Comhairle Cathrach Bhaile Átha Cliath
Dublin City Council

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South Dublin County Council

CITY EDGE PROJECT

Surface Water Management Plan

April 2022

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DUBLIN CITY COUNCIL AND SOUTH DUBLIN COUNTY COUNCIL

CITY EDGE PROJECT

SURFACE WATER MANAGEMENT PLAN

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1 INTRODUCTION

1.1 Overview

This report outlines the findings of the Surface Water Management Plan (SWMP) for the City Edge Strategic Framework also known as **City Edge Project**.

The vision of the City Edge Project is to support the long-term, resilient growth of the Dublin region by making the most of the City Edge lands. Create a major new Urban Quarter on the edge of Dublin City, providing much needed new homes and employment space for the city, whilst ensuring the area's rich industrial history can continue to play an important role into the future. Five new neighbourhood, based on 15-minute city principles, will celebrate the area's existing qualities such as the Grand Canal, the River Camac, and Lansdowne Valley Park. Whilst a network of new biodiversity rich parks, green and blueways, public transport, local high streets, community facilities and energy networks will help to meet our shared climate challenges.

The objectives are defined as:

- **Homes** – Accommodate a mixed and balanced community of between 75,000 and 85,000 new people with a choice of different housing types, tenures, and sizes.
- **Community** – Support the needs of intergenerational communities through the timely provision of community, educational, health and social facilities.
- **Economy -** Create a resilient and diverse employment offer with scope for between 65,000 and 75,000 jobs.
- **Movement** – Ensure Transport Oriented Development by focussing new mixed-use and compact urban development on enhanced active travel and public transport corridors.
- **Natural Infrastructure** – Target 50% green cover to meet the needs of the future population while promoting a reintroduction of biodiversity and combatting climate change impacts such as flood risk.
- **Sustainability** – Fast track to zero carbon and zero waste to help address climate change and promote sustainable communities through the 15-minute city principle.
- **Character** – Integrate the renewal of the City Edge lands with existing residential communities by supporting good place making within the five local neighbourhoods and by celebrating local distinctiveness and ensuring climate resilient design.

- **Delivery** – Ensure a coordinated approach to the funding and delivery of infrastructure and utilities so that land can be developed in a timely and coherent manner that realises the City Edge Vision.

1.2 Project Status

The studies already prepared include a Baseline Analysis and Emerging Preferred Scenario. The project team has drafted a Strategic Framework, and this will be followed by a Statutory Plan. These are all explained in more detail in the following paragraphs.

Baseline Study

A Baseline Analysis was carried out for the project area to establish the characteristics of the area as it is currently. This examined areas including community, housing, employment, economy, transport, infrastructure, historical and archaeological features, and environmental aspects. It also included a review of national, regional, and local planning policy documents. Engagement with landowners was also carried out and a desktop survey of utilities and contaminated lands was undertaken.

Emerging Preferred Scenario

To determine a preferred direction for the project and identify an Emerging Preferred Scenario, three high level scenarios were assessed against the emerging objectives and vision for the City Edge Project Study Area as well as key constraints and opportunities identified in the Baseline Study. Elements from each of the three scenarios were evaluated against various criteria. Those elements that performed the best were combined, to produce the Emerging Preferred Scenario. This comprises a mix of residential-led development with significant employment, based around the creation of a number of development nodes of different character. These “Districts” include a major urban centre; local centres with high street activity; clusters of urban industry & workspaces; and areas for housing and workspace.

Public Consultation

In the interests of engaging with stakeholders and informing the process of developing a Strategic Framework for the City Edge Project, non-statutory public consultation was held over a four-week period in September and October 2021. People were asked for their views on the City Edge project including the Baseline Study, Emerging Preferred Scenario and Environmental Reports which included a Strategic Flood Risk Assessment (SFRA). Several online events were held during the public consultation period including two public presentations with question-and-answer sessions and an international conference event held over two mornings during which guest speakers related their

experience with international regeneration projects and what lessons could be learnt for City Edge. A total of 106 submissions were received from residents, business and landowners, interest groups, state agencies and service providers, etc. and a summary of the issues raised and responses to these is included in a Chief Executive's Report considered at the December Council meetings of both local authorities – South Dublin County Council and Dublin City Council. There was a high level of engagement with the online events and widespread media coverage across all platforms including print, radio, television and online.

Strategic Framework

At present, the two local authorities along with a team of consultants, have gone through the process of drafting a Strategic Framework in tandem with this SWMP as well as the SFRA and Strategic Environmental Screening (SEA) Report. The Strategic Framework will inform a Statutory Plan and sets out a direction of travel in relation to housing, community, economy, movement, natural infrastructure, utilities, and character areas etc. The Framework is set out through a series of layers that together form a strategic whole. To set out the spatial construct of the Framework, a series of core components have been identified, which provide the skeleton that's needed to unlock the full potential of the study area. These would typically not be deliverable by individual landowners but are key in helping to create the place. The exact nature of these core components may evolve in parallel with further detailed investigations into the Framework in later Phases but represent the key infrastructure that can support and catalyse growth. This SWMP relates to the Strategic Framework.

Statutory Plan

The Strategic Framework will be followed by a Statutory Plan to be commenced during 2022 which will set out a development strategy for the area at a finer level of detail. Further consultation with all stakeholders will be carried out during the preparation of the Statutory Plan.

The SWMP is currently based on the visioning of City Edge Strategic Framework and will be updated during the Statutory Plan Process. Furthermore, the findings of The Camac Flood Alleviation Study (FAS) currently being undertaken can be incorporated.

1.3 Surface Water Management Plan

A Surface Water Management Plan (SWMP) is a plan which outlines the preferred surface water management strategy in a given location. In this context, surface water flooding includes flooding from sewers, drains, groundwater, and runoff from land, small watercourses and ditches that occurs as a result of heavy rainfall.

A Stage 1 and 2 Flood Risk Assessment was completed in August 2021 as part of the Strategic Flood Risk Assessment (SFRA) that accompanied the Emerging Preferred Scenario and has now been updated (April 2022) to accompany the Strategic Framework. The SFRA is one of the key triggers which identify the need for a SWMP. A draft SFRA was prepared by Nicholas O'Dwyer for City Edge and the information from the draft SFRA was used to inform this SWMP. Similarly, outputs from a SWMP can also be used to revise the SFRA when it is next updated.

This SWMP study has been undertaken as part of City Edge in consultation with key partners who are responsible for surface water management and drainage in the Greater Dublin Area. A number of liaison meetings were undertaken with the Project Team, South Dublin County Council and Dublin City Council.

This document also establishes a long-term action plan to manage surface water and will influence future capital investment, maintenance, public engagement and understanding, land-use planning, emergency planning and future developments.

1.4 Objectives

The scope of this SWMP is as follows:

- Develop a robust understanding of surface water flood risk in and around the study area, taking into account the challenges of climate change and SFRA
- Summarize fluvial, coastal, and pluvial flood risks as identified in the SFRA.
- Review of the existing drainage network servicing the lands.
- Identify known flood risk hotspots, based upon historic flood incidents as identified by the SFRA.
- Review of sustainable drainage best practices
- Direct exceedance flows though lower vulnerable areas and routes such as open spaces and green infrastructure networks; and
- Reduce runoff from new development and existing areas.
- Demonstrate the benefits by implementation of a sample SuDS component.
- Recommendation for discharge rates for the site.

- Make holistic and multifunctional recommendations for surface water management which improve emergency and land use planning, and enable better flood risk and drainage infrastructure investments
- Develop a strategic-scale SWMP action plan for City Edge

1.5 Document Structure

This SWMP is broken down into seven sections, as described below:

- **Section 1 (Introduction)** provides an overview of the purpose and objectives of the SWMP.
- **Section 2 (Project Catchment Description)** provides an overview of the surface water drainage with the study area
- **Section 3 (Flood Risk Assessment)** provides a summary of the assessments undertaken by SFRA to confirm the sources of flooding and appraises the adequacy of existing information.
- **Section 4 (Existing Legislation)** provides an overview of the surface water management legislations, regulations, policies, and requirements at national and local levels.
- **Section 5 (Sustainable Drainage Principles)** provides an overview of the strategies for managing rainfall run-off
- **Section 6 (Natural Infrastructure as part of City Edge Strategic Framework)** considers the natural infrastructure vision and key strategies for City Edge project area
- **Section 7 (SuDS Network Concept for City Edge)** provides high level proposal for implementation of SuDS to City Edge project area
- **Section 8 (Conclusion)** provides an overview of the conclusions of this report

1.6 City Edge Project Area

The City Edge project area lies within the catchment of the River Camac and is presented in Figure 1-1. For details of the Camac watershed, refer to Figure 2-1.

Figure 1-1: City Edge Project Area

The project area comprises lands within the jurisdiction areas of Dublin City Council (DCC) and South Dublin County Council (SDCC). The size of the area is 700ha approximately and it is located in within the Naas Road, Ballymount and Park West areas of the City and County.

Core spatial uses and concepts that were identified at the Emerging Preferred Concept Stage of the Project have shaped the project area as follows:

- Major centre with a mix of uses and employment capacity for 65,000 – 75,000 jobs
- Urban industry with capacity for range of employment types with clusters of urban industry and workspaces
- Residential-led mixed-use neighbourhoods and local centres with a combined capacity for up to 40,000 housing units and 75,000 – 85,000 people.

To realise the Framework, a number of core components are identified. These represent the key infrastructure that will support and catalyse growth and are listed as:

- **Camac River Re-naturalisation** - Deculverting and renaturalising the river Camac and its tributaries to help with climate change resilience and create a positive setting for future growth.
- **Enhancing the Grand Canal** - Create a more attractive setting for the Canal, enhance active travel routes along it, and enhance biodiversity.
- **Introducing & Enhancing Green & Blue Space** - Introducing new parks and enhancing existing parks in coordination with the renaturalisation of the river and enhancing of the canal, to help with climate change resilience and create a positive setting for future growth.
- **Creating a Tymon to Phoenix Park Greenway** - Link to two enormous assets in the vicinity of the Study Area whilst creating green links both for active travel and for ecology.
- **Undergrounding Pylons** - Increase the developable land available and improve the setting of future growth by undergrounding pylons.
- **Expanding the sewer network** - Supporting future growth by expanding the sewer network whilst coordinating with a study area-wide SuDS strategy.
- **Setting out the street network** - Create a legible movement network for vehicles that responds to accessibility requirements for different uses and provides a parallel cycling network.
- **Introducing orbital connectivity** - Proposal to augment Dublin's orbital connectivity with two routes passing through the Study Area.
- **Introducing New Stations** - Coordinating with the NTA's GDA Strategy for 2022-2042 to create new stations and stops within the study area that can catalyse and support growth.
- **Introducing New Interchanges** - Taking the opportunity to coordinate interchanges between modes across the study area, and to integrate these with new developments.
- **Setting Out Centres & Nodes** - Creating centres and nodes that respond to transport infrastructure and green space and amenity, with a major new centre at Naas Road.
- **Setting Out Land Uses** - Coordinating land uses across the study area to create a cohesive set of districts that support one another.

The regeneration of City Edge lands is consistent with national and regional planning policy, as set out in the National Planning Framework (NPF) and Regional Spatial and Economic Strategy (RSES), respectively. The NPF specifies ambitious targets to achieve compact growth with 50% of housing targeted for Dublin to be provided within its existing built-up footprint. To achieve this, the Metropolitan Area Strategic Plan (MASP) (incorporated within the RSES) identifies strategic residential and employment locations along key public transport corridors. The project area is identified as a key brownfield regeneration opportunity within the South West Strategic Development Corridor.

1.7 Topography and Land Use

Within the project area, there are ground levels range from 75.9 –25.5m OD (Malin Head). The River Camac intersects the project area running from the west to north-east. Approximately 80% of the project area is within the Camac Catchment. Northeast section of The Framework area is occupied by Irish Rail Inchicore Works and located within the intermediary subcatchment of Liffey. Therefore, the northeast section of the project area is not considered in this SWMP.

There are several smaller watercourses which form tributaries of the River Camac: Walkinstown Stream, Ballymount Stream, Robinhood Stream, Gallanstown Stream, Drimnagh Castle Stream. The Grand Canal also runs through the project area (see Figure 1-2).

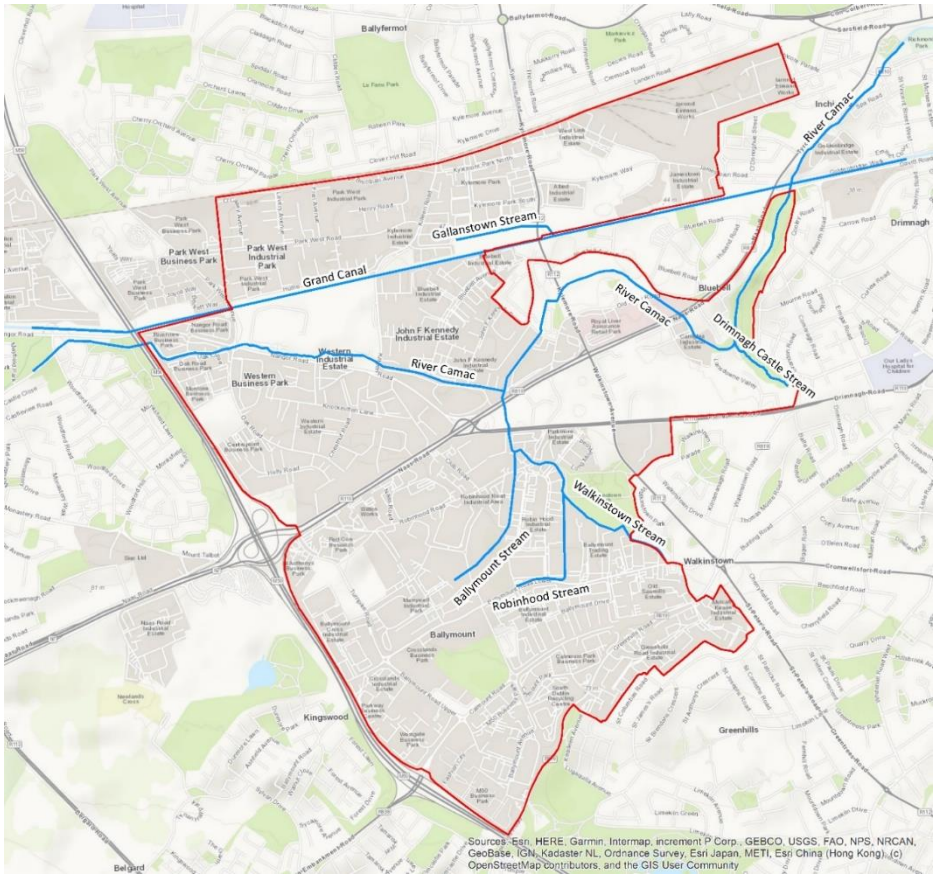


Figure 1-2: River Camac and Tributaries

The project area is highly urbanised and mostly occupied by industrial estates. The SFRA reports that more than 80% of all lands are hardstanding (desktop study), thus considered as impermeable. However, there are small pockets of open areas with the largest being Lansdowne Valley Park to the northeast of the project area.

1.8 Planning Application Considerations

The guidance provided in this SWMP will be incorporated in the Phase 1 non-statutory Framework and will help provide the basis for the consideration of any planning applications that may come forward prior to the adoption of any statutory plan. This guidance can also provide the basis of any future guidance used in the assessment of planning applications post the adoption of a Phase 2 statutory plan for the City Edge Project area. However, flooding is only one of many considerations in considering or assessing a planning application. Measures that are identified as potentially acceptable in addressing flood issues may not be acceptable for other planning reasons under certain circumstances.

1.9 Disclaimer

It is important to note that, although prepared in compliance with the related guidelines, the SWMP is a work in progress and is based on emerging and best available data at the time of preparing the assessment. As a result, all landowners and developers are advised that Nicholas O'Dwyer can accept no responsibility for losses or damages arising due to assessments of the vulnerability to flooding of lands, uses and developments. Owners, users, and developers are advised to take all reasonable measures to assess the vulnerability to flooding of lands and buildings (including basements) in which they have an interest prior to making planning or development decisions.

1.10 List of References

1. CIRIA C753 The SuDS Manual (2015), CIRIA
2. City Edge Project - Strategic Flood Risk Assessment (2022), Nicholas O'Dwyer
3. City Edge Project - Strategic Framework (2022), MLA et.al.
4. Main Lift Pumping Station Drainage Area Plan (DAP) - Stage 1 Report (2019), Irish Water.
5. Greater Dublin Strategic Drainage Study (2005), Dublin Drainage Group
6. Arterial Drainage Act (1945) and Arterial Drainage Act (1995), Office of Public Works
7. The Planning System and Flood Risk Management Guidelines for Planning Authorities (2009), Office of Public Works

8. A Framework for Major Emergency Management (2008), Office of Public works & Department of Housing Community and Local Government
9. Planning Policy Statement 25 (2009), UK Department for Communities and Local Government
10. Dublin City Development Plan 2016-2022, Dublin City Council
11. Draft Dublin City Development Plan 2022-2028, Dublin City Council
12. South Dublin County Development Plan 2016-2022, South Dublin County Council
13. Draft South Dublin County Development Plan 2022-2028, South Dublin County Council
14. Clonburris Strategic Development Zone – Planning Scheme Report (2019), South Dublin County Council
15. Green and Blue Roof Guide (2021), Dublin City Council
16. Sustainable Drainage Design & Evaluation Guide (2021), Dublin City Council
17. The SuDS Manual (2007), Woods-Ballard et.al.

2 PROJECT CATCHMENT DESCRIPTION

2.1 Overview

City Edge lies within the watershed of the River Camac. The River Camac and its tributaries dominate the planning studies in many ways. Therefore, it is of utmost importance to fully understand the river system for meeting environmental objectives and providing a strong relationship with the local communities and nature.

2.2 River Camac

The River Camac is a tributary of the River Liffey. It is a subcatchment of the Liffey and Dublin Bay Catchment. Figure 2-1 shows the river system and its watershed.

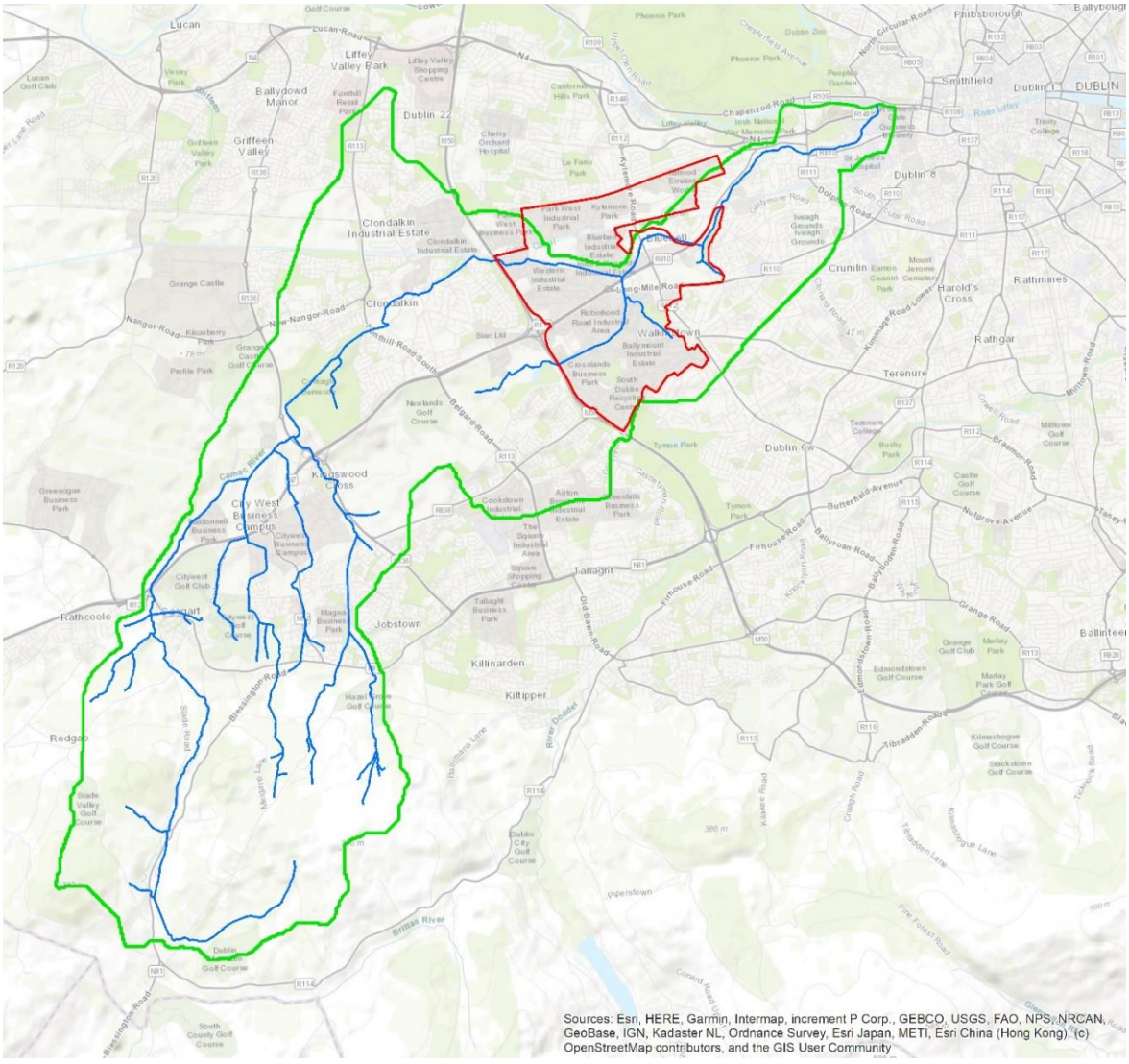


Figure 2-1: River Camac (shown in blue), its natural watershed (shown in green), and the City Edge area (shown in red)

The River Camac rises at Knockannavea, flows in northwest direction, and finally discharges to the River Liffey by passing beneath Heuston Station. Although the upstream is mainly natural, the lower reaches of the river in urban areas mainly comprise artificial channels or culverts.

There are several smaller watercourses within The Framework area which form tributaries of the River Camac. These are Walkinstown Stream, Ballymount Stream, Robinhood Stream, Gallanstown Stream, and Drimnagh Castle Stream (see Figure 1-2).

EPA monitoring data for 2019 states that water quality for the River Camac ranges from Poor (Q-3) to Moderate (Q3-4). The River Camac is at risk of not achieving the Water Framework Status Objectives.

2.3 River Camac Flood Alleviation Study

The River Camac Flood Alleviation Study (FAS) is now in progress and funded by Office of Public Works (OPW). Since many buildings within the Camac Catchment are at significant risk of flooding, this study has been given a high priority.

This is a full catchment study which includes the Camac River itself, its tributaries and the pipes that convey flows to them. The purpose of the project is to enhance the flood defences of the River Camac to the standards of the EU Directive on the Assessment and Management of Flood Risk (Floods Directive 2007/60/EC) transposed into Irish Law as SI 122 of 2010.

The FAS is at Stage 1 currently. In this Stage the FRA will look at establishing the flood risk within the catchment and develop a full understanding of the environment within the catchment. This will involve several surveys within the area and the construction of hydraulic models to develop baseline models and future scenarios. This will then allow the identification of possible flood alleviation options which can be considered at the next stages of City Edge including Statutory Plan.

For further information on this project, refer to https://www.camacfas.ie/

2.4 Existing Surface Water Sewers

The City Edge area is mostly served by an extensive separate surface water network. The River Camac, which passes through the project area in east-west direction, forms the backbone of this network along with its tributaries.

A schematic sketch of existing surface water network is provided in Figure 2-2. Open sections of the River Camac, its streams and Grand Canal are indicated in blue and surface water sewers in brown.

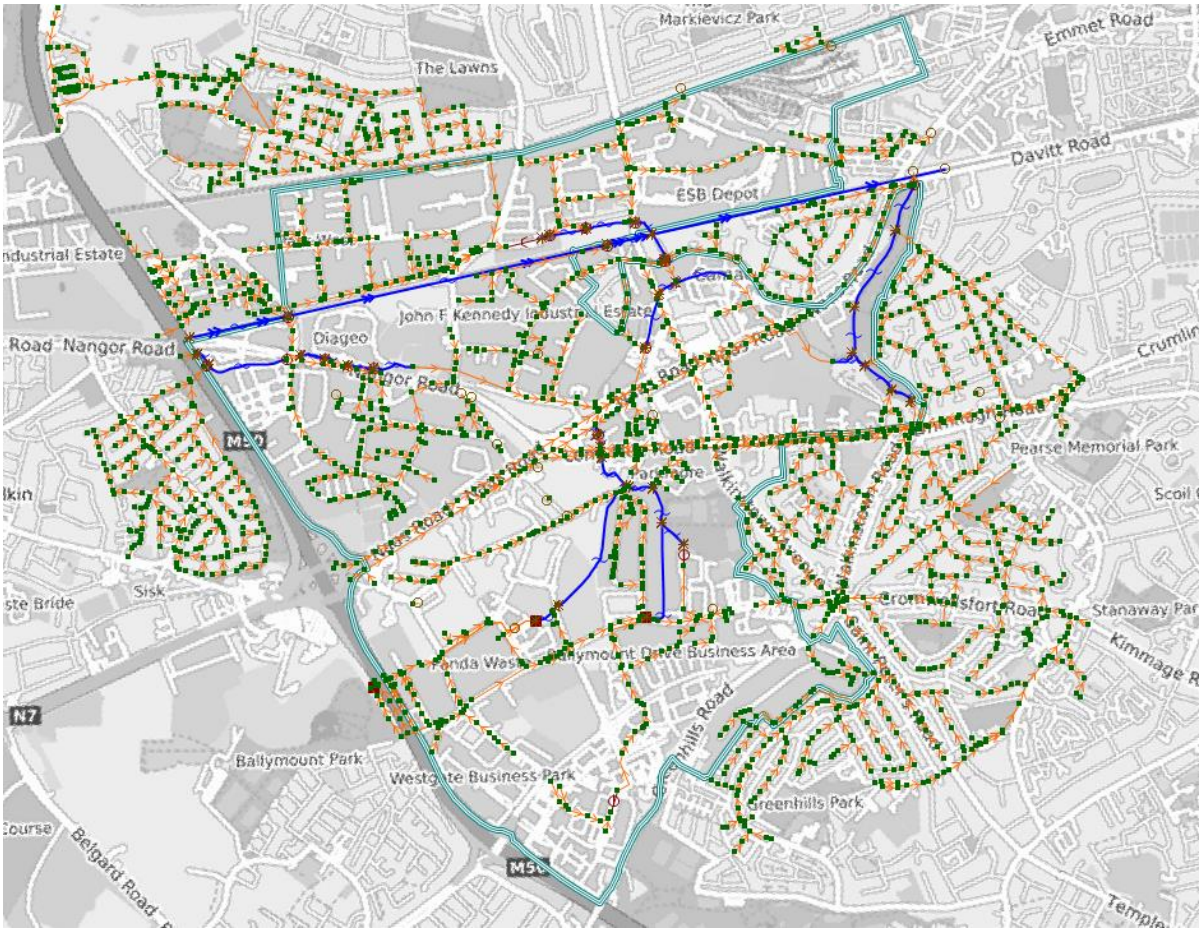


Figure 2-2: Surface water network (open river sections shown in blue)

2.5 Combined Sewers

The project area is mainly served by a separate surface water network. However, some combined sewer lines still exist around Bluebell area. Identified combined sewer lines are presented by red directional lines in Figure 2-3. This is based on current Irish Water GIS information which is in the process of being updated as part of the Main Lift Pumping Station Drainage Area Plan (DAP) – refer to Section 3.7.5.

