Irish Water

Ringsend WWTP Upgrade Project

Ringsend WWTP

Flood Risk Assessment Report

May 2018

Document Control Sheet

Client:	Irish Water				
Project Title:	Ringsend WWTP Ringsend WWTP Upgrade Project				
Document Title:	Flood Risk Assessment Report				
Document No. :	**TOC (incl.)**	**List of Tables (incl.)**	**List of Figures (incl.)**	**Pages of Text**	**Appendices**
FRA-001	Y	Y	Y	23 No.	4 No.

Document Info.		**Verification**	**Name**	**Signature**
Rev.	2.0	**Author(s)**	DMcG	
Status	Final	**Checked By**	AMC	Email Verification
Issue Date	21/05/2018	**Approved By**	MH	Email Verification

Table of Contents

List of Figures

List of Tables

SECTION 1: Introduction

1.1 General

J. B. Barry and Partners Limited carried out a site specific Flood Risk Assessment (FRA) at Ringsend WWTP for J.B. Barry & Partners Ltd, TJ O'Connor and Associates, and Royal Haskoning DHV consortium who are acting as the consultant for Irish for the proposed Ringsend Wastewater Treatment Plant (WWTP) Upgrade Project at Ringsend, Dublin 4. The aim of the FRA is to identify, quantify and communicate to decision makers and other stakeholders the risk of flooding associated with the proposed development. The purpose of this FRA is to support the planning application for the proposed Ringsend WWTP Upgrade Project and, in addition, to consider the flood risk to the existing WWTP infrastructure and proposed temporary site compounds.

The FRA has been carried out in accordance with 'The Planning System and Flood Risk Management Guidelines' (hereafter referred to as the FRM Guidelines) published in November 2009 jointly by the then Department of the Environment, Heritage and Local Government, DEHLG, (now the Department of the Environment, Community and Local Government, DECLG) and the Office of Public Works (OPW).

This FRA report is a revision to the April 2012 Report entitled "Ringsend WwTW Extension Flood Risk Assessment" prepared by CDM & J.B. Barry and Partners Ltd to support a planning application for a previous proposal for the extension of the Ringsend WWTP.

The proposed development site is located at the existing Ringsend WWTP site along Pigeon House Road on the Poolbeg Peninsula in Ringsend, Dublin 4. The site is bordered by the Dublin Waste to Energy Plant to the west and the ESB Poolbeg power generating station to the east, as shown in Figure 1-1 below.

Figure 1-1: Location of Proposed Development *(Source: Google Maps, annotation by J.B. Barry & Partners)*

1.2 Background to Proposed Development

The existing Ringsend WWTP, commissioned in 2003, was designed to cater for a population equivalent (PE) of 1.64 million PE for Dublin City and the Greater Suburbs. The effluent (treated wastewaters) from the Ringsend WWTP is discharged to the Lower Liffey Estuary. The Ringsend WWTP has experienced loadings in excess of the original design and this has contributed to difficulties with plant operation, effluent quality and odour control. With the designation of the River Liffey as a sensitive water body in 2001, the discharge standards have become more stringent. The Urban Wastewater Treatment Directive requires nutrient removal to achieve 10 mg/l Total Nitrogen and 1 mg/l Total Phosphorus for continued discharge into the sensitive water body of the River Liffey Estuary. However the existing WWTP has limited ability to remove nutrients, as currently configured.

Irish Water have appointed the JV as consulting engineers for the upgrade of the Ringsend WWTP. The purpose of the project is to extend the Ringsend WWTP facility from its existing capacity to the maximum achievable within the curtilage of the existing site and to achieve the required discharge standards and the highest standards of odour control. The proposed WWTP Upgrade Project comprises of the following:

- Reconfiguration and retrofitting of the existing Sequence Batch Reactors (SBR's) within the confines of the existing site to facilitate the use of aerobic granular sludge technology in the secondary stage of the wastewater treatment process.
- Provision of a temporary access to the WWTP site on the north boundary of the site along Pigeon House Road.
- The provision of an internal circulation road and adjustment of the site boundary fence in the south east corner of the site.
- Associated works within the confines of the existing site including the provision of:
  - Phosphorus Removal Building
  - Sludge Pasteurisation Building
  - Ancillary works

The proposed development will expand the WWTP to an average daily capacity of 2.4 million PE.

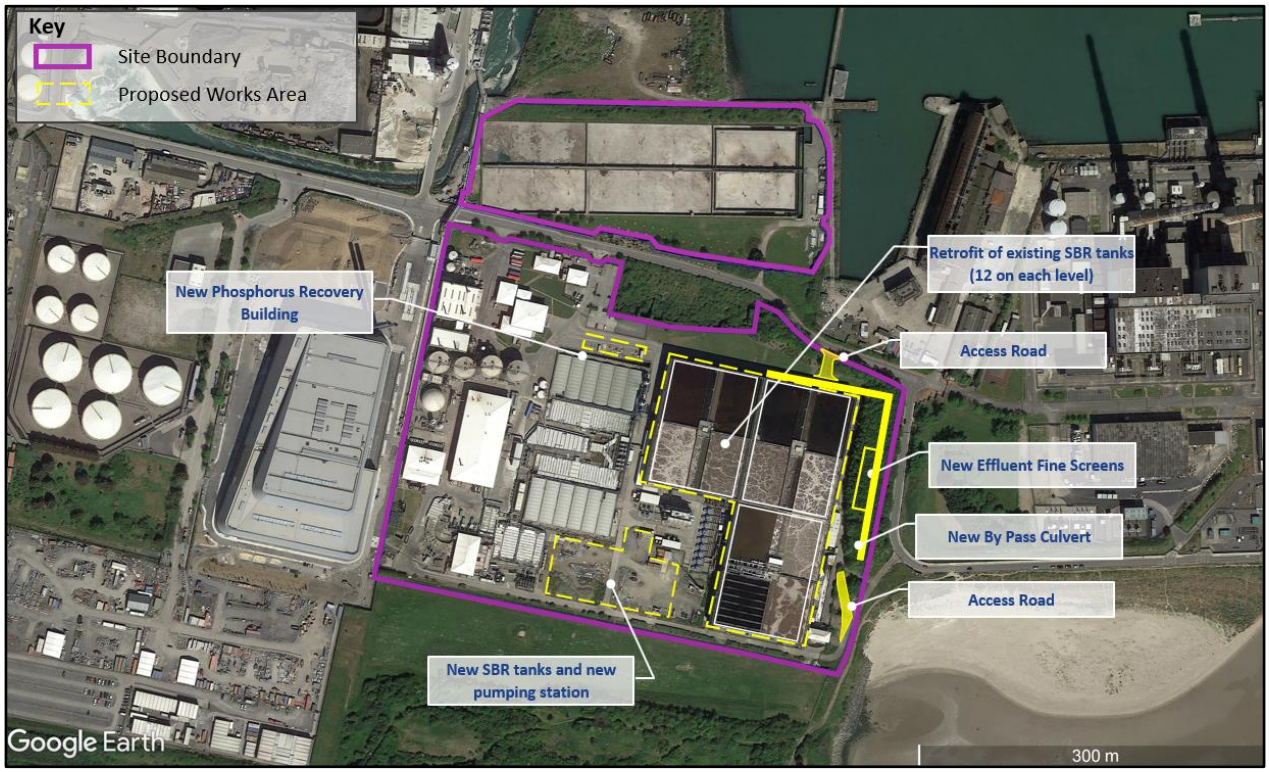


Figure 1-2: Location of proposed works at the Ringsend WWTP Site *(Source: Google Maps, annotation by J.B. Barry & Partners)*

All works for the development of the Ringsend WWTP will be carried out within the existing site. The site of the existing treatment facility is divided by Pigeon House Road. The area to the north of Pigeon House Road currently accommodates the storm water holding tanks and comprises 3.6 Ha. There is no development proposed at this portion of the site. The area of the WWTP to the south of Pigeon House Road comprises 11.2 Ha. The proposed upgrade works will occur at the existing SBR's, proposed access road at the north and south east of the site as well as other ancillary works within the confines of the existing site as shown in Figure 1-2 above. To facilitate construction works and plant installation, a number of contractor compound areas are to be made available. The location of these compound areas are shown in Figure 1-3 below. This FRA, therefore, covers the existing WWTP site and works compound areas.

Figure 1-3: Location of proposed compound areas *(Source: Google Maps, annotation by J.B. Barry & Partners)*

SECTION 2: Flood Risk Assessment Methodology

2.1 Methodology

The methodology used for the flood risk assessment for the proposed development is based on 'The Planning System and Flood Risk Management, Guidelines for Planning Authorities' (2009)'. The FRM Guidelines require the planning system at national, regional and local levels to:

- Avoid development in areas at risk of flooding, particularly floodplains, unless there are proven wider sustainability grounds that justify appropriate development;
- Adopt a sequential approach to flood risk management when assessing the location for new development based on avoidance, reduction and then mitigation of flood risk; and
- Incorporate flood risk assessment into the process of making decisions on planning applications and planning appeals.

The sequential approach (see Figure 3.1 of the FRM Guidelines below) in flood risk management requires the following three steps to identify the necessity for the justification test for a development:

- Step 1: Identification of the Flood Zone at the proposed development site (Section 2.23 of the FRM Guidelines);
- Step 2: Identification of the vulnerability of the type of the proposed development (Table 3.1 of the FRM Guidelines); and
- Step 3: Using the matrix of vulnerability versus Flood Zone (Table 3.2 of the FRM Guidelines), identify the necessity for the justification test for the proposed development.

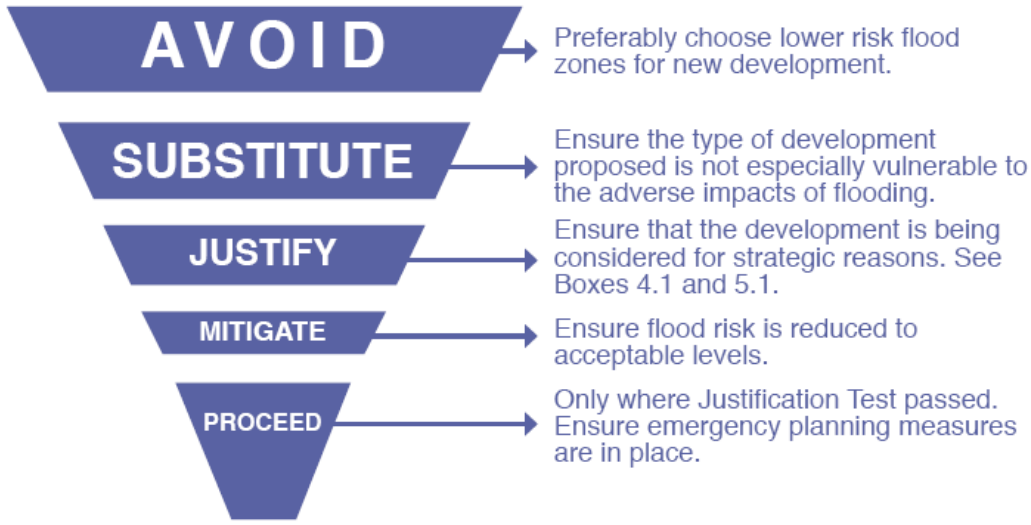


Fig. 3.1: Sequential approach principles in flood risk management

While Figure 3.1 of The FRM Guidelines sets out the broad philosophy underpinning the sequential approach in the flood risk management, Figure 3.2 of the Guidelines (shown below) describes the mechanism of the sequential approach for use in the planning process.

