Kimmage to City Centre Core Bus Corridor Scheme

February 2023

Preliminary Design Report

BUS CONNECTS

SUSTAINABLE TRANSPORT FOR A BETTER CITY.

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List of Acronyms

Acronym	Definition
AC	Asphalt Concrete
AGI	Above Ground Installation
AIAR	Arboricultural Impact Assessment Report
ASLs	Advance Stacking Locations
AVL	Automatic Vehicle Location
AP	Attenuation Ponds
AT	Attenuation Tanks
AVLS	Automatic Vehicle Location System
AlluvMIN	Alluvial(mineral)
BCPDGB	BusConnects Preliminary Design Guidance Booklet
BEP	Building Information Modelling (BIM) Execution Plan
BGL	Below Ground Level
BIM	Building Information Modelling
BJTR	Bus Journey Time Report
BminDW	Deep well drained (Mainly basic)
BminPD	Mineral poorly drained (Mainly basic)
CBR	California Bearing Ratio
CBC	Core Bus Corridor
CDETB	City of Dublin Educational and Training Board
CSC	Characteristic Skid Coefficient
CIRIA	Construction Industry Research and Information Association
CPO	Compulsory Purchase Order
CCTV	Close Circuit Television
DB 32	Design Bulletin 32
DSRC	Dedicated Short Range Communications
DCC	Dublin City Council
DLAM	Dublin Local Area Model
DLRCC	Dún Laoghaire-Rathdown County Council
DM	Do Minimum
DMURS	Design Manual for Urban Roads and Streets
DCP	Dynamic Cone Penetrometer
DEHLG	Department of Environment, Heritage and Local Government
DMRB	TII Design Standards
DART	Dublin Area Rapid Transit
DRA	Designers Risk Assessment

Acronym	Definition
DTTAS	Department for Transport, Tourism and Sport
DS	Do Something
ESB	Electricity Supply Bord
ED	Engineering Designer
EIAR	Environmental Impact Assessment Report
EPR	Emerging Preferred Route
FTA	Federal Transit Administration
FRA	Flood Risk Assessment
FD	Filter Drains
GNI	Gas Networks Ireland
GSI	Geological Survey of Ireland
GDACNP	Greater Dublin Area Cycle Network Plan
GDRCoP,	Dublin Greater Dublin Regional Code of Practice
GDSDS	Greater Dublin Strategic Drainage Study
GDA	Greater Dublin Area
GDA Transport Strategy	Transport Strategy for the Greater Dublin Area 2016-2035'
GI	Ground Investigation
GIS	Geographical Information Systems
GPR	Ground Penetration Radar
GDRCoP	Greater Dublin Regional Code of Practice
GDSDS	Greater Dublin Strategic Drainage Study
HRA	Hot Rolled Asphalt
HGV	Heavy Goods Vehicle
HP	High Pressure
ILP	Institution of Lighting Professionals
IRI	International Roughness Index
ITS	Intelligent Transport System
IW	Irish Water
JTC	Junction Turning Count
KFPA	Kerbs, Footways and Paved Areas
LEBM	Low Energy Bound Mixtures
LOD	Level of Detail
LED	Light Emitting Diode
LP	Low Pressure
LPV	Longitudinal Profile Variance
MMaRC	Motorway Maintenance and Renewals Contract
Msa	Million standard axles

Acronym	Definition
MOVA	Microprocessor Optimise Vehicle Actuation
MPD	Mean Profile Depth
MCA	Multi-Criteria Assessment
MID	Mobility Impaired & Disabled
NCM	National Cycle Manual
NTA	National Transport Authority
NSS	National Spatial Strategy
NCDWC	National Construction and Demolition Waste Council
NPF	National Planning Framework
OPW	Office of Public Works
OSI	Ordnance Survey Ireland
OD	Ordinance Datum
OSP	Oversize pipes
PDR	Preliminary Design Report
PSCI	Pavement Surface Condition Index
PMG	Project Management Guidelines
PMC	People Movement Calculator
RSES	Regional Spatial and Economic Strategies
RC	Rotary Core
RMO	Road Maintenance Office
RSA	Road Safety Audit
RTPI	Real Time Passenger Information
SDCC	South Dublin City Council
SMA	Stone Mastic Asphalt
SuDS	Sustainable Urban Drainage Systems
SCOOT	Split Cycle Offset Optimisation Technique
SCATS	Sydney Coordinated Adaptive Traffic System
SDRAs	Strategic Development and Regeneration Areas
SSD	Stopping Sight Distance
STMG	Sustainable Transport Measures Grants
TII	Transport Infrastructure Ireland
TSM	Traffic Signs Manual
TP	Trial Pit
UCD	University College Dublin
VMS	Variable Message Signs

Executive Summary

This Preliminary Design Report has been prepared for the Kimmage to City Centre Core Bus Corridor Scheme and builds on the previous Feasibility and Options Reports for the Core Bus Corridors (CBC) – namely the Kimmage to City Centre CBC Proposed Scheme.

This report summarises the project background and the need for the Proposed 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 Kimmage to City Centre Core Bus Corridor Scheme wholly achieves the Proposed 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 12 Proposed Schemes.

The CBC Infrastructure Works involves the development of continuous bus priority infrastructure and improved pedestrian & 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 16 of the busiest corridors in Dublin.

The Kimmage to City Centre Core Bus Corridor of the CBC Infrastructure Works (herein after called the 'Proposed Scheme') is 3.7km long as shown in Figure 1-1. At the southern end the Proposed Scheme extends from the Kimmage Cross Roads junction (Terenure Road West / Fortfield Road / Kimmage Road West) northwards along Kimmage Road Lower for 2.2km to Harold's Cross. Bus gates will be provided on Kimmage Road Lower at Ravensdale Park at the southern end and at Harold's Cross Park at the northern, which will achieve bus priority and greatly reduce traffic volumes over a length of 2km without the need for road widening to provide bus lanes.

The Proposed Scheme joins with Harold's Cross Road at the northern end of Harold's Cross Park and extends along Harold's Cross Road for 0.4km to the Grand Canal at the junction with Parnell Road and Grove Road. The proposed scheme crosses the Grand Canal at Robert Emmett Bridge where a new footbridge will be provided on each side of the existing bridge to accommodate road widening for bus lanes and cycle tracks in both directions. A 90m long section of Clanbrassil Street Upper will be widened on the western side for the same reason. The Proposed Scheme continues for 1.1km along Clanbrassil Street Upper and Lower and New Street South to end at the junction with Patrick Street at the northern end where it will join with the Tallaght / Clondalkin to City Centre Core Bus Corridor.

The junction of Harold's Cross Road with Kenilworth Park will be modified to allow the southbound right-turn for traffic displaced by the bus gate on Kimmage Road Lower, and other changes will provide for bus and cyclist facilities at the junction.

A complementary cycle route is included in the Proposed Scheme parallel to the west of Kimmage Road Lower on quiet streets from Ravensdale Park along Poddle Park and Blarney Park to Sundrive Road, where cycle tracks will be provided to connect to Kimmage Road Lower. Poddle Park will be closed to traffic at the southern end and only cyclists and pedestrians will be permitted to link from Ravensdale Park. From Sundrive Road a new pedestrian and cycle link will be provided through a small car park to Mount Argus Square with a boardwalk structure overhanging the River Poddle. This link will connect through Mount Argus View to Kimmage Road Lower. To the east of Kimmage Road Lower Derravaragh Road at the junction with Corrib Road will be closed to traffic at the southern end and only cyclists and pedestrians will be permitted to link in the north-south direction, which is necessary to prevent through traffic from bypassing the bus gate on Kimmage Road Lower at Ravensdale Park.

Figure 1-1: Proposed Scheme Route Overview

1.2 Scheme Aims and Objectives

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

The objectives of the Proposed Scheme 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.
- 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 (extract from Transport Strategy for the Greater Dublin Area 2016-2035).

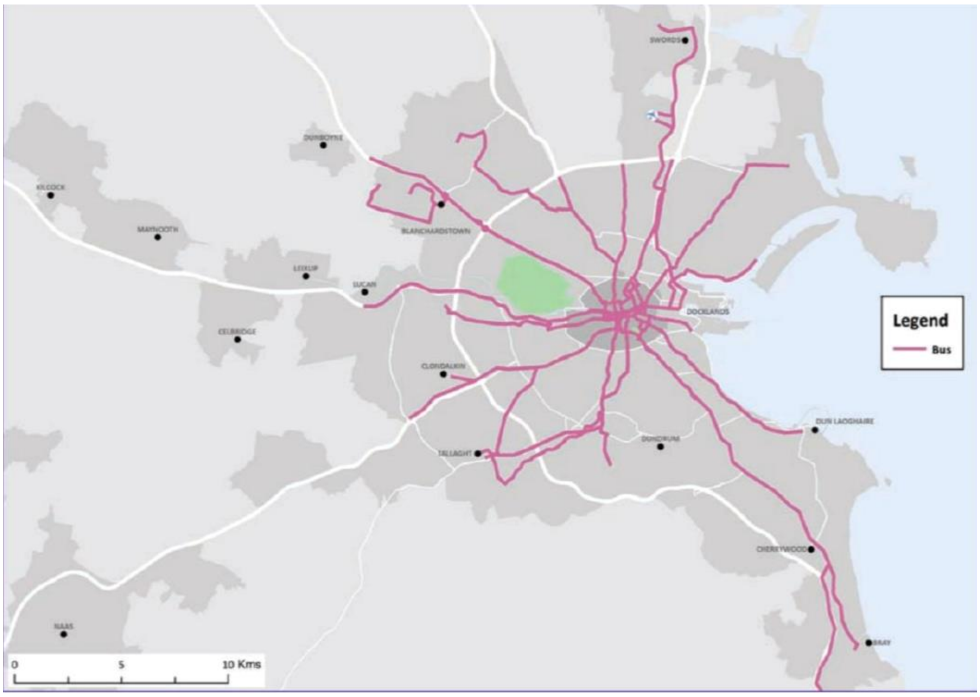


Figure 1-2: 2035 Core Bus Network – Radial Corridors

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 National Transport Authority (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 Ballymun / Finglas to City Centre CBC Scheme.

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
- Ringsend to City Centre Core Bus Corridor Scheme

The twelve radial route Proposed Schemes that form the CBC Infrastructure works are shown on Figure 1-3.

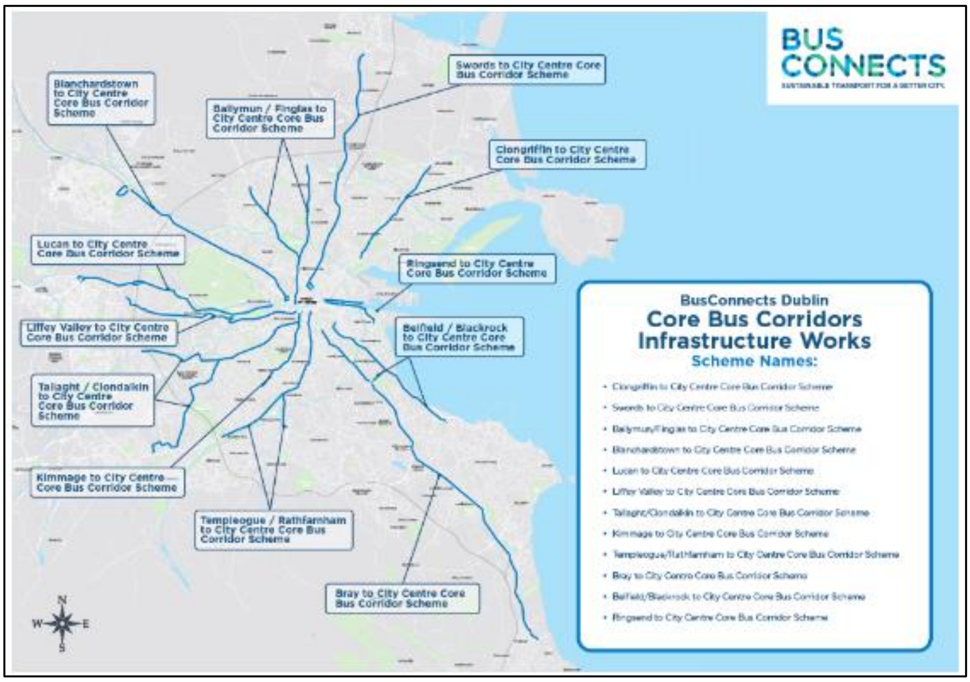


Figure 1-3 - BusConnects Radial CBC Network

1.4 Proposed Construction Procurement Method

The Proposed Scheme will proceed on the basis of procurement through a Design-Build tender process.

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 process in order to construct a CBC that will fulfil the design requirements.

1.5 Stakeholder Consultation

Three rounds of public consultation have taken place over the following dates;

- November 2018 to May 2019 - Consultation on Emerging Preferred Route
- 4th of March 2020 -17th of April 2020 - Consultation on Preferred Route Option
- 4th of November 2020 - 16th of December 2020 - Consultation on Preferred Route Option

Refer to the BusConnects website for the Kimmage to City Centre Core Bus Corridor Consultation Submissions Summary Reports for information on the non-statutory consultations at the links below:

https://busconnects.ie/wp-content/uploads/2022/02/11-kimmage-to-city-centre-report-on-cbc-public-consultation-3.pdf

Consultation with the principal project stakeholders (i.e. Dublin City Council (DCC), Waterways Ireland and statutory undertakers / utility companies, has taken place to date in order to:

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

Specific Proposed Scheme requirements have been discussed and agreed during workshops, with the NTA and 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
- Land Owners (i.e. owners of lands at any specific locations)
- Directly Impacted landowners

1.6 Audit of the Existing Situation

The following surveys have been conducted to inform the preliminary design:

- Problem Identification Audit
- Accessibility Audit
- Route Infrastructure Audit
- Existing Pavement Inspection Audit
- Existing Structures Assessment
- Existing Route Collision Analysis.
- Cellar Survey

- Private Landings Survey
- Baseline Tree Survey
- Cycle Journey Time Survey & Report
- Pavement condition
- Phase 1 Utility Survey
- Bus Stop Survey incl boarding and alighting and AVL
- Traffic Survey (JTC, pedestrian and cyclists counts)
- Parking survey
- Bus Journey Time Report

These surveys have been supplemented with secondary record data to include: utility information, OPW CFRAM Flood Models, IW Drainage Models and existing traffic signal data from DCC.

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. In particular, the PDR outlines the following:

- Sets out the context for the Scheme, the justification for the Scheme, the basis for selecting the proposed scheme improvements, and the design criteria;
- Describes the elements of the 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 tests undertaken in developing the design,
- Sets out traffic management proposals, i.e. permanent changes required as part of the 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 the accommodation works;
- Sets out particular considerations in the context of the urban landscape of the Scheme, and the criteria influencing the associated design; and
- Sets out the benefits of the Scheme.

During design development, designers' risk assessments were undertaken, details of these are included in Appendix A.

1.8 Preliminary Design Drawings

A comprehensive 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 Preliminary Design Report. 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 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 Proposed Scheme chainage structure and provides context for the locality of adjacent Schemes and other notable locations along the route. (See Appendix B1)
GEO_GA	General Arrangement Plans (1:500 @ A1)	Displays information for conveying the overarching Proposed 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 Proposed Scheme (structures or significant features which may be further described on other drawing series). (See Appendix B2)
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). (See Appendix B3)
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. (See Appendix B4)
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 SUDs features and proposed boundary treatment and key street furniture notes. (See Appendix B5)
PAV_PV	Pavement Treatment Plans (1:500@A1)	Provides an indication of the proposed pavement treatment works along the length of the route. (See Appendix B6)
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. (See Appendix B7)
TSM_GA	Traffic Signs and Road Markings Plans (1:500@A1)	Provides an indication of the proposed key the signage (information/directional/regulatory) design requirements and the design intent for the proposed lane marking arrangements along the route. (See Appendix B8)
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. (See Appendix B9)
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. (See Appendix B10)
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. (See Appendix B11)
UTL_UD	Irish Water Fowl Sewer Alteration Plans (1:500@A1)	Provides an indication of the existing trunk fowl sewer network and proposed indicative modification/diversion works (where identified) along the route. The existing and proposed kerb lines have been displayed for Proposed Scheme context. (See Appendix B12)

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 Proposed Scheme context. (See Appendix B13)
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 Proposed Scheme context. (See Appendix B14)
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 Proposed Scheme context. (See Appendix B15)
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 Proposed Scheme context. (See Appendix B16)
UTL_UC	Combined Existing Utilities Record Plans (1:500@A1)	Displays information regarding existing Statutory Undertakers records along the length of the Proposed Scheme with the Proposed Scheme features shown as background information for context. (See Appendix B17)
STR_GA	Bridges and Major Retaining Structures (Varies)	Provides additional details relating to proposed bridge structures works in addition to structural retaining walls along the route. (See Appendix B18)

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 compulsory purchase order 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’.

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 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 identifies the policies and design standards reviewed and applied to the preliminary design.

- Chapter 3: The Scheme – This chapter describes the four sections of the scheme in more detail
- Chapter 4: Road Geometry – In this chapter, the geometrical alignment and cross-section of the scheme are described, along with an overview of the operational safety process which has been implemented
- Chapter 5: Junction Layout – The junction design methodology and modelling process is then set out for the major, moderate and minor junctions along the length of the route in this chapter
- Chapter 6: Ground Investigation and Ground Condition – This chapter provides an overview of the ground investigation process and ground conditions
- Chapter 7: Pavement– This chapter gives an overview of the existing pavement situation and proposed pavement design for the scheme
- Chapter 8: Kerbs, Footways and Paved Areas– This chapter provides the design constraints and considerations of the kerbs, footways and paved areas in the scheme
- Chapter 9: 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
- Chapter 10: 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 11: Services & Utilities – This chapter shows the Utilities design strategy documents surveys undertaken to date, identifies conflicts and recommends a number of diversions
- 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 – 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: How the Proposed Scheme achieves the Objectives – In this chapter benefits provided by the Proposed Scheme are summarised, principally savings in journey times and improved efficiencies of bus priority

Appendices - Various appendices and background information as referenced throughout the report and as listed in the Table of Contents.

2. Policy Context & 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
- Department of Transport: Statement of Strategy (2016 - 2019)
- Smarter Travel: A Sustainable Transport Future (2009 – 2020)
- National Cycle Policy Framework (2009)
- Road Safety Strategy (2013 – 2020)
- Building on Recovery: Infrastructure and Capital Investment Plan (2016-2021)
- The Sustainable Development Goals National Implementation Plan (2018-2020)
- Climate Action Plan (2021)
- Eastern & Midland Regional Assembly, Regional Spatial & Economic Strategy (2019-2031)
- Transport Strategy for the Greater Dublin Area (2022-2042) including the Greater Dublin Area Cycle Network Plan
- Dublin City Development Plan (2022-2028)

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), its purpose is to provide guidance for the various design teams involved in CBC Infrastructure Works, to ensure a consistent design approach across the Proposed Scheme.

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 design standards these deviations have been noted within Section 4.16 with specific details in Appendix C.

3. The Proposed Scheme

3.1 Scheme Description

The Kimmage to City Centre Core Bus Corridor of the CBC Infrastructure Works (herein after called the 'Proposed Scheme') is 3.7km long as shown in Figure 1-1. At the southern end the Proposed Scheme extends from the Kimmage Cross Roads junction (Terenure Road West / Fortfield Road / Kimmage Road West) northwards along Kimmage Road Lower for 2.2km to Harold's Cross. Bus gates will be provided on Kimmage Road Lower at Ravensdale Park at the southern end and at Harold's Cross Park at the northern, which will achieve bus priority and greatly reduce traffic volumes over a length of 2km without the need for road widening to provide bus lanes.

The Proposed Scheme joins with Harold's Cross Road at the northern end of Harold's Cross Park and extends along Harold's Cross Road for 0.4km to the Grand Canal at the junction with Parnell Road and Grove Road. The proposed scheme crosses the Grand Canal at Robert Emmett Bridge where a new footbridge will be provided on each side of the existing bridge to accommodate road widening for bus lanes and cycle tracks in both directions. A 90m long section of Clanbrassil Street Upper will be widened on the western side for the same reason. The Proposed Scheme continues for 1.1km along Clanbrassil Street Upper and Lower and New Street South to end at the junction with Patrick Street at the northern end where it will join with the Tallaght / Clondalkin to City Centre Core Bus Corridor.

The junction of Harold's Cross Road with Kenilworth Park will be modified to allow the southbound right-turn for traffic displaced by the bus gate on Kimmage Road Lower, and other changes will provide for bus and cyclist facilities at the junction.

A complementary cycle route is included in the Proposed Scheme parallel to the west of Kimmage Road Lower on quiet streets from Ravensdale Park along Poddle Park and Blarney Park to Sundrive Road, where cycle tracks will be provided to connect to Kimmage Road Lower. Poddle Park will be closed to traffic at the southern end and only cyclists and pedestrians will be permitted to link from Ravensdale Park. From Sundrive Road a new pedestrian and cycle link will be provided through a small car park to Mount Argus Square with a boardwalk structure overhanging the River Poddle. This link will connect through Mount Argus View to Kimmage Road Lower. To the east of Kimmage Road Lower Derravaragh Road at the junction with Corrib Road will be closed to traffic at the southern end and only cyclists and pedestrians will be permitted to link in the north-south direction, which is necessary to prevent through traffic from bypassing the bus gate on Kimmage Road Lower at Ravensdale Park.

Priority for buses is provided along the entire route consisting primarily of dedicated bus lanes in both directions, with alternatives measures proposed at particularly constrained locations along Kimmage Road Lower.

Cycle tracks will be provided separate from bus lanes. An alternative cycle route is also proposed along a part of the corridor in the southern half.

The following paragraphs will describe each scheme sections in more detail, as well as identify the key design revisions which have been incorporated into the design since the publication of the Emerging Preferred Route (EPR) in January 2019.

The route may be considered in 3 separate sections as follows and as shown on Figure 3-1:

Section 1: Lower Kimmage Road from Kimmage Cross Roads to the junction with Harold's Cross Road over 2.2 km. (In red).

Section 2: Harold's Cross Road from Harold's Cross Park to the Grand Canal over 0.4 km. (In blue).

Section 3: Clanbrassil Street Upper and Lower and New Street from the Grand Canal to the Patrick Street junction over 1.1 km. (In green).

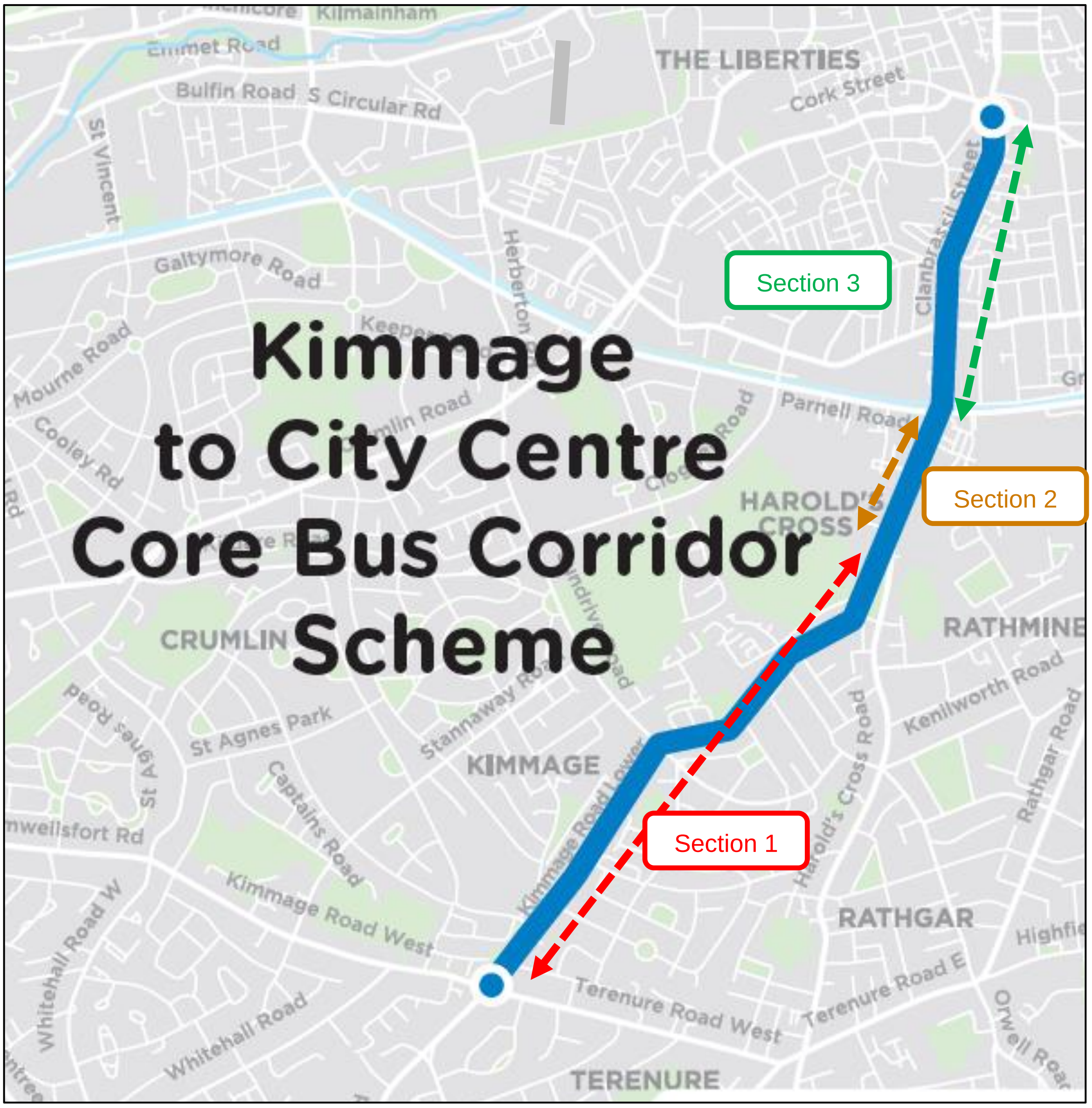


Figure 3-1: Route Sections

3.1.1 Section 1 - Kimmage Road Lower

This section of the Proposed Scheme is 2.2km long and commences on R817 Kimmage Road Lower at the Kimmage Cross-Roads (KCR) junction with R818 Kimmage Road West, R817 Fortfield Road and R818 Terenure Road West. The Proposed Scheme extends along R817 Kimmage Road Lower in a north-eastern direction generally to the junction with R137 Harold's Cross Road at the northern end of Harold's Cross Park.

From the KCR junction northwards for 250m to the junction at Ravensdale Park the existing road is quite wide with four traffic lanes over most of the length and a hatched median island / right-turn lane. Road widening is not necessary in this section and us lanes will be provided in both directions with two traffic lanes and no median island. Cycle tracks will be provided outside the bus lanes, and the footpath on the eastern side will be widened to varying extents, including over a short length where the existing footpath is very narrow.

Bus gates will be provided on Kimmage Road Lower at Ravensdale Park at the southern end and at Harold's Cross Park at the northern, which will achieve bus priority and greatly reduce traffic volumes over a length of 2km without the need for road widening to provide bus lanes. Between the bus gates the existing road layout will be retained with part-time advisory cycle lanes that operate in the peak traffic periods towards the city in the morning and outbound in the afternoon and early evening.

The junction of Harold’s Cross Road with Kenilworth Park will be modified to allow the southbound right-turn for traffic displaced by the bus gate on Kimmage Road Lower, and other changes will provide for bus and cyclist facilities at the junction.

A complementary cycle route is included in the Proposed Scheme parallel to the west of Kimmage Road Lower on quiet streets from Ravensdale Park along Poddle Park and Blarney Park to Sundrive Road, where cycle tracks will be provided to connect to Kimmage Road Lower. Poddle Park will be closed to traffic at the southern end and only cyclists and pedestrians will be permitted to link from Ravensdale Park. From Sundrive Road a new pedestrian and cycle link will be provided through a small car park to Mount Argus Square with a boardwalk structure overhanging the River Poddle. This link will connect through Mount Argus View to Kimmage Road Lower. To the east of Kimmage Road Lower Derravaragh Road at the junction with Corrib Road will be closed to traffic at the southern end and only cyclists and pedestrians will be permitted to link in the north-south direction, which is necessary to prevent through traffic from bypassing the bus gate on Kimmage Road Lower at Ravensdale Park.

Bus Priority in Section 1

Priority for buses will be provided in this section of the Proposed Scheme primarily by bus gate control and with some bus lanes. Bus lanes are proposed in either direction over most of the length of 260m from the KCR junction to a Bus Gate just north of the R817 Kimmage Road Lower and Ravensdale Park Junction as shown in Figure 3-2a. This southern Bus Gate No.1 will operate in tandem with a northern Bus Gate No.2A at the southwestern corner of Harold’s Cross Park to preclude through-traffic over the intervening 2km length of this section, to R137 Harold’s Cross Road at Harold’s Cross Park as shown in Figure 3-2b. A third Bus Gate No.2B will be located at the northern end of Kimmage Road Lower at the junction with Harold’s Cross Road as shown in Figure 3-2c. This bus gate will only permit southbound buses to fork right from Harold’s Cross Road onto Kimmage Road Lower. Local access traffic will divert a little further south to turn right at the south-eastern corner of Harold’s Cross Park where a new right-turn lane and full traffic signals will be provided. This will cater for access to Mount Argus Road and Mount Jerome Cemetery. In the northbound direction Bus Gate No.2B will operate during the morning peak period seven days per week, and this will prevent northbound traffic from skipping any queue on Harold’s Cross Road by diverting around the western side of Harold’s Cross Park. After 10am this bus gate will be open to all traffic in the northbound direction, which will include traffic leaving Mount Jerome Cemetery after a funeral.

The Bus Gates will secure bus priority by deflecting through-traffic off this route, while ensuring enhanced amenity for local residents with the development of a quieter street than currently exists (with existing parking arrangements unchanged). Local traffic access can divert via Sundrive Road on the western side, or Larkfield Avenue on the eastern side. The proposed modification to the junction of Harold’s Cross Road and Kenilworth Park will enable southbound traffic to turn right towards Kimmage when diverted by the northern Bus Gate No.2B.

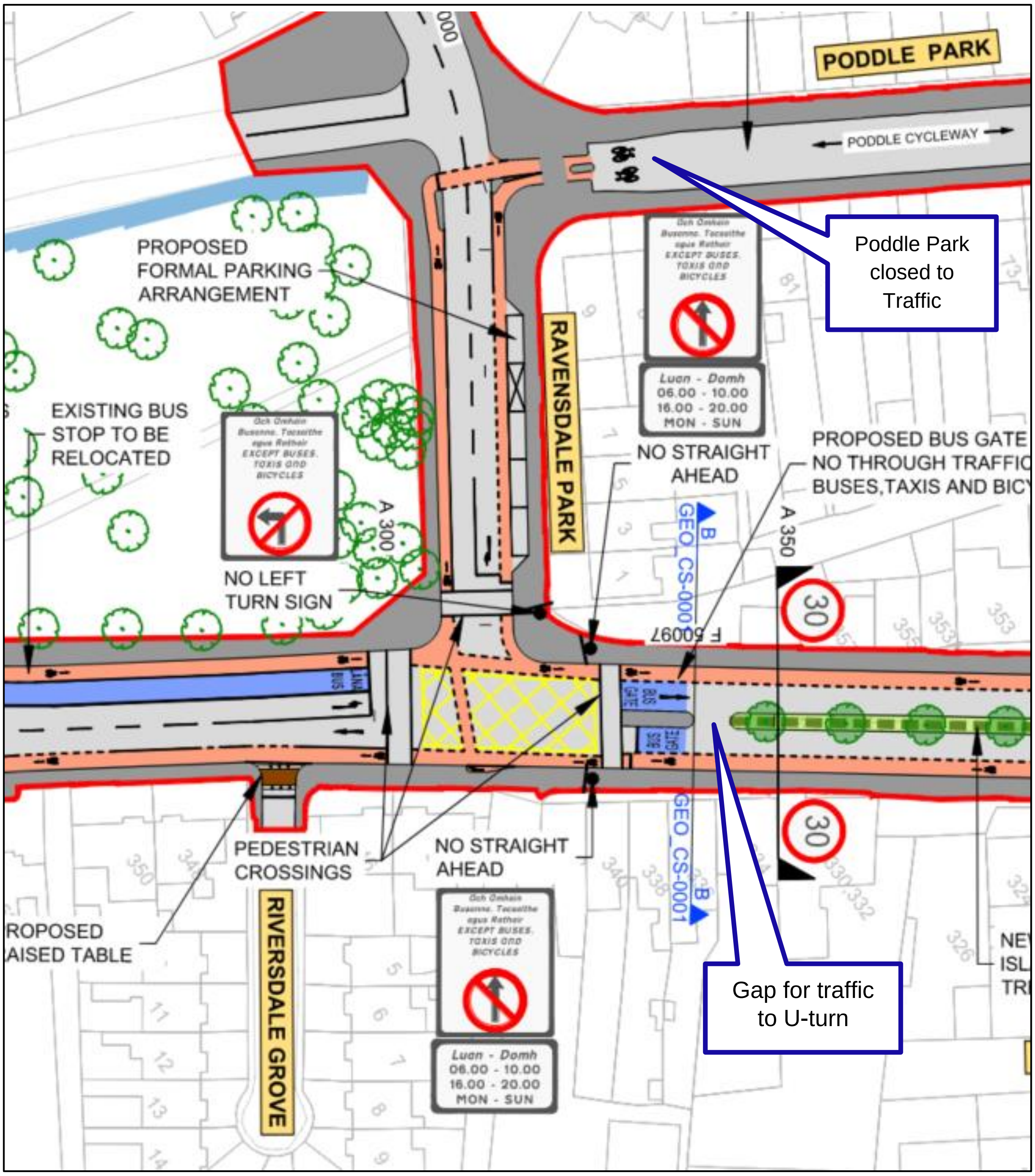


Figure 3-2a: Proposed Bus Gate No.1 at junction of Kimmage Road Lower and Ravensdale Park

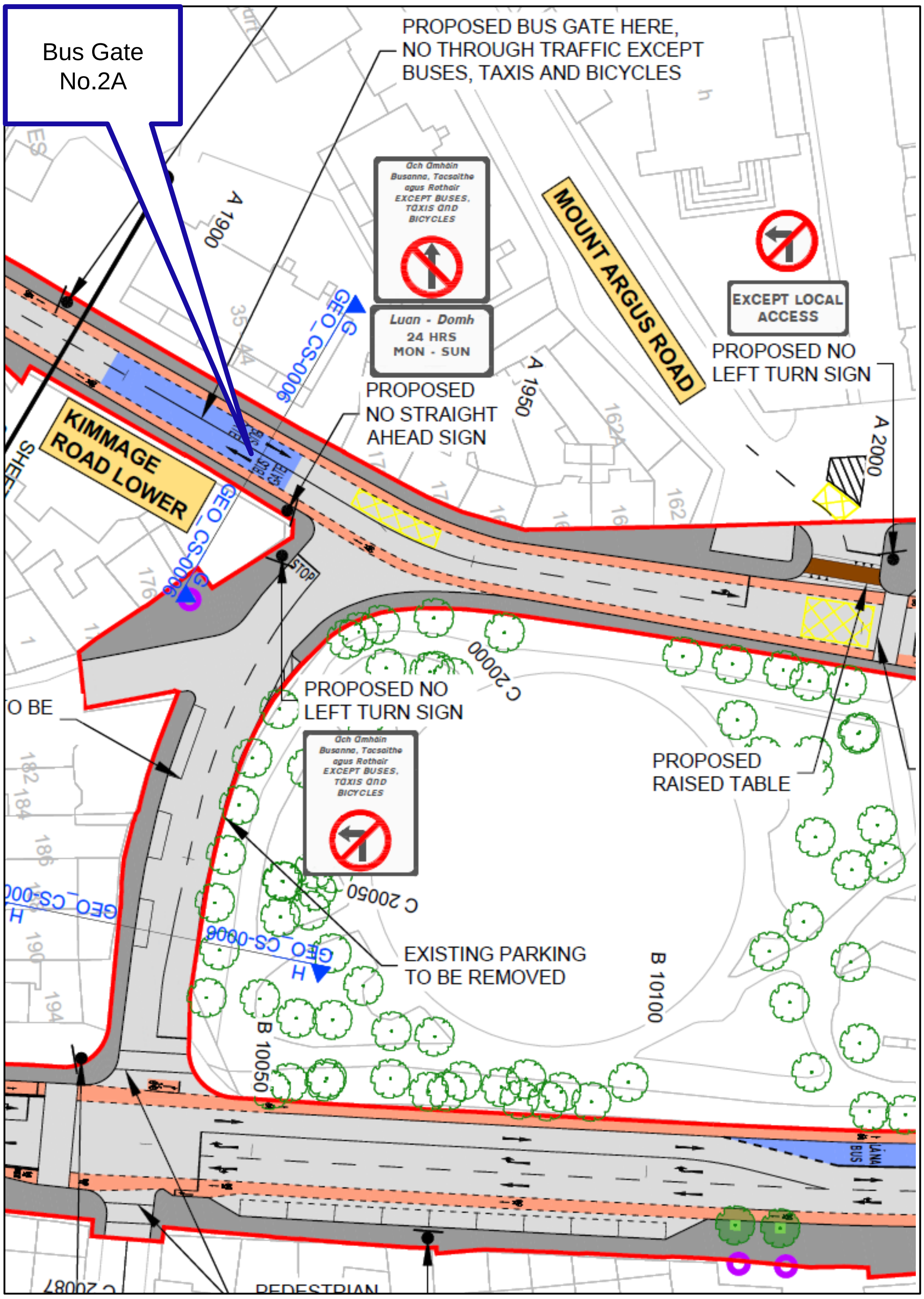


Figure 3-2b: Proposed Bus Gate No.2A at southwest corner of Harold's Cross Park

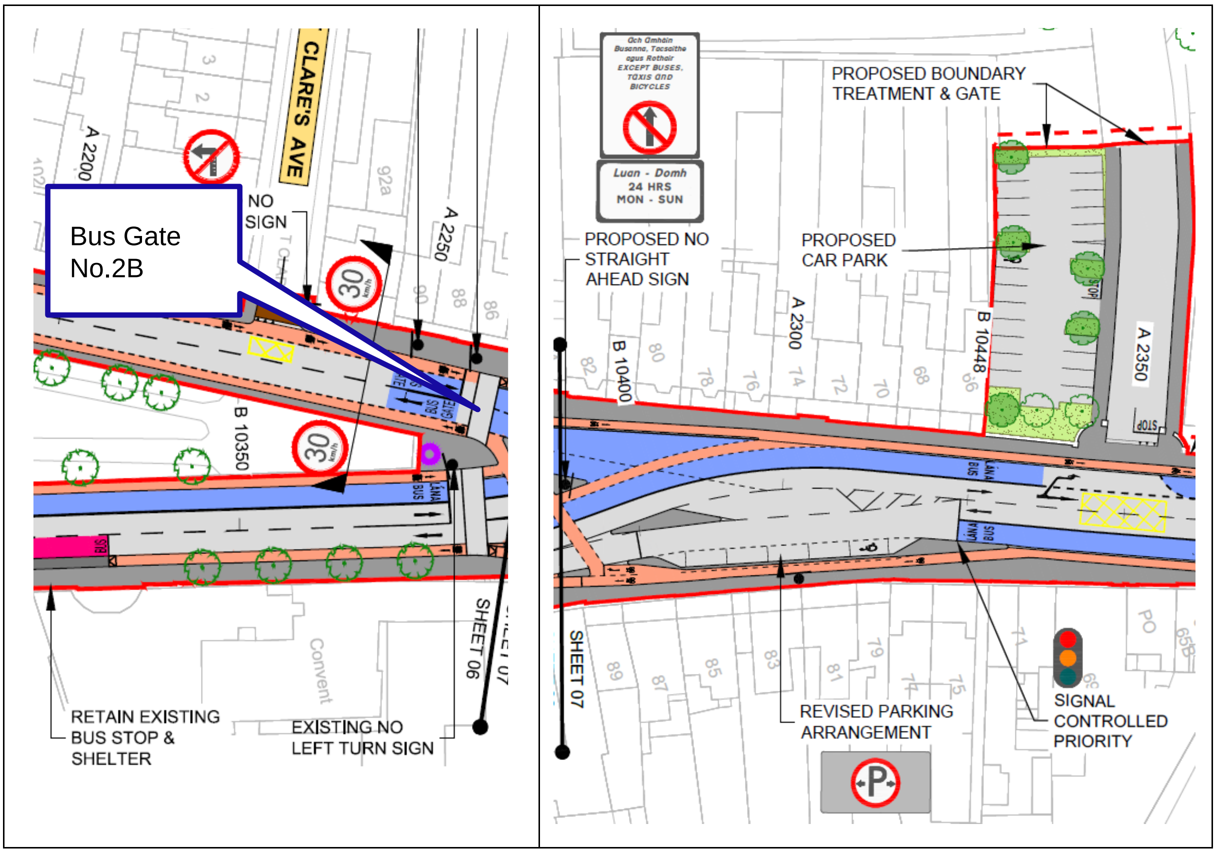


Figure 3-2c: Proposed Bus Gate No.2B at junction of Kimmage Road Lower and Harold's Cross Road

The provision of the southern Bus Gate at the Ravensdale Park Junction will be complemented by a number of traffic management measures on adjoining residential streets to prevent through-traffic or 'rat-running' as follows:

a) Near the southern Bus Gate, Poddle Park to the west will be closed to through-traffic, except for cyclists, at the junction with Ravensdale Park as shown in Figures 3-2a and 3-3.

b) To the east of the southern Bus Gate, Derravaragh Road will be closed to through-traffic, except for cyclists, at the southern side of the junction with Corrib Road as shown in Figures 3-3 and 3-4; and

c) For southbound traffic diverted by the proposed southern Bus Gate, improvements will be made to the junction of R137 Harold's Cross Road and Kenilworth Park (as shown in Figures 3-3 and 3-5) by way of the provision of a southbound right-turn to facilitate local access to R817 Kimmage Road Lower from the north. This will require adjustment to the junction for efficient traffic operation, and a westbound Bus Gate No.3 from Kenilworth Square will simplify the signal staging.

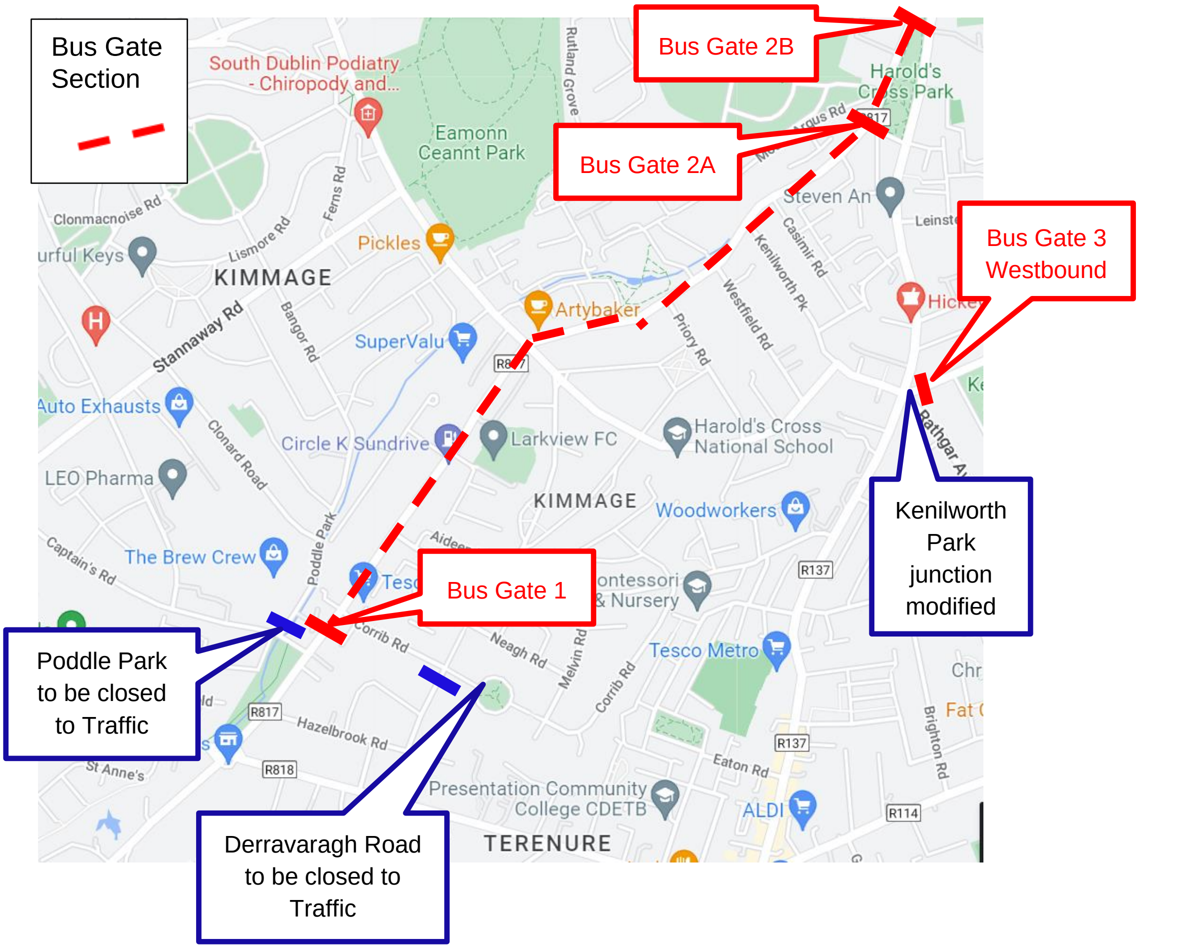


Figure 3-3: Traffic Management Measures for Kimmage Core Bus Corridor Southern Bus Gate

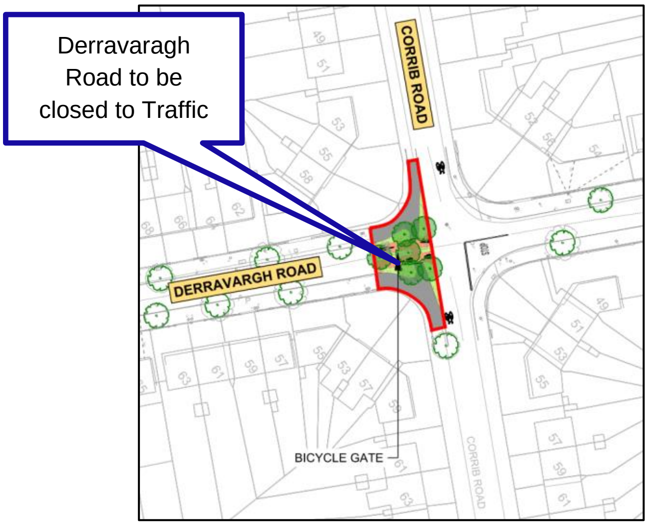


Figure 3-4: Traffic Management Measure at Derravaragh Road

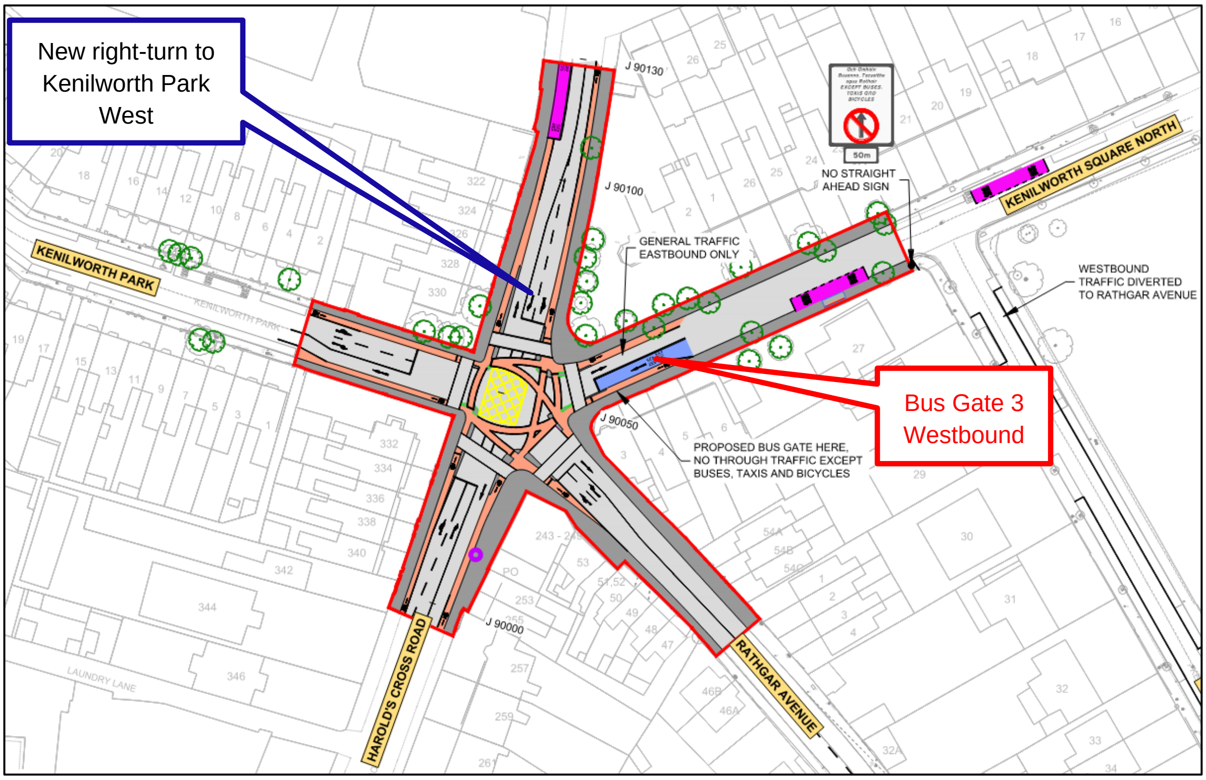


Figure 3-5: Traffic Management Measures at Junction of Kenilworth Park & Harold's Cross Road

Cycling Facilities in Section 1

Segregated cycle tracks will be provided in both directions along the southern 260m long sub-section of the Proposed Scheme from the KCR junction to the Bus Gate at the Ravensdale Park Junction. After this point, the existing advisory cycle lanes will be retained and not altered, as the traffic conditions will be much enhanced as a result of the reduced general traffic restricted by the Bus Gate. A 30 km/h speed limit will apply on the section of Kimmage Road Lower between the proposed bus gates. With much less traffic and lower speeds Kimmage Road Lower will be greatly improved for shared use by cyclists compared to the existing situation.

Kimmage Cross-Roads Junction (KCR)

The southern end of the Proposed Scheme commences at the Kimmage Cross-Roads junction at Kimmage Road West, Fortfield Road and Terenure Road West. It is proposed to upgrade the junction to provide bus priority and to enhance pedestrian and cycle facilities as shown in Figure 3-2. A southbound bus lane will extend to the junction stop line where signal-controlled priority will be provided to enable buses to proceed ahead of traffic, either straight ahead to Fortfield Road, or turning right onto Kimmage Road West. Southbound general traffic will share a single traffic lane, reduced from the current two traffic lanes. A separate signal stage will be provided for this traffic to allow left and right-turns after the bus lane signal has ended and before the opposing northbound traffic phase commences.

