MONAHAN ROAD EXTENSION

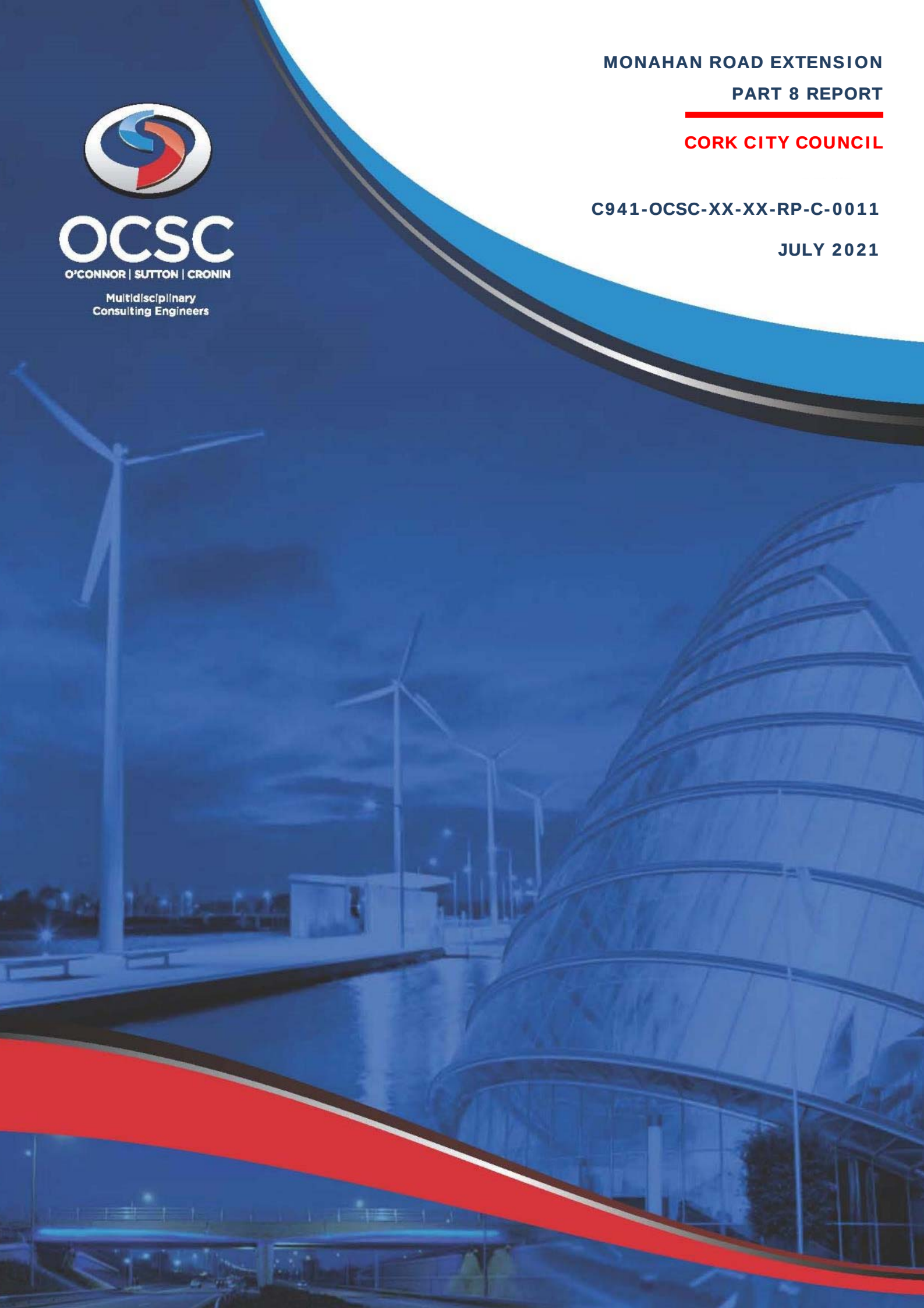
PART 8 REPORT

CORK CITY COUNCIL

C941-OCSC-XX-XX-RP-C-0011

JULY 2021

OCSC
O'CONNOR | SUTTON | CRONIN
Multidisciplinary
Consulting Engineers



MONAHAN ROAD EXTENSION

PART 8 REPORT

CORK CITY COUNCIL

C941-OCSC-XX-XX-RP-C-0011

JULY 2021

Monahan Road Extension

Part 8 Report

NOTICE

DOCUMENT CONTROL & HISTORY

OCSC Job No.:	Project Code	Originator	Zone Volume	Level	File Type	Role Type	Number	Status / Suitability Code	Revision
C941	C941	OCSC	XX	XX	RP	C	0011	A1	C03

Rev.	Status	Authors	Checked	Authorised	Issue Date
C03	A1	J. Mendoza	N. McMenamin	B. O'Rourke	07/07/2021
C02	A1	J. Mendoza	N. McMenamin	B. O'Rourke	06/07/2021
C01	A1	J. Mendoza	N. McMenamin	B. O'Rourke	02/07/2021
P02	S3	J. Mendoza	N. McMenamin	B. O'Rourke	28/05/2021
P01	S3	J. Mendoza	N. McMenamin	B. O'Rourke	18/05/2021
Rev	**Suitability Code**	**Author**	**Checker**	**Authorised**	**Issue Date**

MONAHAN ROAD EXTENSION

PART 8 REPORT

CORK CITY COUNCIL

O'CONNOR SUTTON CRONIN & ASSOCIATES

MULTIDISCIPLINARY CONSULTING ENGINEERS

PROJECT NO. C941

CONTENTS

1. INTRODUCTION

O'Connor Sutton Cronin Multidisciplinary Consulting Engineers (OCSC) was commissioned by Cork City Council to develop a design for the completion of the Monahan Road Extension (MRE) project. The MRE comprises approximately 400m of new 4-lane two-way carriageway (2 eastbound and 2 westbound) with central reservation, verges, cycle tracks and footpaths.

The new roadway will begin on Monahan Road, at the existing junction with Marquee Road where a new cross-roads junction will be formed. From there, the MRE will extend eastwards and pass to the northwest of Páirc Uí Chaoimh. At the eastern end of the MRE, the road levels will be elevated above existing ground level to connect to the future Eastern Gateway Bridge over the River Lee estuary, while providing multi-modal access to adjoining lands in the interim.

This Part 8 Report sets out the objectives, design, and characteristics of the proposed alignment.

2. PROJECT DESCRIPTION

The extension of Monahan Road is one of the objectives of the Cork City Development Plan 2015-2021. The MRE will be one of the key arterial routes in the South Docks; it is proposed to extend the existing Monahan Road in a north easterly direction to provide access to the Cork South Docklands from Tivoli via the proposed Eastern Gateway Bridge, as shown in Figure 1.

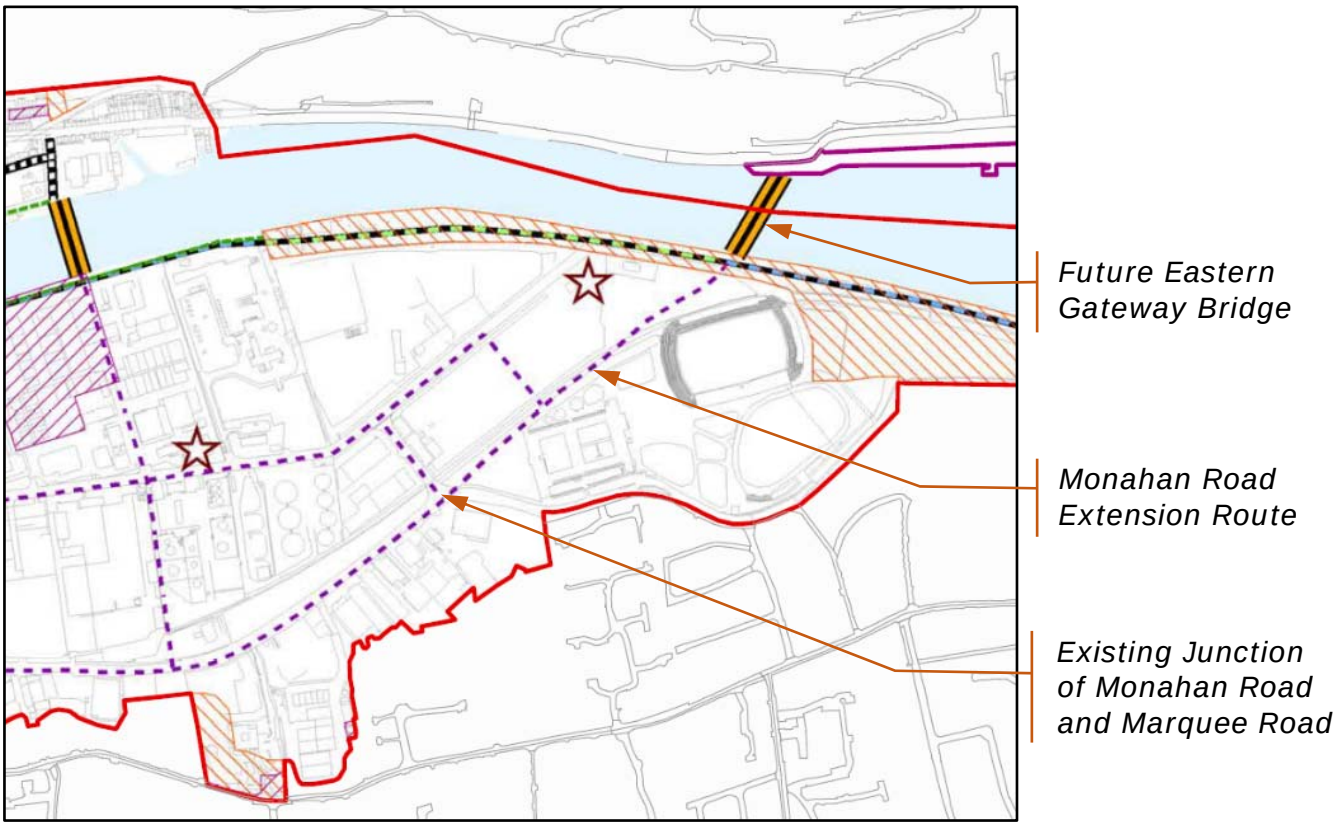


Figure 1: Extract from Cork City Development Plan 2015-2021

The route corridor for the MRE extends from the existing junction of Monahan Road and Marquee Road in a north-easterly direction between the former Ford site and Marina Park – see outline corridor in Figure 2 overleaf.

Figure 2: Monahan Road Extension Route Corridor

The scheme comprises 400m of new road (identified herein as the Monahan Road Extension), 180m realignment of Monahan Road (east of Marquee Road junction) and 30m realignment of Marquee Road (on approach to the new junction.

The realignment of Marquee Road is proposed to facilitate the new junction arrangement and allow for the vertical alignment tie-in of the existing Marquee Road with the proposed levels of Monahan Road Extension. The cross section of the realigned Marquee Road will match the existing, including the new separated cycle lane provided in 2020 under Section 38 works by Cork City Council.

The realignment of Monahan Road (east) is proposed to facilitate the new junction arrangement. The cross section of the realigned Monahan Road (east) will match existing, with the addition of 3m-wide footpaths both sides of the road.

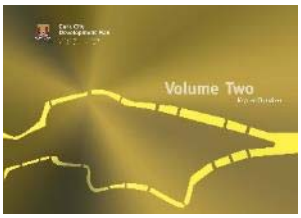
Figure 3: View of Proposed New Road

Further details of the proposed road scheme are presented in the Part 8 Drawings.