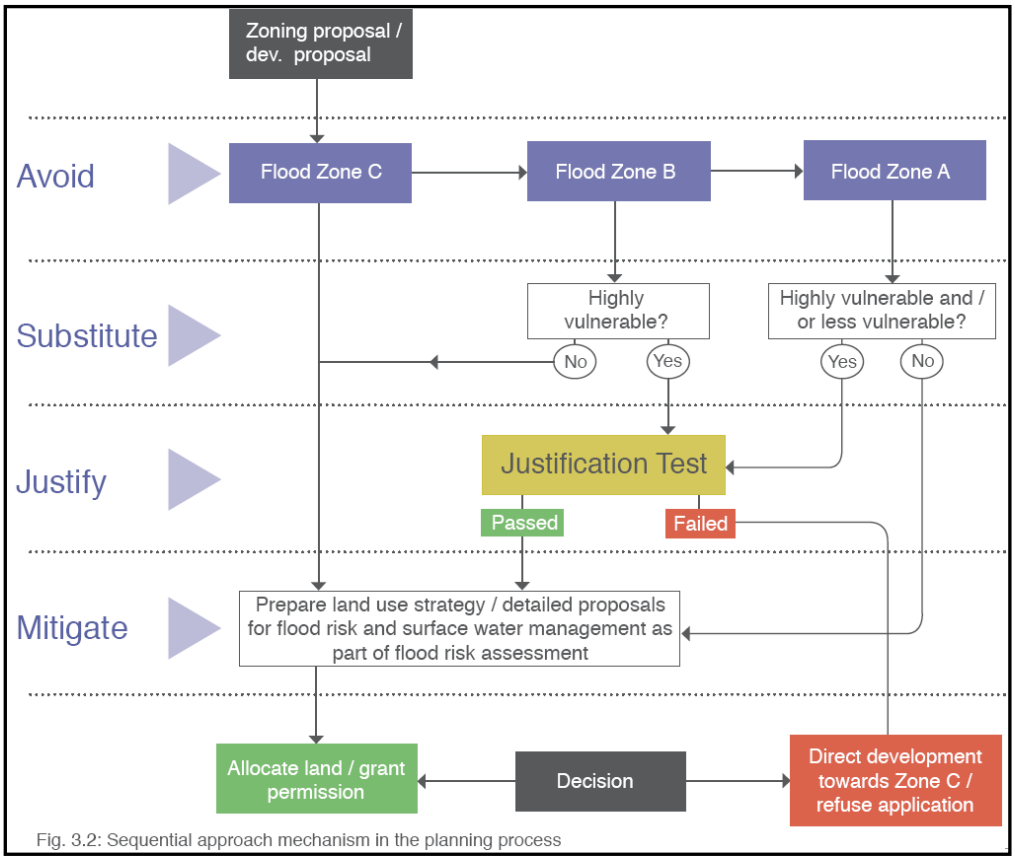


Fig. 3.2: Sequential approach mechanism in the planning process

According to the FRM Guidelines, Flood Zones are graphical areas within which the likelihood of flooding is in a particular range. They are a key tool in flood risk management within the planning process as well as in flood warning and emergency planning. There are three Flood Zones, namely,

- **Flood Zone A** – where the probability of flooding from rivers and the sea is highest (greater than 1% AEP or 1 in 100 year for river flooding or 0.5% or 1 in 200 for coastal flooding);
- **Flood Zone B** – where the probability of flooding from rivers and the sea is moderate (between 0.1% AEP or 1 in 1000 year and 1% AEP or 1 in 100 year for river flooding and between 0.1% AEP or 1 in 1000 year and 0.5% AEP or 1 in 200 year for coastal flooding); and
- **Flood Zone C** – where the probability of flooding from rivers and the sea is low (less than 0.1% AEP or 1 in 1000 for both river and coastal flooding).

Flood Zones A, B and C are based on the current assessment of the 1% AEP and the 0.1% AEP fluvial events and the 0.5% AEP and 0.1% AEP tidal events, without the inclusion of climate change factors. Table 3.1 of the FRM Guidelines (see below) shows the classification of the vulnerability to flooding of different types of development.

Vulnerability class	Land uses and types of development which include*:
Highly vulnerable development (including essential infrastructure)	Garda, ambulance and fire stations and command centres required to be operational during flooding; Hospitals; Emergency access and egress points; Schools; Dwelling houses, student halls of residence and hostels; Residential institutions such as residential care homes, children's homes and social services homes; Caravans and mobile home parks; Dwelling houses designed, constructed or adapted for the elderly or, other people with impaired mobility; and Essential infrastructure, such as primary transport and utilities distribution, including electricity generating power stations and sub-stations, water and sewage treatment, and potential significant sources of pollution (SEVESO sites, IPPC sites, etc.) in the event of flooding.
Less vulnerable development	Buildings used for: retail, leisure, warehousing, commercial, industrial and non-residential institutions; Land and buildings used for holiday or short-let caravans and camping, subject to specific warning and evacuation plans; Land and buildings used for agriculture and forestry; Waste treatment (except landfill and hazardous waste); Mineral working and processing; and Local transport infrastructure.
Water-compatible development	Flood control infrastructure; Docks, marinas and wharves; Navigation facilities; Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location; Water-based recreation and tourism (excluding sleeping accommodation); Lifeguard and coastguard stations; Amenity open space, outdoor sports and recreation and essential facilities such as changing rooms; and Essential ancillary sleeping or residential accommodation for staff required by uses in this category (subject to a specific warning and evacuation plan).
*Uses not listed here should be considered on their own merits	

Table 3.1 Classification of vulnerability of different types of development

Table 3.2 of the FRM Guidelines (shown below) identifies the types of development that would be appropriate for each Flood Zone and those that would be required to meet the Justification Test. The red boxes represent the WWTP Upgrade and as WWTP's are classified as 'Highly vulnerable development' the section highlighted in Table 3.2 presents the required actions for each flood zone. The compound areas meanwhile are represented by the yellow boxes and are classified as "Less vulnerable development".

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (including essential infrastructure)	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water-compatible development	Appropriate	Appropriate	Appropriate

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

The FRM Guidelines (Chapter 2) outlines the following three stages of flood risk assessment:

Stage 1: Flood risk identification – to identify whether there may be any flooding or surface water management issues relating to the proposed development site that may warrant further investigations.

Stage 2: Initial flood risk assessment – to confirm sources of flooding that may affect the proposed development site, to appraise the adequacy of existing information and to determine what surveys and modelling approach is appropriate to match the spatial resolution required and complexity of the flood risk issues. This stage involves the review of existing studies and hydraulic modelling to assess flood risk and to assist with the development of FRM measures.

Stage 3: Detailed flood risk assessment – to assess flood risk issues in sufficient detail and to provide a quantitative appraisal of potential flood risk to a proposed or existing development, of its potential impacts on flood risk elsewhere and of the effectiveness of any proposed mitigation measures. This will typically involve use of an existing or construction of a hydraulic model across a wide enough area to appreciate the catchment wide impacts and hydrological process involved.

2.2 Data Collection

Data required for the flood risk assessment was obtained from various sources, as described below.

- The historic data was obtained from the National Flood Hazard Mapping website www.floodmaps.ie
- The Subsoil and Aquifer vulnerability data was obtained from the Geological Survey of Ireland website www.gsi.ie
- Ringsend Flood Study, interim Report, 2002
- Greater Dublin Strategic Drainage Study (GDSDS), 2005
- Dublin Coastal Flooding Protection Project (DCFPP), 2005
- Irish Coastal Protection Strategy Study (ICPSS), 2008
- River Dodder Flood Risk Assessment and Management Study, 2008
- Draft Flood Risk Management Plans were obtained from the CFRAM Study undertaken by the OPW (2015)
- Dublin Strategic Development Plan 2016 – 2022, Strategic Flood Risk Assessment.

SECTION 3: Existing Hydrological Environment

3.1 Existing Drainage

The Ringsend WWTP Upgrade Project site is located in the Poolbeg Peninsula in the Dublin Port area. It is surrounded by the Liffey Estuary to the north and Dublin Bay to the east and south. Thus, in its natural condition, the site drains directly into Dublin Bay/Liffey Estuary. Given its coastal location, the primary flood risk to the site will therefore be from tidal/coastal flooding. The effect of fluvial flooding in the River Liffey will have less of an impact on flood risk to the site than tidal coastal flooding but will nonetheless be assessed in this report.

3.2 Existing Geology and Hydrogeology of the Area

The Geological Survey of Ireland (GSI) website provides information on their public online mapping service at www.gsi.ie on subsoil type and aquifer vulnerability. The maps presented in Figure 3-1 and Figure 3-2 depict the subsoil type and aquifer vulnerability for the proposed development site. The GSI subsoil mapping (Figure 3-1) indicates that made ground, due to the vast urban extent of the area, is the dominant ground condition within the environs of the development site.

Figure 3-1: GSI Subsoil Mapping (Source: www.gsi.ie, annotation by J.B. Barry & Partners)

The interactive web-mapping site does not extend as far as the southern portion of the WWTP site, however it does classify the aquifer vulnerability in the region, including the northern portion of the site, as having a low vulnerability rating (Figure 3-2). The GSI state that "Vulnerability is a term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated by human activities". The GSI further describes that the vulnerability of groundwater depends on:

(i) The time of travel of infiltrating water (and contaminants);

(ii) The relative quantity of contaminants that can reach the groundwater; and

(iii) The contaminant attenuation capacity of the geological materials through which the water and contaminants infiltrate

Firstly, the vulnerability rating for an area indicates, and is a measure of, the likelihood of contamination. Secondly, the vulnerability map helps to ensure that a groundwater protection scheme is not necessarily restrictive on human economic activity. Thirdly, the vulnerability map helps in the choice of preventative measures and enables developments, which have a significant potential to contaminate, to be located in areas of lower vulnerability.

Figure 3-2: **GSI Aquifer Vulnerability Mapping (Source: www.gsi.ie, annotation by J.B. Barry & Partners)**

3.3 Flood Regime of the Area

The National Flood Hazard Mapping Website www.floodmaps.ie shows no record of historic flooding (from tidal/coastal or groundwater flooding) at the proposed Ringsend WWTP Upgrade Project site. However, as noted in the Dublin Coastal Flooding Protection Project (DCFPP), part of Pigeon House Road, along the southern perimeter of the ESB site, flooded during the February 2002 tidal flood event as a result of wave action. There was also incidents of flooding at the inlet works in 2001 due to pumping philosophy upstream and the nature of the screens at the WWTTP. These issues have since been mitigated and no further flooding events have occurred. The National Flood Hazard Mapping Website shows more than 10 locations of historic flooding in the nearby areas, as shown in Figure 3-3 (also refer to Appendix 1).

It is observed from Figure 3-3 and also from the Flood Map Report (Appendix 1), that there are three prominent historic flooding locations close to the Ringsend WWTP Upgrade Project site, as described below.

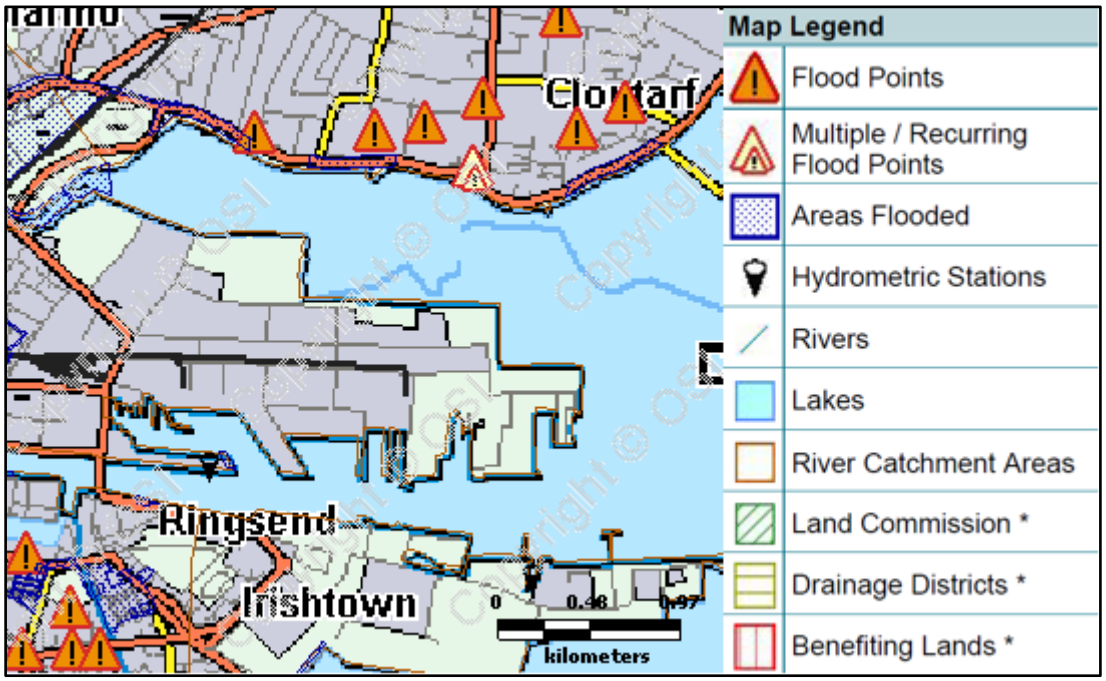


Figure 3-3: Location of historic flooding in the vicinity of the proposed site *(Source: www.floodmaps.ie annotation by J.B. Barry & Partners)*

1. *Ringsend*: Severe flooding events affected the area in the past, the major flooding being that of June 1963 and February 2002. According to the information available in the above website, a total of 97.8mm rainfall was recorded at Ballsbridge on 11th June 1963, which caused very considerable flooding in the area between Dundrum, Blackrock and Sandymount. Similarly, the tidal flooding of February 2002 affected many parts of Dublin City including the Ringsend area. A photograph of tidal flooding of February 2002 at Oliver Plunkett Avenue, Ringsend is shown overleaf.

