cellular root management system	6
Prunus avium 'Plena'	Wild Cherry	Semi-Mature	20-25cm girth	Single stem tree, 4.50-5.50m height, 2.2m clear stem, 4 x transplanted, 2m wide. Rootball, under ground guyed planted in cellular root management system	53
Prunus avium 'Plena'	Wild Cherry	Selected Standard	10-12cm girth	Single stem tree, 3.00-3.50m height, 1.75 - 2.0m clear stem, 1.8m wide. Rootballed double staked planted in softworks with 2.0m diametre backfilled treepit.	6
Ginko biloba	Maidenhair tree	Semi-Mature	20-25cm girth	Single stem tree, 4.50-5.50m height, 2.2m clear stem, 4 x transplanted, 2m wide. Rootball, under ground guyed planted in cellular root management system	5
Prunus subhirtella 'Autumnalis'	Winter flowering cherry	Semi-Mature	20-25cm girth	Single stem tree, 4.50-5.50m height, 2.2m clear stem, 4 x transplanted, 2m wide. Rootball, under ground guyed planted in cellular root management system	7
Platanus x hispanica	London Plane	Semi-Mature	20-25cm girth	Single stem tree, 4.50-5.50m height, 2.2m clear stem, 4 x transplanted, 2m wide. Rootball, under ground guyed planted in cellular root management system	138
Sorbus aria 'Lutescens'	Whitebeam	Semi-Mature	20-25cm girth	Single stem tree, 4.50-5.50m height, 2.2m clear stem, 4 x transplanted, 2m wide. Rootball, under ground guyed planted in cellular root management system	14
Salix alba	White willow	Heavy Standard	12-14cm girth	Single stem tree, 3.00-3.50m height, 1.75 - 2.0m clear stem, 1.8m wide. Rootballed double staked planted in softworks with 2.0m diametre backfilled treepit.	20
Salix alba	White willow	Semi-Mature	20-25cm girth	Single stem tree, 4.50-5.50m height, 2.2m clear stem, 4 x transplanted, 2m wide. Rootball, under ground guyed planted in cellular root management system	7
Sorbus acuparia 'aspleifolia'	Rowan	Semi-Mature	20-25cm girth	Single stem tree, 4.50-5.50m height, 2.2m clear stem, 4 x transplanted, 2m	30

				wide. Rootball, under ground guyed planted in cellular root management system	
Sorbus acuparia 'aspleifolia'	Rowan	Heavy Standard	12-14cm girth	Single stem tree, 3.00-3.50m height, 1.75 - 2.0m clear stem, 1.8m wide. Rootballed double staked planted in softworks with 2.0m diametre backfilled treepit.	14
Sorbus acuparia 'aspleifolia'	Rowan	Selected Standard	10-12cm girth	Single stem tree, 3.00-3.50m height, 1.75 - 2.0m clear stem, 1.8m wide. Rootballed double staked planted in softworks with 2.0m diametre backfilled treepit.	8
Prunus padus 'Watereri'	Bird cherry	Semi-Mature	20-25cm girth	Single stem tree, 4.50-5.50m height, 2.2m clear stem, 4 x transplanted, 2m wide. Rootball, under ground guyed planted in cellular root management system	13
Carpinus betulus	European hornbeam	Semi-Mature	20-25cm girth	Single stem tree, 4.50-5.50m height, 2.2m clear stem, 4 x transplanted, 2m wide. Rootball, under ground guyed planted in cellular root management system	121
Acer campestre 'Elsrijk'	Field maple	Semi-Mature	20-25cm girth	Single stem tree, 4.50-5.50m height, 2.2m clear stem, 4 x transplanted, 2m wide. Rootball, under ground guyed planted in cellular root management system	83
Fagus sylvatica 'Dawyck'	Dawyck beech	Mature	30+ cm	Single stem tree, 5.50-6.50m height, 2.5m clear stem, 4 x transplanted, 2m wide. Rootball, under ground guyed planted in cellular root management system	4
Fagus sylvatica 'Dawyck'	Dawyck beech	Semi-Mature	20-25cm girth	Single stem tree, 4.50-5.50m height, 2.2m clear stem, 4 x transplanted, 2m wide. Rootball, under ground guyed planted in cellular root management system	11
Ulmus glabra	Elm	Semi-Mature	20-25cm girth	Single stem tree, 4.50-5.50m height, 2.2m clear stem, 4 x transplanted, 2m wide. Rootball, under ground guyed planted in cellular root management system	4
Acer platanoides 'Obelisk'	Norway maple	Semi-Mature	20-25cm girth	Single stem tree, 4.50-5.50m height, 2.2m clear stem, 4 x transplanted, 2m wide. Rootball, under ground guyed planted in cellular root management system	21
Tilia cordata 'Greenspire'	Small-leaved lime	Semi-Mature	20-25cm girth	Single stem tree, 4.50-5.50m height, 2.2m clear stem, 4 x transplanted, 2m wide. Rootball, under ground guyed	131

				planted in cellular root management system	
				Proposed Trees	**1048**

15 Scheme Benefits / How we are Achieving the Objectives

This section sets out the manner in which the Proposed Scheme described herein will achieve the following Objectives as set out:

- Enhance the capacity and potential of the public transport system by improving bus speeds, reliability and punctuality through the provision of bus lanes and other measures to provide priority to bus movement over general traffic movements;
- Enhance the potential for cycling by providing safe infrastructure for cycling, segregated from general traffic wherever practicable;
- Support the delivery of an efficient, low carbon and climate resilient public transport service, which supports the achievement of Ireland's emission reduction targets;
- Enable compact growth, regeneration opportunities and more effective use of land in Dublin, for present and future generations, through the provision of safe and efficient sustainable transport networks;
- Improve accessibility to jobs, education and other social and economic opportunities through the provision of improved sustainable connectivity and integration with other public transport services; and
- Ensure that the public realm is carefully considered in the design and development of the transport infrastructure and seek to enhance key urban focal points where appropriate and feasible.