3. BACKGROUND & PURPOSE

Background

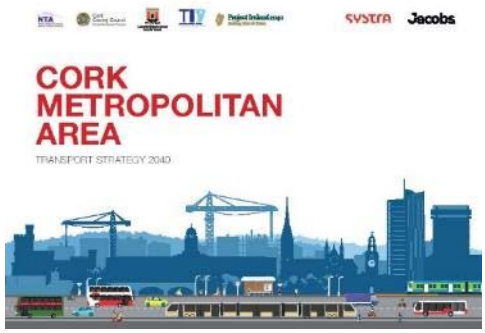
The Cork Area Strategic Plan (CASP) 2001-2020 establishes the policy framework for land use and transportation in the Cork region. A significant component of this plan is the promotion of redevelopment in the Docklands to achieve employment and population growth.



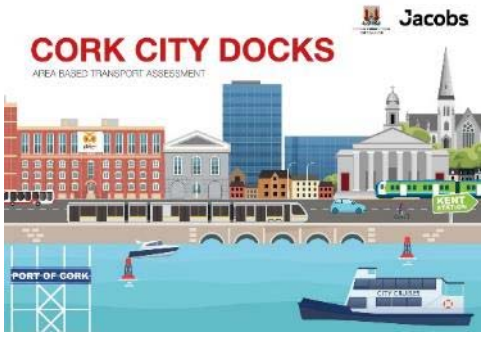
The Cork City Development Plan 2015-2021 identifies the Docklands as one of the Key Development Areas where most growth and development is expected to occur.

Cork City Council developed and published the Docklands Public Realm Strategy 2011, which included the south docklands area up to Monahan Road and Marina Park. The Strategy shows the Monahan Road Extension as an approach to the Eastern Gateway Bridge, with a tree-lined central median for part of the length. Further detail of the public realm requirements for Monahan Road Extension is provided by the Cork Docklands Draft Area Based Transport Assessment (ABTA).

The Cork Metropolitan Area Transport Strategy 2040 (CMATS), which was developed by the National Transport Authority (NTA) in collaboration with Transport Infrastructure Ireland (TII), Cork City Council (CCC) and Cork County Council, sets out a framework for the delivery of transport infrastructure and services in the Cork Metropolitan Area. The CMATS identifies the Eastern Gateway Bridge as providing a key multi-modal access to the South Docks from the strategic road corridors located north of the River Lee.



The Cork Docklands Draft Area Based Transport Assessment (ABTA) was prepared to assist in the process of producing a new City Docks Local Area Plan. The ABTA makes recommendations for transport management of the Area, including key new infrastructure.



Purpose

The overall purpose of the scheme is to provide key transport infrastructure to permit the wider development of the South Docks area, in accordance with the aforementioned documents.

The MRE will be one of the key arterial routes in the South Docks; by connecting Monahan Road with the future Eastern Gateway Bridge, the MRE will provide access to the Cork South Docklands from strategic road infrastructure north of the River Lee. More immediately, the MRE will provide access to Strategic Housing Development on the former Ford site.

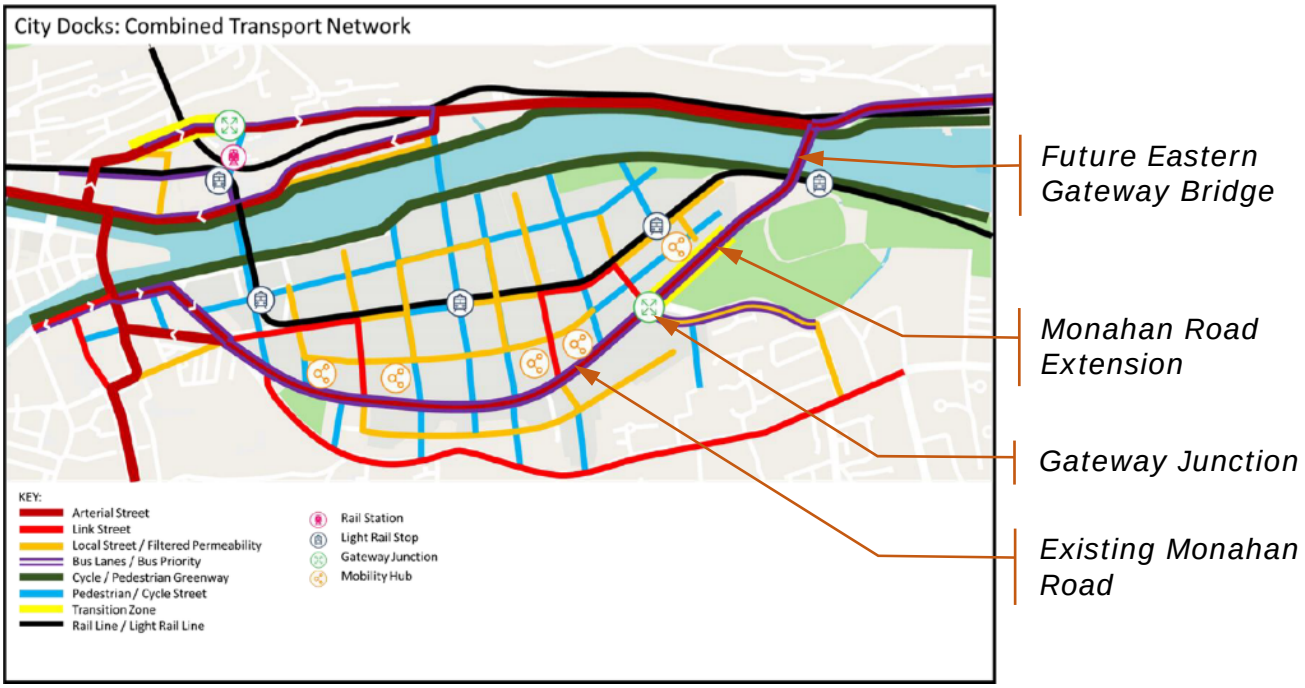


Figure 4: Extract from Cork City Docks ABTA

The MRE is the first of a wider suite of essential infrastructure to be provided in parallel with the ongoing implementation of the ABTA. These later infrastructural elements will be brought forward in future years, as the population (both working and residential) of the Docklands gradually increases. These include the upgrade of Monahan Road to the west of the MRE scheme and the provision of the Eastern Gateway Bridge to the east of the MRE scheme. Together, these three elements form a route that is identified in the Cork Docklands Draft Area-Based Transport Assessment (ABTA) as an Arterial Street; a Primary Pedestrian and Cycle link; and a Bus lane/priority route.

4. NEED FOR THE SCHEME

Identification of Need

The Cork Docklands is a significant brown field redevelopment zone adjacent to Cork City Centre. In general terms, the area is transitioning from light industrial uses to office and residential type developments. The MRE Scheme aims to improve accessibility to the South Docklands and the City Centre while at the same time providing a high-quality public realm in keeping with the ambitious redevelopment plans for the area.

Existing Conditions

The existing Monahan Road runs eastwards from the City Centre approximately along the original shoreline of the Lee Estuary. Marquee Road runs southwards from Centre Park Road to form a priority junction with Monahan Road.

West of the junction, Monahan Road provides a carriageway of approximately 9.0m (kerb-to-kerb) with a c1.6m-wide footpath on the northern side only. Since the implementation of Section 38 works by Cork City Council in 2020, the road provides a west-bound on-road cycle lane c1.4m-wide with flexible bollards providing separation from the traffic lanes.

East of the junction, Monahan Road provides a carriageway of approximately 7.6m (kerb-to-kerb) with c1.8m-wide footpaths on both sides of the road. As part of the development of Marina Park, Phase 1 works (completion imminent) include the removal of the footpath on the northern side and provision of a new footpath running parallel with the road approximately 5m from the existing kerbline.

North of the junction, Marquee Road provides a carriageway of approximately c7.9m (kerb-to-kerb) with c2.0m-wide footpaths on both sides of the road and c1.2m-wide verges on both sides of the road. Since the implementation of Section 38 works by Cork City Council in 2020, the

road provides a south-bound on-road cycle lane c1.6m-wide with flexible bollards providing separation from the traffic lanes.

The junction of Monahan Road and Marquee Road is in a priority junction arrangement with painted splitter island for southbound traffic on Marquee Road. Junction radii are 26m and 53m; this facilitates high speed transit through the junction. On approach to the junction, the southbound cycle lane on Marquee Road splits for left/right turning cyclists and an Advanced Stacking Location (ASL) for right-turning cyclists.

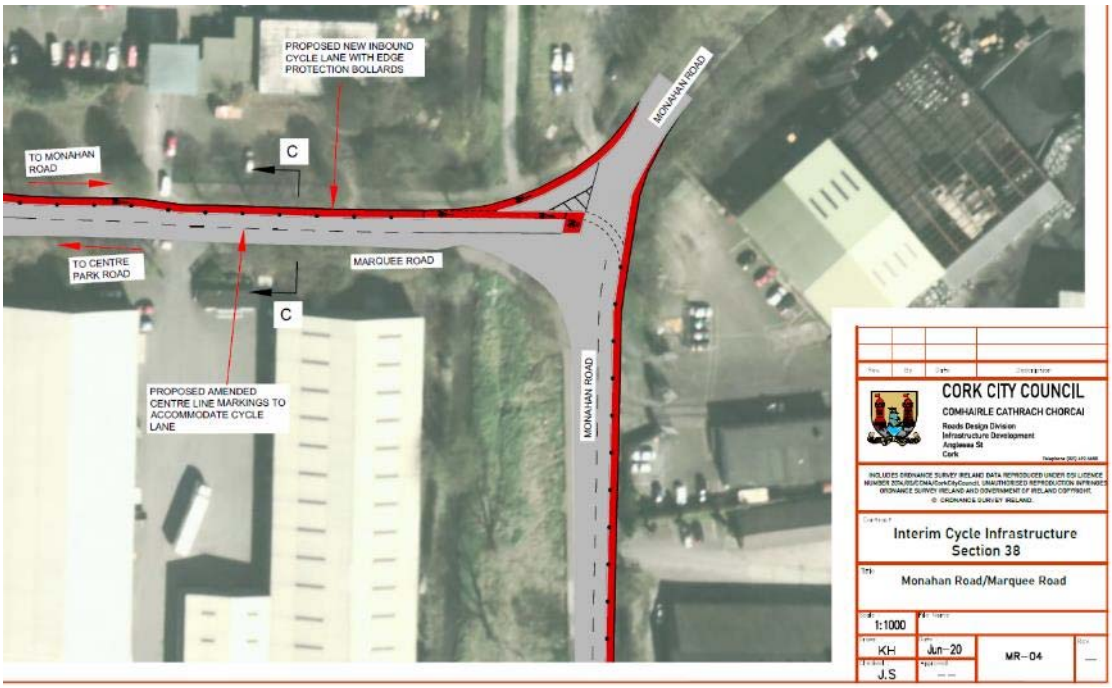


Figure 5: Extract from Cork City's Section 38 works drawing

5. OBJECTIVES OF THE SCHEME

Planning Objectives

Cork City Development Plan 2015-2021 sets out a number of objectives, under different headings that allude to the need for and objectives of the MRE. These needs and objectives are reiterated in the Cork City Docks ABTA.

It is stated in the Cork Metropolitan Area Transport Strategy 2040 (CMATS) that Monahan Road is one of the key roads within the South Docklands. The MRE road will need to be built to accommodate increased demand by public transport, walking and cycling. Bus lanes are proposed for the MRE.

The key objectives of the project include:

- Provide key transport infrastructure that will act as the catalyst for the early development of the adjoining lands within the Docklands area;
- Provide the first element in the Eastern Gateway Scheme link between the local South Docks districts, the other urban districts, and the strategic road network;
- Deliver facilities for all road users but with particular benefits for bus users, cyclists & pedestrians.

6. COLLISION HISTORY

OCSC interrogated the Road Safety Authority (RSA) website https://www.rsa.ie/en/RSA/Road-Safety/RSA-Statistics/ in order to ascertain the number, location, date, and severity of collisions in the area in recent years. The site provides details of all accidents by year between 2005 and 2016 (latest available statistics). Collisions/accidents are categorised by severity i.e. fatal, serious, and minor. The statistics also identify what the collision type was i.e. vehicle only, pedestrian, cyclist/motorcyclist etc. In that regard the dataset provides a host of information that can be used to identify the requirements for, and potential benefits of, any road upgrade. Figure 6 shows an extract from the dataset for the MRE environs.