Photogaph1: Flooding at Oliver Plunkett Avenue, Ringsend, in February 2002 (Source: www.floodmaps.ie)

2. *Bath Avenue*: The Bath Avenue area was also badly affected by the flooding event of June 1963, as shown in Photograph 2 below.

Photograph 2: Flooding at Bath Avenue in June 1963 (Source: www.floodmaps.ie)

3. *Ballsbridge (Dodder):* The Ballsbridge area was flooded from the Dodder River several times in the past, including in 1905, 1931, 1946, 1958, 1963, 1965, 1986, 1987, 2002, etc.

Photograph 3: August 1986 Flooding at Ballsbridge (Source: www.floodmaps.ie)

3.4 Existing Flood Studies and Design Tide Levels

The following is a brief review of recent drainage and flood studies for Dublin. The purpose of this review is to identify the design tide levels for the 0.5% AEP (Annual Exceedance Probability) and the climate change scenarios (i.e. mid-range future scenario (MRFS) and high end future scenario (HEFS)) used in these studies and to determine appropriate levels for the Ringsend WWTP Upgrade Project.

3.4.1 Ringsend Flood Study, Interim Report (2002)

J.B. Barry & Partners Ltd were retained by Dublin City Council (DCC) to prepare a report on the flooding event which occurred in Ringsend, Dublin along the banks of the Dodder River on the 1st February 2002. The study area covered by the River Dodder from the weir at Ballsbridge to the confluence with the River Liffey – a stretch of approximately 2.1km.

According to the Ringsend Flood Study Interim Report (published in April 2002), the February 2002 flood, which was caused by tidal surge, was significantly above any tide level recorded at Dublin Port gauge since records began in 1923.

3.4.2 Greater Dublin Strategic Drainage Study (2005)

The Greater Dublin Strategic Drainage Study (GDSDS), completed in 2005, identifies policies for the management of drainage services in the Greater Dublin Area. According to the GDSDS, all new development should incorporate Sustainable Urban Drainage Systems (SuDS) for the management of surface water runoff.

According to Volume 5 (Climate Change) of GDSDS, the sea level for the 0.5% AEP event, based on historical records, is a level of +2.89mOD at Dublin Port. However, as the February 2002 tidal flood event was +2.95mOD, it is suggested that as a precautionary measure, the 0.5% AEP design flood level to be taken as +2.95mOD.

The predicted rise in sea level in the UKCIP02 model, taking into account surge, by the end of the century, is in the order of 300mm to 400mm. Work carried out by NUI Maynooth which looked at eight GCM models, predict a sea level rise of 480mm by the end of the century. Thus with the 0.4m to 0.48m rise in sea level the realistic 0.5% AEP water level, for the Mid-Range Future Scenario (MRFS), would be at +3.4mOD.

Even higher sea level criterion may be needed for two reasons. The first is that the consequence of inundation from the sea varies and certain critical infrastructure areas, such as Ringsend WWTP, might justify this. For this reason, the suggested High End Future Scenario (HEFS) 0.5% AEP level would be approximately 1.0m above the +2.95mOD. According to the GDSDS, strategic long term Dublin area planning and highly sensitive areas (such as Ringsend WWTP) should use +4.0mOD.

3.4.3 Dublin Coastal Flooding Protection Project (2005)

This project, undertaken by DCC and Fingal County Council, completed in 2005, covers the Dublin City coastal area from the Martello Tower in Sandymount to the north of Portmarnock. The project was implemented as a response to the extreme tide and flood event that was experienced across Dublin on February 1st 2002. The tide was the highest on record since 1922, being in excess of 1m above the predicted tide for that day. This study confirms that Pigeon House Road, on the southern side of the Poolbeg Power Station, flooded as a result of wave overtopping and that water ran back along the road and ponded at the entrance to the Power Station. The WWTP did not flood during the February 2002 flood event.

The report included a detailed analysis of mean sea level using actual historic data as well as a review of the latest international best practice. Based on this it was recommended that an annual sea level rise in all designs of 4.15mm/year to be adopted to the end of this century. This includes an allowance of 0.3mm/year for land subsidence. A number of hydraulic models were constructed to look at wave conditions, tidal modelling, river modelling and overtopping modelling. These models were then used to

develop a coastal flood forecasting and warning system to provide advance warning in the event of a flood event. The analysis of the joint probability of fluvial and tidal flooding events confirmed that tidal levels are the dominant feature when looking at coastal areas. Specifically, the DCFPP modelling work concluded that the influence of even the 1% fluvial flood event on water level's downstream of the Fr. Matthews Bridge is minimal and thus in the Poolbeg Peninsula flood risk is tidally dominated.

The report also investigated the significance of the February 2002 event and concluded that it was an extreme event having a return period in excess of approximately 60 years. The DCFPP Report included information on existing defence assets and drawings showing the extent of the February 2002 tidal flood event, predictive flood hazard maps for the 0.5% AEP tidal event and proposed flood protection works.

The report identified that the coastal stretch on the south side of the ESB Poolbeg Power Station site, including Pigeon House Road, is at risk of flooding particularly as a result of wave overtopping. The report concluded that the WWTP site is not at risk of flooding.

The flood extent maps for the project are for the 0.5% AEP extreme tide level at Dublin Port. Observation of this shows that the proposed development site is located outside of the 0.5% AEP flood extent. The study has determined that this level is +3.13mOD.

3.4.4 Irish Coastal Protection Strategy Study (ICPSS) (2008)

This project, undertaken by the Department of Agriculture, Fisheries and Food (now incorporated into the OPW) was completed in 2008, and covers the coastline between Dalkey and Omeath. From the modelling of combined storm surges and tide levels, the study estimated extreme water levels and coastal flood extent for various design AEP's along the coastline.

Based on the various simulations of storms, time series of the water surface elevations were extracted at 29 points. It is noted that the Ringsend WWTP is located between Points NE_22 and NE_23. Table 11 in "Section 6 – Floodplain Mapping" of the ICPSS Report (2008) provides the result of the joint probability analysis of combined tide and surge events for all locations in the study. The predicted tide levels at various AEP's at Points NE_22 and NE_23 are presented in Table 3-1 below.

Design Event (AEP)	Point NE_22	Point NE_23	***Ringsend WWTP Site***
50%	2.46	2.43	*2.45*
20%	2.58	2.55	*2.57*
10%	2.67	2.64	*2.66*
5%	2.76	2.74	*2.75*
2%	2.88	2.86	*2.87*
1%	2.97	2.95	*2.96*
0.5%	3.07	3.04	***3.06***
0.1%	3.28	3.25	***3.27***

Table 3-1: Design Tide Level (mOD) from ICPSS Report (2008)

The last column of Table 3-1 above contains the estimated tide levels for the Ringsend WWTP site. These are based on the average of the corresponding water levels at the two points NE_22 and NE_23. It is observed from the table that the 0.5% and 0.1% AEP tide levels at the Ringsend WWTP Upgrade Project site are +3.06mOD and +3.27mOD respectively. The ICPSS has not considered a climate change factor in the above predicted water levels. Figure 3-4 below shows an extract of the ICPSS tidal flood extent map in the vicinity of the proposed development site. This map is included in Appendix 2.

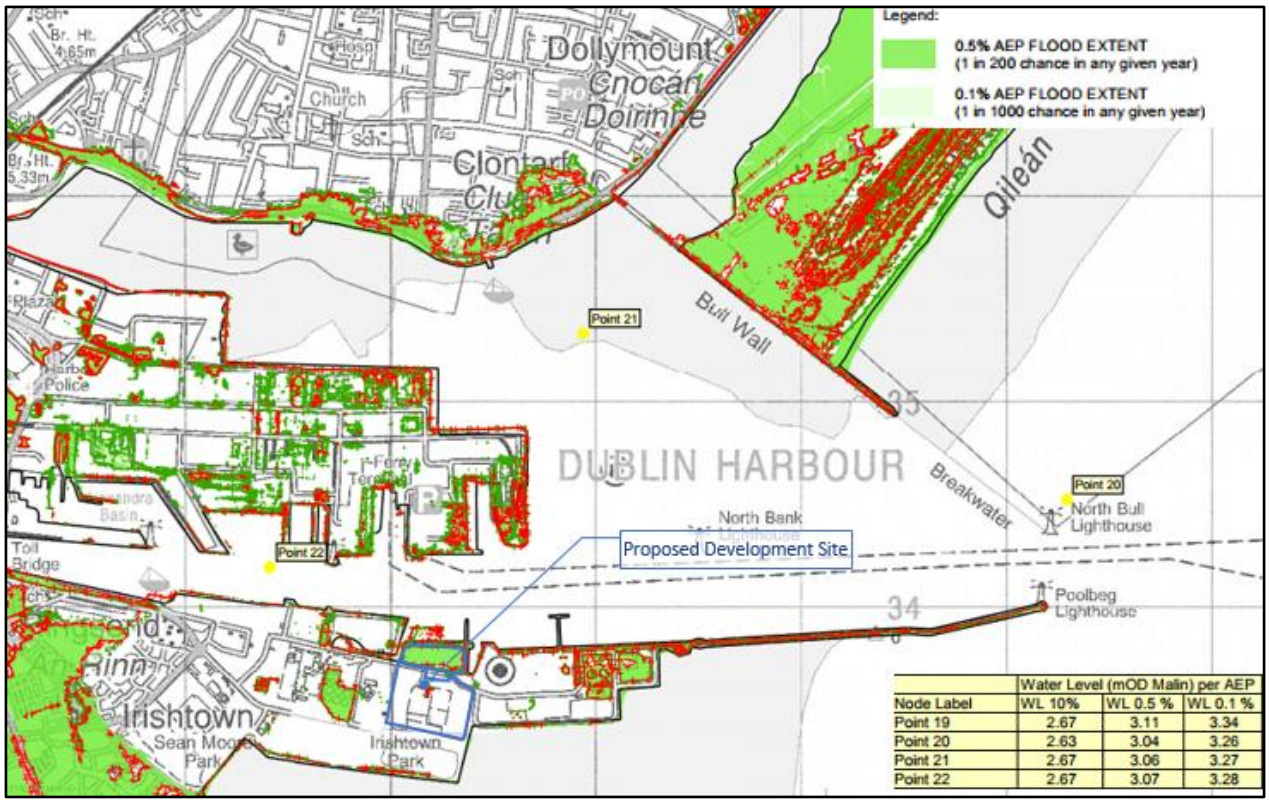


Figure 3-4: Extract of ICPSS Flood Map (Source: www.opw.ie, annotation by J.B. Barry & Partners Ltd)

3.4.5 River Dodder Flood Risk Assessment and Management Study (2008)

DCC appointed RPS Consulting Engineers to carry out the River Dodder Flood Risk Assessment and Management Study (Dodder CFRAMS) in January 2007. The following information is available from the DCC Website regarding the study. The River Dodder, one of Dublin's best known and most important rivers, has a history of flooding and is known as a "flashy" river with a quick response to rainstorms. In the last century it has overflowed its banks on numerous occasions causing damage to adjacent properties. One of the most severe floods in recent times occurred on 25th August 1986 (Hurricane Charlie) with well over 300 properties affected by the flooding. The other most notable flooding event occurred in February 1st 2002 when there was a significant high tide; over 600 properties were flooded on the lower Dodder downstream of Lansdowne Road Bridge. More recently flooding occurred in Ballsbridge during the October 2011 rainfall event.