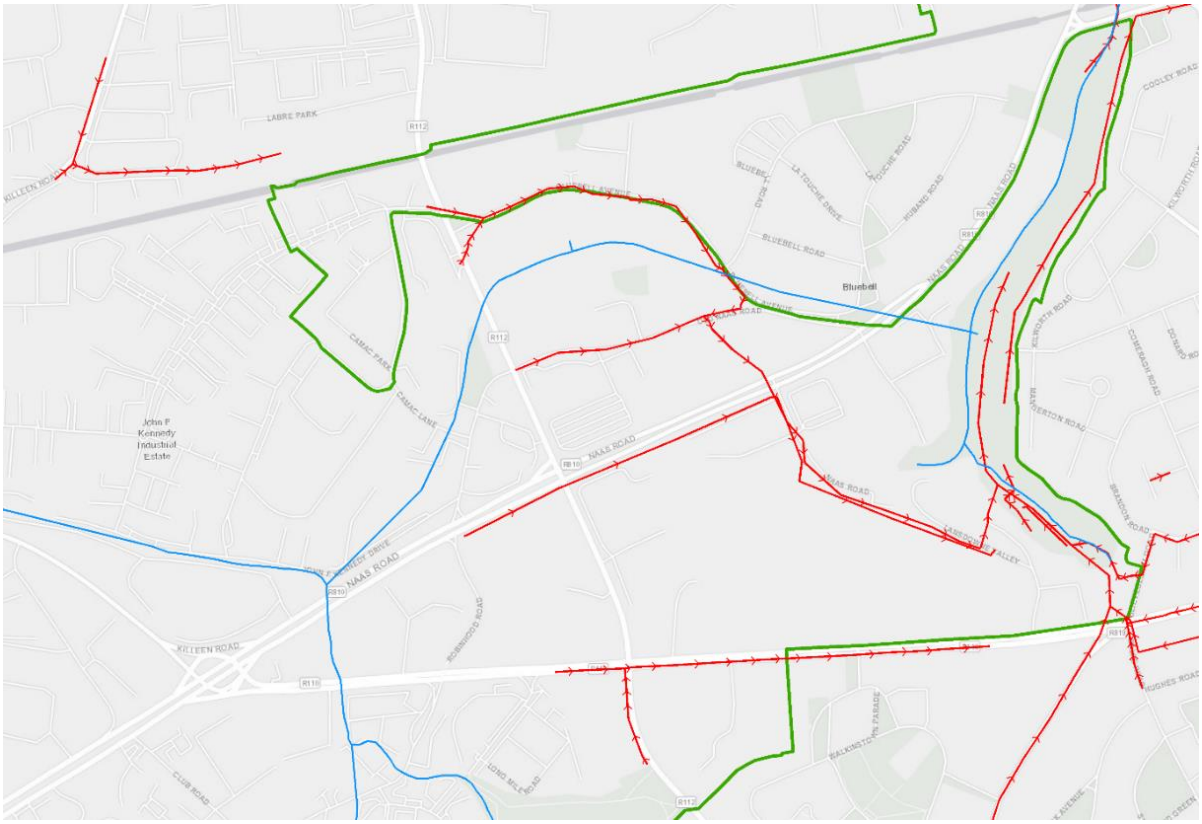


Figure 2-3: Combined sewers (shown in red) around Bluebell

3 FLOOD RISK ASSESSMENT

3.1 Overview

This flood risk identification study was conducted on the Emerging Preferred Scenario (September 2021) to identify whether there may be any flooding or surface water management issues in the project area as identified in the SFRA and prepared in accordance with 'The Planning System and Flood Risk Management Guidelines for Planning Authorities' herein referred to as 'The Guidelines'.

A draft SFRA was prepared by Nicholas O'Dwyer for the Emerging Preferred Scenario and this work was updated under a revised SFRA (April 2022) that accompanies the Strategic Framework.

3.2 Definition of Flood Risk

Flood Risk is defined as a combination of the likelihood of flooding occurring and the potential consequences arising from that flooding. The likelihood of flooding is defined as the percentage probability of a flood of a given magnitude or severity occurring or being exceeded in any given year by The Guidelines. Return periods are often used to describe how often a flooding event will occur. Return periods are an average of how often a flood event of that magnitude will occur. Probability or chance of flooding can also be used instead, such as a 1 in 50-year flood has a 2 per cent probability of occurring in any one year. To this end, the term "annual exceedance probability" (AEP) is used to define the probability of a flood event occurring in any given year.

Consequences of flooding is defined in The Guidelines as the hazards associated with the flooding and the vulnerability of people, property and the environment potentially affected by a flood.

3.3 Flood Zones

The flood zones are based on the likelihood of an area flooding and are split into three categories, with Flood Zone A areas more likely to flood and Flood Zone C areas least likely to flood. It should be noted that these flood zone don't consider blocked drains, etc. so sites in a low-risk flood zone could still experience flooding.

3.4 Significant Infrastructure

There are a large number of potential critical infrastructure assets that could be distributed throughout the project area. It is of utmost importance to determine the nature and extent of critical infrastructure and the locations before and after planning studies within the scope of The Framework and the Statutory Plan that will follow.

These potential assets can be split into three sub-categories as in Table 3-1.

Table 3-1: Flood Vulnerability Categories (Derived from Planning Policy Statement 25, UK Department for Communities and Local Government)

Category	Description
Essential Infrastructure	• Essential transport infrastructure • Mass evacuation routes • Essential utility infrastructure • Electricity generating power stations, grids, and sub stations
Highly Vulnerable	• Garda stations, ambulance stations, fire station, command centres and telecommunication installations • Emergency dispersal points • Installations requiring hazardous substances consent
More Vulnerable	• Hospitals • Health services • Educational establishments • Landfill, waste treatment & hazardous waste management facilities • Electricity installations (street level electricity supply control units) • Sewage treatment works • Prisons

3.5 Significant Future Development Plans

Based on the 2016 Census, the population of the project area is estimated as 4,945, whereas the workforce population is found to be 25,068 (Figure 3-1). It should be noted that these figures may differ slightly as 2016 Census Small Areas does not fully coincide with the boundary of City Edge.

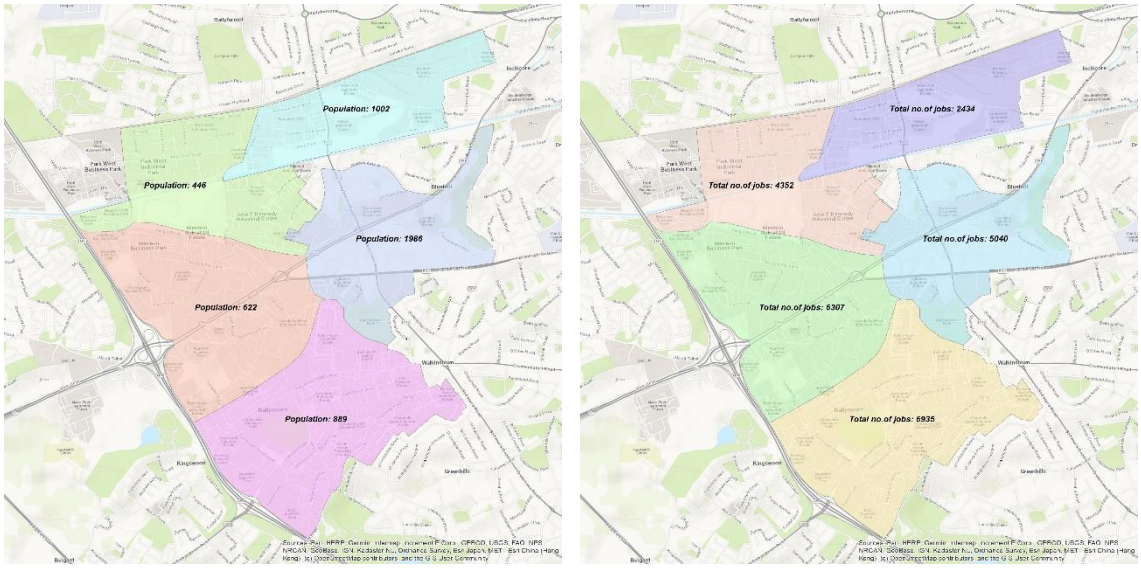


Figure 3-1: 2016 Census (left) and Workplace Zone (right) populations

The Framework aims to regenerate the area through mixed-use residential and employment development with a potential for 75,000 jobs, 75,000 – 85,000 population and up to 40,000 housing units.

3.6 Interactions with Surrounding Areas

City Edge is surrounded by several other residential areas. The River Camac cross connects into the neighbouring areas of Clondalkin, Inchicore, and Kilmainham so the flood risk posed by this watercourse spreads beyond City Edge boundary. This provides scope for the development of cross-boundary solutions and partnership between City Edge and ongoing Camac FAS Project.

3.7 Sources of Flooding

This section explains the flooding sources which may affect the project area. The relevant maps derived from SFRA for the Emerging Preferred Scenario (September 2021) showing the flooding extents are also provided in Appendix A - C (data obtained from OPW CFRAM).

3.7.1 Fluvial Flooding

Fluvial flooding happens when the water level in a water body such as a river or lake rises and overflows onto the surrounding areas. The water level rise could be due to excessive rain or snowmelt. The impact of fluvial flooding on urban environments could be severe, causing significant social, economic, and environmental impacts.

The duration and intensity (volume) of rainfall in the catchment area of the river are the main factors to determine the severity of a river flood. There are other factors which are equally important including soil water saturation and the terrain surrounding the river system. Floodwater rises more slowly and is shallower in flatter areas, whereas floods can occur within minutes after heavy rain in mountainous areas.

The maps showing risk of flooding from fluvial sources (data obtained from OPW CFRAM) are provided in **Appendix A.** Medium risk zones of flooding are determined by the areas flooded by the rainfall with 1% AEP (annual exceedance probability) and Low risk zones of fluvial flooding are the areas flooded by the rainfall with 0.1% AEP.

Main rivers and streams that could contribute to fluvial flooding in the project area are listed below and also presented in Figure 1-2.

- River Camac
- Walkinstown Stream

- Ballymount Stream
- Robinhood Stream
- Gallanstown Stream
- Drimnagh Castle Stream

The major risk of fluvial flooding in the project area is caused mainly by the culverted sections of natural rivers. As a result of culverting the rivers, natural floodplains are no longer available to effectively dissipate effects of increased water level on-site and therefore amplifies the risks of damage that can be caused by fluvial flooding.

Based on information provided by South Dublin County Council, the Robinhood stream which traverses this area is prone to flooding and it is inaccessible for maintenance as it is for the most part located behind buildings and fences. Dumping along the water course contributes to the issue.

3.7.2 Pluvial Flooding

floodinfo.ie defines pluvial flooding as "the amount of rainfall exceeds the capacity of urban storm water drainage systems or the ground to absorb it." There are two common types of pluvial flooding:

- Surface water floods occur when an urban drainage system is flooded, and water flows out into streets and nearby structures. It occurs gradually, which provides people time to move to safe locations, and the level of water is usually shallow. It generally creates no threat to lives but may cause significant economic damage.
- Flash floods are characterized by an intense, high velocity torrent of water triggered by torrential rain falling within a short amount of time within the vicinity or on nearby elevated terrain. They can also occur via sudden release of water from an upstream levee or a dam. Flash floods are very dangerous and destructive not only because of the force of the water, but also the debris that is often carried by the flow.

Pluvial flooding maps (data obtained from OPW CFRAM) are provided in **Appendix B.**

3.7.3 Coastal Flooding

Coastal flooding is the inundation of land areas along the coast by seawater. Common causes of coastal flooding are intense windstorm events occurring at the same time as high tide (storm surge), and tsunamis.

Storm surge is created when high winds from a windstorm force water onshore — this is the leading cause of coastal flooding and often the greatest threat associated with a windstorm. The effects

increase depending on the tide - windstorms that occur during high tide result in devastating storm surge floods. In this type of flood, water overwhelms low-lying land and often causes devastating loss of life and property.

The severity of a coastal flood is determined by several other factors, including the strength, size, speed, and direction of the windstorm. The onshore and offshore topography also plays an important role. To determine the probability and magnitude of a storm surge, coastal flood models consider this information in addition to data from historical storms that have affected the area.

The River Liffey is at risk of coastal flooding. The risk of flooding from tidal sources during 0.1% AEP event (data obtained from OPW CFRAM) is shown in the map provided in **Appendix C**. City Edge is not affected by coastal flooding.

3.7.4 Groundwater Flooding

Groundwater flooding can happen when an underground water table rises, which may result in water emerging through the ground. This source of flooding generally occurs after long periods of heavy rainfall. During these extensive periods of rainfall, a greater volume of water infiltrates through the ground, causing underlying aquifers inability to drain the increased flow away quickly enough. Lowlands, where the water table is likely to be closer to the surface, pose greater risks of groundwater flooding.

Risk management of groundwater flooding poses a distinctive set of technical and environmental challenges that differentiate it from other sources of flooding. According to Geological Survey Ireland (GSI), groundwater flooding in Ireland occurs mainly on the limestone lowlands, such as west of the Shannon.

GSI groundwater flood probability maps indicate that the project area is not prone to groundwater flooding. It should be noted that GSI maps only shows groundwater flood extents in limestone regions which is not relevant for the project area. More information and online map viewer can be accessed from:

https://www.gsi.ie/en-ie/programmes-and-projects/groundwater/activities/groundwater-flooding/gwflood-project-2016-2019/Pages/default.aspx

3.7.5 Sewer Flooding

Sewer flooding can happen due to drainage infrastructure failure or due to an increased flow and volume of water entering a drainage system which exceeds its design capacity, causing the network to surcharge. Sewer flooding can also occur if the outfalls are either blocked or submerged due to high

water levels in receiving environment. Outfall inadequacy may lead to a water back up in a sewer system and cause flooding. Any possible blockages caused by debris or sediment accumulation can further exacerbate the probability of sewer flooding.

Most of the sewer system comprises of separate storm and foul networks in The Framework area. However, the storm network is intertwined with the culverted River Camac system. This may lead to a storm sewer system flooding caused by increased water levels at outfall points. Therefore, it is believed that any improvement to reduce flood risk of the River Camac system will directly affect the conveyance capacity of storm sewer network.

The Sewer 9B, which is the main trunk foul sewer network passes directly through the project area as indicated in Figure 3-2 and connects to the Grand Canal Tunnel (GCT) which conveys flows to Ringsend WwTP, which is the main WwTP for Dublin city and surrounds. Information obtained from Irish Water indicated that Sewer 9B is operating at its hydraulic capacity now. Possible misconnections of surface water to foul sewer network may increase the risk of surcharge of sewer network as foul sewer networks are typically designed to accommodate up to 1 in 30-year rainfall events. It is recommended that all misconnections should be carefully investigated and disconnected from foul sewer network. Combined sewers in Bluebell area of the project area also exhibits an increased risk of flooding.

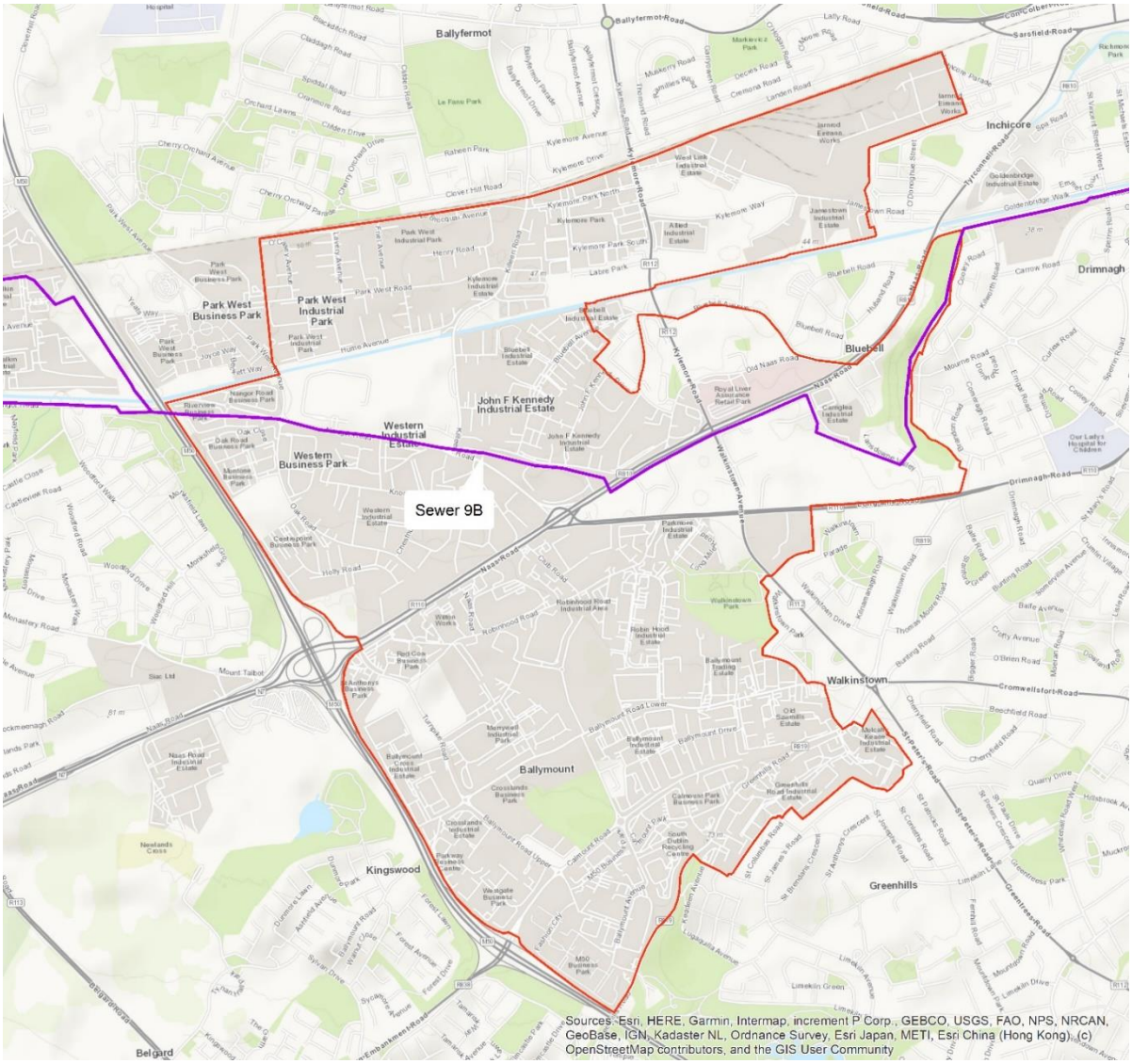


Figure 3-2: Route of Sewer 9B

Registered and geotagged incidents caused by flooding of Sewer 9B and Grand Canal Tunnel (GCT) which is located downstream of the 9B sewer, between August 2008 and October 2011 are provided in Figure 3-3. It should be noted that only flooding incidents with geo-spatial information could be mapped. More information can be found in Main Lift Pumping Station Drainage Area Plan (DAP) - Stage 1 Report (2019) published by Irish Water.

The purpose of the DAP is to investigate the hydraulic, environmental, structural, service and operational performance and risks within the Ringsend Main Lift Pumping Station agglomeration. The study involves a hydraulic model build of the current development status wastewater collection network for the agglomeration. This model is required to meet a level of verification in accordance with Irish Water's Wastewater Network Model Build and Verification Standard. The model will be used to assess short term and long-term developments using evidence-based growth forecasts for the

agglomeration. The Stage 1 DAP report is based on a review of the quality of the data available in order to confirm the suitability for use within the DAP project for the purpose of drainage area planning. Discrepancies and/or deficiencies in data have been identified, along with any additional surveys and studies necessary to improve the accuracy of the future model, thus increasing the understanding of the hydraulic, structural, and environmental performance of the Main Lift Pumping Station (MLPS) Wastewater Collection Network.

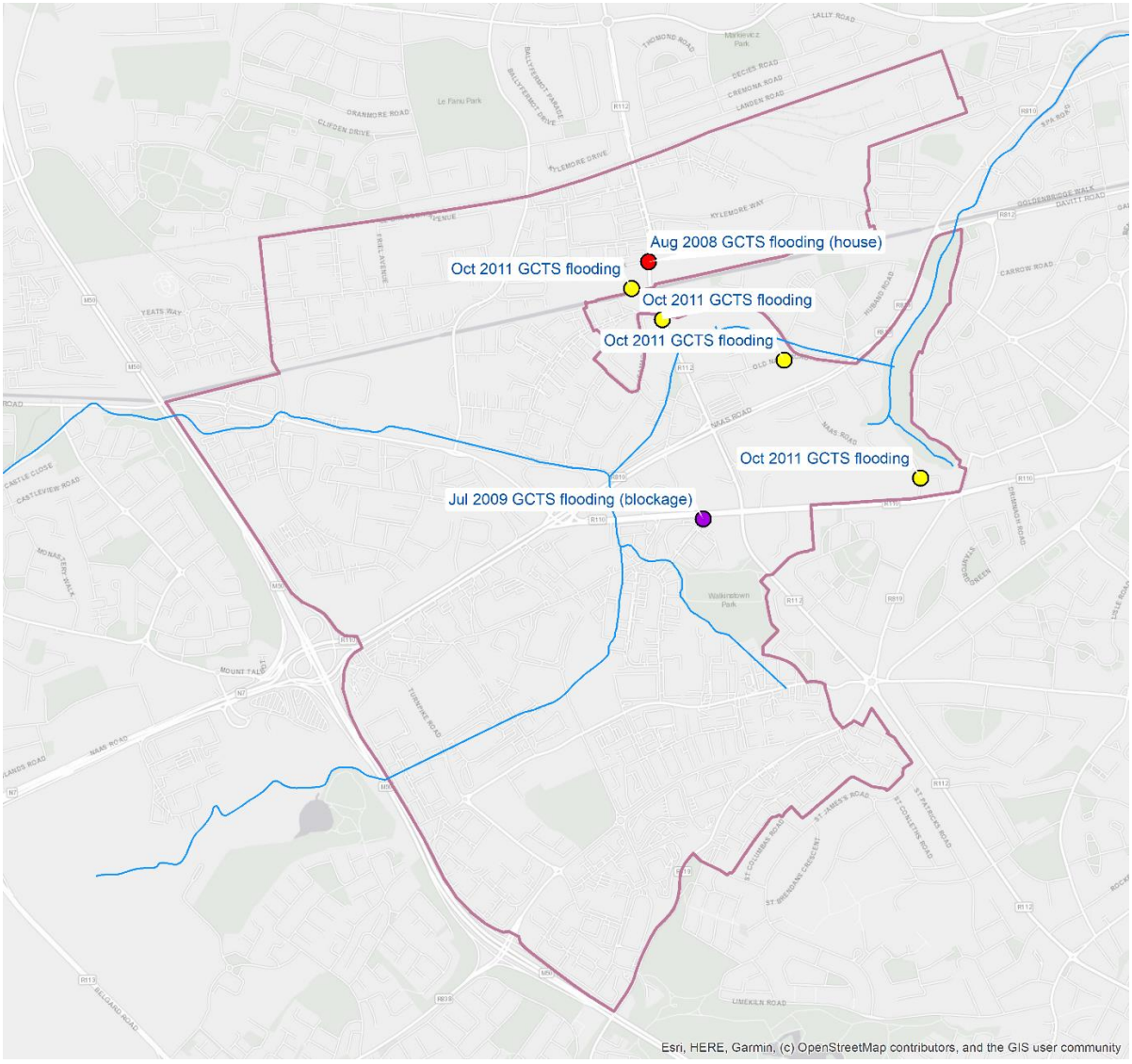


Figure 3-3: GCTS-caused flooding locations

3.7.6 Artificial Sources Flooding

Artificial Flooding can happen when the failure of infrastructure or human intervention results in flooding. Artificial flood sources include reservoirs, canals, water retention ponds, docks, and other

artificial structures. Although the probability of a structural breach is low, the potential extent of damage is significant. Flooding from an artificial source could leave many properties at risk.

The Grand Canal passes through northside of the project area and has several locks to control the water level in the canal and allow barges to navigate. It is important to preserve the infrastructure by sediment removal, canal bank maintenance, repairs of navigation infrastructure, and maintain other appurtenant structures.

3.8 Past Floods

Past recorded floods that occurred in City Edge area are listed below. Locations of the past flood events (data obtained from OPW CFRAM) and the SFRA are also provided in **Appendix D**. For more information, please refer to Strategic Flood Risk Assessment (April 2022).

- Flooding in the Camac Catchment – 05 November 2000
- Flooding at Riverview Business Centre – 24 October 2011
- Flooding at DIAGEO, Nangor Road – 24 October 2011
- Flooding at Robinhood Industrial Estate – 24 October 2011
- Flooding at Walkinstown Crescent – 24 October 2011
- Recurring Flooding of Camac Culvert at Old Naas Road
- Recurring Flooding of Robinhood Stream, Walkinstown

3.9 Surface Water Flooding

In the context of SWMP, surface water flooding is defined as:

- Surface water runoff: runoff as a result of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity, thus causing flooding (known as pluvial flooding).
- Flooding from groundwater where groundwater is defined as all water which is below the surface of the ground and in direct contact with the ground or subsoil.
- Sewer flooding: flooding which occurs when the capacity of underground systems is exceeded due to heavy rainfall, resulting in flooding inside and outside of buildings. Note that the normal

discharge of sewers and drains through outfalls may be impeded by high water levels in receiving waters as a result of wet weather or tidal conditions.

- Flooding from open-channel and culverted watercourses which receive most of their flow from inside the urban area and perform an urban drainage function.
- Overland flows from the urban/rural fringe entering the built-up area; and
- Overland flows resulting from groundwater sources.

This report aims to consider surface water flooding issues in the project area and propose a number of solutions to:

- Direct exceedance flows though lower vulnerable areas and routes; and
- Reduce runoff from new development and existing areas.

It does not address sewer flooding where it occurs as a result of operational issues, i.e., blockages and equipment failure.

3.10 Mapping Outputs

The maps shown within the appendices of this report is suitable to identify broad areas which are more likely to be vulnerable to surface water flooding. This allows The Framework and stakeholders to undertake more detailed analysis in areas which are most vulnerable to surface water flooding.

In addition, the maps can also be used as an evidence base to inform the spatial planning to ensure that surface water flooding is appropriately considered when allocating land for development and devising this SWMP for the City Edge Lands. The maps can also be used to assist emergency planners in preparing the response plans.

It should be noted that these maps only show the predicted likelihood of surface water flooding for defined areas. They focus on overland flow paths and surface water flooding at local depressions; however, they also simulate (less accurately) flooding from sewers, drains, and small watercourses. Due to the nature of the source data used, these are not detailed enough to account for precise addresses. Individual locations may not always have the same risk of flooding as the areas that surround them. It is also recommended to consult ongoing Camac Flood Alleviation Study for availability of most recent flooding maps of areas of interest.

3.11 Impacts of Climate Change

Impact of climate change on flooding was also provided in the relevant maps. Assessment of climate change scenarios for different sources of flooding are provided in Table 3-2.

Table 3-2: Climate change scenarios per flood source

Sources of Flooding	Climate Change Scenarios (Source: OPW CFRAM mapping)
Fluvial	1 in 10-year probability event + 30% increase in rainfall + 1.0m sea level rise 1 in 100-year probability event + 30% increase in rainfall + 1.0m sea level rise 1 in 1000-year probability event + 30% increase in rainfall + 1.0m sea level rise
Pluvial	OPW has not published rainfall flooding maps with potential effects of climate change as of date of writing this report.
Coastal	1 in 1000-year probability event + 20% increase in rainfall + 0.5m sea level rise 1 in 1000-year probability event + 30% increase in rainfall + 1.0m sea level rise
Groundwater	No specific climate change impacts are available for this flood risk source.