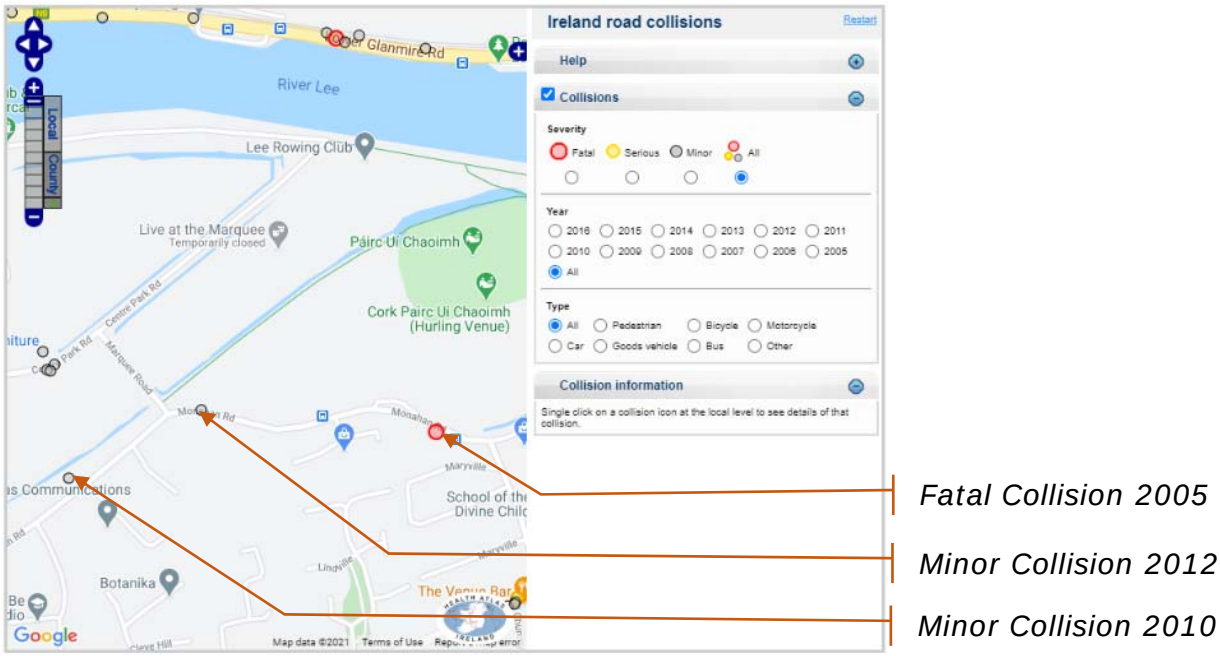


Figure 6: Extract RSA Collision Data

OCSC collated the raw collision data into a table in order to assist in the assessment of same. This is shown in Table 1 over. The table summarises only those recorded accidents which took place along the existing Monahan Road and Marquee Road within the environs of the MRE scheme.

RSA Collision History				
Year	**Fatal**	**Serious**	**Minor**	**Total**
2005	1	0	0	1
2006	0	0	0	0
2007	0	0	0	0
2008	0	0	0	0
2009	0	0	0	0
2010	0	0	1	1
2011	0	0	0	0
2012	0	0	1	1
2013	0	0	0	0
2014	0	0	0	0
2015	0	0	0	0
2016	0	0	0	0
Total	**1**	**0**	**2**	**3**

Table 1: RSA Collision Data MRE Study Area

The dataset shows only one accident (Minor Collision 2012) within the site extents of the MRE scheme; on Monahan Road to the east of the junction with Marquee Road. The collision occurred between the hours of 1900 and 2300 on a Wednesday and involved a car; the circumstances of the collision are described as "other".

The Monahan Road Extension is a new road; the collision history dataset is not directly applicable to the new road. The scheme also involves a realignment of Monahan Road (east) on approach to the new junction; this realigned road has been designed with horizontal and vertical geometry, sightlines and stopping sight distances in accordance with the Design Manual for Urban Roads and Streets (DMURS).

7. OPTIONS CONSIDERED

Do Nothing and Do Minimum options were dismissed as not fulfilling the objectives of the City Development Plan; not achieving implementation of the Draft Docklands ABTA recommendations; and not meeting the needs of the local community, be it in terms of accident or congestion reduction, economic development or providing for the proper planning and development of the area. The Do Nothing option means maintaining the status quo. Thus, part of the infrastructure strategy of the CMATS and the ABTA would not be realised. Future development of the South Docklands and the City as a whole would be constrained. The Do Minimum has the same general outcomes.

As can be seen in Figure 7, the route corridor for the MRE is relatively narrow; therefore, options for the route of the MRE are not available. However, options for the vertical and horizontal alignment of the MRE were considered (discussed later in this section). Furthermore, three options for the route of the realigned Monahan Road (east) were assessed and considered.

Figure 7: Monahan Road Extension Route Corridor

Vertical Alignment Options

Existing ground levels over the extent of Monahan's Road Extension vary between 0.5m OD and 1.3m OD. While existing ground levels along the route of the MRE were a consideration, the following locations represented key constraints on proposed road levels:

1. Tie-in to the existing Monahan Road at the western end of the MRE
2. Junction with Marquee Road and Monahan Road (east)
3. Entrance to Marina Park
4. Entrance road to Strategic Housing Development on former Ford site
5. Entrance footpath to Strategic Housing Development on former Ford site
6. Interface with existing Páirc Uí Chaoimh carpark
7. Future Eastern Gateway Bridge at the eastern end of the MRE

OCSC developed five options for the vertical alignment of the MRE through the introduction of these constraints and achieving appropriate gradients and vertical curvature compliant with the requirements of the Design Manual for Urban Roads and Streets (DMURS). Vertical alignment Option 5 was selected as preferred option within the constraints and satisfying design parameters.

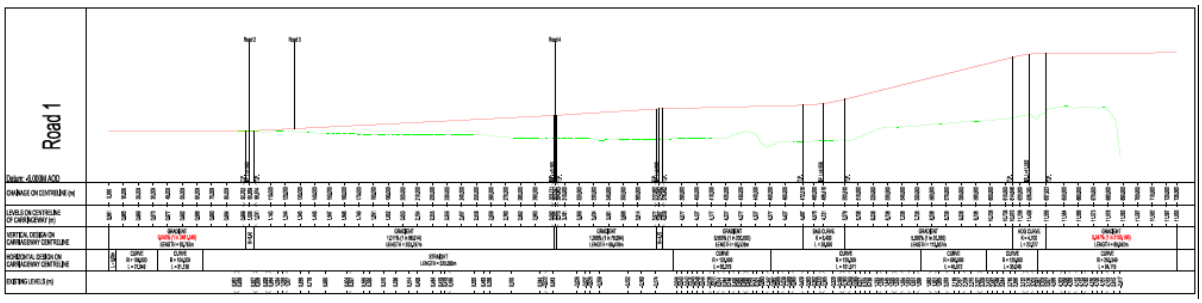


Figure 8: Vertical Alignment Option 5

Horizontal Alignment Options

Consideration of options for the horizontal alignment of the MRE related to the negotiation of the land ownership constraints between the former Ford site and Páirc Uí Chaoimh and the desire to achieve a suitable horizontal curvature for traffic travelling south from the future Eastern Gateway Bridge. Factors influencing design included interaction with development

proposals, interface with the existing Páirc Uí Chaoimh carpark and embankment design. The termination point of the proposed scheme at approximately CH0+400 allows viable options for future continuation of the MRE north-eastwards to the Eastern Gateway Bridge.

Options for Realignment of Monahan Road (east)

The proposed addition of the new MRE road to the existing junction of Monahan Road and Marquee Road creates a four-arm junction. This junction is identified in the ABTA as being a Gateway Junction. The new junction necessitates the realignment of Monahan Road (east) on approach to the junction. Three options were considered for the alignment of Monahan Road (east) – see *Figure 9*.

Figure 9: Monahan Road (east) alignment Options A, B and C.

Option A: With consideration to the extent of publicly owned land at this location, this option results in a stagger of 30m between Marquee Road and Monahan Road (east) and a skew of 30° on the approach of Monahan Road (east).

Option B: Realigning Monahan Road (east) with a 'small' incursion into the Sutton Coal Yard site, this option aligns Marquee Road and Monahan Road (east) with a skew of 30° on the approach of both roads.

Option C: Realigning Monahan Road (east) with a 'large' incursion into the Sutton Coal Yard site, this option aligns Marquee Road and Monahan Road (east) with no skew on the approach of both roads.

These options were presented to Cork City Council and Option B was selected as the preferred option, as it achieves the required junction configuration, minimises the impact on the site and provides a good connection with the adjoining Marina Park.

8. LAND ACQUISITION

The land within Sutton Coal Yard site required for realisation of Option B will need to be acquired from the landowner to complete the project. The extent of the land acquisition required is shown in Figure 10.

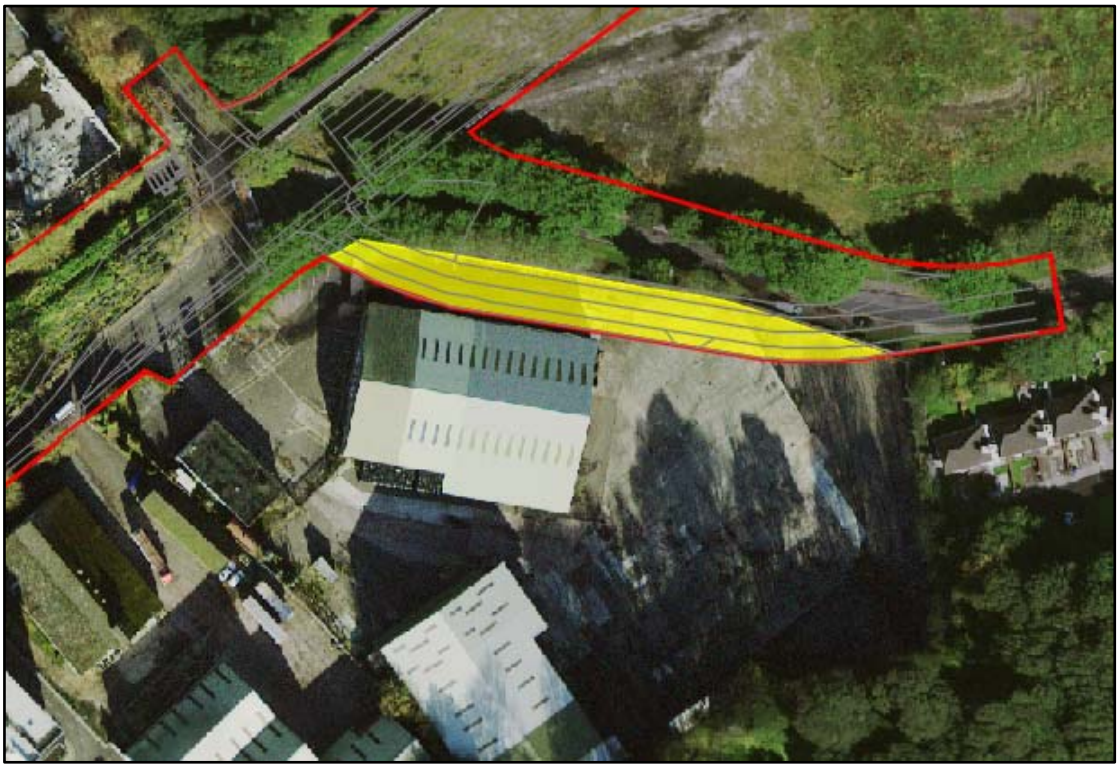


Figure 10: Yellow hatch area shows the extent of land acquisition required from Sutton Coal Yard site

9. CONSTRAINTS

The following constraints were considered in the preliminary design process:

- Available Mapping & Photography;
- Extents of Study Area;
- Land Ownership;
- Granted & Pending Planning Permissions;
- Archaeology;
- Ecology;
- Topography;
- Soils & Geology;
- Site Investigation;
- Traffic;
- Flood risk management and drainage.