According to Chapter 6 of the Dodder FRAMS Hydrology Report (2008), the coastal water levels used as downstream boundary conditions for the River Dodder Main Channel Study hydraulic model were taken from the Irish Coastal Protection Strategy Study (ICPSS). For the purposes of the study a water level increase of 0.5m was adopted for the MFRS and 0.8m for the HEFS. The current, MRFS, and HEFS tide levels from the Dodder FRAMS Hydrology Report are presented in Table 3-2 below.

Design Event (AEP)	Current Scenario	MRFS	HEFS
50%	2.46	2.96	3.26
20%	2.58	3.08	3.38
10%	2.67	3.17	3.47
5%	2.76	3.28	3.24
2%	2.88	3.38	3.68
1%	2.97	3.47	3.77
0.5%	3.07	3.57	3.87
0.1%	3.28	3.78	4.08

Table 3-2: Design Tide Level (mOD) used in Dodder CFRAMS

3.4.6 Draft Flood Risk Management Plans CFRAMS

The OPW, as lead agency for flood risk management in Ireland, is producing Flood Risk Management Plans (FRMP), in line with National Flood Policy and the requirements of the EU Floods Directive. Draft FRMP's are currently being produced by the OPW under the CFRAM Study. The Draft FRMP's make use of the information provided through the flood maps that have previously been produced under the CFRAM Programme and previous parallel projects. The Draft FRMP's set out a range of proposed measures and actions to manage and reduce flood risk within the catchments and coastal reaches covered by each Draft Plan, focusing on the 300 areas of potentially significant flood risk around Ireland that were identified under the PFRA. The Flood Maps associated with the FRMP's are currently being finalised and are made available online to view when the Draft Plans are published for consultation.

Figure 3-5 below is an extract from the Fluvial Flood Extent Map concerning the proposed development site. This map is included in Appendix 3. Observation of Figure 3-5 demonstrates that the entire site as well as the proposed locations for the site compounds lies outside of the 0.1% Fluvial AEP event and is therefore located within fluvial **Flood Zone C.**

Figure 3-6 below is an extract from the Coastal Flood Extent Map concerning the proposed development site. This map is included in Appendix 3. It can be seen that this map demonstrates that the portion of the site where the proposed upgrade is occurring lies outside of the 0.1% Tidal AEP event and is therefore located within Coastal **Flood Zone C**, where flooding is not considered to be significant. The northern portion of the site which contains the storm water tanks lies within the 0.5% AEP flood event, however there is no planned development at this location. It can also be seen that Site Compound 2 lies within the 0.1% AEP tidal event and is therefore considered to be located within **Flood Zone B.** This is consistent with the ICPSS flood map shown in Figure 3-4.

This extract also provides the flood level of the coastal area nearby to the boundary of the proposed development site during the 0.5% and 0.1% AEP Tidal Events. At the northern and southern boundaries of the site, at Nodes E0924C0012 and E0924C0015 water levels are + 3.11mOD and + 3.34mOD for the 0.5% and 0.1% AEP flood events respectively.

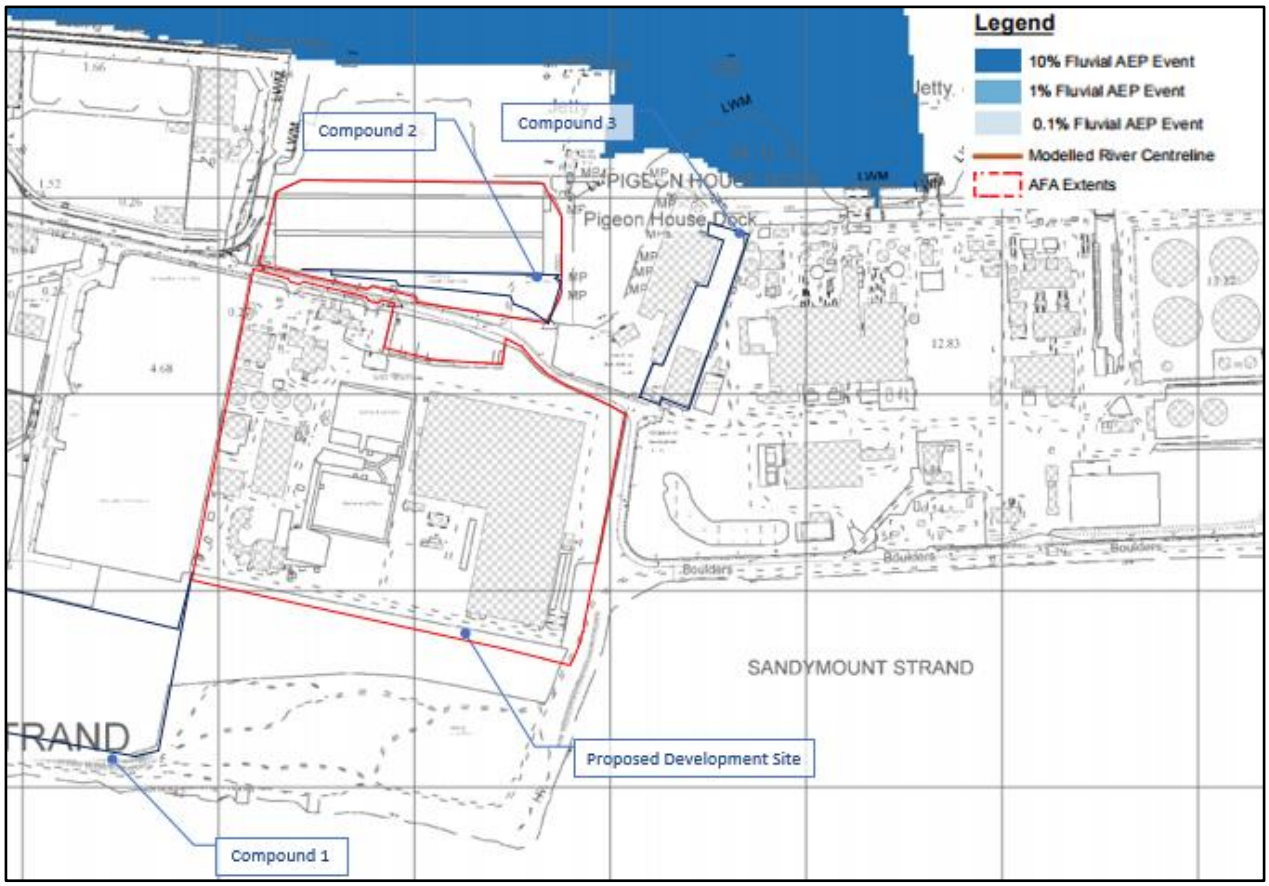


Figure 3-5: Extract from the CFRAMS Current Scenario Fluvial Flood Extent Map

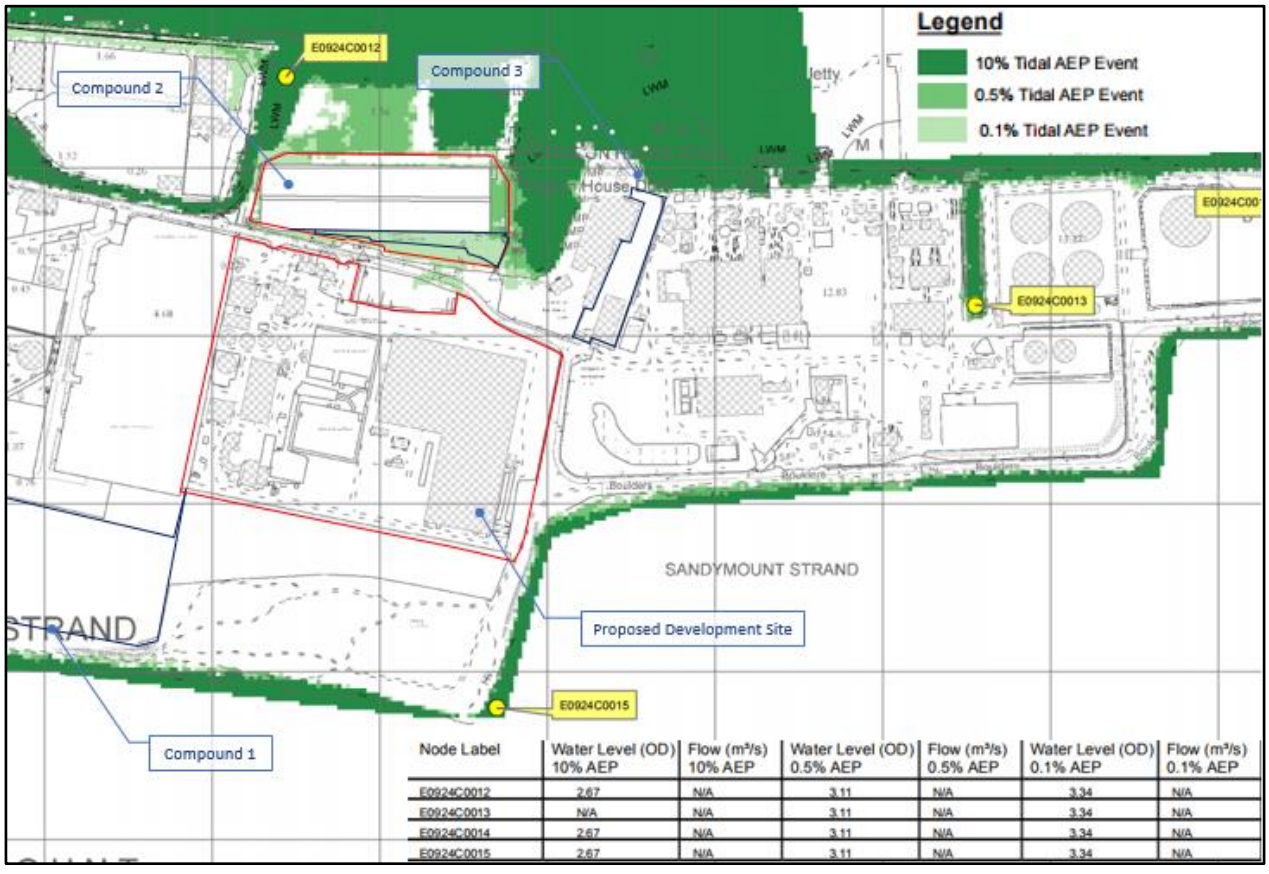


Figure 3-6: Extract from the CFRAMS Current Scenario Coastal Flood Extent Map

3.4.7 Dublin City Development Plan 2016-2022, Strategic Flood Risk Assessment

The Dublin City Council (DCC) Strategic Flood Risk Assessment (SFRA) was developed as part of the Dublin City Council Strategic Development Plan 2016-2022. The SFRA provides an area-wide assessment of all types of significant flood risk to inform strategic land use planning decisions. The SFRA enables DCC to allocate appropriate sites for development and identify how flood risk can be reduced as part of the development plan process.

As part of the SFRA flood zone maps were generated for Dublin City. Figure 3-7 below shows an extract from the Flood Zone Map in the vicinity of the proposed development. The full map is included in Appendix 4. From this figure it can be seen that the proposed development site lies outside of Flood Zones A, and B and can therefore be considered to be located within Flood Zone C.