Segregated cycle tracks will be provided through the junction in all four directions. More direct and shorter pedestrian crossings will be provided, with the existing left-turn slip lanes removed and the corners of the junction tightened.

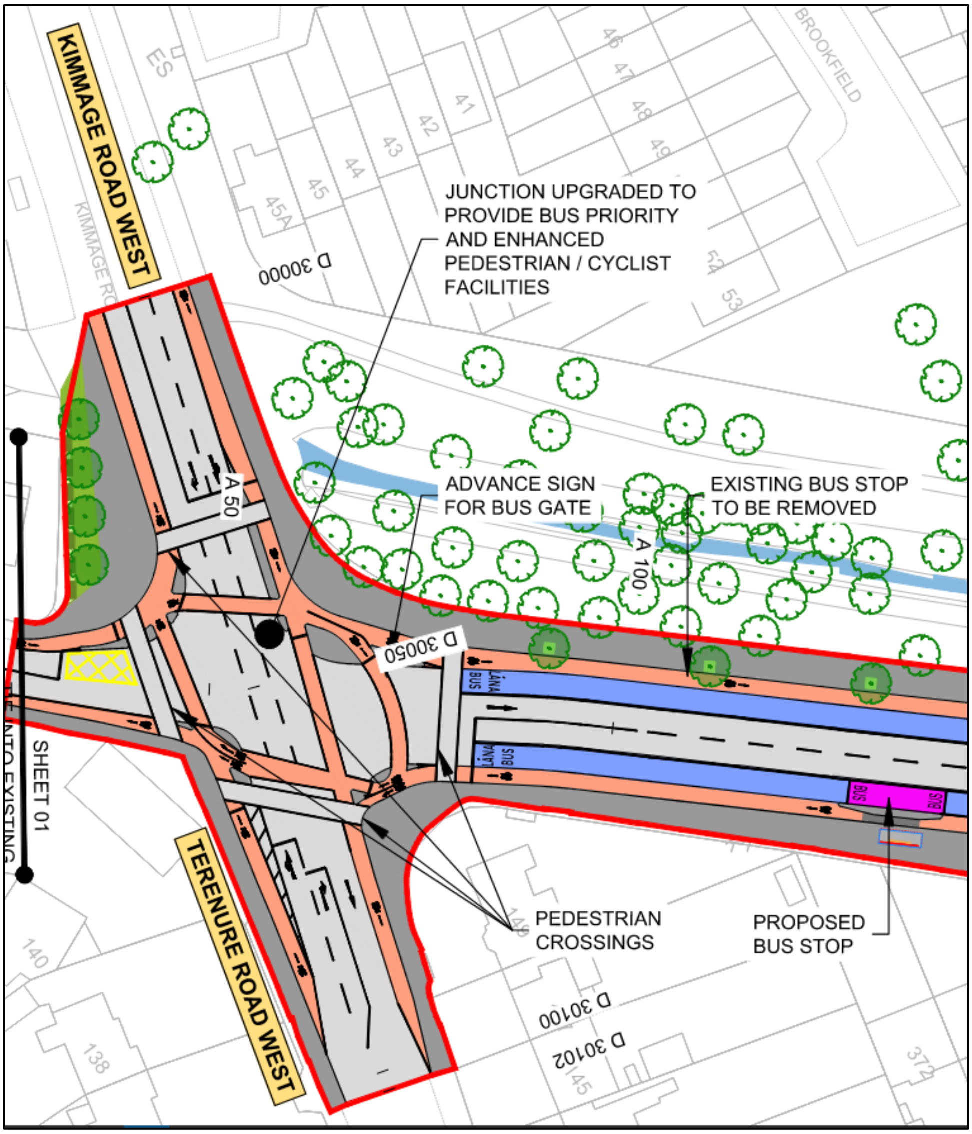


Figure 3-6: Kimmage Cross-Roads – Proposed Junction Modification

Kimmage Road Lower from KCR Junction to Bus Gate at Ravensdale Park

In this section the existing road is wider than the rest of the road further north, and it will be modified to provide bus lanes in both directions, except for a 60m length in the northbound direction immediately south of the junction at Ravensdale Park where the road narrows considerably. The lack of a bus lane over this short length will not diminish bus priority as there will be the advantage of the bus gate immediately before the junction at Ravensdale Park with no through traffic competing for road space with the bus.

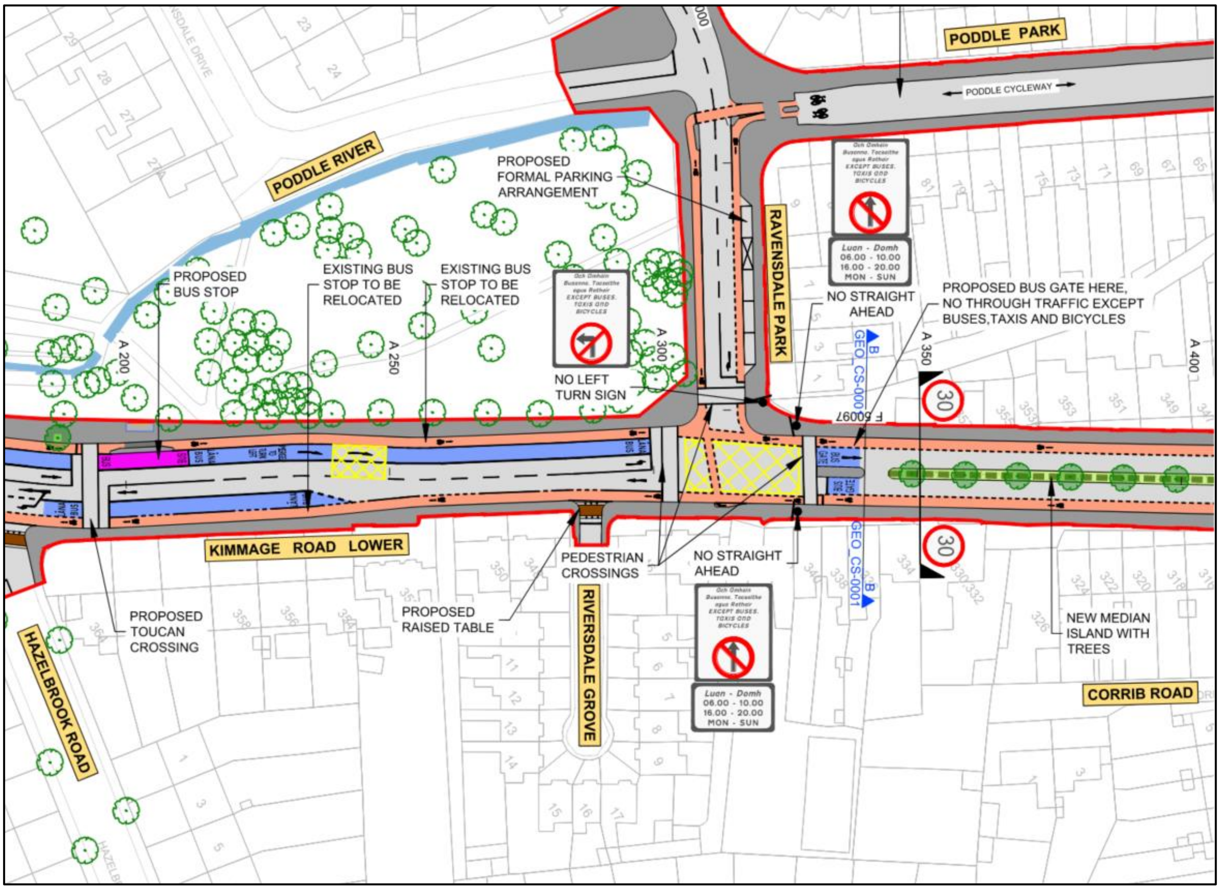


Figure 3-7: Kimmage-Road Lower between KCR and Ravensdale Park

In the middle of the existing road there is a right-turn pocket into Hazelbrook Road with associated hatched markings in the median. This right-turn pocket will be removed, and the traffic lanes will be narrowed to accommodate the proposed bus lanes and cycle tracks. The small number of right-turning vehicles will turn from the single northbound traffic lane, in a reduced volume of general traffic due to the downstream bus gate.

South of Riversdale Grove on the eastern side of the road the existing footpath narrows to less than 2m wide and as little as 1.0m wide over a length of 30m. In the Proposed Scheme this footpath will be widened to 2.0m minimum over the full length.

There are two northbound bus stops at each end of this short section, and these will be replaced by a single bus stop mid-way along the section. The southbound bus stop will be moved to south of Hazelbrook Road where the footpath is wider. Both bus stops will have shared landings for the cycle track to be segregated from the passenger boarding island.

A new signal-controlled pedestrian crossing will be provided to replace the existing uncontrolled crossing with a median island just north of Hazelbrook Road. The Ravensdale Park junction which currently does not have pedestrian crossings will be upgraded to provide a safe pedestrian crossing facility.

There are no existing street trees in this section, and 7 new street trees will be planted, mainly on the western side of the road. There will be no encroachment into Poddle Park on the western side where the River Poddle flows through the small public park area.

Kimmage Road Lower from Ravensdale Park to Harold's Cross

The removal of through traffic from this road will provide an enhanced amenity for the local residents with the development of a quieter street. The existing street layout and parking arrangements will remain unchanged north of Ravensdale Park.

The existing advisory cycle lanes will be retained on this section of the scheme. The road conditions for cyclists will also be enhanced because of reduced general traffic from the provision of bus gates at each end of the road. In addition, a proposal has been developed for a cycle route generally following the River Poddle Park along quiet local streets generally in parallel to Kimmage Road Lower over a length of 1km towards Mount Argus.

Pedestrian facilities in terms of footpaths remain generally unchanged along this section of the route, even though in some places the footpaths are less than 2m wide, which is the desirable minimum width.

The typical existing road layouts of Kimmage Road Lower are shown in Figures 3-8a and 3-8b.

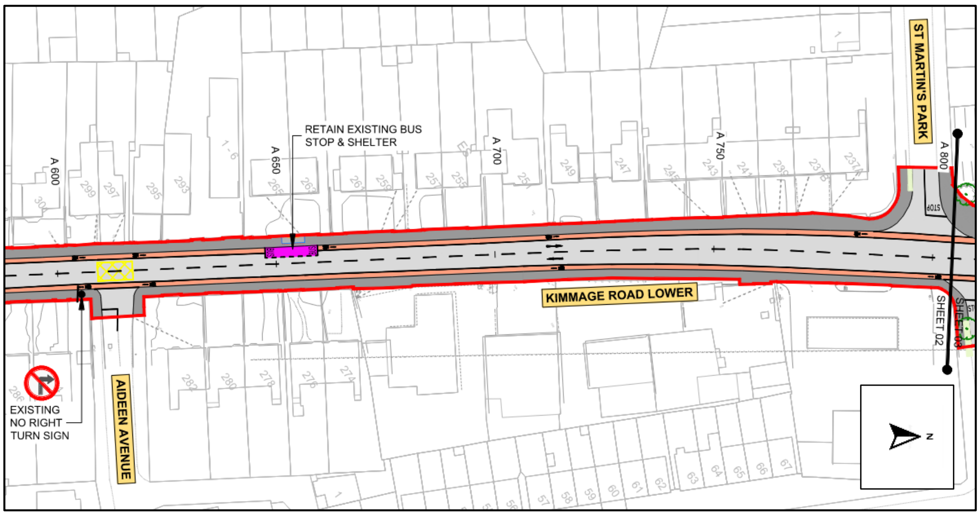


Figure 3-8a: Existing Road Layout Retained on Kimmage Road Lower South of Sundrive Cross

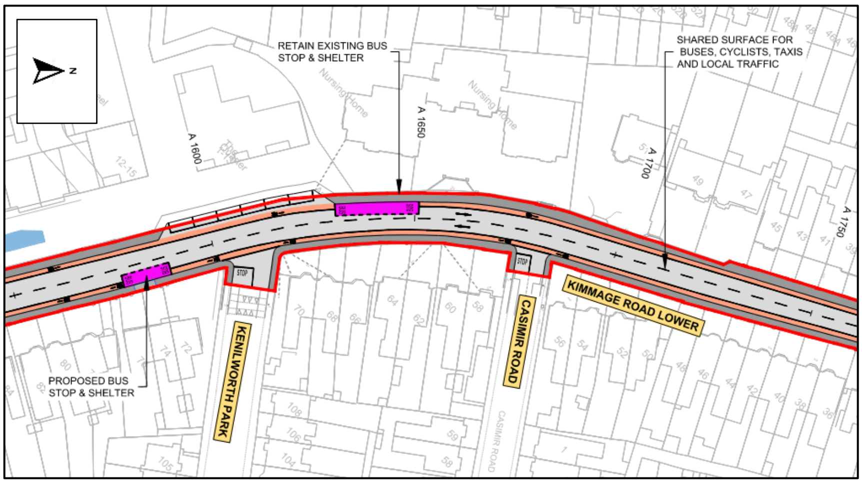


Figure 3-8b: Existing Road Layout Retained on Kimmage Road Lower North of Sundrive Cross

Public Realm Improvements at Corrib Road Junction

Public realm improvements are proposed at the focal point near the southern end of Kimmage Road Lower where there is a cluster of shops at the Corrib Road junction as shown in Figures 3-9. The existing road carriageway is 13m wide along this section. In the middle of the road a 2m wide median island will be provided on which 14 new street trees will be planted. On the eastern side of the road in front of the row of shops 5 parking spaces will be delineated between the pedestrian crossing and the bus stop. The traffic lane between these 2.5m wide parking spaces and the median island will be 3m wide.

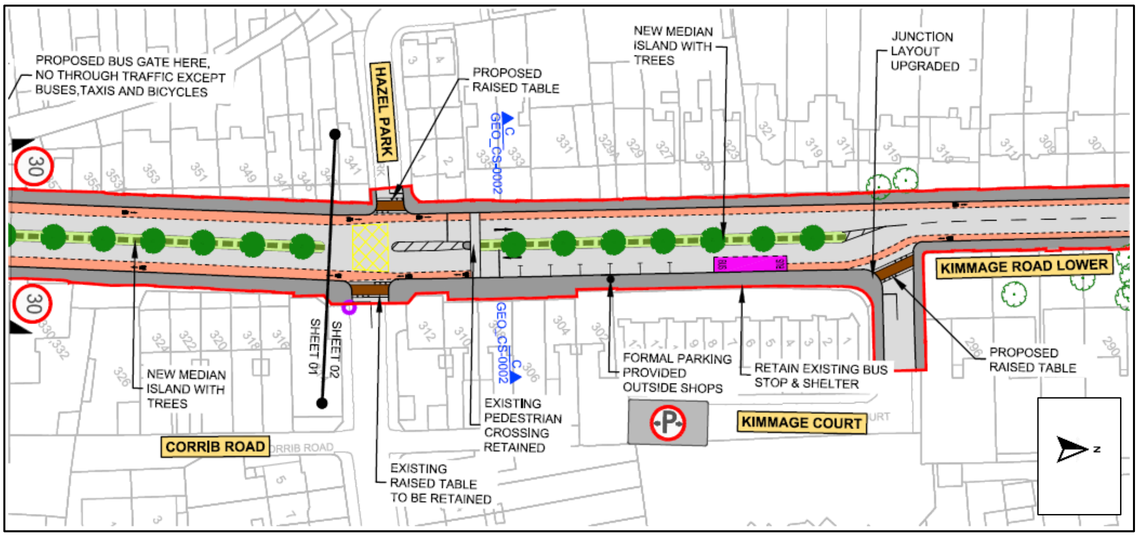


Figure 3-9: Proposed Public Realm Improvement on Kimmage Road Lower at the Corrib Road Junction

Public Realm Improvements at Sundrive Cross Junction

Public realm improvements are proposed at the focal point of the Sundrive Cross junction in the heart of Kimmage Village (Kimmage Road Lower / Sundrive Road / Larkfield Avenue) where there is a cluster of shops and business as shown in Figures 3-10a. These improvements will include high-quality paving materials, planting of trees and suitable street furniture.

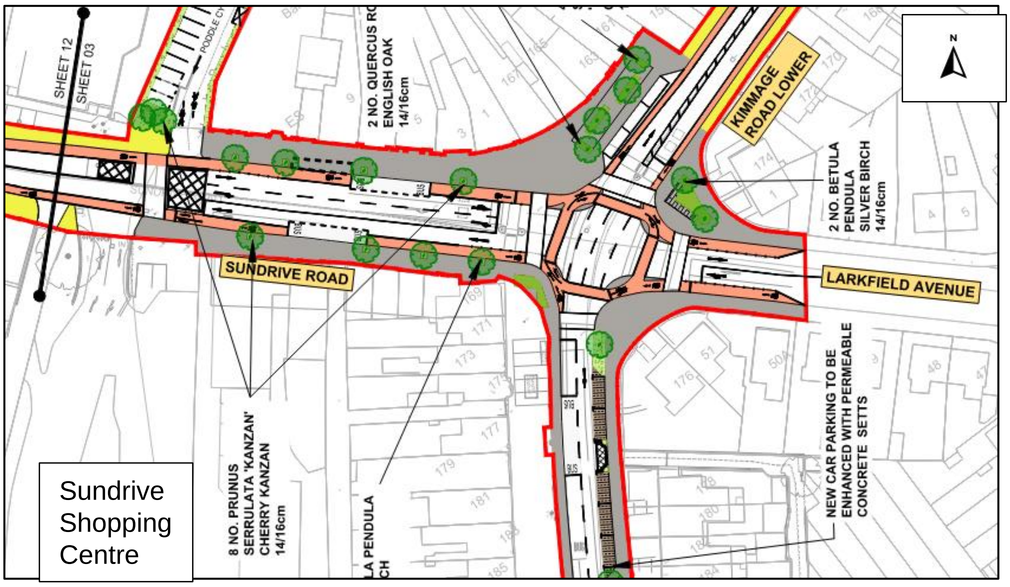


Figure 3-10a: Proposed Public Realm Improvement at Kimmage Village (Sundrive Cross)

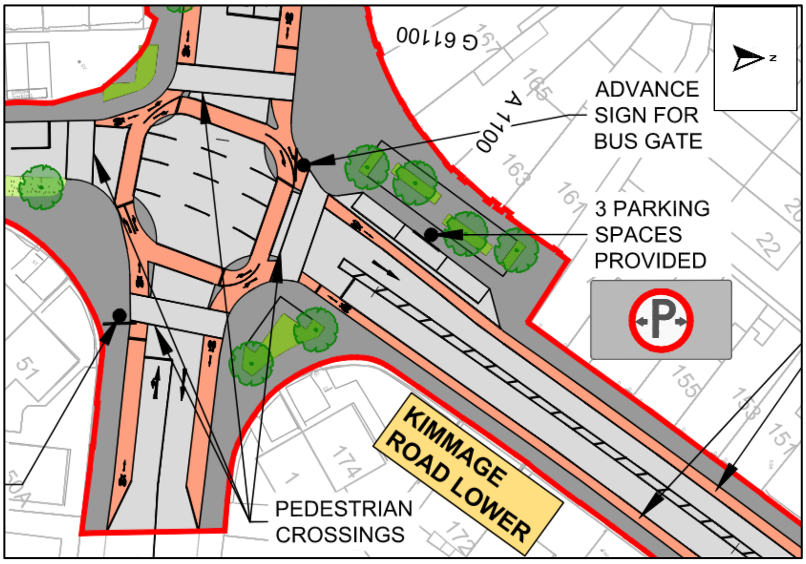


Figure 3-10b: Proposed at Sundrive Road Junction

The Sundrive Cross junction of Kimmage Road Lower, Sundrive Road and Larkfield Avenue will be modified to provide protected cycle tracks at the corners of the junction. The road area will be reduced with tighter corners and shorter pedestrian crossings as shown in Figure 3-10.

Parking on Kimmage Road Lower South of Sundrive Cross

On Kimmage Road Lower south of the Sundrive Cross junction there is a row of 22 houses on the eastern side of the street that do not have driveways. It is proposed to provide a parking layby with 16 spaces on that side of the road, with 10 new street trees to planted between each pair of parking spaces as shown in Figure 3-10b. This proposal will replace the existing part-time on-street parking. The existing road carriageway is 9m wide and this will reduce to 6.5m wide outside the parking layby. The advisory cycle lanes will be removed over this 150m long section of the road and cyclists will share the 3.25m wide traffic lane in the low-speed 30km/h environment.

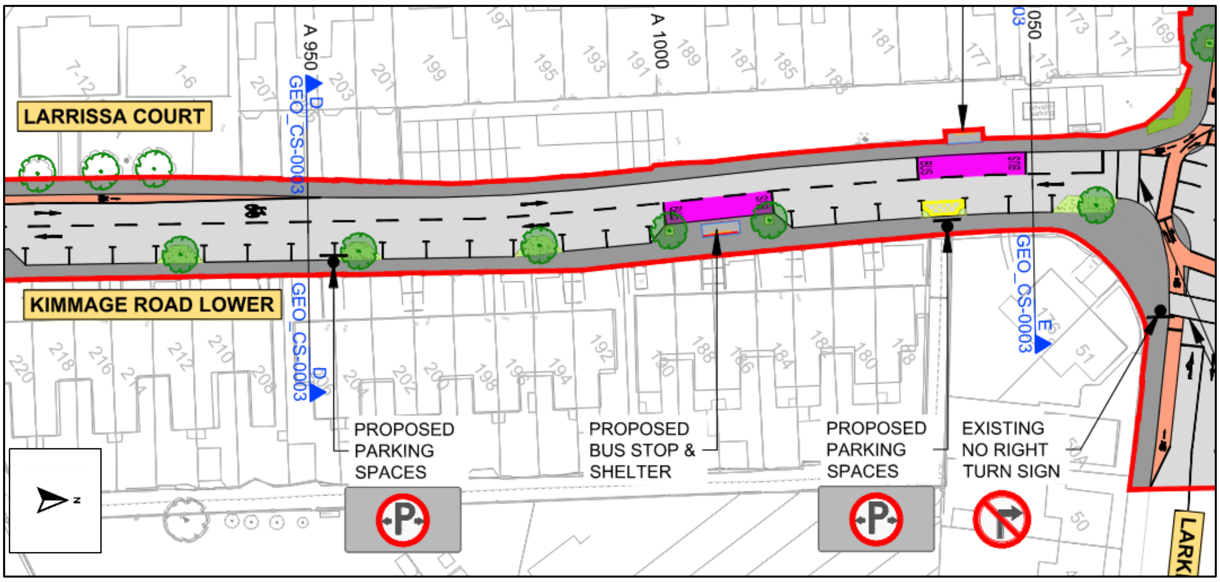


Figure 3-10b: Proposed Scheme on Kimmage Road Lower South of Sundrive Road Junction

Poddle Cycleway & Sundrive Road

A secondary cycle route will also be designated, in parallel to R817 Kimmage Road Lower, along Poddle Park, Bangor Road, and Blarney Park to Sundrive Road. This route along local residential streets will require no changes to the existing road layout north of the junction of Poddle Park and Ravensdale Park which will be closed to through traffic. That traffic restriction will greatly reduce the volume of traffic on the proposed cycle route. A general 30km/h zone is already in place across the residential area of Kimmage/Crumlin west of Kimmage Road Lower as shown in Figure 3-11 (and at rt3369_13 - 30KP Speed Limit Review 2019-11.12.2019 Rev D.dgn (dublincity.ie)). With low traffic volumes and low speeds, the proposed *Poddle Cycleway* will follow suitably quiet streets.

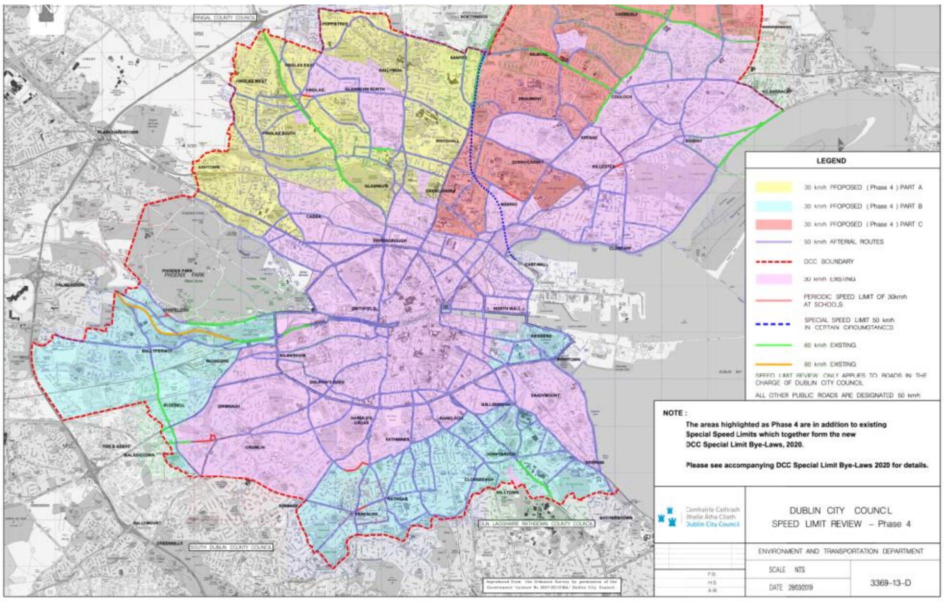


Figure 3-11: Dublin City Council Speed Limits Map

On Sundrive Road cycle tracks will be provided in both directions from the junction at Blarney Park eastwards to Sundrive Cross at Kimmage Road Lower over a length of 200m.

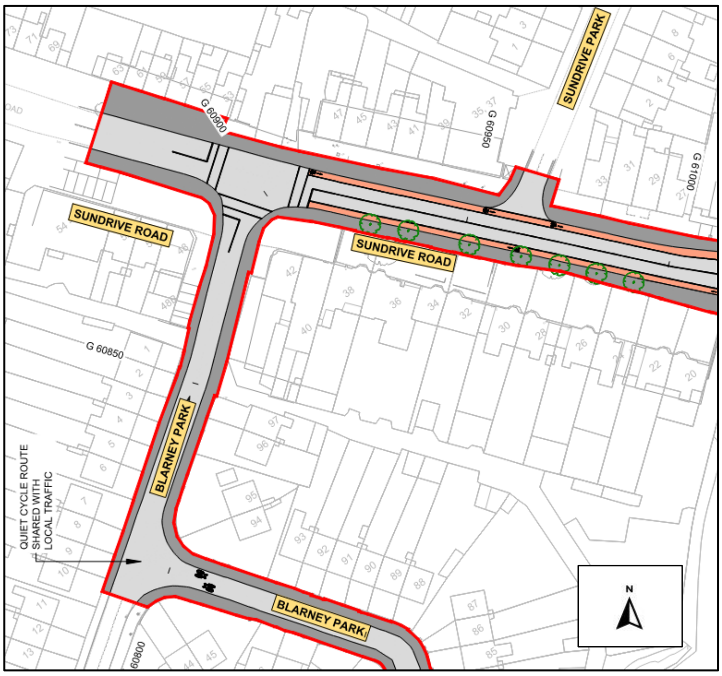


Figure 3-12: Poddle Cycleway at Blarney Park & Sundrive Road

The Poddle Cycleway through Mount Argus & the Stone Boat Boardwalk

At the entrance to Sundrive Shopping Centre the proposed *Poddle Cycleway* will turn northwards into a small car park that sits on top of the culvert that carries the River Poddle under Sundrive Road and the car parks to the north and south of it. From Sundrive Road, a new pedestrian and cycle route connection will be provided along the route of the River Poddle beside Mount Argus Square where a proposed steel boardwalk structure will be provided beside the river at the Stone Boat feature. The *Poddle Cycleway* will share the existing quiet residential streets of Mount Argus Way and Mount Argus View run to where it will join Kimmage Road Lower.

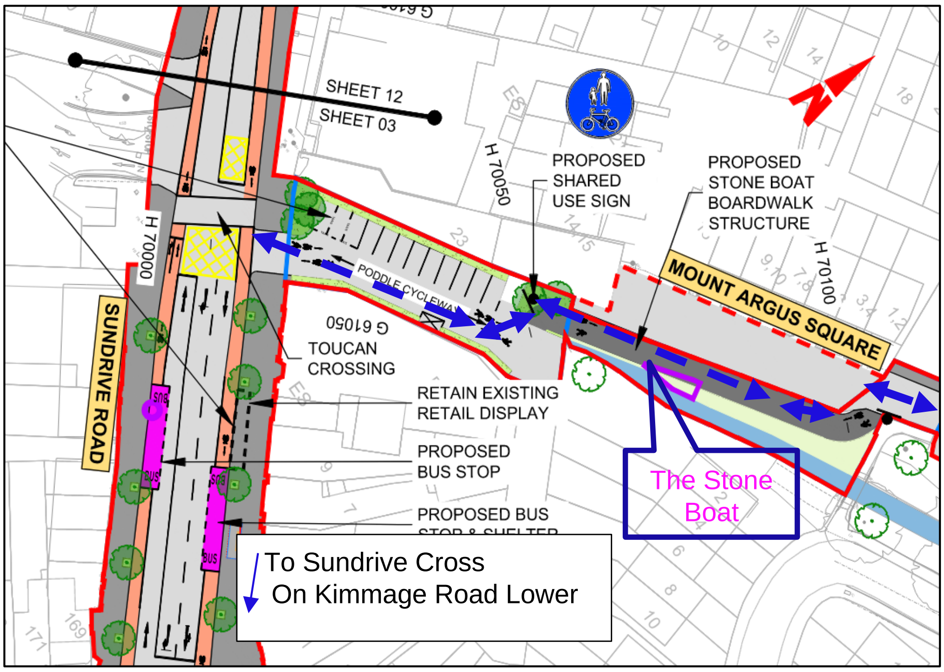


Figure 3-13a: The Poddle Cycleway Link from Sundrive Road to Mount Argus with the proposed Stone Boat Boardwalk

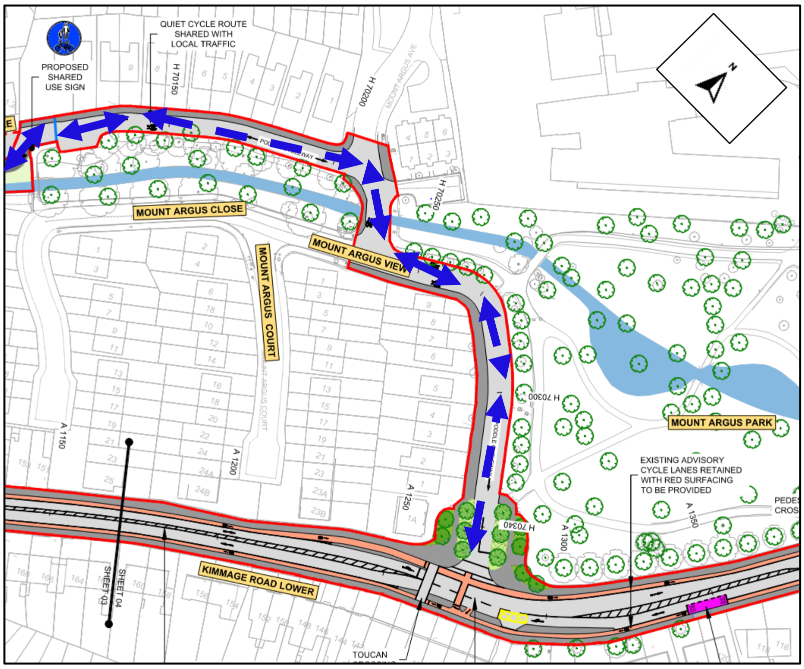


Figure 3-13b: The Poddle Cycleway Link at Mount Argus

Junctions at Mount Argus

The following two junctions on Kimmage Road Lower at Mount Argus will be modified for improvements to pedestrian and cycling facilities:

- Mount Argus View – signal controlled.
- Mount Argus Church – priority controlled.

At Mount Argus View the existing junction is shown in Figure 3-14a. There are left and right turning lanes for traffic with slip lanes and traffic islands at the junction corners which require pedestrians walking along the western side of Kimmage Road Lower to make 3 separate uncontrolled road crossings.

Figure 3-14a: Existing Junction at Mount Argus View (Google Earth)

In the proposed scheme this junction will be modified to a more compact layout without turning lanes or slip lanes, and the traffic islands will be removed, as shown in Figure 3-14b. A pedestrian signal will be provided across the side road arm of Mount Argus View. This will provide significant improvement for pedestrian safety and convenience.

For cyclists there will be a short section of segregated cycle track on Kimmage Road Lower in both directions and a signal controlled right-turn facility into Mount Argus View for access to the *Poddle Cycleway*.

The reclaimed road areas at the junction corners will be landscaped with 12 new street trees planted.

Figure 3-14b: Proposed Junction Layout at Mount Argus View

At Mount Argus Church the existing junction is shown in Figure 3-15a. The junction corners have a wide radius and are set back from the edge of Kimmage Road Lower with parking bays provided beside each corner.

In the proposed scheme this junction will be modified to a more compact layout with corner build-outs to fully enclose the parking bays, as shown in Figure 3-15b. A raised platform crossing for pedestrians will be provided across the side road arm of Mount Argus Church.

Two new feature street trees will be planted at the corners of the junction.

The road pavement at the junction mouth will be resurfaced back to the gate to the avenue leading up to the church.

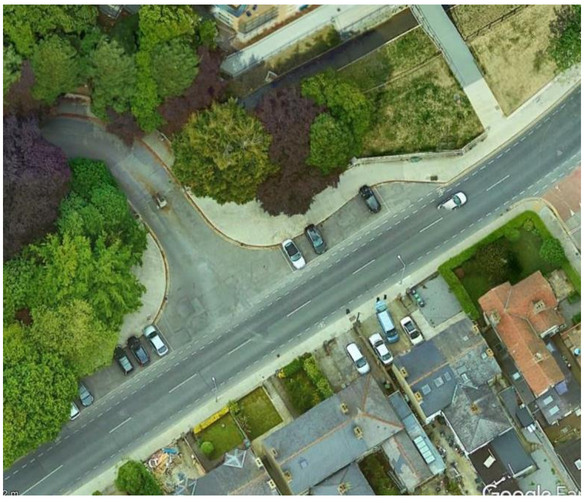


Figure 3-15a: Existing Junction at Mount Argus Church (Google Earth)

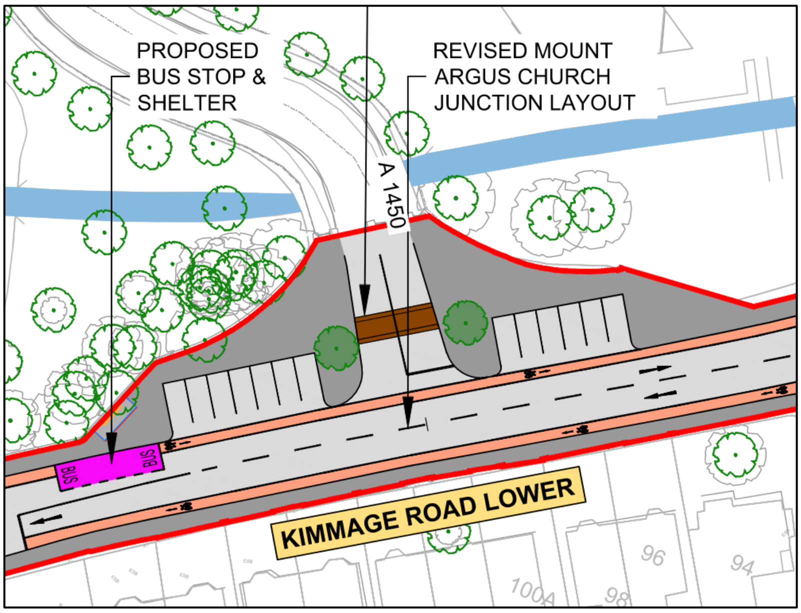


Figure 3-15b: Proposed Junction Layout at Mount Argus Church

There is an existing northbound bus stop just south of the junction where the footpath is quite narrow. This bus stop will be moved a few metres northwards to where the footpath widens, and a new bus shelter will be provided where there is generous space available beside the boundary wall of Mount Argus Park that turns away from the road at an angle.

Northern Bus Gates at Harold's Cross Park

The bus gate section of Kimmage Road Lower will be controlled by a northern Bus Gate No.2A just to the southwest of the corner of Harold's Cross Park beside McGowan's pub as shown in Figure 3-16. This northern bus gate at Harold's Cross will operate in tandem with the southern bus gate at Ravensdale Park to restrict through traffic over a length of 2km along Kimmage Road Lower. The northern bus gate will operate on a 24-hour, 7-days per week basis. An ancillary Bus Gate No.2B will be provided on Kimmage Road Lower at the junction with Harold's Cross Park at northern end of Harold's Cross Park to direct through traffic away from the route towards Kimmage. Bus Gate No.2B will operate on a 24-hour, 7-days per week basis in the southbound direction to remove conflicts between right-turning buses and traffic at the Y-shaped junction at the northern end of Harold's Cross Park. Signal-controlled priority will be provided for southbound buses at this junction so they can turn right or proceed straight-ahead before other traffic. The existing two traffic lanes will be reduced to one lane and the southbound bus lane which currently ends at the entrance to St. Clare's School will be extended 100m southwards to the stop line at the junction. Southbound traffic that requires to turn right for local access at Harold's Cross Park (to the western side of the park, to Mount Jerome Cemetery or to Mount Argus Road), will be diverted to the southern end of the park where a new right-turn lane will be provided and the junction at Park View will be fully signal controlled.

In the northbound direction Bus Gate No,2B is only required to operate in the morning peak period from 6am to 10am, 7-days per week to prevent traffic from skipping the queue on Harold's Cross Road. For the rest of the day general traffic on the western side of the park will be permitted to proceed northwards through Bus Gate No.2B. This will facilitate funeral traffic departing from the busy Mount Jerome Cemetery.

Local traffic access to Kimmage Road Lower will be available from the west via Sundrive Road, and from the east via Clareville Road / Larkfield Avenue. Northbound traffic from the city direction will continue southwards along Harold's Cross Road and turn right at Kenilworth Park where the existing right-turn restriction will be removed, and the junction modified to include a right-turn lane.

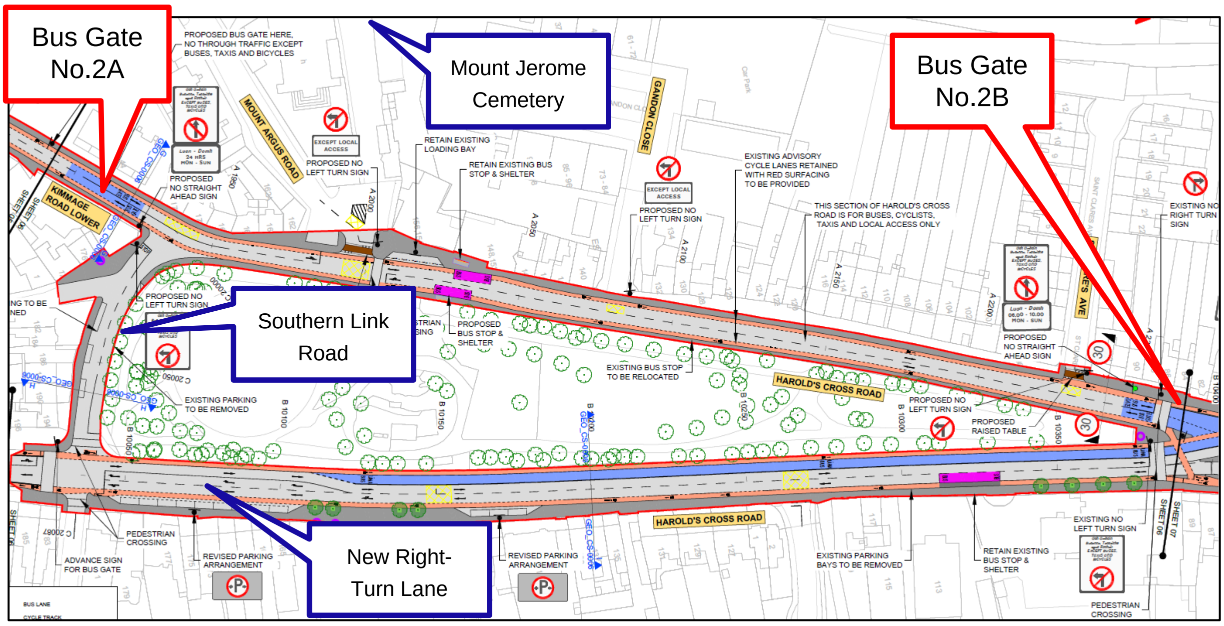


Figure 3-16: Proposed Scheme at Harold's Cross Park

On Harold's Cross Road on the eastern side of the park the existing northbound bus lane will be shortened by 75m at the south-eastern corner of the park to accommodate the proposed southbound right-turn lane.

Link Road at Harold's Cross Park South

At Harold's Cross Park south there is a short link road that connects Harold's Cross Road to Kimmage Road Lower. This narrow street has parking on the southern side that requires passing traffic to give way to oncoming traffic. This street will accommodate local traffic to and from the western side of the park and it will be necessary to widen it for proper two-way traffic. This will be done by removing the existing footpath on the northern side of the street adjoining the park over a length of 50m. This footpath is little used as most pedestrians walk through the adjoining park when it is open during the day. At other times there is the alternative footpath along the southern side of the street. The alternative to this proposal will be to remove the five on-street parking spaces in front of houses for which there is no other parking available nearby.

Figure 3-17: Link Road at southern side of Harold's Cross Park

Kenilworth Park Junction on Harold's Cross Road

To accommodate local access to Kimmage Road Lower from the north, the junction at Harold's Cross Road and Kenilworth Park will be modified to provide for the southbound right turn movement which is currently restricted. This was shown earlier in Figure 3-5. The operation and capacity of this 5-arm junction will be improved by the restriction of the link from Kenilworth Square on the eastern side to a westbound bus gate for buses, taxis, and cyclists only. Traffic from the Rathmines direction will be diverted a short distance via Rathgar Avenue to the south.

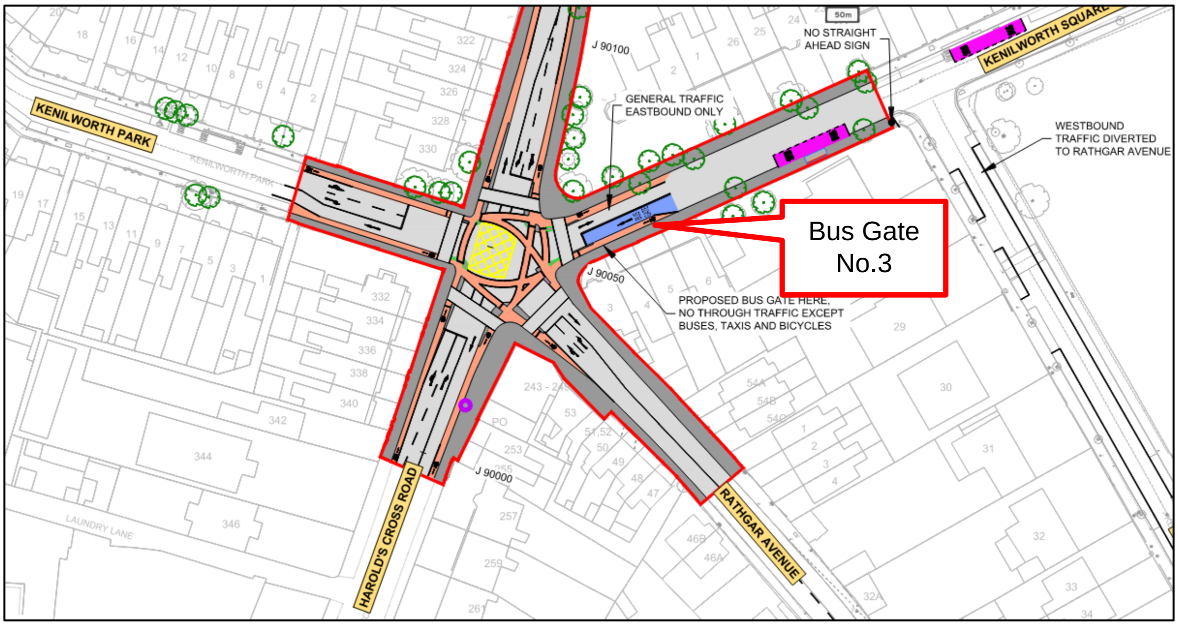


Figure 3-5 (Repeat): Traffic Management Measures at Junction of Kenilworth Park & Harold's Cross Road

3.1.2 Section 2 - Harold's Cross Road

This section along Harold's Cross Road between Harold's Cross Park and Parnell Road is 400m long. There are bus lanes in both directions but no cycle tracks. It is proposed to provide 2m wide footpaths, 1.5m wide cycle tracks, one bus lane 3m wide, and one general traffic lane 3m wide in each direction, with an overall road width of 19m as shown in Figure 3-18.

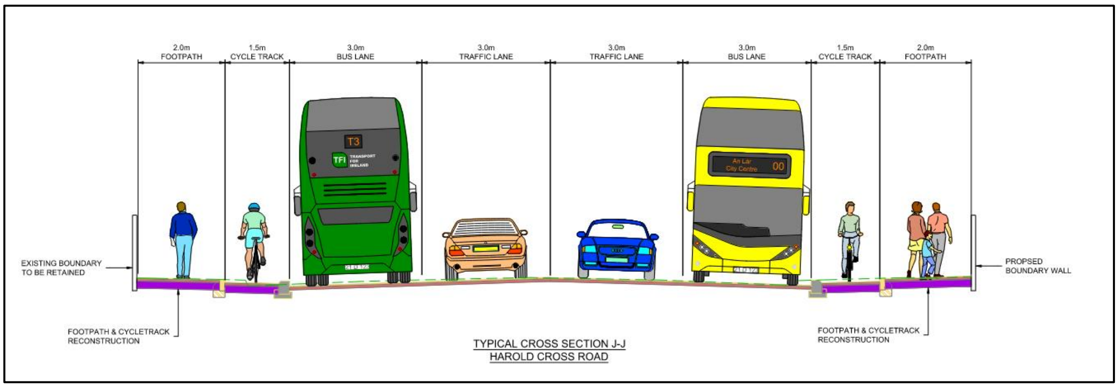


Figure 3-18: Proposed Cross-Section on Harold's Cross Road

The existing road width varies from a minimum of 17m at the southern and northern ends, and up to 20m in the central part. It is proposed to acquire small areas of land from adjacent properties where necessary to accommodate the proposed road layout.

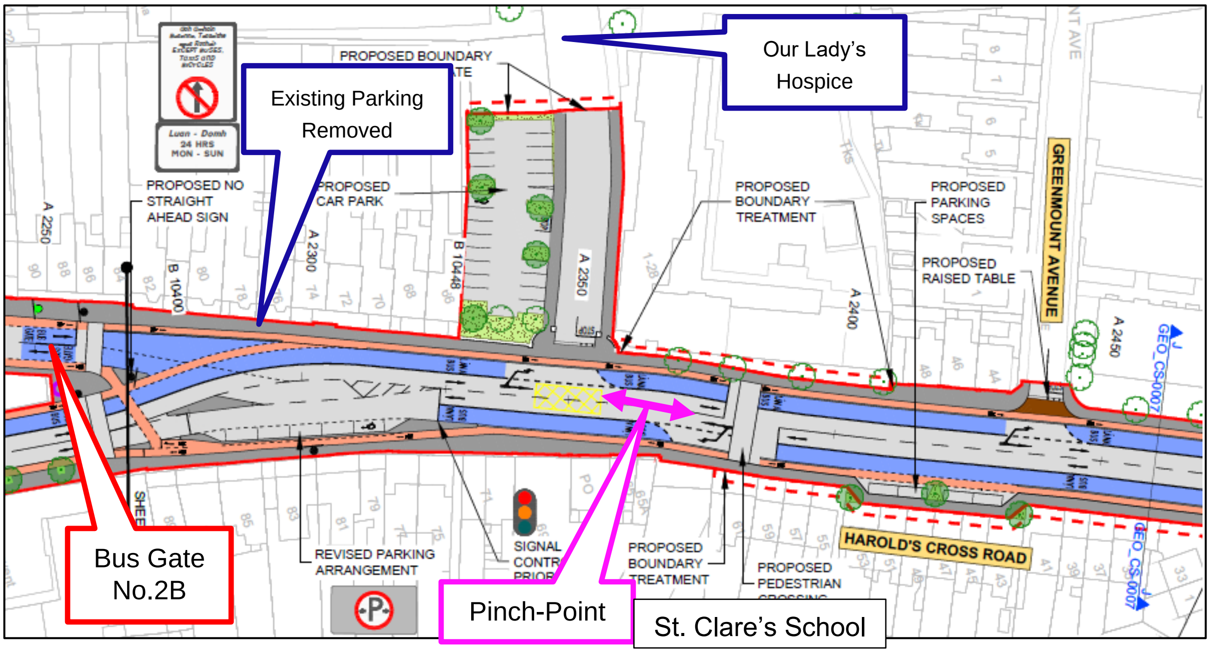


Figure 3-19: Proposed Road Layout on Harold's Cross Road at southern end of Section 2

Just north of the junction at Harold's Cross Park on the western side of the street there is a row of 10 parking spaces, which are very heavily used, that will be removed to accommodate the northbound cycle track. Parking is very limited in this location and very few houses have off-street parking. This context can cause a risk of illegal parking that would obstruct the proposed cycle tracks and bus lanes. It is proposed to provide a replacement for the 10 lost parking spaces and 12 new spaces in a new car park on a lawn area at the front of the grounds of Our Lady's Hospice on the western side of the street as shown in Figure 3-19. A plot of land will be acquired for this purpose.

North of the entrance to the hospice on the western side to the entrance to St. Clare's primary school on the eastern side there is a 20m long pinch-point in the street where it is only 17m wide and there is very limited scope for road widening. On the eastern side the facades of the buildings are directly at the back of the footpath as shown in Figure 3-20a. On the western side there is a small garden area behind a railing at a residential building as shown in Figure 3-20b.

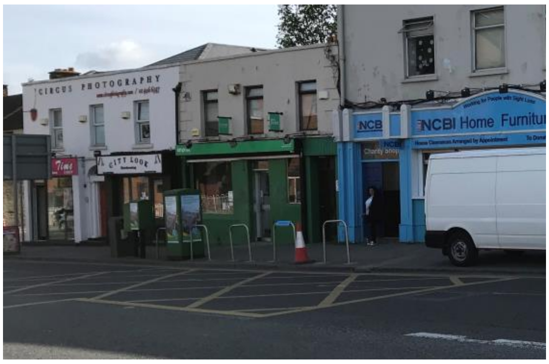


Figure 3-20a: Harold's Cross Road eastern side opposite Our Lady's Hospice

Figure 3-20b: Harold's Cross Road western side north of Our Lady's Hospice

The most land that could be acquired in this location is 1.4m due to the overhang of the building as shown in Figure 3-20b. For this reason the proposed cycle tracks will be locally narrowed to 1.2m which is a departure from the design standards but is wide enough for single file cycling.