3.12 Riparian Zones

A riparian zone is defined as the interface between land and a stream. Riparian zones have utmost importance in ecology, environmental management, and civil engineering.

Riparian zones reduce the effects of floods by slowing down the runoff and providing temporary storage areas. Trees and grasses in riparian areas stabilize streambanks and reduce floodwater velocity, resulting in reduced downstream flood peaks. Irreversible damage to natural riparian zones can increase the vulnerability of surrounding area to flooding.

It should be noted that one of the core components of the City Edge Strategic Framework is the Camac Flood Alleviation Plan and renaturalisation of the river which will include promoting net Biodiversity gain for the river and its associated riparian corridors (source: SDCC SFRA). This core component was pre-empted by the identification of riparian corridors under the Emerging Preferred Scenario for the City Edge Lands (September 2021).

3.12.1 Riparian Habitat

Riparian land provides vital habitat for native plants and animals. The vegetation along rivers and streams provides a connection for native plants and animals to move between patches of vegetation in the landscape.

Trees on riparian zones provide a supply of organic matter to waterways, providing food and habitat for fish and other aquatic animals. Shade from riparian vegetation also helps regulate water temperature, which can be important to fish and helps reduce the likelihood of algal blooms.

The plants on riparian zones play an important role in protecting water quality by filtering nutrients and sediment out of run-off entering waterways which assist with addressing water quality issues –

one of the 4 key SuDS Design Principles (refer to Section 5.4). Good coverage of vegetation also reduces soil erosion and flood damage by stabilising the riverbed and banks.

By managing riparian zones well, there are opportunities to manage climate change and its impacts. Riparian vegetation helps mitigate climate change by absorbing carbon.

3.12.2Flood Zoning

Assessing and zoning floodplains throughout the catchment is key to defining appropriate land use practices, future sustainable development, and informing proposals under this SWMP for the City Edge Lands. The impacts of climate change should be considered as the areas liable to flood in the near future may increase significantly over present-day extents.

Indicated flood risk areas for 1% and 0.1% AEP events for future scenario along with riparian corridors are provided in Figure 3-4. In this map, dark blue regions represent the flood extend of a 1% AEP event with 30% climate change uplifting factor and light blue regions indicate the flood extend of a 0.1% AEP event with 30% climate change uplifting factor. Riparian corridor designated by SDCC SFRA (source - Draft SDCC Development Plan, July 2021) is bounded by green dashed lines. Larger format maps are also provided in **Appendix E**.

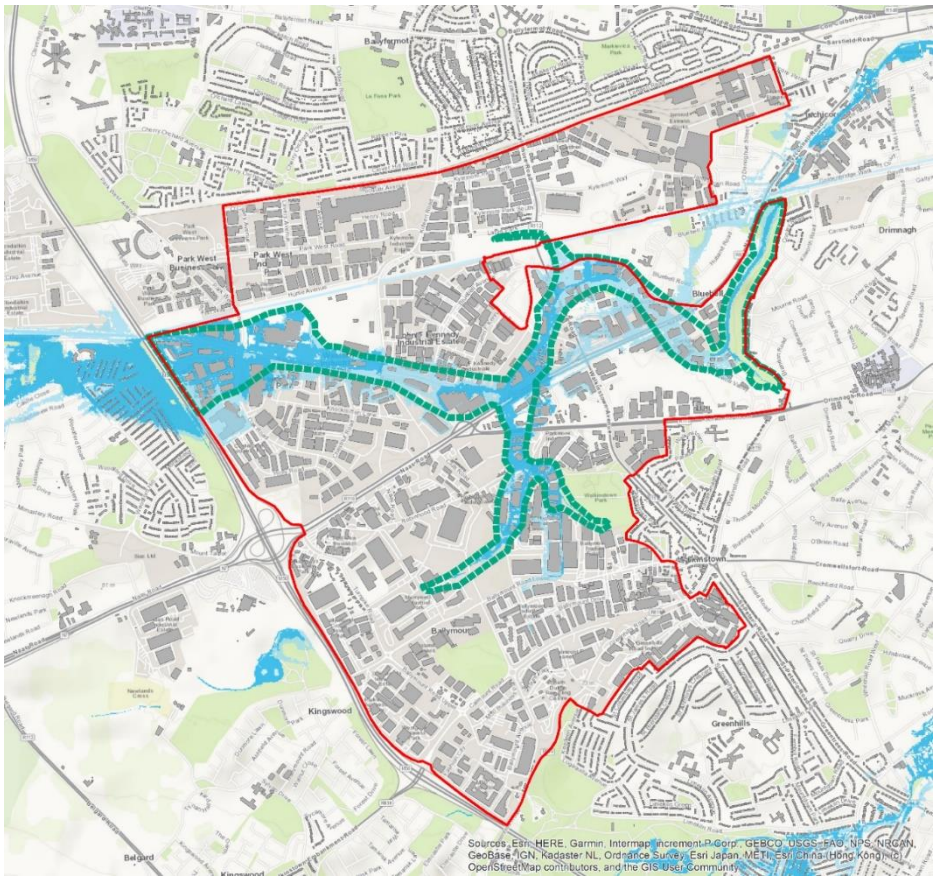


Figure 3-4: Indicated flood risk areas (with 30% climate change uplift) and riparian corridors (in green) for City Edge (source SDCC Shapefiles)

3.12.3Riparian Zones Objectives

The objectives to protect and enhance the riparian zones in Strategic Flood Risk Assessment of Draft South Dublin County Development Plan 2022-2028 are as follows:

1. To ensure that hydromorphological assessments are undertaken where proposed development is within lands which are partially or wholly within the riparian corridors identified in this SFRA.
2. To require development proposals that are within riparian corridors to demonstrate how the integrity of the riparian corridor can be maintained and enhanced having regard to flood risk management, biodiversity, ecosystem service provision, water quality and hydromorphology.
3. To promote and protect native riparian vegetation along all watercourses and ensure that a minimum 10m vegetated riparian buffer (recommended by SDCC SFRA) from the top of the riverbank is maintained or reinstated along all watercourses within any development site.

The objectives to protect and enhance the riparian zones in Draft Dublin City Council Development Plan 2022-2028 are as follows:

1. To protect, maintain, and enhance the watercourses and their river corridors in the city and to ensure that development does not cover or encroach upon rivers and their banks.
2. To maintain natural riverbanks and restore them as part of any new development. The creation and/or enhancement of river corridors will be required and river restoration opportunities where possible will be supported to help improve water quality, and ecology, provide natural flood relief as well as providing amenity and leisure benefits.
3. SI11: To manage all development within and adjacent to the Camac River Corridor in a way that enhances the ecological functioning and water quality of the river and aligns with the principles for river restoration. All development shall provide for a minimum set-back distance of 10-25m from the top of the riverbank depending on site characteristics. Large development sites in excess of 0.5ha should provide a minimum set-back of 25m from the top of the riverbank where informed by a hydromorphological study.

These objectives are considered in this SWMP.

4 EXISTING LEGISLATION

4.1 Overview

This section provides an overview of the surface water management legislations, regulations, policies, and requirements at national and local levels and are considered in this SWMP. The policies referenced in this section may be superseded in time. To ensure that development proposals are in line with the most up to date policy, it is advised that developers, planning consultants and Local Planning Authority officers keep well-informed of any changes.

4.2 Key Policies and Requirements

4.2.1 CIRIA C753 The SuDS Manual 2015

"The SuDS Manual guidance covers the planning, design, construction, and maintenance of SuDS to assist with their effective implementation within both new and existing developments. It looks at how to maximise amenity and biodiversity benefits and deliver the key objectives of managing flood risk and water quality – www.ciria.org.

This SWMP considers the objectives of the SuDS Manual.

4.2.2 Flood Management Policies

The Arterial Drainage Acts of 1945 and 1995 provide the OPW with powers for drainage and improvement of agricultural land and the undertaking of localised flood defence schemes to reduce flood risk in urban areas.

The OPW is responsible for the implementation of the EU Directive on the Assessment and Management of Flood Risks [2007/60/EC] which was transposed into Irish law by the EU (Assessment and Management of Flood Risks) Regulations SI 122 of 2010. An objective of the Catchment-based Flood Risk Assessment and Management (CFRAM) Programme is to achieve the requirements of the EU Floods Directive.

The functions and responsibilities in relation to coastal protection and coastal flooding transferred from the Department of Agriculture, Fisheries and Food to the OPW on 1 January 2009.

The key flood management policies are:

- "The Planning System and Flood Risk Management Guidelines for Planning Authorities" published in 2009. "Plan, prepare, protect" was published in 2006 (www.flooding.ie) to provide practical advice to the public on how to prepare for potential flooding (revision issued in 2014) (Figure 4-1, left image)

- Guidelines and templates for flood event emergency response plans were prepared in 2008 by the OPW and Department of Housing, Community and Local Government under the Framework for Major Emergency Management (revision issued in 2013) (Figure 4-1, right image)

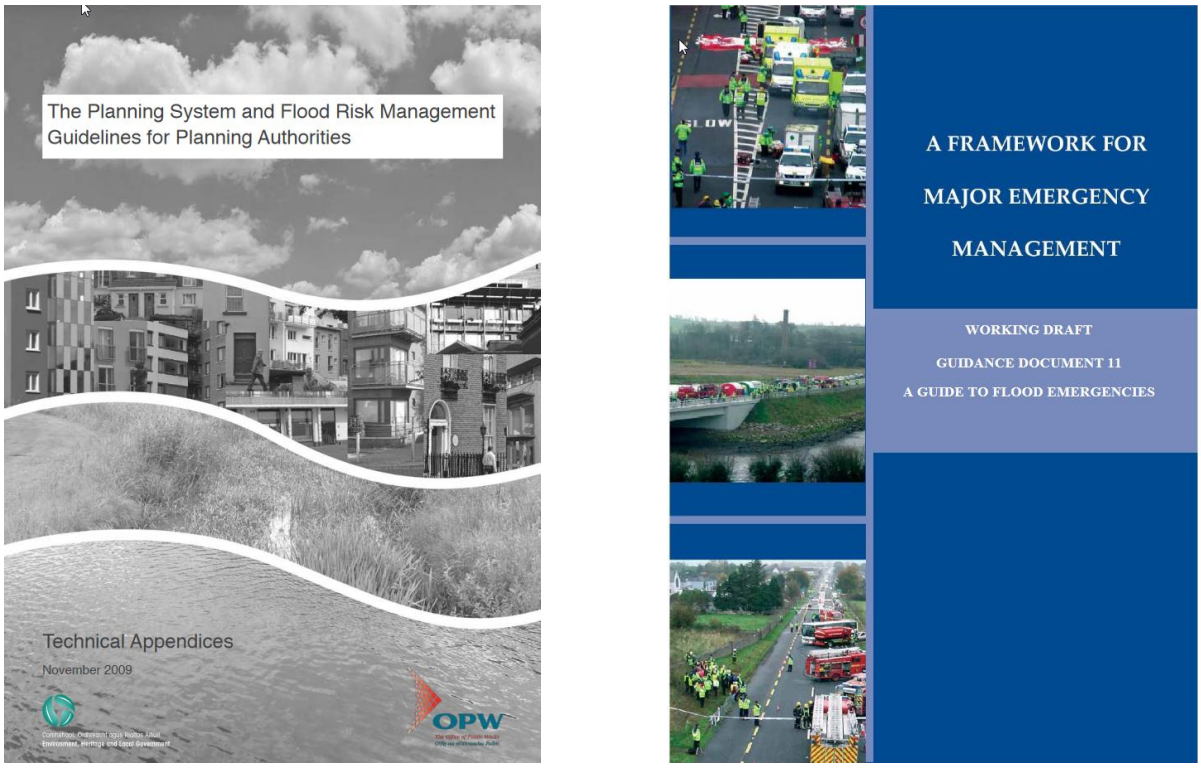


Figure 4-1: Main Guidelines

The following policies provided are as set out in DCC and SDCC Development Plans (2016-2022) and Draft Development Plans (2022-2028).

4.2.2.1 Dublin City Council's Policies

Dublin City Council's flood risk management policies in Development Plan 2016-2022 are:

- **SI8**: To mitigate the effects of floods and droughts, subject to Environmental Assessment.
- **SI9**: To assist the Office of Public Works in developing catchment-based Flood Risk Management Plans for rivers, coastlines and estuaries in the Dublin city area and have regard to their provisions/recommendations.
- **SI10**: To have regard to the Guidelines for Planning Authorities on the Planning System and Flood Risk Management and Technical Appendices, November 2009, published by the Department of the Environment, Community, and Local Government as may be

revised/updated when assessing planning applications and in the preparation of plans both statutory and non-statutory.

- **SI11**: To put in place adequate measures to protect the integrity of the existing Flood Defence Infrastructure in Dublin City Council's ownership and identified in the Strategic Flood Risk Assessment and to ensure that the new developments do not have the effect of reducing the effectiveness or integrity of any existing or new flood defence infrastructure and that flood defence infrastructure has regard also to nature conservation and amenity issues.
- **SI12**: To implement and comply fully with the recommendations of the Strategic Flood Risk Assessment prepared as part of the Dublin City Development Plan.
- **SI13**: Development of basements or any above ground buildings for residential use below the estimated flood levels for Zone A or Zone B will not be permitted.
- **SI14**: To protect the Dublin City coastline from flooding as far as reasonably practicable, by implementing the recommendations of the Dublin Coastal Flood Protection Project and the Dublin Safer Project.
- **SI15**: To minimise the risk of pluvial (intense rainfall) flooding in the city as far as is reasonably practicable and not to allow any development which would increase this risk.
- **SI16**: To minimise the flood risk in Dublin City from all other sources of flooding, including fluvial, reservoirs and dams and the piped water system.

Dublin City Council's flood risk management policies in Draft Development Plan 2022-2028 are:

- **SI13**: To minimise the flood risk in Dublin City from all other sources of flooding as far as is practicable, including fluvial, reservoirs and dams, and the piped water system.
- **SI14**: To implement and comply fully with the recommendations of the Strategic Flood Risk Assessment prepared as part of the Dublin City Development Plan 2022-2028 and to have regard to the Flood Risk Management Guidelines (2009), as revised by Circular PL 2/2014, when assessing planning applications and in the preparation of statutory and non-statutory plans.
- **SI15**: All development proposals shall carry out, to an appropriate level of detail, a Site-Specific Flood Risk Assessment (SSFRA) that shall demonstrate compliance with:
    - The Planning System and Flood Risk Management, Guidelines for Planning Authorities, Department of the Environment, Community and Local Government

(2009), as revised by Circular PL 2/2014, and the Strategic Flood Risk Assessment (SFRA) as prepared by this Development Plan.

- The application of the sequential approach, with avoidance of development in areas at risk of flooding as a priority. Where the Justification Test for Plan Making and Development Management have been passed, the SSFRA will address all potential sources of flood risk and will consider residual risks including climate change. The SSFRA will include site-specific mitigation measures, flood-resilient design and construction, and any necessary management measures (the SFRA and Appendix B4 of the above-mentioned national guidelines refer). Attention shall be given in the site-specific flood risk assessment to building design and creating a successful interface with the public realm through good design that addresses flood concerns but also maintains appealing functional streetscapes.

- **SI16**: Proposals which may be classed as 'minor development', for example, small-scale infill, extensions to houses and small-scale extensions to existing commercial and industrial enterprises in Flood Zone A or B, should be assessed in accordance with the Guidelines for Planning Authorities on the Planning System and Flood Risk Management and Technical Appendices (2009), as revised by Circular PL 2/2014, with specific reference to Section 5.28 and in relation to the specific requirements of the Strategic Flood Risk Assessment. The policy shall be not to increase the risk of flooding to the development or to third party lands, and to ensure risk to the development is managed.

- **SI17**: To assist the OPW in implementing catchment-based Flood Risk Management Plans for rivers, coastlines, and estuaries in the Dublin City area, including planned investment measures for managing and reducing flood risk, and have regard to their provisions/ recommendations.

- **SI18**: To put in place adequate measures to protect the integrity of flood alleviation infrastructure in Dublin City and to ensure new developments or temporary removal of any flood alleviation asset does not increase flood risk, while ensuring that new flood alleviation infrastructure has due regard to nature conservation, natural assets, open space, and amenity values.

- **SI19**: To facilitate the provision of new or the upgrading of existing flood alleviation assets where necessary and in particular, the implementation of proposed flood alleviation schemes, on the Santry, Camac, Dodder, Wad, Naniken, Mayne, Tolka and Poddle rivers as well as

Clontarf Promenade, Sandymount, Liffey estuary and any other significant flood risk areas being progressed through the planning process during the lifetime of the 2022-2028 Dublin City Development Plan, with due regard to the protection of natural heritage, built heritage and visual amenities.

- **SI20**: That there is a general presumption against the development of basements for residential use below the estimated flood levels for Flood Zones A or B

- **SI21**: To minimise flood risk arising from pluvial (surface water) flooding in the city by promoting the use of natural or nature- based flood risk management measures as a priority and by requiring the use of sustainable drainage systems (SuDS) to minimise and limit the extent of hard surfacing and paving, and requiring the use of sustainable drainage techniques, where appropriate, for new development or for extensions to existing developments, in order to reduce the potential impact of existing and predicted flooding risk and to deliver wider environmental and biodiversity benefits.

4.2.2.2 South Dublin County Council's Policies

SDCC Development Plan 2016 - 2022 flood risk management policies are:

- **IE3-1:** To support and co-operate with the Office of Public Works in delivering the Catchment-Based Flood Risk Assessment and Management Programme and in particular the Eastern District CFRAMS and associated Flood Risk Management Plan (FRMP), the River Dodder CFRAMS and associated Flood Risk Management Plan (FRMP). The recommendations and outputs arising from the CFRAM study for the Eastern District shall be considered in preparing plans and assessing development proposals.

- **IE3-2:** To support the implementation of the EU Flood Risk Directive (2007/60/EC) on the assessment and management of flood risks and the Flood Risk Regulations (SI No 122 of 2010).

- **IE3-3:** To manage flood risk in the County in accordance with the requirements of The Planning System and Flood Risk Management Guidelines for Planning Authorities, DECLG and OPW (2009) or any updated version of these guidelines, and Circular PL02/2014 (August 2014) when preparing plans and programmes and assessing development proposals. For lands identified as at risk of flooding in (but not limited to) the Strategic Flood Risk Assessment, a site-specific Flood Risk Assessment (FRA) to an appropriate level of detail, addressing all potential sources of flood risk, is required, demonstrating compliance with the aforementioned Guidelines or any updated version of these guidelines, paying particular attention to residual flood risks and any proposed site-specific flood management measures.

South Dublin County Council's flood risk management policies and objectives in Draft Development Plan 2022-2028 are listed as:

- **IE4:** Ensure the continued incorporation of Flood Risk Management into the spatial planning of the County, to meet the requirements of the EU Floods Directive and the EU Water Framework Directive and to promote a climate resilient County.
    - **IE4 Objective 1:** To require site specific flood risk assessments to be undertaken for all new developments within the County in accordance with The Planning System and Flood Risk Management – Guidelines for Planning Authorities (2009) and the requirements of DECLG Circular P12/2014 and the EU Floods Directive.
    - **IE4 Objective 2:** To require all developments in the County to be designed and constructed in accordance with the "Precautionary Principle" detailed in the OPW Guidelines.
    - **IE4 Objective 3:** To continue to support and co-operate with the Office of Public Works in delivering the relevant Catchment-Based Flood Risk Assessment and Management Programme.
    - **IE4 Objective 4:** To support and facilitate the delivery of flood alleviation schemes in South Dublin County.
    - **IE4 SLO 1: T**o require the preparation of a site and catchment specific Flood Risk Assessment and Mitigation Strategy, prepared by a qualified person(s), to be submitted with any proposal for development on the 'EE' zoned lands at Moneenalion Commons Upper, Baldonnell (See Development Plan Map).

4.2.3 SuDS Policies

SuDS is a series of management practices and control structures that aim to mimic natural drainage. SuDS reduces flood risk, improves water quality, and provides amenity through the use of permeable paving, swales, green roofs, rainwater harvesting, detention basins, ponds and wetlands. For further information, refer to Section 5.

The following policies provided are as set out in DCC and SDCC Development Plans (2016-2022) and Draft Development Plans (2022-2028).

4.2.3.1 Dublin City Council's Policies

Dublin City Council's Development Plan 2016-2022 and SuDS policy is provided in the following paragraph.

SI18: To require the use of Sustainable Urban Drainage Systems in all new developments, where appropriate, as set out in the Greater Dublin Regional Code of Practice for Drainage Works. The following measures will apply:

- The infiltration into the ground through the development of porous pavement such as permeable paving, swales, detention basins.
- The holding of water in storage areas through the construction of green roofs, rainwater harvesting, detention basins, ponds, wetlands.
- The slowdown of the movement of water

Dublin City Council's SuDS policies in Draft Development Plan 2022-2028 are:

- **SI22**: To require the use of Sustainable Drainage Systems (SuDS) in all new developments, where appropriate, as set out in the Greater Dublin Strategic Drainage Study (Vol 2: New Development)/ Greater Dublin Regional Code of Practice for Drainage Works. Sustainable Drainage Systems (SuDS) should incorporate nature-based solutions and be designed in accordance with the Dublin City Council Sustainable Drainage Design and Evaluation Guide (2021). SuDS should protect and enhance water quality through treatment at source while enhancing biodiversity and amenity.
- **SI23**: To require all new developments with roof areas in excess of 100 sq. metres to provide for a green blue roof designed in accordance with the requirements of Dublin City Council's Green and Blue Roof Guide (2021).
- **SI24**: To require that all surface water run-off from new/extended domestic driveways, repaired/replacement driveways, and vehicular entrances (where such development is not exempted from the requirement to obtain planning permission) is managed through the use of SuDS, ensuring no increase in surface water discharges to the public drainage network.
- **SI25**: To require the preparation of a Surface Water Management Plan as part of all new developments in accordance with the requirements of the Council's Surface Water Management Guidance.
- **SI26**: To require that all new surface water infrastructure within public or private developments be constructed in accordance with the standards set out within the Greater Dublin Regional Code of Practice for Drainage Works, irrespective of the management and maintenance regime proposed for the development or whether the development is intended

to be taken in charge, in full or in part (i.e., infrastructure shall be designed to taking in charge standards).

DCC published a design and evaluation guide for SuDS in Q4 2021. The document aims to guide the designers in SuDS for new developments within the DCC region. It is also intended to support the evaluation of planning applications against the Policies and Standards set out in Dublin City Development Plan 2022-2028. The guide provides comprehensive information on Stage 1, Stage 2, and Stage 3 design process with examples

4.2.3.2 South Dublin County Council's Policies

South Dublin County Council Development Plan (2016-2022) and SuDS policies are:

- **IE2-3:** To maintain and enhance existing surface water drainage systems in the County and promote and facilitate the development of Sustainable Drainage Systems (SuDS), including Integrated Constructed Wetlands, at a local, district and County level, to control surface water outfall and protect water quality.
- **IE2-4:** To incorporate Sustainable Drainage Systems (SuDS) as part of Local Area Plans, Planning Schemes, Framework Plans and Design Statements to address the potential for Sustainable Drainage at a site and/or district scale, including the potential for wetland facilities.
- **IE2-5:** To limit surface water runoff from new developments through the use of Sustainable Drainage Systems (SuDS) and avoid the use of underground attenuation and storage tanks.
- **IE2-6:** To promote and support the retrofitting of Sustainable Drainage Systems (SuDS) in established urban areas, including integrated constructed wetlands.
- **G5-1:** To promote and support the development of Sustainable Drainage Systems (SuDS) at a local, district, and county level and to maximise the amenity and biodiversity value of these systems

South Dublin County Council's SuDS policies and objectives in Draft Development Plan 2022-2028 are listed as:

- **IE3:** Manage surface water and protect and enhance ground and surface water quality to meet the requirements of the EU Water Framework Directive.

- **IE3 Objective 1:** To maintain, improve and enhance the environmental and ecological quality of our surface waters and groundwater by implementing the relevant programme of measures set out in the River Basin Management Plans.
- **IE3 Objective 2:** To maintain and enhance existing surface water drainage systems in the County and to require Sustainable urban Drainage Systems (SuDS) in new development including, where feasible, integrated constructed wetlands, at a local, district and County level, to control surface water outfall and protect water quality.
- **IE3 Objective 3:** To protect the regionally and locally important aquifers within the County from risk of pollution.
- **IE3 Objective 4:** To continue efforts to improve water quality under the Local Government (Water Pollution) Act 1977, as amended and by implementing the measures outlined under the Nitrates Directive (91/676/EEC) and the current National Nitrates Action Programme (NAP) and all other relevant legislation.
- **IE3 Objective 5:** To generally prohibit development within restricted areas identified on the Bohernabreena/Glenasmole Reservoir Restricted Areas Map.
- **IE3 Objective 6:** To protect salmonid water courses, such as the Liffey and Dodder River catchments (including Bohernabreena Reservoir), which are recognised to be exceptional in supporting salmonid fish species.
- **IE3 Objective 7:** To protect surface water quality by continuing to assess the impact of domestic and industrial misconnections to the drainage network in the County and the associated impact on surface water quality, and by implementing measures to address same, and to diagnose and repair any misconnections in Council housing stock as part of the re-letting process.

4.2.4 Green Infrastructure Policies

The following policies provided are as set out in DCC and SDCC Development Plans (2016-2022) and Draft Development Plans (2022-2028).

4.2.4.1 Dublin City Council's Policies

DCC Development Plan 2016 – 2022 Green infrastructure policies relevant to drainage and flood risk management are:

- **GI2**: That any plan/project, either individually or in combination with other plans or projects that has the potential to give rise to significant effect on the integrity of any European Site(s)

shall be subject to an appropriate assessment in accordance with Article 6(3) and 6(4) of the EU Habitats Directives.

- **GI4**: To co-ordinate open space, biodiversity, and flood management requirements, in progressing a green infrastructure network.
- **GI9:** To incorporate open space into the green infrastructure network for the city providing a multi-functional role including urban drainage, flood management, biodiversity, outdoor recreation, and carbon absorption.
- **GI14**: To promote the development of soft landscaping in public open spaces, where feasible, in accordance with the principles of Sustainable Urban Drainage Systems.

The following key principles for green and blue infrastructure are also identified by DCC in Dublin city Development Plan 2016-2022 – Appendix 23:

- Increase habitat protection to support the wider green infrastructure network.
- Provide additional green space to meet deficiencies in connectivity of the green infrastructure network.
- Ensure retention of mature habitats and provide for long-term ecological succession.
- Increase connections and improve accessibility for pedestrians and cyclists to the wider green infrastructure network.
- Apply sustainable urban drainage systems (SUDS) and soft engineering solutions to protect water quality and mitigate the environmental impacts of flooding and erosion.
- Provide for public access to ensure that the benefits of access to the green infrastructure network is available to all citizens
- Ensure that proposed developments do not create negative impacts on the existing green infrastructure network.

Dublin City Council's green infrastructure policies in Draft Development Plan 2022-2028 are:

- **GI1**: To identify and protect the integrity of the city's GI assets, as appropriate, and to enhance and expand the connectivity, multi-functionality, and accessibility of the city's green infrastructure network, while addressing gaps in the network.
- **GI2**: To develop an interconnected green infrastructure network of strategic natural and semi-natural areas with other environmental features including green spaces, rivers, canals, the

coastal and marine area, and other physical features including streets and civic spaces that supports ecological, wildlife, and social connectivity.