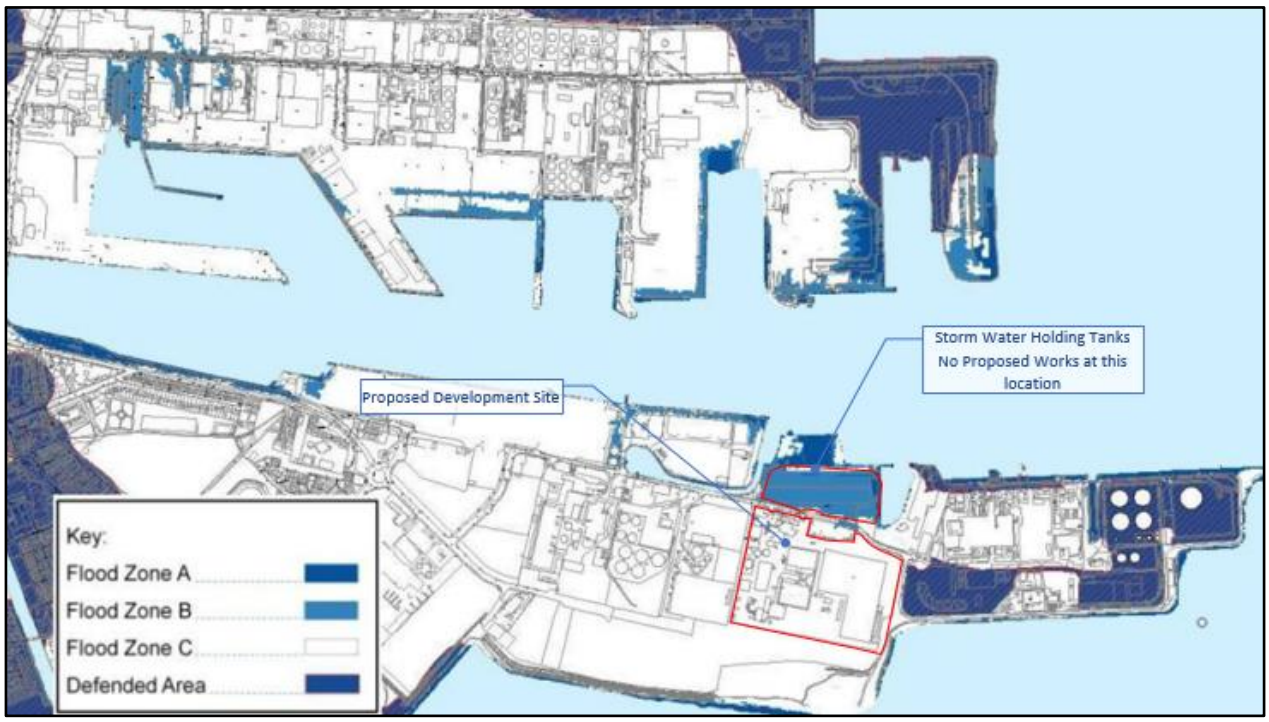


Figure 3-7: Extract from the Dublin City Council SFRA Flood Zone Map (annotation by J.B. Barry & Partners)

The SFRA states that the area is highly sensitive to climate change and an increase of 0.5m on top of the 0.5% AEP tide would put much of the area underwater. It recommends that a 1.0m rise in sea level should be assessed for high vulnerability/high risk developments.

Figure 3-8 below shows an extract of the Pluvial Flood Hazard Map which demonstrates the flood hazard associated with the 1% AEP storm event with a 3-hour duration. Observation of Figure 3-8 and Appendix 4 shows that the proposed site is classified as having a low flood hazard. The SFRA describes low hazard areas as *flood zones with shallow flowing water or deep standing water.* In conclusion, while there is a low risk of pluvial flooding, it is important to be cognisant of managing surface water which may accumulate on site. Surface water will be managed by appropriate SuDS measures.

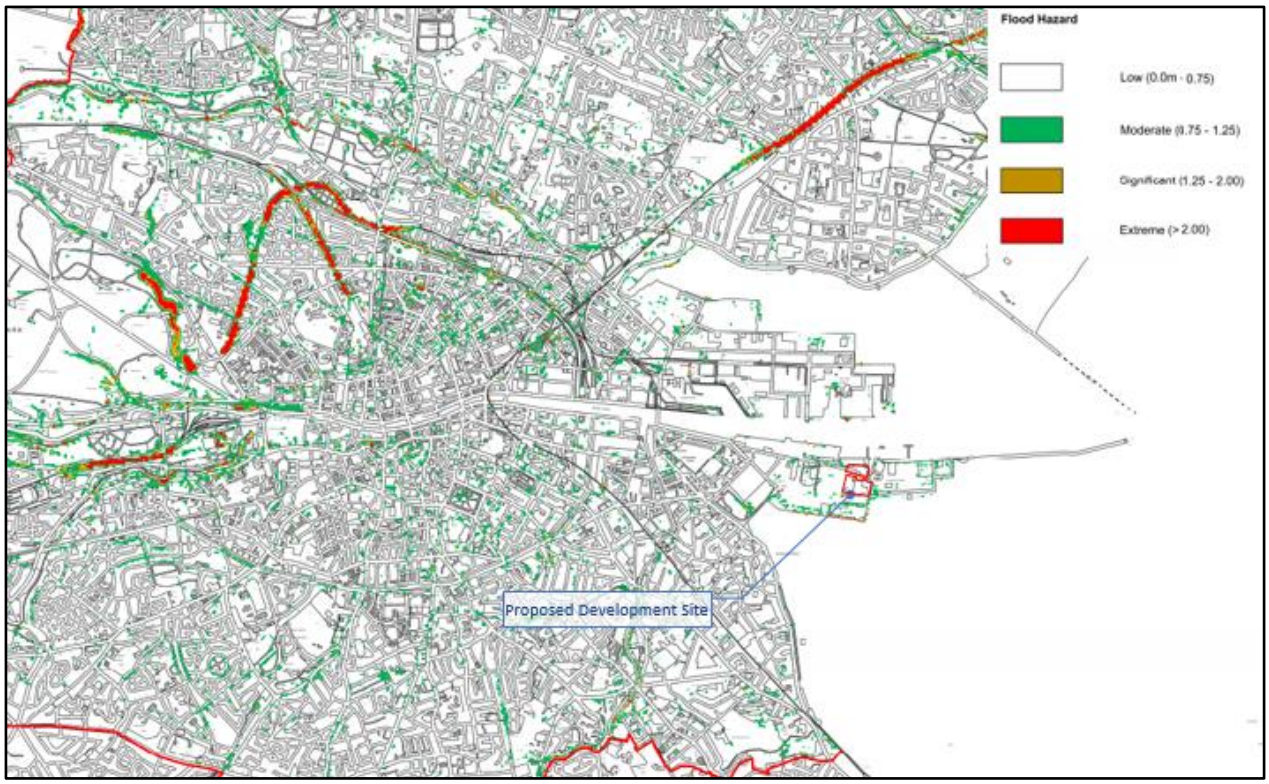


Figure 3-8: Extract from the Dublin City Council SFRA Pluvial Flood Hazard Map (annotation by J.B. Barry & Partners)

3.4.8 Discussion on Tide Levels

There are a variety of studies for the Dublin area that have considered tide levels and the effects of climate change. The design tide levels from each of the studies are summarised in Table 3-3 below.

Study	0.5% AEP	0.1% AEP
GDSDS	2.95	-
DCFPP	3.13	3.31
ICPSS	3.06	3.27
River Dodder CFRAMS	3.07	3.28
Draft Flood Risk Management CFRAMS	3.11	3.34

Table 3-3: Summary of Design Tide Levels (mOD)

It is observed from Table 3-3 that the most conservative estimate of the extreme 0.1% AEP flood event level at the Ringsend WWTP Upgrade Project site was provided by the recent Draft Flood Risk Management CFRAMS and as such, this study will be utilised for this assessment. In accordance with the Dublin SFRA, an increase of 0.5m is adopted to allow for the MRFS (mid-range future scenario) and an allowance of 1.0m is adopted to allow for the HEFS (high end future scenario) effects of climate change. Therefore, the predicted water level for the current, 0.5% and 0.1% AEP coastal flood event for the Ringsend WWTP Upgrade Project site is presented in Table 3-4 below.

Design Event (AEP)	Current (CFRAMS)	MRFS	HEFS
0.5%	3.11	3.61	4.11
0.1%	3.34	3.84	4.34

Table 3-4: Design Tide Levels (mOD) for the Ringsend WWTP Upgrade Project Site

SECTION 4: Flood Risk Assessment

4.1 Introduction

As outlined in Section 2 of this report the FRM guidelines identifies three stages of Flood Risk Assessment namely;

- Stage 1: Flood Risk Identification
- Stage 2: Initial Flood Risk Assessment
- Stage 3: Detailed Flood Risk Assessment

4.2 Flood Risk Identification

According to the FRM Guidelines, flood risk identification is the process for deciding whether a plan or project requires further investigation. This is a desk based exercise based on existing information. All the existing information is summarised in Section 3 and the identification of flood risk from each of the five sources of flooding (coastal, fluvial (river), groundwater, pluvial (rainfall) and from artificial drainage systems) is considered.

Coastal Flood Risk

As noted earlier, Pigeon House Road flooded during the February 2002 tidal flood event. This flood risk is confirmed in the ICPSS, DCFPP and CFRAMS maps. Therefore, the greatest flood risk to the site is from coastal flooding and hence this risk is brought forward for the Stage 2 – Initial Flood Risk Assessment.

Fluvial Flood Risk

The River Liffey discharges into Dublin Bay to the north of the Poolbeg Peninsula. There are no other large rivers or streams on the Poolbeg Peninsula which could cause fluvial flooding. Modelling of the interaction between the fluvial and tidal areas has confirmed that tide levels are the dominant feature in coastal areas. Specifically the DCFPP study modelled the interaction between the River Liffey and the coastal area and concluded that the influence of even the 1% AEP fluvial flood event on water levels downstream of the Fr. Matthews Bridge is minimal and thus in the Poolbeg Peninsula flood risk is tidally dominated. This is consistent with the CFRAM Fluvial Flood Extent map in Appendix 3 which clearly shows no fluvial flood risk to the proposed development site and indicates that the WWTP Upgrade Project site is located in fluvial Flood Zone C. Fluvial flood risk is therefore not considered to be significant.

Groundwater Flood Risk

Groundwater levels are linked to tide level and vary with tide level. Any build-up of groundwater will discharge to the drainage system or to the adjacent Dublin Bay. Groundwater risk is therefore not considered to be significant.

Pluvial Flood Risk

There is a surface water drainage system around the existing WWTP site and the road drainage discharges to Dublin Bay. During pluvial events the drainage system is sufficient to collect, treat and then discharge to Dublin Bay. If the drainage system becomes overloaded the surface water can drain to the adjacent Dublin Bay and thus the topography ensures that it is unlikely that there will be significant surface water flooding. The Dublin City SFRA Pluvial Flood Hazard Map indicates the site has a low hazard. Pluvial flood risk is therefore not considered to be significant.

Artificial Drainage Systems Flood Risk

Other than the drainage system mentioned above, there are no artificial drainage systems identified at the proposed site, and consequently artificial drainage systems flood risk is not relevant.

4.3 Initial Flood Risk Assessment

The Flood Risk Assessment has identified that there is a potential flood risk to the site due to coastal flooding. Under the sequential approach identified in the FRM Guidelines a three step approach is required to confirm the appropriateness of the development in terms of flood risk.

Step 1: Identification of the Flood Zone at the proposed development site

Using the Flood Zone criteria from the FRM Guidelines and as defined in Section 2 previously, the flood zones for each of the sites were determined.

- **Flood Zone A** – where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 year for river flooding or 0.5% or 1 in 200 for coastal flooding);
- **Flood Zone B** – where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 100 year and 1% or 1 in 1000 year for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 year for coastal flooding); and
- **Flood Zone C** – where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding).

According to the FRM Guidelines the flood zones are 'based on the current assessment of the 1% and the 0.1% AEP fluvial events and the 0.5% and 0.1% tidal events, without the inclusion of climate change factors'. The current tide levels are discussed in Section 3.4.8. This information was used in conjunction with available topographic information at the existing WWTP site and site compounds to determine the flood zone.

The ground levels at the WWTP site range from +4.2mOD (at the North West perimeter of the site), +4.8mOD (North East perimeter), +5.6mOD at the SBR's (South East perimeter), and +6.34mOD (South West perimeter). The WWTP ground levels are all above the 0.1% AEP tide level of +3.34mOD. The WWTP is therefore locate within **Flood Zone C – low risk area.** This is consistent with the ICPSS, DCFPP and CFRAMS flood extent maps as discussed above.

Observation of the tidal flood extent map in Appendix 3, and as mentioned in Section 3.4.6, shows that a small portion of Site Compound 2 is located in an area susceptible to flooding by the 0.1% AEP tidal event. Therefore it is determined that the compound area is located within **Flood Zone B – moderate risk area.**

Step 2: Identification of the vulnerability of the type of the proposed development (Table 3.1 of the FRM Guidelines)

The different types of proposed infrastructure are then assigned a vulnerability classification according to the definitions in 'Table 3.1 – Classification of vulnerability of different types of development' of the FRM Guidelines.