A new pedestrian crossing will be provided on Harold's Cross Road just north of St. Clare's School, which will be more convenient for access to the school. The nearest existing pedestrian crossings are located 130m to the north and 120m to the south.

From St. Clare's School northwards there is a row of 15 houses on the eastern side of the street with front gardens that vary in length from 6m to 9m, as shown in Figure 3-21. It is proposed to acquire a trip of land off these gardens to widen the road on that side of the street by 2m to obtain the required 19m road width, to include 1.5m wide cycle tracks. It was decided not to widen the road by a further 1m to fit 2m wide cycle tracks on this section because many of the gardens are already quite small and it is preferable to provide reasonably consistent width of cycle track along the overall length of Section 2, for which 1.5m is the maximum that can be achieved in other parts of this section.

Figure 3-21: Houses on the eastern side of Harold's Cross Road north of St. Clare's School

The central block of 6 houses in this row have longer gardens than the other houses and it is proposed to widen the road by an additional 2.5m in front of these houses so as to accommodate a row of 4 parking spaces which can be used for deliveries and short stays at these houses that have no such facility at present. This indent will also provide space for 3 new street trees to replace the existing trees that need to be removed to fit the proposed road layout.

At the junction of Mount Drummond Avenue the crossing distance is very long for pedestrians walking along the eastern side of Harold's Cross Road. This junction will be narrowed for a shorter crossing distance as shown in Figure 3-22. New street trees will be planted on reclaimed road space and 4 more parking spaces will be provided.

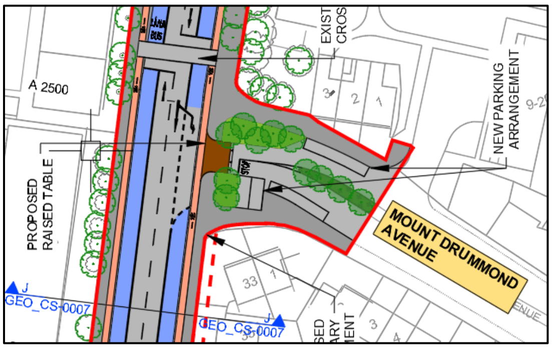


Figure 3-22: Junction Improvement

Towards the northern end of Section 2 there is another very constrained pinch-point where road widening is not possible, and it is necessary to narrow the cycle tracks to 1.2m over a length of 50m in the vicinity of Armstrong Street.

Minor road widening is proposed on the western side at the northern end of Section 2 approaching the junction of Harold's Cross Road with Parnell Road beside the Grand Canal as shown in Figure 3-23. This widening is into a garden area beside an office building, and it will enable the proposed cycle tracks to be brought as far as the junction.

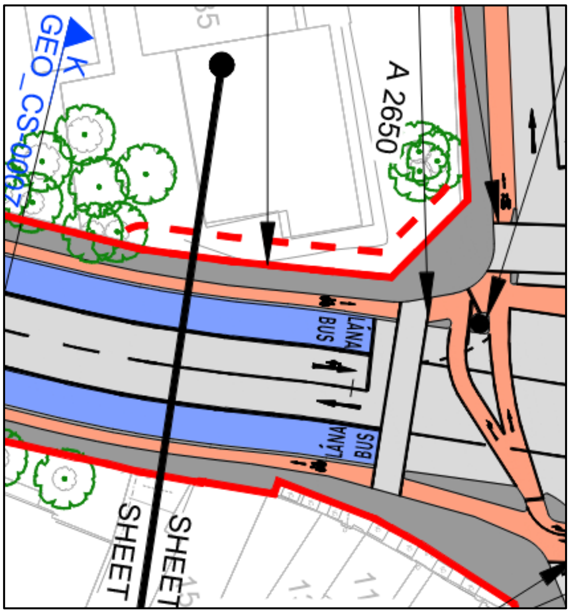


Figure 3-23: Widening at Southern Corner of Parnell Road

Grand Canal Junction at Harold's Cross

The junction of Harold's Cross Road with Parnell Road, Grove Road and Clanbrassil Street Upper beside the Grand Canal is a particularly busy place where a major radial route intersects with one of the main orbital routes around the city centre. A major improvement is proposed at this junction for public transport and cyclists for which the existing situation is quite unsatisfactory with limited space and congestion and conflicts with turning traffic.

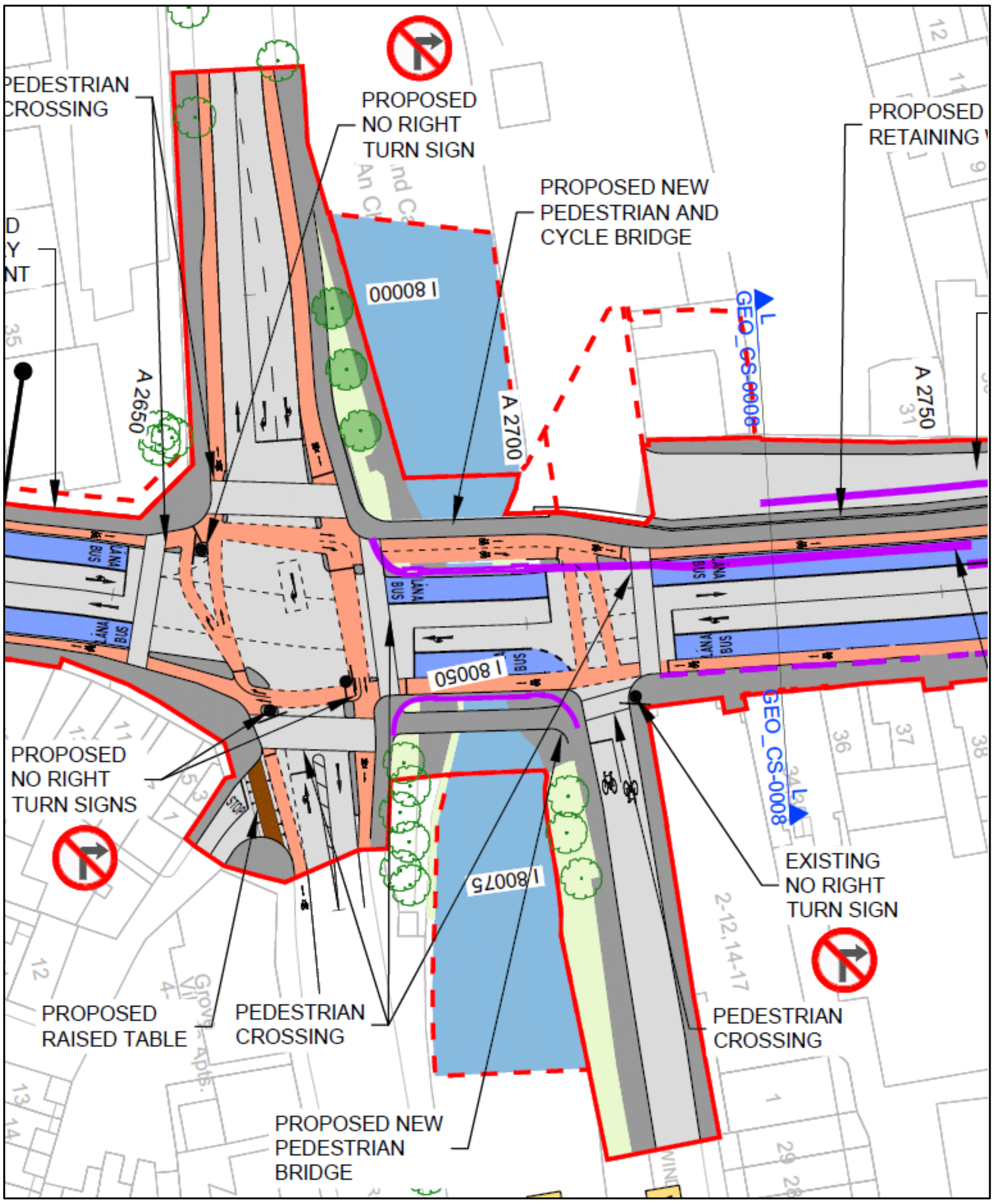


Figure 3-24: Grand Canal Junction at Harold's Cross

In Figure 3-24 the following proposed modifications to this major junction are shown:

a) Continuous bus lanes in the north-south direction with traffic lanes reduced from two to one in each direction.
b) Segregated cycle tracks through the junction with protective islands at the corners.
c) A new eastbound right-turn lane on Parnell Road with a filter signal to reduce the risk of late running traffic conflicting with the following pedestrian crossing signal stage.
d) No right-turn from Harold's Cross Road northbound to Grove Road – traffic may divert to South Circular Road 300m further north. This allows the northbound bus lane to be extended up to the junction stop line and removes the conflict with left-turning traffic.

Widening at Robert Emmett Bridge over the Grand Canal is required to complement the proposed changes at the junction at the southern end of the bridge, and this is described in Section 3 following.

3.1.3 Section 3 - Clanbrassil Street Upper & Lower, and New Street South

The proposed road cross-section in Section 3 will be similar to Section 2 with a footpath, a segregated cycle track, one bus lane, and one general traffic lane in each direction. The main changes from the existing road layout will be to extend the lengths of bus lanes as much as possible, and to introduce continuous segregated cycle tracks over the full length of this section. Over most of the length of Section 3 the existing street is wide enough for the proposed cross-section apart from two locations:

- On Clanbrassil Steet Upper from the junction south of the Grand Canal northwards for a length of 130m to the junction with Clanbrassil Close, where it is proposed to widen the road on the western side of the street to provide the necessary road width.
- On Clanbrassil Street Upper and Lower through the junction with South Circular Road at Leonard's Corner over a length of 280m where there will be just one bus lane and instead signal-controlled priority will be provided.

Proposed Footbridges at Robert Emmett Bridge

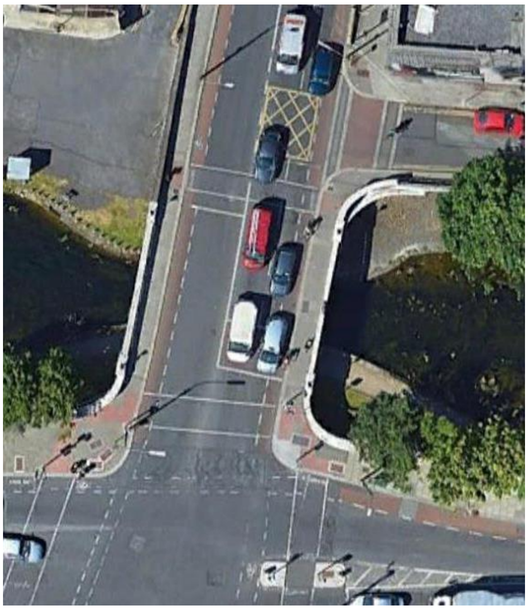


Figure 3-25a & 3-25b: Robert Emmett Bridge

The existing road layout at Robert Emmett Bridge is shown in Figure 3-25a. There is one wide northbound traffic lane and an advisory cycle track alongside it. In the southbound direction there are two narrow traffic lanes with an advisory cycle lane marked within the left-hand traffic lane. Between the parapets the overall width of the bridge is 15m and the carriageway is 11m wide. There is insufficient room on the existing bridge for the proposed road cross-section of at least 19m as described for Section 2 earlier.

It is therefore proposed to provide new footbridges on each side of the existing concrete arch bridge. On the western side a 6m wide footbridge will be provided which will accommodate a 3m wide northbound cycle track, with 0.5m separation from the eastern parapet railing, and a 2.5m wide footpath on the western side. The 3m wide cycle track will be divided into two cycle lanes, one on the left for the straight-ahead direction, and one on the right for the right-turn onto Windsor Terrace to join the Grand Canal Cycleway on the northern side of the canal. A significant demand is expected for this right-turn by cyclists, and they can wait on the bridge for the traffic signal without impeding the straight -ahead cyclists.

On the eastern side of Robert Emmett Bridge a new 2.5m wide footbridge will be provided which will allow for the eastern footpath to be removed off the existing bridge.

The new 3-span steel footbridges will be structurally independent of the existing concrete arch bridge and will have new piers on the canal banks supported on pile foundations. Horizontal separation of 1.0m will be provided from the new footbridge to the existing bridge on the western side, and slightly wider separation of 1.5m on the eastern side. Glass parapets will be provided on the new footbridges to retain visibility of the existing characteristic balustrades on Robert Emmett Bridge as shown in Figure 3-26.

Figure 3-26: Proposed Footbridge on western side of Robert Emmett Bridge

On the existing road bridge the layout will be modified to accommodate 2 x 3m wide bus lanes, and 2 x 3m traffic lanes in each direction, with a 2m wide southbound cycle track. Buffer zones 0.5m wide will separate the northbound bus lane and the southbound cycle track from the balustrade parapets.

Clanbrassil Street Upper Widening

Road widening is proposed on the western side of Clanbrassil Street Upper over a length of 100m northwards from Robert Emmett Bridge. For the first 65m length of this section there is a level difference of up to 3.5m between the existing road and the land to the west where the road climbs on a ramp up to the level of Robert Emmett Bridge over the Grand Canal. There is an existing stone retaining wall that supports this section of Clanbrassil Street Upper on the western side. Below this wall there is a narrow laneway that provides access to a yard on the canal bank at a disused harbour. The yard is occupied by the business of Gordon’s Fuels. The access lane is also used by Waterways Ireland for access to the canal for maintenance. Immediately to the north of the Gordon’s Fuels business is Mullen Scrap whose yard is at a lower level of 1.5m. Access to this second business is from another laneway beside the laneway to Gordon’s Fuels with a second stone retaining wall separating the two levels. The retaining walls are shown as dashed red lines on Figure 3-27.

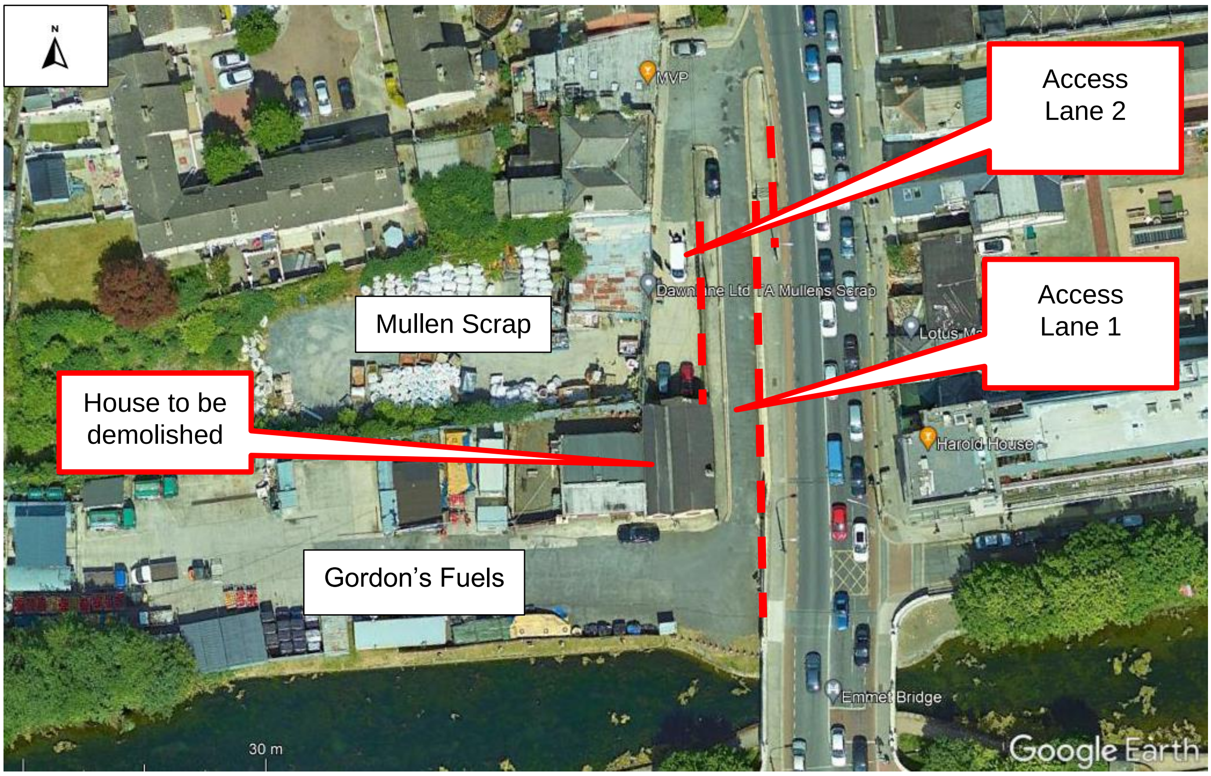


Figure 3-27a: Access to Properties on western side of Clanbrassil Street Upper at Grand Canal

In Figure 3-27b the proposed scheme road layout is shown with road widening on the western side of the street. The two existing access lanes will be combined into a single shared access lane for both the Mullen Scrap and Gordon's Fuels properties, and a new higher retaining wall up to 4m high will separate this from the main road at the higher level as shown in Figure 3-27c. Loading at Mullen Scrap will take place on the new access laneway, and traffic to and from Gordon's Fuels will pass in single file on a shuttle basis. It will be necessary to demolish the existing dwelling house at Gordon's Fuels to accommodate the new access lane in the new more westerly location.

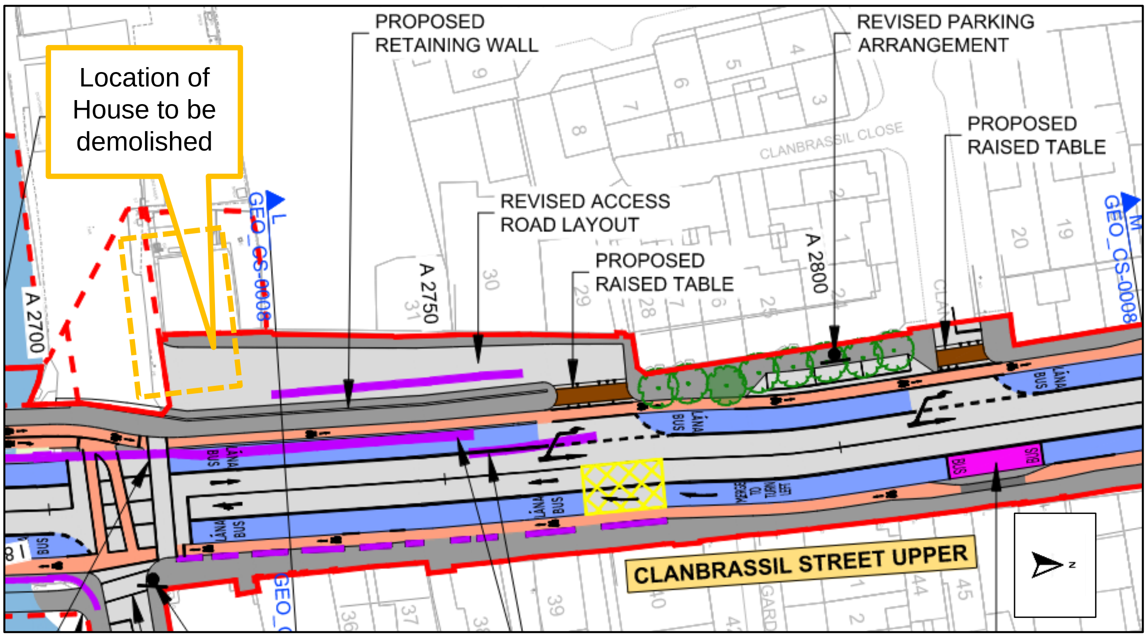


Figure 3-27b: Proposed Scheme Layout at Clanbrassil Street Upper southern section

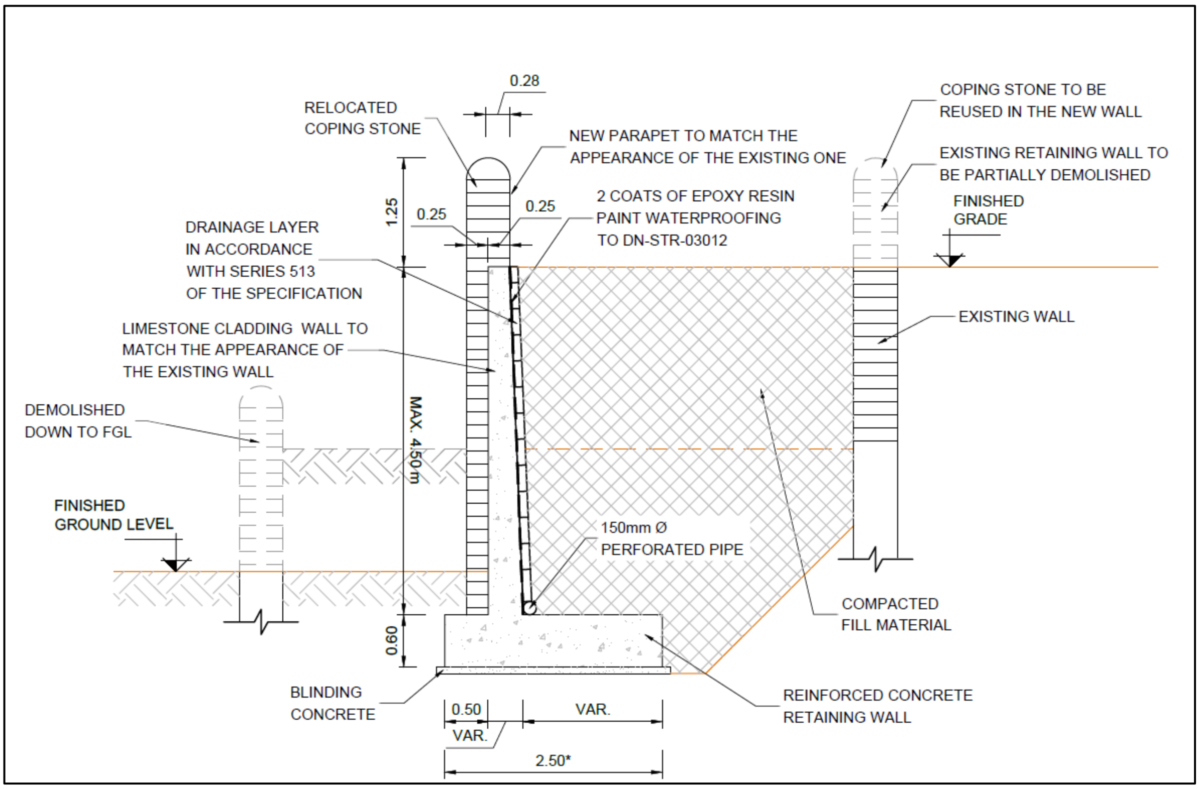


Figure 3-27c: Proposed Retaining Wall at Clanbrassil Street Upper southern section

To the north of the access lanes at No.29 Clanbrassil Street Upper, there will be minor road widening to provide space for the northbound cycle track as shown in Figure 3-27b. There are two footpaths in this location separated by a low wall which will be removed, and the parking layby will be moved 1.5m westwards with the existing street trees retained.

From Clanbrassil Court northwards for a length of 50m to Wesley Place the existing street is wide enough for the proposed cross-section with bus lanes and cycle tracks in both directions. There are 3 on-street part-time parking spaces on the eastern side that will be removed in this section to accommodate a full-time bus lane.

North of Wesley Place for a length of 90m to the stop line at the Leonard’s Corner junction the existing street is too narrow for the proposed cross-section, and it is necessary to omit the southbound bus lane. Instead signal-controlled priority will be provided at the Leonard’s Corner junction so that southbound buses can get ahead of general traffic to reach the start of the southbound bus lane that then continues for 180m to the junction at the Grand Canal.

Over the 250m length of Clanbrassil Street Upper north of Robert Emmett Bridge the street is not wide enough to fit 2m wide cycle tracks, and the proposed cycle tracks will be 1.5m wide generally. However, the southbound cycle track will be reduced to 1.2m immediately south of the Leonard’s Corner junction so as to avoid narrowing the footpath and to retain three street trees.

Leonard's Corner Junction

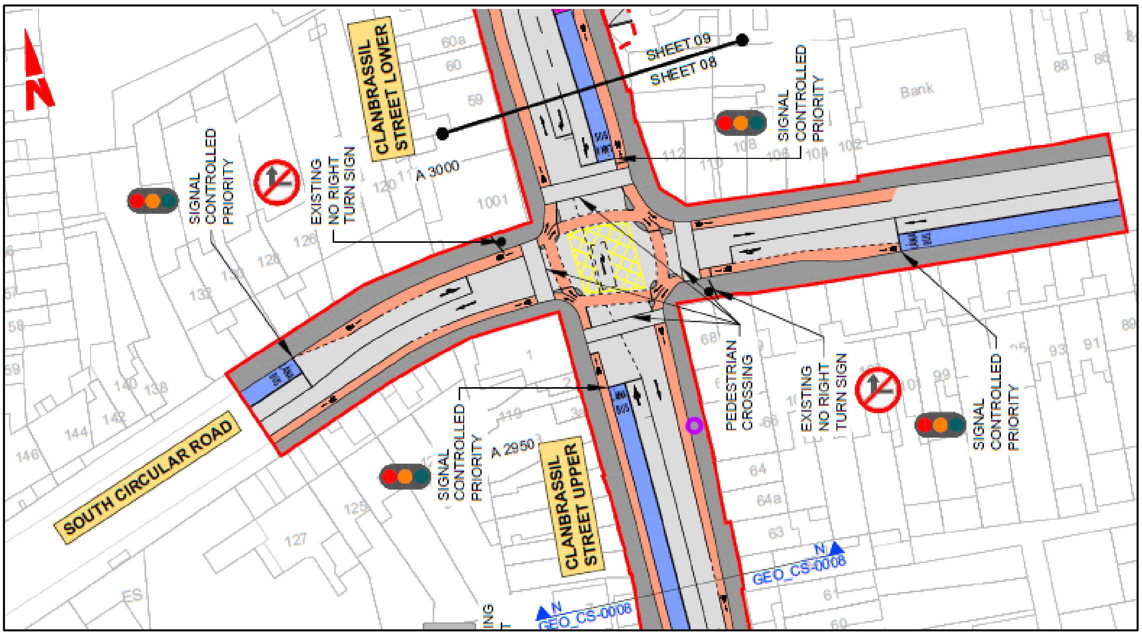


Figure 3-28: Proposed Scheme Layout at Leonard's Corner Junction

The junction of Clanbrassil Street and South Circular Road at Leonard's Corner is a busy urban centre with many shops, restaurants and businesses clustered at the junction and on the approaches. The footpaths are very busy, and they have been widened into the road in the past to provide more comfortable and safer space for pedestrians. The existing roads on all four approaches to this junction are too narrow to accommodate separate facilities for bus, bike and general traffic while retaining the existing necessary footpath widths. In the proposed scheme, as shown in Figure 3-28, bus priority will be managed mainly through signal-controlled priority on both the radial north-south bus corridor and on the east-west orbital bus corridor on South Circular Road. Bus lanes can be brought to the stop lines in the northbound and southbound directions, where signal-controlled priority will allow buses to start ahead of general traffic into the shared downstream lane. In the east-west direction all traffic will be held about 40m back from the junction where the existing bus lanes end, and signal-controlled priority will release buses into the final section of shared lane leading up to the junction ahead of general traffic. These arrangements will provide the necessary space for segregated cycle tracks through the junction in all four directions, and protective islands will be provided on the corners of the junction.

The existing southbound right-turn lane will be retained on Clanbrassil Street Lower as the street is wide enough for this alongside a combined straight-ahead and left-turn traffic lane with a new southbound bus lane on the left-hand side extending all the way to the stop line. This proposed bus lane will replace one of the existing three general traffic lanes, which will be reduced to two lanes. There is a heavy demand for right-turning traffic onto South Circular Road heading towards the southwestern quadrant of the city. In the northbound direction the right-turn demand is quite low, and a right-turn pocket will be provided at the junction with suitable provision in the signal timings for the right-turn demand, which will include some traffic displaced from the preceding junction at the Grand Canal where the northbound right-turn will not be permitted.

Clanbrassil Street Lower: Leonard's Corner to Lombard Street West

North of Leonard's Corner in the northbound direction there is a wide general traffic lane and no bus lane for a length of 160m to St. Patrick's Court on the western side, opposite Lombard Street West, where the street widens abruptly. Part-time parking is accommodated on this section of street on both sides with advisory cycle lanes that operate at peak periods inbound in the morning and outbound in the evening. Recently there have been some adjustments to the street layout with protected cycle lanes inside the parking bay on a small part of the street as shown in Figure 3-29a. In the southbound direction there are two traffic lanes that operate in the PM peak and there is no bus lane.

Figure 3-29a: Clanbrassil Street Lower north of Leonard's Corner on the western side

In the Proposed Scheme, as shown in Figure 3-29b, the road cross-section will consist of full-time segregated cycle tracks 1.5m to 1.9m wide in both directions, with one general traffic lane in both directions and a southbound bus lane. All on-street parking and loading will be removed in this section of street to facilitate the cycle tracks and bus lane. There is extensive parking available on the nearby side streets, and there is a small public car park just off St. Vincent Street South on the eastern side to the north of Leonard's Corner, as may be seen on the right in Figure 3-29a. This car park will be rearranged to move the bottle banks for a small increase in the number of parking spaces.

From Lombard Street West northwards Clanbrassil Street Lower widens out to a dual carriageway and there are regular parking and loading bays at intervals along the street which can be used for servicing of the local businesses on the narrower part of the street to the south.

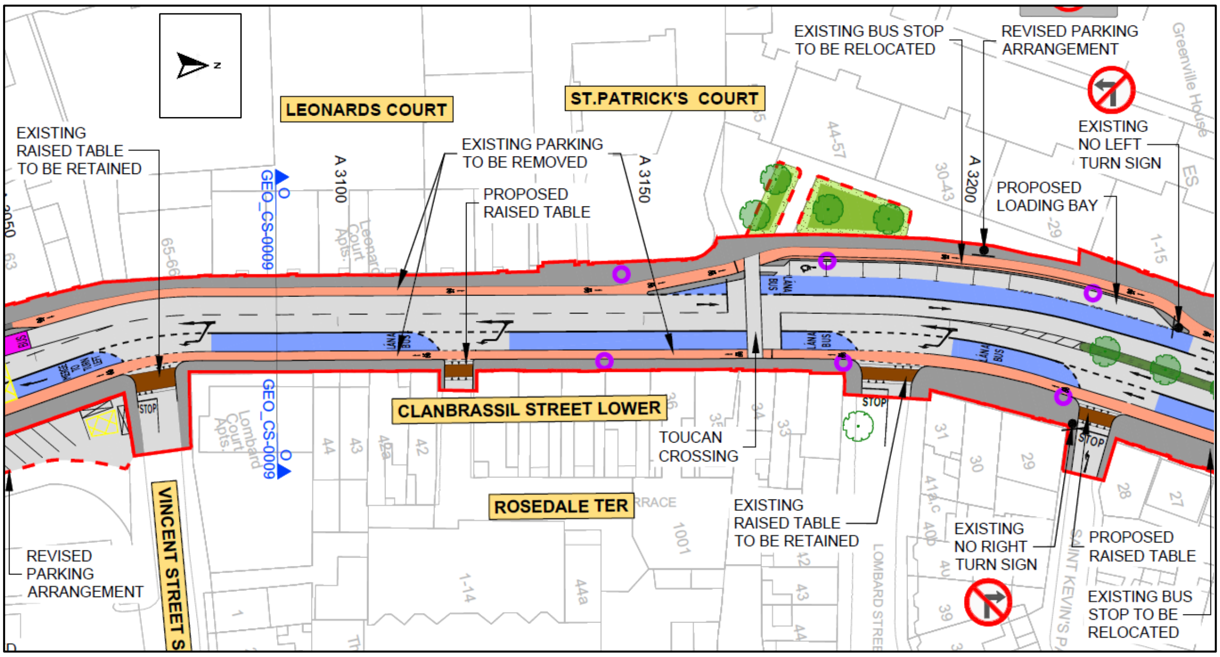


Figure 3-29b: Proposed Road Layout on Clanbrassil Street Lower north of Leonard's Corner

Clanbrassil Street Lower north of Lombard Street West and New Street South

There is a northbound bus lane and a general traffic lane within a 7.5m wide carriageway on the western side of the street in this section. In the southbound direction there are two 3m wide traffic lanes and a 1.5m wide advisory cycle lane on the eastern side of the street. In the middle of the street there is a median island that is typically 2m wide with a long row of street trees along most of the length of this section. The existing footpaths are typically very wide up to 6m, but locally reduce to 3m minimum. There are parking bays and bus bays at various places where the footpath is reduced to 2.2m wide.

Figure 3-30a: Clanbrassil Street Lower north of Lombard Street West – eastern side

Between Lombard Street West and Kevin Street Upper, it is proposed to modify the street layout to accommodate a 2.0m wide cycle track alongside a 3m wide bus lane and one 3m wide general traffic lane in each direction as shown in Figure 3-30b. The existing central median in this section will be retained and all existing trees in the median will also be retained. The proposed cycle tracks will sit mostly on the existing road but will encroach into the footpaths by 0.5m.

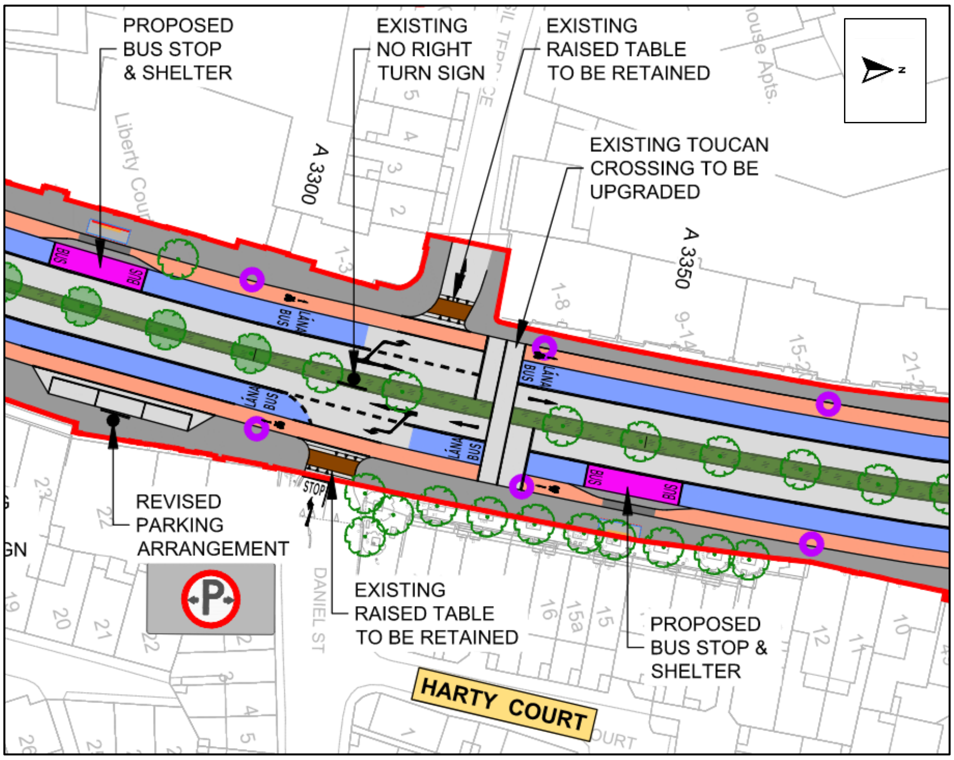


Figure 3-30b: Typical Proposed Road Layout on Dual Carriageway Section of Clanbrassil Street Lower & New Street South

The northern end of the Proposed Scheme is at the junction with Patrick Street and Kevin Street as shown in Figure 3-31.

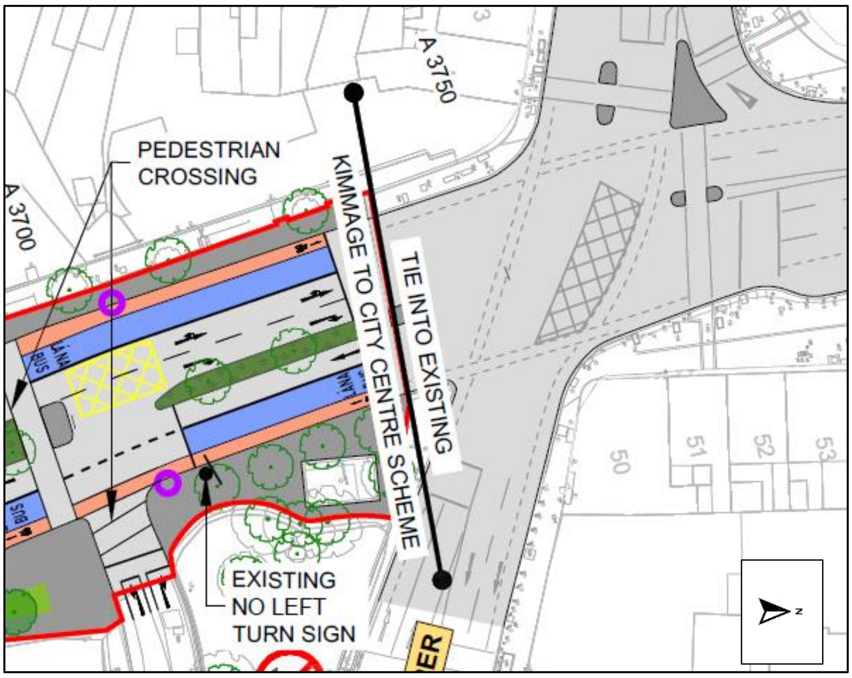


Figure 3-31: Northern limit of the Proposed Scheme at junction with Patrick Street.

3.2 Associated Infrastructure Project and Developments

There are no other infrastructure projects planned within the vicinity of the Proposed Scheme which will interface with the proposals.

Various private developments have obtained planning permission along the Proposed Scheme, and the significant ones of potential relevance to the design of the project are outlined in Table 3-1 below. The planning and design of the Proposed Scheme took these other proposed developments into consideration where relevant. In all cases there was no relevance to the Proposed Scheme.

Table 3-1:Relevant Development Projects Planned Along the Proposed Scheme

Reference No.	Applicant	Description	Location
4041/17	Crekav Trading GP Ltd	197 residential units – completed in 2021 as “Mount Argus Mills”	Mount Argus Road, Mount Argus, Harold's Cross, Dublin 6w
4412/17	Minister for Education & Skills	Construction of a temporary primary school	Harold's Cross Greyhound Stadium, Harold's Cross, Dublin 6w
2688/20	Via properties Ltd.	Demolition of existing buildings, Construction of 38 apartments	146-156 Harold’s Cross Road Dublin 6
4735/18	Rivergate Property Harold's Cross Ltd.	34 residential units in 2 buildings, over basement level.	126-128, Harold's Cross Road, Dublin 6w
4544/17	Kavcre St Clare's Ltd.	Construction of 153 residential units – completed in 2021	115-119, Harold's Cross Road, Dublin 6w
3713/16	Martin & John Smith	Demolition of existing structures and construction of mixed use development	69-73, Harold's Cross Road, Dublin 6w
3605/16	The Adroit company	8 year permission for 0.998ha development of 12,874 sqm, which will include 4 3-storey and 2 one storey residential buildings.	Harold’s Bridge Court, and 1, 2,3 Clare Villas Harold’s Cross Road, Parnell Road and Greenmount Lane, Harold’s Cross, Dublin 6
3676/20	Clopen Limited	Demolition of existing buildings for mixed use development consisting of 11 residential units and two retail units	39,40,41,42 & 42A Clanbrassil Street Upper, Dublin 8
2132/20	Dawson Buildings Ltd.	Demolition of existing structures and construction of a 5 storey part 6 storey over basement mixed use building	Leonard’s Corner, 52, 52A,53,54 & 55 Clanbrassil Street Lower & 110,112 & 108 South Circular Road, Dublin 8
2183/19	Sherborough Enterprises Ltd.	Construction of a 5 storeys with 9 new apartments	Block 200 Cathedral court, New Street South, Dublin 8
2689/18	Peter McVerry Trust	4 storey apartment block - 573sqm	26 New Street South, Dublin 8

3.3 Integration with Other Core Bus Corridor Schemes

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. 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 will interact with the following other CBC Schemes:

- Tallaght / Clondalkin to City Centre CBC Scheme where the two CBCs will join at the junction of New Street South and Patrick Street as shown in Figure 3-32.
- Templeogue / Rathfarnham to City Centre CBC Scheme on which there is a proposed cycle route along Harold's Cross Road that will integrate with the proposals in this Kimmage to City Centre CBC Scheme at the junction with Kenilworth Park as shown in Figure 3-33, and also at Harold's Cross Park as shown in Figure 3-34.

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.

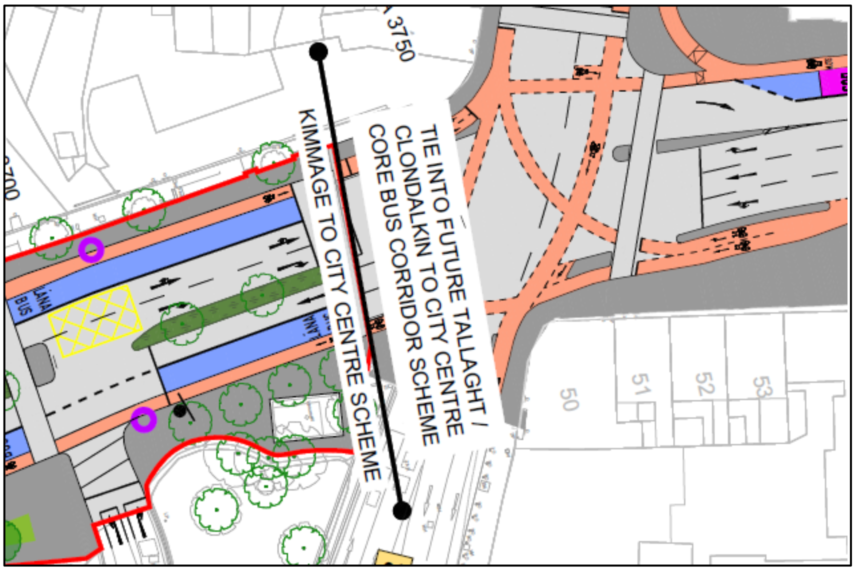


Figure 3-32: Interface with Tallaght / Clondalkin to City Centre CBC Scheme at junction with Patrick Street.

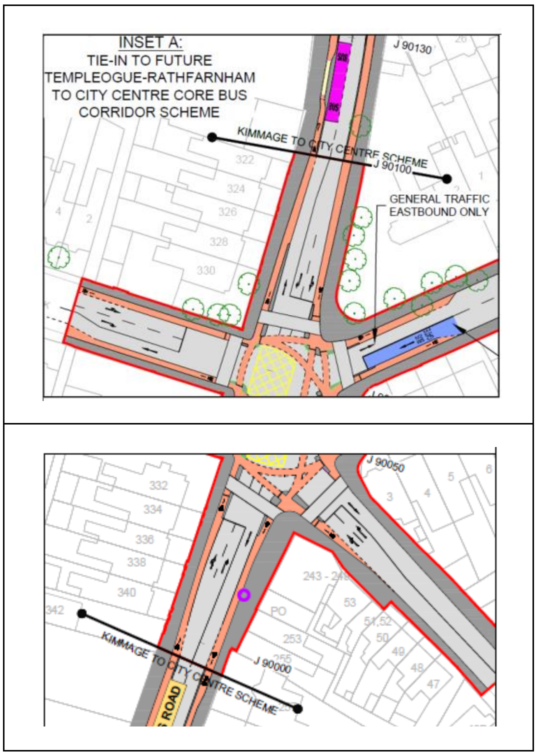


Figure 3-33: Interface with Templeogue / Rathfarnham to City Centre CBC Scheme at Kenilworth Park junction.

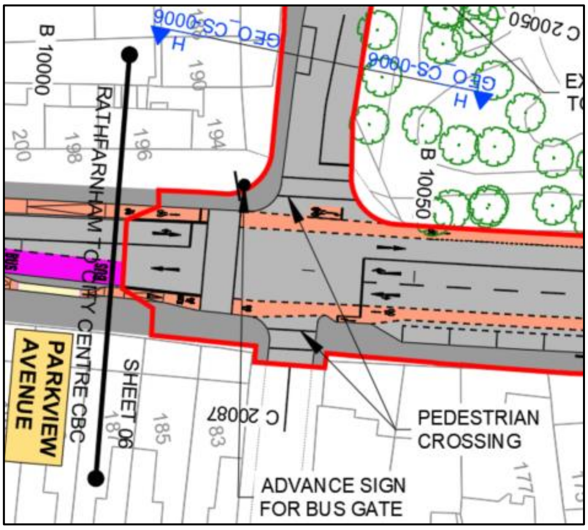


Figure 3-34: Proposed Scheme at Harold's Cross Road / Parkview Avenue Junction: Interface with Templeogue / Rathfarnham to City Centre CBC Scheme.

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 roads and streets, as is the case for this scheme.

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

Where DMURS contains insufficient design guidance, several documents have been interrogated to provide the correct design guidance including the National Cycle Manual, the TII DMRB and the Preliminary Design Guidance Booklet for BusConnects Core Bus Corridors.

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

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

Table 4-1 below 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(footpaths), 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		Link Street/Local Streets	DMURS (Figure 3.3)
Footpath	Footway Widths	Nominal footway widths in low pedestrian activity areas and pinch point areas.		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 footpaths		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 footpaths 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 footpaths		1 in 50 nominal gradient	NDA[1] (Section 1.5.1.1)
		Existing footpaths 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	BCPDG (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	BCPDG (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	BCPDG (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
		Minimum horizontal radius (Island Bus Stops)		4m radius (Entry deflection radius) 6m radius (Exit deflection radius)	BCPDG (Figure 34)
		Nominal deflection – Parking & Loading Bays		1 in 3 horizontal taper at cycle protected parking	BCPDG (Figure 12)

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(s)
		Nominal deflection – Island Bus Stops		1 in 1.5 horizontal taper at Island Bus Stops	BCPDG (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	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
	Nominal with flow Bus Lane Widths	Nominal lane widths adjacent to cycle track/footpath		3m min width & lane widening as required by vehicle tracking assessment on tight bends	BCPDG (Section 5.1)
		Bus lanes adjacent to on street parking (no cycle track/footpath)		3m min width with consideration for designated buffer zones and delineated parking areas	BCPDG (Figure 12)
	Design Speed	Design speed for vehicles in bus lane along the Proposed Scheme		50 km/h	DMURS (Section 4.1.1 & Table 4.1)
	Visibility	Forward Visibility Stopping Sight Distance SSD (Buses & HGV vehicles).	50 km/h	49m	DMURS (Table 4.2 – 50km/h)
	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		50 km/h	DMURS (Section 4.1.1 & Table 4.1)
	Traffic Lane Width	Min carriageway lane width	50 km/h	3m min width & lane widening as required by vehicle tracking assessment on tight bends	BCPDG (Section 5.1)
			60 km/h	3.25m min width	

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(s)
	Visibility	Forward visibility Stopping Sight Distance SSD (cars & smaller vehicles).	50 km/h	45m	DMURS (Table 4.2 – 50 km/h)
		Forward visibility Stopping Sight Distance SSD (Buses & HGV vehicles).	50 km/h	49m	DMURS (Table 4.2 – 50km/h)
		Visibility to regulatory signage	Up to 50 km/h	60m recommended clear	TSM (Table 5.1)
	Horizontal Curvature	Minimum radius with adverse camber of 2.5%	50 km/h	104m	DMURS (Table 4.3)
	Vertical Curvature	Crest curve K value	50 km/h	4.7	DMURS (Table 4.3)
		Sag curve K value	50 km/h	6.4	DMURS (Table 4.3)
	Longitudinal Gradient	Longitudinal gradient		0.5% minimum grade 5% desirable maximum grade 8.3% absolute maximum grade	DMURS (Section 4.4.6)
	Cross Fall	Cross-fall		2.5% nominal	DMURS (Section 4.4.6)
All - Junctions	Visibility	Intra-junction visibility envelope		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)		X Value = 2.4m 45m SSD (cars & smaller vehicles) 49m SSD (HGV/Buses)	DMURS (Figure 4.63) DMURS (Figure 4.63 / Para 4.4.5)
		Visibility to primary traffic signals	50 km/h	70m desirable min 50m absolute min	TSM (Table 9.1)
	Corner Radii	Few larger vehicles (local streets)		1m -3m radius (subject to vehicle tracking assessment & balance of junction form/function)	DMURS (Section 4.4.3)

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(s)
		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)	DMURS (Section 4.4.3)
		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)	DMURS (Section 4.4.3)
		Frequent larger vehicles (industrial estates)		9m radius (subject to vehicle tracking assessment)	DMURS (Section 4.4.3)
	Pedestrian Crossings	Signalised crossing type/length *(subject to confirmation by traffic modelling and site constraints)*		• 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)	BCPDG (Section 5) TMG (Section 10.7, Diagram 10.15) DMURS (Section 4.3.2)
		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		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)	BCPDG (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)

Cross Section Element	Design Parameter	Description	Design Speed (km/h)	Adopted Design Parameter(s)	Reference(s)
		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 in consultation the NTA, a design strategy was implemented to determine the appropriate cross-section for scheme, taking account of the design speed and nature of the locations.

Traffic lane widths have been considered in line with the guidance outlined in DMURS, with the preferred width of traffic lanes on the Proposed Scheme 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. 2.0m is a desirable minimum width for footpaths with 1.2m being a minimum width at pinch points.

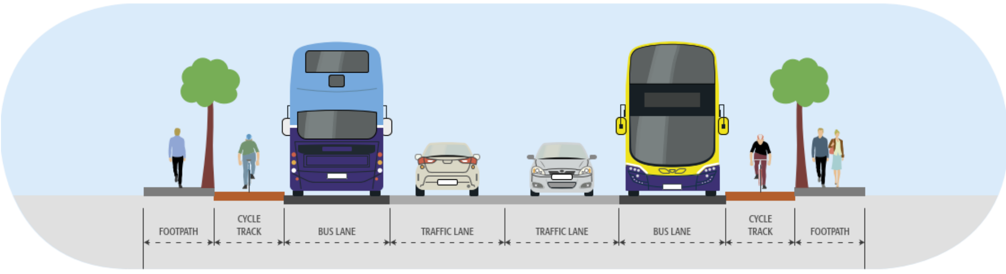


Figure 4-1: Typical CBC Cross Section

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 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 A.2.

In the following tables and on the drawings the Proposed Scheme consists of two alignments with associated Chainage references:

Alignment A: CBC Alignment.