Currently, bus priority along the route of the Proposed Scheme is characterised by discontinuity. Bus priority is only provided along certain sections and a number of pinch-points cause significant delays which result in a negative impact on the performance of the bus service as a whole. Within the extents of the Proposed Scheme route, bus lanes are currently provided on only approximately 18% and 23% (Tallaght to City Centre Section), 43% and 59% (Clondalkin to Drimnagh Section) of route outbound and citybound respectively of which significant portions of the route are shared with cyclists.

Issues related to frequency, reliability and a complex network have persisted for many years and will continue to do so without further intervention. As well as the existing services on the Proposed Scheme there are a number of planned high frequency public bus services along the route which are anticipated to be in operation prior to the Proposed Scheme being implemented, including the D spine from Citywest to City Centre, G1 branch line and orbital routes S2, S4 and W2. In addition to this there are multiple other bus services which run along this corridor intermittently, providing interchange opportunities with other bus services. The Proposed Scheme interventions will seek to make all these services more reliable, particularly in peak times, thus providing a more attractive and sustainable alternative mode of transport. The introduction of segregated cycle and parking facilities will facilitate optimum bus speeds to improve on the punctuality and reliability of the bus service. Similarly, the use of active bus signalling measures will improve continuity of bus journey times through junctions.

Without the interventions of the Proposed Scheme there would likely be an exacerbation of the issues which informed the need for the Proposed Scheme itself. The capacity and potential of the public transport system would remain restricted by the existing deficient and inconsistent provision of bus lanes and the resulting sub-standard levels of bus priority and journey-time reliability. Thus, the unreliability of bus services would continue. As such the Proposed Scheme is actively enhancing the capacity and potential of the public transport system, and supports the delivery of an efficient, low carbon and climate resilient public transport service, which supports the achievement of Ireland's emission reduction targets.

A key objective of the Proposed Scheme is to enhance the potential for cycling along the route. Without the provision of safe cycling infrastructure, intended as part of the Proposed Scheme, there would continue to be an insufficient level of safe, segregated provision for cyclists who currently, or in the future would be attracted to use the route of the Proposed Scheme.

In terms of the need to improve facilities for cyclists along the route of the Proposed Scheme, the design intent is that segregated facilities should be provided where practicable to do so. Within the extents of the Proposed Scheme cycle tracks are currently provided on only approximately 6% and 7% (Tallaght to City Centre Section) and 14% and 23% (Clondalkin to Drimnagh Section) of the route outbound and inbound respectively, while advisory cycle lanes are provided on only approximately 49% and 51% (Tallaght to City Centre Section) and 27% and 4% (Clondalkin to Drimnagh Section) of the route outbound and inbound respectively. The remaining extents have no dedicated cycle provision or cyclists must cycle within the bus lanes provided.

The Proposed Scheme is implementing safe, segregated. infrastructure along the corridor in both directions and as such is greatly enhancing the potential for cycling.

Within the extents of the Proposed Scheme there are a number of amenities, village and urban centres which will be enhanced as part of the proposed works. In order to improve accessibility to jobs, education and other social and economic opportunities through the provision of an integrated sustainable transport system, there needs to be a high quality pedestrian environment, including specifically along the route of the Proposed Scheme. There are a number of uncontrolled crossings along the route of the Proposed Scheme, particularly at side roads which are generally of poor standard, including lack of provision for the mobility and visually impaired. There are multiple incidences of ‘patch repairs’ along footways that in some instance has led to undulating, uneven surfaces caused by settlement of patch repair material. This is often a hazard to pedestrians, particularly the mobility impaired.

The Proposed Scheme includes significant improvements to the pedestrian environment, both along links and at both junctions and crossings by the provision of enhanced footway finishes and additional pedestrian crossing facilities. As such the Proposed Scheme will improve accessibility to jobs, education and other social and economic opportunities not only through improvement to the public transport network and cycling infrastructure but through improvements to the pedestrian environment.

The landscape and urban realm proposals for the Proposed Scheme are based on an urban context and landscape character analysis of the route. The proposals have been informed through discussions with the NTA, local authorities and stakeholders.

The overall landscape and public realm design strategy for the Proposed Scheme was developed to create attractive, consistent, functional and accessible places for people alongside the core bus and cycle facilities. It aims to mitigate any adverse effects that the proposals may have on the streets, spaces, local areas and landscape through the use of appropriate design responses. In addition, opportunities have been sought to enhance the public realm and landscape design where practicable.

Through a combination of the above benefits, such as the provision of safe and efficient sustainable transport networks, improved infrastructure for walking and cycling, and urban realm strategies, the Proposed Scheme specifically facilitates improvements to encourage more journeys generally at a local level by active travel, including connecting to and from bus stops for all pedestrians, and in particular improving facilities for the mobility and visually impaired. Bus stops have also been carefully designed to incorporate cycle parking, where practicable, providing an integrated sustainable solution for combining active travel with longer distance trips by bus. Therefore, it is considered that the Proposed Scheme as described enables compact growth, regeneration opportunities and more effective use of land in Dublin, for present and future generations.

It is therefore considered that the design of the Proposed Scheme wholly achieves the objectives set out herein. In doing so it fulfils the aim of the Proposed Scheme in providing enhanced walking, cycling and bus infrastructure on key access corridors in the Dublin region, enabling the delivery of efficient, safe, and integrated sustainable transport movement along this corridor.

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