- **GI3**: To ensure delivery of multifunctional green and civic spaces that meet community needs, support biodiversity, promote active and passive recreation, flood, and surface water management and local habitat improvements. The multi- functionality of spaces will be balanced against the need to protect and enhance local habitat and the recreational and functional requirements of parks.

- **GI4**: To ensure universal design for access for all to the green infrastructure network. Priority of access is to be given to pedestrians over all other users. In line with the Parks Strategy, access to facilities and to public parks and open spaces will be provided equally to all citizens and inequalities of access shall be identified and addressed.

- **GI5**: To integrate urban greening features including nature-based solutions into the existing public realm where feasible and into the design of public realm projects for civic spaces and streets. The installation of living green walls will be encouraged to the fullest possible extent throughout the city of Dublin.

- **GI6**: To integrate Green Infrastructure and an ecosystem services approach into new developments / new growth areas in the city that contributes to the city's green infrastructure network by its extension and enhancement and that provides for the environmental resilience of new development.

- **GI7**: To avoid the fragmentation of green spaces in site design and to link green spaces/greening elements to existing adjacent green infrastructure/the public realm where feasible and to provide for ecological functions.

- **GI8**: To support the development of Metropolitan Greenways connecting Dublin Bay to regional and national greenway projects, subject to careful routing and design to ensure ecological functions are maintained and existing biodiversity and heritage is protected and enhanced. The delivery of Metropolitan Greenways is identified in the National Planning Framework as one of the key enablers for the growth of Dublin City.

The following policy for green and blue roofs are identified by DCC in Green and Blue Roof Guide (2021): **S123**: To require all developments with roof areas in excess of 100 sq. metres to provide for a green blue roof in accordance with the requirements of Dublin City Council's Green & Blue Roof Guide (2021)

4.2.4.2 South Dublin County Council's Policies

SDCC Development Plan 2016 – 2022 Green infrastructure policies relevant to drainage and flood risk management are:

- **G1 Overarching**: It is the policy of the Council to protect, enhance and further develop a multifunctional Green Infrastructure network by building an interconnected network of parks, open spaces, hedgerows, grasslands, protected areas, and rivers and streams that provide a shared space for amenity and recreation, biodiversity protection, flood management and adaptation to climate change.
- **G3-3**: To ensure the protection, improvement, or restoration of riverine floodplains and to promote strategic measures to accommodate flooding at appropriate locations, to protect ground and surface water quality and build resilience to climate change.

South Dublin County Council's green infrastructure policies and objectives in Draft Development Plan 2022-2028 are listed as:

- **GI1:** Protect, enhance, and further develop a multifunctional GI network, using an ecosystem services approach, protecting, enhancing and further developing the identified interconnected network of parks, open spaces, natural features, protected areas, and rivers and streams that provide a shared space for amenity and recreation, biodiversity protection, water quality, flood management and adaptation to climate change.
    - **GI1 Objective 1:** To establish a coherent, integrated and evolving GI Network across South Dublin County with parks, open spaces, hedgerows, trees including public street trees and native mini woodlands (Miyawaki-Style), grasslands, protected areas and rivers and streams and other green and blue assets forming strategic links and to integrate and incorporate the objectives of the GI Strategy throughout all relevant land use plans and development in the County.
    - **GI1 Objective 2:** To implement and monitor the South Dublin County GI Strategy during the lifetime of this plan and develop a fit for purpose GI scoring for the County which will support ongoing identification, protection, enhancement and management of GI in the County and which will enable the assessment and monitoring of GI interventions in the County.
    - **GI1 Objective 3:** To facilitate the development and enhancement of sensitive access to and connectivity between areas of interest for residents, wildlife and biodiversity, and other distinctive landscapes as focal features for linkages between natural, semi

natural and formalised green spaces where feasible and ensuring that there is no adverse impact (directly, indirectly or cumulatively) on the conservation objectives of Natura 2000 sites and protected habitats outside of Natura 2000 sites.

- **GI1 Objective 4:** To require development to incorporate GI as an integral part of the design and layout concept for all development in the County including but not restricted to residential, commercial and mixed use through the explicit identification of GI as part of a landscape plan, identifying environmental assets and including proposals which protect, manage and enhance GI resources providing links to local and countywide GI networks.
- **GI1 Objective 5:** Continue to liaise with adjoining local authorities to ensure the protection and enhancement of cross county GI corridors
- **GI1 Objective 6:** To collaborate with Kildare County Council to identify a common approach to a greenbelt/green spaces between the growing settlements within South Dublin and Kildare County Councils within the lifetime of the Development Plan and to advise the councillors of any such collaboration and proposed study or approach.
- **GI1 Objective 7:** To develop linked corridors of small urban 'Miyawaki' native mini-woodlands, a minimum of 100sqm in size, to capture carbon and encourage biodiversity in suitable existing built-up areas, in low grade parkland, and other areas of zoned lands where deemed suitable and appropriate.
- **GI1 Objective 8:** To increase over the lifetime of this plan the percentage of land in the County, including residential, managed for biodiversity including supporting the delivery of the objectives of the County Pollinator Plan and to continue to investigate the potential for the use of low-mow methods during the lifetime of the Plan.

- **GI2:** Strengthen the existing GI network and ensure all new developments contribute towards GI, in order to protect and enhance biodiversity across the County as part of South Dublin County Council's commitment to the National Biodiversity Action Plan 2021- 2025 and the South Dublin County Council Biodiversity Action Plan, 2020-2026, the National Planning Framework (NPF)and the East Region Spatial and Economic Strategy (RSES).
    - **GI2 Objective 1:** To reduce fragmentation and enhance South Dublin County's GI network by strengthening ecological links between urban areas, Natura 2000 sites, proposed Natural Heritage Areas, parks and open spaces and the wider regional network by connecting all new developments into the wider GI Network.

- **GI2 Objective 2:** To protect and enhance the biodiversity and ecological value of the existing GI network by protecting where feasible (and mitigating where removal is unavoidable) existing ecological features including tree stands, woodlands, hedgerows and watercourses in all new developments as an essential part of the design and construction process.
- **GI2 Objective 3:** To retrospectively repair habitat fragmentation and provide for regeneration of flora and fauna where weaknesses are identified in the network through the implementation of new GI interventions.
- **GI2 Objective 4:** Integrate GI, and include areas to be managed for biodiversity, as an essential component of all new developments.
- **GI2 Objective 5:** To protect and enhance the County's hedgerow network, in particular hedgerows that form townland, parish and barony boundaries recognising their historic and cultural importance in addition to their ecological importance and increase hedgerow coverage using locally native species including a commitment for no net loss of hedgerows on any development site and to take a proactive approach to protection and enforcement.
- **GI2 Objective 6:** To continue to support and expand the County Pollinator Plan through the management and monitoring of the County's pollinator protection sites as part of the Council's commitment to the provisions of the National Pollinator Plan 2021-2025.
- **GI2 Objective 7:** To enhance the biodiversity value of publicly owned hard infrastructure areas by incorporating the planting of new trees, grasses and other species, thereby integrating this infrastructure into the overall GI network.
- **GI2 Objective 8:** To take all possible steps to mitigate the impacts on biodiversity of increased recreation within the GI network, bearing in mind the effects of scramblers, dogs, drones, littering and illegal dumping.
- **GI2 Objective 9:** To exploit the full potential of existing underutilised perimeter and border park spaces through the augmentation of wild grasses and other naturally occurring vegetation that enhance local area biodiversity and habitats in support of the National Pollinator Plan and to consider wildflower meadows where beneficial to biodiversity.

- **GI2 Objective 10:** To enhance biodiversity and the health of pollinator species by banning the use of glyphosphate in or close to public parks, public playgrounds, community gardens/allotments and within residential estates, whether by directly employed Local Authority staff or private contractors.

- **GI3:** Protect and enhance the natural, historical, amenity and biodiversity value of the County's watercourses. Require the long-term management and protection of these watercourses as significant elements of the County's and Region's Green Infrastructure Network and liaise with relevant Prescribed Bodies where appropriate. Accommodate flood waters as far as possible during extreme flooding events and enhance biodiversity and amenity through the designation of riparian corridors and the application of appropriate restrictions to development within these corridors.

    - **GI3 Objective 1:** To ensure that hydromorphological assessments are undertaken where proposed development is within lands which are partially or wholly within the Riparian Corridors identified.

    - **GI3 Objective 2:** To require development proposals that are within riparian corridors to demonstrate how the integrity of the riparian corridor can be maintained and enhanced having regard to flood risk management, biodiversity, ecosystem service provision, water quality and hydromorphology.

    - **GI3 Objective 3:** To promote and protect native riparian vegetation along all watercourses and ensure that a minimum 10m vegetated riparian buffer from the top of the riverbank is maintained/reinstated along all watercourses within any development site.

    - **GI3 Objective 4:** To uncover existing culverts where appropriate and in accordance with relevant river catchment proposals to restore the watercourse to acceptable ecological standards for biodiversity wherever possible improving habitat connection and strengthening the County's GI network.

- **GI4:** Require the provision of Sustainable Urban Drainage Systems (SUDS) in the County and maximise the amenity and biodiversity value of these systems.

    - **GI4 Objective 1:** To limit surface water run-off from new developments through the use of Sustainable Urban Drainage Systems (SuDS) using surface water and nature-based solutions and ensure that SuDS is integrated into all new development in the

County and designed in accordance with South Dublin County Council's Sustainable Drainage Systems (SuDS) Explanatory, Design and Evaluation Guide.

- **GI4 Objective 2:** To incorporate a SuDS management train during the design stage whereby surface water is managed locally in small sub-catchments rather than being conveyed to and managed in large systems further down the catchment.
- **GI4 Objective 3:** To require multifunctional open space provision within new developments to include provision for ecology and sustainable water management.
- **GI4 Objective 4:** To require that all SuDS measures are completed to a taking in charge standard.
- **GI4 Objective 5:** To promote SuDS features as part of the greening of urban and rural streets to restrict or delay runoff from streets entering the storm drainage network.
- **GI4 Objective 6:** To maintain and enhance existing surface water drainage systems in the County and promote and facilitate the development of Sustainable Urban Drainage Systems (SUDS), including integrated constructed wetlands, at a local, district and County level, to control surface water outfall and protect water quality.

- **GI5:** Strengthen the County's GI in both urban and rural areas to improve resilience against future shocks and disruptions arising from a changing climate.
  - **GI5 Objective 1:** Protect and enhance the rich biodiversity and ecosystems in accordance with the ecosystem services approach to development enabling mitigation of climate change impacts, by absorbing excess flood water, providing a buffer against extreme weather events, absorbing carbon emissions and filtering pollution.
  - **GI5 Objective 2:** To protect and enhance the natural regime of the watercourses of the County to more efficiently capture their flood resilience value.
  - **GI5 Objective 3:** To ensure compliance with the South Dublin Climate Change Action Plan and the provisions of the Council's Tree Management Strategy.
  - **GI5 Objective 4:** To implement an urban greening factor for all new developments subject to an appropriate scoring mechanism being developed for the County based on best international standards and its appropriate application to the unique features of the County. Developers will be required to demonstrate how they have achieved

urban greening targets based on the scoring mechanism developed through relevant interventions as part of the proposed development.

- **GI5 Objective 5:** To promote positive land and soil protection measures to avoid degradation or loss of natural soil resources, to minimise sealing of soils and to remediate contaminated land.
- **GI5 Objective 6:** To provide more tree cover across the county, in particular to areas that are lacking trees.
- **GI5 Objective 7:** Require the provision of green roofs and green walls, providing benefits for biodiversity and as an integrated part of Sustainable Drainage Systems (SuDS) and Green Infrastructure, in apartment, commercial, leisure and educational buildings, wherever possible and develop an evidence base for specific green roof requirements as part of the Council's ongoing SuDS strategy development.

The following key principles for green and blue infrastructure are also identified by SDCC in Clonburris Strategic Development Zone – Planning Scheme Report (2019):

- To protect, enhance and develop an interconnected green and blue infrastructure network of parks, open spaces, hedgerows, grasslands, protected areas, rivers and streams for amenity and recreation, biodiversity protection, flood management and adaptation to climate change.
- To retain and improve key landscape and ecological features
- To incorporate new elements of Green and Blue Infrastructure such as tree planting, parks and natural open spaces and sustainable urban drainage systems.
- To reduce fragmentation and strengthen ecological links.
- To connect parks and areas of open space with ecological and recreational corridors to aid the movement of biodiversity and people and to strengthen the overall Green Infrastructure network.
- To support native plant and animal species and encourage corridors for their movement.
- To seek to retain hedgerows, aquatic habitats, and established tree lines wherever possible.

4.2.5 Climate Change Policies

The OPW has prepared a Climate Change Sectoral Adaptation Plan for Flood Risk Management, in line with the requirements of the National Adaptation Framework and the Climate Action Plan 2021.

Dublin City Council's and South Dublin County Council's climate change mitigation policies are provided in the following sections.

The following policies provided are as set out in DCC and SDCC Development Plans (2016-2022) and Draft Development Plans (2022-2028).

A Climate Action Plan has also been prepared for City Edge which identifies opportunities to address urban climate adaptation issues (i.e., SuDS, heat island effect, etc.) on the City Edge lands and should be read in conjunction with this SWMP.

4.2.5.1 Dublin City Council's Policies

DCC Development Plan 2016 – 2022 climate change policies are:

- **CC1**: To prioritise measures to address climate change by way of both effective mitigation and adaptation responses in accordance with available guidance and best practice.
- **CC5**: To address flood risk at strategic level through the process of strategic flood risk assessment, and through improvements to the city's flood defences.

Dublin City Council's climate change policies in Draft Development Plan 2022-2028 are:

- **CA1**: To support the implementation of national objectives on climate change including the 'Climate Action Plan 2019 to Tackle Climate Breakdown', the 'National Adaptation Framework' 2018 and the 'National Energy and Climate Plan for Ireland 2021-2030' and other relevant policy and legislation.
- **CA2**: To prioritise measures to address climate change by way of both effective mitigation and adaptation responses in accordance with available guidance and best practice.
- **CA25**: To support the delivery of soft, green, and grey adaptation measures to enhance flood and water resource resilience in the city and support the delivery of grey adaptation measures to enhance flood and water resource resilience where necessary.
- **CA26**: To address flood risk at strategic level through the process of Strategic Flood Risk Assessment, and through improvements to the city's flood defences.
- **CA27**: To encourage the use natural flood risk mitigation or nature-based solutions including integrated wetlands, green infrastructure, and Sustainable Drainage Systems (SuDS) as part of wider adaptation and mitigation responses to achieve flood resilience.

- **CA28**: To protect, connect and expand the city's Green Infrastructure while optimising the climate change adaptation and mitigation services it provides.
- **CA29**: To support coastal zone management measures for adapting to climate change which include restoration of degraded ecosystems, increased flood resilience, water quality improvement, habitat conservation and provision of amenities for the residents and visitors of Dublin city.

4.2.5.2 South Dublin County Council's Policies

SDCC Development Plan 2016 – 2022 climate change policies are:

- Development of further flood alleviation schemes
- Cross-boundary flood management with neighbouring local authorities
- Coordinating our emergency response plans

South Dublin County Council's climate change policies and objectives in Draft Development Plan 2022-2028 are listed as:

- **CA1:** To support the implementation of International and National objectives on climate action including the Climate Action and Low Carbon Development Act 2015 (and any amending legislation), the 'Climate Action Plan 2019' (and any updated Plans) and ensure that South Dublin's Climate Change Action Plan and County Development Plan are aligned
    - **CA1 Objective 1:** To collaborate with the Eastern Midland Regional Authority (EMRA), the Dublin Metropolitan Climate Action Regional Office (Dublin CARO), City of Dublin Energy Management Agency (Codema) and the Sustainable Energy Authority of Ireland (SEAI) to achieve the climate action policies and objectives set out in the Eastern and Midland Region Spatial and Economic Strategy.
    - **CA1 Objective 2:** To ensure spatial and infrastructure planning are consistent with climate mitigation and adaptation objectives.
    - **CA1 Objective 3:** To implement the South Dublin County Council Climate Change Action Plan 2019 - 2024 (SDCC CCAP) or superseding plans and to facilitate a just transition to a climate resilient low carbon County.

4.3 Responsibilities

4.3.1 Department of Housing, Local Government and Heritage

Department of Housing, Local Government and Heritage and The Office of Public Works (OPW) jointly published "The Planning System and Flood Risk Management Guidelines for Planning Authorities and Technical Appendices" in November 2009. The aim of this publication is to ensure a systematic approach to assessment of flood risk and managing those risks in design of new developments.

This document defines the responsibilities of regional authorities, local authorities (LA), OPW, developers, and planners with recommendations for surface water management.

4.3.2 Office of Public Works

The Office of Public Works (OPW), part of the Department of Public Expenditure and Reform, is the lead agency for the co-ordination and implementation of Government policy on flood risk management in Ireland. OPW develops and implements policies and strategies for flood risk management The OPW is also the national authority for the implementation of the EU Directive on the Assessment and Management of Flood Risks [2007/60/EC].

The primary functions of the OPW Flood Risk Management Programme are:

- to develop and deliver on flood risk management work programmes and measures;
- to maintain an effective programme of maintenance of river courses drained under the provisions of the Arterial Drainage Acts; and
- to advise the Government on flood risk management and flood risk management policy.

4.3.3 Irish Water

Irish Water is responsible for flooding from the combined sewers that are generally found in older urban areas. Responsibility for implementation and operation of stormwater drainage networks belongs to the relevant Local Authority (LA) or the OPW.

Some of the combined sewers do not have the capacity to handle heavy rainfall and this can result in sewer flooding. During intense rainfall, the combined sewer overflows (CSOs) also discharge excess flows into nearby watercourses. Irish Water is proposing several strategies to deal with these issues, including identifying and recording properties at risk of flooding from combined sewers and implementing measures to reduce and mitigate the risk, and also to deliver measures to reduce the pollution impact from combined sewer overflows. It is also noted that in Water Services Strategic Plan, Irish Water recognise that climate change will cause greater frequency of extreme weather events and

it will be important to adapt their assets to be resilient to climate change impacts and to mitigate their impact by reducing their carbon footprint.

4.3.4 Local Authorities (Councils)

Local Authorities are responsible for introducing flood risk assessments in accordance with "The Planning System and Flood Risk Management Guidelines for Planning Authorities and Technical Appendices, 2009". All local area plans (LAPs) are to be supplemented by detailed Site-Specific Flood Risk Assessments.

Local Authorities are also responsible for the repair and maintenance of flood and coastal defence structures in their ownership and management.

4.3.5 Developers

Developers are required to carefully examine their development proposals to ensure consistency with the requirements set out in 'The Planning System and Flood Risk Management Guidelines for Planning Authorities and Technical Appendices, 2009' and within this SFRA. This includes thoroughly investigating whether there have been instances of flooding on specific sites and stating any known flood history on the planning application form as required. Developers are also encouraged to engage with the Local Authorities at an early stage regarding any flood risk assessment issues that may arise. They are required to carry out a Site-Specific Flood Risk Assessment and comply with the terms and conditions of any grant of planning permission with regards to the minimisation of flood risk.

4.3.6 Property Owners

It is the responsibility of property owners to look after their property which includes protecting it from flooding. It is a vital role of individuals, communities, and businesses to manage flood risks.

Property or landowners who own land which is adjacent to a watercourse, or which has a watercourse running through it, are riparian owners and have certain legal responsibilities to maintain the watercourse. Where a watercourse marks the boundary between adjoining properties, it is normally presumed the riparian owner owns the land up to the centre line of the watercourse.

5 SUSTAINABLE DRAINAGE PRINCIPLES

5.1 Overview

A sustainable approach to drainage is to manage the surface water runoff from rainfall near to where it lands, at source, and to consider carefully where excess runoff is discharged by following a hierarchical approach.

The SuDS Manual (2015) is the principal document that is being followed on foot of the SFRA for the Strategic Framework and the Flood Risk Management Guidelines for Planning Authorities (OPW, 2009) to shape proposals around a SWMP for the City Edge Project lands.

A sustainable drainage system (SuDS) is designed to reduce the potential impact of development with respect to surface water drainage discharge. SuDS philosophy considers rainwater as a natural resource to control whereas traditional piped surface water sewerage systems consider rainwater as wastewater to convey.

Conventional drainage systems concentrate runoff, causing pollution and/or flooding if their limited capacity is exceeded during storm events. SuDS deliver effective long-term surface water site drainage and can have significant secondary benefits by minimising a development's impact on the receiving environment and where possible deliver additional amenity, environmental and biodiversity benefits.

These principles are considered as part of this SWMP.

5.2 Surface Water and Urbanization

When rain falls on a natural catchment it may evaporate or infiltrate into the soil, nourishing the natural habitat by replenishing groundwater or flowing overland into ponds and watercourses.

In urbanised areas where many surfaces are covered by buildings and paving, natural infiltration is limited. Instead, conventional drainage networks consisting of pipes and culverts concentrate the direct discharge to specific parts of the local watercourse.

Pipe and culvert networks often increase both the velocity and volume of surface water runoff and can cause flooding downstream. These networks can also cause deterioration in river water quality caused by diffuse pollution. Additionally, when combined sewers are overwhelmed by surface water, they must release polluted water into other receiving water bodies. The likely impact of climate change of more intense rainfall will worsen this situation further.

5.3 SuDS Management Train

The concept used in development of sustainable drainage systems is the SuDS management train. As in a natural catchment, drainage techniques can be used in series to change the flow and quality characteristics of the runoff in stages. Figure 5-1 outlines the integrated sequence of measures employed in a SuDS scheme.

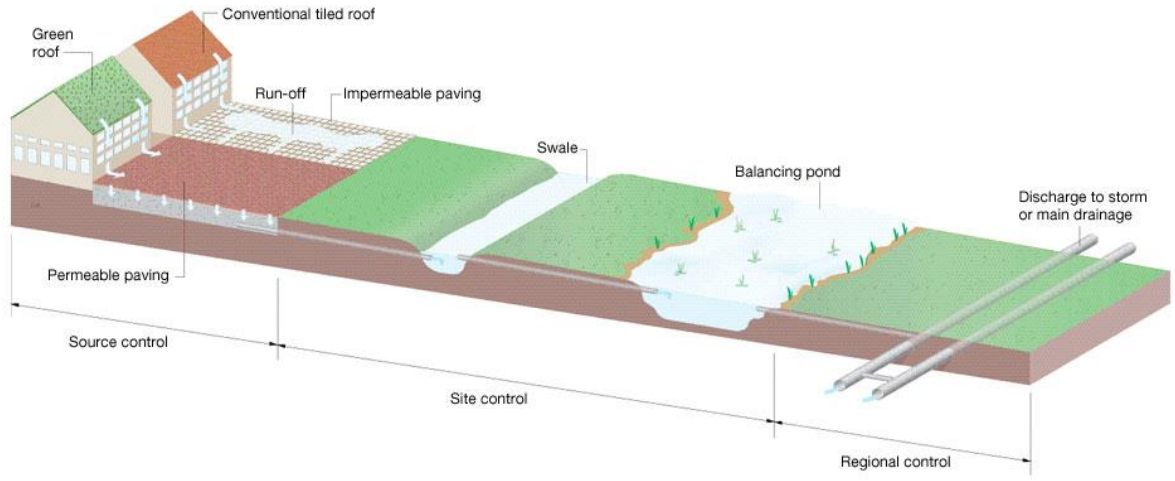


Figure 5-1: Example of a SuDS Management Train (source: permcalc.co.uk)

5.3.1 Prevention

This may include good housekeeping and site design to reduce and manage runoff and pollution, e.g., land-use planning, reduction of paved surfaces.

5.3.2 Source Control

This management train approach aims to retain as much rainwater as possible as close to where it falls, as is feasible, which is called Source Control. Runoff managed as close to the source as possible, e.g., green roofs, rainwater harvesting, permeable paving, and filter stripes.

5.3.3 Site Control

Runoff managed in a network across a site or local area, e.g., swales, detention basins, public realm SuDS components for attenuation and treatment.

5.3.4 Catchment/Regional Control

This provides a natural method of handling excess water thereby reducing the risk of flooding events. Typically, it includes downstream management of runoff for a subcatchment or a whole catchment, e.g., retention ponds, wetlands.

5.4 SuDS Design Principles

SuDS should be based on the four pillars of SuDS design as set out in CIRIA C753 The SuDS Manual 2015. These are listed as:

- Water quantity
- Water quality
- Amenity
- Biodiversity

5.4.1 Water Quantity

SuDS mitigate the impact of everyday rainfall and high-intensity storms by dealing with the same quantity of water over a longer period. This process is called attenuation.

Attenuation aims to limit the rate of runoff to the rate which would have existed before the area was developed (that is a greenfield rate). Hydraulic criteria defined in the GDSDS, and Regional Drainage Code of Practice restricts the surface runoff from new developments to 2 l/s/ha for 1% AEP rainfall event. Structures, such as inlets, outlets, weirs, and spillways can be used to regulate flow.

Water quantity refers to the volume and flow rate of surface water runoff. Restricting the flow of surface water before it can pass through to the next stage of the system alleviates pressure on the sewer system.

5.4.2 Water Quality

Surface water is often polluted. Runoff from roads, for example, includes contaminants from tyre abrasion such as rubber and soot, nickel and chromium from brake pad linings and oil, silt and iron oxide from general traffic use.

During warm, dry periods, these substances build up on sun-warmed surfaces and heavy showers can wash them into the drainage system. This creates a warm, contaminated, low-oxygen water mix, which flows into watercourses and groundwater.

Managing the quality of runoff helps protect the natural environment from pollution and SuDS can be crucial in this respect. The risk of pollution in a SuDS scheme must be assessed and a mitigation strategy proposed to determine the required number of treatment stages to ensure water is clean enough to flow to a watercourse. SuDS can also improve the quality of water entering combined sewers, reducing pressure on sewage treatment plants.

Improvements to water quality can also contribute to amenity and the potential for biodiversity. Reed beds, for example, which naturally slow and treat water, provide an active edge to water features and attract a wide range of birds and insects. Designing for water quality must take account of:

- Interception and treatment methods to meet CIRIA C753 standards SuDS Manual (2015)
- The quality of surface water and groundwater receiving run-off
- The extent of existing pollution control systems in the catchment
- The extent to which risk management measures for spillages of contaminants, such as oil, are in place
- The proportion of permeable surfaces, green roofs, and/or surfaces discharging to a rainwater harvesting system or soil-based feature
- The proportion of the surface water management system that is on or near the surface to facilitate treatment
- The extent to which the design of the system incorporates sediment retention, such as forebays or hydrodynamic separators
- System resilience to cope with future demand, including allowances for climate change and urban intensification

5.4.3 Amenity

The way a city's public realm looks and feels has a direct effect on people's quality of life. As the population grows, this becomes increasingly important. SuDS may enhance the amenity of a city's public realm in a range of different ways, including:

- Contributing to integrated green infrastructure
- Enhancing character/sense of place
- Improving the quality of space
- Providing a backdrop to existing buildings and streetscape
- Supporting biodiversity
- Reducing air temperature
- Improving air quality

- Reconnecting people with the natural water cycle
- Supporting community involvement and knowledge-sharing though education, engagement, and participation

By including surface drainage as part of an integrated urban design approach, SuDS can make a major contribution to the look and feel of streets and other spaces throughout the city.