- Section 1 — Lower Kimmage Road from Kimmage Cross Roads to the junction with Harold’s Cross Road: CH A0000 to CH A2200
- Section 2 — Harold’s Cross Road from Harold’s Cross Park to the Grand Canal: CH A2200 to CH A2600
- Section 3 — Clanbrassil Street Upper and Lower and New Street from the Grand Canal to the Patrick Street junction: CH A2600 to CH A3740

Alignment B: Parkview Avenue to Harold's Cross Road: CH B10000 to CH B10400

Alignment C: Link Road at Harold’s Cross Park south from Kimmage Road Lower to Parkview Avenue: CH C20000 to CH C20080

Alignment J: Kenilworth Square Junction: CH J90000 to CH J90130

Table 4-2 Road Cross Section Details

Location	Existing Outbound Carriageway / Proposed Outbound Carriageway				Existing Inbound Carriageway / Proposed Inbound Carriageway				Notes
	Footpath Width (m)	Cycle Lane / Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Lane/Track Width (m)	Footpath Width (m)	
Kimmage to City Centre Route (Alignment A) – Kimmage Road Lower									
CH. A0+080 to CH. A0+240	1.5-3.0	1.5*	N/A	4.0-7.4	4.5-7.0	N/A	1.5*	3.0	Hatching & right-turn lane marking vary from 1.8 to 5.0. * Cycle lane
	2.1-5.3	2.0**	3.0	3.0	3.0	3.0	2.0*	3.8 -5.4	Right-turn lane removed. * Footpath widened for island bus stop ** Cycle lane upgraded to cycle track
CH. A0+240 to CH. A0+300	1.0-3.0	1.5*	N/A	4.0-6.0	3.0-5.0	N/A	1.5*	3.0	Hatched marking vary from 0.1-1.6m. * Cycle lane
	2.0**-3.2	2.0*	N/A	3.0-4.0	3.0	3.0	2.0*	2.3-3.3	Median hatching removed. * Cycle lane upgraded to cycle track ** 1.0m wide footpath widened to 2.0m
CH. A0+330 to CH. A0+440	2.5-3.0	1.5	N/A	4.3-5.0	4.1-5.1	N/A	1.5	2.0-2.6	
	2.5-3.0	2.0	N/A	3.3-4.3	3.5-4.1	N/A	2.0	2.0-2.6	Proposed hedgerow median kerb island of 2.0m width.
CH. A0+440 to CH. A0+530	3.0-4.3	1.5	N/A	4.5-5.0	4.8-5.1	N/A	1.5	2.0-2.2	
	2.1-2.5	2.3 parking	N/A	3.3	5.5	N/A	N/A	2.8-4.3	Proposed 2m wide median kerb island 2.5m wide parking outbound side.
CH. A0+530 to CH. A0+860	2.0-2.5	1.2*	N/A	3.0-4.0	3.0-3.8	N/A	1.2*	2.1	* Existing advisory cycle lanes
	2.0-2.5	1.2*	N/A	3.0-4.0	3.0-3.8	N/A	1.2*	2.1	* Existing advisory cycle lanes retained

Location	Existing Outbound Carriageway / Proposed Outbound Carriageway				Existing Inbound Carriageway / Proposed Inbound Carriageway				Notes
	Footpath Width (m)	Cycle Lane / Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track Width (m)	Footpath Width (m)	
Kimmage to City Centre Route (Alignment A) – Kimmage Road Lower									
CH. A0+860 to CH. A0+890	2.0	1.1	N/A	3.9	3.4	N/A	1.3	2.0	
	2.0-2.7	1.2	N/A	3.2-3.8	3.4	N/A	1.3	2.0	
CH. A0+890 to CH. A0+950	1.3-1.5	1.1-1.4	N/A	3.7-4.0	3.2-4.0	N/A	1.2	2.3	
	2.0	N/A	N/A	3.0-3.6	3.1	N/A	1.2	2.0-2.4	Provided parking bay areas on outbound of 2.3m in width.
CH. A0+950 to CH. A1+000	1.7-2.0	1.2	N/A	3.3	2.7-3.3	N/A	1.3	1.8-2.0	
		2.3 parking	N/A		3.0	N/A		2.0-2.4	
CH. A1+000 to CH. A1+020	1.7	1.2	N/A	3.3	3.3	N/A	1.2	2.0	
	5.0*	N/A	N/A	3.0	3.0	N/A	N/A	2.0+9.5	
CH. A1+020 to CH. A1+060	1.7	1.2	N/A	3.4	3.3	N/A	1.3	2.0	
	2.3	2.3 parking	N/A	3.1	3.0		4.6 parking	9.0	
CH. A1+090 to CH. A1+130	1.9	1.1	N/A	3.1	2.5-2.8	N/A	1.2	2.5-5.4	Parking bay 4.5m on inbound. Narrow Traffic lane beside advisory cycle lane has greater combined effective width.
	2.0	1.1	N/A	3.0	2.5	N/A	1.2	2.3-8.0	

Location	Existing Outbound Carriageway / Proposed Outbound Carriageway				Existing Inbound Carriageway / Proposed Inbound Carriageway				Notes
	Footpath Width (m)	Cycle Lane / Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track Width (m)	Footpath Width (m)	
Kimmage to City Centre Route (Alignment A) – Kimmage Road Lower									
CH. A1+130 to CH. A1+410	2.0	1.2	N/A	3.0-3.2	2.3	N/A	1.2	2.0	Narrow Traffic lane beside advisory cycle lane has greater combined effective width.
	2.0	1.2	N/A	3.0-3.2	2.3	N/A	1.2	2.0	No change proposed
CH. A1+410 to CH. A1+490	2.0	1.2	N/A	3.1	2.8	N/A	1.2	2.0 min	
	2.0	1.2	N/A	3.1	2.8	N/A	1.2	2.0 min	
CH. A1+490 to CH. A1+930	1.3-1.5	1.2	N/A	2.2-3.5	2.5-3.0	N/A	1.2	1.8-2.3	Narrow Traffic lane beside advisory cycle lane has greater combined effective width.
	1.3-2.2	1.3	N/A	2.4-3.5	2.4-3.0	N/A	1.3	1.3-2.3	No change proposed
CH. A1+930 to CH. A2+000	2.0	1.2	N/A	2.4-2.5	2.3-2.8	N/A	1.3	2.1-4.1	Narrow Traffic lane beside advisory cycle lane has greater combined effective width.
	2.0	1.2	N/A	2.4-2.5	2.3-2.8	N/A	1.3	2.1-4.1	No change proposed
CH. A2+000 to CH. A2+025	1.3	1.2	N/A	2.8	3.4	N/A	1.3	4.6-7.5	Narrow Traffic lane beside advisory cycle lane has greater combined effective width.
	1.5	1.2	N/A	3.0	3.0	N/A	1.3	3.1-6.1	Retained loading bay on inbound of 2.85m in width.
CH. A2+025 to CH. A2+260	1.2	1.2	N/A	2.4-2.8	3.0-3.1	N/A	1.3	2.0	Narrow Traffic lane beside advisory cycle lane has greater combined effective width.
	2.1	1.8 parking	N/A	2.3-3.5	3.3	N/A	n/a	n/a	No change proposed
CH. A2+260 to CH. A2+280	N/A	N/A	N/A	5.1	3.2-4.0	2.8	Shared	1.7	Parking bay is of 1.67m on inbound.
	N/A	1.5	N/A	3.2	3.5-4.4	N/A	1.3	3.2	

Location	Existing Outbound Carriageway / Proposed Outbound Carriageway				Existing Inbound Carriageway / Proposed Inbound Carriageway				Notes
	Footpath Width (m)	Cycle Lane / Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track Width (m)	Footpath Width (m)	
Kimmage to City Centre Route (Alignment A) – Harold's Cross Road									
CH. A2+280 to CH. A2+350	2.4	1.2	N/A	7.0	3.8	2.9	n/a	1.6	Parking bays are of widths 1.6m on inbound and 1.8m on outbound.
	2.0	1.5	N/A	4.2	3.0	3.0	1.5	2.5	Hatched marking vary from 0.2-4.0m; Provided parking bay width of 2.3m on outbound.
CH. A2+350 to CH. A2+370	3.0-3.5	n/a	2.8	3.0	3.0-3.3	3.0	n/a	2.0-2.5	
	2.0-2.3	1.2	3.0	3.0	3.0	3.0	1.2	2.0	Very constrained section between buildings over short length of 20m, with minor encroachment into property on western side.
CH. A2+370 to CH. A2+410	3.0	n/a	3.0	3.0	3.0	3.0	n/a	2.0	
	2.0	1.5	3.0	3.0	3.0	3.0	1.5	2.0	Constrained section with encroachment into properties on eastern side. Not 2m to be more consistent with rest of this section.
CH. A2+410 to CH. A2+440	3.0	n/a	3.0	3.0	3.0	3.0	n/a	3.5	
	2.0	1.5	3.0	3.0	3.0	3.0	1.5	3.4	Parking bay area on eastern side.
CH. A2+440 to CH. A2+510	2.8	n/a	3.0	3.0	3.2	3.3	n/a	2.5	
	2.1	1.6	3.0	3.0	3.0	3.0	1.5	2.1	Not 2m to be more consistent with rest of this section.
CH. A2+510 to CH. A2+620	2.7-6.5	n/a	2.8-3.7	2.8-3.0	3.1	3.0-3.3	n/a	2.5-3.2	
	2.0-4.3	1.5	3.0	3.0	3.0	3.0	1.5	2.0	
CH. A2+620 to CH. A2+650	1.5-3.0	1.2	N/A	4.6	4.9	N/A	1.2	2.6-3.0	Parking bay is of 1.85m width on outbound. Advisory Cycle lanes
	2.0-2.7	1.8	3.0	3.0	3.0	3.0	1.6	1.8-2.3	Upgrade from cycle lanes to cycle tracks.

Location	Footpath Width (m)	Cycle Lane / Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track Width (m)	Footpath Width (m)	Notes
	Existing Outbound Carriageway				**Existing Inbound Carriageway**				
	Proposed Outbound Carriageway				**Proposed Inbound Carriageway**				
Kimmage to City Centre Route (Alignment A) – Clanbrassil Street Upper									
CH. A2+680 to CH. A2+710	2.0	(1.2)*	N/A	2.75 x 2	4.2	N/A	1.3	2.0	Robert Emmet Bridge at Clanbrassil Street Upper * Advisory cycle lane within the traffic lane
	2.5**	2.0 +0.5 buffer	3.0	3.0	3.0	3.0 +0.5 buffer	3.0*	2.0*	*Proposed two-lane cycle track & footpath over new bridge on western side of Robert Emmett Bridge. **Proposed footbridge on eastern side of Robert Emmett Bridge
CH. A2+710 to CH. A2+780	2.3-3.2	1.2	N/A	4.5	3.0-3.7	N/A	1.2	2.0-2.7	
	3.0	1.5	3.0	3.0	3.0	3.0	1.5	2.0	
CH. A2+780 to CH. A2+860	2.8	1.3	N/A	5.1-6.5	3.0-3.2	2.9	N/A	1.5-2.7	Parking bays are of 1.8-2.9m & 1.65m vary in width on outbound and inbound respectively.
	-2.8	1.7	3.0	3.0	3.0	3.0	1.8	1.7-1.8	Provided bus-stop islands on outbound and inbound of width 1.0m vary & parking bay of 2.85m on inbound.
CH. A2+860 to CH. A2+960	2.5-2.8	1.3	N/A	4.4-5.1	5.2	N/A	1.2	3.0-3.75	
	2.7-3.2	1.2-2.0	N/A	3.4-4.1	3.0	3.0	1.5	2.0-4.3	Provided parking bay of 2.5m width on inbound.
Kimmage to City Centre Route (Alignment A) – Clanbrassil Street Lower									
CH. A2+990 to CH. A3+060	3.0	(1.2*)	N/A	2 x 3.25	4.8	N/A	1.5*	1.8	* Part-time advisory cycle lanes. Outbound cycle lane is inside traffic lane.
	3.0	2.0	3.0	3.4-6.0	3.0	N/A	2.0	2.5-3.0	Provided bus-stop islands on outbound and inbound of width 1.0m vary.
CH. A3+060 to CH. A3+150	1.8	(1.2*)	N/A	2 x 3.25	4.8	N/A	1.5*	1.8 – 2.1	* Part-time advisory cycle lanes. Outbound cycle lane is inside traffic lane. Inbound till 10am and parking afterwards.
	1.8	1.5	3.0	3.0	3.0	N/A	1.5	1.9	

Location	Existing Outbound Carriageway / Proposed Outbound Carriageway				Existing Inbound Carriageway / Proposed Inbound Carriageway				Notes
	Footpath Width (m)	Cycle Lane / Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track Width (m)	Footpath Width (m)	
Kimmage to City Centre Route (Alignment A) – Clanbrassil Street Lower									
CH. A3+150 to CH. A3+220	1.8	1.5*	N/A	2 x 3.3	3.2	4.3	N/A	4.3 - 6.0	* Advisory cycle lane in traffic lane 1.4m wide median island
	1.8	2.0	3.0	3.0	3.0	3.0	2.0	2.2 – 3.9	2.1m widening on western side only
CH. A3+220 to CH. A3+450	2.6 - 5.4	1.5*	N/a	2 x 3.0	3.2	4.3	N/A	4.1 - 4.7	Loading/parking bays 2.4-3.0m on both sides. Median island of 1.4-2.4m. * Advisory cycle lane
	2.1 - 4.9	2.0	3.0	3.0	3.0	3.0	2.0	3.6 – 4.2	0.5m reduction of footpaths to fit cycle tracks Existing median island retained
Kimmage to City Centre Route (Alignment A) – New Street South									
CH. A3+450 to CH. A3+550	2.9	1.5*	N/A	8.4 (3 x 2.8)	3.0	4.0	N/A	4.7-5.2	* Cycle lane Southbound right-turn lane / median island
	3.2	1.8	3.0	3.0 +2.5*	3.0	3.0	2.0	3.5-5.4	* Southbound right-turn lane / median island
CH. A3+550 to CH. A3+630	3.0-3.5	1.5*	N/A	2 x 3.0	3.2	4.3	N/A	2.2 (+2.7**)	* Advisory cycle lane ** Parking Bay 1.2m median island
	2.0-3.5	2.0	3.0	3.5	3.4	3.0	2.0	2.2 (+2.7**)	No change to footpath & parking on inbound side Median island removed
CH. A3+630 to CH. A3+700	3.0-9.0	1.5*	N/A	2 x 3.0	2 x 3.75	N/A	N/A	3.8 - 5.0	Median island is of 1.7-4.5m width
	2.5-8.5	2.0	3.0	3.0	3.0	3.0	2.0	3.3 - 4.5	
CH. A3+700 to CH. A3+740	5.6	1.5*	N/A	2 x 3.0	4.0 + 2 x 3.25	N/A	N/A	2.8	Median island is of 1.7-4.5m width NB right-turn lane
	5.6	1.5	3.0	3.0	3.0	2 x 3.0*	1.5	2.8	

Location	Existing Outbound Carriageway / Proposed Outbound Carriageway: Footpath Width (m)	Cycle Lane / Track Width (m)	Bus Lane Width (m)	Traffic Lane Width (m)	Existing Inbound Carriageway / Proposed Inbound Carriageway: Traffic Lane Width (m)	Bus Lane Width (m)	Cycle Track Width (m)	Footpath Width (m)	Notes
Harold's Cross Road: Parkview Avenue to Kimmage Road Lower junction (Alignment B)									
CH. B10+010 to CH. B10+110	2.2-4.3	Shared	3.6	3.0	3.0	3.5	Shared	N/A*	No footpath on inbound side at the park. Parking bay 1.9m width on outbound.
	2.2-4.3	1.5	N/A	2 x 3.0*	3.0	N/A	1.5	N/A	* New southbound right-turn lane. Parking widened to 2.25m + 0.75m buffer zone to outbound cycle track.
CH. B10+110 to CH. B10+230	3.0-3.8	n/a	3.2-3.5	3.0-3.3	3.0	3.5	Shared	N/A	
	3.0-3.8	1.5-2.0	N/A	3.0	3.0	3.0	1.5-2.0	N/A	
CH. B10+230 to CH. B10+400	1.7-3.8	1.4-1.7	3.2-3.5	3.0-3.3	3.0	3.5	Shared	N/A	*Advisory cycle lane
	7	1.5-2.0		3.0	3.0		1.5-		
Link from Kimmage Road Lower to Harold's Cross Road south of park (Alignment C)									
CH. C20+000 to CH. C20+025	2.5 Northern side	N/A	N/A	4.1	4.5-5.0	N/A	N/A	2.0	
	2.5	N/A	N/A	4.1	4.5-3.5	N/A	N/A	2.0-3.5*	* Footpath widened at Shamrock Villas junction.
CH. C20+025 to CH. C20+080	2.2	N/A	N/A	3.5*	3.0	N/A	N/A	2.0	*Parking spaces 2.2m wide in the traffic lane on southern side.
	0.5*	N/A	N/A	3.0	3.0 + 1.8 Parking	N/A	N/A	2.1	* Footpath removed on northern side for two-way traffic past parking spaces
Kenilworth Square Junction (Alignment J)									
CH. J90+000 to CH. J90+040	2.7-6.4	(1.2*)	N/A	5.0-5.3	2 x 3.1	N/A	(1.2*)	2.5-2.8	*Advisory cycle lane in traffic lane
	2.4-5.0	1.25	N/A	3.0	2 x 3.0	N/A	1.25	2.5-2.8	
CH. J90+060 to CH. J90+100	3.0	(1.3*)	N/A	4.5-5.8	3.5	3.0	Shared	2.6-3.4	*Advisory cycle lane
	2.6	1.5	N/A	3.0 + 2.75	3.0	N/A	1.5	2.2-3.0	

4.3 Design Speed and Speed Limits

The design speed to which the horizontal and vertical alignment of the Proposed Scheme has been developed has been governed by DMURS and the guidance provided by the Department of Transport, Tourism and Sport (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.

DMURS advocates an approach to speed that is cognisant of the place and movement function of the road. In relation to 30 km/h speed limits it states:

> *"Lower speed limits of 30km/h are a requirement of Smarter Travel (2009) within the central urban areas, where appropriate."*

and

> *"Where pedestrians and cyclists are present in larger numbers, such as in Centres, lower speed limits should be applied (30-40km/h)."*

PEDESTRIAN PRIORITY — VEHICLE PRIORITY

FUNCTION					
ARTERIAL	30-40 KM/H	40-50 KM/H	40-50 KM/H	50-60 KM/H	60-80 KM/H
LINK	30 KM/H	30-50 KM/H	30-50 KM/H	50-60 KM/H	60-80 KM/H
LOCAL	10-30 KM/H	10-30 KM/H	10-30 KM/H	30-50 KM/H	60 KM/H
CONTEXT	CENTRE	N'HOOD	SUBURBAN	BUSINESS/ INDUSTRIAL	RURAL FRINGE

Figure 4-2 DMURS Design Speed Selection Matrix

A design speed of 50kph is proposed along the proposed route as per the existing designation for arterial roads.

A lower 30 km/h speed limit is proposed along the Kimmage Road Lower Bus Gate Section – Ravensdale Park Junction to Harold's Cross Road Junction (Ch.A-350 to A-2,260). This proposal is in line with the DMURS guidance that the speed limit should relate to the place context and movement function of a town centre street and to suit shared use of the street by cyclists with buses and a low volume of traffic.

Table 4-3: Existing and Proposed Speed Limits

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)
A-70 to A-350	Kimmage Road Lower	Arterial	Suburban	50	50	50
A-350 to A-2,260	Kimmage Road Lower – Bus Gate Section	Arterial	Suburban	50	50	**30**
A-2,260 to A-2,660	Harold's Cross Road	Arterial	Suburban	50	50	50
A-2,660 to A-2,980	Clanbrassil Street Upper	Arterial	Centre	50	50	50
A-2,980 to A-3,740	Clanbrassil Street Lower / New Street South	Arterial	Centre	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. 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 practicably possible. 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 possible. 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 footpath levels will require additional temporary land-take to facilitate tie-in.

However, the philosophy of the design in this Proposed Scheme is the retention of the existing levels all along the routes, specially at footpaths where the levels will require slight changes to adapt appropriate crossfalls and the outer edges of the footpaths will retain the existing levels, especially at the existing accesses.

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 possible 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.

The horizontal alignment of the mainline remains as existing along the full length of the Proposed Scheme.

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 vertical alignment adheres as closely as possible 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 along the have not been identified on the Proposed Scheme due to the nature of the existing urban road network.

The vertical alignment of the existing road falls gently from south to north and the existing drainage system is satisfactory with no tendency for flooding.

The vertical alignment of the mainline remains as existing along the full length of the Proposed Scheme.

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 Stopping Sight Distance 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.

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 in 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

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.

A suite of vehicles was collated for consideration in assessment of alignment/ junction designs and entrances to private properties as shown below in Figure4-3.

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 4-3 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;
- 14.1m Double Decker Regional 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;
- FTA Design Articulated Vehicle (1998) – Analysis undertaken along the regional roads of the Proposed Scheme.

Some refuge island and some corner radii have been modified to allow vehicles turning path.

4.9 Pedestrian Provision

DMURS defines the footpath cross section by three distinct areas. The 'footway' area is designated as the main throughfare within the footpath 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 footpath. The assessment of these areas is further discussed in Chapter 13.

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

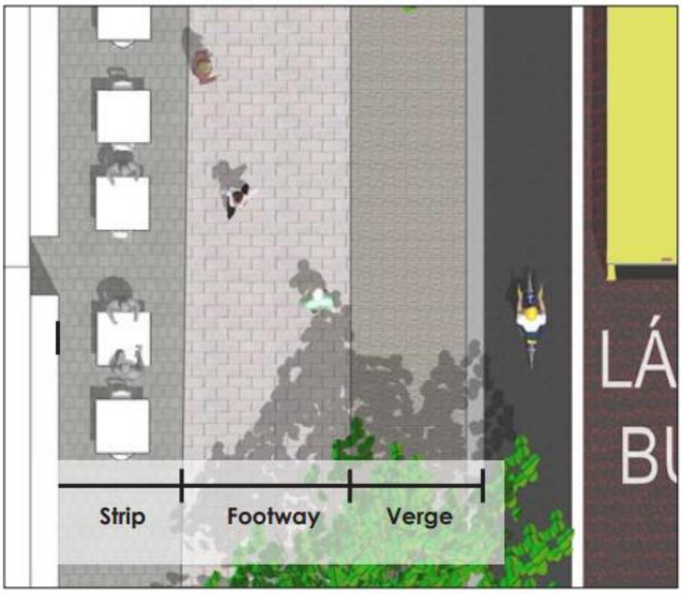


Figure 4-4 Key components of the footpath

4.9.1 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 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 footpath regime.

At specific pinch points, Building for Everyone: A Universal Design Approach, defines acceptable minimum footpath 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 footpath is reduced. For the majority of the Proposed Scheme extents minimum lane widths have been adopted.

Throughout the scheme, footway widths of 2.0m 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.The Proposed Scheme will provide significant improvements to the footway width provisions for the most part.

4.9.2 Footway Crossfall

The relevant design standard requirements are shown in in Table 4-5.

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 cross falls 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 footpath extents. As the proposed scheme consists of a retrofit onto existing streets the existing levels of the footpaths will be largely retained, in which case the crossfalls may be flatter than would be applied for new footpath construction. A minimum crossfall of 0.5% is sufficient to ensure adequate drainage of the footpath.

4.9.3 Longitudinal Gradient

The adopted footway design longitudinal grading parameters have been provided in Table 4-1. The footpath longitudinal gradient follows the gradient of the proposed carriageway. DN-PAV-03026, Figure 2.3 shown in Table 4-4 recommends a longitudinal gradient of 1.25%-5%.

Similar to cycle tracks throughout the scheme, longitudinal gradients of footpaths are likely to be constrained by the longitudinal gradient of the adjacent carriageway with little scope to vary the footpath separately. There are no designated ramps for the Proposed Scheme with longitudinal grading generally falling within the acceptable range.

4.9.4 Pedestrian Crossings

The adopted pedestrian crossing design parameters have been provided in Table 4-1.Where possible, 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 inter-green 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.

4.10 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 been 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;
- 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. A copy of the Audit has been provided in Appendix A.10. 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 Proposed 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 kerb between the footway and the cycle track is of particular importance for guide dogs, where by 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.

The main general design issues considered in the Audit are summarized below:

- 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;
- 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.

4.11 Cycling Provision

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.

Table 4-6 shows the cycle facilities provided in the Proposed Scheme:

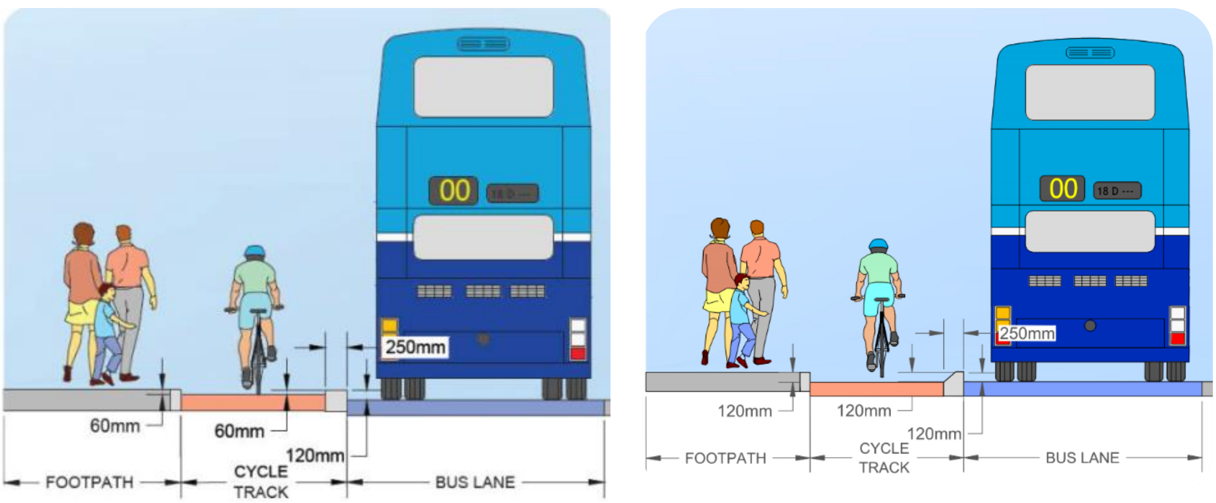
Table 4-6: Cycle Facilities Provision Both Directions

Location	Road Length (m)	Existing Length (m)		Existing Segregated %	Proposed Length (m)	%
		Segregated	Non-Segregated		Segregated	
Kimmage Road Lower	2,200	0	2,200	0%	250	11%
Harold’s Cross Road	400	0	0	0%	400	100%
Clanbrassil Street / New Street South	1,100	0	600	0%	1,100	100%
Totals	**3,700**	**0**	**2,700**	**0%**	**1,750**	**47%**

* Note: Some cycling lanes were improved in 2021 with provision of bollards and intermittent raised kerbs for segregation from traffic as part of emergency works during the COVID-19 pandemic.

4.11.1 Segregated Cycle Track

A Cycle Track is a segregated cycle lane which is physically segregated from the adjacent traffic lane and/or bus lane horizontally and/or vertically as shown in Figure 4-5 below taken from the BCPDGB.



Raised Adjacent Cycle Track ***Cycle Track with Upstand Kerb***

Figure 4-2: Fully Segregated Cycle Track Options

4.11.2 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 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.
- For side road crossings where the cycle track is locally reduced to road level.
- Along Kimmage Road Lower within the bus gate section where the traffic volumes will be greatly reduced, and segregation will be neither practicable nor necessary.

4.11.3 Offline Cycle Track

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

- Poddle Cycleway from Sundrive Road to Mount Argus over a length of 50m at the proposed Stone Boat Boardwalk.

4.11.4 Quiet Street Cycle Route

A quiet street cycle route follows 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.”*

They are called Quiet Streets due to the low amount of general traffic and are deemed suitable for cyclists sharing the roadway with the general traffic without the need to construct segregated cycle tracks or painted cycle lanes. The Quiet Street Treatment would involve appropriate advisory signage and lane marking for both the general road users and cyclists.

The Quiet Street Cycle Route will require appropriate advisory signage for both the general road users and cyclists, and if necessary other traffic management measures to reduce general traffic flows.

Quiet street cycle routes will be provided on the Kimmage to City Centre CBC corridor in the following areas:

- West of the corridor along Poddle Park and Blarney Park, and Mount Argus Way & View over a length of 1.95km.
- Along Derravaragh Road to the east of Kimmage Road Lower.

This will provide a complementary cycling route on the west side of the corridor along quiet residential streets.

4.11.5 Cycling Facilities at Constrained areas

At some locations along the Proposed Scheme, the desired cycleway width of 2m cannot be achieved, and localised narrowing is required. Providing a standard width would require additional land take from either surrounding private properties or pedestrian areas, or the loss of mature street trees that are of significant value. These locations are recorded in the Deviations Report in Appendix C and are as follows:

- On Kimmage Road Lower in the bus gate section between Ravensdale Park and Harold's Cross Road the existing 1.2m wide advisory cycle lanes will be retained, but the traffic conditions will be significantly improved with greatly reduced traffic flows due to the bus gates and a lower speed limit of 30 km/h.
- On Harold's Cross Road there are severe constraints on the overall road width between existing buildings and the cycle tracks will be 1.5m wide generally, but they will reduce to 1.2m over some very short sections.
- On Clanbrassil Street Upper there are severe constraints on the overall road width between existing buildings and the cycle tracks will be 1.5m wide generally, but they will reduce to 1.2m over some very short sections.
- On Clanbrassil Street Lower there is a pinch-point section where the cycle tracks will be 1.9m wide.
- On New Street South approaching the major junction at Patrick Street the cycle tracks will be 1.5m wide so as not to encroach into the footpaths which are heavily used and fairly limited in width at 2.8m.
- On the ancillary route along Harold's Cross Road to the east of Kimmage Road Lower, the cycle tracks will be 1.5m wide generally to fit within the narrow road, and they will reduce to 1.25m at the junction with Kenilworth Park so as not to encroach on the footpaths which are only wide enough for comfort at the pedestrian crossing waiting areas.

4.11.6 Cycle Parking

As noted in Section 4:13 bike racks will generally be provided, where practicable, at Island Bus Stops and key additional locations as noted in the Landscape drawings.

4.12 Bus Provision

The Proposed Scheme design drawings show the improved extent of bus provision. Table 4-7 summarises the Bus priority provision along the Scheme.

Table 4-7: Bus Priority Provision Summary

Bus priority – Northbound to City Centre	Road Length	Existing Length	%	Proposed Length	%
Kimmage Road Lower Bus Lane Bus Gate section	2,200	0	0%	 250 1,950	100%
Harold's Cross Road: Bus Lane	400	350	88%	400	100%
Clanbrassil Street / New Street South: Bus Lane	1,100	540	49%	900	82%
Total	**3,700**	**890**	**24%**	**3,500**	**95%**
Bus priority – Southbound from City Centre					
Clanbrassil Street / New Street South: Bus Lane	1,100	0	0%	1,000	90%
Harold's Cross Road: Bus Lane	400	240	60%	400	100%
Kimmage Road Lower Bus Lane Bus Gate section	2,200	0	0%	 200 1,950	98%
Total	**3,700**	**240**	**6.5%**	**3,550**	**96%**

4.12.1 Signal Controlled 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.

Over the majority of the route a 3m wide dedicated 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.

Where this full 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 as described in Chapter 3 for each location.

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 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. Signal Controlled Priority is proposed at the locations listed in Table 4-8.

Table 4-8: Signal Controlled Priority for Buses Summary

Location	Direction	Reason
Kimmage Cross Roads	Southbound	To enable buses to proceed ahead of general traffic into the downstream links where there are no bus lanes, including for the right-turn to Kimmage Road West from the bus lane on the left of the traffic lane.
Harold's Cross Road / Kimmage Road Lower junction	Southbound	For buses to turn right across the traffic lane to enter Bus Gate No.2B at the northern end of Kimmage Road Lower.
Leonard's Corner (South Circular Road)	All directions	For the north-south direction to enable buses to proceed ahead of general traffic into the downstream links where there are no bus lanes. For the east-west direction at advance stop lines where the bus lanes end about 40m in advance of the junction.

4.12.2 Bus 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.

Three bus gates are proposed along the Proposed Scheme at the locations shown in Table 4-9:

Table 4-9: Proposed Bus Gates

Location	Direction	Operational Times
Kimmage Road Lower Just north of the Ravensdale Park junction	Northbound	6am to 10am & 4pm to 8pm / 7 Days
	Southbound	6am to 10am & 4pm to 8pm / 7 Days
Kimmage Road Lower Just south of Harold's Cross Park	Northbound	24 Hours / 7 Days
	Southbound	24 Hours / 7 Days
Kimmage Road Lower Junction with Harold's Cross Road	Northbound	6am to 10am / 7 days
	Southbound	24 Hours / 7 Days
Kenilworth Park westbound at junction with Harold's Cross Road	Westbound	24 Hours / 7 Days

General traffic will use alternative routes to access Kimmage Road Lower from the west via Sundrive Road, or from the east via Kenilworth Park / Clareville Road / Larkfield Avenue. Through traffic may choose from a wide variety of alternative routes. Direction signs will not be provided to indicate any specific alternative traffic routes other than for local destinations.

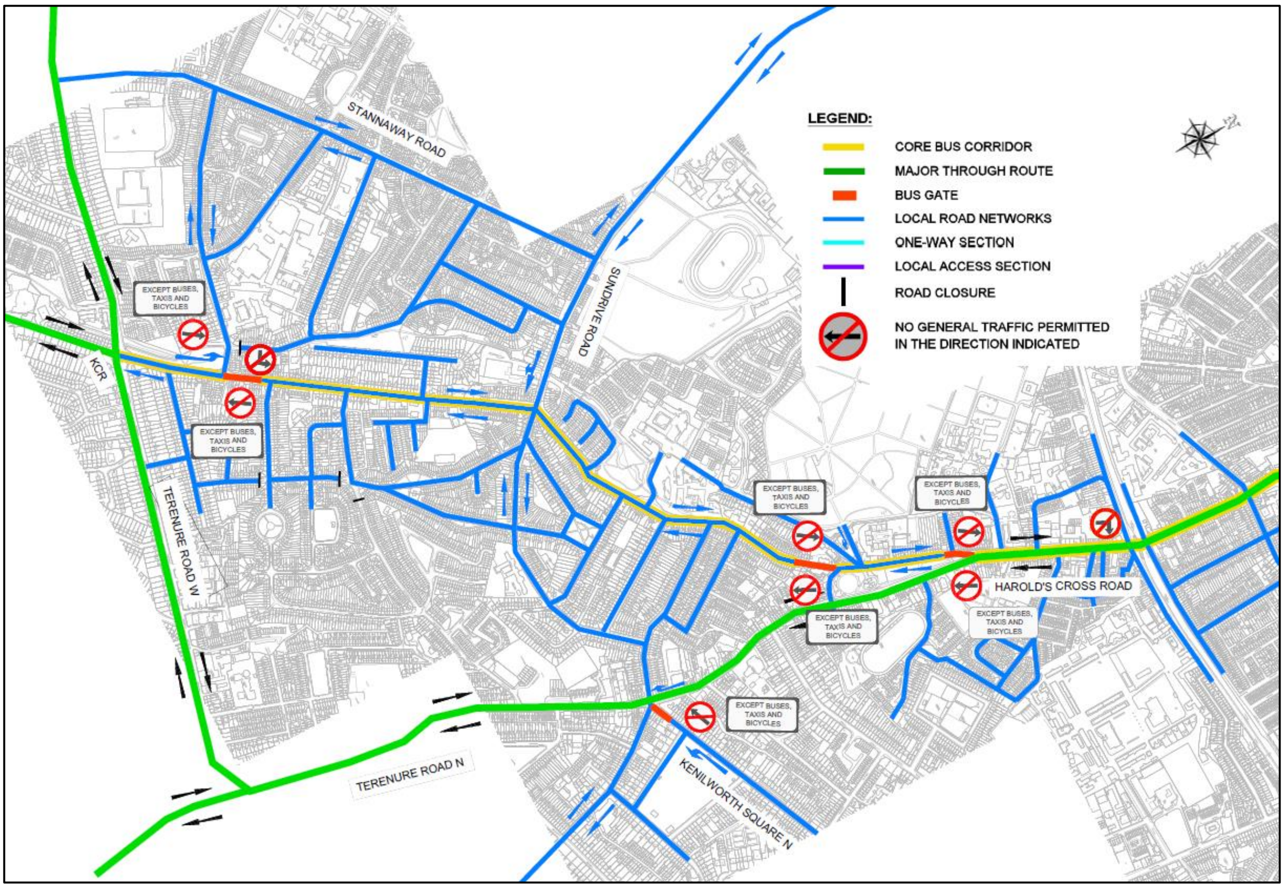


Figure 4 -6 Alternative Routes

4.13 Bus Stops

This section of the report presents a summary of the Bus Stop Review process which was conducted for the Proposed Scheme.

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

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

The below flow chart outlines the process for examining the Proposed Scheme and assessing and reporting on the bus stops along the route, as shown in Figure 4-7.

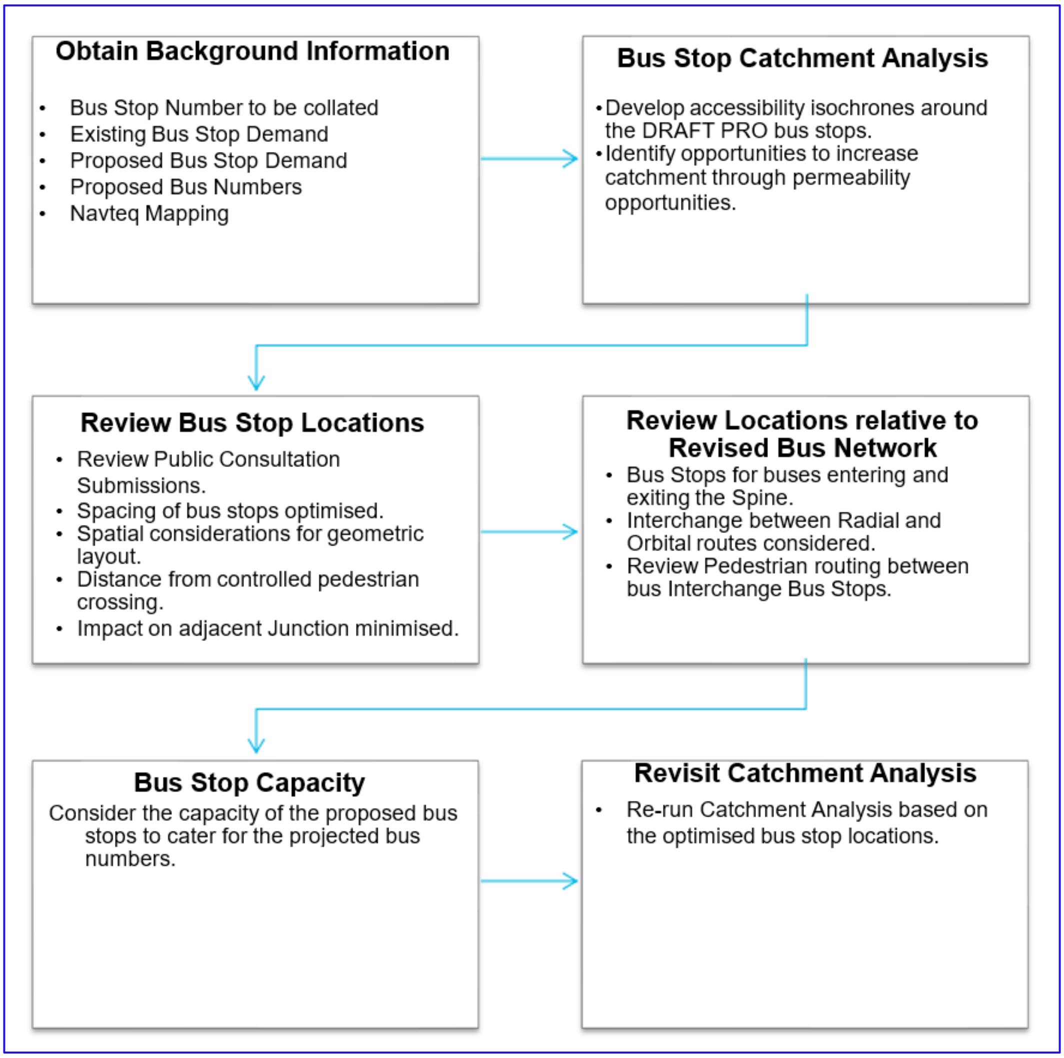


Figure 4-7: Bus Stop Location Assessment Process

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

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

- Bus Driver 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
- 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. Their optimum location is a short distance from a controlled crossing point.

4.13.1 Bus Stop Summary

The list below provides an overview of the key changes to the locations for bus stops along the route. A more detailed breakdown of the bus stop review in addition to the catchment analysis outputs is provided in Appendix H. Where specific feedback in relation to bus stops from the public consultation process has been provided this has been acknowledged in the assessment also.

Summary of Bus Stops

- A total of 23 bus stops.
  - Island bus stops: 12
  - Inline bus stops: 11
- 8 existing stops will be removed as they are too closely spaced to other stops, or they will be replaced with an amalgamated stop between an existing pair.
- In addition on the orbital bus corridor on Sundrive Road, 2 further bus stops will be modified for better spacing for interchange with the radial bus route, and for upgraded facilities.

Table 4.10: Proposed Bus Stops ORBITAL Direction

Inbound / Outbound	Bus Stop Name	Bus Stop Number	Chainage	Bus Stop Type	Bus Shelter	
Orbital Eastbound	Sundrive Park	2497	G-61080	Narrow island	Yes	Moved 70m closer to the junction with Kimmage Road Lower.
Orbital Westbound	Sundrive Road	2485	G-61060	Narrow island	Yes	

4.13.2 Island Bus Stops

The preferred bus stop arrangement for the Proposed Scheme is the island bus stop arrangement as shown below in Figure 4-8.

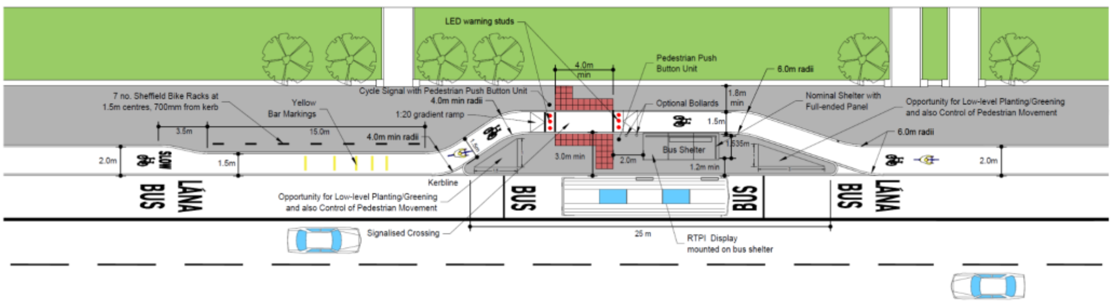


Figure 4-8: Example of an Island Bus Stop

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 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 is 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 4-9. Audible tactile units will also be a featured at the crossing points.

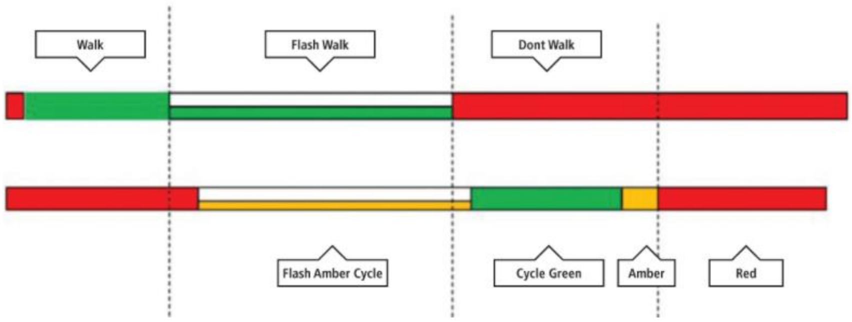


Figure 4-9: Example of nested pelican sequence

A 1:20 ramp is provided on the cycle track to raise the cycle track to the level of the footpath/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 the gradual transition to the cycle track.

The desired minimum island width of 3m has been developed 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 in the immediate vicinity to promote the use sustainable mode interchange at bus stops for longer distance trips.

Figure 4-10 Example landscaping arrangement at island bus stops on Oxford Road Manchester (source: Google Street-View 2021)

Table 4-11 List of Island Bus Stops

Stop Number	Stop Name	Existing Chainage	Proposed Chainage	Reason for Moving Stop	Shelter?
Inbound					
New	New	-	A-205	N/A	Yes
New	New	-	A-2530	N/A	Yes
1347	Clanbrassil St Upper	A-2850	A-2850	N/A	Yes
2634	Clanbrassil Street	A-3040	A-3040	N/A	Yes
New	New	-	A-3280	N/A	Yes
5097	Kevin Street	A-3660	A-3660	N/A	Yes
Outbound					
2386	New South Street	A-3650	A-3670	Moved 20m north for wider footpath for island	Yes
New	New	-	A-3350	Stop 2387 and 2388 combined at new location to improve spacing between stops	Yes
New	New	-	A-3025	New stop for interchange with orbital route.	Yes
1290	Clanbrassil Street Upper	A-2815	A-2820	Moved 5m north for better spacing on footpath	No
1291	Harold's Cross Road	A-2550	A-2550	N/A	Yes
2394	Poddle Park	A-235	A-135	Moved 100m closer to junction and better spacing for Island	Yes

4.13.3 Shared Landing Area Bus Stops

Not applicable to the proposed scheme.

4.13.4 In-line Bus Stops

In-line bus stops are generally only provided in areas of low-medium flow, cyclists will generally have to yield when a bus is stationary at the stop to avoid collisions with the bus as it pulls away. In the bus gate section of the Proposed Scheme the traffic flows will be very low and the existing in-line bus stops are suitable for retention.

Table 4-12 List of Inline Bus Stops

Stop Number	Stop Name	Existing Chainage	Proposed Chainage	Reason for Moving Stop	Shelter?
Inbound					
2440	Aideen Avenue	A-650	A-650	N/A	Yes
2441	Kimmage Grove (Sundrive)	A-1020	A-1040	Moved 20m North closer to S2 orbital route	Yes
2442	Mount Argus Church	A-1410	A-1410	N/A	Yes
2443	Brookfield	A-1645	A-1645	N/A	Yes
2444	Mount Argus Road	A- 2030	A- 2030	N/A	Yes
Inbound					
1292	Harold's Cross Park	B-10320	B-10320	N/A	Yes
2389	St. Clare's Avenue	A-2105	A-2030	Moved 75m to the south, closer to park entrance, and pedestrian crossing.	Yes
2390	Mount Argus Park	A-1580	A-1580	N/A	Yes
2391	Mount Argus Church	A-1365	A-1350	Moved 15m to the south for improved spacing on footpath	Yes
2392	Kimmage Grove (Sundrive)	A-980	A-1005	Moved 25m to the north closer to S2 orbital route	Yes
2393	Corrib Road	A-500	A-500	N/A	Yes

4.13.5 Layby Bus Stops

Not applicable to the proposed scheme.

4.13.6 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 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 4-11 provides an example image of the preferred full end panel shelter arrangement. The desirable minimum footpath/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 footpath widths are considered in the following sections.

Figure 4-11: 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 footpath locations. Figure 4-12 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 footpath/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.

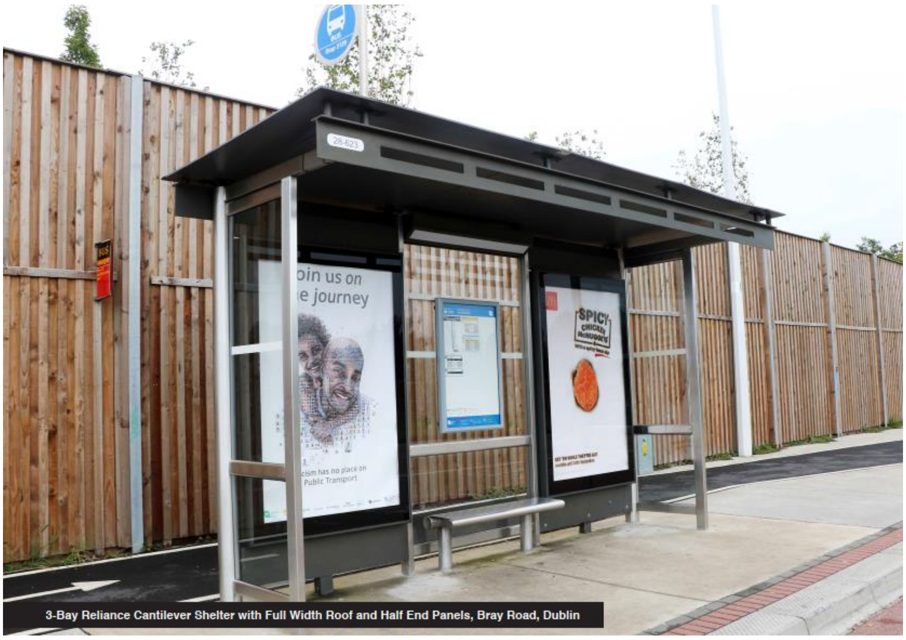


Figure 4-12: Example of a 3-Bay Reliance Cantilever Shelter with full width roof and half end panels (Source: JCDecaux)

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 footpath widths for the narrow roof configuration are 2.75m (with end panel) and 2.1m (no end panel). The absolute minimum footpath 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 4-13: 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 to perpendicular to the island to the rear of the footpath. Where bus shelters cannot be located directly on the dedicated island or perpendicular 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.