In addition to the above headline items, regard was had to the existing built environment along with various objectives of the Cork City Development Plan 2015-2021 as reiterated in the Cork City Docks ABTA.

10. GEOMETRY & DESIGN STANDARDS

Design Standards

The MRE is located to the south and east of South Docks. As a safety improvement, junction improvement and traffic management scheme within an urban area, the scheme has 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. The current speed limit along the Monahan Road is 50 kph where the proposed MRE links to the existing road and the proposed speed limit along the MRE is taken herein as being the same.

The design philosophy adopted for the scheme applies a balanced and integrated approach to street design by applying, as far as possible, the four design principles of DMURS i.e. connected networks; multi-functional streets; pedestrian focus; and multidisciplinary approach. Where DMURS contains insufficient design guidance, alternative guidance documents are used, e.g. for drainage design, the South Docks Drainage Strategy has been used as the standard.

Road Classification

In accordance with the Cork City Docks ABTA, the MRE will be designed as an Arterial Street will facilitate the development of zoned lands. The new route aims to connect the southeast of the city with the strategic road network north of the River Lee.

The route will serve as a public transport route, cater for private vehicular traffic, and will include facilities for cyclists and pedestrians throughout its length. The MRE is therefore being classified in accordance with Table 3.1 of DMURS as an Arterial Route. Table 3.1 of DMURS is replicated over as Table 2.

DMURS Description	Roads Act/NRA DMRB	Traffic Management Guidelines	National Cycle Manual
Arterial	National	Primary Distributor Roads	Distributor
Link	Regional[1]	District Distributor Local Collector[1&2]	Local Collector
Local	Local	Access	Access

Notes:

Note 1: Larger Regional/District Distributors may fall into the category of *Arterial* where they are the main links between major centres (i.e. towns) or have an orbital function.

Note 2: Local Distributors may fall into the category of *Local* street where they are relatively short in length and simply link a neighbourhood to the broader street network.

Table 2: Table 3.1 DMURS, Terminology

Road Design Speed

The proposed MRE will have a Design Speed of 50 kph. This Design Speed is in compliance with Table 4.1 of DMURS which is replicated as *Table 3* below.

		Pedestrian Priority		Vehicle Priority		
Function	Arterial	30-40 kph	40-50 kph	40-50 kph	50-60 kph	60-80 kph
	Link	30 kph	30-50 kph	30-50 kph	50-60 kph	60-80 kph
	Local	10-30 kph	10-30 kph	10-30 kph	30-50 kph	60 kph
		Centre	Neighbourhood	Suburban	Business/ Industrial	Rural
				Context		

Table 3: Replica DMURS Table 4.1, Design Speed

Road Cross Section

The Cork City Docks ABTA establishes the typical cross section configuration for the extension and future upgrade of Monahan Road – see Figure 11. In addition, the ABTA establishes the typical cross section configuration for the Eastern Gateway Bridge – see Figure 12; this is a reduced-width version of Monahan Road, recognising the constraints inherent in bridge structures.

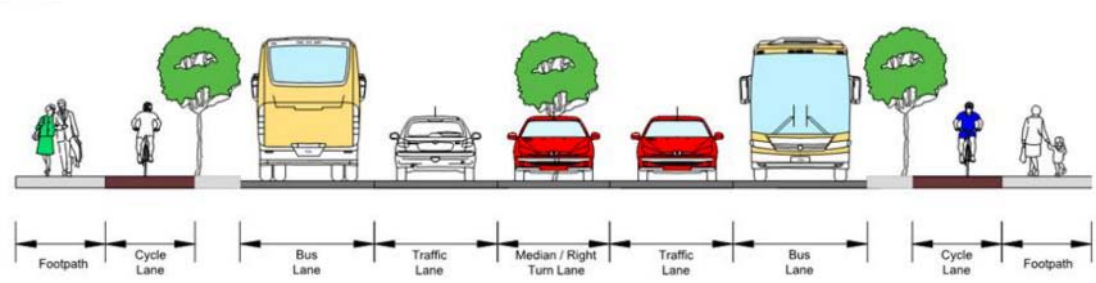


Figure 11: ABTA Cross Section for Monahan Road

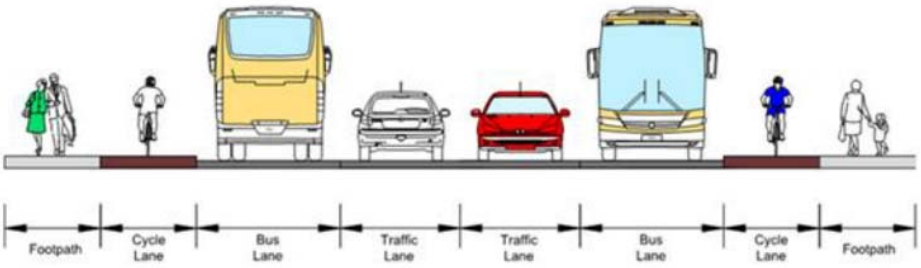


Figure 12: ABTA Cross Section for Eastern Gateway Bridge

The future continuation of the MRE north-eastwards to the Eastern Gateway Bridge will be constrained by land ownership on both sides of the road. In addition, as it serves as an approach to the Eastern Gateway Bridge, the proposed road levels of the future MRE will rise significantly above existing ground levels; this elevated part of the road is necessarily on a tall embankment or structure. Furthermore, east of the Strategic Housing Development on the former Ford site, the MRE will provide no access to adjacent lands, due to the necessary elevational difference. For these reasons, it is appropriate for the cross section to transition from the ABTA Monahan Road cross section to the Eastern Gateway Bridge cross section.

While ABTA establishes the cross-section configuration, the selection of cross section dimensions is left to the designer, with reference to DMURS. The dimensions of the traffic and bus lanes will be the same for both cross section configurations.

With reference to DMURS Section 4.4.1, the carriageway lane widths were selected from Figure 4.55 of DMURS, which is replicated below as Figure 13, for a multi lane Arterial street, including bus lanes. The bus lanes will be 3.25m wide and the traffic lanes will be 3.0m wide. The central median and right-turning lane will be 2.8m wide.

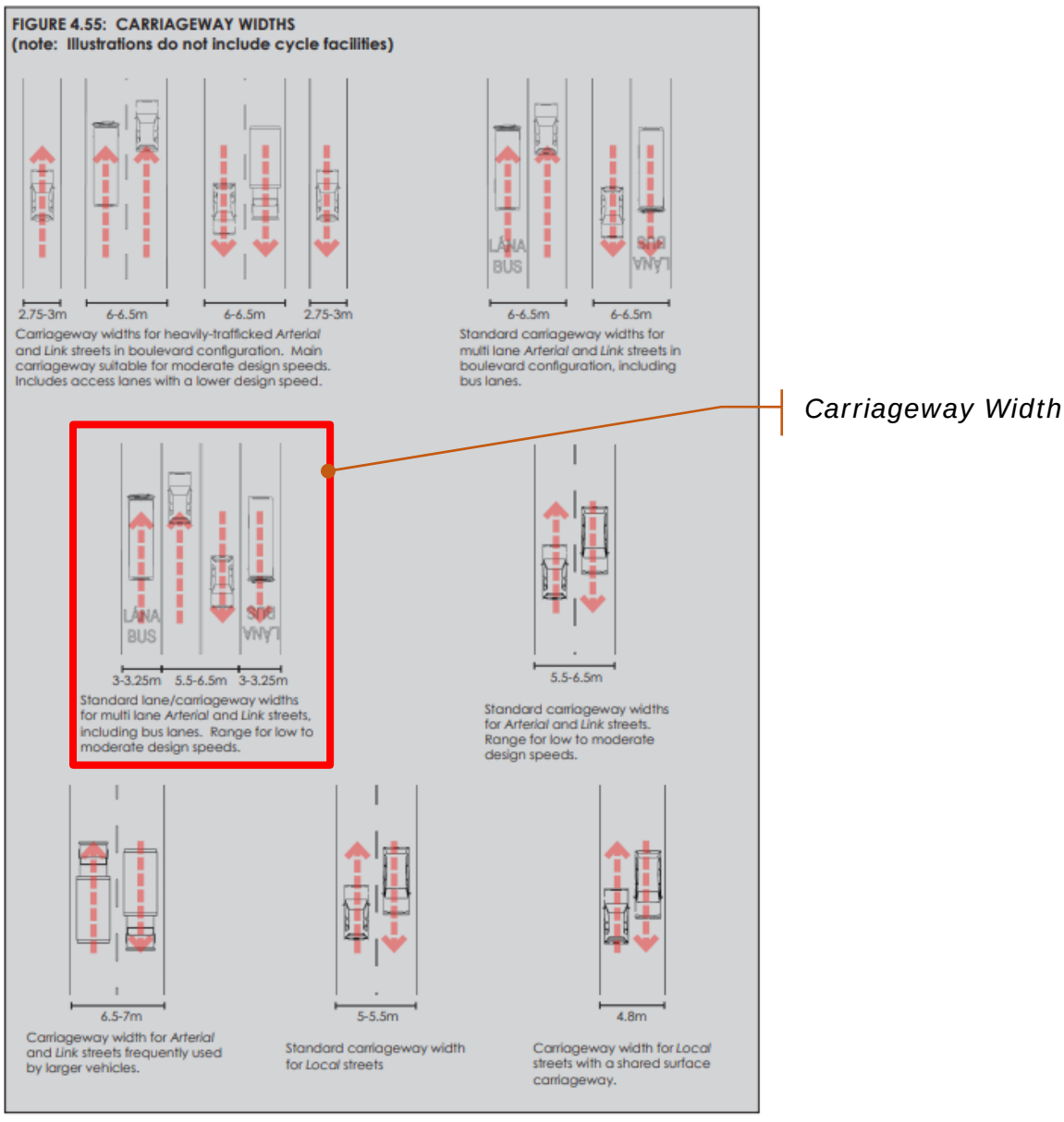
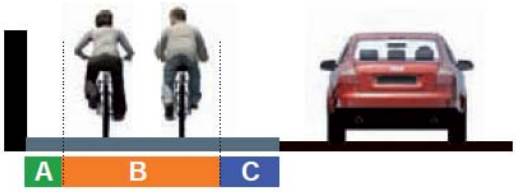


Figure 13: DMURS Carriageway Widths

The width of the footpaths is determined by reference to DMURS Section 4.3.1. Where the road is adjacent to the Marina Park and the Strategic Housing Development on the former Ford site, a footpath width of 3.25m will be provided. On approach to the Eastern Gateway Bridge, where the absence of interaction with adjacent land will lead to reduced activity, a footpath width of 2.5m will be provided.

The width of cycle facilities was determined in accordance with the recommendations of the National Cycle Manual.