5.4.4 Biodiversity

Natural habitats, catchments and river ecosystems have been disrupted by urbanisation and intensification. SuDS can address this by incorporating and creating a range of habitats that benefit water quality and urban wildlife. Aspects of biodiversity that can be addressed by sustainable drainage include:

- Habitat creation, including the significant existing and potential urban forest resource of street trees and parkland trees
- Connectivity and the ability of fauna and flora to move through the city, especially along linear infrastructure such as road, rail, and canal corridors
- Source control with living roofs, green walls, trees, and other green infrastructure, which can also help intercept rainwater and mitigate the urban heat island effect
- Improvements to air and water quality

The goals of the *Government of Ireland Department of Culture, Heritage and the Gaeltacht, "Ireland's Biodiversity Sectoral Climate Change Adaptation Plan"* is to protect biodiversity from the impacts of climate change and to conserve and manage ecosystems so that they deliver services that increase the adaptive capacity of people and biodiversity.

5.5 EU Water Framework Directive

The Water Framework Directive requires member states to make plans to protect and improve the water environment. It applies to all surface freshwater bodies, including lakes, streams, rivers, and canals; transitional bodies such as estuaries; groundwater; and coastal waters. There are four main aims of the WFD:

- improve and protect inland and coastal waters
- promote the sustainable use of water as a natural resource
- create better habitats for wildlife that live in and around water

- create a better quality of life for everyone

A significant problem is sewage-related pollution of waterbodies. Main nutrients affecting Camac River are provided in Figure 5-2. SuDS can reduce this and therefore help meet WFD requirements.

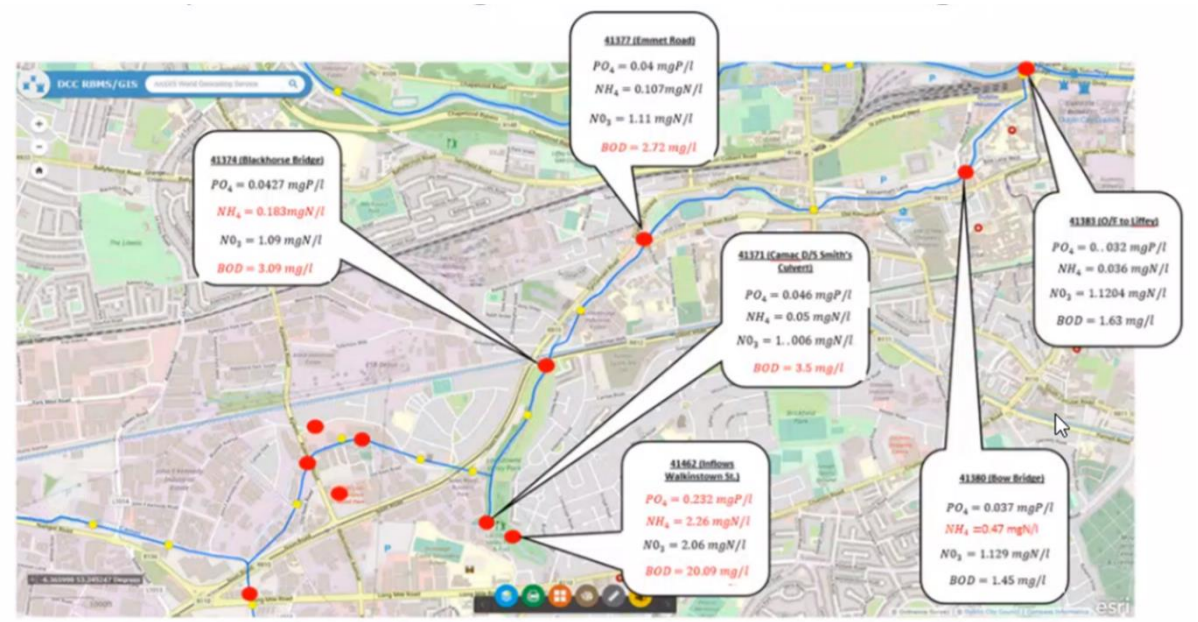


Figure 5-2: Sewage-related exceedances during 2nd and 3rd quarter of 2019 at EPA monitoring points (Source: Dublin City Council)

5.6 Planning and Design of SuDS

Surface water drainage should be considered at the start of the design process to ensure drainage systems are effectively delivered. Features should be integral to the master-planning design of the development from the beginning. This approach should be applied to all sizes of development sites. Overall objectives should consider but not limited to the following:

- Proposals for all development cells include provision for at least two separate SuDS features
- Promote the use of green roofs, alternatives roofs to be routed through vegetated SuDS features where possible
- Runoff from roads adjacent to suitable parkland or landscape strips should be conveyed in vegetated open channel SuDS features
- New streets, walkways and cycle paths incorporate drainage discharges from carriageway runoff to tree pits or similar SuDS features
- New parking areas consider the use of permeable pavements

5.6.1 Planning

It is of utmost importance to keep in mind that not all SuDS components are suitable in all areas. Some development sites may have challenges to delivering SuDS. Sites with low permeability or contaminated soils can be challenging but some SuDS measures are suitable. It should be noted that if the site is located where there is a risk of high groundwater levels special consideration should be given as some SuDS components may be restricted. This should be explored further at preliminary design stage of individual developments. SuDS techniques can also be adapted to deal with lack of space and poor soil infiltration. Poor soil infiltration can be perceived as an obstacle to SuDS implementation and needs to be considered in individual cases. This also should be explored further at preliminary design stage of individual developments. However, some SuDS techniques do not require infiltration and can be designed accordingly, while still providing effective water treatment and attenuation.

Sustainable drainage design manages surface water runoff at source and reduces conveyance as much as it can. To do this water flow across the site needs to be managed. To allow this to happen, drainage needs to be considered before the building placements have been finalised. This will allow the buildings and the SuDS to fit together and, in many cases, complement each other.

5.6.2 Concept Design

Preliminary design stage of specific SuDS schemes/components for individual developments should be conducted to determine:

- A location plan identifying existing natural flow paths. Unless the site topography is radically altered, these corridors will continue to be the preferred flow routes for water even when the development has been completed.
- A site constraints plan identifying potential physical restrictions within the site such as areas of contaminated ground, access issues, or existing utility locations.
- An indication of the hydraulic discharge restrictions that will apply to the site that will impact on the sustainable drainage strategy for the site. This may include agreed discharge restrictions, infiltration potential and potential maintenance issues. Also, will require an estimate of the surface water attenuation volume.

There are some key considerations that may have an impact on the concept design. These are:

- Site characteristics, such as ground conditions, topography, existing infrastructure
- Flood risk, such as flood routes, groundwater level, volume of attenuation required

- Previously developed brownfield sites to reduce the discharge to close to the greenfield rates. This item is particularly important to The Framework area as the area mainly consists of impervious surfaces.

5.6.3 SuDS Design Process

SuDS design process for specific SuDS schemes/components is a series of design steps to be commenced after finalizing concept design. There are several design guides available such as the CIRIA SuDS Manual19 that can be used to inform detailed design. Design process is summarised as:

1. Determine source control requirements. Commercial and industrial sites may have the potential for high pollutant loads greater than for other land uses. Sites with contaminated ground may require sealed attenuation systems to be used.

2. Develop a conceptual design. Select the appropriate system type, location, and size for each proposed system, Sites with steep slopes will typically require more complex engineering.

3. Develop a landscape plan. Appropriate soil and plant selection is critical to the success of a system and must not be left unspecified. Harsh urban conditions may require hardier species.

4. Complete a Sustainable Surface Water Drainage Strategy. Detailed SuDS design (plans and specification etc.) must be prepared or closely supervised by a qualified design professional. Confirm that all design criteria are met.

5. Prepare an operation and maintenance plan. Outline the scope of activities, maintenance schedule, and responsible parties for inspecting and maintaining the system both during the warranty period (if applicable) and for the lifetime of the development.

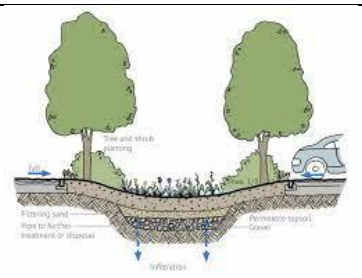
6. Submit final plans and obtain planning permissions and permits. Submit detailed SuDS design and supporting hydraulic calculations for approval to satisfy planning conditions.

7. Construct and inspect. Once detailed SuDS design is approved the developer should ensure construction is undertaken in accordance with agreed design and required programme of construction.

5.7 SuDS Components

SuDS is not a single technique; it is building a collection of techniques across a single system. These components are the elements that can be put together in a variety of ways in order to capture and manage surface water within a site. SuDS components are summarized in Table 5-1.

Table 5-1: Summary of SuDS components

Component	Description	Setting	Required Area
 Green roofs	A planted soil layer is constructed on the roof of a building to create a living surface. Water is stored in the soil layer and absorbed by vegetation.	Building	Building integrated
 Rainwater harvesting	Rainwater is collected from the roof of a building or from other paved surfaces and stored in an overground or underground tank for treatment and reuse locally. Water could be used for toilet flushing and irrigation.	Building	Water storage (Underground or aboveground)
 Soakaway	A soakaway is designed to allow water to quickly soak into permeable layers of soil. Constructed like a dry well, an underground pit is dug filled with gravel or rubble. Water can be piped to a soakaway where it will be stored and allowed to gradually seep into the ground	Open space	Dependent on runoff volumes, water table and soils
 Filter strip	Filter strips are grassed or planted areas that runoff is allowed to run across to promote infiltration and cleansing.	Open space	Minimum length 5m
	Paving which allows water to soak through. Can be in the form of paving blocks with gaps between solid blocks or porous paving where water filters through the block itself. Water can be stored in the sub-base	Street/open space	Can typically drain double its area

Component	Description	Setting	Required Area
Permeable paving	beneath or allowed to infiltrate into ground below.		
 Bioretention area	A vegetated area with gravel and sand layers below designated to channel, filter, and cleanse water vertically. Water can infiltrate into the ground below or drain to a perforated pipe and be conveyed elsewhere. Bioretention systems can be integrated with tree-pits or gardens.	Street/open space	Typically, surface area is 5-10% of drained area with storage below
 Swale	Swales are shallow depressions designed to convey and filter water. These can be 'wet' where water gathers above the surface, or 'dry' where water gathers in a gravel layer beneath. Can be lined or unlined to allow infiltration.	Street/open space	Account for width to allow safe maintenance typically 2–3 metres wide
 Hardscape storage	Hardscape water features can be used to store run-off above ground within a constructed container. Storage features can be integrated into public realm areas with a more urban character.	Street/open space	Could be above or below ground and sized to storage need
 Pond / Basin	Ponds can be used to store and treat water. 'Wet' ponds have a constant body of water and run-off is additional, while 'dry' ponds are empty during periods without rainfall. Ponds can be designed to allow infiltration into the ground or to store water for a period of time before discharge.	Open space	Dependent on runoff volumes and soils

Component	Description	Setting	Required Area
 Wetland	Wetlands are shallow vegetated water bodies with a varying water level. Specially selected plant species are used to filter water. Water flows horizontally and is gradually treated before being discharged. Wetlands can be integrated with a natural or hardscape environment.	Open space	Typically 5–15% drainage area to provide good treatment
 Underground storage (as a last option)	Water can be stored in tanks, gravel or plastic crates beneath the ground to provide attenuation.	Open space	Dependent on runoff volumes and soils

5.8 SuDS Selection

Selection of SuDS techniques depends on several factors. A selection guideline considering 6 major factors is provided in Table 5-2.

Table 5-2: SuDS selection guideline (Source: Woods-Ballard et.al., 2007)

SuDS Component	Flow Rate Control Potential	Runoff Volume Reduction Potential	Maintenance Requirement	Space Take-up	Cost	Public Safety Concerns
Soakaway	High	High	Low	Low	Medium	No
Infiltration basin	High	High	Medium	High	Low	Yes
Filter drains	High	Low	Medium	Low	Medium	No
Filter strips	Medium	Low	High	High	Medium	No
Ponds	Medium	Low	High	High	High	Yes
Constructed wetlands	Medium	Low	High	High	High	Yes
Swales	High	Medium	Low	High	Low	Yes
Detention basins	High	Low	Low	High	Low	Yes
Subsurface storage	High	Low	Low	Low	Medium	No
Permeable pavement	High	High	Medium	Low	Medium	No
Green roof	High	High	High	Low	High	No
Rainwater harvesting	High	Medium	High	Low	High	Yes

Since roads are the major hardstanding areas in an urban environment. Table 5-3 also provides a matrix for SuDS components and their suitability to various road scenarios.

Table 5-3: SuDS selection matrix for roads

SuDS Component / Road Type	Permeable Blocks	Porous Asphalt	Swale	Bioretention Areas	Filter Drains	Retention Basin	Detention Basin	Infiltration Basin	Modular Storage	Tank Storage
Trunk Road	×	×	✓	×	✓	✓	✓	✓	×	✓
Distributor Road	×	×	✓	✓	✓	×	✓	✓	✓	✓
General Access Road	×	ü	✓	✓	✓	×	✓	✓	✓	×
Industrial Access Road	×	×	✓	×	✓	✓	✓	✓	✓	✓
Short Culs-De-Sac	✓	✓	✓	✓	×	×	×	✓	✓	×
Homezone	✓	✓	✓	✓	×	×	×	×	✓	×
Minor Access Link	✓	✓	✓	✓	✓	×	×	✓	✓	×
In-Street Car Parks	✓	✓	×	✓	×	×	×	×	✓	×

SuDS components which are suitable for buildings i.e., green roofs and rainwater harvesting should be designed by individual developers during design phase of each development.

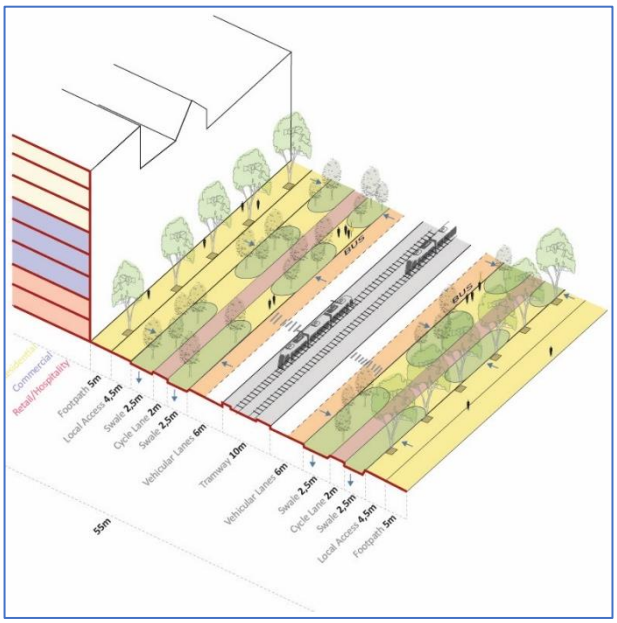
5.9 Districts within Strategic Framework

The Strategic Framework has broken the project area into 5 Districts as shown in Figure 5-3.

Figure 5-3: Districts as identified in the Strategic Framework 2022

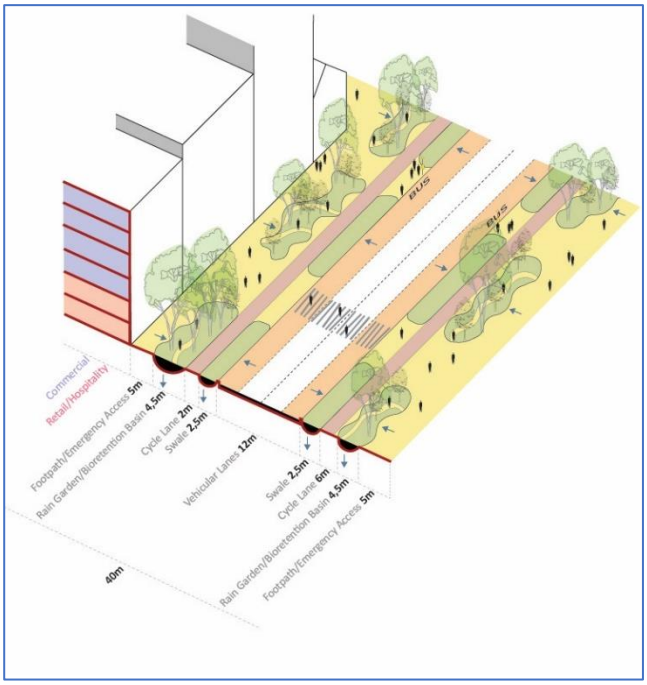
Within these areas, several different road typologies were identified that incorporates SuDS requirements. These include:

Arterial Street:



The Arterial streets, as defined in the Design Manual for Urban Roads and Streets (DMURS) are 'the major routes via which major centres/nodes are connected. They may also include orbital or cross metropolitan routes within larger cities and larger towns.'. Within the City Edge study area these arterial routes will be the highest in the street hierarchy. These movement corridors will be a minimum of 55m in width, incorporating a light rail corridor, bus corridor (ie. bus connects), cycle lanes, local access streets and pedestrian footpaths. Various layers of SUDS techniques can potentially be used across the Arterial typology such as swales, attenuation tanks & permeable pavements.

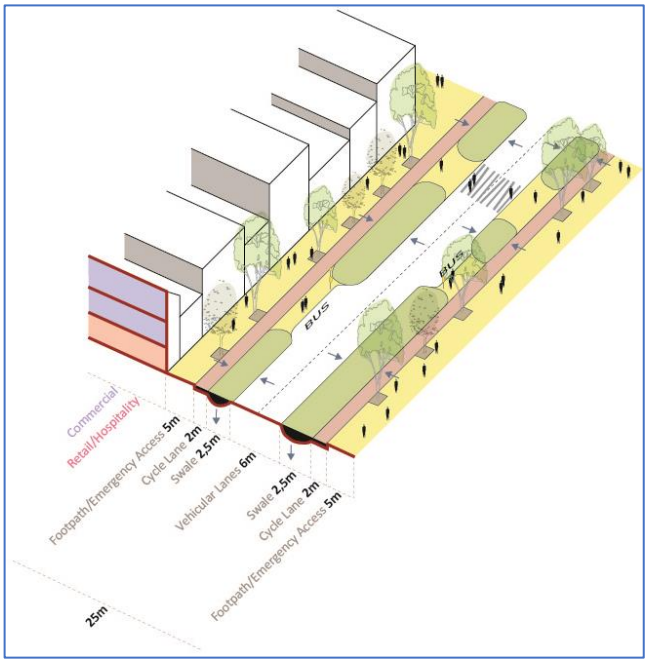
Major Link Street:



Link Streets as defined in the DMURS are 'links to Arterial streets, or between Centres, Neighbourhoods, and/or Suburbs.' We have further sub-divided this street typology into 'Major Link Streets' and Minor Link Streets'. The major link streets would be a minimum of 40m in width having the potential to incorporate two-way traffic movement, bus corridor, cycle lanes and a pedestrian footpath which can double as an emergency access to the ground floor of the adjacent buildings. Potential SUDS features here include swales, attenuation tanks, permeable pavements, and bio-retention basins. Bio retention basins doubling as usable public space.

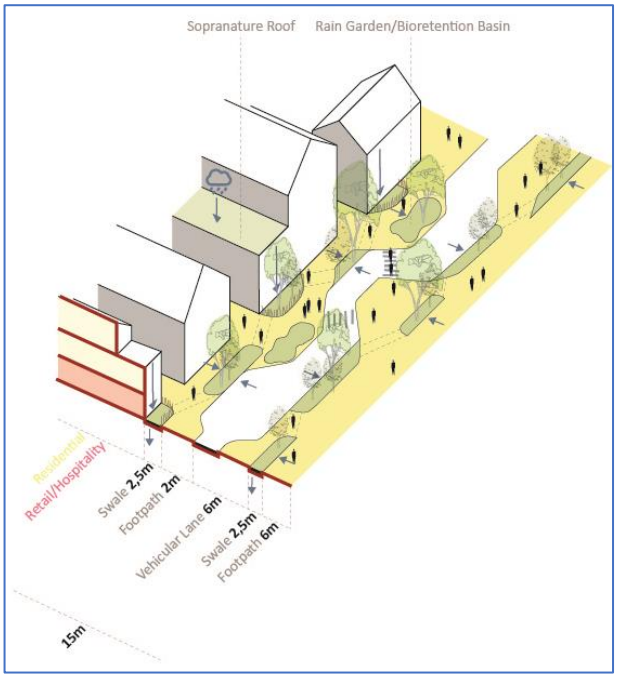
Minor Link Street:

The minor link street typology would be a minimum of 25m in width, incorporating two-way traffic movement, cycle lanes and pedestrian footpaths/emergency access. Any potential bus routes would share the vehicular corridor, however, dedicated 'pull-in' spaces will be included at bus stops. Potential SUDS features include swales, permeable pavements, tree planting.



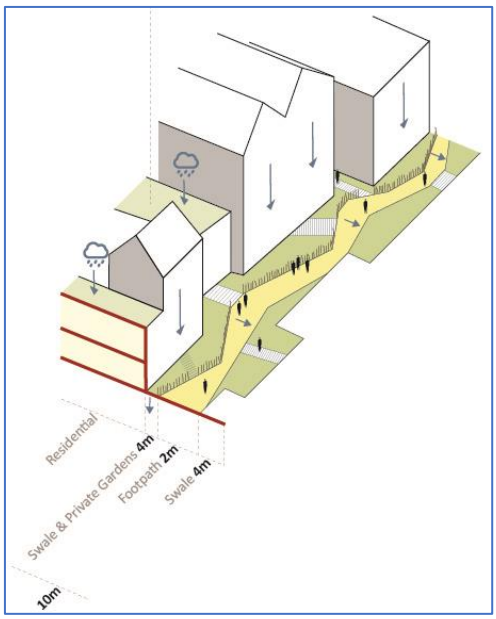
Local Street:

The Local Streets, as defined in the DMURS are 'the streets that provide access within communities and to Arterial and Link streets. These typologies would be a minimum of 15m in width, incorporating traffic calming vehicular movement and pedestrian footpaths. The traffic calming vehicular movement will be achieved using chicanes which double as spaces for potential public use or SUDS infrastructure. Bicycle movement will be facilitated on these reduced speed streets. Potential SUDS features include swales, bio-retention basins/rain gardens and sopranature rooves.



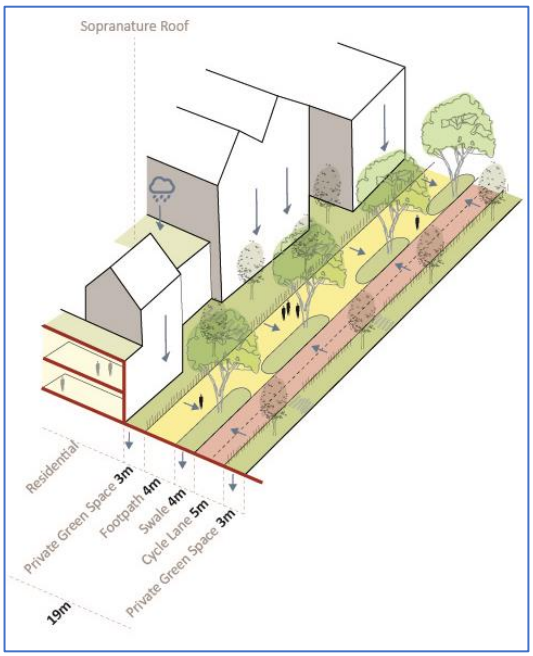
Pedestrian street:

Pedestrian streets, as defined in the DMURS are fully segregated 'from motor vehicular movement (although emergency access is possible and limited access may also be provided for service vehicles). They are generally only appropriate in areas where higher levels of activity can be sustained throughout the day and into the evening period, as the removal of vehicular traffic will reduce surveillance levels.' These pedestrian streets would be a minimum of 15m in width. Potential SUDS features on these pedestrian streets could be swales, sopranature rooves and permeable paving.



Greenway:

The greenway typology would be a for pedestrian and cycle movement along designated corridors across the City Edge study area. This typology would be a minimum of 19m in width. SUDS features which could be incorporated include swales, permeable pavements and sopranature rooves. An example of a proposed greenway within the study area is the Tymon to Phoenix Greenway.



6 NATURAL INFRASTRUCTURE AS PART OF CITY EDGE STRATEGIC FRAMEWORK

6.1 Overview

On first inspection the City Edge is a very unnatural, harsh urban landscape. Since the 1960's onwards has been developed out in a very utilitarian way providing space for industrial/ manufacturing use mostly in the form of large sheds and warehouse, associated car parking with roads connecting them with little regard to providing green Infrastructure, urban design principles or environmental issues. This has provided the function of this area up until now but as it to be re imagined and regenerated as a new Urban Quarter of Dublin this is an opportunity to examine the baseline of the study area to understand the area and identify existing environmental assets that could be utilised and enhanced.

The Strategic Framework proposes principle green and blue routes as part of the 50% greening concept, connecting to existing assets to the city centre. The existing Grand Canal, Camac River and tributaries, and the railway/tram route, mark blue routes that have great potential for greening enhancements for biodiversity and provide 'blue' wildlife corridors that connect to waterbodies. Smaller existing sites of ecological importance in between larger open green space assets, can be enhanced to provide a continuity of habitats for wildlife, creating 'green' corridors at smaller scales.

The overarching green infrastructure vision is to transform the City Edge from grey to green as an exemplar of a Landscape City- ecologically healthy and environmentally inspiring urban quarter.

The next stage of the Statutory Plan and development of surface water management strategies will need to consider the existing site characteristics. This can be assessed through flow route analysis to determine the natural behaviour before further development. This is the basis for low flow conveyance, overflow arrangements and exceedance routes when design criteria are exceeded. This can be managed within subcatchments using natural overland conveyance from one subcatchment to the next with consideration of the SuDS management train.

6.2 Vision for a Natural Infrastructure

The following high-level strategy contained in the Strategic Framework illustrate how a balance of retained existing green spaces, new public parks, river naturalization works, green and blue infrastructure circulation routes and targets for developers on plot greenery using green factor calculations or similar environmental measurement methodologies can work in harmony to target a combined critical mass of 50% green& blue infrastructure.