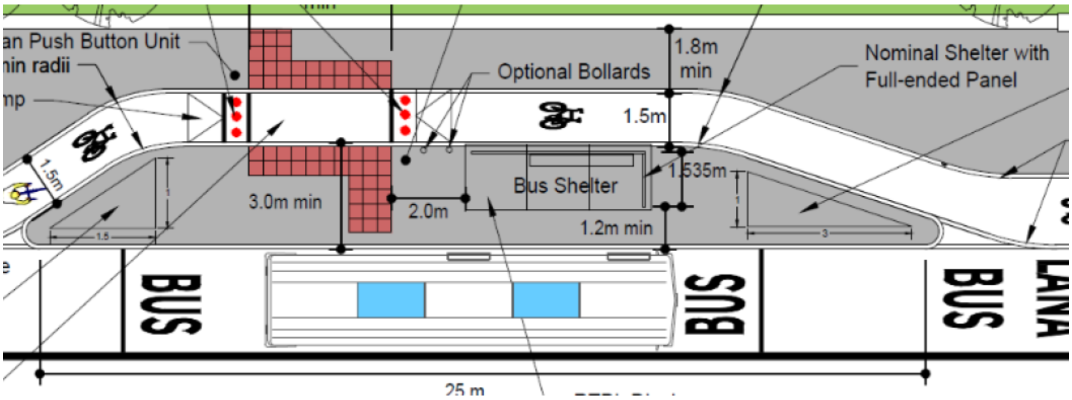


Figure 4-14 Preferred Shelter Location (on island)

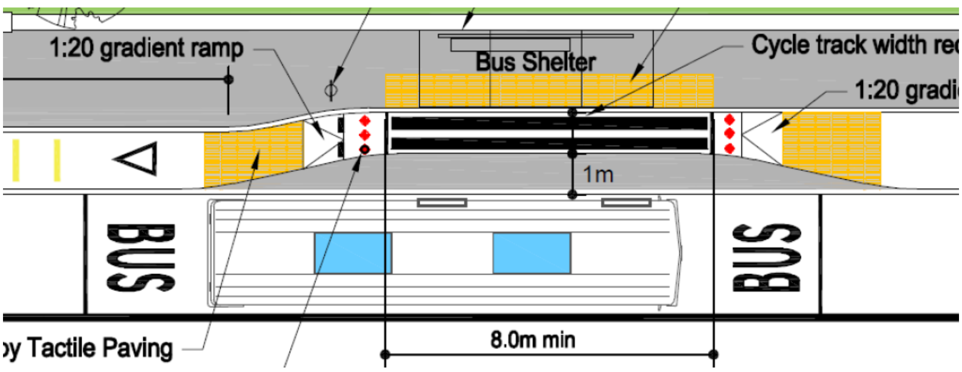


Figure 4-15 Alternative Shelter Location back of footpath (narrow island with adequate footpath widths)

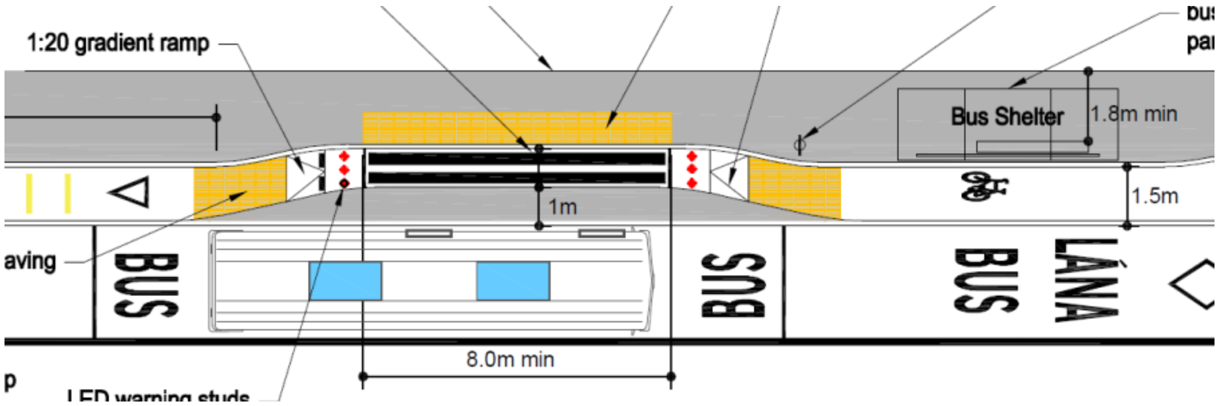


Figure 4-16 Alternative Shelter Location downstream of island (narrow island with narrow footpath widths at landing area)

4.14 Parking and Loading

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 provides the details of the Parking and Loading Report.

The report was prepared in the absence of parking survey data, which could not be obtained due to ongoing movement restrictions as a result of the international Covid-19 pandemic. 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 possible mitigation measures / alternative parking arrangements;
- Analyse mitigation measure to inform the optimum recommendation; and
- Provide recommendations and identify 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);
- 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;

- 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.

4.14.1 Summary of Parking Impact and Mitigation

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. The proposed changes in parking provision are summarised in Table 4-13.

Table 4-13: Summary of Proposed Parking Amendments

Section	Location	Type	Part Time / Full Time /	Loading / Other	Disabled	Existing Parking	Proposed	Change	Section change
Section 1	Ravensdale Park	Informal	FT			7	4	-3	-39
	LKR shops at Corrib	Informal	PT			30	30	0	
	Ravensdale to Sundrive	Informal	PT			180	180	0	
	LKR at Sundrive - East	Informal	PT			22	16	-6	
	LKR at Sundrive - Southwest	Permit	FT			52	52	0	
	Sundrive Road 1	Taxi	FT			2	0	-2	
	Sundrive Road 2	Informal	FT			8	0	-8	
	Sundrive Road 3	Informal	FT			5	0	-5	
	Sundrive Road 3	Pay & Display	FT			24	12	-12	
	LKR at Sundrive - Northwest	Informal	FT			4	3	-1	
	Harold's Cross Road East 1	Paid	FT			7	7	0	
	Harold's Cross Road East 2	Paid	FT			3	3	0	
	Harold's Cross Road East 3	Paid	FT			2	0	-2	
	Sundrive to Harold's Cross Park	Informal	PT			80	80	0	
	Lower Kimmage Road at Mount Argus Church Entrance	Pay & Display/Permit	FT			13	13	0	
	Mount Argus Apartments	Permit	FT			6	6	0	
Section 2	Harold's Cross Road West	Paid	FT			10	0	-10	12
	Harold's Cross Road East 4	Disabled	FT		1		1	0	
	Harold's Cross Road East 4	Paid	FT			6	4	-2	
	Harold's Cross Road East 5	Pay & Display	FT				4	4	
	New car Park - Hospice	Pay & Display	FT				22	22	
	Grand Canal junction	Paid	FT			2	0	-2	
Section 3	Clanbrassil St. Upper West 1	Paid	FT			4	3	-1	-19
	Clanbrassil St. Upper East	Paid	PT			3	0	-3	
	Clanbrassil St. Upper West 2	Paid	FT			4	3	-1	
	Clanbrassil St. Lower West 1	Paid	PT			11	0	-11	
	St. Vincent Street Car Park (Bottle Bank)	Paid	FT			10	12	2	
	Clanbrassil St. Lower East 1	Paid	PT			10	0	-10	

Section	Location	Type	Part Time / Full Time /	Loading / Other	Disabled	Existing Parking	Proposed	Change	Section change
	Clanbrassil St. Lower West 2	Disabled	PT		1		1	0	
	Clanbrassil St. Lower West 2	Loading	FT	3			3	0	
	Clanbrassil St. Lower West 2	Pay & Display	FT				5	5	
	Clanbrassil St. Lower East 2 (McDonnell Street)	Paid	PT	3			3	0	
	Clanbrassil St. Lower West 2 (Malpas Steet)	Paid	FT			3	3	0	
	Cathedral Court	Paid	FT			2	2	0	
	Cathedral Court	Paid	FT			5	5	0	
	New Street East (Maldron Hotel)	Loading	FT			1	1	0	
				6	**2**	**516**	**478**	**-46**	

4.15 Turning Bans and Traffic Management

Bus gates will be provided at 3 locations along Kimmage Road Lower and on Kenilworth Park as listed in Table 4-14 with a summary of the turning bans along the Proposed Scheme.

Table 4-14 Summary of Proposed Turning Bans and Traffic Management Measures

Chainage	Minor Road	Major Road	Measure	Reason	Impact
A-310	Ravensdale Park	Kimmage Road Lower	No left turn onto Major Road. Northbound bus gate on Kimmage Road Lower.	Bus gate on Kimmage Road Lower.	Rerouting of traffic via, Stannaway Road, or Terenure.
A-335	Ravensdale Park	Kimmage Road Lower	Northbound & Southbound Bus Gate on Kimmage Road Lower.	To minimise delays for buses.	Rerouting of traffic via, Stannaway Road, or Terenure.
A-605	Aideen Avenue	Kimmage Road Lower	No right turn onto minor road.	Existing	N/A
A-1075	Larkfield Avenue	Kimmage Road Lower	No right turn onto major road.	Existing	N/A
A-1930	Harold’s Cross Road	Kimmage Road Lower	Northbound & Southbound Bus Gate on Kimmage Road Lower south of Harold's Cross Park	To minimise delays for buses.	Reroute of traffic via Harold's Cross Road, Kenilworth Park, and Clareville Road.
A-1935	Harold's Cross Road (South)	Kimmage Road Lower/Harold's Cross Road	No left turn on major road.	To minimise delays for buses.	Reroute of traffic via Harold's Cross Road, Kenilworth Park, and Clareville Road.
A-2000	Mount Argus Road	Harold's Cross Road	No left turn onto major road except local access	To minimise delays for buses.	N/A
n/a	Kenilworth Park	Harold's Cross Road	Westbound bus gate on Kenilworth Park	To enable a revised traffic signal staging	Short local diversion to Rathgar Avenue

Table 4-14 (continued) Summary of Proposed Turning Bans and Traffic Management Measures

Chainage	Minor Road	Major Road	Measure	Reason	Impact
A-2090	Gandon Close	Harold's Cross Road	No left turn onto major road except local access	To minimise delays for buses.	N/A
A-2230	St Clare's Avenue	Harold's Cross Road	No left turn onto Major Road. Northbound bus gate on Harold's Cross Road. (Except local access)	To minimise delays for buses.	N/A
A-2250	N/A	Harold's Cross Road	Northbound & Southbound Bus Gate on Harold's Cross Road	To minimise delays for buses.	Reroute of traffic via Harold's Cross Road, Kenilworth Park, and Clareville Road.
A-2255	N/A	Harold's Cross Road	No Right turn	Existing	N/A
A-2256	N/A	Harold's Cross Road	No Left turn	Existing	N/A
A-2660	Grove Road	Harold's Cross Road	No right turn onto minor Road.	To enable the northbound bus lane to extend to the stop line and not to delay through traffic.	Traffic displaced 300m north to turn onto South Circular Road
A-2665	Grove Road	Clanbrassil Street Upper	No right turn onto major road.	Existing	N/A
A-2675	Parnell Road	Clanbrassil Street Upper	No right turn onto minor road.	Existing	N/A
A-2705	Windsor Terrace	Clanbrassil Street Upper	No right turn onto major road.	Existing	N/A
A-2975	South Circular Road	Clanbrassil Street Lower (Northbound)	No right turn onto major road.	Existing	N/A
A-2990	South Circular Road	Clanbrassil Street Upper (Southbound)	No right turn onto major road.	Existing	N/A
A-3230	Saint Kevin's Parade	Clanbrassil Street Lower	No right turn onto major road.	Existing	N/A
A-3240	Donovan Lane	Clanbrassil Street Lower	No left turn onto minor road.	Existing	N/A
A-3250	Donovan Lane	Clanbrassil Street Lower	No right turn onto major road.	Existing	N/A
A-3255	Donovan Lane	Clanbrassil Street Lower	No right turn onto minor road.	Existing	N/A
A-3310	Daniel Street	Clanbrassil Street Lower	No right turn onto major road.	Existing	N/A
A-3400	William's Place South	Clanbrassil Street Lower	No right turn onto major road.	Existing	N/A
A-3420	Long Lane	Clanbrassil Street Lower	No right turn onto minor road.	Existing	N/A

Table 4-14 (continued) Summary of Proposed Turning Bans and Traffic Management Measures

Chainage	Minor Road	Major Road	Measure	Reason	Impact
A-3465	Long Lane	New Street South	No left turn onto minor road.	Existing	N/A
A-3530	New Street Gardens	New Street South	No right turn onto major road.	Existing	N/A
A-3700	Kevin Street Upper (Slip Road)	New Street South	No left turn onto minor road.	Existing	N/A
J-90050	Kenilworth Square North	Harold's Cross Road	No Straight Ahead	Bus gate on Kenilworth Square North	Rerouting traffic via Kenilworth Square West, Kenilworth Square South and Rathgar Avenue

4.16 Relaxations and Departures

The terms relaxation and departure are derived from the TII requirements for national roads projects.

A Relaxation from Standard is where a design element is below the desirable parameter, but still meets the minimum requirement permitted in the standard.

As defined in GE-GEN-01005, a Departure from Standard shall mean any of the following:

A Departure is where a design element is below the minimum parameter for any of the mandatory requirements of TII Publications (Standards);
The use of technical design standards and/or specifications other than those in TII Publications (Standards);
The use of a set of requirements or additional criteria for any aspect of the Works for which requirements are not defined in the Contract;
The use of a technical design standard or technical specification in a manner or circumstance which is not permitted or provided for in such directive or specification;
A combination of any of the criteria specified above.

The following are variations that are not considered as constituting a Departure from Standard:

Suggestions/Recommendations within TII Publications (Standards);
Relaxations – these need to be recorded in the Deviations Report, but a formal application for approval does not need to be completed.

For urban renewal schemes DN-GEO-03030 provides suitable guidance on the application of DMURS for the design of all urban roads and streets with a 60km/h or less speed limit. A scheme that is being designed in accordance with DMURS shall require a Design Report. Any deviations from the requirements or guidance set out in DMURS shall be detailed in the Design Report. Notwithstanding, Schemes that are being designed in accordance with DMURS shall comply with relevant TII Specifications with regards to materials, standard construction details and maintenance requirements.

The Design Report for schemes designed in accordance with DMURS shall contain a DMURS Compliance Statement. This statement shall include a table demonstrating compliance with the four Core Design Principles.

Design Principle 1: To support the creation of integrated street networks which promote higher levels of permeability and legibility for all users, and in particular more sustainable forms of transport.

Design Principle 2: The promotion of multi-functional, place-based streets that balance the needs of all users within a self-regulating environment.

Design Principle 3: The quality of the street is measured by the quality of the pedestrian environment.

Design Principle 4: Greater communication and co-operation between design professionals through the promotion of a plan-led, multidisciplinary approach to design.

For the BusConnects Infrastructure the design is required to adhere to the BusConnects Preliminary Design Guidance Booklet (BCPDG), which provides project specific details that are not included in the other applicable national design standards.

Details of deviations, departures and relaxations from standards are provided in Appendix C.

4.16.1 DMURS Design Compliance Statement

The Proposed Scheme has been designed in line with the principles and guidance outlined within the Design Manual for Urban Roads and Streets (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 footpaths, 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.
- 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.

4.17 Road Safety and Road User Audit

Road Safety Audits 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 possible).

Stage 4: Early operation at 2 to 4 months' post road opening with live traffic.

In line with the above a Stage 1 Road Safety Audit (RSA) was undertaken as part of the Preliminary Design development. This RSA has been included in Appendix M complete with the proposed designer’s responses.

The Stage 1 RSA represents the response of an independent audit team to various aspects of the Proposed 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 Proposed Scheme as constructed can be improved to address issues of road safety.

5. Junctions

5.1 Overview of Junction Design and Junction Modelling

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 BCPDG. 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 5.3.5 .

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' – 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
- Do Something' – 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 'Do Minimum' 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 DoSomething model were not deemed appropriate for a specific location the flows associated with the Do Minimum 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.

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 possible. 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 BCPDG;
- 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 practical;
- People Movement Calculator (PMC) 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;
- Cyclist quantification

5.3 Junction Geometric 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 possible. 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 hasn't been feasible i.e. due to crossing distances and the associated inter-green 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 cycle times at all signalised junctions in the DoSomething scenario in comparison to the Do Minimum cycle times, are shown in the summary Table 5-1.

Table 5-1 Traffic Signal Junction Cycle Times

No.	Junction Name	Cycle Time (Seconds)		
		Do Minimum	Do Some-thing AM	Do Something PM
1.	Kimmage Cross Roads	85	100	110
2.	Kimmage Road Lower / Ravensdale Park	-	70	75
3.	Kimmage Road Lower / Sundrive Road	60	90	90
4.	Kimmage Road Lower / Mount Argus View	-	60	60
5.	Kimmage Road Lower / Harold's Cross Road	110	60	60
6.	Harold's Cross Road / Parnell Road / Grove Road	120	120	120
7.	Leonard's Corner: Clanbrassil Street / South Circular Road	120	100	120
8.	Clanbrassil Street Lower / Malpas Street / New Street South / Long Lane	-	On demand	On demand
9.	Clanbrassil Street Lower / Patrick Street / Kevin Street	-	120	120
10.	Harold's Cross Road / Park View	-	90	100
11.	Harold's Cross Road / Kenilworth Park	-	120	115

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 placing the cyclists within viewing of traffic waiting at the junction. Cycle signals will control the movement of cyclists including the second stage movement i.e. right turners.
- Cyclist and pedestrian crossings have been kept as close as possible 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.

In some instances, 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 at Junctions

The BCPDG includes four different types of junctions to achieve bus priority - referred to as Junction Types 1-4. Junction Type 1 only is proposed on the Proposed Scheme. The following is a description of the four junction layout types.

5.3.3.1 Junction Type 1

Junction Type 1, described at BCPDG Section 7.4.1 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 while general traffic is held. The bus lane gets red, allowing the general traffic lane to proceed. If the volume of left-turning vehicles is greater than 150 PCUs (passenger car units), then the cyclists should also be held on red. If the volume of left turners is approx. 100 – 150 PCUs, left turners will be controlled by a flashing amber arrow and cyclists can proceed with general traffic, while also receiving an early start. See Figure 5-1

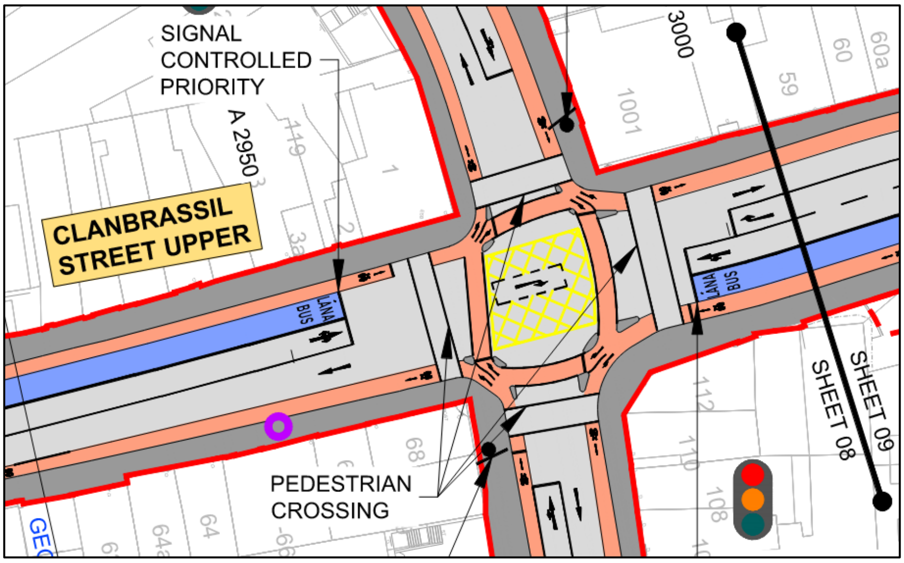


Figure 5-1: Junction Type 1 Proposed South Circular Road Junction

5.3.3.2 Junction Type 2

Junction Type 2, described at BCPDG Section 7.4.2, 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;
- High volume of left turning traffic which can be controlled separately with exiting traffic from side roads.

In this instance, left turning general traffic is 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, then mainline cyclists could still proceed with left turnings from the left turning pocket on a flashing amber arrow.

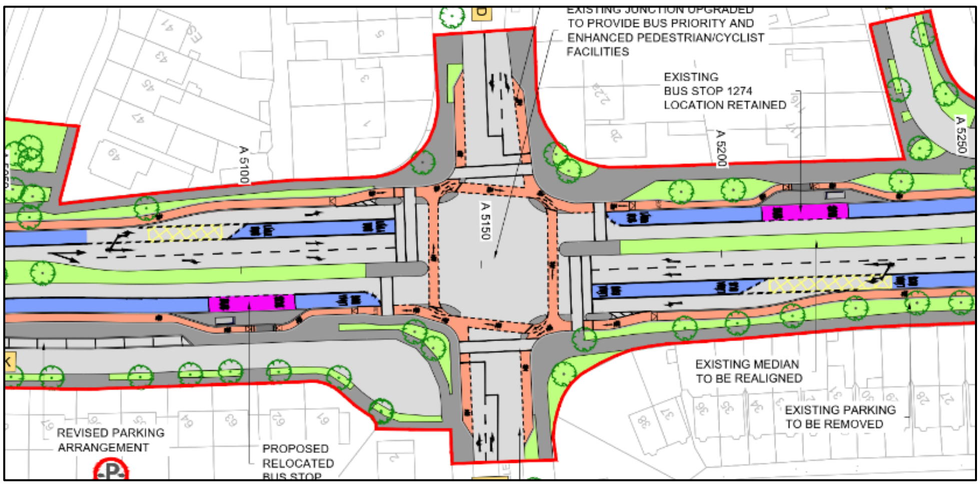


Figure 5-2: Example of Junction Type 2 from BCPDG

Junction Type 2 has not been applied to the Proposed Scheme.

5.3.3.3 Junction Type 3

Junction Type 3, described at BCPDG Section 7.4.3, is a signalised junction 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;
- Urban setting, no space available for a dedicated left turning lane / pocket.

In this instance, mainline buses and general traffic (including left turners) proceed together, but before they do, mainline cyclists are given an early start of approximately 5 seconds to assist with cyclist priority and to minimise potential conflicts. When this early start is complete, the mainline cyclists can still proceed, assuming turning volumes are less than 150 PCUs per hour. Left turning from the left turn pocket are given a flashing amber.

Figure 5-3 - Example of Junction Type 3 from BCPDG

Junction Type 3 has not been applied to the Proposed Scheme.

5.3.3.4 Junction Type 4

Junction Type 4, described at BCPDG Section 7.4.4, is 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 footpath 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
- Pedestrians and cyclists can cross at the same time due to the segregated and non-conflicting crossings;
- 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:

- High incidence of HGV movements e.g. at industrial estates or where two major regional roads meet;
- Suburban setting and lower pedestrian volumes.

In this instance, mainline buses and left turning from the mainline proceed together.

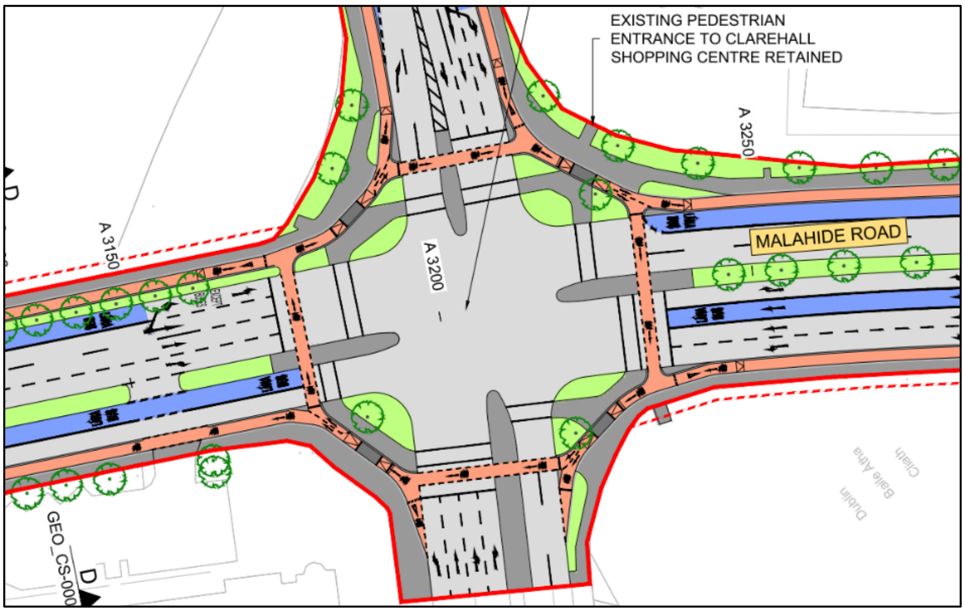


Figure 5-4 - Example of Junction Type 4 from BCPDG

Junctions Type 4 has not been applied to the Proposed Scheme.

5.3.4 Staging and Phasing

The optimum staging for each junction is determined by the junction configuration and the level of demand for each movement. One of the key considerations in the design of the signalised junctions is the conflict between left turning traffic and buses, and cyclists and pedestrians continuing along the main corridor. The following presents an overview of the design approach:

- 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 for straight-ahead cyclists on the main corridor will enable cyclists to advance before general traffic. The amount of green given to cyclists is subject to junction dimensions and signal operation;
- Cycle movements along the main corridor, crossing the side road, can run simultaneously with the bus stage in the same direction, so long as the bus is not permitted to turn left from the bus lane; 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 are provided for right turning cyclists.

5.3.5 Junction Design Summary

A detailed junction assessment has been undertaken in line with the principles described in Section 5.3.3. The following summary tables provide an overview of the key design principles adopted at each junction location. More detailed information for each junction location can be found in the Junction Design Reports in Appendix A.11. All junction designs on the proposed scheme

Table 5-2: Overview of Major Junctions

No.	Junction	Type	Key Design Notes
1	Kimmage Cross Roads: Kimmage Road Lower / Terenure Road West / Fortfield Road / Kimmage Road West	1	Signal Junction Type 1: 4 arms
			Bus lanes on northern arm in both directions. None on the other 3 arms. Cycle tracks on northern side. Cycle lanes on other 3 arms. Pedestrian signal crossings on all arms. Slip lanes removed.
24	Harold's Cross Road / Parnell Road Clanbrassil Street Upper / Grove Road	1	Signal Junction Type 1: 4 arms
			Bus lanes on northern and southern arms in both directions. Cycle tracks on northern and southern arms in both directions. Pedestrian signal crossings on all arms. No right turn in northbound (new), southbound (existing) and westbound (existing) directions. Right-turn filter lane and signal eastbound.
29	Leonard's Corner Clanbrassil Street Upper / South Circular Road	1	Signal Junction Type 1: 4 arms
			Bus lanes in northbound and southbound directions on approaches but not downstream. Bus lanes on eastbound and westbound approaches end 40m to 50m before the junction with advance stop signals. Signal-controlled priority for bus in all 4 directions through the junction. Cycle tracks on all 4 arms in both directions. Pedestrian signal crossings on all arms. Right-turn filter lane and signal southbound. Right-turn box and filter signal in northbound direction. No right turn in eastbound and westbound directions (existing).
42	New Street South / Dean Street / Patrick Street / Kevin Street Upper	1	Signal Junction Type 1: 4 arms
			Only southern arm of junction is in the proposed scheme. Bus lanes on southern arm in both directions. Cycle tracks on southern arm in both directions. Pedestrian signal crossings on all arms.

Table 5-3: Moderate Junctions

No.	Junction	Type	Key Design Notes
9	Kimmage Road Lower / Sundrive Road / Larkfield Avenue	n/a	Existing Signal Junction – 4 arms
			In bus gate section. No bus lanes. Advisory cycle lanes on northern arm. Cycle tracks on eastern and western arms. Shared road on southern arm Pedestrian signal crossings on all arms.
19	Kimmage Road Lower / Harold's Cross Road	1	Existing Signal Junction – 3 arms
			Bus gate on southwestern arm. Bus lanes on northern arm with signal controlled priority for southbound right-turn. Northbound bus lane on south-eastern arm. Cycle tracks on northern and on south-eastern arms. Advisory cycle lanes on southwestern arm. Pedestrian signal crossings on all arms.
41	New Street South / Kevin Street Link	1	Existing Signal Junction – 3 arms
			Bus lanes on main road arms. Cycle tracks on main road arms. Additional pedestrian signal crossing on main road southern arm. Existing pedestrian signal crossing on eastern arm.

5.3.6 Minor and Priority Junctions

Table 5-4: Minor Junctions

No.	Junction	Type	Key Design Notes
2	Kimmage Road Lower / Hazelbrook Road	1	Priority junction – 3 arms
			Bus lanes. Cycle tracks. Pedestrian signal crossing on main road adjacent. Uncontrolled pedestrian crossing on minor road with raised platform.
3	Kimmage Road Lower / Riversdale Grove	1	Priority junction – 3 arms: cul-de-sac side road
			Bus lanes northbound only. Cycle tracks. Uncontrolled pedestrian crossing on minor road with raised platform.
4	Kimmage Road Lower / Ravensdale Park	1	Existing Signal Junction Type 1 – 3 arms
			Bus lanes northbound. Bus Gate southbound. Cycle tracks on southern side. Advisory cycle lanes and bus gate on northern side. Pedestrian signal crossing on all arms.
5	Kimmage Road Lower / Corrib Road	n/a	Priority junction – 3 arms
			In bus gate section. No bus lanes. Advisory cycle lanes. Pedestrian signal crossing on main road adjacent. Uncontrolled pedestrian crossing on minor road with raised platform.
6	Kimmage Road Lower / Kimmage Court	n/a	Priority junction – 3 arms: cul-de-sac side road
			In bus gate section. No bus lanes. Advisory cycle lanes. Uncontrolled pedestrian crossing on minor road with raised platform.
7	Kimmage Road Lower / Aideen Avenue	n/a	Priority junction – 3 arms
			In bus gate section. No bus lanes. Advisory cycle lanes. Uncontrolled pedestrian crossing on minor road.
8	Kimmage Road Lower / St. Martin's Park / Kimmage Grove	n/a	Priority junction – 4 arms staggered cross-roads
			In bus gate section. No bus lanes. Advisory cycle lanes. Uncontrolled pedestrian crossing on minor roads
10	Kimmage Road Lower / Mount Argus Way	n/a	Existing Signal junction – 3 arms
			In bus gate section. No bus lanes. Advisory cycle lanes with signal crossing for southbound right-turn. Signal Pedestrian crossings on southern and western arms. Slip lanes removed.
11	Kimmage Road Lower / Mount Argus Church	n/a	Priority junction – 3 arms
			In bus gate section. No bus lanes. Advisory cycle lanes. Uncontrolled pedestrian crossing on minor road with raised platform.
12	Kimmage Road Lower / Priory Road	n/a	Priority junction – 3 arms
			In bus gate section. No bus lanes. Advisory cycle lanes. Uncontrolled pedestrian crossing on minor road.

Table 5 4: Minor Junctions (Continued)

No.	Junction	Type	Key Design Notes
13	Kimmage Road Lower / Westfield Road	n/a	Priority junction – 3 arms
			In bus gate section. No bus lanes. Advisory cycle lanes. Uncontrolled pedestrian crossing on minor road.
14	Kimmage Road Lower / Kenilworth Park	n/a	Priority junction – 3 arms
			In bus gate section. No bus lanes. Advisory cycle lanes. Uncontrolled pedestrian crossing on minor road.
15	Kimmage Road Lower / Casimir Road	n/a	Priority junction – 3 arms
			In bus gate section. No bus lanes. Advisory cycle lanes. Uncontrolled pedestrian crossing on minor road.
16	Kimmage Road Lower / Harold's Cross Park South	n/a	Priority junction – 3 arms
			In bus gate section. No bus lanes. Bus gate on southern arm. Advisory cycle lanes. Uncontrolled pedestrian crossing on minor road.
17	Kimmage Road Lower / Mount Argus Road	n/a	Priority junction – 3 arms
			In bus gate section. No bus lanes. Advisory cycle lanes. Pedestrian signal crossing on main road northern arm. Uncontrolled pedestrian crossing on minor road.
18	Kimmage Road Lower / St. Clare's Avenue	n/a	Priority junction – 3 arms
			In bus gate section. No bus lanes. Advisory cycle lanes. Pedestrian signal crossing on main road northern arm. Uncontrolled pedestrian crossing on minor road.
19	Harold's Cross Road / Parkview Avenue	n/a	Priority junction converted to Signal Junction – 4 arms
			Not on Core Bus Corridor. No bus lanes. Cycle tracks Pedestrian signal crossing on main road southern arm. Signal pedestrian crossing on minor roads.
20	Harold's Cross Road / Greenmount Avenue	1	Priority junction – 3 arms
			Bus lanes on main road. Cycle tracks on main road. Uncontrolled pedestrian crossing on minor road with raised platform.
21	Harold's Cross Road / Mount Drummond Avenue	1	Priority junction – 3 arms
			Bus lanes on main road. Cycle tracks on main road. Uncontrolled pedestrian crossing on minor road with raised platform.
22	Harold's Cross Road / Le Vere Terrace	1	Priority junction – 3 arms
			Bus lanes on main road. Cycle tracks on main road. Uncontrolled pedestrian crossing on minor road with raised platform.

Table 5 4: Minor Junctions (Continued)

No.	Junction	Type	Key Design Notes
23	Harold's Cross Road / Armstrong Street	1	Priority junction – 3 arms
			Bus lanes on main road. Cycle tracks on main road. Uncontrolled pedestrian crossing on minor road with raised platform.
25	Clanbrassil Street Upper / Windsor Terrace (Grand Canal north)	1	Priority junction upgraded to Signal Junction Type 1 – 3 arms
			Bus lanes on main road. Cycle tracks on main road with right-turn lane and signal northbound Signal controlled pedestrian crossings on northern and eastern arms.
26	Clanbrassil Street Upper / Access to Gordon's Fuels & others	1	Priority junction – 3 arms
			Bus lanes on main road. Cycle tracks on main road. Uncontrolled pedestrian crossing on minor road with raised platform.
27	Clanbrassil Street Upper / Clanbrassil Close	1	Priority junction – 3 arms
			Bus lanes on main road. Cycle tracks on main road. Uncontrolled pedestrian crossing on minor road with raised platform.
28	Clanbrassil Street Upper / Wesley Place	1	Priority junction – 3 arms
			Bus lanes on main road. Cycle tracks on main road. Uncontrolled pedestrian crossing on minor road with raised platform.
30	Clanbrassil Street Lower / St. Vincent Street South	1	Priority junction – 3 arms
			Bus lane southbound. Cycle tracks on main road. Uncontrolled pedestrian crossing on minor road with raised platform.
31	Clanbrassil Street Lower / Lombard Street West	1	Priority junction – 3 arms
			Bus lanes on main road. Cycle tracks on main road. Uncontrolled pedestrian crossing on minor road with raised platform.
32	Clanbrassil Street Lower / St. Kevin's Parade	1	Priority junction – 3 arms
			Bus lanes on main road. Cycle tracks on main road. Uncontrolled pedestrian crossing on minor road with raised platform. No right-turns (existing) with median island.
33	Clanbrassil Street Lower / Donovan Lane	1	Priority junction – 3 arms
			Bus lanes on main road. Cycle tracks on main road. Uncontrolled pedestrian crossing on minor road with raised platform. No right-turns (existing) with median island.
34	Clanbrassil Street Lower / Daniel Street	1	Priority junction – 3 arms
			Bus lanes on main road. Cycle tracks on main road. Uncontrolled pedestrian crossing on minor road with raised platform. No right-turns (existing) with median island.

Table 5 4: Minor Junctions (Continued)

No.	Junction	Type	Key Design Notes
35	Clanbrassil Street Lower / Clanbrassil Terrace	1	Priority junction – 3 arms
			Bus lanes on main road. Cycle tracks on main road. Pedestrian signal crossing on main road northern arm. Uncontrolled pedestrian crossing on minor road with raised platform. No right-turns (existing) with median island.
36	Clanbrassil Street Lower / Williams Place South	1	Priority junction – 3 arms
			Bus lanes on main road. Cycle tracks on main road. Uncontrolled pedestrian crossings on minor road with raised platform. No right-turns (existing) with median island.
37	Clanbrassil Street Lower / Malpas Street / New Street South / Long Lane	1	Existing signals modified to Signal Junction Type 1 – 4 arms, but only 3 inbound.
			Bus lanes on main road. Cycle tracks on main road. Pedestrian signal crossing on main road southern arm. Uncontrolled pedestrian crossing on minor road with raised platform. Eastern arm on Long Lane is one-way westbound.
38	New Street South / New Street Gardens	1	Priority junction – 3 arms
			Bus lanes on main road. Cycle tracks on main road. Uncontrolled pedestrian crossings on minor road with raised platform. No right-turns (existing) with median island.
39	New Street South / Fumbally Lane	1	Priority junction – 3 arms
			Bus lanes on main road. Cycle tracks on main road. Uncontrolled pedestrian crossings on minor road with raised platform. No right-turns (existing) with median island.
40	New Street South / New Court	1	Priority junction – 3 arms
			Bus lanes on main road. Cycle tracks on main road. Uncontrolled pedestrian crossings on minor road with raised platform. No right-turns (existing) with median island.

5.3.7 Roundabouts

There are no existing or new roundabouts in the Proposed Scheme.

5.4 Junction Modelling

5.4.1 Overview

Junction modelling was undertaken with the LINSIG software to enable understanding of the likely impact of the proposed route design on traffic operation on the surrounding road network and

- To formulate appropriate signal staging for all movements at signal-controlled junctions;

- To understand delays / capacity characteristics for bus movements;
- To ensure that appropriate timings are included within the signal cycle to accommodate the necessary pedestrian and cyclist crossing times.

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.

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 people movement calculator to provide a preliminary understanding of the typical green time proportion for each mode and provided an initial input for the 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 Local Area Model (LAM) which is a subset model of the NTA's Eastern Regional Model (ERM). The LAM outputs provided projected traffic flows for the DoSomething Operational Year for the peak periods. In addition, traffic dispersion plots were provided, comparing the DoSomething (DS) vs the Do Minimum (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 as part of an iterative process until a suitable level of dispersion was achieved;
- **LINSIG & 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.
- **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.

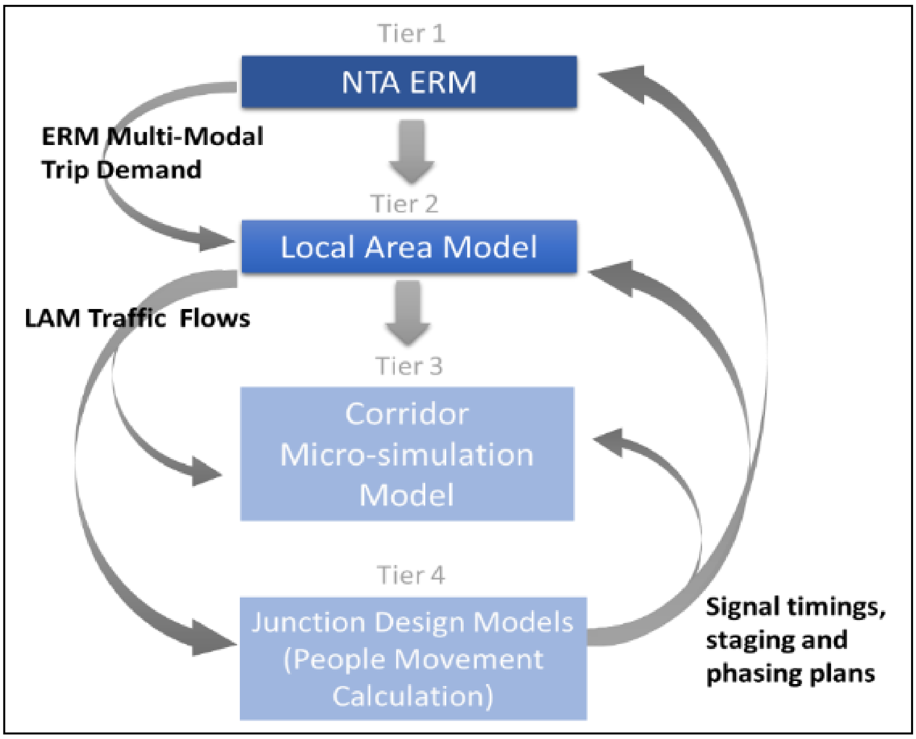


Figure 5-5: Proposed Scheme Traffic Modelling Hierarchy

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 People Movement Calculation 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 outputs from the earlier emerging designs are provided in Appendix A.11 but should be noted that these have been somewhat superseded by the final design outputs for people movement assessment as part of the cycle quantification exercise for 10% mode share.

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 (LAM)

As noted previously, the Proposed Scheme design and traffic signal operation was assessed within the Local Area Model. The LAM outputs provided projected traffic flows for the DoSomething Operational Year 2028 and Future Year 2043 for the respective AM and PM peak periods. In addition, traffic dispersion plots were produced, comparing the DoSomething (DS) vs the Do-Minimum (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.

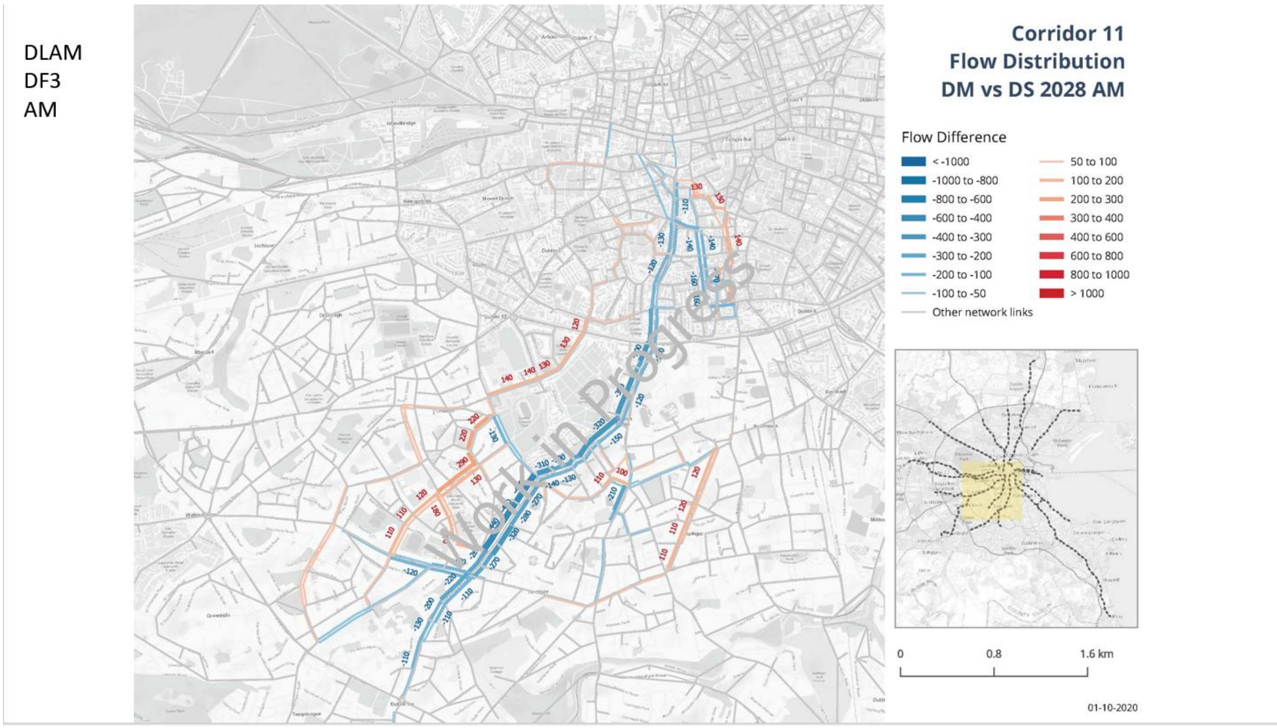


Figure 5-7: An initial 2028 AM Peak DLAM Distribution Plot

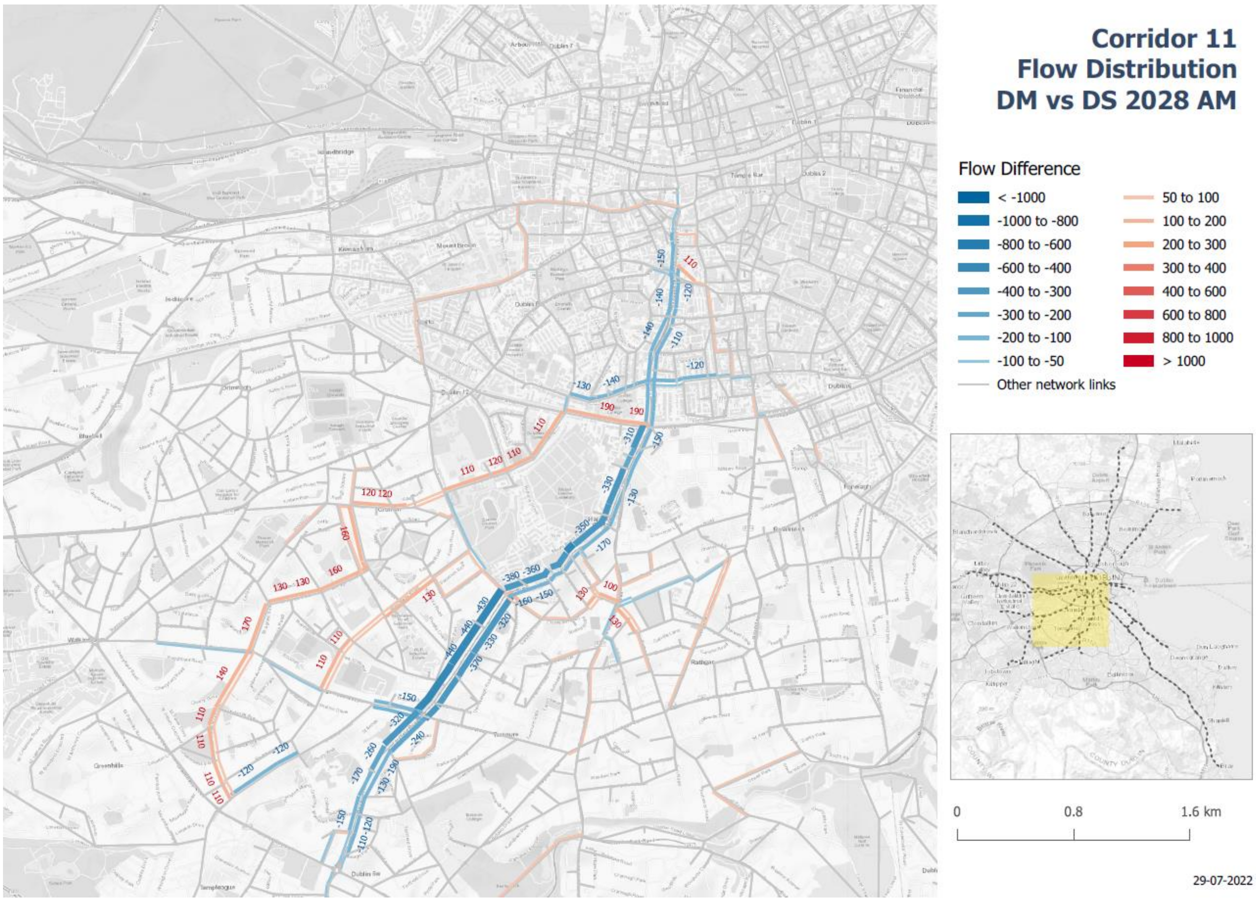


Figure 5-8: Optimised and Iterated 2028 AM Peak DLAM Distribution Plot

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 Do-Something 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: 7s minimum green time for pedestrians;
- Inter-green: based on a walking speed of 1.2m per second plus a 2 second all red 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.
- 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). If the existing demand is already 10% mode share or more, then a growth provision of 20% has been added for increased future demand.

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 National Cycle Policy Framework. 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 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:

1) A minimum 10% cycle mode share is provided for when summing people movement across all arms (including side roads).
2) The calculated cycle capacity (calculated from above) exceeds existing cycling flow.
3) 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;
- Resulting LinSig models provided for input to VISSIM models which will model the same cycling flows.

Table 5-5 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 5-5: 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
Kimmage Crossroads	513	1360	514	1360
Ravensdale Park BUS GATE	431	1500	326	1500
Sundrive Cross	563	1967	518	1967
Mount Argus View	498	2050	299	2050
Kenilworth	520	2925	368	2275
Harold's Cross Park North	1015	3000	624	3000
Harold's Cross Road / Grand Canal	1584	3000	942	3000
Clanbrassil Street Upper / South Circular Road	830	3000	856	3000
Patrick's Street / Kevin Street	1066	1250	1337	1250

5.4.5 LinSig Results

Table 5-6 provides an overview of the junction analysis results

Table 5-6: Signalised Junction Analysis

No	Junction Name	Cycle Time (Seconds)			Practical Reserve Capacity (%)	
		Do-Minimum	Do Something AM	Do-Something PM	AM Peak Hour	PM Peak Hour
1	Kimmage Crossroads	85	100	110	1.0	3.6
2	Kimmage Road Lower / Ravensdale Park	-	70	75	4.0	12.8
3	Sundrive Cross	60	90	90	16.8	49.4
5	Harold's Cross Road / Kenilworth Park	110	60	60	0.1	3.1
6	Harold's Cross Road Parkview Avenue	120	120	120	4.1	5.5
7	Harold's Cross Park North	120	100	120	49.9	49.9
8	Harold's Cross Road / Grand Canal	-	120	120	1.2	2.6
9	Clanbrassil Street Upper / South Circular Road	-	90	100	24.0	-0.4
10	Patrick Street / Kevin Street	-	120	115	0.7	0.2

6. Ground Conditions

6.1 Ground investigation Overview

The existing site investigation information for the area has been taken from the Geological Survey of Ireland (GSi) website and the British Geological Survey (BGS) website, including the Quaternary and Bedrock Geology of Dublin and Depth of Bedrock digital maps.

Refer also to Geotechnical Interpretation Report contained in Appendix E.

6.2 Desktop Review

The following selection of published papers has found to be of relevance to estimate the lithology and geotechnical properties:

- "Geotechnical properties of Dublin boulder clay". Authors: Long, Michael M and Menkiti, Christopher O. Sept 2007, Géotechnique 57 (7): 595-611. Published by the ICE.
- Ground Investigation Report of the National Paediatric Hospital Project, Dublin. Roughan & O'Donovan Consulting Engineers, January 2015.
- Geological Survey of Ireland (GSI) website, thematic maps related to the study area

6.2.1 Overview of Existing Ground Conditions along the Proposed Scheme

Quaternary sediments cover up to 80% of the Dublin region. Quaternary thicknesses at the city area range from 5 to 20m. Maximum thicknesses are recorded along a Tertiary channel occurring on the north shore of the River Liffey valley, reaching 45m, and along a channel-like feature running along the south margin of the Dodder valley Quaternary sediments, with a thickness of 15 to 25 m.

The most commonly occurring Quaternary deposit in the area has been termed locally as the Dublin Boulder Clay. It is a glacial deposit derived from the Lower Carboniferous Limestone and it is classified by its two main members: the Black Boulder Clay (BkBC) and the Brown Boulder Clay (BrBC). The Brown Boulder Clay is less consolidated and since it overlies the Black Boulder Clay it has been interpreted as its weathered upper layer.

The Upper Brown Boulder Clay (UBrBC) is the outcome of the oxidation of the clay particles in the top 2m to 3m of the UBkBC, resulting in a change in colour from black to brown and a lower strength material. It is usually described as thick stiff to very stiff brown, slightly sandy clay, with rare silt / gravel lenses and some rootlets, particularly in the upper metre.

The Upper Black Dublin Boulder Clay (UBkBC) is a very stiff, dark grey, slightly sandy clay, with some gravel and cobbles. It is typically 4 m to 12 m thick.

The Lower Brown Dublin Boulder Clay (LBrBC) exists as a 5 m to 9 m thick hard, brown, silty clay, with gravel, cobbles and boulders. It has previously been called the "sandy boulder clay" as it is similar to but siltier than the UBkBC above.

The Lower Black Dublin Boulder Clay (LBkBC) is a patchy layer of hard slightly sandy gravelly clay with an abundance of boulders. Its thickness does not exceed 4 m and is typically less than 2 m.

Note that not all four distinct formations of the Dublin Boulder Clay are always present. The upper two units though have been proven at all investigation sites across the city.

Bedrock close to the surface occurs mostly along the main riverbeds as well as the coastline and the higher ground areas of the Howth peninsula. The bedrock map of Ireland shows a wide variety of rock types which have originated at different periods of geological time. Underlaying the project area consists of Lower Carboniferous Limestone of the Lucan (Calp).

The following image from the Geological Survey Ireland website shows the expected depth to Bedrock.