A Inside Edge		B Cycling Regime		C Outside Edge		D Additional Features	
Kerb	0.25m	Single File	0.75m	30kph, 3.0m wide lane	0.50m	Uphill	0.25m
						Sharp bends	0.25m
Channel Gully	0.25m	Single File + Overtaking, Partially using next lane	1.25m	50kph, 3.0m wide lane	0.75m	Cyclist stacking, Stopping and starting	0.50m
Wall, Fence or Crash Barrier	0.65m	Basic Two-Way	1.75m	Raised kerb, dropped Kerb or physical barrier	0.50m	Around primary schools, Interchanges, or for larger tourist bikes	0.25m
Poles or Bollards	0.50m	Single File + Overtaking, Partially using next lane	2.00m	Kerb to vegetation etc. (ie. cycleway)	0.25m	Taxi ranks, loading, line of parked cars	1.00m (min 0.8m)
		2 Abreast + overtaking (tracks and cycleways)	2.50m			Turning pocket cyclists	0.50m

Figure 14: National Cycle Manual Width Calculator

The typical cross section configuration for the MRE provides an off-road cycle track between the footpath and the verge. The width of the cycle track is therefore determined on the following basis:

A- Inside Edge:	Kerb	0.25m
B- Cycling Regime:	Single File + Overtaking	1.25m
C- Outside Edge:	Kerb to vegetation	0.25m
Minimum Required:		1.75m
Proposed Width:		2.00m

On approach to junctions, the MRE provides an on-road mandatory cycle lane between the kerb and the bus lane. The width of the cycle lane is therefore determined on the following basis:

A- Inside Edge:	Kerb	0.25m
B- Cycling Regime:	Single File	0.75m
C- Outside Edge:	50kph 3.0m wide lane	0.75m
Minimum Required:		1.75m
Proposed Width:		2.00m

On approach to the Eastern Gateway Bridge, the MRE provides an off-road cycle track between the footpath and carriageway. The width of the cycle track is therefore determined on the following basis:

A- Inside Edge:	Kerb	0.25m
B- Cycling Regime:	Single File + Overtaking	1.25m
C- Outside Edge:	50kph 3.0m wide lane	0.75m
Total:		2.25m

In summary, two different cross-section configurations are proposed for the Monahan Road Extension, as described below:

- Cross Section Configuration 1 (from chainage 0+062 to 0+385) is 27.8m wide, distributed as follows:
  - Footpaths – 3.25m width, both sides of the road
  - Verge – 1.00m width, both sides of the road
  - Cycle Track/Lane – 2.00m width, both sides of the road; off-road Cycle Track changes to on-road Cycle Lane on approach to junctions
  - Bus Lane – 3.25m width, both sides of the road

- Traffic Lane – 3.00m width, both sides of the road
- Median/Right-Turning Lane – 2.80m width, centre of the road; planted Median changes to Right-Turning Lane on approach to junctions

- Cross Section Configuration 2 (from chainage 0+385 to 0+400) is 22.0m wide, distributed as follows:
  - Footpaths – 2.50m width, both sides of the road
  - Cycle Track – 2.25m width, both sides of the road
  - Bus Lane – 3.25m width, both sides of the road
  - Traffic Lane – 3.00m width, both sides of the road

Figure 15: View of Proposed New Road (Cross Section Configuration 1)

From Chainage 0+000 to 0+062, there will be a transition between the proposed Cross Section Configuration 1 and the existing cross section of Monahan Road, which is approximately 9.0m wide.

Horizontal and Vertical Geometry

The alignment has been designed so that the various geometric elements, including horizontal and vertical curvature, super elevation and sight distance will have at least the minimum values consistent with the 50 kph design speed of the road. It is important that these geometric elements are not exceeded as this can lead to operating speeds greater than the intended design speed. This is as set out in Section 4.4.6 of DMURS. A standard carriageway cross fall of 2.5% will be adopted throughout with super elevation applied if necessary, noting that adverse camber is allowable under DMURS designs in accordance with Table 4.3. A cross fall of 2.5% will be used for footpaths and cycle facilities. Table 4.3 of DMURS is replicated as Table 4 hereunder.

Horizontal Curvature

Design Speed (kph)	10	20	30	40	50	60
Minimum Radius with adverse camber of 2.5%	-	11	26	56	104	178
Minimum Radius with superelevation of 2.5%	-	-	-	46	82	136

Vertical Curvature

Design Speed (kph)	10	20	30	40	50	60
Crest Curve K Value	N/A	N/A	N/A	2.6	4.7	8.2
Sag Curve K Value	N/A	N/A	2.3	4.1	6.4	9.2

Table 4: Proposed H & V Curvature

Junction Design

Junctions along the MRE will be designed as fully signalised junctions and will include controlled crossing facilities for pedestrians. In line with the design philosophy of DMURS, crossing facilities will be provided on all arms, kerb radii will be reduced thereby shortening crossing distances for cyclists and pedestrians and signal cycle times will minimise waiting times for pedestrians and cyclists.

In accordance with the recommendations of the National Cycle Manual, Box Turns ("Stay Left to Go Right") will be used to accommodate right-turning cyclists on Monahan Road Extension, due to the overall width of the MRE. Due to the narrower width of the minor roads (single lanes), direct right turns will be accommodated. As the existing Marquee Road includes a mandatory cycle lane, an Advanced Stacking Location (ASL) will be provided in front of the vehicular stop line on Marquee Road.

As the proposed junction providing access to the Strategic Housing Development on the former Ford site is a three-arm junction, provision of Box Turns is not appropriate for cyclists turning right from the MRE into the former Ford site. Instead, a Jug Turn with Push Button control of traffic signals will be provided.

The primary principle in the design of junctions along the route will be to provide junctions that are safe and consistent with existing layouts in order to present a uniformity of approach to drivers. The primary junction strategy objectives will be:

- To optimise road safety by ensuring adequate visibility and consistency;
- To function as traffic calming measures;
- To provide safe crossing facilities for pedestrians
- To provide safe crossing and turning facilities for cyclists;
- To provide an economic solution, so that the cost of implementing the design will be, to the maximum possible extent, offset by the economic benefits derived;
- To optimise road construction costs;
- To minimise environmental impacts, such as air pollution and engine noise, by minimising fuel consumption through reductions in the number of speed changes and the number of stop/starts required.

Visibility at signalised junctions, development of approach lanes and merging of lanes on exit arms are not specified in DMURS and as such the guidance outlined in UK DMRB TD50/04 as amended by TII DN-GEO03044 will be adopted as best practice.

Principle Geometric Parameters

The principal geometrics for the proposed MRE are set out below in Table 5.

Design Heading	Design Element	Requirement	Standards Ref.
Road Type	Road Type	Arterial Street	Table 3.1 DMURS/ NRA TD 9/07
	Design Standard	Urban	DMURS
Design Speed	Mandatory Speed Limit	50 kph	Table 4.1 DMURS
	Design Speed	50 kph	Table 4.1 DMURS
Sight Distance	Stopping Sight Distance	45 m	Table 4.2 DMURS
	Stopping Sight Distance on Bus Route	49 m	Table 4.2 DMURS
Horizontal Alignment	Road Camber	2.5%	DMURS 4.4.6
	Superelevation	2.5%	DMURS 4.4.6
	Min. R (no s/e)	104m	Table 4.3 DMURS
	Des. Min. R	82m	Table 4.3 DMURS
	1-step below Des. Min. R	56m	Table 4.3 DMURS
Vertical Alignment	Des. Min. K Crest	4.7	Table 4.3 DMURS
	Des. Min. K Sag	6.4	Table 4.3 DMURS
	1-step Below Des. Min. K	4.1	Table 4.3 DMURS
	Des. Max. Gradient	5%	DMURS 4.4.6
	Max. Gradient with Relaxation	8.3%	DMURS 4.4.6
	Min. Gradient	0.5%	DMURS 4.4.6
Cross-Section & Headroom	Cross-Section	3.00m traffic lane width	DMURS 4.4.1
		3.25m bus lane width	DMURS 4.4.1
		1.0m verge	DMURS 4.4.1
		2.00m/2.25m cycleway	DMURS 4.4.1
		3.25m/2.5m footpath	DMURS 4.4.1
Junctions	Arterial Street	Signalised: Yes	DMURS 4.4.3

Table 5: Principle Geometric Parameters

11. PUBLIC REALM & LANDSCAPE DESIGN

As the MRE will provide access to the future Eastern Gateway Bridge, which provides a new link between the South Docks and the strategic road infrastructure on the north bank of the Lee, the MRE will form a key gateway approach to the South Docklands area. Furthermore, the MRE comprises the northern perimeter of Marina Park Phase 1, a new urban park for South Docklands. The realignment of Monahan Road (east) creates new public realm space adjacent to the primary entrance to Marina Park Phase 1.

It is recognised that public realm design and interface with Marina Park are important aspects of Monahan Road Extension. To ensure these aspects are addressed in the proposed scheme, OKRA Landschapsarchitecten BV were appointed to advise on these crucial issues. OKRA is also lead designer for Cork City Council on Marina Park Phase 1.

Figure 16: View of Proposed New Road with Marina Park Phase 1

12. SITE INVESTIGATION

OCSC has prepared tender documents for a comprehensive site investigation of the MRE works. The scope of the works involved in this site investigation include:

1) Excavation of 4 no. slit trenches to an indicative depth of 1.5m below ground level.
2) Excavation of 19 no. trial pits 4m deep.
3) Excavation of 11 no. rotary core boreholes to an indicative depth of 25m (at least 3m into bedrock).
4) 19 no. plate load tests and 19 no. CBR tests to be carried out in the base of the trial pits.

The following assessment of the geology of the site and ground conditions has been inferred from available information. Information on the geology of this area has been obtained from maps and field guides published by the Geological Survey of Ireland (GSI).

Bedrock Geology

According to the Geologic Survey of Ireland (GSI) the bedrock beneath the study area is underlain predominantly by the Ballysteen Formation commonly characterised by dark muddy limestone and shale; and by the Cuskinny Member (Kinsale Formation) commonly characterised by flaser-bedded sandstone and mudstone.

Quaternary Geology

Mapping of the Quaternary geology performed by the GSI indicates that the study area is in urban quaternary sediments.

Geoenvironmental Lab Testing

Geoenvironmental laboratory testing including chemical testing for waste acceptance criteria will be carried out in accordance with Suite I, and in accordance with Rilta suite with LOI for waste soil classification. Testing for TPHCWG will be included.

13. DRAINAGE

Design Guidelines Overview

The development is required to adhere to Local Authority requirements i.e. the Cork City Development Plan 2015-2021 and the South Docks Drainage Strategy (SDDS). The new development must ensure that a comprehensive Sustainable Drainage System (SuDS) is incorporated into any design. Sustainable drainage systems (SuDS) aim to maximise the opportunities and benefits that can be secured from surface water management. Design should consider the four 'pillars' of SuDS: water quantity, water quality, amenity and biodiversity. In general terms, SuDS are designed to manage and use rainwater close to where it falls, on the surface and incorporating vegetation, to provide the greatest benefits.

Existing Site Drainage

An existing open watercourse that runs generally the full length of the MRE will be diverted through Marina Park as part of the Marina Park Phase 1 works (completion imminent). The watercourse will pass in culvert beneath the MRE close to the junction with Marquee Road and Monahan Road (east). The watercourse (in culvert) presents a suitable discharge point for surface water runoff from the MRE. As the MRE will result in substantial changes in ground level along the length of the road, new drainage infrastructure will be required to service the MRE.

South Docks Drainage Strategy

The South Docks Drainage Strategy (SDDS) states that, "in South Docklands, SuDS in the form of infiltration to ground, and attenuation to greenfield runoff are not considered appropriate. This is due to its situation as a polder in a tidal reach with an important aquitard preventing infiltration."

The SDDS provides a hierarchy of potentially suitable SuDS components for development within the docklands (as the MRE comprises roadways only, some of the listed components are not suitable):

1. Prevention

- Good site design to prevent runoff and pollution i.e. rainwater reuse / harvesting

2. Source control
    - Green roofs
    - Raingardens/bioretention that are lined and piped off to side to discharge to a conveyance feature. Not infiltrating into the ground.
    - Permeable pavements that are lined and piped off to discharge to a conveyance feature. Not infiltrating into the ground.
    - Filter drains
    - Filter strips
3. Conveyance
    - Swales/bioretention swales
    - Rills
4. Site control at downstream end
    - Attenuation basins or ponds

Surface Water Catchment

The proposed MRE is part of the Southern Catchment, as identified in the South Docklands Drainage Strategy (SDDS). This catchment drains eastwards via existing surface water drainage and open channels to Atlantic Pond in Marina Park.