As described in Section 1.2 above, the proposed development consists of the upgrade of a WWTP. WWTP's are classified as 'highly vulnerable development'. The proposed development requires the necessity of site compounds during the construction stage of the project. As discussed in Section 2.1 the compound areas are considered 'less vulnerable development'.

Step 3: Using the matrix of vulnerability versus Flood Zone (Table 3.2 of the FRM Guidelines), identify the necessity for the justification test for the proposed development

The proposed WWTP Upgrade Project site is located in Flood Zone C and is categorised as Highly Vulnerable Development. Table 3.2 of the FRM guidelines and Figure 3.2 – Sequential approach

mechanism in the planning process (FRM guidelines) stipulate that a justification test is not required for such a development and is deemed appropriate development for the flood zone categories.

One of the compound areas is located in Flood Zone B and are categorised as less vulnerable development. Therefore this type of development is appropriate for this location and the Justification Test is not required. Figure 4-1 below highlights the sequential approach and the matrix of vulnerability versus flood zone, with the WWTP Upgrade represented by the red boxes and the compound areas represented by the yellow boxes.

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (including essential infrastructure)	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water-compatible development	Appropriate	Appropriate	Appropriate

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Figure 4-1: Matrix of Vulnerability versus Flood Zone to illustrate appropriate development

The conclusion to the above three steps in the sequential approach is that the proposed development at the WWTP is appropriate for the location in terms of flood risk.

The Ringsend WWTP Upgrade Project site is not a greenfield site, and hence the proposed development will not produce any significant amount of additional surface water. There will be no increased risk of flooding to adjacent areas as a result of the development as the surface water will be managed through the use of appropriately designed drainage systems and SuDS.

A number of studies have been undertaken in the Ringsend area as described in Section 3.4 above. It is considered that sufficient detail, modelling and mapping has been carried out to date for the purposes of this flood risk assessment and that it is not necessary to proceed to a Stage 3 – detailed flood risk assessment. Instead, it is proposed to proceed to the development of flood risk mitigation measures and residual risks in accordance with the sequential approach.

4.4 Flood Risk Mitigation Measures and Residual Risks

The following proposals for flood risk and surface water management are recommended for the WWTP site.

- According to the FRM Guidelines, 'the minimum floor levels for new development should be set above the 1% AEP river flood level (0.5% AEP coastal flood level) including an allowance for climate change, with appropriate freeboard'. The 0.5% AEP coastal flood event High End Future Scenario (HEFS) water level was previously determined to be +4.11mOD. It is stated in the Dublin City Strategic Flood Risk Assessment 2016-2022 that 0.3m is a suitable freeboard allowance for development taking place in an area of tidal risk. Incorporating an allowance of 0.35m for freeboard, the recommended minimum floor level of all new development is set at **+4.46mOD.**

- As the construction stage is to occur within the next 5 years, the 0.5% AEP current scenario of +3.11mOD is the design tide level as there is no requirement to account for climate change effects in this short term. Therefore, development proposed for the construction stage (i.e. compound areas) should be set above the 0.5% AEP current scenario of +3.11mOD. Any materials stored at the compounds shall be carefully stored to prevent spillage in the event of an extreme flood.

- The Ringsend WWTP site is not a greenfield site, and hence the proposed development will not produce any significant amount of additional surface water. A surface water drainage system will be

constructed for the new works which will connect into the existing drainage system. This will be designed in accordance with best practice including the provision of pollution interceptors and treatment of surface water prior to discharge to Dublin Bay.

- If the above mitigation measures are implemented it is considered that there would be negligible or no residual flood risk to the proposed development.

SECTION 5: Conclusions and Recommendations

5.1 Summary of Results

A flood risk assessment for the Ringsend WWTP Upgrade Project Site has been undertaken following the methodology recommended in the FRM Guidelines. The Ringsend WWTP Upgrade Project site is located in the Poolbeg Peninsula and naturally drains to Dublin Bay. There are no records of groundwater or surface water flooding at the site, but Pigeon House Road flooded during the February 2002 tidal event. The biggest flood risk was determined to be from tidal/coasting flooding.

The sequential test was applied to the proposed development at the WWTP. The WWTP is categorised as a highly vulnerable development and is located in Flood Zone C – low risk. Contractors compounds required during the construction stage of the project are categorised as less vulnerable development and is located in Flood Zone B. In both cases, the proposed development passed the sequential test and flood risk and surface water management proposals have been developed.

5.2 Impact of the proposed development on the existing flood regime of the area

As the proposed Ringsend WWTP Upgrade Project is located in a low risk flood zone and is not at risk of flooding it will not have an impact on the existing flood risk to the site or to the surrounding areas. As the site is a brownfield site the proposed development will not produce any significant additional surface water runoff . The sites are located in a peninsula and there is natural drainage to Dublin Bay. Therefore, the proposed development the two sites will have an imperceptible impact on the existing flood regime of the area.

5.3 Vulnerability of the Proposed Development to Flooding

The WWTP Upgrade Project site lies within Flood Zone C – low risk and is categorised as highly vulnerable development (including essential infrastructure). The compounds are located in Flood Zone B – and are categorised as 'less vulnerable development'. The assessment has demonstrated that these developments are appropriate for these locations.

The recommended design level to cater for any future flood risk (for highly vulnerable development) has been based on the 0.5% AEP HEFS tide level, and was determined to be +4.46mOD, which includes an allowance for climate change and appropriate freeboard. This level is greater than the 0.1% AEP HEFS tide level.

5.4 Vulnerability of the Existing Development to Flooding

The assessment has indicated that the entire WWTP site is located within Flood Zone C – low risk. Whilst some of the existing buildings have a FFL below the design recommendation for FFL, there is no requirement to retrospectively apply this criterion to the existing WWTP infrastructure particularly as it's in Flood Zone C.

Appendix 1:

OPW Summary Local Area Reports

OPW National Flood Hazard Mapping

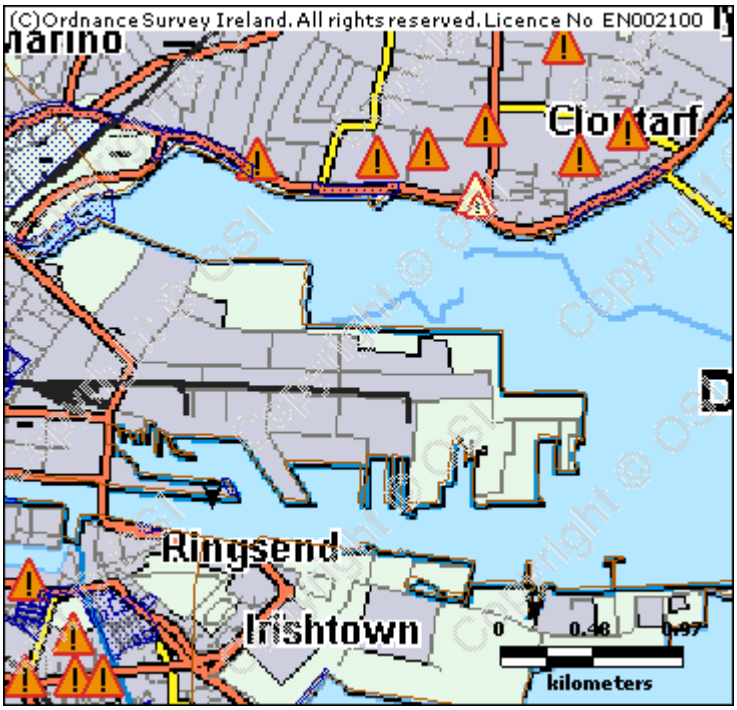
Summary Local Area Report

This Flood Report summarises all flood events within 2.5 kilometres of the map centre.

The map centre is in:

County: Dublin

NGR: O 195 350



Map Scale 1:40,001

Map Legend	
	Flood Points
	Multiple / Recurring Flood Points
	Areas Flooded
	Hydrometric Stations
	Rivers
	Lakes
	River Catchment Areas
	Land Commission *
	Drainage Districts *
	Benefiting Lands *

* Important: These maps do not indicate flood hazard or flood extent. Thier purpose and scope is explained in the Glossary.

20 Results

1. Flooding at Bessborough Avenue, North Strand, Dublin 3 on 24th Oct 2011
County: Dublin
Start Date: 24/Oct/2011
Flood Quality Code:3
Additional Information: Reports (1) More Mapped Information

2. Flooding at Clanmoyle Road, Donnycarney, Dublin 5 on 24th Oct 2011
County: Dublin
Start Date: 24/Oct/2011
Flood Quality Code:3
Additional Information: Reports (1) More Mapped Information

3. Tolka December 1954
County: Dublin
Start Date: 08/Dec/1954
Flood Quality Code:1
Additional Information: Photos (2) Reports (13) Press Archive (9) More Mapped Information

4. Tolka November 2002
County: Meath, Dublin
Start Date: 13/Nov/2002
Flood Quality Code:1
Additional Information: Photos (126) Reports (9) Videos (3) Press Archive (13) More Mapped Information

5. Dublin City Tidal Feb 2002
County: Dublin
Start Date: 01/Feb/2002
Flood Quality Code:1

Additional Information: Photos (32) Reports (10) Press Archive (27) More Mapped Information

---

6. North Strand Road June 1963
Start Date: 11/Jun/1963
County: Dublin
Flood Quality Code:3

Additional Information: Reports (3) Press Archive (2) More Mapped Information

---

7. Ringsend June 1963
Start Date: 11/Jun/1963
County: Dublin
Flood Quality Code:3

Additional Information: Reports (3) Press Archive (2) More Mapped Information

---

8. Flooding at Havelock Square, Sandymount, Dublin 4 on 24th Oct 2011
Start Date: 24/Oct/2011
County: Dublin
Flood Quality Code:2

Additional Information: Reports (1) More Mapped Information

---

9. Flooding at Bath Avenue, Sandymount, Dublin 4 on 24th Oct 2011
Start Date: 24/Oct/2011
County: Dublin
Flood Quality Code:2

Additional Information: Reports (1) More Mapped Information

---

10. Flooding at ESB Sportsco, Ringsend, Dublin 4 on 24th Oct 2011
Start Date: 24/Oct/2011
County: Dublin
Flood Quality Code:2