1. 20% of greening provided by Natural Infrastructure

2. 30% of greening provided by developments and streets

Table 6-1:Strategic Framework Strategy for Open and Development & Streets Spaces

Total Site (715ha)	**100%**
Proposed Natural Infrastructures	**% of Site**
Linear Parks	10%
1. Grand Canal Linear Park	4%
2. Camac River Linear Park	6%
Major Parks	5%
3. Walkinstown Eco Park	2%
4. Lansdowne Drimnagh Castle Park	3%
Green Corridors	5%
5. Tymon-Phoenix Greenway (25m-40m)	1%
6. M50 Green Corridor (20m)	1%
7.Railway Green Greenway (15m)	1%
8. Secondary Green Corridors (20m)	2%
Natural Infrastructure Total Area	**21%**

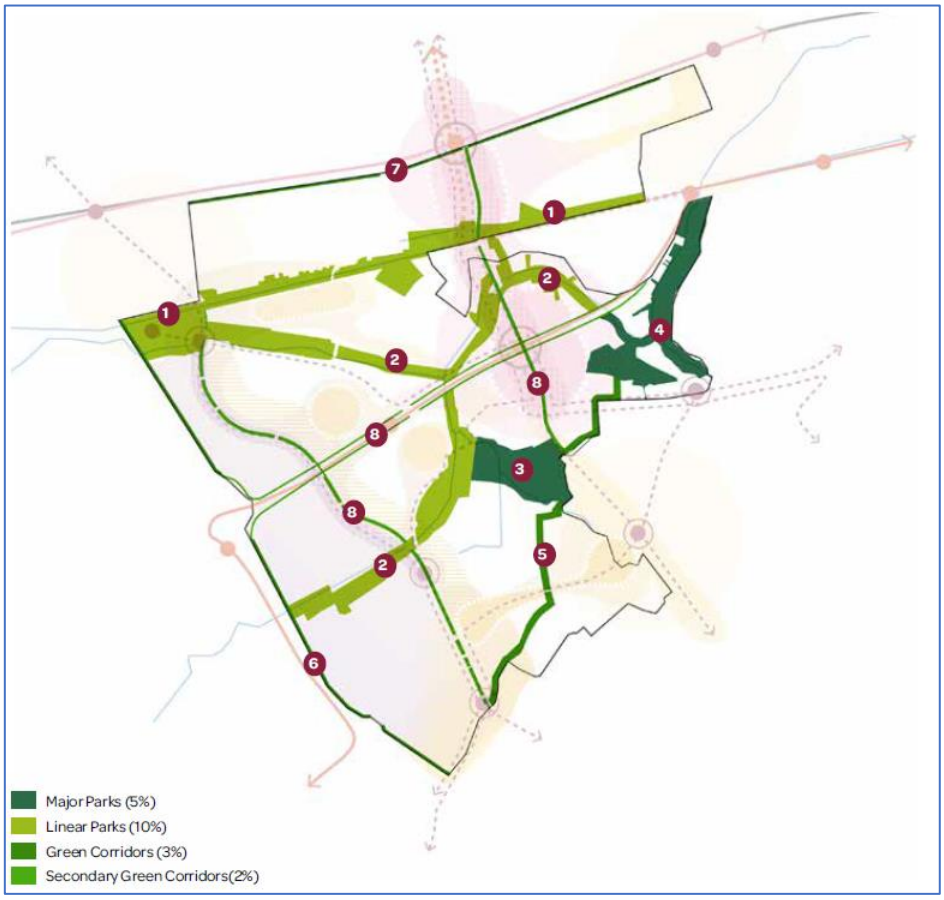


Figure 6-1: City Edge Green Space Strategy

Key spatial components will include:

1. Tymon to Phoenix Park Greenway - Creating a greenway connection between two parks supporting green infrastructure, active travel, and biodiversity.
2. Camac Flood Alleviation Scheme - Renaturalising the river and setting it within a parkscape containing amenity spaces to reduce flood risk and enhance biodiversity.
3. Introducing and enhancing Green Infrastructure by creating linear parks along the Grand Canal and River Camac, green corridors and enhancing Walkinstown Avenue and Lansdowne Valley in a manner that improves amenity, biodiversity and increases climate resilience.

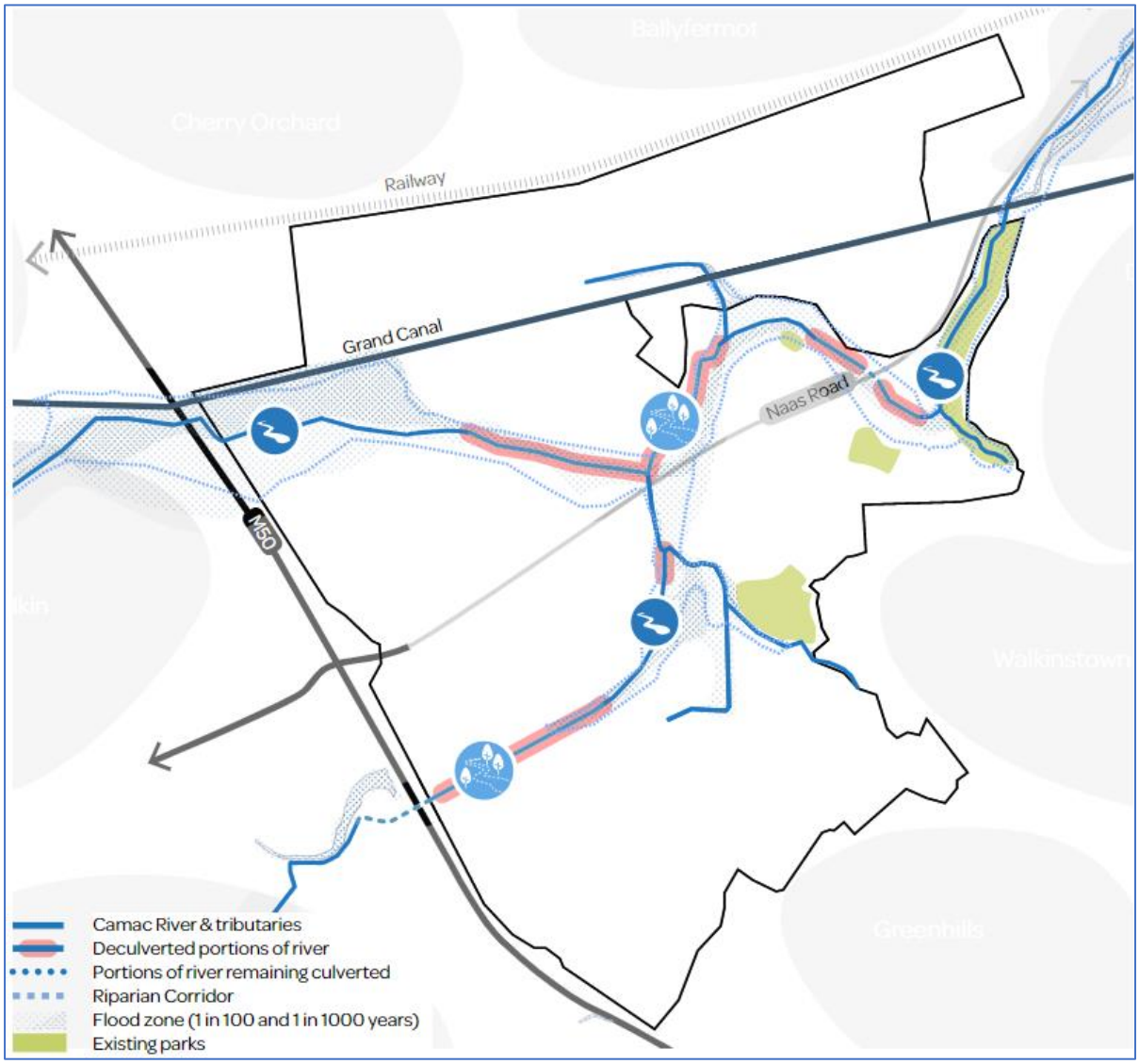


Figure 6-2: Camac renaturalisation strategy

7 SUDS NETWORK CONCEPT FOR CITY EDGE LANDS

7.1 Overview

Drawing on the strategic vision outlined in Section 6, the following is a worked example of a SUDS network concept for the City Edge Lands and how it can be achieved at a high level. It utilizes a high-level modelling approach to simulate the performance of present-day and future configuration of the surface water management infrastructure.

This sample study is intended to provide a demonstration of how SuDS can help to manage the surface water issues within the Framework Area by directing runoff from new development and existing areas. The results provided herein should not be used in any planning or design practices and will require further development.

At the date of writing this report, Irish Water are progressing the Main Lift Pumping Station Drainage Area Plan (refer to Section 3.7.5) which includes detailed sewer studies and hydraulic modelling incorporating The Framework area. This Drainage Area Plan should be consulted for any detailed recommendations or conclusions.

A high level unverified InfoWorks ICM[1] model was prepared to simulate flows in Camac catchment. This model is then used to determine the following based on a combination of flagship parks, increasing green areas in the catchment and SuDS strategies.

1. Baseline flows in the catchment based on present day scenario
2. Add Linear Parks, Green Corridors and Enhanced Parks
3. Add Linear Parks, Green Corridors and Enhanced Parks and 30% lower impermeable areas
4. Add Linear Parks, Green Corridors and Enhanced Parks and SuDS Strategies

7.2 Hydraulic Model

InfoWorks ICM was used to build the surface water network model of the project area. An Irish Water InfoAsset Manager[2] file is the main source of network configuration. Missing asset information was completed by using built-in InfoWorks ICM inference tools. The missing data are:

- Ground levels of manholes, LIDAR image was used for data source

[1] InfoWorks ICM (Integrated Catchment Modelling) is the first software of its generation to allow modelling urban and river catchments in a single model. It can integrate storm and sever networks as well as rivers.
[2] InfoAsset Manager is an asset management system developed for water supply, storm, or sewer networks. InfoAsset Manager allows operators to manage, integrate, validate, analyse their asset data to provide reliable and up-to-date information.

- Pipe dimension, missing info completed from connected pipes
- Invert levels. Missing levels were inferred from known invert levels of connecting pipes or from known gradients. If neither are available, missing levels are interpolated.

The aim of the model is to simulate peak runoff from each subcatchment and flows in selected discharge points during a 1% AEP rainfall event. The simulations were run for the following high-level scenarios to make a direct comparison:

- Present-day baseline scenario,
- Future scenario 1: implementation of Linear Parks, Green Corridors and Enhanced Parks
- Future scenario 2: 30% decrease in hardstanding areas after implementation of Linear Parks, Green Corridors and Enhanced Parks
- Future scenario 3: Introduction of SuDS strategies after implementation of Linear Parks, Green Corridors and Enhanced Parks

7.3 Present-Day Land Use

The existing land use within the project area mainly consists of hardstanding and impervious surfaces. The Framework area is mostly served by an extensive separate surface water network however, certain areas are considered as combined which requires further validation. The River Camac, which passes through the project area in east-west direction, forms the backbone of this network along with its tributaries.

The River Camac enters the project area at M50/Nangor Road overpass and runs beneath the Grand Canal on the Northern end of Lansdowne Park towards Heuston Station where it finally discharges to the River Liffey. The majority of the project area drains to the River Camac. Considering the high level of imperviousness in City Edge area due to industrialisation, surface water contributions to the River Camac is significantly higher than greenfield runoff rates.

A schematic sketch of existing surface water network is provided in Figure 7-1. The open sections of the River Camac, its streams and Grand Canal are indicated in blue, whereas culverted river and stream sections are shown with red lines.

The project area consists of 147 individual subcatchments draining to the River Camac. The subcatchment layout is provided in Figure 7-2. The total area discharging to the River Camac is determined to be 560 ha, approximately. The remaining areas drain outside the project area.

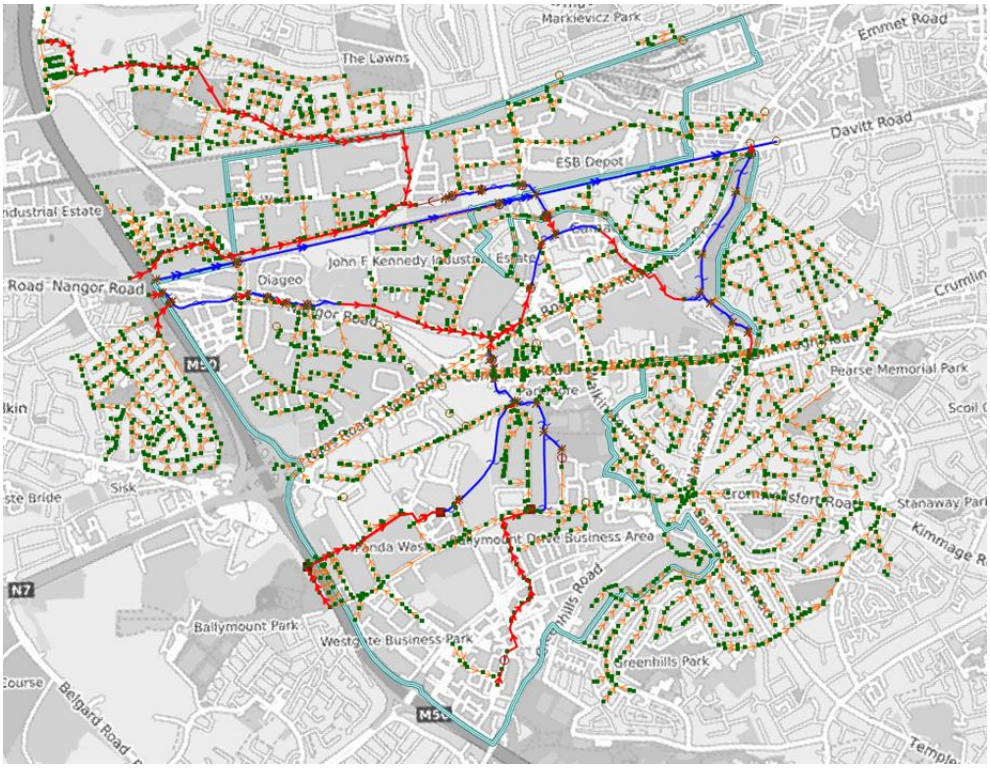


Figure 7-1: River system and surface water network (culverts are red, open channels are blue)

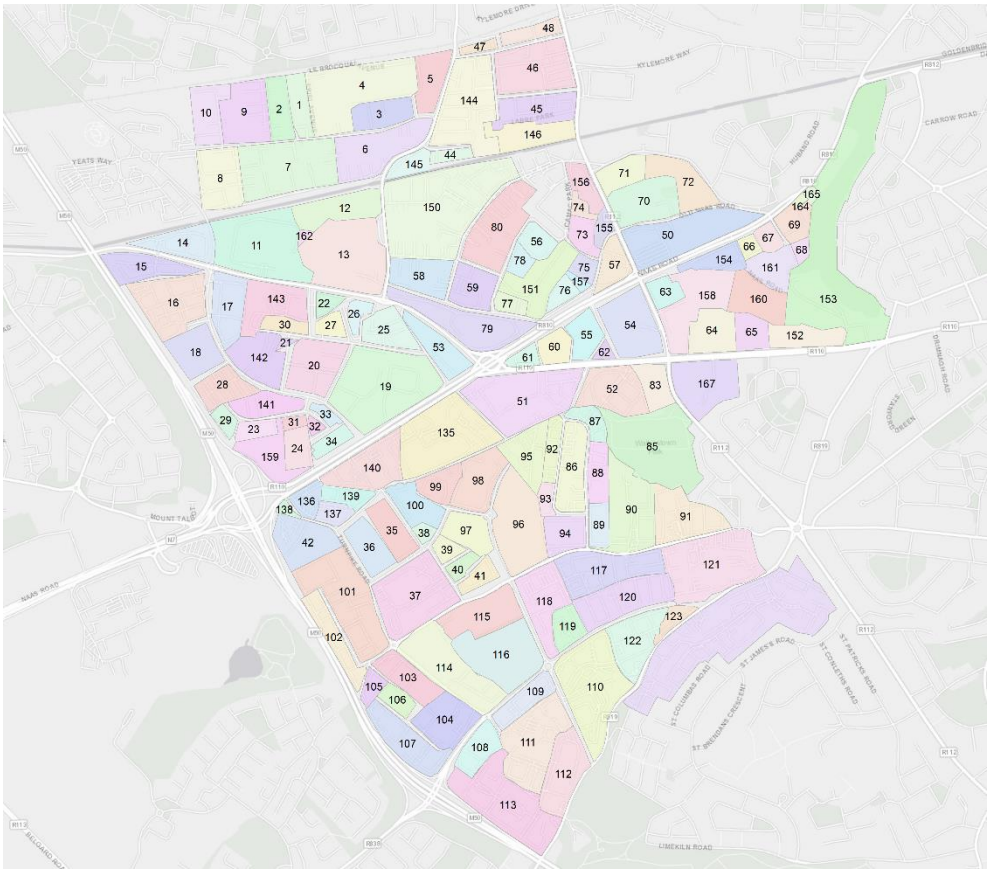


Figure 7-2: Present-day subcatchment layout

The performance of surface water management practices was also measured at some key outfalls to River Camac system. Figure 7-3 indicates the selected 5 major outfalls where the majority of the drainage system passes through.

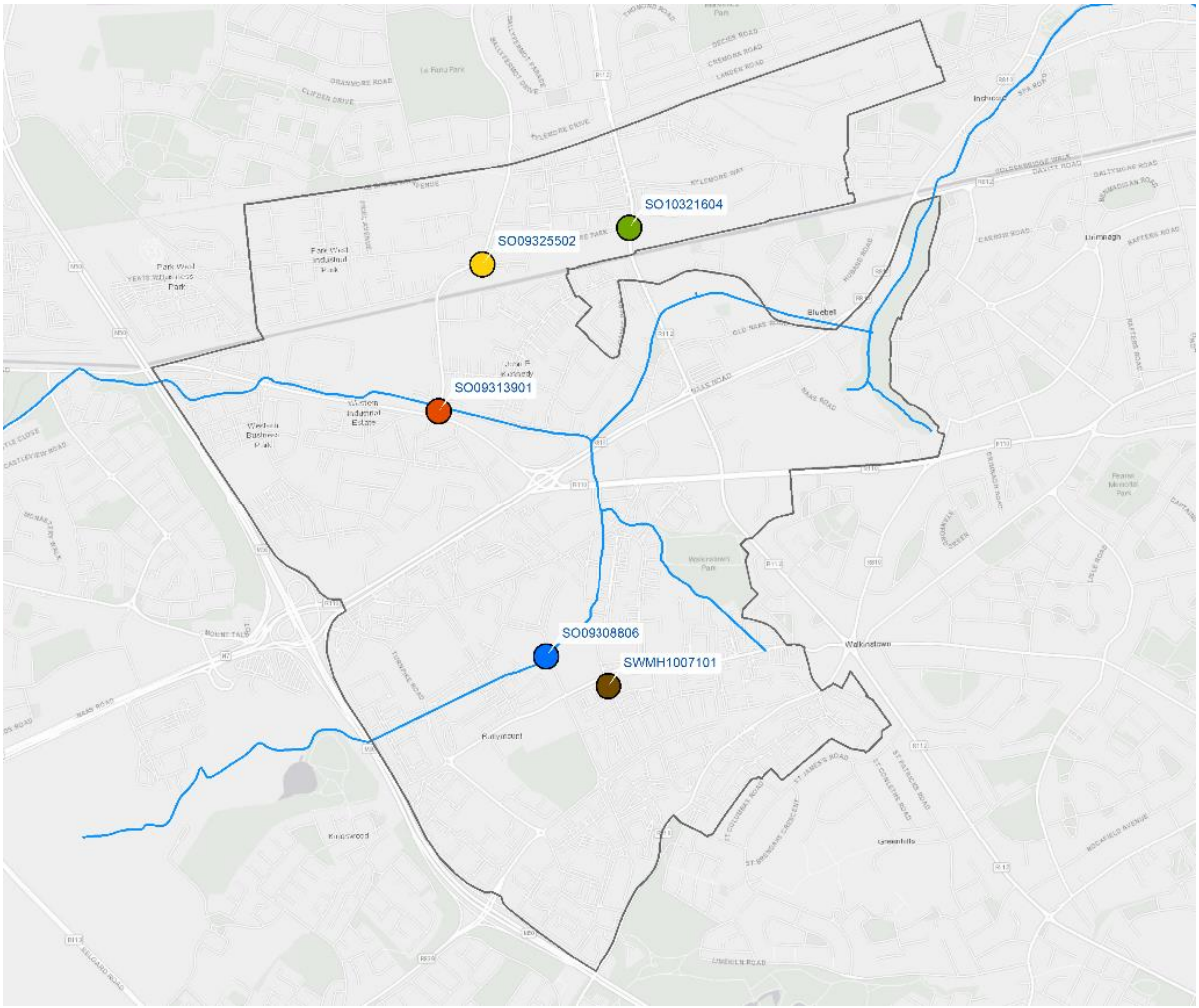


Figure 7-3: Outfall locations

Table 7-1: Outfalls and connected subcatchments

OUTFALL	SO09308806	SO09313901	SO09325502	SO10321604	SWMH1007101
SUBCATCHMENT (ID numbers, see Figure 7-2)	35	19	1	45	108
	36	20	2	46	109
	37	22	3	48	110
	38	23	4		111
	39	24	5		112
	40	25	6		113
	41	26	7		116
	97	28	8		118
	101	29	9		119
	102	31	10		122
	103	32	145		123
	104	33			
	105	34			
	106	53			
	107	141			
	114	159			
Total Area (ha)	***53.8***	***39.1***	***49.3***	***7.1***	***55.7***

The project area was modelled using InfoWorks ICM to obtain the contribution of each subcatchment during a 1% AEP rainfall event. Present-day average peak discharge from subcatchments is found to be 238 l/s/ha.

The Mean Annual Flood, referred to as QBAR, is the value of the average annual flood event recorded in a river. This flow rate is used to provide a measure of the Greenfield runoff performance of a site in its natural state to enable flow rate criteria to be set for post development surface water discharges for various return periods. – www.gov.uk.

Mean greenfield runoff rates, QBAR, of each subcatchment were also determined to indicate how significant the effect of hardstanding areas. To this end, the methodology recommended by Institute of Hydrology Report no. 124 was used. The QBAR values obtained by IH124 method has a return

period[3] of 2.33 years. The estimated QBAR is then multiplied by 1.96 to get the 100-year peak flow. Present-day average QBAR-100 of individual subcatchments in the project area is found to be 7.54 l/s/ha.

QBAR-100 of selected outfalls were also obtained by same approach and provided in Table 7-2

Table 7-2: QBAR and QBAR-100 of selected outfalls

Outfall	Total Area [ha]	QBAR [l/s]	QBAR-100 [l/s/ha]
SO09308806	53.8	147.09	**5.35**
SO09313901	39.1	109.66	**5.50**
SO09325502	49.3	135.73	**5.39**
SO10321604	7.1	24.29	**6.71**
SWMH1007101	55.7	151.86	**5.34**

7.4 Implementation of Flagship Parks

A sustainable drainage strategy needs to be implemented to limit surface water discharges to the River Camac and its tributaries. The first step of SuDS Management Train is to prevent surface water flow by modifying land use.

The project area currently consists of approx. 16% green cover. The aim is to achieve a total green coverage of approx. 50%, of which 20% is by natural infrastructure and 30% by development. To this end, new flagship parks, linear parks and enhanced major parks, have been planned to be implemented to the project area.

2 linear parks and 2 enhanced major parks are considered to establish distinct character of City Edge and to provide improved biodiversity. Figure 7-4 shows existing and planned green areas.

[3] The probability that events such as floods, wind, storms, or tornadoes will occur is often expressed as a return period. The inverse of probability (generally expressed in %), it gives the estimated time interval between events of a similar size or intensity.

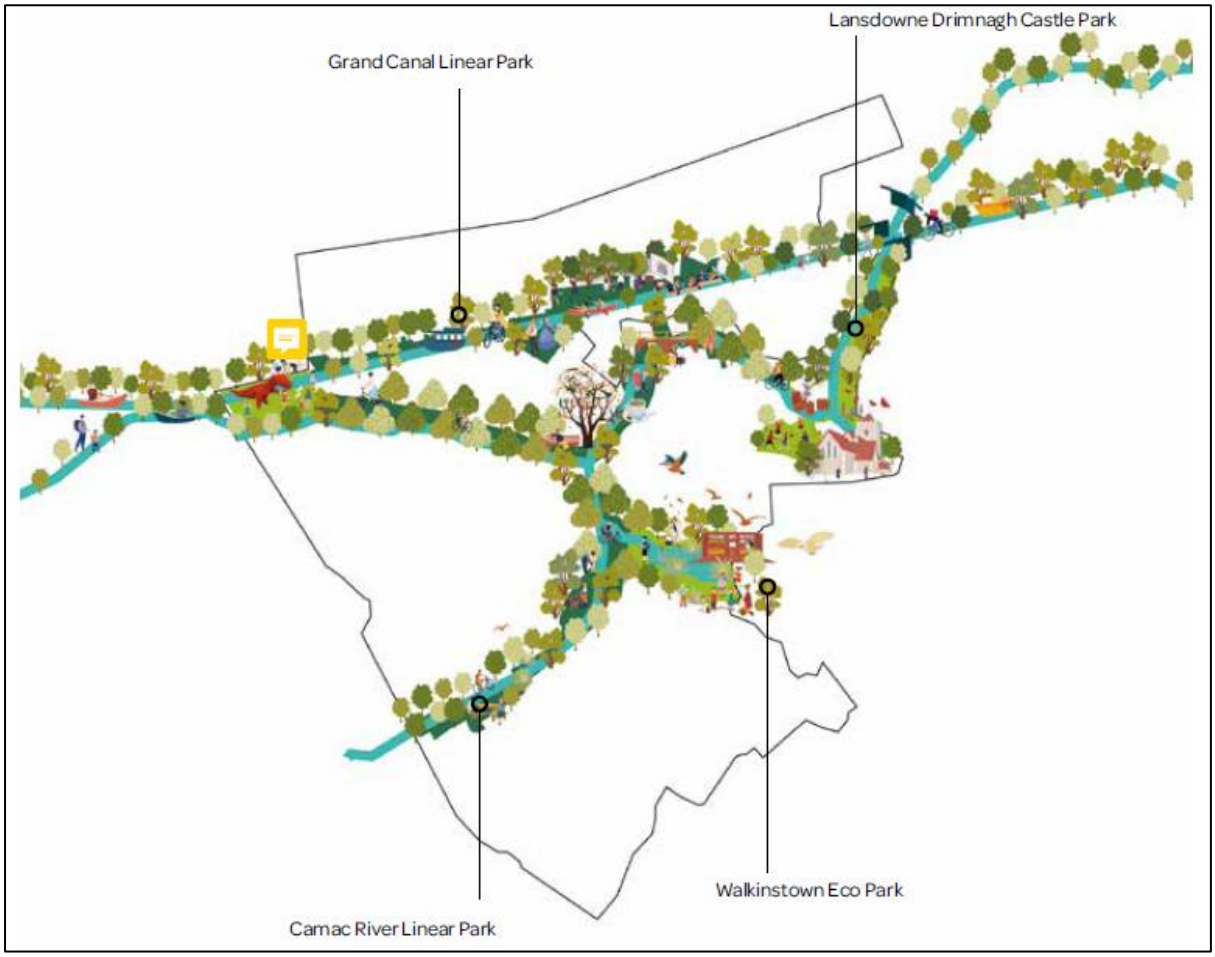


Figure 7-4: Indicative locations and illustration of proposed parks (Source: Grant Associates)

The subcatchment layout needs to be modified after implementation of flagship parks and other planned green cover. The new layout to be used in ICM model is given in Figure 7-5.