Proposed Development Rainfall Runoff

In accordance with the requirements of the SDDS, runoff will be attenuated to 68l/s/ha. Attenuated runoff will be stored in bio-retention areas, including the sub-surface components of bio-retention areas. As the permissible runoff rate is 68l/s/ha, the volume of storage required will be relatively low.

Verge Bio-Retention Areas

It is proposed to utilise the verge along the length of the MRE to collect, treat and attenuate the surface water runoff at source. The verge will be designed to act as a series of individual bio-retention areas, allowing for the

gradient and change in level of the MRE – see reference image in Figure 17 and bio-retention area components shown in Figure 18.

Figure 17: Reference image for verge as SuDS device (extract from SDDS)

#

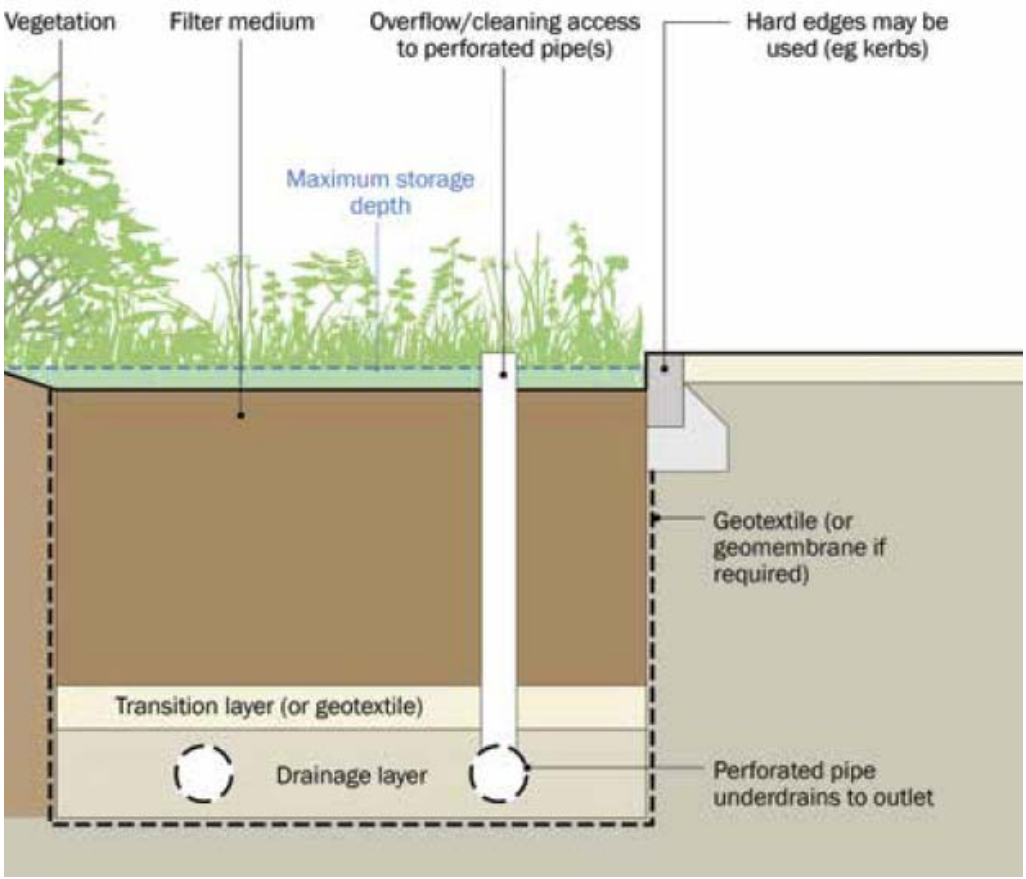


Figure 18: Components of a bio-retention system (extract from CIRIA C753 The SuDS Manual)

Kerb-Drainage

On approach to junctions, the proposed cycle track will transition to an on-road cycle lane. At these locations, it is proposed to collect surface water runoff using proprietary kerb-drains with high conveyance capacity – see example shown in Figure 19. This will minimise the presence of ironmongery in the cycle lane.

Figure 19: Example kerb-drain unit for (image from Marshalls)

Trapped Road Gullies

Surface water runoff from the realigned sections of Marquee Road and Monahan Road (east) will be collected in road gullies. In addition, road gullies will be provided to act as overflows from bio-retention areas. All road gullies will be trapped, with 150mm outlets, to help prevent sediment and gross pollutants from entering the surface water network, thus improving the water quality discharging from site. The grated covers are to have a minimum load classification of D400, for frequent vehicular traffic, and shall be lockable – see Figure 20 over.

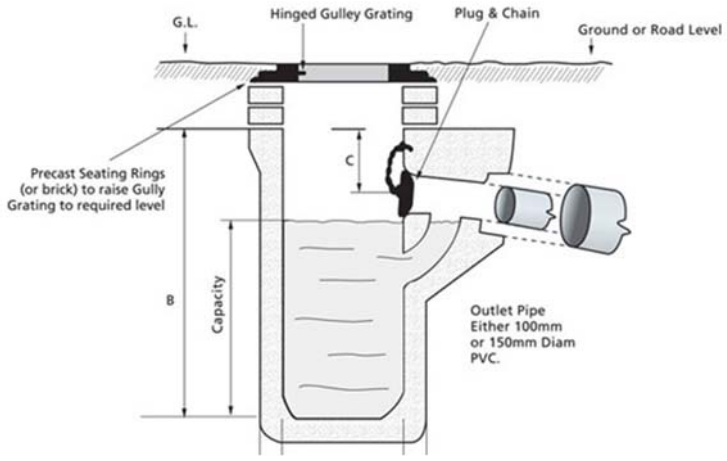


Figure 20: Trapped Road Gully (Typical Detail)

Flow Control Devices

In accordance with the requirements of the SDDS, runoff will be attenuated to 68l/s/ha through the use of flow control devices. While bio-retention areas inherently reduce runoff rates, flow control devices will be used prior to discharge to receiving watercourses to ensure that the surface water discharge form the MRE meets the required standard. Suitable flow control devices include orifice plates and vortex flow control devices (e.g. Hydro-Brake). Each flow control chamber is to be fitted with a penstock valve at the inlet and a bypass lever at the outlet (if required), to allow for easy access and maintenance.

Figure 21: Example vortex flow control device (Hydro-Brake by HRD)

Oil Separators

Oil separators are designed to separate gross amounts of oil and large (>250µm) suspended solids from the surface water, mainly through a sedimentation process. The proposed surface water network already provides bio-retention areas which are very effective in removing hydrocarbons. However, a Class 1 bypass fuel separator will be provided prior to surface water discharge to the receiving drainage system.

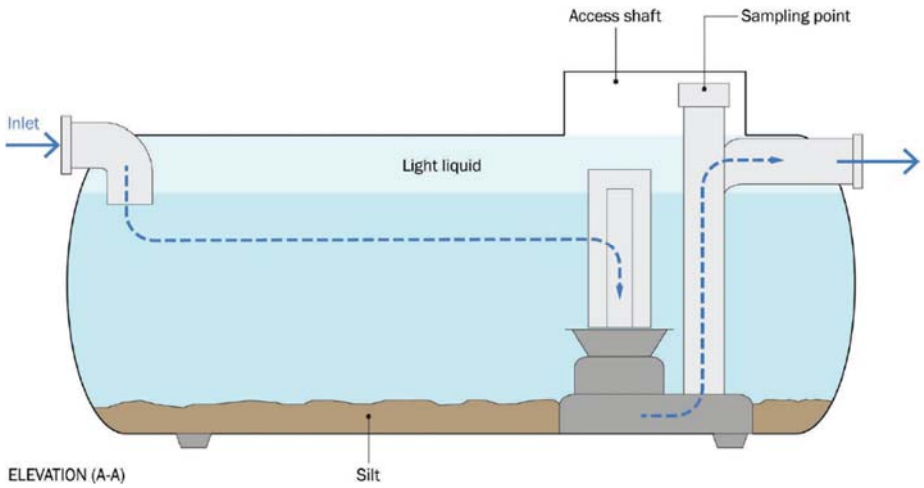


Figure 22: Typical Section Detail of Fuel Separator (CIRIA C753)

Design Software

The proposed surface water network will be designed in accordance with the requirements and guidelines outlined earlier, using MicroDrainage Network Design package, by Innovyze Inc., which simulates the performance of the integrated drainage network for varying rainfall return periods and storm durations. The MicroDrainage Network Design software applies the Flood Studies Report (FSR) methodology for analysis of rainfall profiles.

Climate Change

The proposed drainage system will be designed to allow for 40% increase in rainfall intensity to allow for Climate Change projections, in accordance with the requirements of the South Docks Drainage Strategy.

Surface Water Piped Network Design

As described earlier, the proposed surface water drainage system provides a SuDS solution utilising bio-retention areas for collection, treatment, and attenuation of surface water runoff. Piped components of the network will be designed in accordance with EN752, with minimum full-bore velocities of 1.0 m/s achieved throughout. All carrier pipes will be sized to ensure no surcharging for rainfall events up to, and including, the 1 in 5-year Average Recurrence Interval (ARI) event (20% Annual Exceedance Probability (AEP)) and no flooding for rainfall events up to, and including, the 1 in 100-year ARI event (3.3% AEP).

Where gravity pipe and manhole network will be provided, manholes are to be provided for maintenance access at branched connections, changes in pipe size and gradient, and at intervals no greater than 90m distance.

Maintenance

The proposed surface water drainage network is to be carefully designed to minimise risk of blockage throughout the network, through provisions that limit and restrict the size of pollutants entering the network, such as bio-retention areas and trapped road gullies.

Road gullies and flow control devices should be inspected regularly and maintained, as appropriate and in accordance with manufacturer's recommendations and guidelines. Items such as flow controls will be located so as to provide easy vehicular access for inspection and maintenance.

Parameter	Value
Annual Average Rainfall (AAR) Value	1046mm
Rainfall M5-60 Value	18.70mm
Rainfall M5-2D Value	70.9mm
Jenkinson's r	0.26
Impermeability Factor for paved areas	1.0
Time of Entry	4 minutes
Smallest pipe diameter to use for carriageway drainage	150mm
Roughness Coefficient	0.6
Minimum permissible velocity (self-cleansing velocity)	1.0 m/s
Maximum velocity	2.99 m/s
Minimum cover to pipes (unprotected)	1200mm
Pipe Levels	Soffit-to-Soffit
Return Period for no surcharge	5 years
Return Period for no flooding	100 years

Table 6: Summary of Drainage Design Parameters

14. PAVEMENT DESIGN

General

The pavement design will be prepared in accordance with TII/NRA Addendum to HD 24/06. This Addendum amends Standard HD24/06 – Pavement Design and Maintenance: Traffic Assessment of the DMRB. The preliminary design of capping layer, sub-base and pavement layers follow the requirements of TII/NRA HD 25-26/10 – Pavement and Foundation Design. The pavement materials to be used will further be in accordance the requirements of Series 700 to 1000 inclusive of the TII/NRA Specification for Road Works contained within Volume 1 of the Manual of Contract Documents for Road Works.

The design recommendations for the foundation layers of 'capping' and sub-base are given in the design standard TII/NRA HD 25-26/10 and are based on the strength of the sub- grade, measured as its 'CBR' value. Capping is used to improve weak sub-grade material. Where deemed necessary and within the detailed design phase of the project, it may be proposed to use a capping layer using granular material conforming to Series 600 of the TII/NRA Specification for Road Works. The thickness of same will be as required by the above standard as appropriate to the CBR value of the sub-grade and selected pavement type.

Pavement Typology

Given the relatively short length of carriageway involved, and that the noise characteristics of concrete pavements would be inappropriate in the surrounding environment, the use of a concrete pavement option for the MRE is discounted.