Additional Information: Reports (1) More Mapped Information

---

11. Clontarf Tidal Flooding October 2004
Start Date: 27/Oct/2004
County: Dublin
Flood Quality Code:3

Additional Information: Reports (2) More Mapped Information

---

12. Clontarf Rd Seaview Avenue August 2004
Start Date: 23/Aug/2004
County: Dublin
Flood Quality Code:3

Additional Information: Reports (3) More Mapped Information

---

13. Mount Prospect Ave Clontarf August 2004
Start Date: 23/Aug/2004
County: Dublin
Flood Quality Code:3

Additional Information: Reports (3) More Mapped Information

---

14. Clontarf Oulton road area August 2004
Start Date: 23/Aug/2004
County: Dublin
Flood Quality Code:3

Additional Information: Reports (1) More Mapped Information

---

15. Kincora Court Conquer Hill Rd Aug 2004
Start Date: 23/Aug/2004
County: Dublin
Flood Quality Code:3

Additional Information: Reports (3) More Mapped Information

---

16. Vernon Avenue Clontarf Road Aug 2004
Start Date: 23/Aug/2004
County: Dublin
Flood Quality Code:3

Additional Information: Reports (2) More Mapped Information

---

17. Clontarf Kincora Park August 2004
Start Date: 23/Aug/2004
County: Dublin
Flood Quality Code:3

Additional Information: Reports (2) More Mapped Information

---

18. Seapark Drive Seafield Road Aug 2004
Start Date: 23/Aug/2004
County: Dublin
Flood Quality Code:3

Additional Information: Reports (3) More Mapped Information

---

19. Vernon Avenue Kincora Road Aug 2004

Start Date: 23/Aug/2004

County: Dublin

Flood Quality Code: 3

Additional Information: Reports (3) More Mapped Information

20. Bath Avenue June 1963

Start Date: 11/Jun/1963

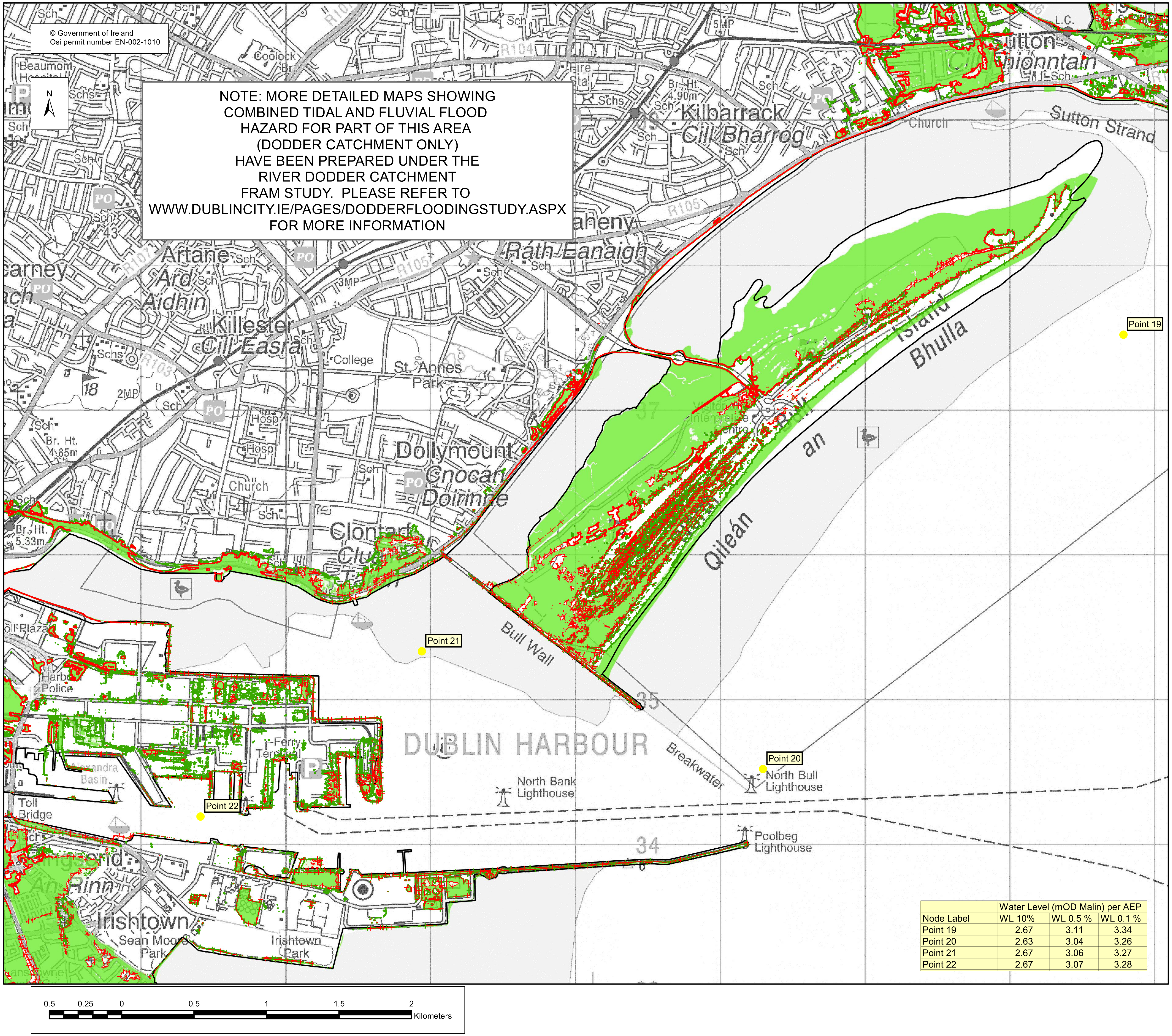
County: Dublin

Flood Quality Code: 2

Additional Information: Photos (1) Reports (2) More Mapped Information

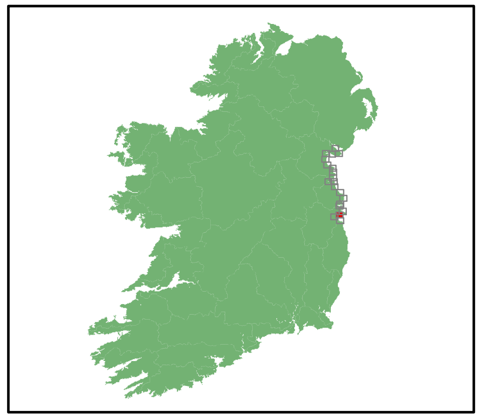
Appendix 2:

ICPSS Map



Node Label	Water Level (mOD Malin) per AEP		
	WL 10%	WL 0.5 %	WL 0.1 %
Point 19	2.67	3.11	3.34
Point 20	2.63	3.04	3.26
Point 21	2.67	3.06	3.27
Point 22	2.67	3.07	3.28

Location Plan :



EXTENT MAP

Legend:

- 0.5% AEP FLOOD EXTENT (1 in 200 chance in any given year)
- 0.1% AEP FLOOD EXTENT (1 in 1000 chance in any given year)
- Very High Confidence (0.1% AEP)
- High Confidence (0.1% AEP)
- Medium Confidence (0.1% AEP)
- Low Confidence (0.1% AEP)
- Very Low Confidence (0.1% AEP)
- Very High Confidence (0.5% AEP)
- High Confidence (0.5% AEP)
- Medium Confidence (0.5% AEP)
- Low Confidence (0.5% AEP)
- Very Low Confidence (0.5% AEP)
- High Water Mark (HWM)
- Node Point
- Point 34 Node Label (refer to table)

USER NOTE :

USERS OF THESE MAPS SHOULD REFER TO THE DETAILED DESCRIPTION OF THEIR DERIVATION, LIMITATIONS IN ACCURACY AND GUIDANCE AND CONDITIONS OF USE PROVIDED AT THE FRONT OF THIS BOUND VOLUME. IF THIS MAP DOES NOT FORM PART OF A BOUND VOLUME, IT SHOULD NOT BE USED FOR ANY PURPOSE.

RPS
Elmwood House
74 Boucher Road
Belfast
BT 12 6RZ
Northern Ireland

OPW
Office of Public Works
17-19 Lower Hatch Street
Dublin 2
Ireland

Project :
IRISH COASTAL PROTECTION STRATEGY STUDY - PHASE III

Map :
NORTH EAST COAST FLOOD EXTENT MAP

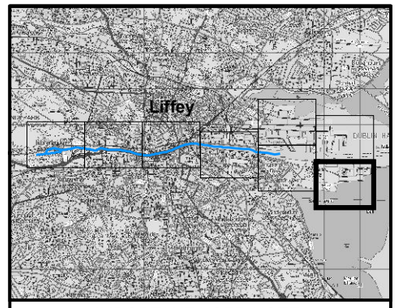
Map Type : FLOOD EXTENT
Source : TIDAL FLOODING
Map area : RURAL AREA
Scenario : CURRENT
Figure By : PJW — Date : Jan 2010
Checked By : JMC — Date : Jan 2010

Figure No. : NE / RA / EXT / 18 — Revision 1

Drawing Scale : 1:25,000 — Plot Scale : 1:1 @ A3

Appendix 3:

CFRAMS Map



IMPORTANT USER NOTE:
THE VIEWER OF THIS MAP SHOULD REFER TO THE DISCLAIMER, GUIDANCE NOTES AND CONDITIONS OF USE THAT ACCOMPANY THIS MAP.

Legend

- 10% Fluvial AEP Event
- 1% Fluvial AEP Event
- 0.1% Fluvial AEP Event
- Modelled River Centreline
- AFA Extents
- Node Point
- Node ID Node Label

FINAL

REV:	NOTE:	DATE:

EASTERN CFRAM STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT

OPW Oifig na nOibreacha Poiblí The Office of Public Works

RPS

The Office of Public Works
Jonathan Swift Street
Trim
Co Meath

Elmwood House
74 Boucher Road
Belfast
BT12 6RZ

T +44(0) 28 90 667914
F +44(0) 28 90 668286
W www.rpsgroup.com
E ireland@rpsgroup.com

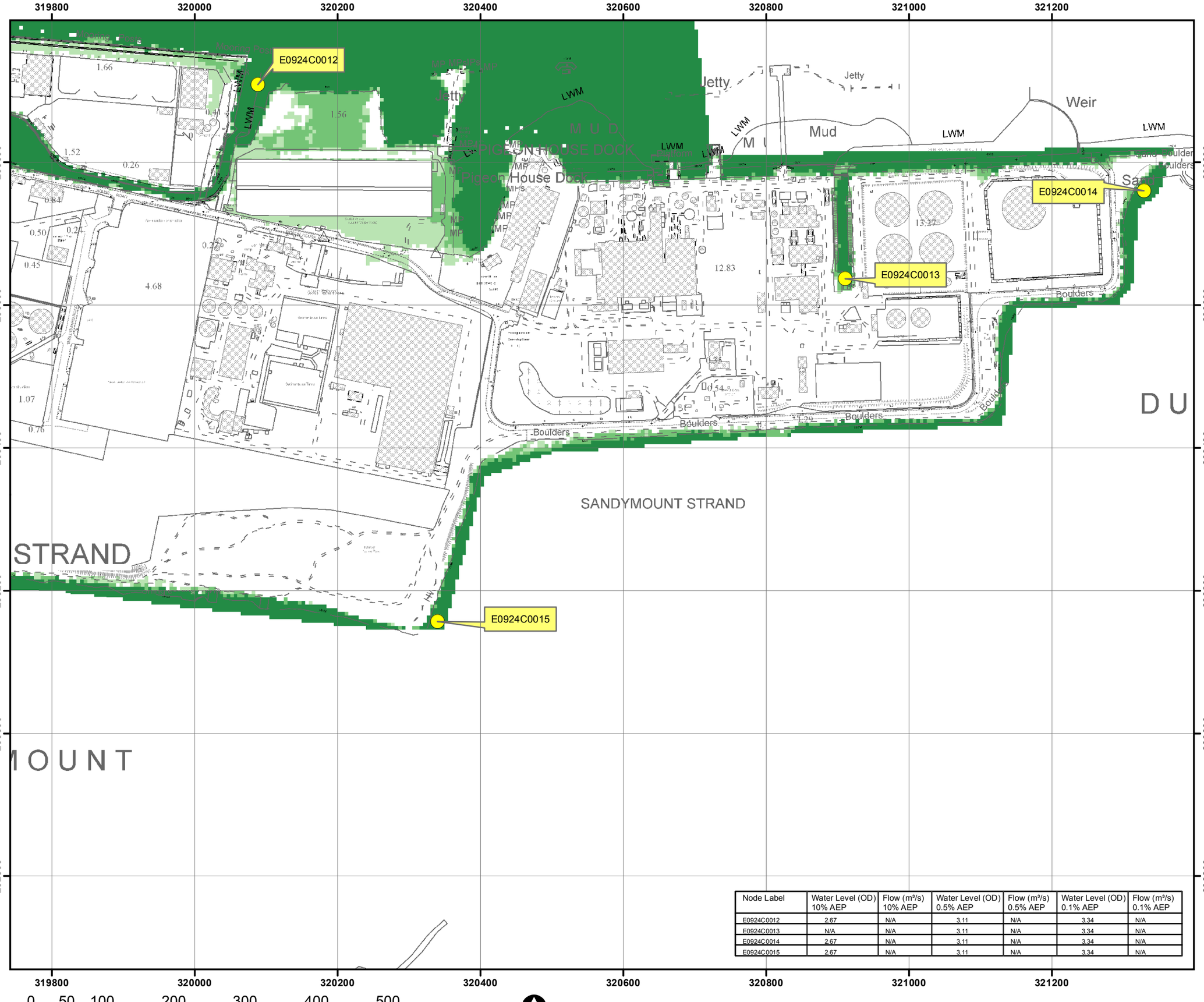
Map:
Liffey Fluvial Flood Extents

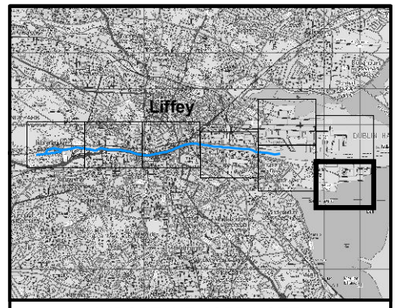
Map Type:	EXTENT
Source:	FLUVIAL
Map Area:	HPW
Scenario:	CURRENT
Drawn By : C.C.	Date : 28 July 2016
Checked By : A.S.	Date : 28 July 2016
Approved By : S.P.	Date : 28 July 2016

Drawing No. :
E09LIF_EXFCD_F0_06

Map Series : Page 6 of 8

Drawing Scale : 1:5,000 @ A3





IMPORTANT USER NOTE:
THE VIEWER OF THIS MAP SHOULD REFER TO THE DISCLAIMER, GUIDANCE NOTES AND CONDITIONS OF USE THAT ACCOMPANY THIS MAP.