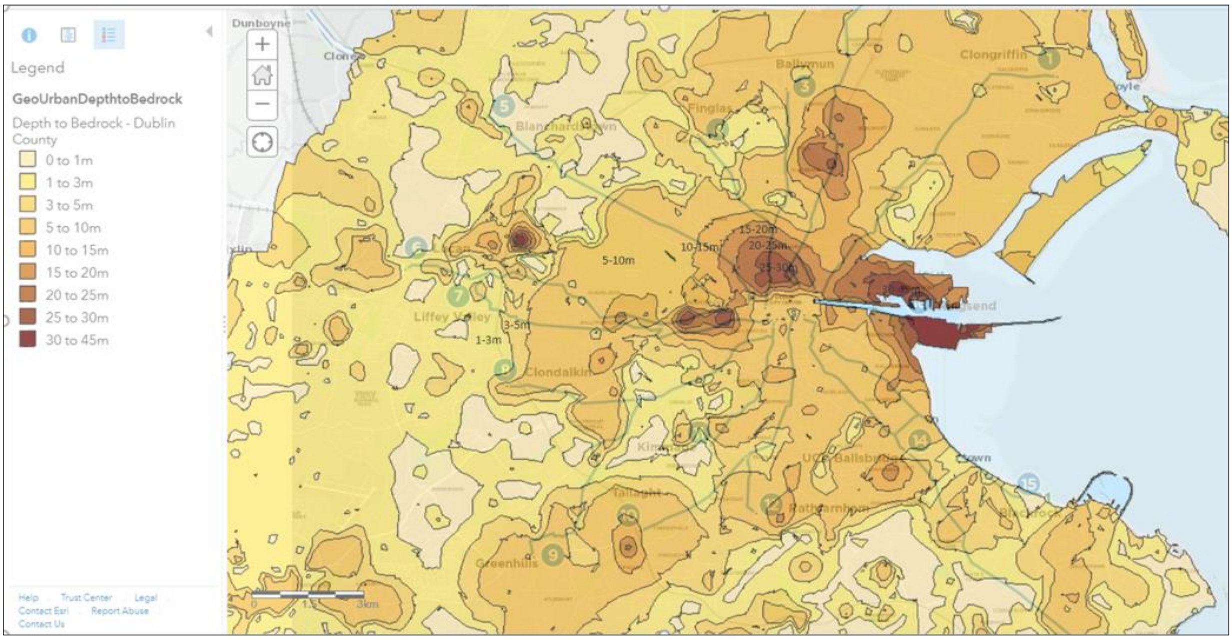


Figure 6-1 Depth of Bedrock from the Geological Survey Ireland website

The water pressures correspond to hydrostatic conditions with a groundwater table about 2m below ground level.

6.2.2 Summary of Desktop Review.

The following preliminary lithology and geotechnical properties has been assumed based on the Desktop Review:

Table 6-1: Geotechnical and lithology summary

Layer	Depth	Thickness	Undrained shear strength, c_u (kPa)
Made ground / Urban / Alluvium	0 to 1 m	1	0
Upper Brown Boulder Clay, UBrBC	1 to 3 m	2	80
Upper Black Boulder Clay, UBkBC	3 to 10 m	7	200
Lower Brown Boulder Clay, LBrBC	10 to 18 m	8	400
Lower Black Boulder Clay, LBkBC	18 to 22 m	4	600
Bedrock	>22 m	N/A	>600

The expected depth to bedrock at Routes 3, 4, 11 & 16 has been included in Section 6.2.

6.3 Summary of Ground Investigation

The ground investigation works aimed to assess the geology of the site and determine the ground properties and conditions to enable the design of the Proposed Scheme works. The GI provided for boreholes, trial pits, dynamic probes, standpipes/piezometer installation and monitoring, in-situ testing, geotechnical and environmental laboratory testing and preparation of a factual report, all in accordance with the "*Specification and Related Documents for Ground Investigation in Ireland*".

Where boreholes were undertaken, in situ tests included standard penetration tests and laboratory tests mainly comprised particle size distribution, Atterberg limits, density and moisture content to identify soils and direct shear strength, triaxial CU or UU and uniaxial compression to determine the strength of the soil/rock.

Table 6-2: Ground Investigation Points

Structure	Borehole Ref.		Borehole Depth (m) – Cable Percussion	Borehole Depth (m) – Rotary Core
Kimmage 01	R11-CP01	5-10m	8.7	6.5 to 12.5
	R11-CP02	5-10m	3.9	-
	R11-CP03	5-10m	6.3	-
	R11-CP04	5-10m	2.9	-
	R11-WS01	5-10m	3.6	-

14 SPT tests were conducted at 1 metre intervals alternating with disturbed samples and 9 GWL recordings.

10 disturbed samples were taken at each change of soil consistency or between SPT tests. Geotechnical testing consisting of 10 moisture content, 5 Atterberg limits, 1 Bulk Density and 7 Particle Size Distribution. Rock strength testing included 2 Unconfined Compressive Strength (UCS) testing.

Environmental & Chemical testing consisted of 9 Suite E samples and 2 PH and Organic matter content tests.

6.4 Overview of Soil Classification

6.4.1 Made Ground

Made Ground deposits were encountered beneath the Topsoil/Surfacing and were present to depths of between 1.50m and 3.70m BGL.

These deposits were described generally as brown, dark brown, grey, dark grey or greyish brown sandy gravelly Clay with occasional cobbles or grey sandy subangular to subrounded fine to coarse Gravel with occasional cobbles and contained occasional fragments of ceramic, concrete, glass, metal, mortar, plastic, red brick and wood.

The made ground included the following materials:

- Soil classified as CLAY of lower to intermediate plasticity, with a plasticity index ranging between 16% and 18%.
- The Particle Size Distribution tests confirm percentages of sands and gravels of about 24% and 31% respectively.
- PH and total organic carbon (TOC) were determined at R11-CP03 and C11-WS01 both at 1m depth. Organic matter content (OMC) was estimated from TOC. A PH average value of 8.1 was obtained.
- TOC and OMC values at R11-WS01 were 1.8% w/w C and 3.1% w/w respectively. At R11-CP03, total organic carbon test showed high values (>6% w/w C).
- Asbestos was detected at 1m depth at boreholes R11-CP03 and R11-CP04.

6.4.2 Cohesive deposits

Cohesive deposits were encountered beneath the Made Ground or interbedded with Granular Deposits and were described typically as brown, grey, brownish grey or greyish brown sandy gravelly CLAY or as greyish brown or grey slightly sandy gravelly SILT. These deposits had rare, occasional, some or frequent cobble and boulder content.

The strength of the cohesive deposits typically increased with depth. In the majority of the exploratory holes, it was stiff below 3.0m BGL.

The geotechnical testing carried out on recovered soil samples generally classify the deposits as CLAY of low plasticity, with a plasticity index ranging between 12% and 16%.

The Particle Size Distribution tests confirm generally well-graded deposits with percentages of sands and gravels ranging between 25% and 28% and 27% and 34%, respectively.

6.4.3 Rock

The rotary core boreholes recovered medium strong to strong thinly laminated to thickly bedded grey/dark grey fine-grained LIMESTONE locally interbedded with medium strong dark grey fine grained laminated MUDSTONE.

The depth to rock varies from 4.40m BGL to 8.90m BGL. The total core recovery is good, typically 100%. The SCR and RQD both are relatively poor, but both show an increase with depth in each of the boreholes.

6.5 Summary of Geotechnical Interpretation Report

For Kimmage to City Centre CBC scheme, the following lithology and soil strength properties has been assumed based on the GI findings:

Table 6-3 Geotechnical Parameters

Layer	Depth (m)	SPT	Undrained shear strength, c_u (kPa)
Topsoil	0 to 0.5	-	-
Made Ground: Brown Clay (possibly UBrBC) / Grey Clay	0.5 to 3.5	6	40
Stiff Brown Boulder Clay (UBrBC)	3.5 to 4	50	325
Stiff Grey Boulder Clay / Very stiff dark Grey Boulder Clay (UBkBC)	4 to 9	30-50	250
Limestone	Top level between 5 and 10m	-	-

2 uniaxial compression tests (rock strength) undertaken within the Limestone have shown base resistant values between 31.3 and 49.5 MPa. This range of values have been sustained by 7 UCS tests, 13 point load tests and 3 Brazil tests done in Glasnevin project and 5 UCS tests done in Metrolink project, in which base resistant values range between 17 and 101 MPa, with an average value around 46 MPa.

6.6 Hydrogeology

Groundwater was noted during the investigation although the exploratory holes did not remain open for sufficiently long periods of time to establish the hydrogeological regime. However, standpipes were installed to allow the equilibrium groundwater level to be determined.

Groundwater levels recorded during the GI works are summarized below:

Table 6-4 Groundwater Levels

Date:	4/5/21	21/5/21
R11-CP01	1.44	1.94
R11-WS02	0.47	0.40
R11-CP03	2.74	2.67
R11-WS03	-	1.35
R11-WS01	0.68	0.61

6.7 Geotechnical Inputs to Structures

Table 6-5 shows the expected depth to bedrock, based on the data from the Desktop Review, as well as the depth of the encountered bedrock in the GI undertaken.

A preliminary assessment of the characteristic compressive resistance of piles has been obtained following the alternative procedure in accordance with the Eurocode 7 and the Irish National Annex. This procedure makes use of the ground parameters (such as the undrained shear strength, cu) to estimate the shaft and base compressive resistance of piles.

Cu values have been derived from SPT values obtained in each borehole following the SPT-Cu relationship proposed by Stroud and Butler (1975). Refer to Appendix E.

For piles embedded in the Dublin boulder clay, the estimated pile lengths are shown in Table 6-5.

Table 6-5 Geotechnical Conclusions for Structures

Structure	Permanent loads / Variable loads (KN)	Borehole Ref.	Expected Depth to Bedrock	Depth to encountered Bedrock	Depth to N_{SPT} values of Refusal	Piles estimated length (m)
Kimmage D=0.5m	TBC	R11-CP01	5-10m	9m	8m	-
		R11-WS02	5-10m	-	4m	-
		R11-CP03	5-10m	4.5m	3m	-
		R11-WS03	5-10m	-	2.5m	-
		R11-WS01	5-10m	-	3.5m	-

7. Pavement, Kerbs, Footways and Paved Areas

7.1 Pavement

7.1.1 Introduction

This section covers the preliminary design for:

- Widening of existing carriageways including bus lanes.
- Rehabilitation and strengthening of the existing carriageways.
- New on road cycleways.

For the BusConnects routes, two pavement networks are being considered. The primary network, which refers the bus routes under consideration while the secondary network refers to the roads impacted by the re-routing of existing traffic from the bus routes to the nearby road network.

In the preliminary design stage, the pavement evaluation studies the nature, severity and extent of the road deterioration, the cause of the deterioration and the strength of the existing road pavement.

In case of the existing roadway may be subject to widening and consequent differential settlement, new pavement design is required.

During the detailed design stage, the pavement evaluation will be based on preliminary design, but frequency of measurement is increased, to validate the results of the previous stage and optimize the design of each segment.

7.1.2 Relevant Documents

- TII AM-PAV-06050 Pavement Assessment, Repair and Renewal Principles. Volume 7 Section 3 Part 4. NRA HD31/15. March 2015.
- TII AM-PAV-06045, Management of Skid Resistance. Volume 7 Section 3 Part 1. NRA HD 28/11.November 2011.
- Irish Pavement Asset Group IPAG. Pavement Asset Management Guidance. December 2014.
- DN PAV-03021 Pavement & Foundation Design. Volume 7 Section 2 Part 2A. NRA HD 25-26/10. December 2010.
- DN-PAV-03026. Footway Design. January 2005
- DCC CSRSW- Construction Standards for Road and Street Works In Dublin City Council
- SRW-Specification for Road Works. Transport Infrastructure Ireland (TII).

7.1.3 Dublin City Council (DCC) Pavement Management System

The extents of the Proposed Scheme assessed in this report comprise radial roads managed by Dublin City Council (DCC). The DCC pavement management system provided relevant information for the assessment of the existing structural and surface condition of road pavements along the route of the Proposed Scheme as described in this section.

7.1.3.1 Road Pavement surveys

The following data sources were available:

- The Road Condition Index (RCI) data recorded in September 2019.
- Sideway force Coefficient Routine Investigation Machine (SCRIM) surveys in September 2019.
- SCANNER surveys of all regional and primary roads undertaken in different seasons each year.

7.1.3.2 Pavement inventory

- There is no comprehensive historical record of all pavement construction, but details of schemes built in the last 6-7 years are available.

- The extent of concrete slabs is not recorded, but this is known to be the most common form of pavement construction beneath a macadam surface layer on most main roads in the inner parts of the urban area in Dublin.

7.1.3.3 Pavement Maintenance Works Strategy

- DCC uses the TAMS (Transportation Asset Management System) by Confirm ® system to prioritize maintenance works, which includes many parameters.
- Normal surface course renewal practice consists of planning off and replacement with a new wearing course consisting of either Hot Rolled Asphalt (HRA) or Stone Mastic Asphalt (SMA).
- The trigger level for resurfacing is the SCRIM Investigatory level of 0.35.
- In jointed concrete slabs, typically 150mm thick, rehabilitation generally comprises removal of 60mm material and overlaying with asphalt over a geogrid, where required. Concrete slabs are rarely replaced, and only on a bay-by-bay basis typically where damaged by utility excavation.
- March to December is the resurfacing season.

7.1.4 Design Constraints

The major design constraints which need to be considered to determinate the required pavement structure are as follows:

- Traffic Loading
- Geometry
- Existing pavement condition

7.1.4.1 Traffic Loading Considerations

- Pavement design for the required design life and the projected traffic volumes.
- The new pavement is be designed for a 40-years design life.
- Existing pavement is be rehabilitated where required to provide 20 years design life.
- Specific paver loading areas were categorized based on the loading or end use.

7.1.4.2 Geometry Considerations

Horizontal realignment: widening or narrowing of the road will change in the positions of traffic lanes with a relocation of the wheel-tracks. Particular care should be given in the placement of longitudinal joints to avoid being in the wheel-track. All surface joints should be considered as a weakness in the system and should be positioned to avoid areas of high stress turning, acceleration and braking zones.

Where pavement widening is proposed this shall be tied to the existing pavement in accordance with the construction details TII CC-SCD-00704-02 in Figure 7-1 and CC-SCD-00704-03 in Figure 7-2.

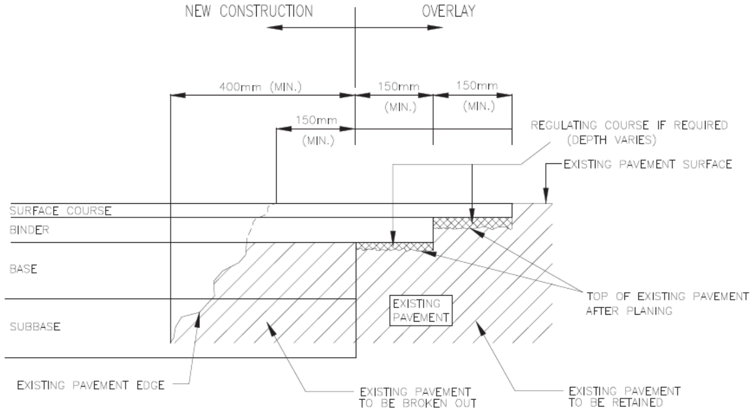


Figure 7-1: Longitudinal Joint between new construction and existing road as per CC-SCD-00704-02

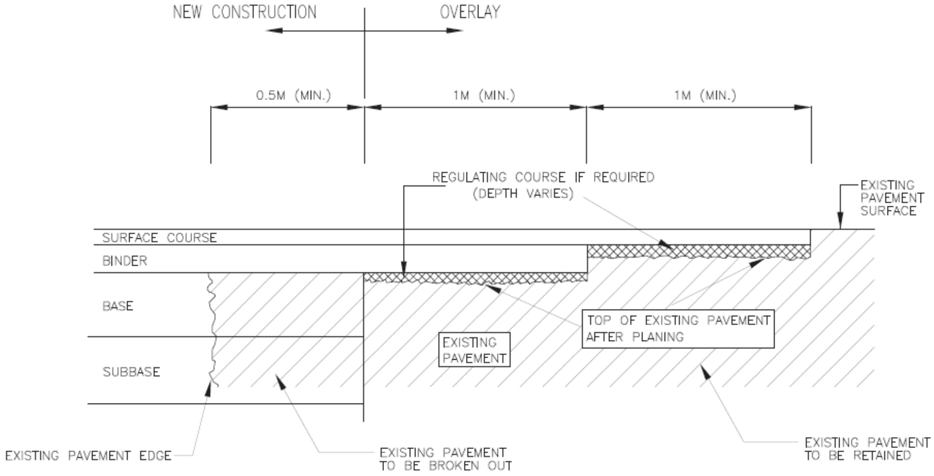


Figure 7-2: Transversal Joint between new construction and existing road as per CC-SCD-00704-03

7.1.4.3 Existing Pavement Conditions

7.1.4.3.1 Inner Urban Routes

The typical construction of the old concrete urban radial routes is understood to be as follows

- 40mm to 60mm of macadam overlay, probably resurfaced periodically and often in Hot Rolled Asphalt, which could be 20 years old or more depending on durability. Some roads may have been resurfaced more recently in Stone Mastic Asphalt.
- Possible old reinforcement layer in hessian across joints in the concrete slabs.
- 200mm thick (or possibly 150mm to 250mm) concrete slabs – usually unreinforced.
- Possible sub-base and probably of doubtful quality.
- Capping Layer: unlikely.

7.1.4.3.2 Suburban Areas

The typical construction of the more modern urban radial routes in suburban areas constructed from the 1980's onwards is understood to be as follows:

- 40mm surface course often in Hot Rolled Asphalt, which could be 20 years old or more depending on durability. Some roads may have been resurfaced more recently in Stone Mastic Asphalt.
- 60mm of macadam binder course.
- 200mm thick (or possibly 150mm on lesser routes) Dense Bitumen Macadam road-base.
- 300mm Sub-base.
- Capping Layer: possibly in occasional soft spots, but uncommon on the generally strong boulder clay with CBR >15%.

7.1.4.3.3 Road Pavement Condition Assessment

Data Collection & Analysis

Two pavement survey data have been provided for the routes: Road Maintenance Office (RMO) and Dublin City Council (DCC) datasets, which include:

- RMO Pavement Survey: SCRIM coefficient, International Roughness Index IRI, Rut depth, Longitudinal Profile Variance LPV; Mean Profile Depth MPD, Pavement Surface Condition Index PSCI, Surface inventory material type, Road schedule, Completed and planned interventions. Survey date are from 2011 to 2019.
- DCC Pavement Survey: Road Condition Index RCI and SCRIM coefficient carried out in 2019.

For assessment purposes, condition data values before 2016 were discarded, assumed they do not reflect the current condition of the pavement because the age of the survey. In the same way, recent RCI and SCRIM coefficient values by DCC have been considered for the condition assessment instead of older RMO's PSCI and SCRIM survey.

RMO Pavement Survey

Access to RMO dataset was granted with the information mentioned above. Some main indicators: IRI, rut depth, Longitudinal Profile Variance LPV; and Surface inventory material type database have been assessed.

International Roughness Index IRI and Longitudinal Profile Variance LPV are measurements of the longitudinal profile and indicate the irregularities in the pavement that influence the public's perception of the quality of service (ride quality).

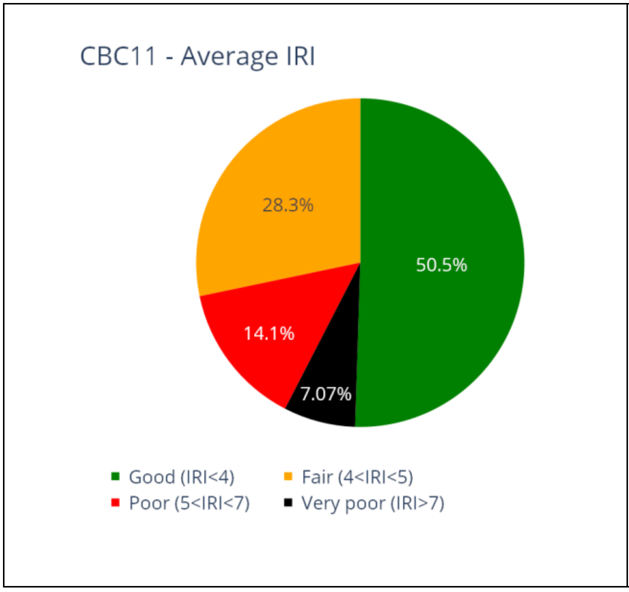
SCRIM measures the frictional resistance generated between the road surface and a tyre under wet conditions. The micro-texture is the main contributor to skid resistance at low speeds. Statistically, low skid resistance values are directly related to traffic accidents.

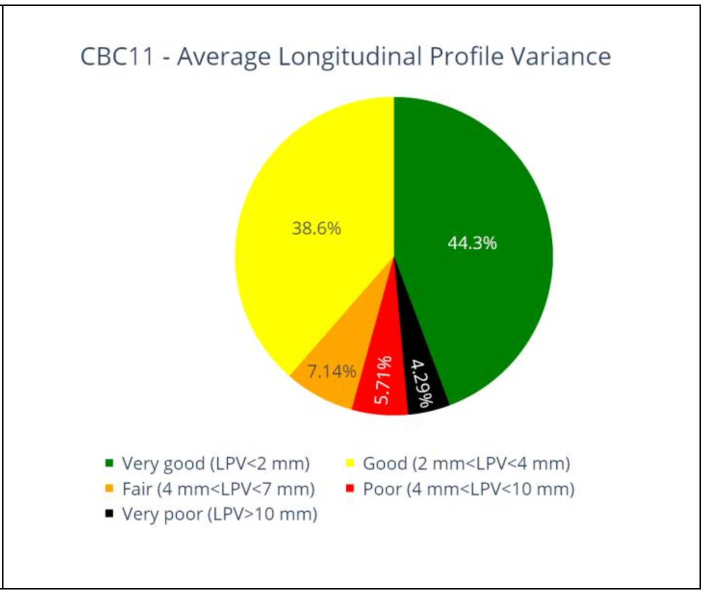
Rut depth is defined as the difference in elevation between the centre of the wheel path and the centre of the travel lane. Ruts can form through the inadequate asphalt, underlying material or repeated heavy loadings.

This data is presented in Figures 7-3 and 7-4.

Visual Inspections

A visual inspection was undertaken along the length of the Proposed Scheme to provide an assessment for the condition of the pavements in addition to the recorded pavement condition data.





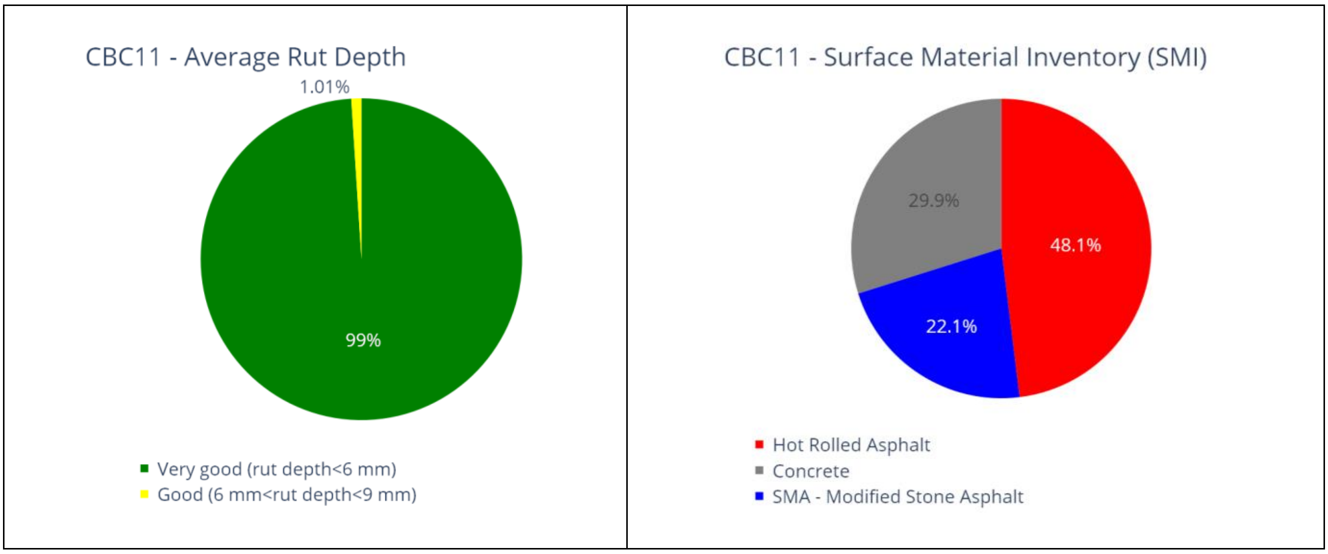


Figure 7-3. CBC 11 Kimmage. LPV, Rut depth and SMI

Summarizing, around 50% IRI and LPV range of very good and good condition. Rut Depth in good and very good condition in almost all the route, and pavement surface are mainly comprised of Hot Rolled Asphalt, Stone Mastic Asphalt and Concrete (current overlay with asphalt surfacing course).

Road condition Indicator

The Road condition Indicator (RCI) indicates the current overall condition and a value of the pavement asset. The measured parameters that describe the existing condition are longitudinal profile (ride quality), transverse profile, condition of the edge, texture surface, cracking, which indicate defects in the surface, binder and the base course. Noted RCI values on its own in not sufficient to design a pavement rehabilitation but provides information to prioritize and plan future interventions by Authorities.

For skid resistance, SCRIM of the existing pavement identifies the sections with need of resurfacing if skid resistance values do not comply with the threshold values. In order to assess the SCRM coefficient results and assign the appropriate level of skid resistance in accordance with the investigatory levels defined in Table 4.1 of the TII Standard for Management of Skid Resistance AM-PAV-06045.

Site category and definition		Investigatory Level at 50km/h							
		0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65
A	Motorway								
B	Dual carriageway non-event								
C	Single carriageway non-event								
G1	Gradient 5-10% longer than 50m								
G2	Gradient >10% longer than 50m								
K	Approaches to traffic signals. pedestrian crossings								
Q	Approaches to and across major and minor junctions,								
R	Roundabout								
S1	Bend radius <250m – dual carriageway								
S2	Bend radius <250m – single carriageway								

Traffic > 250 commercial vehicles / lane/ per day
Traffic < 250 commercial vehicles/lane/ per day

Figure 7-4. CSC investigatory level depending on Site Category. Source: TII

Assuming preliminarily that the roads of the project could be categorized in Category Q, with an investigatory level of 0.45 (traffic greater than 250 commercial vehicle/lane per day) and not including the approach to traffic signals and pedestrian crossings, the SCRIM thresholds are shown below

- GREEN: Good condition (Corrected SCRIM values >=0.45)
- AMBER: Regular condition (Corrected SCRIM values <0.45 and <=0.35)
- RED: Bad condition (Corrected SCRIM values <0.35)

Figure 7-5 shows the RCI and SCRIM values for the route.

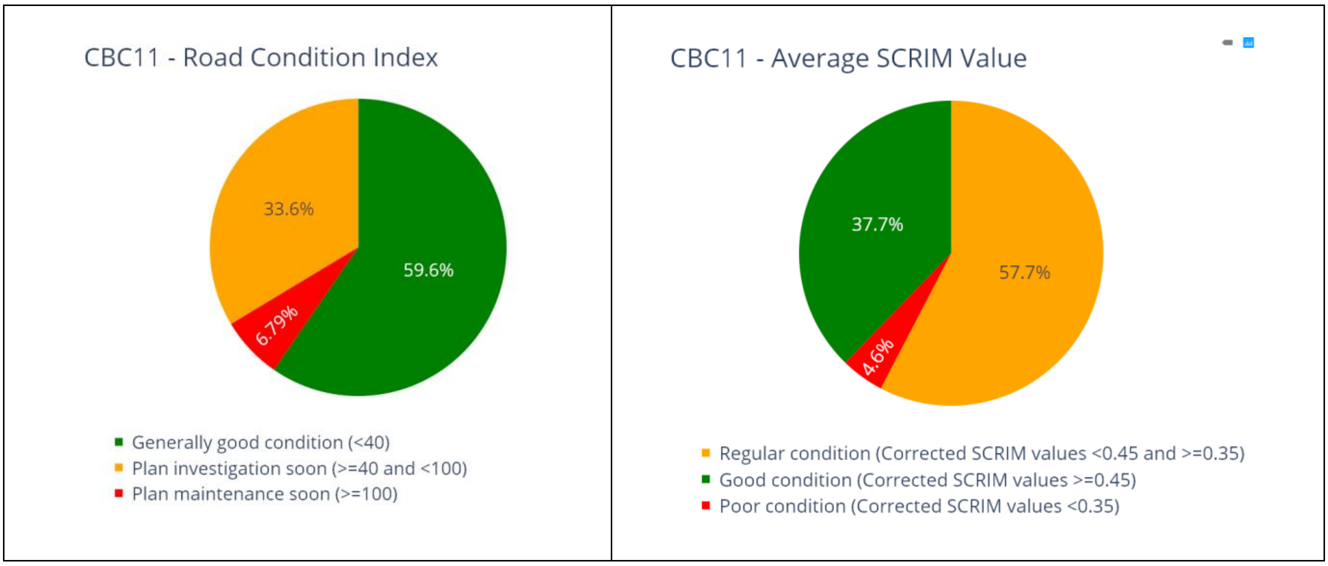


Figure 7-5. CBC 11 Kimmage. RCI and SCRIM condition

The RCI survey along the Kimmage route indicates that the pavement is generally in good condition for around 60% of the length. Around 7% of the total is in poor condition and this is localised at major junctions, including, Clanbrassil Street Lower at South Circular Road, Clanbrassil Street Upper at Grove/Parnell Road, Harold's Cross Road at Parkview Avenue, and Kimmage Road Lower at Sundrive Road and Terenure Road West. The remaining 33% is in amber condition.

Subgrade Condition

No information was available, in terms of bearing capacity, represented by California Bearing Ratio- CBR, required to the design for full depth reconstruction at the widening areas. A Design CBR of 2.5% is assumed as per minimum permitted value stated in Clause 3.23 of DN-PAV-03021. However, the actual CBR values are likely to be considerably higher due to compaction under these roads over more than a century of traffic loading.

7.2 Pavement Design

7.2.1 Full Depth Construction

New road pavements have been designed in accordance with DN PAV-03021 Pavement & Foundation Design. Volume 7 Section 2 Part 2A. NRA HD 25-26/10 for the traffic loading considerations described below.

Pavement Design Life and Design Load

Where pavement reconstruction is required within a bus lane, the design thickness may vary according to the frequency of bus services and the associated traffic loading. These loadings are shown in Figure 7-6 for the applicable bus frequency. The associated pavement thickness is shown in Figure 7-7 in accordance with the relevant design standard for a 40 Year Design Life.

ROAD PAVEMENT DESIGN Dublin Bus Connects

Preliminary Design

Template Author: SMG
Update Date: 7/11/2020

Design Method: TII Standards PE-SMG-02002 & DN-PAV-03021 (formerly NRA DMRB Vol 7, Section 2, Part 3, HD 24 and 26)

Project: **BusConnects**   Ref: 19.117   Revision

Road Section: **CBC 3 Ballymun**   Status:
Design by: SMG   **Design Life:** 40 **years**   365   Year

Bus Traffic	Per Hour	Hours / day	AADT Bus
	15	18	270

Traffic Data (AADT)	Year	AADT	
Opening Year	2024	270	one-way
HCV Content	100.0%		

Total Cumulative HCV traffic **3,942,000**

Table 2.4a - Calculation of Design Traffic (PE-SMG-02002)

PSV + OGV1	Proportion	Lifetime Traffic cv	Wear Factor (W)	Weigthed Traffic (msa)
Buses (> 18 seats)	1.0	**3,942,000**	**2.6**	**10.2**

Note: Wear Factor for Maintenance as required by NRA amended Paragraph 2.26

Total Traffic in lane   million standard axles   10.25 msa

% in left hand lane (Refer to Figure 2.5 of HD 24/06)   100%

Design Traffic Loading   10 msa

Figure 7-6: Kimmage CBC Design Traffic Loading

Pavement Design Thickness

Flexible pavement options are provided for Asphalt Concrete using 70/100 Pen Bitumen (the least stiff material requiring the thickest construction) and Asphalt Concrete utilizing 40/60 Pen Bitumen (a stiffer material requiring a reduced pavement thickness to provide the same structural equivalence.). Material thickness options are selected in accordance with the requirements of Figure 4.2 of DN-PAV-03021 as shown in Figure 7-8 and Table 7-1.

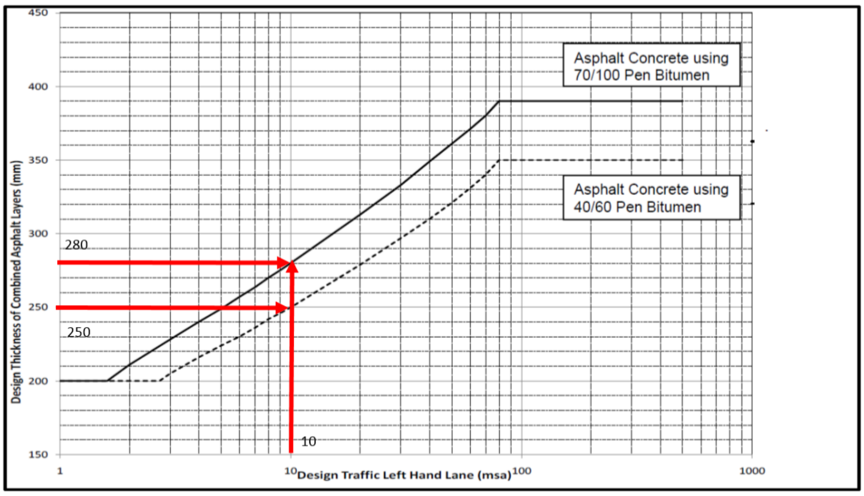


Figure 7-7: CBC 11 Kimmage. Pavement Design Thickness

Table 7-1: Asphalt Design Thickness in accordance with DN-PAV-03021

Bus Frequency Per hour	Traffic Loading Million standard axles (msa)	Pavement Thickness (mm) / Material	
		40/60 Pen	70/100 Pen
15	10	250	280

Pavement Foundation Design

For preliminary design purposes a Design CBR of 2.5% is used as per minimum permitted value stated in Clause 3.23 of DN-PAV-03021.

Table 7-2: Foundation Design for Fully flexible pavement with Asphalt Concrete Base

Pavement Type	Single Foundation Layer	Subbase on Capping Foundation Layers
Fully Flexible Pavement with Asphalt Concrete base	350mm Granular Subbase	150mm Granular Subbase on 400mm Capping

Full depth construction layers are as follows:

- Capping Layer: Considering Design CBR of 2.5%, 400 mm thickness of capping material class 6F2 material, in accordance with Clause 613 and compacted in compliance with Clause 612.
- Sub-base: 150 mm thickness of subbase material Type B granular material, in accordance with Clause 804 and compacted in compliance with Clause 802.
- Base course: 150 mm thickness of AC 32 HDM base 40/60 des. It shall comply with the requirements of Clause 929, 930, 937 and 943, S.R.W. It shall be laid and compacted to Clause 903
- Binder course: 60/65 mm thickness of AC20 HDM bin 40/60 des. It shall comply with the requirements of Clause 929, 930, 937 and 943, S.R.W. It shall be laid and compacted to Clause 903
- Surface course: 35/40 mm thickness of HRA (HRA 30/14 F surf 40/60 des or HRA 35/14 F surf 40/60 de) or SMA 10 surf des PMB 65/105-60 It shall comply with the requirements of Clause 929, 930, 937 and 943, SRW. It shall be laid and compacted to Clause 903.

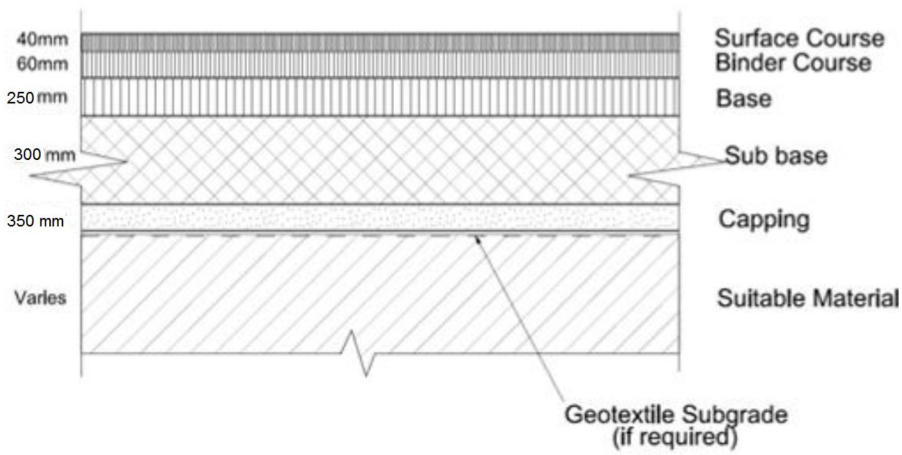


Figure 7-8 Pavement Structure for Full Depth Construction

7.2.2 Existing Road Treatment

The condition of the existing pavement structure along the proposed scheme was assessed based on Surface Condition Index surveys conducted for the road authority, which categorises the pavement as follows:

- Green condition: good

- Amber condition: moderate
- Red condition: poor

For each type of pavement structure the required strengthening will be as follows:

Strengthening for fully flexible pavement

- Green condition : Do nothing
- Amber condition: Pavement reinforcement: 150 mm new surface and binder course : 40 mm wearing course +110 mm binder course.
- Red condition: Full pavement reconstruction. New surface, binder, base and subbase course: 40 mm wearing course+110 mm binder course + 150 mm base course+ 300 mm sub-base.

Strengthening requirements for rigid pavement with asphalt surface course according to Condition Assessment

- Green condition : Do nothing
- Amber condition: 40 mm wearing course overlay.
- Red condition: New surface and concrete slab reconstruction: 40 mm wearing course +200mm concrete slab+300 mm subbase.

Surfacing improvements

Following treatment to improve the skid resistance depending on condition are:

- Green condition: Do nothing
- Amber condition: 40 mm wearing course overlay
- Red condition: 40 mm wearing course overlay.

Table 7-3 Rehabilitation treatment for existing fully flexible pavement

Condition	Proposed treatment	Proposed works
RCI<40 and SCRIM ≥0.45	Do nothing	
RCI<40 and 0.35≤SCRIM <0.45	New surface overlay	40 mm PSMA wearing course
RCI<40 and SCRIM <0.35	New surface overlay	40 mm PSMA wearing course
40 ≤RCI<100	New surface and binder course	40 mm PSMA wearing course+110 mm binder course
RCI ≥100	New surface, binder, base and subbase course	40 mm PSMA wearing course+110 mm binder course + 150 mm base course+ 300 mm subbase

Table 7-4 Rehabilitation treatment for Rigid pavement with asphalt surface course

Condition	Proposed treatment	Proposed works
RCI<40 and SCRIM ≥0.45	Do nothing	
RCI<40 and 0.35≤SCRIM <0.45	New surface overlay	40 mm PSMA wearing course
RCI<100 and SCRIM <0.35	New surface overlay	40 mm PSMA wearing course
RCI ≥100	New surface and concrete slab reconstruction	40 mm PSMA wearing course +200mm concrete slab+300 mm subbase.

7.2.3 Reuse and Recycling Considerations

Opportunities for reuse and recycling of secondary materials include:

- 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.

7.3 Kerbs, Footways and Paved Areas

The design of kerbs footways and paved areas is based on the following:

- Preliminary Design Guidance Booklet for BusConnects Core Bus Corridors.
- DCC CSRSW- Construction Standards for Road and Street Works in Dublin City Council. May 2016.
- DN-PAV-03026. Footway Design. January 2005
- CC-SPW--Specification for Road Works. Transport Infrastructure Ireland (TII).
- BS 7533 Pavement constructed with clay, natural stone or concrete pavers
- Landscape Architects Requirements
- Existing condition and construction build-up.

7.3.1 Design Parameters

7.3.1.1 Traffic Loading Considerations

Footway foundations should be sufficiently robust to give satisfactory performance over a design life of 40 years. For the traffic consideration, the design are given for three construction categories, the appropriate category being chosen according to the necessary to consider the pedestrian and vehicular which the footway may to support.

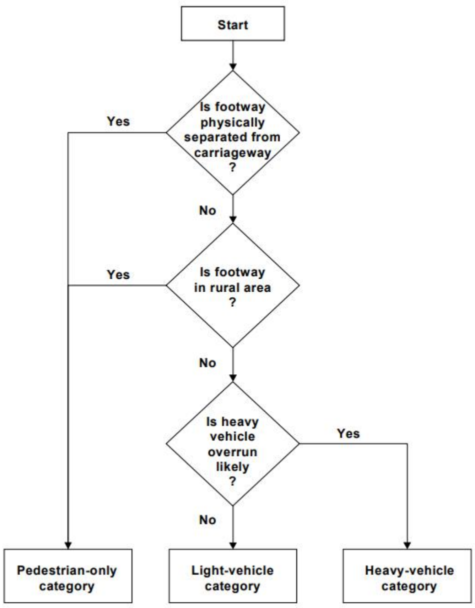


Figure 7-9: Flowchart for Selection of Footway Category. Source: DN-PAV-03026. Footway Design

- Pedestrian-only Category: When are not designed to support any type of vehicle use, not even small cleaning and maintenance vehicles, except those that are pedestrian controlled.
- Light-vehicle Category: For Residential Vehicular Access. Light vehicle overrun is common but overrun by heavy vehicles would not be expected to occur more than very occasionally, vehicle overrun, such as might occur two or three times a year with occasional delivery vehicles to private houses.
- Heavy Vehicle Category: In case of the footway is adjacent to a busy road and overrun is not prevented by some physical means, then the footway should be designed to sustain heavy vehicle overrun. For this category of footway the design traffic is assumed to be 50,000 standard axles (approximately one vehicle per working day over a design life of 40 year, assuming that one heavy vehicle is, on average, equivalent to one standard axle and multiplied by 3 to take channelisation into account and some allowance has been made for dynamic loading due to the vehicle mounting the footway) But, in areas when see a significant amount of delivery or maintenance vehicles, pavement design shall be carried out according in HD 26 (DMRB 7.2.3.2).

In general, most of the footways are listed as pedestrian-only footway, except in residential vehicular accesses and the commercial area at Sundrive Road with Kimmage Road Lower, where access for loading is required at businesses.

Off road cycleways will be constructed adjacent footways and should be designed as per National Cycle Manual. The section 5.6 of the NCM refers details for appropriate cycle track surfacing and materials.

7.3.1.2 Geometry Considerations

Along these routes there were not many changes in vertical alignment since the design is keeping the existing crossfall or considering 1 in 40 for the new areas. The drainage is always towards the road and away from the buildings and entrances.

Most of the major changes in geometry are originated by road design and are the result of realignment of kerbs and changes in the configuration of junctions.

Landscape and urban design have not originated changes in crossfalls even in those areas where the changes are more prominent or more extensive.

7.3.1.3 Existing Footpath Pavement Conditions

The footpath pavement conditions are quite good along the Proposed Scheme which mainly consists of poured concrete footpaths south of the Leonard’s Corner junction at South Circular Road and there are concrete paving slabs on Clanbrassil Street Lower and New Street South.

There are existing heritage granite kerbs on Clanbrassil Street Upper and Leonard’s Corner, and around Harold’s Cross Park which will be retained or repositioned.

7.3.2 Pavement Design for Footways and Cycleways

7.3.2.1 Pavement Materials

For areas outside city centres and commercial zones, poured concrete surfaces are proposed as the main pavement material.

Areas with proposed stone paving are shown on the Landscaping Drawings in Appendix B5 and include large stone pavers (0.60x0.60m) and cobble setts (0.10x0.10m). Stone pavers are proposed in historical / conservation zones and around heritage buildings. Cobble setts are proposed in smaller areas marking mixed pedestrian vehicular areas, small, landscaped areas, or vehicular entrances. Otherwise concrete paving slabs (0.60x0.60m) are proposed for commercial areas. Proposed Self Binding-gravel is used in some plaza and park areas.

All historical stone pavers will be conserved and reused onsite or kept in good conditions to be used elsewhere, preferably in nearby locations.

7.3.2.2 *Footway and Paved Areas*

The primary concept of the landscape proposal regarding pavement design for village and conservation areas will provide high-quality paving materials. The more extensive peripheral areas will feature poured concrete footways since these are more cost-effective and low-maintenance surfaces. Examples of the various footway paving types are presented in the Figure 7-10.

Asphalt Footway ***. Concrete Paving Footway***

Granite Flagstone Footway ***. Concrete Footway***

Figure 7-10: Footway Paving Types

The types of surfacing for footways proposed will be as follows:

- For concrete footways, in situ concrete shall be C30P and shall comply with Clause 1106 of CC-SPW-01100.
- Paving stones are natural stones or precast concrete as per DCC CSRDW Standards. For paved footways with the concrete blocks shall comply Clause 11007 of CC-SPW-01100 and BS 6717: Part 1 and Concrete Flags shall comply Clause 1104 of CC-SPW-01100 and BS 7263: Part 1.
- Subbase shall be Granular material Type A, shall comply with Clause 803 of CC-SPW-00800 or Granular adjacent Cement Bound Material, and shall comply with Clause 808 of CC-SPW-00800.
- Base shall be CBGM B shall comply with Clause 822 of CC-SPW-00800 or AC 20 dense bin 40/60 des and shall comply with CC-SPW-00900.
- Reclaimed Asphalt shall be assessed and classified according to IS EN 13108-8, Table 13a, Table 13b and Table 13c of with CC-SPW-00900.
- All Capping materials shall be Class 6F1 or 6F2 and shall comply with Clause 613 of CC-SPW-00600.

7.3.2.3 *Cycleways*

To improve legibility, it is proposed that all cycle tracks and cycle lanes are to have red coloured epoxy type surfacing, or red coloured asphalt, or similar in accordance with the National Cycle Manual.

The National Cycle Manual route surface indicates that surface should be as smooth as possible to ensure efficient surface water run-off and a rough texture will provide for increased grip and reduced wheel spray compared to a smooth texture. Therefore, wearing course should consist of smaller aggregates 10 mm or less. The materials commonly used include: 45/6F or 45/10F hot rolled asphalt wearing course, 0/6 or 0/10 Dense bitumen macadam surface course (30 mm AC 10 close surf 70/100 des) or close graded SMA (10/6mm aggregate) and Coloured high-friction (anti-skid) surfacing. The materials shall be in accordance with CC-SPW-00900.

Resin Based Surface
(Treatment (High Friction Surfacing Type 2)

The proposed segregated cycleway pavement construction is:

- Red epoxy resin with 3 mm uncoated chips
- 30 mm AC 10 close surf 70/100 des.
- 50 mm AC 20 dense bin 70/100 des
- 150 mm granular subbase Type B

7.3.2.4 Kerbs

- Precast concrete kerbs shall comply with Clause 1101 of CC-SPW-01100.
- In situ concrete kerbs shall comply with the Clause 1104 of CC-SPW-01100 and meet the requirements for exposure class XF4 in ISEN 206-1.
- Granite kerbs shall comply with IS EN 1341 “Kerbs of Natural Stone for external Paving”.

8. Structures

8.1 Overview of Structures

Five new structures are required for the proposed scheme. Four of these are concentrated around Robert Emmett Bridge over the Grand Canal on Clanbrassil Street Upper where widening is required to provide sufficient space for continuous bus lanes and segregated cycle tracks. The fifth structure is at Sundrive Road in Kimmage for a new pedestrian and cyclist link between Sundrive Road and Mount Argus along the channel of the River Poddle.

The preliminary design of the structures for the proposed scheme was carried out in accordance with the BusConnects Core Bus Corridor criteria and recommendations. The structural design proposed for new bridges and other structures has been developed complying with the applicable standards:

- TII Design Manual for Road and Bridges, and related publications.
- Irish Standards: Eurocodes with the Irish National Annex

The principal design objectives, other than structural considerations of resistance and durability, are as follows:

- To satisfy the new layout and roadway design requirements in terms of space for new lanes, footpaths, maximum slopes, etc.
- To provide a pleasant structure consistent with its environment, with minimal visual impact to positively affect its setting.
- To minimise construction stage disruption.
- To satisfy the requirements of the key stakeholders, especially Dublin City Council, Iarnród Éireann and Waterways Ireland.
- To avoid or minimise impacts on existing structures – in particular historic quay walls – and to avoid introducing extra loads onto these old structures where practicable.

Liaison has been held with Iarnród Éireann and Waterways Ireland to discuss about the design and to implement any suggestion that was raised to fulfil their requirements.

A structural survey was carried out by the structures specialist to know better the condition and typologies of the existing bridges. The information collected during the site visit can be seen in more detail in the Appendix F.

The following table lists a summary of the existing structures in the Proposed Scheme. The last column shows whether there is any expected work at the existing structure location and, if there is, the name of the proposed structure.

8.2 Summary of Existing Structures

Table 8-1: Existing Principal Structures in Kimmage Scheme

ID	Name	Typology	Obstacle	Expected structural Works?
01	Robert Emmet Bridge, Harold's Cross	Concrete arch	Grand Canal	Kimmage 01A &01B

In the Preferred Route Option Report several alternatives were studied in the vicinity of the existing Harold's Cross bridge. The option chosen involves 2 new footbridges independent of the existing one, one on each side of it.

8.3 Summary of Principal Proposed Structures

There are 5 new structures required for the Proposed Scheme:

01A: Footbridge on western side of Robert Emmett Bridge for Cyclists and Pedestrians

01B: Footbridge on eastern side of Robert Emmett Bridge for Pedestrians

02: Stone Boat Boardwalk beside River Poddle at Mount Argus

03: Retaining Wall on western side of Clanbrassil Street Upper

04: Pedestrian Ramp at Windsor Terrace, Grand Canal

Specific Preliminary Design Reports are provided for each proposed structure in Appendix J.

8.3.1 Structures Kimmage 01A and 01B: Footbridges at Robert Emmett Bridge

The proposed footbridges Kimmage 01A & 01B are 3-span steel bridges of 23.0m and 24.0m length respectively. The proposed footbridges will be constructed on each side of the existing Robert Emmet Bridge, over the Grand Canal. The two lightweight bridges are to carry the proposed cycle lane and footpaths part of the proposed road layout. The indicative location of both structures is shown in Figure 8.1.