Traffic Growth Rates & Expansion Factors

Traffic growth will be applied based on PAG Unit 5.3 – Travel Demand Projections (May 2019) guidelines which set out a standard approach to traffic growth rates as shown in Figure 23 over. The growth rates in Table 6.1 (Link-Based Growth Rates: Metropolitan Area Annual Growth Rates) can be applied.

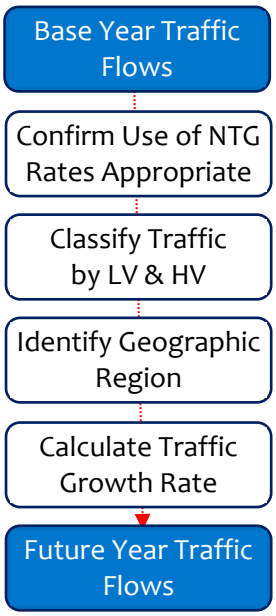


Figure 23: Application of National Traffic Growth Forecasts

Based on the foregoing and allowing that the MRE is located in Cork Metropolitan Area, the following traffic national growth figures apply:

National Traffic Growth Forecasts: Annual Growth Factors [East]						
Period	Low Growth		Central Growth		High Growth	
	LV	HV	LV	HV	LV	HV
2016 – 2030	1.0153	1.0279	1.0169	1.0294	1.0202	1.0328
2030 – 2040	1.0072	1.0128	1.0090	1.0149	1.0125	1.0185
2040 – 2050	1.0065	1.0164	1.0083	1.0182	1.0166	1.0276

Table 7: National Traffic Growth Factors

AADT Expansion Factors can be calculated based on PAG Unit 16.1 - *Expansion Factors for Short Period Traffic Counts*.

MRE Pavement Design

TII/NRA Addendum to HD 24/06 specifies a formula for calculating traffic loading which in turn is used to calculate the required design thickness of combined asphalt layers. This formula is as follows:

$$T_i = W \times P \times 10^{-6} \times 365 \times F_o \times Y \times G \qquad \text{(msa)}$$

The definitions for the above symbols and corresponding values used are as follows:

Symbol	Definition	Value
T_i	Pavement traffic loading for each individual class of vehicle over the design period (msa)	TBC
W	Wear Factor for each traffic class	2.7
P	Percentage of vehicles in the heaviest loaded lane	100%
F_o	Annual Average Daily Flow of traffic (AADF) for each traffic class in the year of opening	TBC
Y	Design Period (Years)	20
G	Growth Factor	TBC

Table 8: HD24/06 Symbols

The following notes are made with respect to the calculation in this instance:

- Design Traffic (T) typically equals the ΣT_i, where T_i is the traffic calculated for a specific class of vehicle. However, where insufficient data is available to make a separate calculation for every vehicle class, a combined approach may be adopted using a single calculation, so that $T = T_i$;
- TII/NRA Addendum to HD 24/06 specifies the Wm values in HD 24/06 Table 2.3 be used which does not allow a factor for combined vehicle type assessments. However, HD 24/06 was superseded by CD 224 in March 2020. This updated design document includes a wear factor for "all commercial vehicles" in Table 2.18, and this may be used for this calculation;
- The MRE is proposed to have a single traffic lane in each direction meaning the value for P is taken as 100%;
- There is currently no predicted AADT available for the MRE. As the MRE will provide access to the future Eastern Gateway Bridge, which provides a new link between the South Docks and the strategic road infrastructure on the north bank of the Lee, the strategic modelling carried out for the

Cork Metropolitan Area as part of the CMATS and ABTA assessments will inform the traffic loading for the MRE.

- The Growth factor may be calculated based on PAG Unit 5.3 as outlined earlier. While the design period is noted as 20 years, the growth factor may make additional provision for time between year of assessment and year of opening.

This Design Traffic figure will be applied to Figure 4.2 of TII *Pavement & Foundation Design* DN-PAV-03021, to estimate the design thickness of combined asphalt layers for fully flexible design – reproduced in Figure 24.

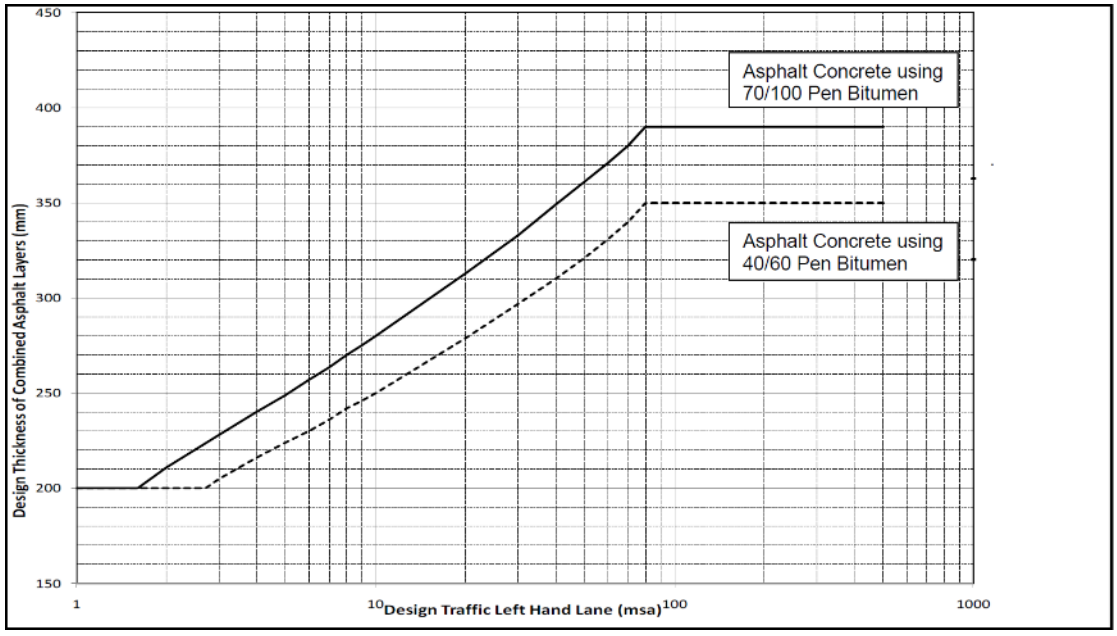


Figure 24: Design Traffic Estimate to TII Design Thickness Chart

Summary Pavement Thickness Design

Based on the predicted traffic loading, the process described above will be used to determine the total pavement depth. Based on proposals for arterial routes elsewhere in the Cork City Council jurisdiction, a total pavement depth of 245mm is proposed for preliminary purposes. The recommended pavement thickness make-up is presented in Table 9 over.

Pavement Course	Clause	Mixture Designation/ Material	Thickness (mm)
Surface Course	5	PMSMA 10 surf PMB 65/105-60 des	45
Binder Course	3	AC 20 dense bin 40/60 des	60
Base	3	AC 32 dense bas 40/60 des	140
Sub-base	808	Granular Material Type B	150
Total Pavement Thickness (excl. Sub-base)			245

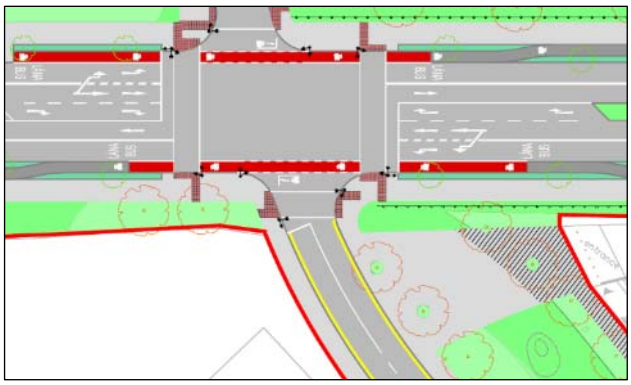
Table 9: Preliminary Pavement Thickness

15. SIGNAGE & DELINEATION

Directional and Regulatory Signage for the scheme will be provided in accordance with the Department of Transport, Tourism & Sport '*Traffic Signs Manual*' (TSM) August 2019. All Regulatory and Warning signage will be consistent with the design speed of the mainline and secondary roads.

Directional information signage will be consistent with the classification and design speed of the mainline and secondary roads. The route will most likely be designated either a Local or perhaps Regional Route on opening, so that directional information signage will comprise black lettering, symbols, and borders on a white background. Any Tourism signage (e.g. to Marina Park) will comprise white lettering, symbols, and borders on a brown background. All Regulatory Signage will be provided in accordance with Chapter 5 of the TSM with all Warning Signs provided in accordance with Chapter 6 of the TSM. All advance directional signs and directional signs will be designed using the 'AutoSign' traffic sign design software. It is not envisaged that any Variable Message Signing (VSM) will be required on the route.

Road markings, reflective markings and studs will be provided in accordance with Chapter 7 of the TSM and in accordance with the Specification for Road Works Series 1200 - Traffic Signs and Road Markings - CC-SPW-01200 (January 2019) as published by the TII.



Temporary traffic signs during construction will comply with the TSM and in accordance with Series 1200 of the 'Specification for Road Works' as published by the NRA.

Tactile paving with a blister surface is to be provided at all pedestrian crossings to provide information to vision impaired people. The tactile paving shall be provided in accordance with the guidance set out in the Guidance on the use of Tactile Paving Surfaces (2005) published by the UK Department of the Environment, Transport, and the Regions. "L" shaped tactile paving shall be laid across the full width of the drop kerb with the stem extending to the back of the footway.

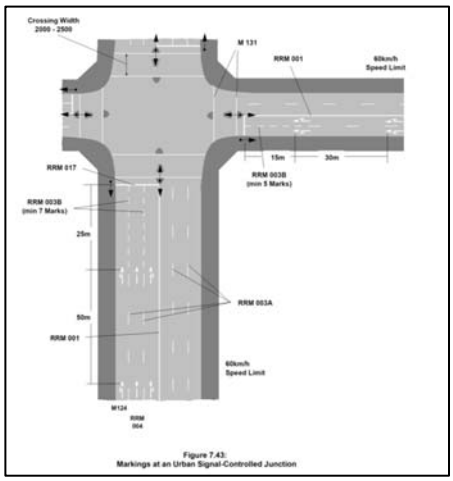


Figure 7.43:
Markings at an Urban Signal-Controlled Junction

16. PUBLIC LIGHTING

The design of public lighting for the MRE will be in accordance with the requirements of BS 5489-1 (2020) Lighting of Roads and Public Amenity Areas – Code of Practice and I.S. EN13201-2 (2015) Road Lighting Part 2, Performance Requirements.

The height of lighting columns will be selected to accord with the scale of the built and planned environment and with consideration to the prominence of the elevated section of roadway on approach to the Eastern Gateway Bridge. Consideration will be given to providing lower intensity pedestrian lanterns mounted on the same columns as the streetlights. In accordance with DMURS 4.2.5, only white light sources will be considered in the design of street lighting (metal halide, white SON, Cosmopolis and LED). The installation of the lighting network will comply with the requirements of Series 1300 and 1400 of the Specification for Road Works as published by TII and in accordance with the recommendations of BS5489 and BS5649.

Full cut-off lanterns will be utilised to minimise night-time visual intrusion if required by the Environmental Assessment.

17. STAGE 1/2 ROAD SAFETY AUDIT

The preliminary design of the Monahan Road Extension will be subjected to an independent Stage 1 Road Safety Audit. The Audit will be carried out in accordance with the requirements of TII, Publication Number GE-STY-01024, dated December 2017. The Road Safety Audit Team will comprise of one Team Leader and one Team member, each with certified appropriate training in Road Safety Auditing. The Road Safety Audit will comprise an examination of the OCSC drawings and a site visit by the Audit Team.

As with all Road Safety Audits, the audit report will follow the 'Problem'/'Observation' format. Problems are considered to require action by the Design Team that addresses the safety of the scheme for road users. Observations are for information only. All problems identified can be addressed by the designers during the detailed design of the MRE.