Legend

- 10% Tidal AEP Event
- 0.5% Tidal AEP Event
- 0.1% Tidal AEP Event
- Modelled River Centreline
- AFA Extents
- Node Point
- Node ID Node Label

Node Label	Water Level (OD) 10% AEP	Flow (m³/s) 10% AEP	Water Level (OD) 0.5% AEP	Flow (m³/s) 0.5% AEP	Water Level (OD) 0.1% AEP	Flow (m³/s) 0.1% AEP
E0924C0012	2.67	N/A	3.11	N/A	3.34	N/A
E0924C0013	N/A	N/A	3.11	N/A	3.34	N/A
E0924C0014	2.67	N/A	3.11	N/A	3.34	N/A
E0924C0015	2.67	N/A	3.11	N/A	3.34	N/A

FINAL

REV:	NOTE:	DATE:

EASTERN CFRAM STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT

The Office of Public Works
Jonathan Swift Street
Trim
Co Meath

Elmwood House
74 Boucher Road
Belfast
BT12 6RZ

T +44(0) 28 90 667914
F +44(0) 28 90 668286
W www.rpsgroup.com
E ireland@rpsgroup.com

Map:
Liffey Tidal Flood Extents

Map Type: EXTENT
Source: TIDAL
Map Area: COASTAL
Scenario: CURRENT
Drawn By : C.C. **Date :** 28 July 2016
Checked By : A.S. **Date :** 28 July 2016
Approved By : S.P. **Date :** 28 July 2016

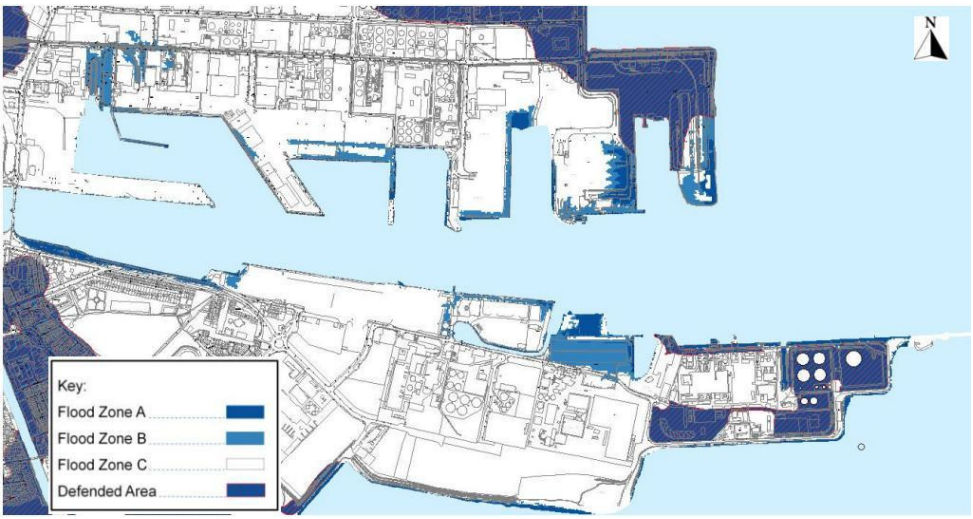
Drawing No. :
E09LIF_EXCCD_F0_06

Map Series : Page 6 of 8

Drawing Scale : 1:5,000 @ A3

Appendix 4:

Dublin City Strategic Flood Risk Assessment Maps

Site: 1. Dublin Port South of the Liffey from Eastlink Bridge	
	
 *Dublin City Council Development Plan 2016-2022(zoning map key at back of tables)*	
Site Description	The area is heavily developed by industrial units to the north some related to Dublin Port activities. There are a number of chemical sites in this area. To the south there are a number of greenfield areas such as Ringsend, Sean Moore and Irishtown Nature Parks. To the west of the area there is some residential use. Most of the area is reclaimed from the sea. Developments are likely to be industrial with some residential. The Irish Glass Bottle site is the largest in the area. The areas at high risk are in the vicinity of the stormwater tanks at the Ringsend Wastewater Treatment Plant and the inlet in the centre of the ESB Power Generating Station.
Benefitting from Defences (flood relief scheme works)	The portion of the sea wall along the western end of Pigeon House Road offers some protection to properties to the south of it. The rest of the area is largely undefended. Much of the residential development is also defended from tidal flooding from the River

Site: 1. Dublin Port South of the Liffey from Eastlink Bridge	
	Dodder Estuary.
Sensitivity to Climate Change	The area is highly sensitive to climate change and an increase of 0.5m on top of the 200 year tide level would put much of it underwater. A 1m rise in sea level should be assessed for high vulnerability / high risk developments, including Seveso and other industrial uses.
Residual Risk	Any proposed developments in the protected areas on the west of Pigeon House Road will require a detailed assessment of current defences and will have to consider the impact of a defence breach, particularly where it relates to high vulnerability industrial development.
Historical Flooding	The flood maps attached are consistent with previous flooding of this section of Dublin Port. The road to the east of the toll plaza is at high flood risk as well as a portion of roadway in front of Portview House.
Surface Water	All surface water in this area needs to be carefully managed and provision made for significant rainfall events during high tides. A one year high tide event should be assumed during a 100-year rainfall event. Should development be permitted, best practice with regard to surface water management should be implemented across the development area to limit surface water runoff to current values. All Developments shall have regard to the Pluvial Flood Maps in their Site Specific Flood Risk Assessment, see Flood ResilienCity Project, Volume 2 City Wide Pluvial Flood Risk Assessment at http://www.dublincity.ie/main-menu-services-water-waste-and-environment-drains-sewers-and-waste-water/flood-prevention-plans

Commentary on Flood Risk:
The flood extents indicate flow paths generally coming directly out of the tidal region.
The flood maps are based on the OPW CFRAM Study and checked against historic flooding in the area.

Development Options:
Industrial development, including a mix of infill and redevelopment / regeneration would be the obvious continuation of land use from the adjoining exiting development, particularly in the area east of the Irish Glass Bottle site. There are also existing Seveso sites, which could see further development in the future. Some residential development may take place to the west.

Justification Test for Development Plans

1. **Section 1 is covered elsewhere in this SFRA justifying all of Dublin City**

2. **The zoning or designation of the lands for the particular use or development type is required to achieve the proper planning and sustainable development of the urban settlement and, in particular:**

(i) **Is essential to facilitate regeneration and/or expansion of the centre of the urban settlement**

Answer: Yes: This area is essential for the future expansion and operation of Dublin Port and its related operations. The area comprises mainly brownfield sites. To the south there are a number of greenfield areas such as Ringsend, Sean Moore and Irishtown nature Parks. To the west of the area there is some residential use. Most of the area is reclaimed from the sea. Likely developments are industrial with some residential.There are a number of Seveso sites located in this area. Some of the area forms a portion of Strategic Development and Regeneration Areas 6 Docklands. These are important brownfield sites

with the potential to deliver a significant quantum of mixed uses and create synergies to regenerate their respective areas.

(ii) Comprises significant previously developed and/or under-utilised lands

Answer: Most of the lands would comprise industrial uses directly related to the Port use. There would be large sites in the Port area, mainly comprising of brownfield sites and some greenfield sites. There are also a number of greenfield sites including Ringsend, Sean Moore and Irishtown nature Parks. A portion of the lands include the SDRA 6 Docklands Area as described above.

(iii) Is within or adjoining the core of an established or designated urban settlement

Answer: Yes: This area is essential for the future expansion and operation of Dublin Port and its related operations. Some of the area forms part of Strategic Development and Regeneration Areas 6 Docklands. These are important brownfield sites with the potential to deliver a significant quantum of mixed uses and to create synergies to regenerate their respective areas. The Development Plan prioritises renewal and regeneration of these areas by a series of guiding principles (see Section 15.1.1.6 of the Written Statement)

(iv) Will be essential in achieving compact and sustainable urban growth

Answer: Yes: This area is essential for the future expansion and operation of Dublin Port and its related operations. Some of the area forms part of Strategic Development and Regeneration Areas 6 Docklands. These are important brownfield sties with the potential to deliver a significant quantum of mixed uses and to create synergies to regenerate their respective areas. The Development Plan prioritises renewal and regeneration of these areas by a series of guiding principles. (see Section 15.1.1.6 of the Written Statement)

(v) There are no suitable alternative lands for the particular use or development type, in areas at lower risk of flooding within or adjoining the core of the urban settlement.

Answer: There are no suitable alternative lands for the particular uses or development type in areas at lower risk of flooding, within or adjoining the urban settlement.

3. Specific Flood Risk Assessment

- Some of the lands shown in the above flood cell are directly connected with Dublin Port and its related facilities. The lands are zoned Z7 in the Development Plan which is to provide for the protection and creation of Industrial uses and facilitate opportunities for employment creation. The types of uses that generally go into this area would be heavy industrial port related uses. There are a number of existing Seveso sites located in the Port area, and fuel storage depots etc. Part of the lands above is included in the Docklands Strategic Development and Regeneration Area (SDRA 6) which will provide a significant amount of mixed uses.
- Use Classes considered as 'Vulnerable Development' shall not be permitted in Flood Zone A or B (this includes Essential Infrastructure such as primary transport and utilities distribution including electricity generating power stations and sub stations, water and sewage treatment, and potential significant sources of pollution (SEVESO sites, IPPC sites etc).
- Within this area it is essential that the impact of sea level rise by 0.5m for ordinary sites and 1.0m for critical / highly vulnerable infrastructure and high risk chemical sites is carried out as detailed in this SFRA. For some developments it may be appropriate to include a more detailed assessment of likely climate change impacts, including the frequency of lower high tide return periods with wave action.
- As the flood risks are tidal, mitigation through land raising (or bunding for smaller developments) will have no impact on neighbouring development, so compensatory

Site: 1. Dublin Port South of the Liffey from Eastlink Bridge
storage will not be required. The focus of the FRA will be to ensure the safety and long-term operability of the development and safety of operatives. • Where development will be in the defended area, consideration should be given to the likelihood of the defences failing (either through overtopping or breach) and how the operation will ensure it can retain functionality / recover following an extreme flood event. Buildings should be of flood resilient construction. • Proposals for residential development should be treated in accordance with the guidance in this SFRA. • Special FRA's should be carried out for all basements and underground structures with respect to any human access. No underground offices or residential units (whether temporary or permanent) will be allowed.

Comhairle Cathrach Bhaile Átha Cliath
Dublin City Council

FloodResilienCity Project

DUBLIN CITY

Type 1 Pluvial Flood Hazard Map

1% AEP Event - 3Hr Duration Model

Legend:

Flood Hazard

- Low (0.0m - 0.75)
- Moderate (0.75 - 1.25)
- Significant (1.25 - 2.00)
- Extreme (> 2.00)

Notes

Tresholds for Flood Hazard Rating H= d x (y+0.5) +DF	Degree of Flood Hazard	Description
<0.75	Low	Caution - Flood zone with shallow flowing water or deep standing water
0.75 - 1.25	Moderate	Dangerous for some (i.e. children) Danger - Flood zone with deep or fast flowing water.
1.25 - 2.0	Significant	Dangerous for most people. Danger - Flood Zone with deep and fast flowing water.
> 2.00	Extreme	Dangerous for all - Extreme Danger - Flood Zone with deep and fast flowing water.
Debri Factor	Debris Factor of 0.5 has been applied for depths 0.25m and a debris factor of 1 has been used for depths >=0.25	

The Flood ResilienCity Dublin Pluvial Study final report can be viewed on the Dublin City Council website www.dublincity.ie under Flood Prevention Plans