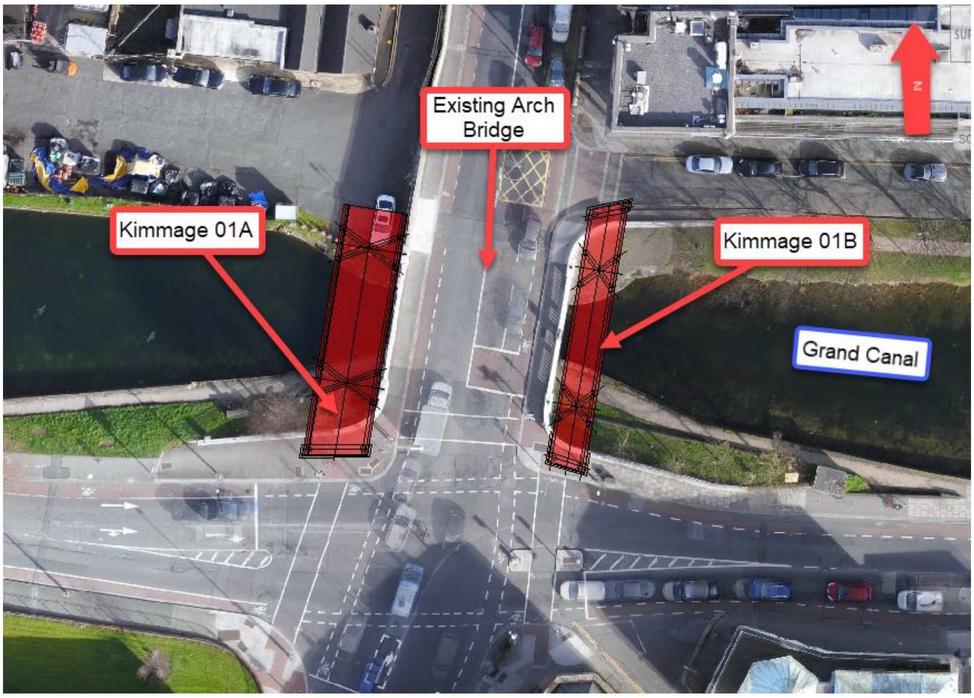


Figure 8.1: Plan view Kimmage 01A & 01B

The typical cross section of Kimmage 01A is shown in Figure 8.2 with an overall width of 6m to accommodate a 2.5m wide footpath on the western side and a 3m wide cycle track with a 0.5m wide buffer strip on the eastern side.

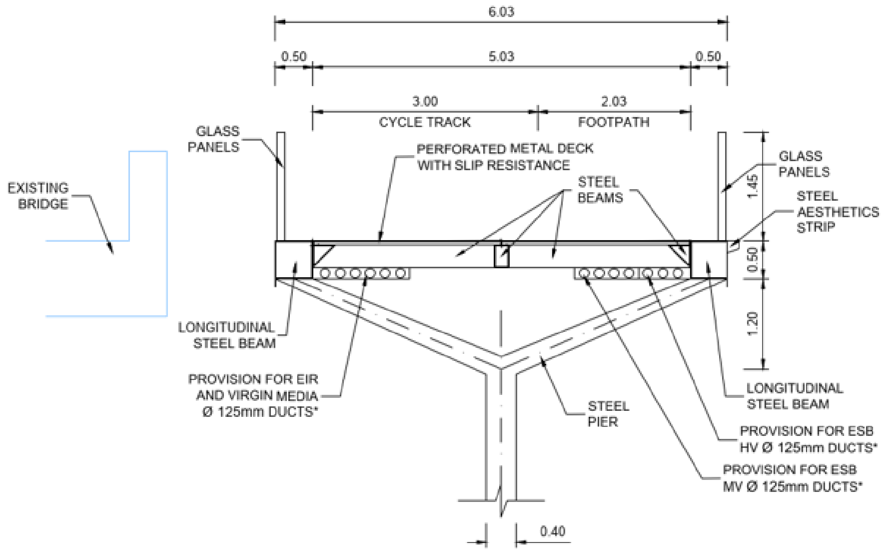


Figure 8.2: Kimmage 01A – Typical Cross Section

Kimmage 01B is located on the east side, and it is 3m wide. The typical cross section of Kimmage 01B is shown in Figure 8.3.

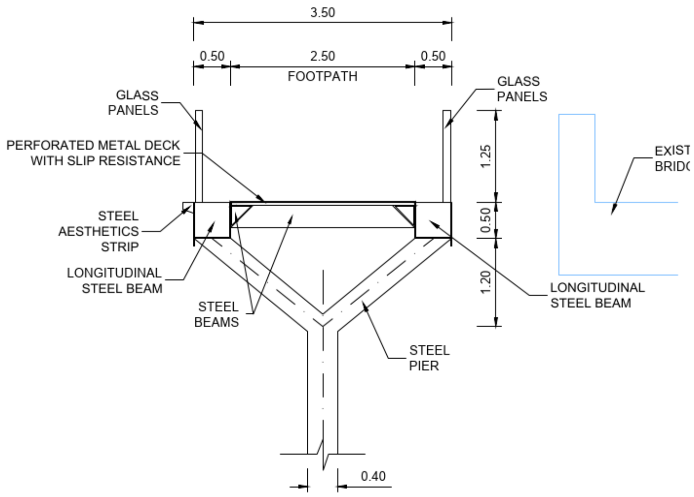


Figure 8.3: Kimmage 01B – Typical Cross Section

The deck superstructure is formed by two main longitudinal structural steel beams (square hollow sections) with several transverse and longitudinal beams supported the steel perforated deck. The bridges also incorporate glass panels as pedestrian restraint system to reduce the visual impact on the existing bridge. The structural depth (0.50m) of the proposed bridges is kept constant along the spans for both bridges, and it is similar to the existing arch bridge at its crown, hence the vertical clearance over the canal remains the same. Elevation of both bridges are shown in Figure 8.4. & 8.5.

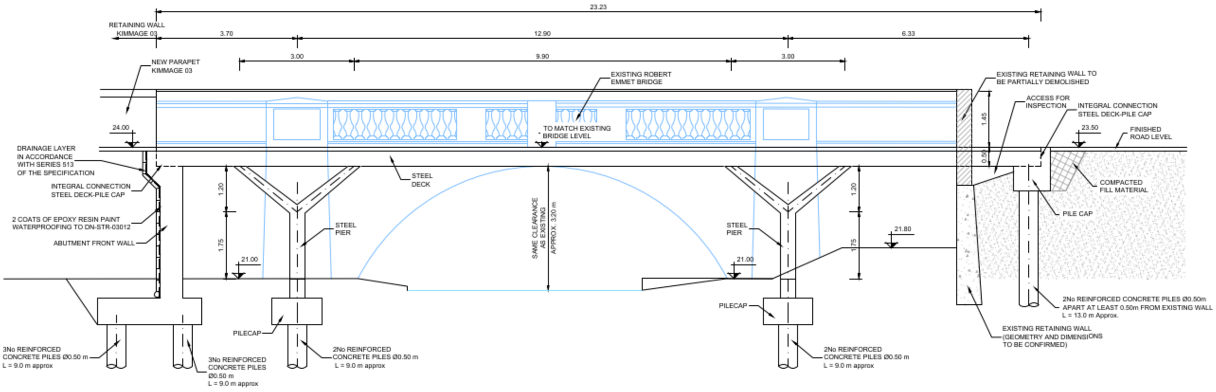


Figure 8.4: Elevation view Kimmage 01A

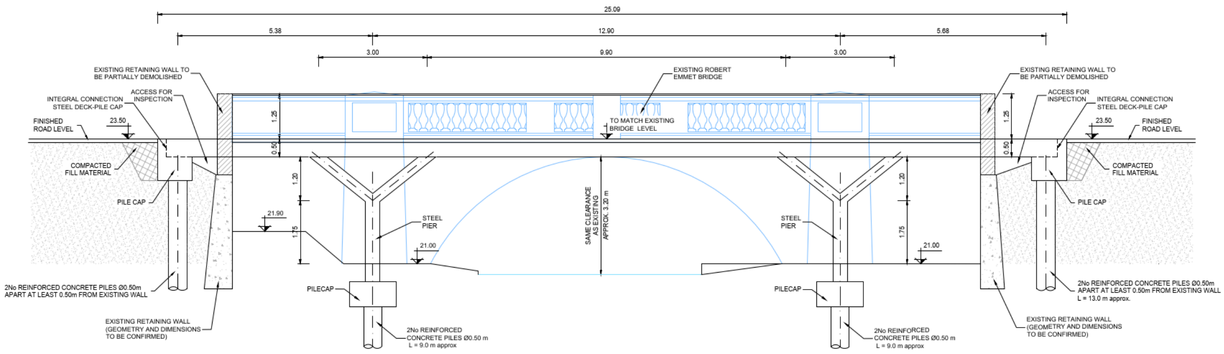


Figure 8.5: Elevation view Kimmage 01B

The piers are also made of steel and have a Y-shape, in order to resemble the existing arch. The piers reduce the length of the central span and thus keep the bridge depth to a minimum to maintain visibility of the arch bridge behind it when viewed from the canal.

Glass panels will be installed as pedestrian and cyclist's parapet on both sides of the bridge deck to reduce the visual impact on the existing bridge.

The substructure comprises of embedded foundations, formed by bored in-situ reinforced concrete piles and in-situ reinforced concrete piles caps, where the steel piers will be supported. North abutment of Kimmage 01A will consist of an in-situ reinforced concrete wall or bank-seat supported by piled foundations. For south abutment of Kimmage 01A and both abutments of Kimmage 01B, the steel superstructure will be supported directly on to the pile caps and piled foundations.

8.3.2 Structure Kimmage 02 – The *Stone Boat Boardwalk*

The proposed Stone Boat Boardwalk (Kimmage 02) will provide a footway / cycleway link between the rear of the car park on Sundrive Road to Mount Argus Way. The new walkway structure will be located over the western bank of the River Poddle. The walkway is elevated about 3m above the river channel bed. The finished surface level of the bridge will match the level of the existing car park at each end and road surface on Mount Argus Way. The indicative location is shown in Figure 8.6.

Figure 8.6: Plan View Kimmage 02

The elevated walkway consists of a steel frame, formed by longitudinal and transversal steel beams. The deck incorporates perforated metal sheets. The superstructure will be supported by single row of reinforced concrete piles separated 4m apart longitudinally. The structure aims to be as slender as possible to minimise visual effect from the opposite riverbank. The deck is 4m wide for shared use by pedestrians and cyclists. The bridge has 12No. spans with an average length of 4m. The overall length of the structure is 50.50m approx. The typical cross section is shown in Figure 8.7.

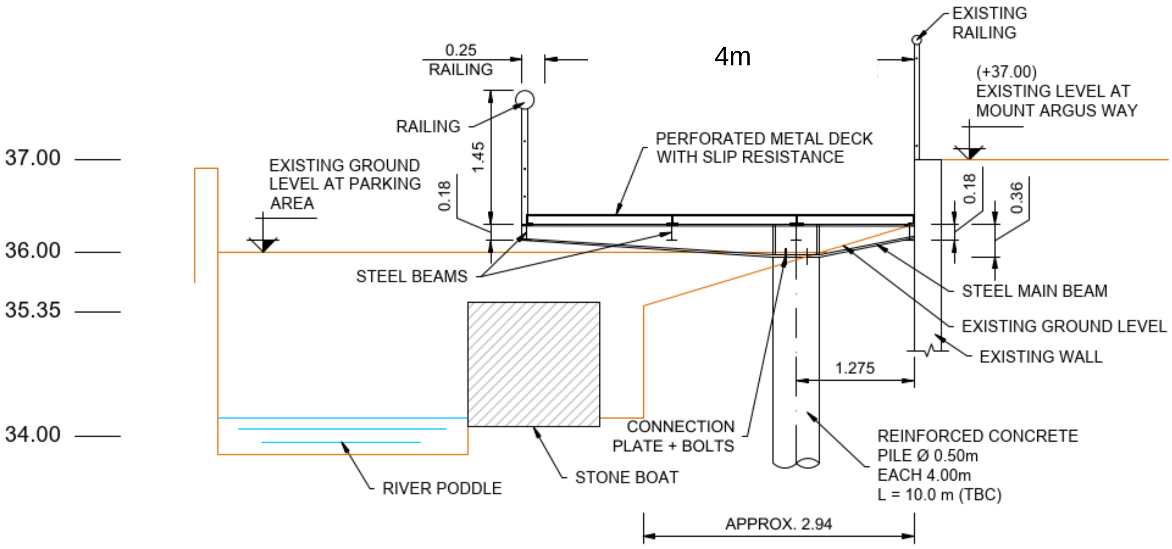


Figure 8.7: Kimmage 02 – Typical Cross Section

The walkway superstructure will be supported directly on the foundations, which are in-situ reinforced concrete single-pile columns. The piles will be continuous flight auger (CFA) bored piles that will be installed into the River Poddle riverbank.

There will be no works in the river or near the Stone Boat that could have an impact on the historic feature. The soffit of the proposed structure is over the existing Stone Boat and the culvert at the vicinity of the walkway. Access to the works area will be provided mainly from the car park at Sundrive Road, with a secondary access from the existing road at Mount Argus Way. Protective measures will be provided to prevent materials falling into the River Poddle and prefabricated elements of the proposed walkway will be deliver to the works location from the southern end. CFA piles will be installed using a piling rig from the car park at the Mount Argus Square apartments where a part of the car park will be acquired temporarily for this purpose.

8.4 Summary of Minor Structures

8.4.1 Kimmage 04 – Ramp at Windsor Terrace

A new ramp will be provided at Windsor Terrace to accommodate a new wider footpath, as the existing is very narrow and to provide adequate access to the new footbridge (Kimmage 01B). The location of the proposed ramp is shown in Figure 8.8.

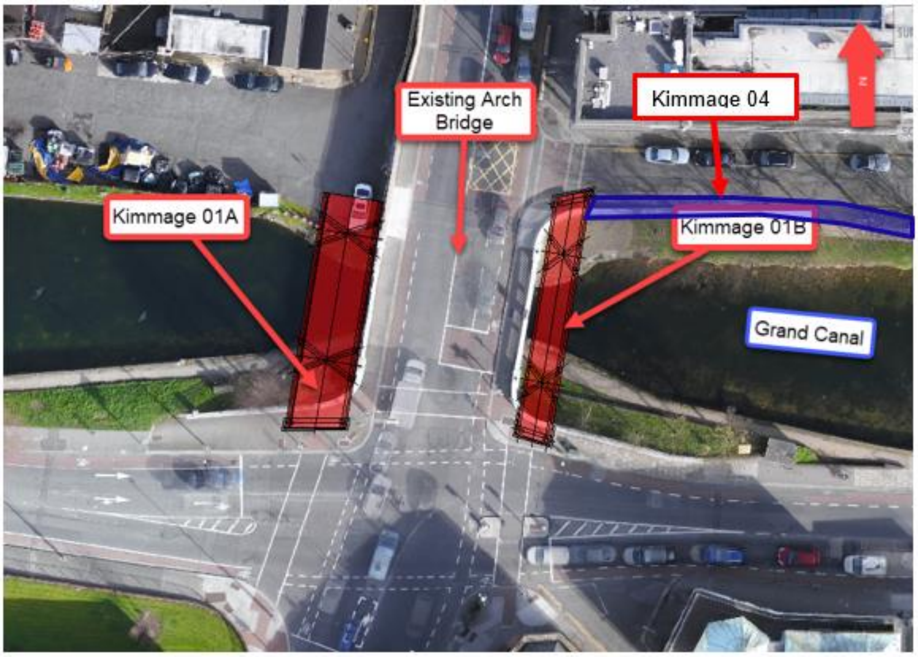


Figure 8.8: Plan View Kimmage 04

The existing narrow path will be widened to form a structural cantilever section over the existing retaining wall to accommodate a 2m wide footpath, at the upper level. This section of the ramp will also be lengthened to approximately 20m to provide a suitable gradient and to fit with the levels of the proposed eastern footbridge (Kimmage 01B) over the canal. The structural ramp will consist of a steel cantilever walkway anchored to a cast in-situ reinforced concrete slab, that will serve as a counterweight block. Existing retaining wall will be partially demolished where required. The typical cross section is shown in Figure 8.9.

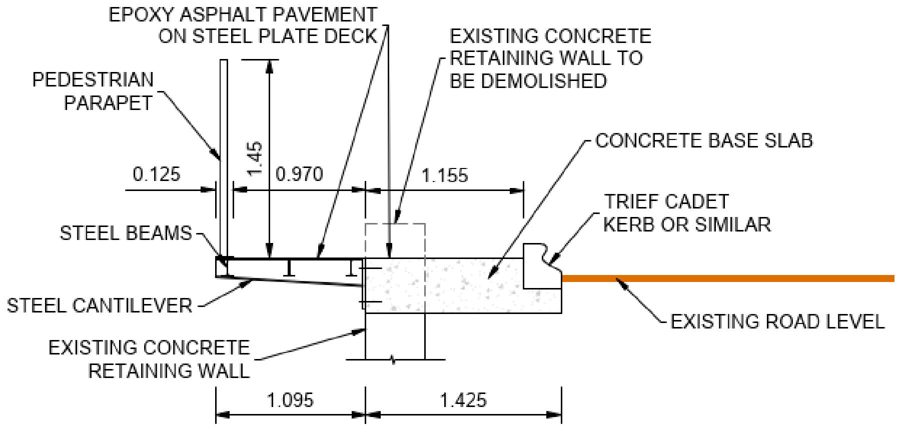


Figure 8.9: Kimmage 04 – Typical Cross Section of structural ramp

The remaining section of the ramp, the lower section, will be formed as a reinforced earth structure or low earth embankment with geosynthetic cells, minimising foundation requirements. Furthermore, the lower section of the ramp blends naturally with the riverbank surroundings, in addition to provide a tree root protection system, mitigating any negative effect on adjacent trees. The typical cross section is shown in Figure 8.10.

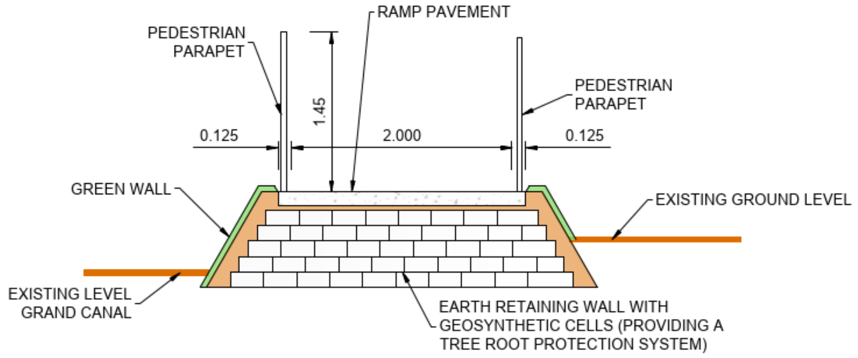


Figure 8.10: Kimmage 04 – Typical Cross Section of earth embankment ramp

Edge restraints in the form of pedestrian railings will be installed on both sides of the ramp.

8.5 Summary of Retaining Walls

8.5.1 Kimmage 03 – Retaining Wall at Clanbrassil Street Upper

Clanbrassil Street Upper will be widened over a length of 60m by up to 7m on the western side immediately north of the Grand Canal to provide enough space for bus lanes and segregated cycle tracks in both directions as shown in Figure 8-11a and 8-11b. There is an existing stone retaining wall along the western side of Clanbrassil Street Upper that is up to 4.5m high, including the parapet. This wall will be buried in the widened street and the parapet with curved granite coping stones will be carefully dismantled for reuse on top of the new wall. A second existing stone retaining wall at a lower level will be demolished and the stone will be salvaged for reuse as cladding on the western face of the proposed new concrete retaining wall.

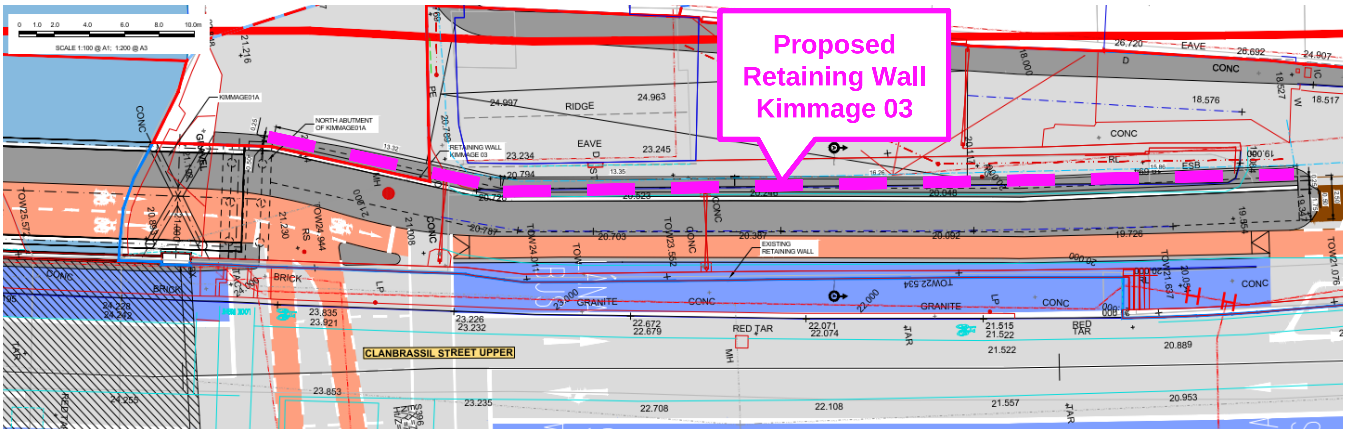


Figure 8-11a: Plan View Structure Kimmage 03

Figure 8-11b: Plan View Structure Kimmage 03

The typical cross section is shown in Figure 8.12.

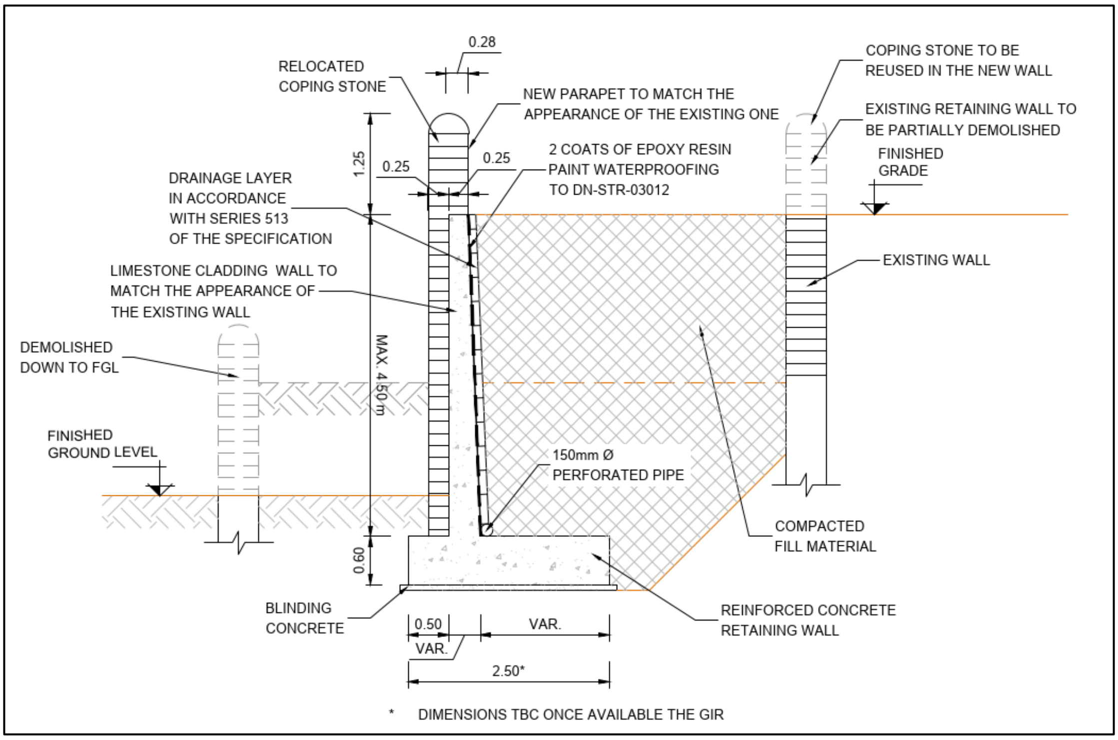


Figure 8.12: Kimmage 03 – Typical Cross Section of Retaining Wall

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 Dublin BusConnects is summarised in the 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).
- 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 as limited by the capacity of the existing highway drainage network.

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 run off 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

There are two watercourses in the proximity of the Bus corridor 11, the Poddle and the Grand Canal. The Kimmage to City Centre Scheme crosses the following watercourses:

Table 9-1 Watercourses Crossed by the Schemes

Scheme	Watercourse	Chainage	Crossing type
Kimmage to City Centre	Grand Canal	A-2690 - A-2700	Existing Bridge at Harold’s Cross Road

The Grand Canal bridge will be extended by one cycle lane and two footpaths. The proposed finishing of the bridge deck allows the water to percolate through it (permeable deck) and therefore there is no need for any positive drainage. Accordingly, no new outfall to the Royal Canal is expected. Same applies for the boardwalk at Argus Square.

In the rest of the proposed scheme there are no additional outfalls proposed to any watercourses. The existing drainage network will be maintained and used as the main discharge point for the new drainage system and therefore the runoff from the proposed corridors will reach the water body at the same location as in the current situation.

9.3 Existing Drainage Description

The surfaces of the Bus Corridor is drained via combined water sewers and surface water sewers. The majority of the surface water drainages networks are located south-southeast of Argus Park. The catchments towards the City Centre are manly draining by combined sewer networks which drain to the Ringsend treatment plant. (refer to drawing number BCIDD-ROT-DNG_ZZ-0011_XX_00-DR-CD-0001 - BCIDD-ROT-DNG_ZZ-0011_XX_00-DR-CD-0002). An overview of the catchment sizes is listed in Table 9-2.

Table 9-2 Existing Catchments

Catchment Reference	Approx. Drainage Catchment Area (m2)	Existing Network Type	Existing Outfalls
K_01	66,470	CW	Into existing Combined sewer network, outfalls to Ringsend treatment plant
K_02	401,840	CW	Into existing Combined sewer network, outfalls to Ringsend treatment plant
K_03	56,100	CW	Into existing Combined sewer network, outfalls to Ringsend treatment plant
K_04	15,290	CW	Into existing Combined sewer network, outfalls to Ringsend treatment plant
K_05	58,560	CW	Into existing Combined sewer network, outfalls to Ringsend treatment plant
K_06	132,900	SW	Into Poddle River (culverted)
K_07	204,440	CW	Into existing Combined sewer network, outfalls to Ringsend treatment plant
K_08	70,030	CW	Into existing Combined sewer network, outfalls to Ringsend treatment plant
K_09	105,280	SW	Into Poddle River
K_10	162,600	SW+CW	CW into existing Combined sewer network, outfalls to Ringsend treatment plant, SW not clear
K_11	78,230	SW	Into Poddle River
K_12	22,780	SW	Into existing Combined sewer network, outfalls to Ringsend treatment plant
K_13	431,720	SW	Into existing Combined sewer network, outfalls to Ringsend treatment plant
K_14	2,153,760	SW+CW	CW into existing Combined sewer network, outfalls to Ringsend treatment plant, SW not clear
K_15	25,700	CW	Into existing Combined sewer network, outfalls to Ringsend treatment plant
K_16	102,260	SW+CW	CW into existing Combined sewer network, outfalls to Ringsend treatment plant, SW into existing SW network that outfalls into the Poddle River.
K_17	38,305	SW	Into Poddle River
K_18	470,350	SW	Into Poddle River
K_19	343,470	SW	Into existing SW network, outfalls to Poddle River
K_20	1,690,940	SW	Into Poddle River
K_21	17,580	SW	Into Poddle River
K_22	26,940	SW	Into Poddle River

The Dodder River adjacent to the Corridor is causing flooding at various locations. Please refer to the Flood Risk Assessment. In consequence the catchment to the adjacent Dodder is illustrated as well to receive a full understanding of the drainage system.

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 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, infiltration trenches, silt traps and attenuation features if necessary.

The drainage strategy described in chapter 1.1 results into a drainage design that does not significantly increase the flow of the existing network. Pipes and sewers that require diversion will be demolished and reconstructed with same diameter according to the requirements of DCC and IW. Drainage areas that receive a change of the surface characteristic require the consideration of SuDS or when not possible attenuation in form of the provision of underground storage. Such areas are located at Poddle Park, Argus Square, Argus Park and on Harold's Cross road. The areas at Kimmage Park and Argus Park will be compensated by an infiltration trenches. The areas at Argus Square and the Grand Canal bridge extension will be compensated by permeable paving. The runoff of the additional areas on Harold's Cross will be attenuated by an oversized pipe. In consequence the expected runoff after the proposed drainage system will be slightly less.

Table 9-3 provides information of the proposed additional catchments (new paved areas) against the proposed permeable areas (current paved areas to become grassed).

Table 9-3: Summary of Increased Permeable and Impermeable Areas

Existing Catchment Reference	Chainage	Road Corridor Area (m2)	Change of use to impermeable areas (m2)	Change of use to permeable areas (m2)	Net Change (m2)	Percentage Change (%)
K_01	A3100 - A3700	7,603	0	0	0	0.00%
K_02	A2680 - A3710	14,059	77	0	77	0.55 %
K_03	A2680 - A3100	7,226	34	0	34	0.47%
K_04	A2470 - A2680	5,008	24	110	-86	-1.67%
K_05	A2010 - A2650	2,445	485	0	485	24.74%
K_07	B10050&A1950 - A2480	15,706	731	0	731	4.88%
K_08	A1740 - A2000	1,855	0	0	0	0.00%
K_09	H70090 - A1740	5,359	285	0	285	5.62%
K_10	A1250 - A 1420	2,342	0	0	0	0.00%
K_11	G60600-H70030	7,679	30	115	-86	-1.10%
K_12	A900 - A1160	6,595	0	132	-132	-1.96%
K_13	Derravaragh Road	571	0	75	-75	-11.61%
K_14	J90000-J90130& A1420-A1940	10,748	0	0	0	0.00%
K_15	G60140-G60250	1,391	0	0	0	0.00%

Existing Catchment Reference	Chainage	Road Corridor Area (m2)	Change of use to impermeable areas (m2)	Change of use to permeable areas (m2)	Net Change (m2)	Percentage Change (%)
K_16	A60 - A900	16,467	0	-320	-320	-2.00%
K_17	A10 - A210	392	0	0	0	0.00%
K_18	G60000-G60140	2,564	0	0	0	0.00%
K_19	A0 - A60	1,098	0	0	0	0.00%
K_20	A0 - A60	903	0	0	0	0.00%
K_21	G60140-G60450	213	0	0	0	0.00%
K_22	G60230-G60590	4,365	0	0	0	0.00%

9.5 Preliminary drainage design

The following drainage types were considered for Kimmage Scheme catchments comprising newly paved and combined existing/newly paved areas:

- **Sealed Drainage (SD)** which collects, conveys and discharges runoff via a sealed pipe network. For the purposes of the BusConnects Development, this type of drainage comprises sealed pipes which are connected to side entry gullies within the kerb line. These gullies will be located in the kerb line between the cycle-track and the bus lane and/or the footpath and the cycle track depending on the highway profile.
- **Grass Surface Water Channels, Swales and Bio Retention Areas/Rain Gardens (SW/RG**) are provided as road edge/footpath edge drainage collection systems. They will provide treatment and might provide attenuation if required.
- **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.
- **Tree Pits (TP)** are provided in close proximity to the road. These receive flows from the sealed pipe network and are designed to convey, attenuate and treat runoff prior to discharge.
- **SuDS/Ponds**
- **Soakaways and Infiltration Systems (SO/IS)** where infiltration takes place in the existing situation, These systems comprise soakaways, infiltration trenches, infiltration blankets and infiltration basins.
- **Attenuation in Oversize Pipes (AT/OSP)** – Where there is insufficient attenuation volume provided by the proposed SuDS drainage measures, attenuation in over-sized pipes is required to provide the required volume.

SuDS measures are included for each catchment where there is an increase in the impermeable drainage area to ensure no increase in run off and provision is made for treatment.

For catchments where there is no change in the impermeable surface area, the existing sealed pipe network will be retained with new side entry gully connections provided as appropriate. As for any new drainage network, the gullies will be located in the kerb line between the cycle-track and the bus lane and/or the footpath and the cycle track depending on the highway profile. Development of the design for the side entry gully and their associated spacing requirement is currently ongoing and will be confirmed at a later stage in the design.

9.5.1 Summary of Surface Water Drainage

The Bus Corridor is generally divided into four catchments, north and south of the Grand Canal. The area north of the Grand Canal does not have any changes in terms of permeability and stay in general the same. Only some gullies will be replaced by site-entry-gullies. The area south of the Grand Canal has two types of drainage systems, the surface water drainage system that enter the Poddle river at various locations and a combined water catchment, that Is draining towards the Ringsend treatment plant. On the project consists of the bus corridor itself and some additional cycle lanes. On the bus corridor itself south of the Grand canal are minor changes regarding the pavements only. At Harold's Cross road and at the corner Parnell Road/Harold's Cross Road. The Grand Canal bridge will be widened by an additional cycle lane and two footpaths. An additional cycle lane will cross Poddle Park and Argus Park. At Argus square this additional cycle lane will pass a new boardwalk partially along the Poddle river. The drainage of the cycle lane will be done by infiltration trenches along the new track. The impermeable paving of the existing footpath will be connected to the infiltration trench. No overflow will be provided. At the proposed structures at the Poddle river and the Gan Canal bridge the water will pass permeable paving and enter the watercourse by its natural way. In consequence the expected runoff after the implementation of the proposed drainage system will be slightly less.

Table 9-4 Summary of Proposed Surface Water Infrastructure

Catchment	Chainage	Drainage Type
K_01	A3100 - A3700	Existing drainage retained
K_02	A2680 - A3710	Existing drainage retained
K_03	A2680 - A3100	Existing drainage retained
K_04	A2470 - A2680	Existing drainage retained, discharging into Poddle River, catchment not connected to CBC corridor
K_05	A2010 - A2650	Existing drainage retained, oversized pipe at Harold's Cross Road.
K_07	B10050&A1950 - A2480	Existing drainage retained, oversized pipe at Harold's Cross Road.
K_08	A1740 - A2000	Existing drainage retained
K_09	H70090 - A1740	Existing drainage retained, permeable board walk for additional cycle track at Mount Argus Square, partially over the Poddle river.
K_10	A1250 - A 1420	Existing drainage retained
K_11	G60600 - H70030	Existing drainage retained
K_12	A900 - A1160	Existing drainage retained
K_13	Derravaragh Road	Existing drainage retained
K_14	J90000 - J90130 & A1420 - A 1940	Existing drainage retained
K_15	G60140 - G60250	Existing drainage retained
K_16	A60 - A900	Existing drainage retained
K_17	A10 - A210	Existing drainage retained, discharging into Poddle River, catchment not connected to CBC corridor
K_18	G60000 - G60140	Existing drainage retained, discharging into Poddle River, catchment not connected to CBC corridor
K_19	A0 - A60	Existing drainage retained
K_20	A0 - A60	Existing drainage retained, discharging into Poddle River, catchment not connected to CBC corridor
K_21	G60140 - G60450	Existing drainage retained
K_22	G60230 - G60590	Existing drainage retained

9.5.2 Summary of Attenuation Ponds, Outfalls and SUDS

SuDS measures are to be provided to ensure no increase in existing run off rates from newly paved and combined existing/newly paved catchment areas.

In Figure 9-1, SuDS measures are to be provided to ensure no increase in existing runoff rates from newly paved and combined existing/newly paved catchment areas. The SuDS measures are designed to cater for:

- Combined New/Existing Paved Areas: the 1 in 30-year storm with a 20% allowance for future climate change
- Newly Paved Areas: the 1 in 100-year storm with a 20% allowance for future climate change

The capacity of the proposed SuDS measures was based on the incoming flows and permitted discharge for each catchment. The permitted discharge rate was taken to be:

- Combined New/Existing Paved Catchment Areas: the existing 1 in 5-year flow unless available network/model information shows an alternative existing rate of discharge from existing paved areas
- Existing Paved Catchment Areas: the existing 1 in 5-year flow unless available network/model information shows an alternative existing rate of discharge
- Newly Paved Catchment Areas: 2l/s/ha with minimum flow of 2l/s

The permitted discharge from newly paved catchment areas (i.e. the existing greenfield rate) was calculated using the Institute of Hydrology Report No. 124 Flood Estimation for Small Catchments Method.

A range of storm durations was tested for each catchment from 30-minutes to 1440 minutes to ensure that the proposed SuDS measures have sufficient capacity to cater for high intensity, short duration storms and longer duration, low intensity storms where the total run off volumes are greater. This hierarchy promotes the concept of a SuDS Management Train, where measures are proposed as a sequence of component to collectively manage catchment runoff. A schematic of the SuDS Management Train is provided in Figure 9-1.

Scale		SuDS Management Train
Less Preferred Approach	Source	**Rainwater Harvesting –** capture and reuse within the local environment
		Pervious Surfacing Systems – structural surfaces that allow water to penetrate into the ground reducing discharge to a drainage system e.g. pervious pavement
	Site	**Infiltration Systems –** structures which encourage infiltration into the ground e.g. Bioretention Basins
		Conveyance Systems – components that convey and control the discharge of flows to downstream storage components e.g. Swales
	Regional	**Storage Systems –** components that control the flows before discharge e.g. attenuation ponds, tanks or basins

Figure 9-1: The SuDS Management Train. Source: from CIRIA SuDS Manual 2015

For this Preliminary Design, Source scale solutions have been specified, where reasonably practicable. Where Source type solutions cannot fully address an increase in runoff from a development, residual flows are discharged to be managed at the Site and then Regional scales.

The proposed SuDS measures from Kimmage to City Centre CBC is summarised for each proposed catchment within Table 9.6 below. This table shows SUDS techniques and locations. Please note all volumes and dimensions will be indicative at this stage of the design.

Table 9-5 Summary of Proposed Attenuation Features, SuDS & Outfalls

Chainage	Existing Catchment Reference	Approx. Impermeable Surface Area		Permitted Discharge (l/s)	SuDS Measures Proposed	Catchment Outfall
		Existing* (m2)	Proposed (m2)			
A3100 - A3700	K_01	7,603	7,603	As existing	None	Existing CW DCC
A2680 - A3710	K_02	13,982	14,059	Only infiltration	Permeable paving on bridge	No outfall
A2680 - A3100	K_03	7,192	7,226	Only infiltration	Permeable paving on bridge	No outfall
A2470 - A2680	K_04	5,094	5,118	As existing	None	Existing CW DCC
A2010 - A2650	K_05	1,960	2,445	19l/s	Attenuation/ oversized pipe, ca. 29m3	Existing CW DCC
B10050&A1950-A2480	K_07	14,975	15,706	Only infiltration	Attenuation/ oversized pipe linked to K_05	Existing CW DCC
A1740 - A2000	K_08	1,855	1,855	As existing	None	Existing CW DCC
H70090 - A1740	K_09	5,074	5,359	Only infiltration	Permeable paving on boardwalk	No outfall
A1250 - A 1420	K_10	2,342	2,342	As existing	None	Existing CW DCC
G60600-H70030	K_11	7,765	7,679	As existing	None	Existing CW DCC
A900 - A1160	K_12	6,727	6,595	As existing	None	Existing CW DCC
Derravaragh Road	K_13	646	571	As existing	None	Existing CW DCC
J90000 - J90130 & A1420 - A 1940	K_14	10,748	10,748	As existing	None	Existing CW DCC
G60140 - G60250	K_15	1,391	1,391	As existing	None	Existing CW DCC
A60 - A900	K_16	15,967	15,647	As existing	None	Existing CW DCC
A10 - A210	K_17	392	392	As existing	None	Into Poddle River
G60000 - G60140	K_18	2,564	2,564	As existing	None	Into Poddle River
A0 - A60	K_19	1,098	1,098	As existing	None	Into Poddle River
A0 - A60	K_20	903	903	As existing	None	Into Poddle River
G60140 - G60450	K_21	213	213	As existing	None	Into Poddle River
G60230 - G60590	K_22	4,365	4,365	As existing	None	Into Poddle River

9.5.3 Catchments K_05 & K_07 at Harold's Cross Road

Between the junctions of Harold's Cross Road / Our Lady's Hospice and Harold's Cross Road /Parnell Road are additional paved areas to be drained by the existing network. An oversized pipe is designed to retain and reduce the discharging water from the additional areas.

9.6 Drainage at New Bridge Structures

Along the Kimmage to City Centre Scheme there are three proposed new structures for which the proposed drainage is described in Table 9-6.

Table 9-6 – Drainage at New Bridge Structures

Structure code	Proposed works	Drainage strategy	Comment
Kimmage 1A and 1B	Two footbridges beside the existing Robert Emmett Bridge	Run off from additional areas falls through the permeable deck and follow its natural way to the waterbody of the Grand Canal	Catchment area currently draining directly into the Grand Canal
Kimmage 2	Stone Boat Boardwalk	Run off from additional areas falls through the permeable deck and follow its natural way to the waterbody of the Poddle River	Catchment area currently draining directly into the River Poddle

9.7 Flood Risk

9.7.1 Flood Risk Assessment

The Bus Connect corridor 11 has been assessed for existing and future sources of flood risk. The primary source of flood risk identified for the corridor is from fluvial flooding from the adjacent River Poddle. Sections of the site have been identified to be within Flood Zone A. The proposed Bus Connect corridor 11 is categorised as local transport infrastructure according to the OPW Guidelines. The assessment undertaken as part of this FRA indicates that the development will have negligible impact on flooding and the surface water drainage network within the catchment. SuDS will be provided where applicable to manage runoff quantity and quality.

Corridor 11 comprises a reconfiguring of the existing surface layout within a restively dense urban area. As per Circular PL 2/2014 of Environmental, Community and Local Government (13.08.2014), appendix, minor proposals in areas of flood risk (such as the proposed scheme) are unlikely to raise significant flooding issues as long as they do not increase flood risk. The development will not have adverse impacts or impede access to a watercourse, floodplain or flood protection and management facilities and will be flood resilient in design. As per Circular PL 2/2014 the proposed scheme does not require a Justification Test. Thus, the proposed development is suitable for the associated flood risk as per the OPW Guidelines.

9.7.2 Development of specific Flood Alleviation Proposal

There is no change in flood risk as consequence of the Kimmage to City Centre scheme. No specific flood risk measures are therefore required.

9.7.3 Section 50 Consents

Apart from the Grand Canal, which is not relevant for Section 50 Consents from the Office of Public Works. there are no new proposed culverts/bridges or modifications proposed to existing culverts/bridges that cross watercourses along the Proposed Scheme. Section 50 Consents are therefore not required for the Proposed Scheme.

10. Services and Utilities

10.1 Overview of Utilities Strategy and Survey

Utility records from all providers were sought at an early stage of the scheme design. These records combined with topographic survey records, 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 by ROD/TYPSA along the Routes. These records have assisted with informing the scheme design. Utility records were received from the following service providers:

- Gas Networks Ireland (GNI);
- Electricity Supply Bord (ESB);
- Irish Water;
- Communications: Eir, Virgin Media, BT, Vodafone, Enet;
- South Dublin County Council drainage;
- Dublin City County Council drainage.

10.1.2 Phase 1 Utility Survey

A targeted utility survey to PAS 128A, including GPR (Ground Penetrating Radar), 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 required to inform the detailed design phase of the 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, Gas Networks Ireland, 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 Conflicts

The construction of the proposed Kimmage to City Centre route 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:

- Gas Networks Ireland
- ESB,
- Irish Water (Water & Public Sewer),
- Telecommunication Services – Eir, Virgin Media, Enet & BT.

In addition to the above, it will be necessary to relocate and upgrade some of the existing public lighting along the extents of the scheme.

The services conflicts and the associated diversions will have implications for the design and construction of the scheme. The design considerations have been taken into account as much as possible at this stage, but it is likely that design modifications will be required at the Design-Build Stage when further site investigations have taken place.

During construction, it may 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 roadworks including the permanent diversion of services. The sequence of roadworks 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.

10.3 Summary of Service Conflicts with Critical Services and Recommended Diversions and/or Protection Measures

A summary for each critical service infrastructure has been identified for notional diversion and/or protection measures where service conflicts have not been designed out at this stage and were incorporated into the overall scheme design. Trunk assets were incorporated into the overall scheme design with notional protection measures where identified.

10.3.1 Gas Networks Ireland

Consultations took place with Gas Network Ireland (GNI) regarding the impact of the Proposed Scheme on their assets, and their requirements have been incorporated within the design. The Proposed Scheme with Gas Networks Ireland assets overlaid is included on drawings within Appendix B14.

No High and Medium pressure pipes were identified for diversions along the route where conflicts with GNI infrastructure occur, and protection measures were required. .

10.3.2 ESB

Consultations took place with ESB Energy regarding the impact of the Proposed Scheme on their assets and their requirements have been incorporated within the design. The Proposed Scheme with ESB assets overlaid is included on drawings within Appendix B13.

Table 10-1: Kimmage to City Centre – ESB Asset Works

Reference No.	Utility Provider	Chainage	Asset/ Apparatus Impacted	Description of Works
R11-UG-MV-009	ESB	B 10050 - 10100 C20020 - C20080	Medium Voltage Underground ESB Electricity	60m Localised Diversion Required to ESB Specification
R11-UG-LV-042	ESB	C20020 - C20080	Low Voltage Underground ESB Electricity	60m Localised Diversion Required to ESB Specification
R11-UG-LV-022	ESB	A2375 - A2445	Low Voltage Underground ESB Electricity	65m Localised Diversion Required to ESB Specification
R11-UG-LV-020	ESB	A2650 - A2660 LHS	Low Voltage Underground ESB Electricity	35m Localised Diversion Required to ESB Specification
R11-UG-MV-021	ESB	A2675 - A2700 LHS	Medium Voltage Underground ESB Electricity	144m Localised Diversion Required to ESB Specification
R11-UG-HV-054	ESB	A2675 - A2815	High Voltage Underground ESB Electricity	585m Localised Diversion Required to ESB Specification
R11-UG-LV-055	ESB	A2785 - A2815 LHS	Low Voltage Underground ESB Electricity	60m Localised Diversion Required to ESB Specification
R11-UG-MV-036	ESB	A3420 - A3450 LHS	Medium Voltage Underground ESB Electricity	24m Localised Diversion Required to ESB Specification
R11-UG-LV-052	ESB	A3420 - A3450 LHS	Low Voltage Underground ESB Electricity	24m Localised Diversion Required to ESB Specification

10.3.3 Irish Water Mains

Consultations took place with Irish Water regarding the impact of the Proposed Scheme on their Watermain and Foul Sewer assets, and their requirements have been incorporated within the design. Drawings of the Proposed Scheme with Irish Water assets overlaid is included within Appendix B15.

Table 10-2: Kimmage to City Centre – Irish Water Watermain Asset Works

Reference No.	Utility Provider	Chainage	Asset/ Apparatus Impacted	Description of Works
R11-UW-007	Watermain	A128 - A139 RHS	DN250mm DI	11m Localised Diversion to Irish Water Specification
R11-UW-004	Watermain	A2378 - A2426 RHS	DN102mm CI	48m Localised Diversion to Irish Water Specification

10.3.4 Telecommunications

Consultation took place with telecommunications providers regarding the impact of the Proposed Schemes on their assets for incorporation within the design. Drawings of the Proposed Scheme with telecommunications assets overlaid is included within Appendix B.16.

Table 10-3: Kimmage to City Centre – Telecommunications Asset Works

Reference No.	Utility Provider	Chainage	Asset/ Apparatus Impacted	Description of Works
R11-UG-004	EIR	B10159 - B10179 RHS	Eir Existing	20m Localised Diversion to Eir Specification
R11-UG-005	EIR	B10343 RHS	Eir Existing	4m Localised Diversion to Eir Specification
R11-UG-021	VM	A2378 - A2444 RHS	Virgin Media Existing	76m Localised Diversion to Virgin Media Specification
R11-UG-015	EIR	A2677 - A2733 LHS	Eir Existing	68m Localised Diversion to Eir Specification
R11-UG-020	EIR	A3650 - A3669 RHS	Eir Existing	9m Localised Diversion to Eir Specification

11. Waste Quantities

11.1 Overview of Waste

The majority of the waste arisings from the works 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 be 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 stockpiled and 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 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. 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 need to 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 sub-base, 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 footpath/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 scheme.

Waste arisings from street furniture, trees and materials from within the public domain (Bricks, Mixed metals, Plastic, wood, 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	100 kg per tree	Average value per tree across the entire route
Vegetation (e.g. hedges, shrubs, leaves and branches)	Organic	N/A	*Organic material from hedges, shrubs, leaves and branches have not been quantified. It is assumed that this material will be collected and mulched before removal from site to organic treatment facility. Therefore, the quantity of organic waste will be minimal and not significant for the assessment.*
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 2 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	260 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
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:
	Wood	8kg	

Item	Material	Assumed nominal weight	Notes
			https://www.lostart.co.uk/pdf/lost-art-limited-product-information.pdf (Accessed on 6 May 2021)
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	27.9 kg per m width of road	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*
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	50kg	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	50kg	Pam Saint- Gobain (2016). *Ductile Iron Access Covers and Gratings: Product selection and specification guide*. Available online: https://www.saint-gobain-

Item	Material	Assumed nominal weight	Notes
			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/m^3)	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
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)

Asset type	**Assumed nominal average trench width (m)**	**Assumed material spec. (TII)**	**Assumed nominal average trench depth under pavement layer (m)**	**Notes**
		Class ½ 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)
		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 footpath i.e. obvert at 0.55m under subbase layer of footpath / 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 footpath i.e obvert at 0.55m sub.base layer of footpath)	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 footpath i.e. obvert at 0.4m subbase layer of footpath)	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 footpath)	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: Footpath and Verge Widening Excavation Assumptions

Layer	Assumed Layer thickness (m)	Assumed material spec. (TII)
Footpath surface treatment due to all works (remove and replace)	0.1	Concrete
FDC new pavement depth	0.85	As per DCC standard bus corridor detail with 200mm capping assumed.
Footpath sub-layer excavation due to Full Depth Construction (FDC) widening (material under footpath)	0.1	Granular material- Class ½ 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 footpath 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 ½ 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 works are likely to accumulate from excavation 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 18,000 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..

Potentially up to 100% of concrete and asphalt material could be sent to a suitable aggregate recovery facility for recycling. Under the 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 sub-base material type A (for use under bituminous footpath) in addition to LEBM pavements for roads with <5MSA or consideration in offline cycle track base material. These pavement materials could be removed directly from site or temporarily stockpiled on site and removed at a later date as part of a spoil/waste management strategy in consideration of the intermittent nature of the street works construction activities.

Potentially up to 90% of excavated subbase material and capping material could be stockpiled on site for reuse as sub-base material under footways & 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.

As mentioned above, material reuses will be developed with additional site investigations in later design stages.

Potential mitigations to be considered include soil recovery (existing sub-base, capping layer and topsoil material) and new asphalt pavement using recycled aggregates and reclaimed asphalt material.

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 5,500 Tonnes of recycled/reused aggregates to improve the overall sustainability of the scheme.

It is estimated that an order of magnitude of 180 Tonnes of waste arisings from street furniture, trees and materials from within the public domain (Bricks, Mixed metals, Plastic, wood, 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.

12. Traffic Sign, Lighting and Communications

12.1 Traffic Signs

Traffic Signs 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.

A preliminary Traffic Sign and Road Markings design has been undertaken to identify the requirements of the Proposed Scheme, as shown on the drawings in Appendix B8, 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; junctions/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 TSM, particularly where place values are very high, such as in the Centre context'.

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.

12.1.1 Traffic Signs - 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. 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 possible to eliminate the need for vehicle restraint systems.

12.1.2 Traffic Diversion Routes

Permanent diversions of traffic will be required at a number of locations as a result of the proposed scheme. These are set out below.