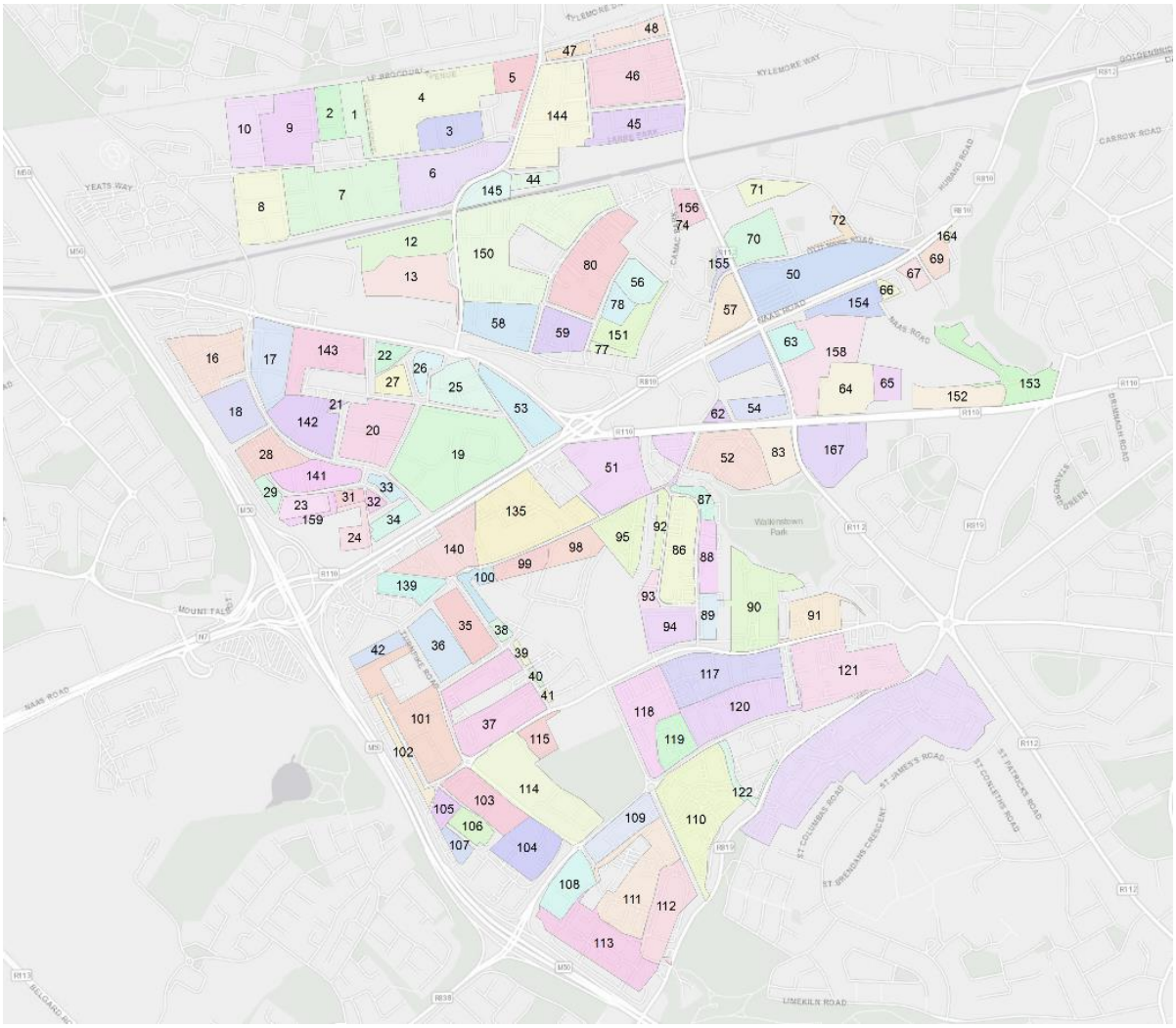


Figure 7-5: Modified subcatchment layout

Peak discharges from each modified subcatchments under the same simulation conditions provided an average value of 200 l/s/ha without any other improvements. Comparison of the peak discharges at selected outfalls after implementation of the flagship parks are provided in Table 7-3.

Table 7-3: Peak discharges at outfalls after implementation of flagship parks

Outfall	Peak Discharge [l/s/ha]	
	Present Day	with Flagship Parks
SO09308806	109.6	80.5
SO09313901	66.4	68.2
SO09325502	100.6	97.1
SO10321604	105.3	103.3
SWMH1007101	61.9	53.9

7.5 Reducing Impervious Surfaces

Drainage from impervious surfaces such as car parks and road, usually drain to surface water piped systems rather than infiltrate into the subsurface. Converting those hardstanding areas to permeable surface will help to decrease the volume and the flow rate of the runoff. This is mainly targeting public realm areas.

To simulate the benefits of the reduction of impervious surfaces, a separate scenario was built by reducing the total impervious areas in each subcatchment by 30%. Comparison of the peak discharges at selected outfalls after reduction of impervious surfaces is provided in Table 7-4.

Table 7-4: Peak discharges at outfalls after the reduction of impervious surfaces

Outfall	Peak Discharge [l/s/ha]		
	Present Day	with Flagship Parks	with FP + 30%↓HS
SO09308806	109.6	80.5	61.6
SO09313901	66.4	68.2	62.7
SO09325502	100.6	97.1	76.6
SO10321604	105.3	103.3	88.2
SWMH1007101	61.9	53.9	47.7

7.6 Implementation of a SuDS Element

Permeable pavement is one of the SuDS element that is believed to improve water quality and reduce the impacts of urban runoff. It catches precipitation and surface runoff, storing it in the reservoir while

slowly allowing it to infiltrate into the soil below or discharge via a drain tile. The most common uses of permeable pavement are parking lots, low-traffic roads, sidewalks, and driveways.

Implementation of permeable pavement (up to 50% in some subcatchments) to the project areas was modelled to demonstrate the potential reduction in peak flows during a 1% AEP event. Permeable pavements were chosen for this purpose because it is recommended to all suitable hardstanding areas as it does not have any space take-up and any public safety concerns. Their potential benefits are:

- To re-establish a more natural hydrologic balance and reduce runoff volume by trapping and slowly releasing precipitation into the ground instead of allowing it to flow into storm drains and out to receiving waters as effluent. This same process also reduces the peak rates of discharge by preventing peaks through the stormwater system.
- To reduce the concentration of some pollutants either physically (by trapping it in the pavement or soil), chemically (bacteria and other microbes can break down and utilize some pollutants), or biologically (plants that grow in-between some types of pavers can trap and store pollutants).
- To cool down the temperature of urban runoff by slowing down the process and reduce the stress and impact on the stream or lake environment.
- To control the runoff at the source, such as car park. Permeable pavement can also reduce the need for or the required size of a regional SuDS element, such as a detention pond, which saves money and effort.
- Reduced need to apply road salt for de-icing in the wintertime.

Figure 7-6 indicates the expected reduction of peak runoffs from subcatchments during a flood event in The Framework area by implementation of SuDS practices. High level InfoWorks ICM model results demonstrated that permeable pavements alone could lower the average and maximum 1% AEP rainfall event discharges across all subcatchments by up to 68% and 53% respectively. It is believed that a comprehensive SuDS design with various components may further decrease the discharges and help to satisfy DCC surface water discharge guidance limit of 2 l/s/ha.

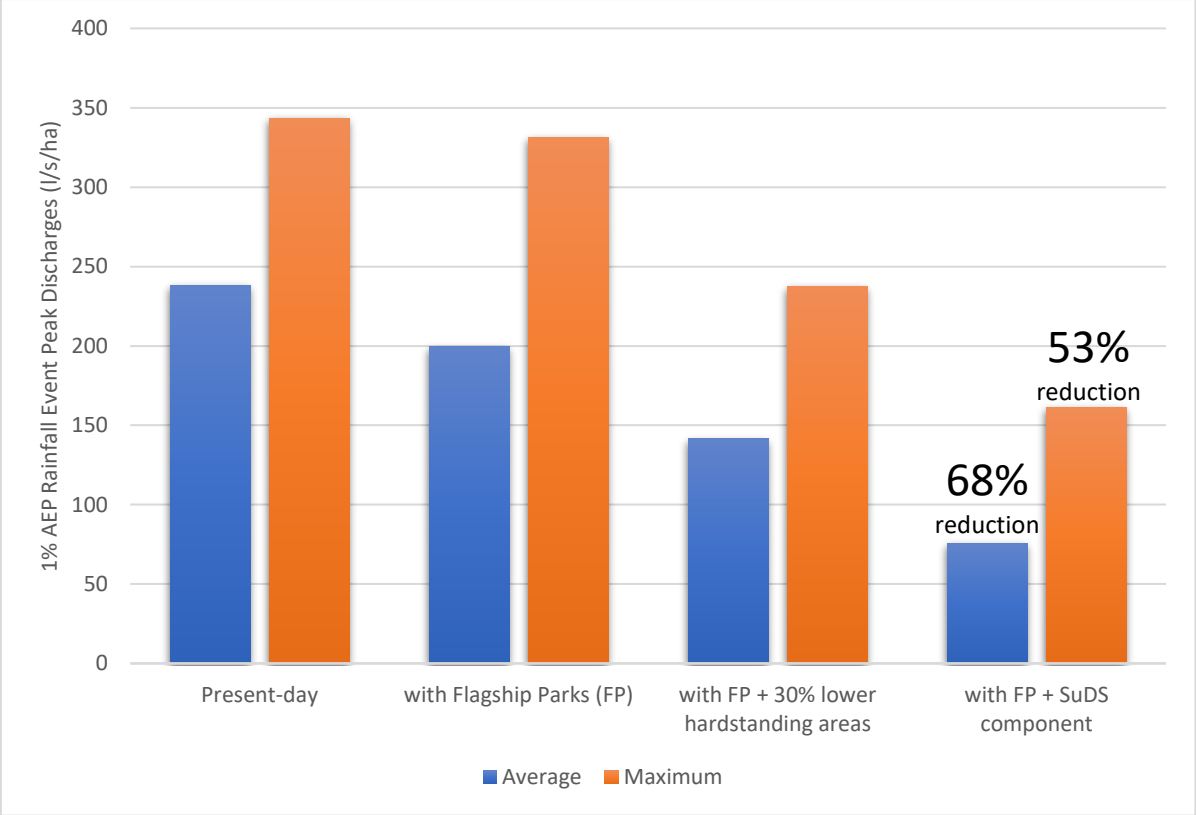


Figure 7-6: Performance of surface water management practices

Comparison of the peak discharges at selected outfalls after implementation of SuDS component is provided in Table 7-5.

Table 7-5: Peak discharges at outfalls after implementation of SuDS component

Outfall	Peak Discharge [l/s/ha]				
	Present Day	with Flagship Parks	with FP + 30%↓HS	with FP + SuDS	QBAR-100
SO09308806	109.6	80.5	61.6	38.8	5.35
SO09313901	66.4	68.2	62.7	49.6	5.50
SO09325502	100.6	97.1	76.6	49.5	5.39
SO10321604	105.3	103.3	88.2	65.0	6.71
SWMH1007101	61.9	53.9	47.7	24.0	5.34

An assessment of the benefits of surface water management practices are provided as the percentage of present-day peak discharges after implementation of each management practice at the selected outfalls (see Figure 7-3 for colour-coded outfall locations) The findings are provided in Figure 7-7.

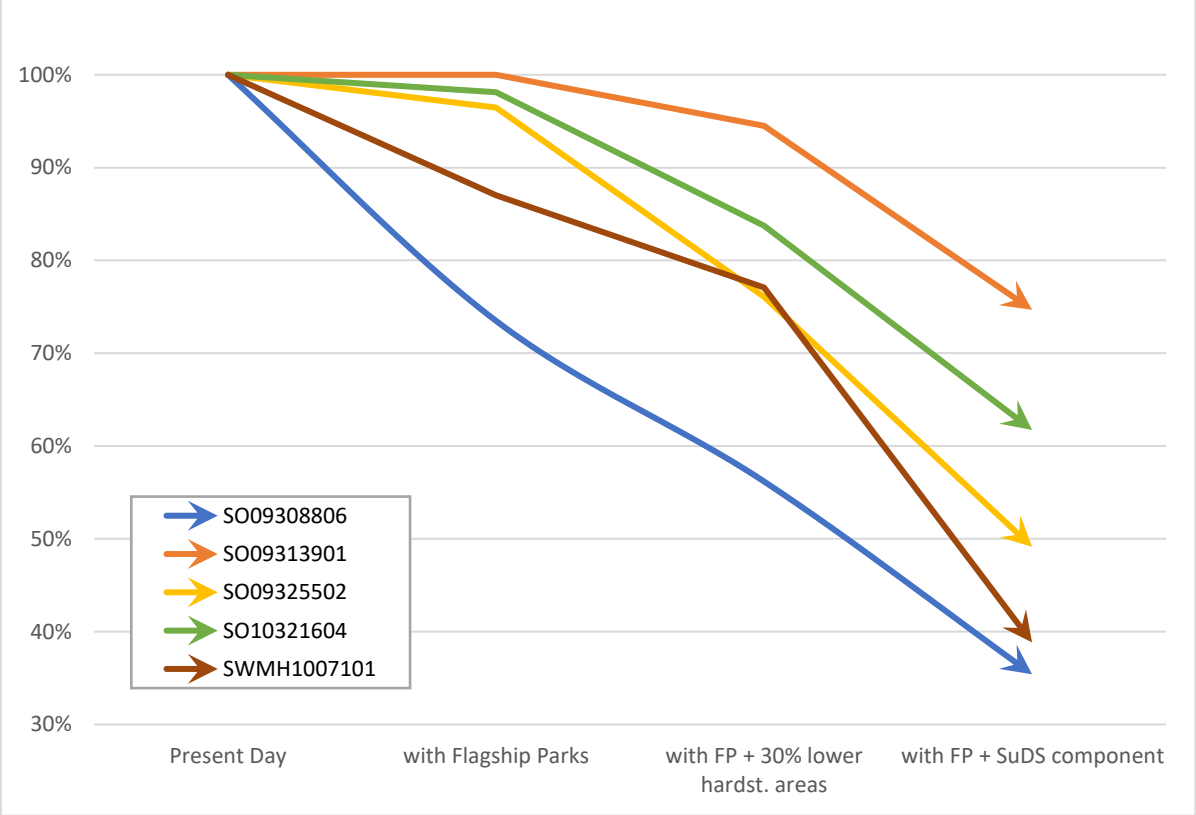


Figure 7-7: Percent of present-day peak discharge

8 CONCLUSIONS

- The scope of this SWMP is to Develop a robust understanding of surface water flood risk in and around the study area, review of sustainable drainage best practices, demonstrate the benefits of best management practices by implementation of a sample SuDS component, make holistic and multifunctional recommendations for surface water management and develop a strategic-scale SWMP action plan for The Framework.
- This report should be read in conjunction with the Strategic Framework report, Climate Action Plan and the Strategic Flood Risk Assessment.
- City Edge lies within the watershed of the River Camac which is a tributary of the River Liffey. There are several smaller watercourses within the project area which form tributaries of the River Camac. These are Walkinstown Stream, Ballymount Stream, Robinhood Stream, Gallanstown Stream, and Drimnagh Castle Stream.
- Specific strategies within City Edge include but not limited to the following:
    - Target a combined critical mass of 50% green & blue infrastructure (20% of greening provided by Natural Infrastructure and 30% of greening provided by developments and streets),
    - Camac River Re-naturalisation,
    - Enhancing the Grand Canal,
    - Introducing & Enhancing Green & Blue Space,
    - Creating a Tymon to Phoenix Park Greenway,
    - Upgrades to the sewer network to remove surface water connections to the foul/combined sewer network
    - Upgrade existing public realm to consider a minimum of 2 no. SuDS components
    - New streets and Districts to incorporate SuDS
- The River Camac Flood Alleviation Study (FAS) is now in progress by the steering of Dublin City Council (DCC) and South Dublin County Council (SDCC) and is funded by Office of Public Works (OPW). This project is fundamental to meeting key City Edge objectives

8.1 Strategic Flood Risk Assessment

- The Framework area is prone to fluvial, pluvial, and sewer flooding.

- The maps provided in the appendices of this report is suitable to identify broad areas which are more likely to be vulnerable to surface water flooding.
- The areas which are most vulnerable to surface water flooding may require a more detailed analysis.
- Impact of climate change on flooding was also provided in the relevant maps.
- More information can be found in The Framework Strategic Flood Risk Assessment (SFRA).
- Outcomes of ongoing Camac Flood Alleviation Study should also be considered during land development planning.
- The objectives to protect and enhance the riparian zones should be adopted in all planning stages.

8.2 Sustainable Drainage Strategy

- A sustainable drainage system (SuDS) is designed to reduce the potential impact of development with respect to surface water drainage discharge.
- SuDS have significant benefits by minimising a development's impact on the receiving environment and where possible deliver additional amenity, environmental and biodiversity benefits.
- Overall objectives should consider but not limited to the following:
    - Proposals for all development cells include provision for at least two separate SuDS features
    - Promote the use of green roofs, alternatives roofs to be routed through vegetated SuDS features where possible
    - Runoff from roads adjacent to suitable parkland or landscape strips should be conveyed in vegetated open channel SuDS features
    - New streets, walkways and cycle paths incorporate drainage discharges from carriageway runoff to tree pits or similar SuDS features
    - New parking areas consider the use of permeable pavements
- With consideration for individual developments within the project area, a concept for individual surface water drainage design at an early planning application stage is recommended to reduce the chance of issues that could later arise and conflict with the ability of development proposals to incorporate SuDS.

8.3 Outline Surface Water Interventions

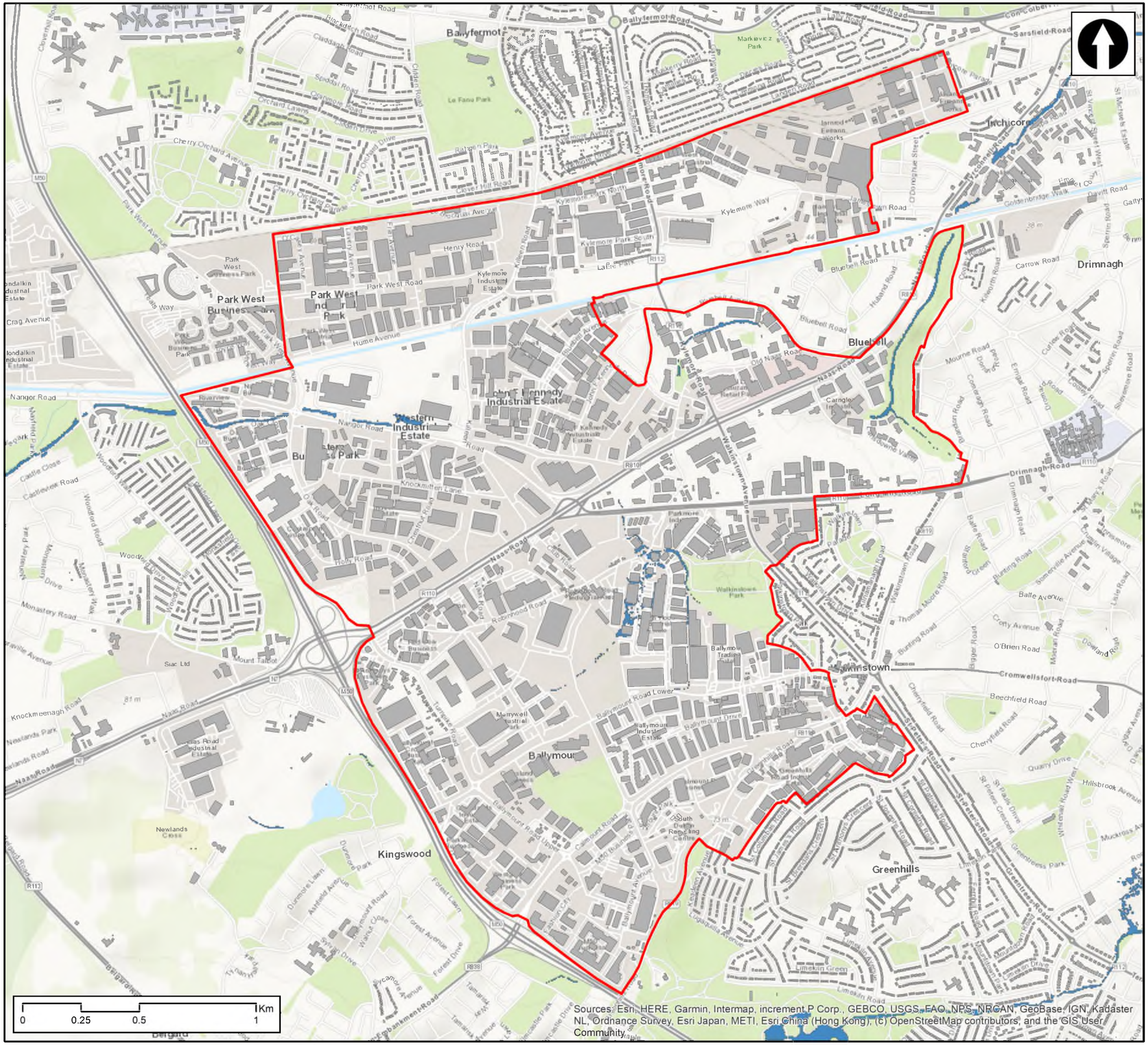
- InfoWorks ICM was used to build the surface water network model of the project area. The aim of the model is to simulate peak runoff from each subcatchment and flows in selected discharge points during a 1% AEP rainfall event
- A sample study provided in this document demonstrates how effective SuDS can be in reaching the target surface water discharge rates. This includes the following analysis:
    - Baseline flows in the catchment based on present day scenario
    - Add Flagship Parks
    - Add Flagship Parks and 30% lower impermeable areas
    - Add Flagship Parks and SuDS Strategies
- 5 no. Districts were defined to include a number of different of road typologies that incorporates SuDS requirements. Such typologies should be considered at Statutory Plan stage and preliminary design of future developments
- The hydraulic model results based on the above simulations indicates that significant surface water peak flow rates and volumes can be reduced based on the above strategies. The results indicate that the above interventions could lower the 1% AEP peak discharge flow as an average across all subcatchments, by approximately 50%. This should be further explored at Statutory Plan stage and advancing design of specific developments.

8.4 Recommendations

- Continue stakeholder engagement with the Camac Flood Alleviation Scheme delivery team to ensure alignment of key objectives.
- Continue stakeholder engagement with Irish Water to align objectives of City Edge with the outputs from the Main Lift Pumping Station Drainage Area Plan (DAP).
- Consideration of the adaptation and mitigation measures addressed in City Edge Climate Action Plan
- Alignment with the objectives set out in SDCC & DCC Development Plans (2016-2022) and SDCC & DCC Draft Development Plans (2022-2028)
- Consideration of the recommendations included in the City Edge Strategic Flood Risk Assessment

- Further develop the SuDS design concepts at Statutory Plan stage including Linear Parks, Enhanced Major Parks and Green Corridors, lower impermeable areas and introduce SuDS strategies as outlined in this report
- Further develop the concept of “Districts” by incorporating SuDS with the street scapes and typologies as identified in the Strategic Framework

APPENDIX A - FLUVIAL FLOODING MAPS



Project_Boundary

10% AEP Fluvial Flood Extent - Present

Buildings

Comhairle Cathrach Bhaile Átha Cliath
Dublin City Council

Comhairle Contae Átha Cliath Theas
South Dublin County Council

City Edge Project

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PROJECT No.	STAGE	REVISION
20849	Surface Water Management Plan	-

DRAWING No.

20849-SWMP001

Project_Boundary

1% AEP Fluvial Flood Extent - Present

Buildings

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PROJECT No.	STAGE
20849	Surface Water Management Plan

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20849-SWMP002	-

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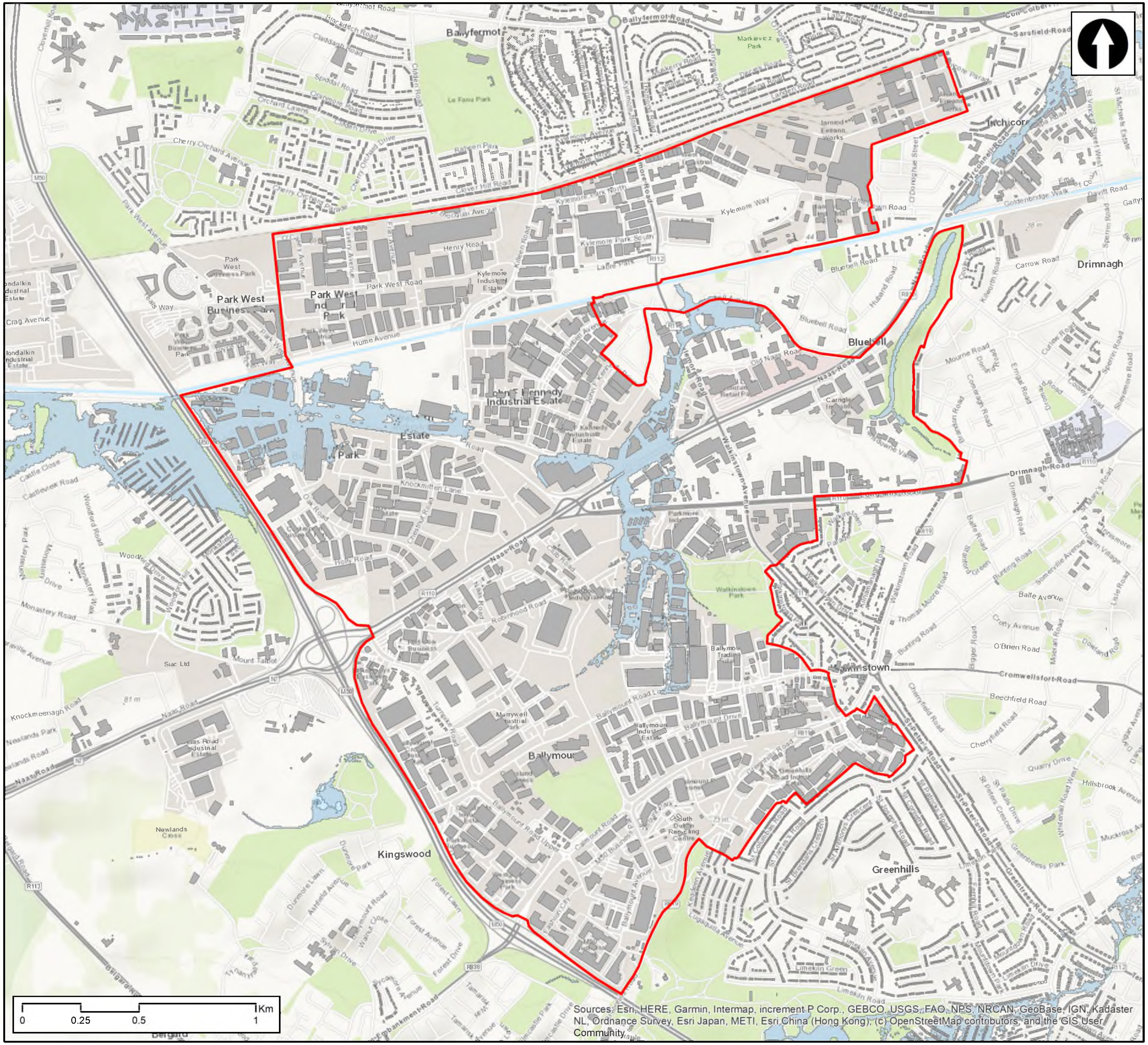

- Project_Boundary
- 0.1% AEP Fluvial Flood Extent - Present
- Buildings

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20849	Surface Water Management Plan

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20849-SWMP003	-

Project_Boundary

10% AEP Fluvial Flood Extent (30% Uplift)

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PROJECT No.	STAGE
20849	Surface Water Management Plan

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20849-SWMP004	-

0 0.25 0.5 1 Km

Project_Boundary

1% AEP Fluvial Flood Extent (30% Uplift)