18. FLOOD RISK ASSESSMENT

OCSC inspected the South Docks Drainage Strategy report (SDDS), the Cork City Council Climate Change Adaptation Strategy 2019-2024 and the Lee Catchment Flood Risk Assessment and Management Study (Lee CFRAMS).

The MRE is located in an area of reclaimed land in the South Docks, which is defended from high water levels in the River Lee estuary by the Marina embankment. The SDDS describes the area of the South Docks as a polder.

The Lee CFRAMS shows the site of the MRE to be subject to fluvial and tidal flood risk, but in a defended area.

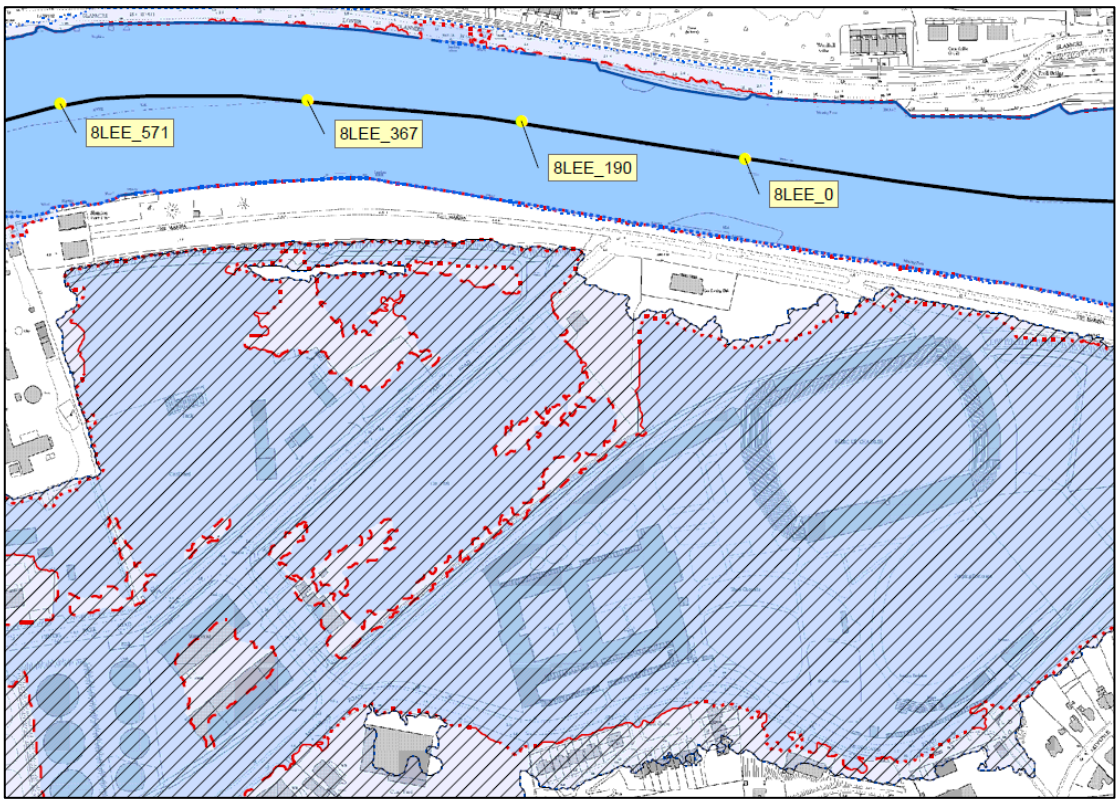


Figure 25: Extract from Lee CFRAMS Fluvial Flood Extent Map

Figure 26: Extract from Lee CFRAMS Tidal Flood Extent Map

Existing ground levels over the extent of Monahan's Road Extension vary between 0.5m OD and 1.3m OD. Predicted flood levels in the adjacent River Lee estuary are presented in Table 10.

	1.0 % AEP	0.1 % AEP
Fluvial Flood Level	2.74mOD	3.07mOD
Tidal Flood Level	3.00mOD	3.20mOD

Table 10: Predicted Flood Levels in Lee estuary (from Lee CFRAMS)

As noted earlier, the site of the MRE is in a defended area. Due to the presence of flood defences, the active floodplain does not extend to the site of the MRE – see Figure 27 and Figure 28 over.

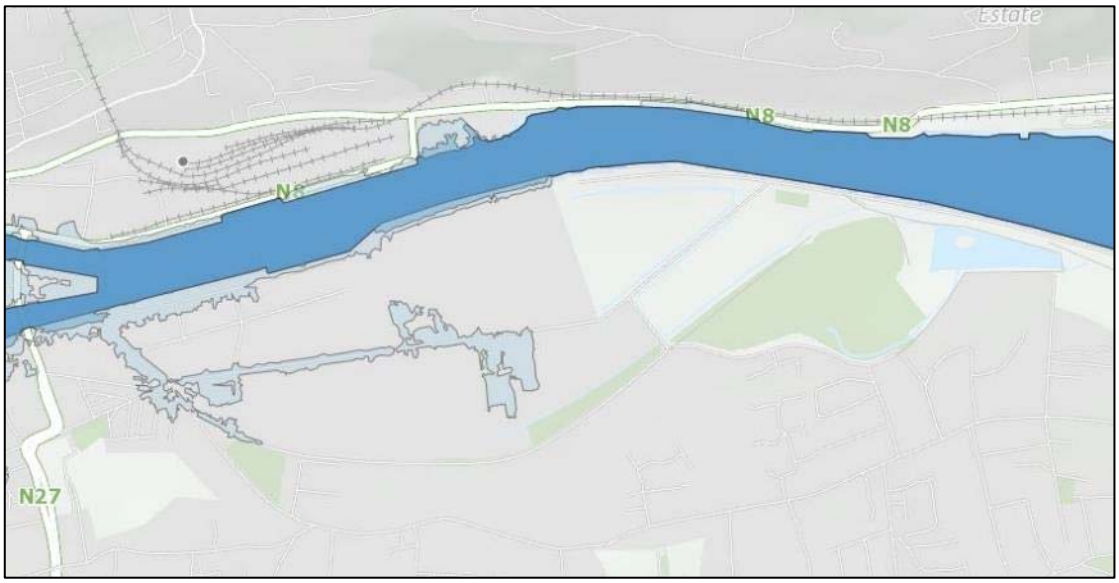


Figure 27: 0.1%AEP active fluvial floodplain, from OPW's floodinfo.ie

Figure 28: 0.1%AEP active tidal floodplain, from OPW's floodinfo.ie

The Lower Lee Flood Relief scheme, when implemented, will further reduce flood risk arising from the River Lee estuary by raising flood defences and ground levels at Albert Quay and Victoria Road – see Figure 29 over.

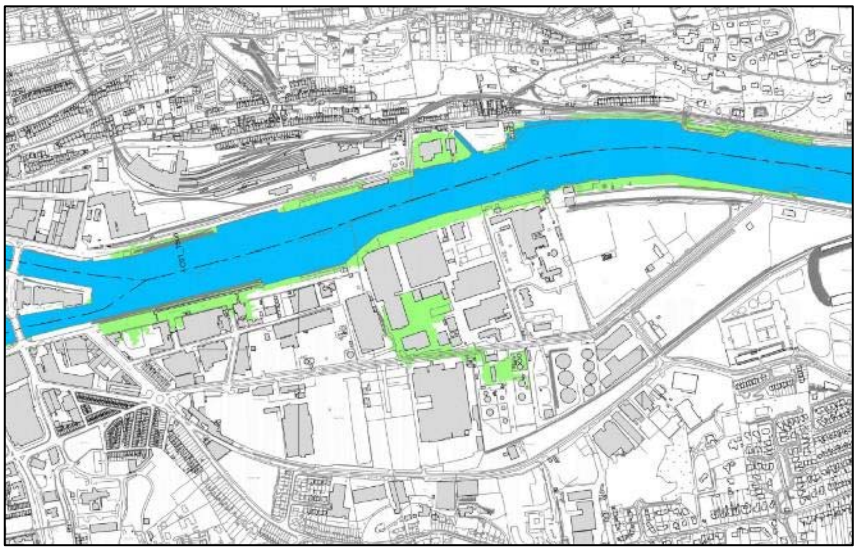


Figure 29: Extract from Lower Lee Flood Relief Scheme LL_604, showing post-scheme 1.0%AEP fluvial flood extents

As part of the SDDS, a baseline model of the drainage system within the South Docks polder was created to assess system capacity and the impact of tidal locking. From this, a baseline model flood risk map was produced – see Figure 30.

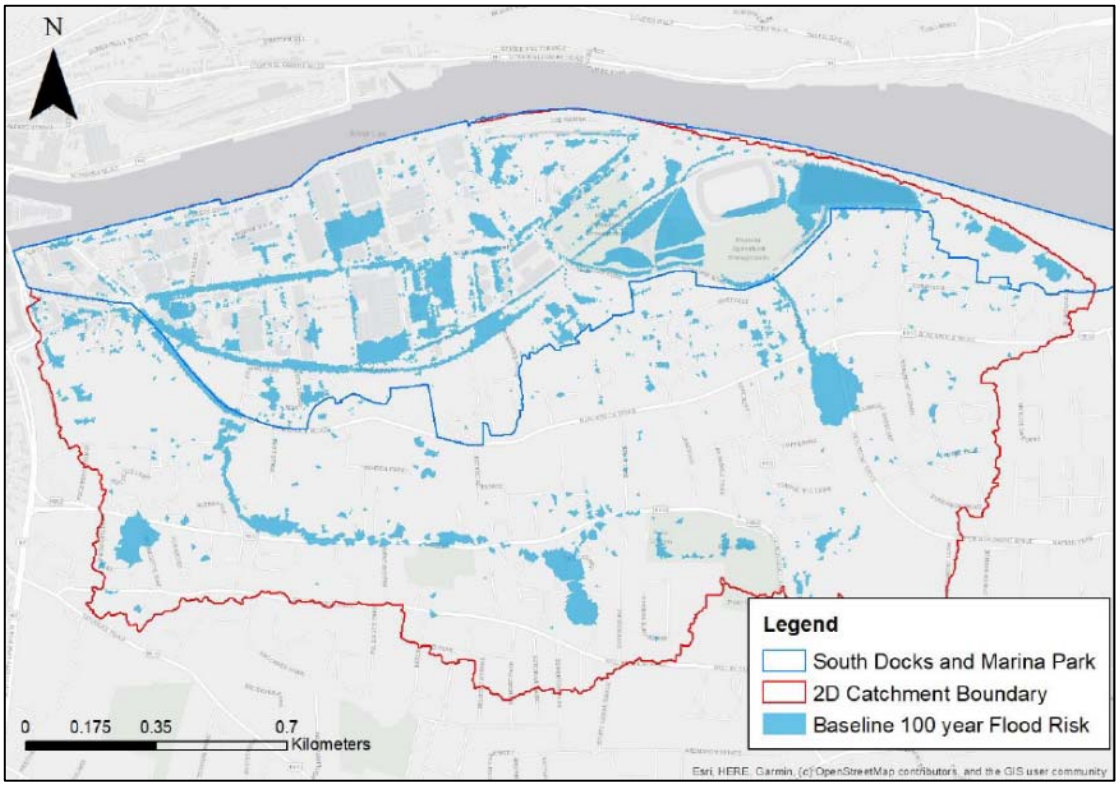


Figure 30: Extract from SDDS, showing current 1.0%AEP flood extents

The SDDS concludes that some of the low points on Monahan Road need be raised locally, up to a min of 0.7mOD to 1mOD (the variation allowing for longitudinal and cross falls for surface drainage). This has been adopted in the design of the MRE.

OCSC

O'CONNOR | SUTTON | CRONIN

Multidisciplinary
Consulting Engineers

9 Prussia Street
Dublin 7
Ireland

T | +353 (0)1 8682000
F | +353 (0)1 8682100
W | www.ocsc.ie