In conjunction with the proposed Bus Gates on Kimmage Road Lower just north of Ravensdale Park, it is proposed to provide direction signs for traffic diversions onto available alternative routes as illustrated in Figure 12-1 below.

- Local traffic diversions for northbound traffic from Kimmage Road Lower via Ravensdale Park/Captains Road, heading northbound via Stannaway Road, and southeast via Sundrive Road or;
- For traffic on Fortfield Road, traffic will be directed to turn right onto Terenure Road West, Terenure Place, and northbound via Terenure Road North.

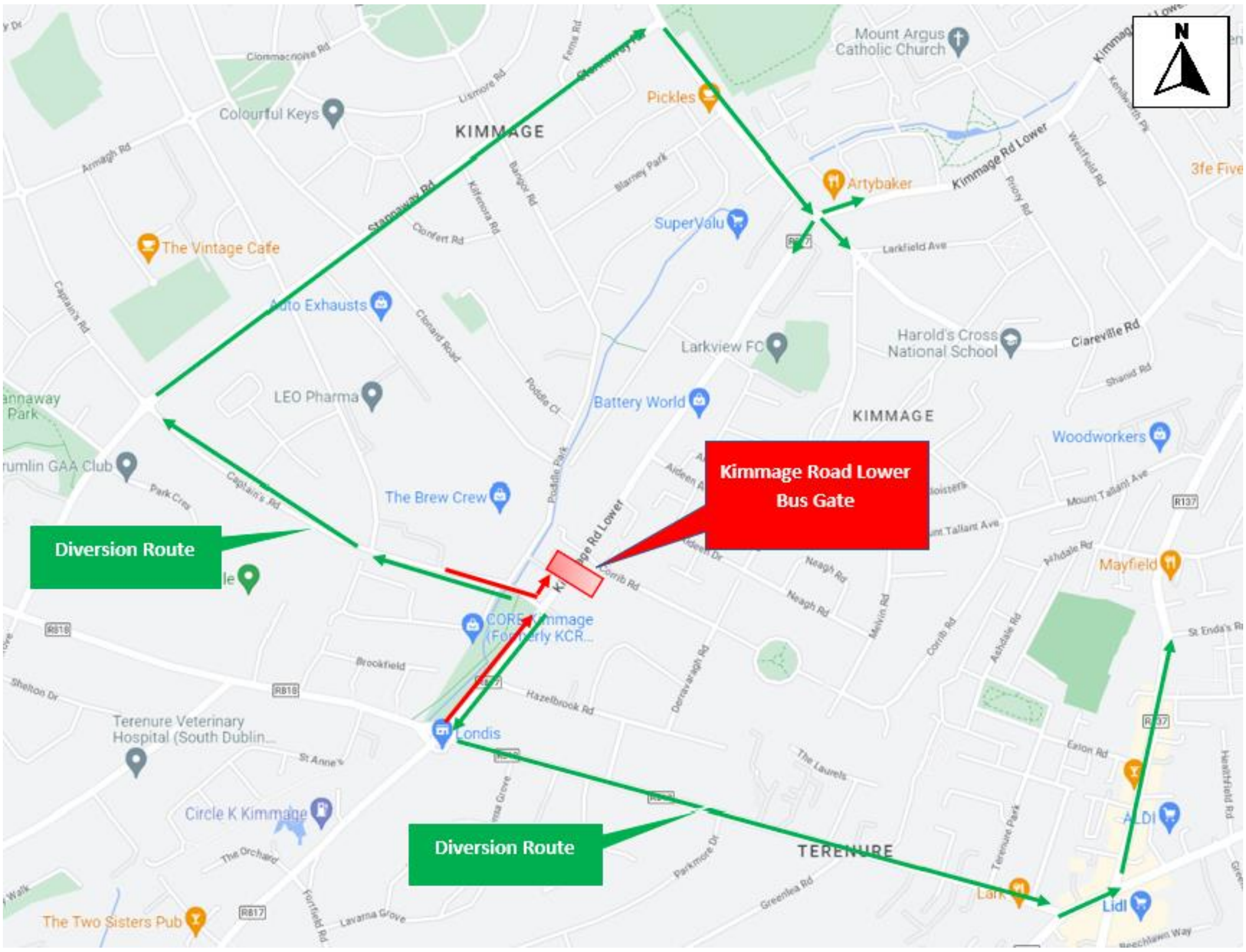


Figure 12-1: Diversion for northbound traffic on Kimmage Road Lower

In conjunction with the proposed Bus Gates on Kimmage Road Lower just south of Harold's Cross Park and Harold's Cross at the northern end of the park, it is proposed to provide direction signs for traffic diversions onto available alternative routes as illustrated in Figure 12-2 below.

- Traffic wishing to access the Mount Jerome Cemetery area from Harold's Cross will be directed by provision of appropriate signage to Harold's Cross Road on the east side of the park.
- Traffic wishing to access Kimmage Road Lower towards Harold's Cross Road and via the new right turn at Kenilworth Square junction and then left onto Clareville Road which connect to Kimmage Road Lower.

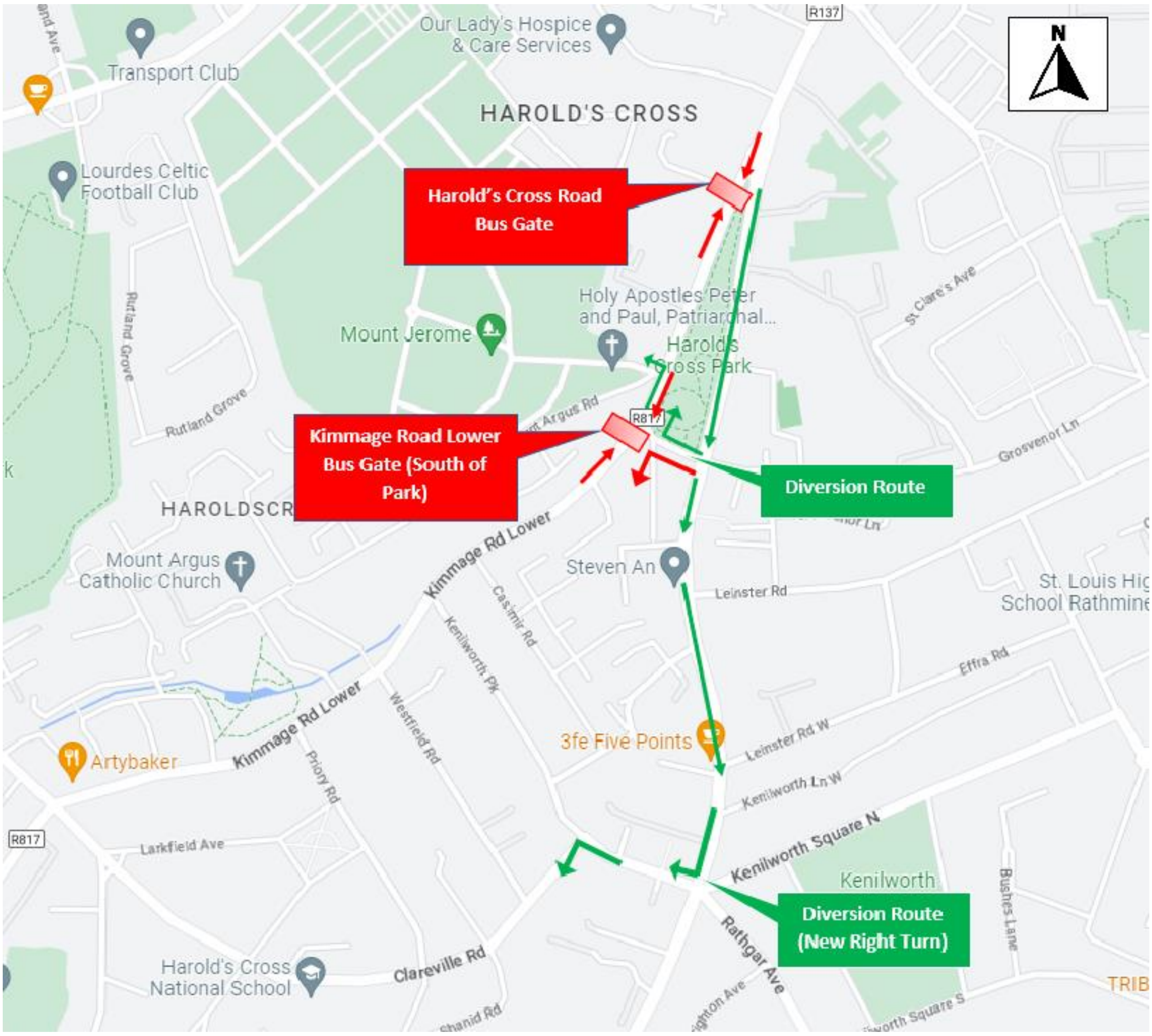


Figure 12-2: Diversion on Harold's Cross Road

It is proposed to restrict the right turn movement from Harold's Cross Road to Grove Road. Directional signs will be provided for traffic diversion onto available alternative routes as illustrated in Figure 12-3 below.

- North to east traffic from Harold's Cross Road will be diverted via Clanbrassil Street Upper then right onto South Circular Road.

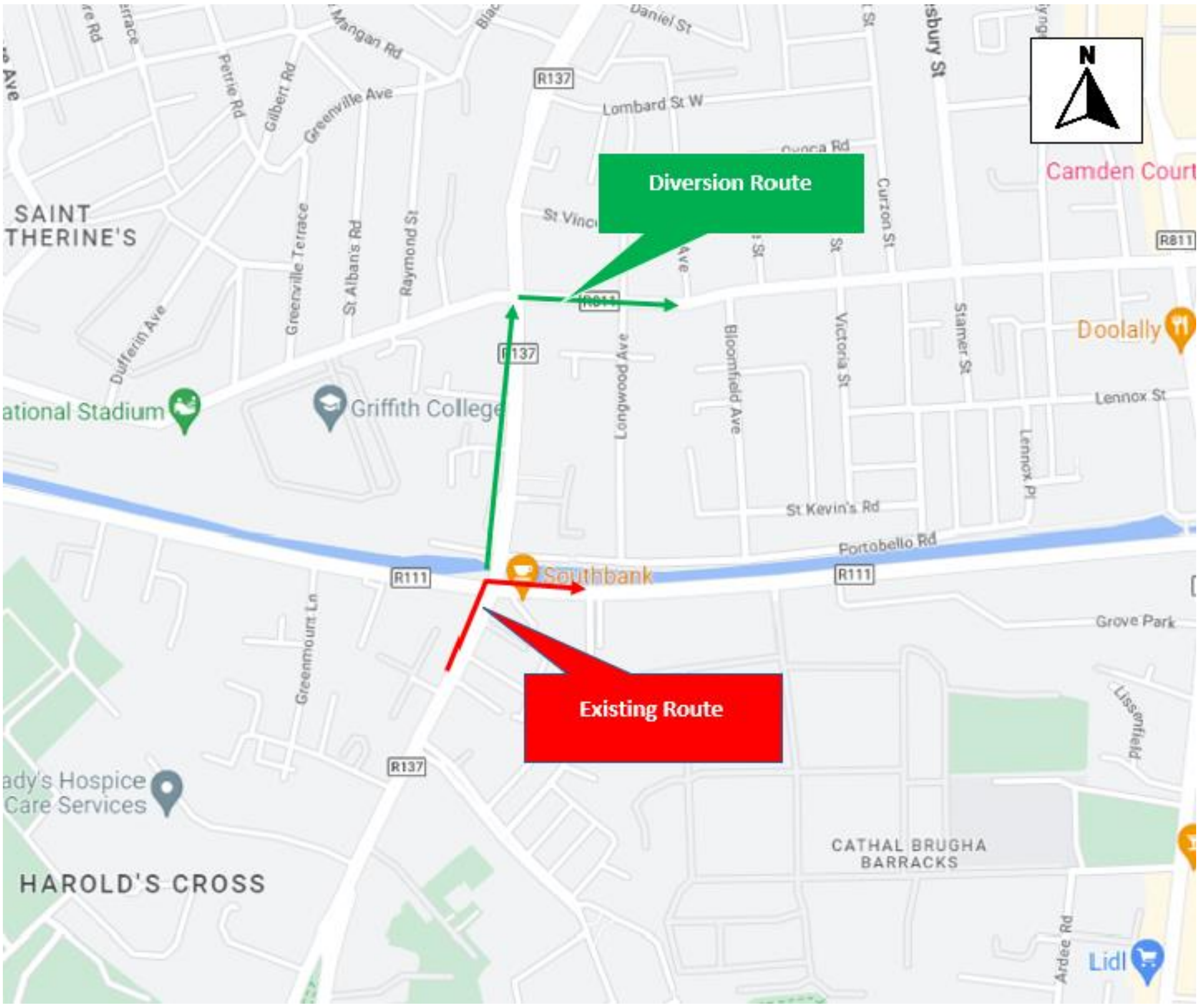


Figure 12-3: Diversion for eastbound from Harold's Cross Road

In conjunction with the proposed Bus Gate on Kenilworth Square North, it is proposed to provide direction signs for traffic diversions onto available alternative routes as illustrated in Figure 12-4 below.

- Westbound traffic from Kenilworth Square North will be diverted via Kenilworth Square West, right onto Kenilworth Square South and then right onto Rathgar Avenue.

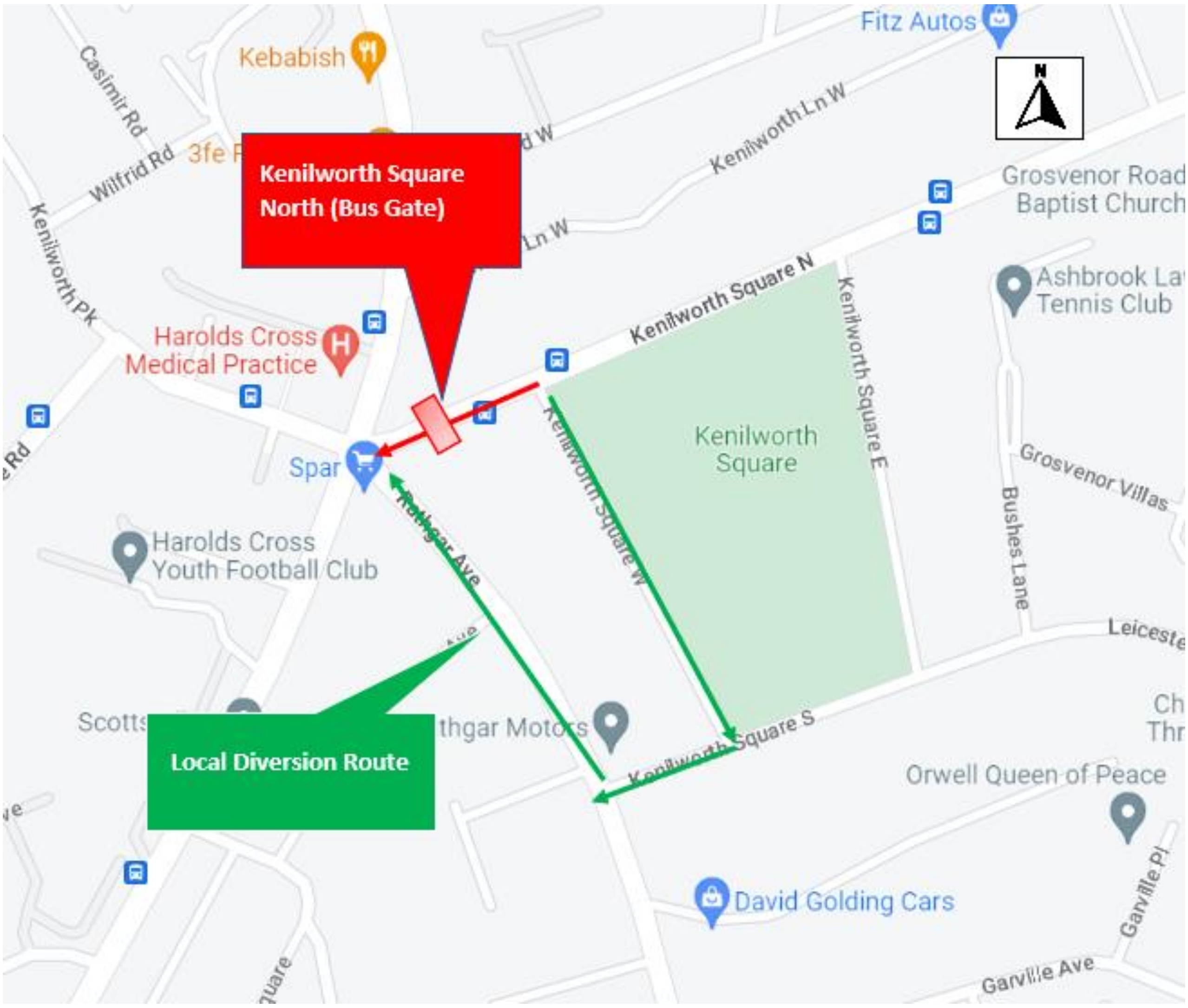


Figure 12-4: Diversion for westbound traffic on Kenilworth Square North

12.2 Road Markings

A preliminary design of road markings has been undertaken in accordance with TSM Chapter 7. Refer to the preliminary design drawings contained within Appendix A.2 for details. This exercise also included the preliminary road marking design of the following items:

- Bus lanes are provided along the majority of the scheme and will be marked accordingly.
- Cycle tracks have been provided along the majority of the scheme. The pavement will be marked according to best practice guidelines such as DMURS and the National Cycle Manual with particular attention given to junctions. Advance Stacking Locations (ASLs) have been designed predominantly on the side roads where possible to provide a safer passage for cyclists at signal-controlled junction for straight ahead or right turn movements.
- 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 relatively high number of pedestrians. DMURS classifies pedestrian crossing widths in areas of low to moderate pedestrian activity as 2.5m and areas of moderate to high pedestrian activity as 3m.

12.3 Public Lighting

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 B9.

In order to describe the design approach at this preliminary stage, this corridor has been divided in the following sections:

- Kimmage Road Lower from Terenure Road West to Sundrive Road
- Kimmage Road Lower from Sundrive Rd to Harold's Cross Road
- Harold's Cross Road from Parkview Avenue to Grand Canal
- Clanbrassil Street Upper, Clanbrassil Street Lower and New Street South.

12.3.1 Existing Lighting

Light Emitting Diode (LED) lanterns should 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 CBC. 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 footpath, where possible, 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 in association with the Public Lighting Departments of the relevant Local Authority to ensure that the current standard of public lighting is maintained or improved. To determine whether existing public lighting is to be improved / relocated or where new public lighting is required, an inspection shall be carried out in association with the relevant Local Authority, to identify any new column locations required for particular sections of the 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.

12.3.2 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;
- Institution of Lighting Professionals “GN01 Guidance Notes for Reduction of Obtrusive Light”

All new lighting shall minimise the effects 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).

12.3.3 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 stations provide clearance for buses).

12.4 Traffic Monitoring Cameras

A network of digital cameras is proposed to be introduced at key locations along 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 route 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.

12.4.1 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.

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, the design will assume that the post will be mounted in a NAL-type post 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.

12.4.2 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.

12.4.3 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.

12.4.4 Data Communications

Where it is not practicable to use existing network for a continuous fibre optic cable network the Proposed Scheme will require a new telecommunications ducting network consisting of two ducts with chambers at 180m centres along one side of the road with spurs to connect to cabinets and equipment. 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.

12.4.5 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 possible 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 100 metres 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 100 metres.

12.5 Real Time Passenger Information

The design for the Proposed Scheme assumes the provision of real-time passenger information (RTPI) at all of the bus stops. This will comprise a “live” display identifying the estimated arrival time of each bus at the stop.

Figure 12-5: Flag Type RTPI Display

12.5.1 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.

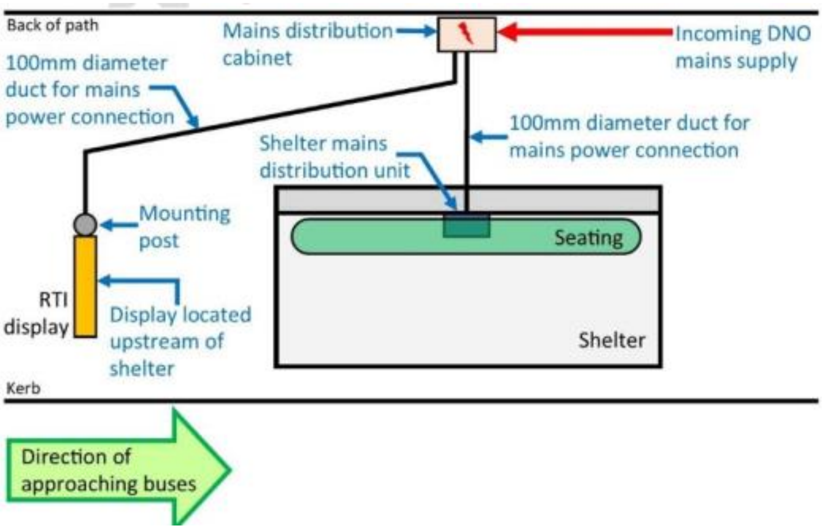


Figure 12-6: Typical Layout for Bus stop with RTPI Display

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.

Design of the above, for both location of an RTPI display and connectivity requirements for mains power, will therefore require an understanding of each detailed bus stop layout, in particular where the shelter is to be located and whether the requirements of other facilities need to be taken into consideration.

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 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.

The specification provided for the mounting post illustrates a fixed post design so it has been assumed for design purposes that a tilt-down post, as described for the cameras, will not be required for the RTPI display. However, if such a design is needed then it can be accommodated by the NAL-type socket.

12.5.2 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 Figure12-2 from a mains distribution cabinet or feeder pillar located at the bus stop, where the mains service provider (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 Figure12-2**.**

12.5.3 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 Kimmage to City Centre CBC route, 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.

12.6 Traffic Signals

12.6.1 Traffic Signal Poles

All traffic signal equipment is designed in accordance with Chapter 9 (Traffic Signals) of the Department of Transport Traffic Signs Manual. 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 Traffic Signs Manual 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.

12.6.2 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.

12.6.3 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
- 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 footpaths, to minimise the impact on the effective width of the footpath 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.

12.6.4 Ducts

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.
- **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.

12.6.5 Chambers

Chamber 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 access in a safe manner, without the need for extensive traffic and pedestrian management.

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.

12.6.6 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. Cabinets 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.

12.6.7 Signal Controlled Priority

12.6.7.1 Overview

It proposed to provide specific detection for buses located a sufficient distance from the junction to allow the traffic signal junctions to respond safely and efficiently to the requested bus priority request. There would 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 would 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.

Signal controlled priority for buses providing queue relocation is proposed in areas where physical constraints cannot be overcome, and physical bus priority cannot be provided through the delivery of a bus lane such as village centre areas where the built form is close to the carriageway edge. Bus Priority Traffic Signals allow the bus to achieve virtual priority through a section where the bus shares a lane with general traffic through the management of queues within this section and providing priority to the bus on approach.

Figure 12-7 Bus Priority Signal Schematic Operation

The scenarios in which a bus priority traffic signals can operate effectively requires assessment on a case-by-case basis, however designers should consider the following factors:

- The corridor length through which the bus will share the lane with general traffic should be reasonably clear from potential disruption. A bus priority traffic signal is not likely to operate effectively over a long distance with a large number of accesses for instance, or where a major junction is contained within this area.
- The availability and appropriateness of stacking space for traffic upstream should be considered as queues will be relocated to this area.
- Downstream queue detection will be used to ensure a clear route for the bus through the section without a bus lane.

The system provided can interface with all of the junctions along the corridor, and where required other parts of the network. This will require an AVL system that communicates both with the Central Dublin SCATS system, in an updated version of the DPTIM SCATS centralised priority system, other local authority SCOOT systems and direct interfaces with local traffic signals where these typically run MOVA. Options for local control include direct from optical sensors or using an AVL system interface.

The intention is that 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 would be achieved using either using 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 would 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 predominately comprise Junction Type 1. These junction types facilitate general traffic and bus through movements travelling in unison. This therefore gives DCC a high degree of flexibility regarding the level of bus priority applied at the respective junctions along the Proposed Scheme.

12.6.7.2 Infrastructure for Signal-Controlled Priority

Public Transport Priority will be provided through a number of passive and active means. The means of passive priority are discussed in Section 4.12 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. Dublin City Council use Sydney Coordinated Adaptive Traffic System (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.
- 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.
- 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.

Additional inputs from the Automatic Vehicle Location System (AVLS) 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.

12.6.8 Communications Network

Communications will be used to connect on-street devices with the appropriate 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.
- Fibre breakout cabinets will be provided at each Traffic Signal Controller, or CCTV camera.
- Microwave Wireless Point-to-Point Links - Where it is not possible 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 Variable Messages Signs (VMS).

12.7 Safety and Security

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:

- 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
- Bus shelters will be generally provided at Bus Stops to provide rest facilities and weather protection for users where space permits, unless there are particular local constraints that preclude provision of a shelter. Details were listed earlier in the tables of bus stop locations.

12.8 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
- 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 and Land Acquisition Requirements

As part of the proposed Works, land is to be acquired at several locations in the Proposed Scheme. The land use at the affected comprises a mix of residential and commercial properties.

13.2 Summary of Compulsory Land Acquisition

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 'Compulsory Purchase Order (CPO) Documents' prepared as part of the planning application.

In total approximately 0.38 Hectares of land will be permanently acquired to construct to Proposed Scheme.

There will also be an additional 0.21 Hectares of temporary land required to allow for construction of boundary treatment and surface tie in works.

13.3 Summary of affected landowners/ properties

The locations for proposed land take are summarised in Table 13-1.

Table 3-1:Locations for Land Take

Address	Permanent Land Take	Temporary Land Take
Car park at Sundrive Road, Kimmage	Yes	No
River channel and open space at Mount Argus Square	Yes	No
Car park and driveway at Mount Argus Square	Yes	Yes
Lawn and driveway at Our Lady's Hospice, Harold's Cross	Yes	Yes
Garden area at Greenmount Close, Harold's Cross Road	Yes	No
Entrance road area at St. Clare's School, Harold's Cross Road	Yes	No
No. 33 to 61 Harold's Cross Road – front gardens at 15 houses	Yes	Yes
Garden area at Fottrell House, Parnell Road, Harold's Cross	Yes	Yes
Banks of the Grand Canal at Robert Emmett Bridge	Yes	Yes
No.32a Clanbrassil Street Upper	Yes	Yes
Road at No. 29 to 31 Clanbrassil Street Upper	Yes	No
Public car park at St. Vincent Steet South	No	Yes
Public landscaped areas at St. Patrick's Court, Clanbrassil Street Lower	No	Yes

13.4 Demolition

There is one building proposed to be demolished as part of the Proposed Scheme at No.32a Clanbrassil Street Upper where a dwelling will be acquired and removed to accommodate a new access to Gordon's Fuels and the Grand Canal harbour.

Boundary walls and railings will be removed and replaced as part of the works as listed in Table 13-1 above.

All reasonable precautions to prevent pollution of the site, works and the general environment including streams and waterways to be taken. All demolition waste to be segregated and, where practicable, sent for recycling. All 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 should 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.
- Best practice Guidelines on the preparation of Waste Management Plans for
- Construction and Demolition Waste
- Department of Environment, Heritage and Local Government July 2006

13.5 Summary of Accommodation Works and Boundary Treatment

The locations for proposed new boundary treatments along the Proposed Scheme are consistent with the landholdings to be acquired as shown in Table 13-1 and also shown on the SPW_BW Fencing and Boundary Treatment Plans located in Appendix A.2 .

For boundary treatment requirements the following criteria has been used to calculate the area of temporary land take needed during construction:

- Walls <900mm in height– Typically two metre working room offset for temporary land take.
- Walls> 900mm in height – Typically two metre working room offset for temporary land take.
- Fences – Typically two metre offset for temporary land take.
- Significant retaining walls –There are no significant retaining walls within the Proposed Scheme.
- Specific structures (bridges etc) –Provide enough room for the storage of equipment and materials for the construction process.

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 shall be between 2.5m and 3.6m in width.

Existing gates will be reused where practicable however considerations will be required for the use of bifold gates to mitigate impacts on parking in driveways. All gates will be hung such that they will open inwards onto the property.

14. Landscape and Urban Realm

A Landscape is understood as the result of the interaction of landforms, natural elements (visible and concealed) with man-made features, and human activities over a certain area in time. The specificities of the sites that contains give each landscape a distinct character from others. Landscape is always a cultural construction, but the urban landscapes are those areas where the human actions are preponderant. Urban realm could be understood as publicly accessible spaces within an urban landscape, it encompasses streets, squares, paths, building entrances, lanes and all areas primarily dedicated for pedestrians.

A good urban realm should be safe, functional, appealing for varied users, should provide comfort and protection from distressing elements, should be identifiable and perceivable as distinctive but simultaneously well integrated in the Urban Landscape.

The success of different urban realms settings is also determined by function. Footpaths along a narrow street, for instance, need to provide optimal routes from point A to point B. Assuring pedestrians can move in the most effective, safe, and comfortable way. Large squares on the other hand are also meeting points, places to stay, socialize and rest. People routes needs to be assured but other objectives are also important. These can be met by introducing specific urban furniture elements such as benches, trees, for shading or streetlighting.

Some main policy and strategic documents that have been considered as guidance to develop the landscape and urban realm proposals where:

- Dublin City Development Plan 2016-2022
  - Vol 1: Written statement - 7.4 Retail Guidance (Kimmage and Harold's Cross)
  - Vol 2: Appendix 8 - Paved Areas and Streets with Granite Kerbing
  - Vol.4: Record of Protected Structures
- Dublin City Tree Strategy 2016-2020
  - Chapter 4.0 Action Plan 2016–2020
- Dublin City Biodiversity Action Plan 2015-2020
  - Theme 1: 1.4 Invasive Species.
  - TGN on Biodiversity for Development Management in Dublin City- Site Design chapter.

14.1 Consultation with Local Authority

Periodic consultations were held with local stakeholders throughout the design process, namely local associations, resident groups, and Dublin City Council, including representative experts for local heritage, landscape, and ecology.

14.2 Landscape and Character Analysis

The strategy for the urban realm design was developed comprehensively to achieve coherence between the different schemes while enhancing the special character of each segment. It was initially based on a common mapping exercise for Urban Realm Initiatives which provided the general planning framework on which to base site specific designs.

Within the analysis of the existing urban realm, a classification of segments with similar character was carried out. It included heritage features such as particular buildings or groups of buildings, boundaries, existing vegetation, planting, light fixtures. and hardscape materials. It also considered the available space, distance to attraction points or relative position within the city network. The objective was to identify the existing character and perceive how the design proposal may affect it. The result of the analysis was made clear by the identification of areas of opportunities for enhancing the urban realm character or improve what currently exists. These areas were identified and will be analysed in the next chapters of the report The main activities considered were introducing/ extending planting, upgrading the paving materials, decluttering the streets and general contributions for upgrading zones.

There is limited existing landscaping or high-quality urban realm along the Proposed Scheme apart from a few public park areas along the edges of the corridor from south to north at Poddle Park, Mount Argus and Harold's

Cross, as well as the Grand Canal at Robert Emmett Bridge. There are very few street trees along most of the route, except for Clanbrassil Street Lower and New Street South at the northern end where there is a median with a line of trees.

14.3 Arboricultural Survey

14.3.1 Scope of Assessment

An Arboricultural Impact Assessment Report identifies the trees, groups of trees, or hedgerows that may be impacted by the Proposed Scheme. The surveyed trees contained within the Arboricultural Impact Assessment Report are located within or adjacent to the proposed Bus Connects route. 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 B5.

The assessment was informed by an extensive tree survey prepared by Michael Garry Arbor-Care (Ltd) Professional Consulting Tree Service, based on the requirements of BS 5837 (2012) Trees in relation to design demolition and construction – Recommendations (BS5837).

The objective of the Arboricultural Impact Assessment was to identify the areas that contained trees, groups of trees, or hedgerows, and to ensure where possible that these areas would be retained and to identify the trees that are to be removed to facilitate the development.

The report considers the following:

- Client brief and Methodology.
- General description of trees.
- Guidance for the design team and any key considerations.
- Statutory or non-statutory designations affecting trees within the survey area.
- Schedule of surveyed trees
- Tree protection/constraint plan.

14.4 Hardscape

14.4.1 Design Principles

Landscape design has been directed by a good understanding of the original landscape values, heritage elements and ecological values. An effort has been made to support the enhancement of significant places and the protection of trees and shrubs which are thriving.

The main elements that have been considered are:

- Building typologies, uses, scale, pedestrian environment, landmarks, landscape character and any other relevant place attributes.
- Assessment of the general route proposals and impacts to the local conditions that require mitigation for the risk of being detrimental for some public space users.
- Development of strategic public realm proposals that provide compensation of detrimental effected of the general proposal.
- Development of public realm design proposals for each section following both the vision of Bus Connects Dublin Infrastructure Works and the specificities of the sites that relate to identity and character.

14.4.2 Typical Material Typologies

A palette of proposed materials was put forward to create a consistent design response for various sections of the route. The proposed materials were based on the existing elements, landscape character, function, and durability.

The material employed in the preliminary design are:

- **Poured in situ concrete pavement**. - Used extensively on existing footpaths and in areas to reinstate according to existing. Sometimes these are laid without kerbs but in some locations, they have concrete or stone curbs. These pavements are durable, resistant, and non-slippery, but are impermeable. With time and weathering they frequently present cracks and a non-homogeneous colouring. If utility works are needed the patches will be visible.
- **Natural stone. –** Used in high quality urban realm areas, mostly in city centre locations or around heritage buildings. This typology includes stone surface treatments such as granite used to create enhanced public spaces.
- **Precast concrete pavers**. - Includes concrete paving slabs or concrete blocks, 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 public realm enhancements for commercial areas where large slabs are included.
- **Stone setts**. - Proposed for distinguishing pedestrian crossing points and special locations of road traffic in high quality urban areas (footpath or road level).
- **Self-binding gravel** - Proposed for distinguishing pedestrian crossing points and special locations of road traffic in high quality urban areas (footpath or road level).
- **No change**. - There were also areas where no change in materials is required. For example, where pavement has recently been laid and is in good condition or is not new but is in perfect conditions.

Other design responses also included in particular areas:

- **Tree pit insertion** larger tree pits should be included whenever possible. In some cases, it was also necessary to construct tree pits to accommodate trees that were formerly within green areas that are now hardscape areas.
- **Street furniture** is mostly confined to replacing or relocating existing furniture, there is opportunity at the Hot Spots to provide additional street furniture where it would most enhance the communal spaces.

14.5 Softscape

14.5.1 Tree Protection and Mitigation

One of the landscape design main concerns is to protect existing trees along the route following recommendations from the arboricultural report. The arboricultural survey assessment information was overlaid on the designs and reviewed with the objective of retaining where practicable trees that are in good condition even if special protection to those specimens will be required during works.

14.5.2 Tree Loss and Mitigation

Almost all existing trees that are in good condition will be retained in the Proposed Scheme, with 81 trees retained, and only 17 trees required to be removed where it has not been possible to modify the proposed road layout to avoid this impact. In some cases, such as along Clanbrassil Street Upper, the proposed cycle track will be narrower than the desirable minimum standard so as to retain 3 mature street trees on the eastern side at the edge of the footpath.

To improve the urban real along the Proposed Scheme it is proposed to plant a large number of new street trees in concentrated groups as follows:

- 14 trees in a new median island on Kimmage Road Lower at the junction with Corrib Road.
- 27 new trees in Kimmage Village centre at the junction of Kimmage Road Lower and Sundrive Road.
- 14 new trees at junctions on Kimmage Road Lower at Mount Argus.
- 20 new trees on Harold’s Cross Road.
- 14 new trees on Clanbrassil Street Lower to fill in gaps in the existing planting along the street.

- A few other new trees at various locations where possible.
- In total 117 new street trees will be planted along the proposed scheme.

Table 14-1 summarises the numbers of trees that will be retained, removed and newly planted with an overall total increase of 100 trees to double the total number of trees along the route to 198 number.

Table 14-1 Summary of trees protected, lost and planted as part of the Bus Connects Route.

Retained Trees	Removed Trees	Proposed Trees	Total Trees in Proposed Scheme
Street trees retained in development	Total identified tree numbers to be removed	Street trees to be planted	
81	**-17**	**117**	**198**

14.5.3 Planting Strategy

It has been developed according to of the Dublin City Tree Strategy and the Dublin Biodiversity Action Plan. To have an influence on the local environment to improve air quality; stormwater runoff; health and well-being; and habitat provision.

- Green corridors and new green areas have been kept and enhanced to promote biodiversity in urban areas.
- Street trees are proposed throughout in agreement with recommendations of the Dublin City Tree Strategy.
- Support for the role of SuDS opportunities within the Proposed Scheme in coordination with the drainage engineers. (Refer the Drainage, Hydrology and Flood Risk section of this report). New street trees will be planted in pits linked to the road drainage system for irrigation and flood mitigation.
- The biodiversity 10-20-30 rule (no more than 10% of any one species, 20% of any one genus, or 30% of any family) to reduce the risk of catastrophic tree loss due to pests was taken into consideration for the selected tree palette outside the Quays where like-for-like use of Lime-trees prevailed.

14.5.4 Typical Planting Typologies

Several typologies were implemented to address the issues discussed before.

- **New Street Trees** - Medium to large canopy trees planted in large urban tree pit systems to allow for protection of the soil structure and good root development.

Figure 14-1 Examples of existing street trees on Clanbrassil Street Lower and New Street South

- **Ornamental Planting -** Small landscape interventions at local community spaces provide opportunities for a combination of street trees, seating, and more formal planting arrangements. These exist at certain intervals (example bellow) and are often picked up as 'Hot Spots'.

Figure 14-2 Example of a minor public space at St. Patrick's Court where new trees are proposed

14.6 Proposed Urban Realm Design

The landscaping design proposal is presented on drawings in Appendix B5, and it includes the identification of relevant existing vegetation and paving surfaces to be retained and proposed paving types. These are stone, concrete, stone/concrete sett paving and self-binding gravel. As proposed vegetation there are trees and pockets of ornamental planting at a small number of locations that are the focus for public realm improvement. The design identifies where it is necessary to remove existing vegetation and trees. The notes include information for proposed tree species with reference to purchase dimensions.

The existing tree alignments and small residual green spaces are to be unified by being extended to gap areas, thus allowing for a more coherent design and better natural connectivity. The new enlarged pedestrian areas will feature new green ornamental planting and urban furniture while some areas will include also a more differentiated design with different paving materials.

As a preliminary plant listing of trees/shrubs the following can be considered (Native flower species and more trees to be found in annexes):

Table 14-2 Preliminary plant listing of trees/shrubs

Scientific name	Common names in English - Irish
Alnus glutinosa	Alder - Fearnóg
Arbutus unedo	Arbutus - Caithne
Betula pubescens / Betula pendula	Birch - Downy - Beith chlúmhach / Silver - Beith gheal
Corylus avellana	Hazel - Coll
Crataegus monogyna	Hawthorn - Sceach gheal
Cytisus scoparius	Broom - Giolcach sléibhe
Euonymous europaeus	Spindle - Feoras
Fraxinus excelsior	Ash - Fuinseóg

Scientific name	Common names in English - Irish
Hedera helix	Ivy - Eidhneán
Ilex aquifolium	Holly - Cuileann
Juniperus communis	Juniper - Aiteal
Lonicera periclymenum	Honeysuckle - Féithleann
Malus sylvestris	Crab Apple - Crann fia-úll
Pinus sylvestris	Scots Pine - Péine albanach
Populus tremula	Aspen - Crann creathach
Prunus avium	Wild Cherry or Gean - Crann silín fiáin
Prunus padus	Bird Cherry – Donnroisc
Prunus spinosa	Blackthorn - Draighean
Quercus petraea	Sessile Oak - Dair ghaelach
Quercus robur	Pedunculate Oak – Dair ghallda
Rhamnus cathartic	Buckthorn - Paide bréan
Rosa canina	Dog Rose - Feirdhris
Rubus fructicosus	Bramble - Dris
Salix spp	Willows - Saileach
Sambucus nigra	Elder - Tromán
Sorbus aucuparia	Rowan - Caorthann
Sorbus spp	Whitebeam - Fionncholl
Taxus baccata ‘fastigata	Irish yew
Tilia cordata	Small leaved lime
Ulex europaeus and Ulex gallii	Gorse - Aiteann
Ulmus glabra	Wych Elm - Leamhán sléibhe
Viburnum opulus	Guelder Rose - Caorchon

14.6.1 Kimmage Road Lower at Corrib Road

There is a local commercial centre at the junction of Kimmage Road Lower and Corrib Road near the southern end of the Proposed Scheme. The existing road carriageway is 13m wide, which is more than required for traffic purposes. It is proposed to improve the urban realm at this location by provision of a 2m wide medial island plated with 14 new street trees as shown in Figure 14-3.

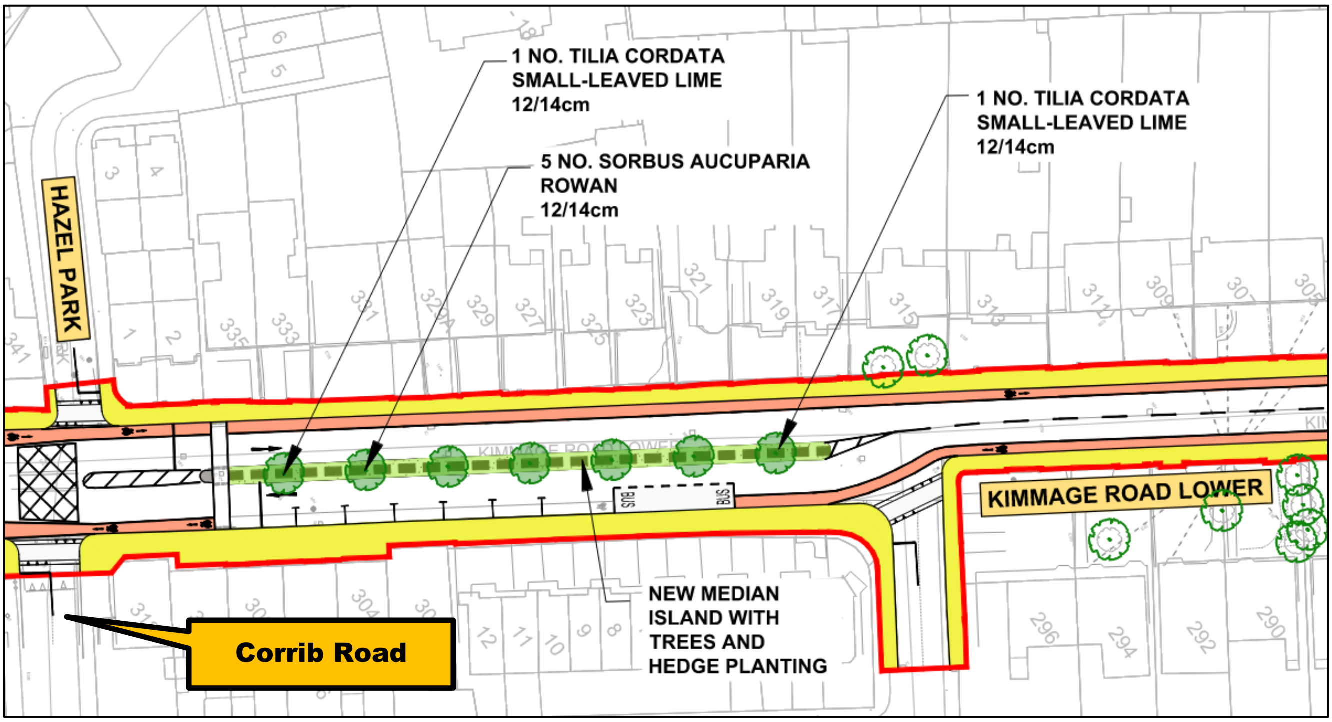


Figure 14-3 Proposed Urban Realm improvement on Kimmage Road Lower at Corrib Road (part of)

14.6.2 Kimmage Village at Sundrive Cross

This location at the junction of Kimmage Road Lower and Sundrive Road represents an opportunity to implement significant improvements to the village centre. There is a visual predominance of space dedicated to car parking south of the junction, but there are also extensive footpath areas available for improved public realm. The proposal provides high-quality public space around the focal point at the junction with small pocket green areas with benches, planters, and trees.

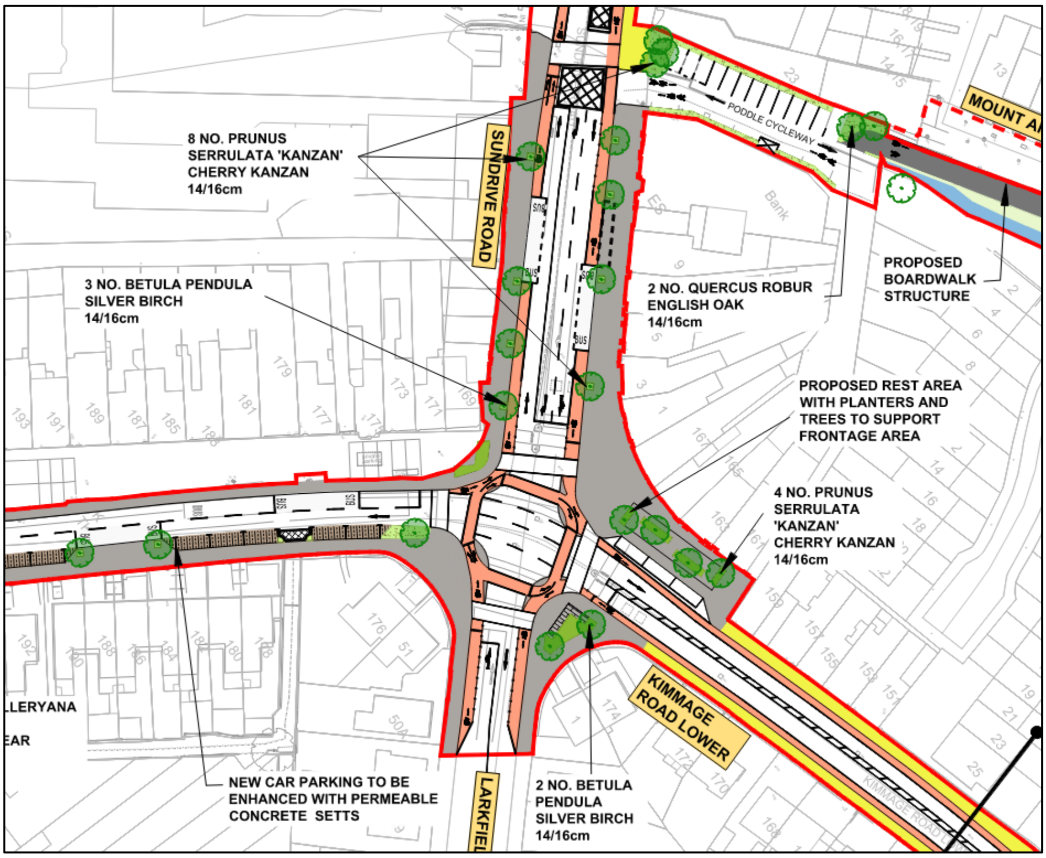


Figure 14-4 Proposed Urban Realm improvement at Sundrive Cross

14.6.3 St Patrick's Court

There is small public area on the western side of Clanbrassil Street Lower that will be upgraded to include ornamental planting and trees in the existing green areas as shown in Figure 4-15.

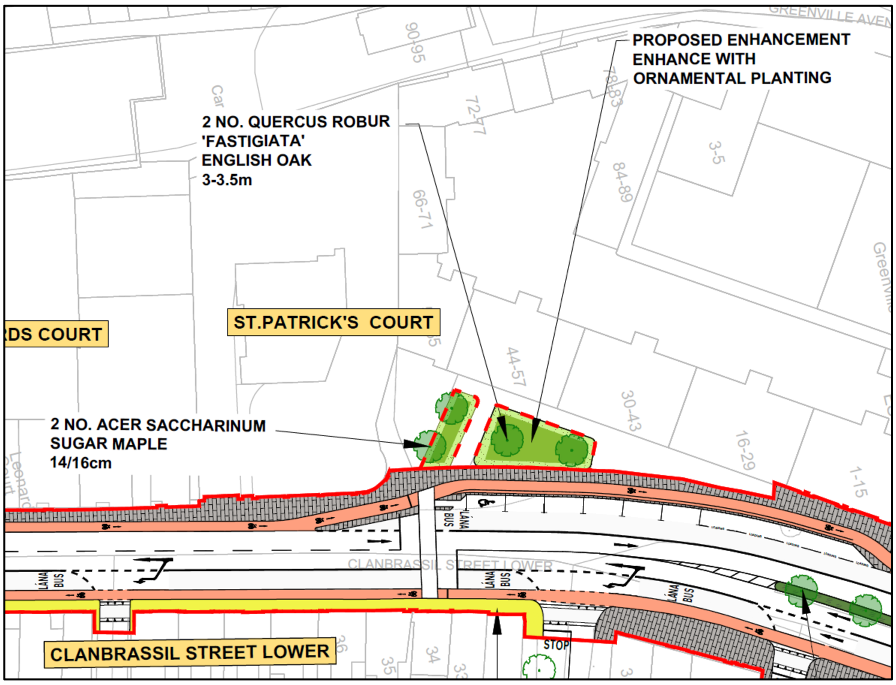


Figure 14-5 Proposed Landscaping improvement at St. Patrick's Court

15. How the Proposed Scheme Achieves the Objectives

This section sets out the manner in which the Proposed Scheme described will achieve the following Objectives:

1. 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;
2. Enhance the potential for cycling by providing safe infrastructure for cycling, segregated from general traffic wherever practicable;
3. Support the delivery of an efficient, low carbon and climate resilient public transport service, which supports the achievement of Ireland's emission reduction targets;
4. 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;
5. 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
6. 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 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 24% of the route inbound and 6.5% outbound, which are shared with cyclists and or part-time parking.

Issues related to frequency, reliability and a complex network have persisted for many years and will continue to do so without further intervention. There are a number of planned high frequency public bus services along the route which will be improved by the Proposed Scheme including the F1, F2. F3 and 85 bus routes, as well as multiple orbital routes including O, S2, S4 and 82. The Proposed Scheme interventions will seek to make 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 there are no mandatory cycle lanes or cycle tracks provided at present. Part-time advisory cycle lanes are provided on approximately 59% of the inbound route and 73% of the outbound route. The remaining extents have no dedicated cycle provision or cyclists must cycle within the bus lanes where provided, or within the general traffic lane.

The Proposed Scheme is implementing safe, segregated. infrastructure throughout 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 footpaths 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. A number of submissions were also received as part of the non-statutory consultation in which members of the public indicated specific locations where the existing provision is unsafe for pedestrians – many of which are proposed to be addressed by the Proposed Scheme.

Along with these interventions, the proposals include significant improvements to the pedestrian environment, both along links and at both signalised and priority junctions and crossings. 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 local authorities and stakeholders. The proposals have been developed alongside the other technical teams so that the preliminary landscape design is integrated into the overall Proposed Scheme design.

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, 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.