Buildings

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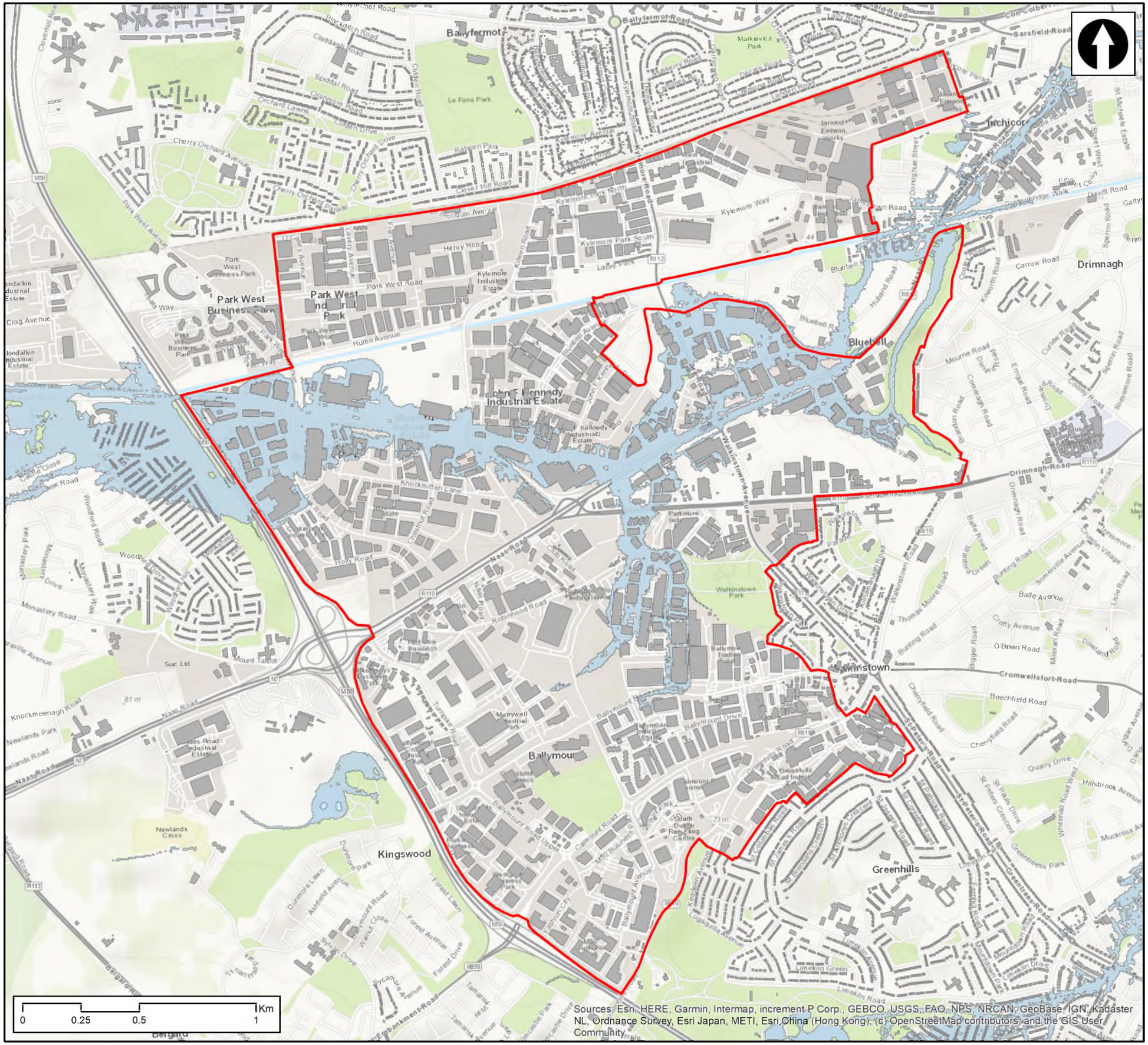
20849-SWMP005	-

Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

0 0.25 0.5 1 Km

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community



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PROJECT No.	STAGE
20849	Surface Water Management Plan

DRAWING No.	REVISION
20849-SWMP006	-

APPENDIX B - PLUVIAL FLOODING MAPS

Project_Boundary

1% AEP Pluvial Flood Extent - Present

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PROJECT No.	STAGE
20849	Surface Water Management Plan

DRAWING No.	REVISION
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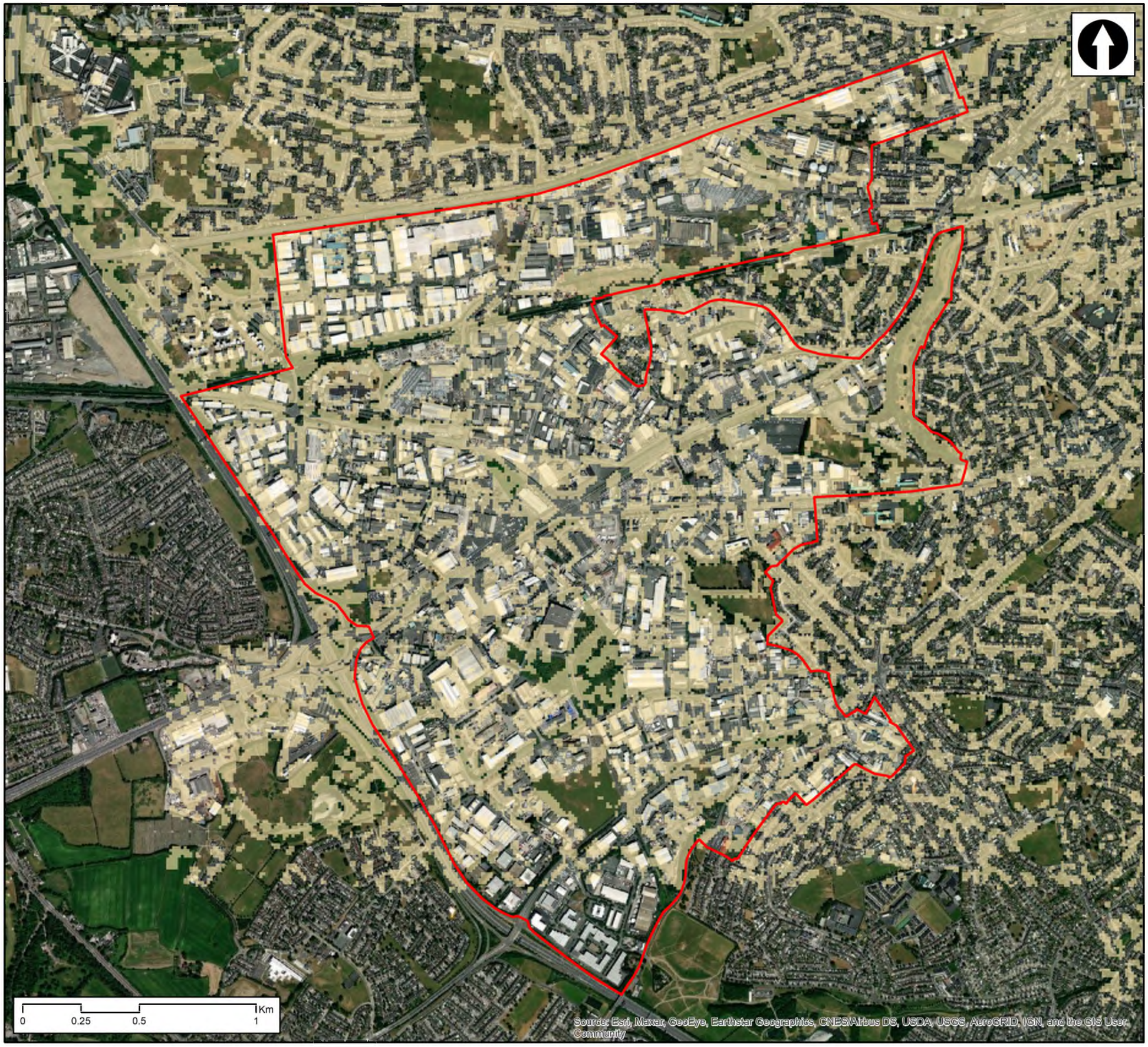

Project_Boundary

0.5% AEP Pluvial Flood Extent - Present

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PROJECT No.	STAGE
20849	Surface Water Management Plan

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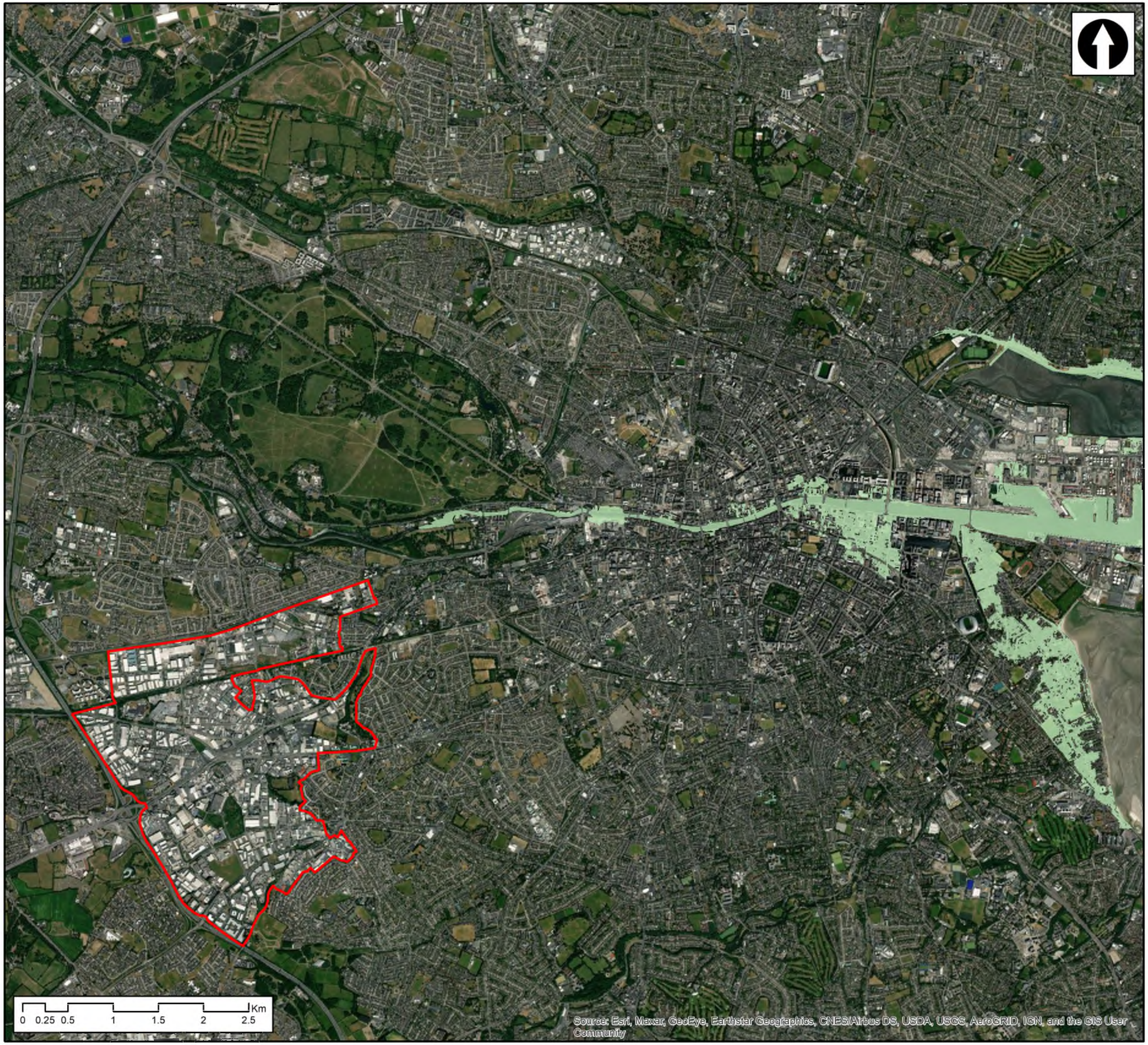
20849-SWMP012	-

APPENDIX C - COASTAL FLOODING MAPS



Project_Boundary

0.1% AEP Coastal Flood Extent - Present

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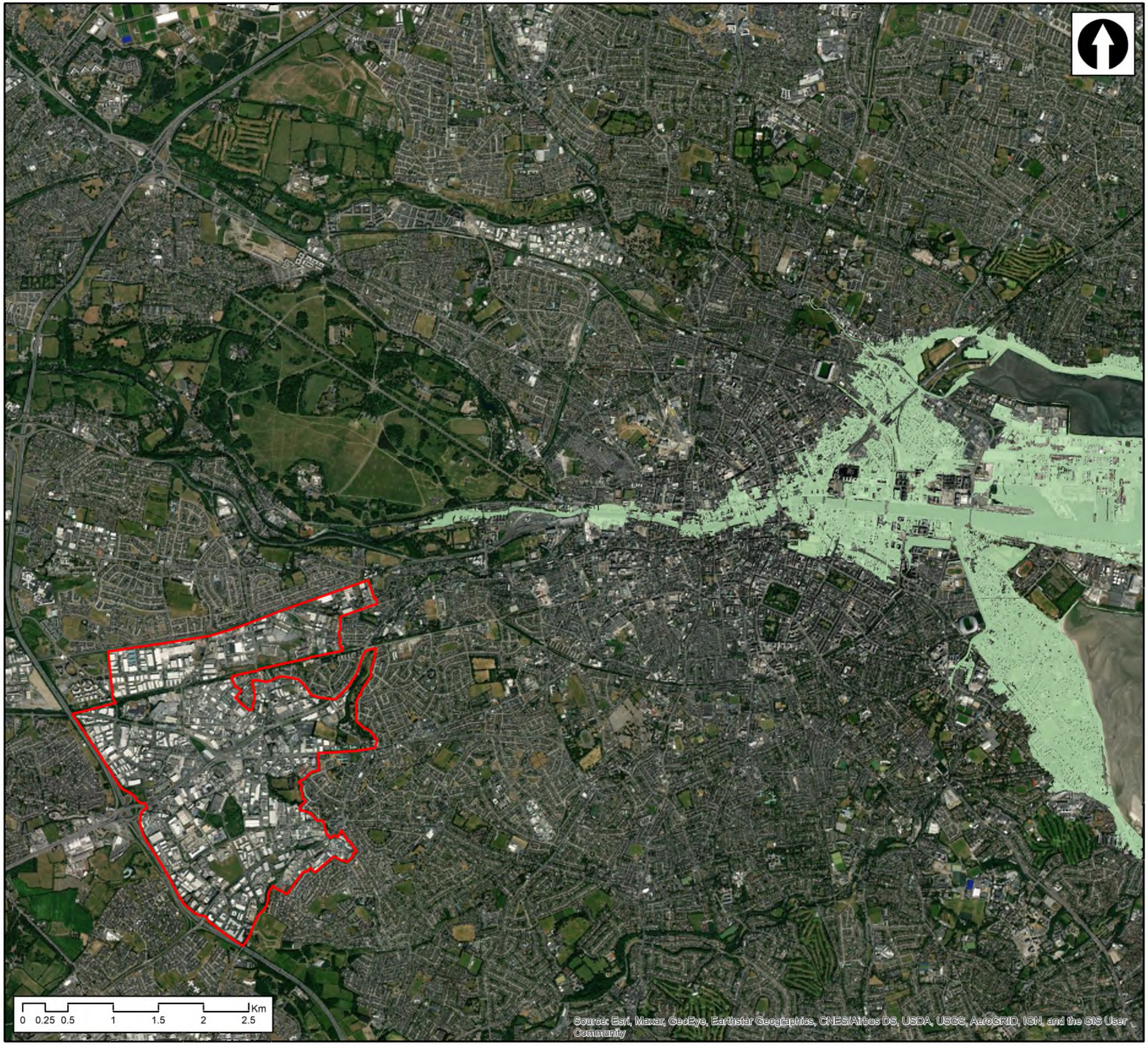
PROJECT No.	STAGE
20849	Surface Water Management Plan

DRAWING No.	REVISION
20849-SWMP021	-



Project_Boundary

0.1% AEP Coastal Flood Extent (20% Uplift)

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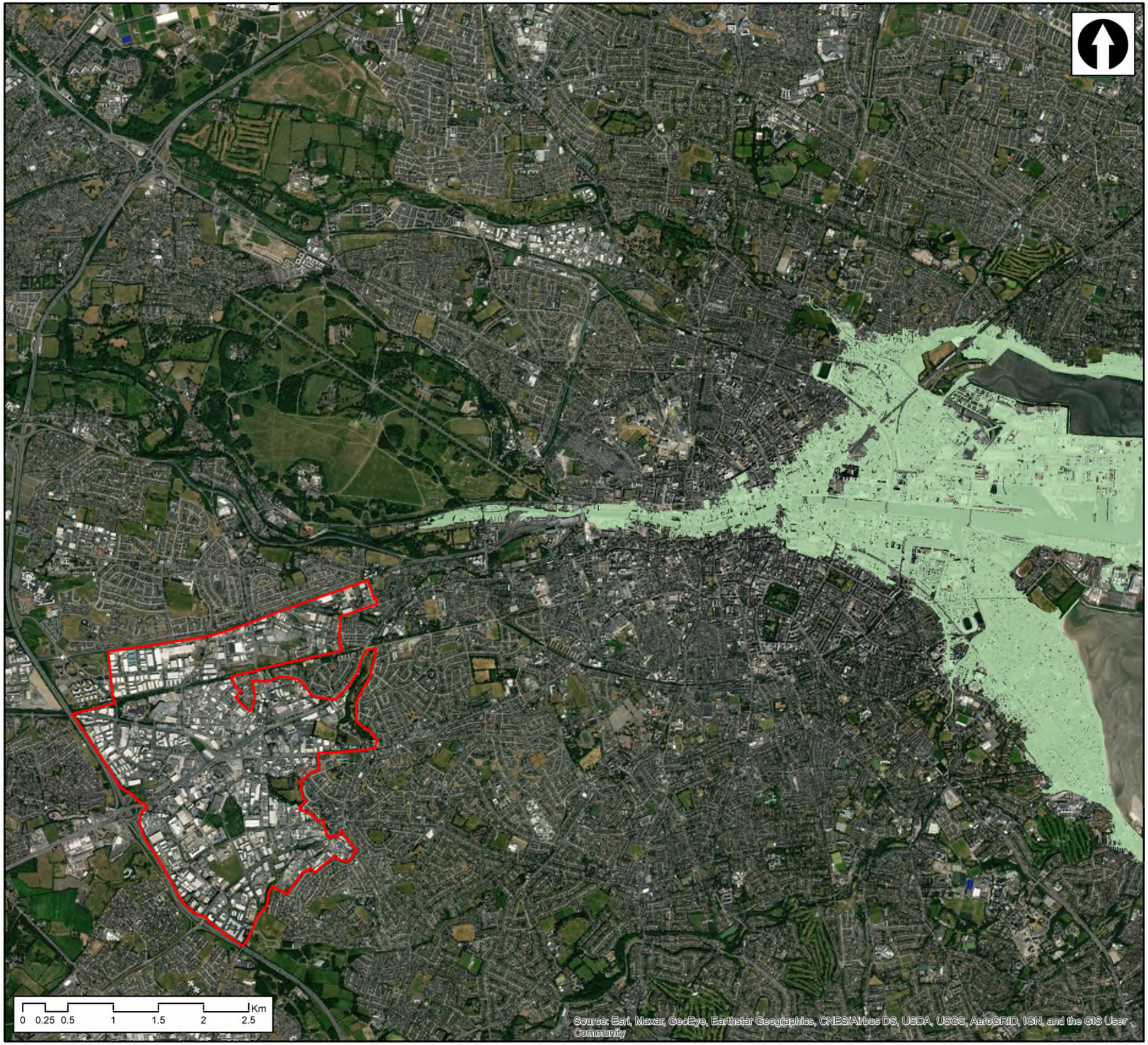
PROJECT No.	STAGE
20849	Surface Water Management Plan

DRAWING No.	REVISION
20849-SWMP022	-



Project_Boundary

0.1% AEP Coastal Flood Extent (30% Uplift)

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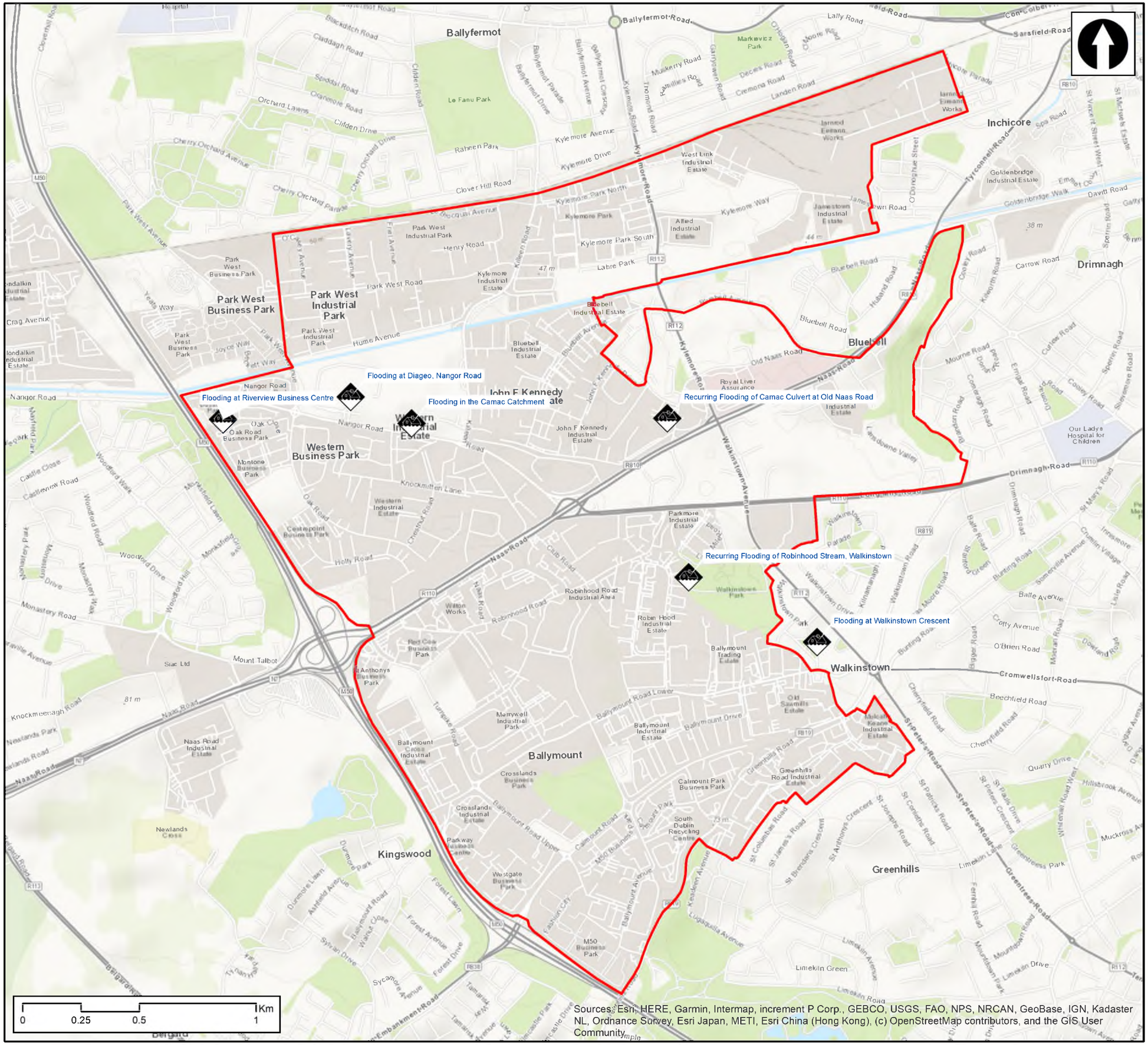
PROJECT No.	STAGE
20849	Surface Water Management Plan

DRAWING No.	REVISION
20849-SWMP023	-

APPENDIX D - PAST FLOODS



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PROJECT No.	STAGE
20849	Surface Water Management Plan

DRAWING No.	REVISION
20849-SWMP031	-

APPENDIX E – RIPARIAN CORRIDOR MAPS

Project_Boundary

Riparian Corridor

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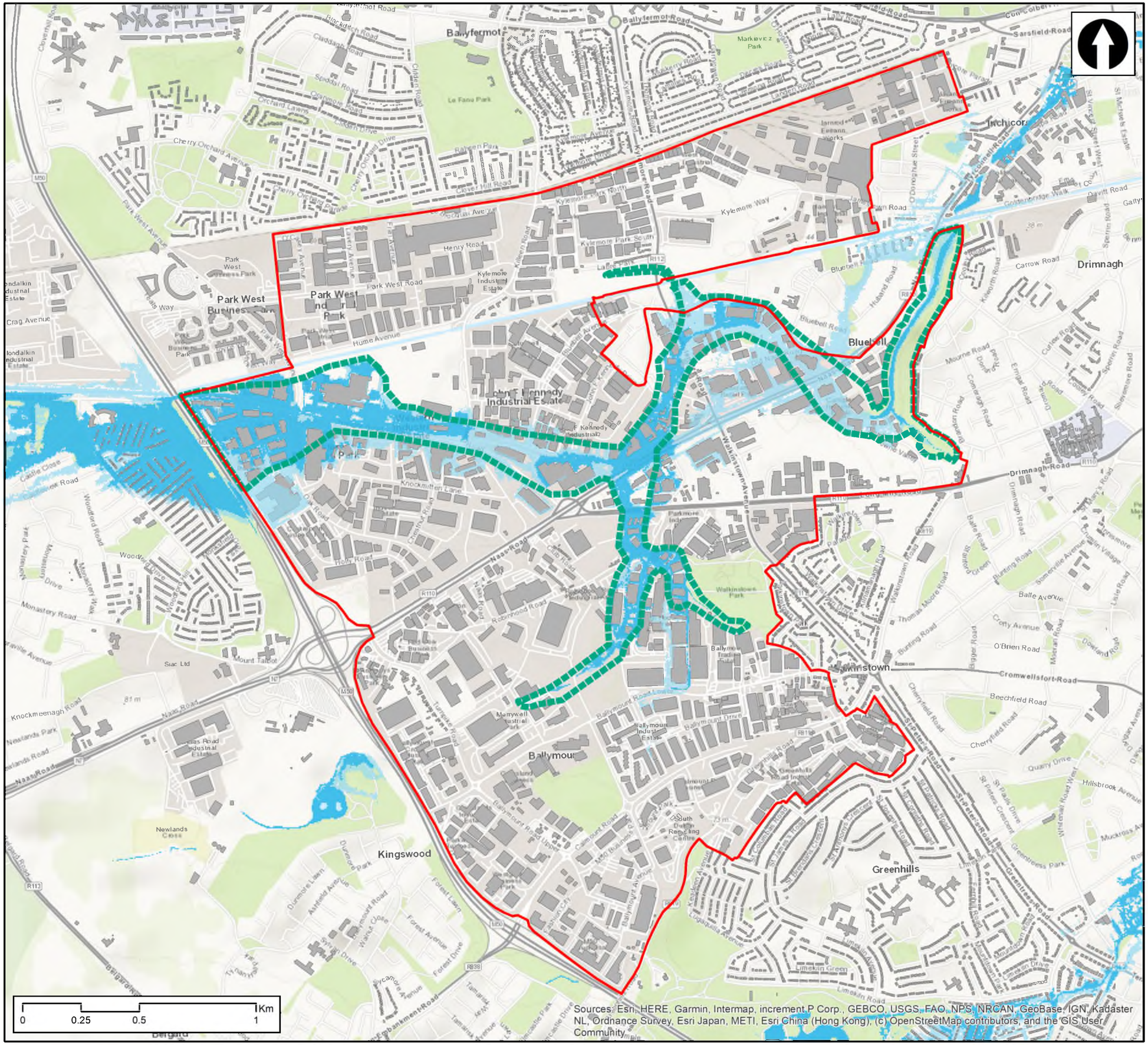
PROJECT No.	STAGE
20849	Surface Water Management Plan

DRAWING No.	REVISION
20849-SWMP041	-



Project_Boundary
Riparian Corridor
1% AEP Flood Extent Extent (30% Uplift)
0.1% AEP Fluvial Flood Extent (30% Uplift)
Buildings

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Comhairle Contae Átha Cliath Theas
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20849-SWMP042	-