UISCE ÉIREANN : IRISH WATER

Greater Dublin **Drainage Project**

Flood Risk Assessment

JACOBS® TOBIN Consulting Engineers

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1 INTRODUCTION

1.1 General

J. B. Barry and Partners Limited were commissioned by Irish Water to undertake a site specific flood risk assessment (FRA) for the Greater Dublin Drainage Project (hereafter referred to as the Proposed Project).

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 scheme. The purpose of this FRA is to support the planning application for the Proposed Project.

The FRA has been carried out in accordance with '*The Planning System and Flood Risk Management Guidelines'* (hereafter referred to 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).

1.2 The Proposed Project

The table below provides a summary of the Proposed Project elements. A full description of the Proposed Project is detailed within Volume 2 Part A, Chapter 4 Description of the Proposed Project of the Environmental Impact Assessment Report (EIAR).

Proposed Project Element	Outline Description of Proposed Project Element
Proposed Wastewater Treatment Plant (WwTP)	• Regional WwTP to be located on a 29.8 hectare (ha) site in the townland of Clonshagh (Clonshaugh) in Fingal. • 500,000 Population Equivalent (PE) wastewater treatment capacity. • Maximum building height of 18m. • Sludge Hub Centre (SHC) to be co-located on the same site as the WwTP with a sludge handling and treatment capacity of 18,500 tonnes of dry solids (TDS)/annum. • SHC will provide sustainable treatment of municipal wastewater sludge and domestic septic tank sludges generated in Fingal to produce a biosolid end-product. • Bio-gas produced during the sludge treatment process will be utilised as an energy source. • Access road from the R139 Road, approximately 400m to the southern boundary of the site. • Egress road, approximately 230m from the western boundary of the site to the Clonshaugh Road. • A proposed temporary construction compound to be located within the site boundary.
Proposed Abbotstown Pumping Station	• Abbotstown pumping station to be located on a 0.4ha site in the grounds of the National Sports Campus (NSC) at Abbotstown. • Abbotstown pumping station will consist of a below ground structure housing the wet/dry wells and an above ground structure located directly above the wet/dry wells housing ancillary equipment. • The plan area of the above ground structure will be 305m^2 and this will have a maximum height of 10m. • A proposed temporary construction compound to be located adjacent to the Abbotstown pumping station site.
Proposed Orbital Sewer Route	• The orbital sewer route will intercept an existing sewer at Blanchardstown and will divert it from this point to the WwTP at Clonshagh. • Constructed within the boundary of a temporarily acquired construction corridor. • 13.7km in length; 5.2km of a 1.4m diameter rising main and 8.5km of a 1.8m diameter gravity sewer. • Manholes / service shafts / vents along the route. • Odour Control Unit (OCU) at the rising main/gravity sewer interface. • Proposed temporary construction compounds at Abbotstown, Cappoge, east of Silloge, Dardistown and west of Collinstown Cross to be located within the proposed construction corridor.
Proposed Diversion of the North Fringe Sewer (NFS)	• The NFS will be intercepted in the vicinity of the junction of the access road to the WwTP with the R139 Road in lands within the administrative area of Dublin City Council (DCC). • NFS diversion sewer will divert flows in the NFS upstream of the point of interception to the WwTP. • 600m in length and 1.5m in diameter. • Operate as a gravity sewer between the point of interception and the WwTP site.
Proposed Outfall Pipeline Route (Land Based Section)	• Outfall pipeline route (land based section) will commence from the northern boundary of the WwTP and will run to the R106 Coast Road. • 5.4km in length and 1.8m in diameter. • Pressurised gravity sewer. • Manholes / service shafts / vents along the route. • Proposed temporary construction compounds (east of Malahide Road and east of St. Doolagh's) located within the proposed construction corridor.
Proposed Outfall Pipeline Route (Marine Section)	• Outfall pipeline route (marine section) will commence at the R106 Coast Road and will terminate at a discharge location approximately 1km north-east of Ireland's Eye. • 5.9km in length and 2m in diameter. • Pressurised gravity tunnel/ subsea (dredged) pipeline. • Multiport marine diffuser to be located on the final section. • Proposed temporary construction compounds (west and east of Baldoyle Bay) to be located within the proposed construction corridor.
Proposed Regional Biosolids Storage Facility (RBSF)	• Located on an 11.4ha site at Newtown, Dublin 11. • Maximum height of 15m. • Further details and full impact assessment are provided in Volume 4 Part A of the EIAR.

The proposed WwTP, orbital sewer route, Abbotstown pumping station and outfall pipeline route (land based section), shall be collectively referred to as the **proposed WwTP and associated pipelines** unless specific reference is required for a particular Proposed Project element. The proposed outfall pipeline route (marine section) shall be collectively referred to as the **proposed marine outfall** unless specific reference is required for a particular Proposed Project element.

Figure 1.1 presents the Proposed Project.

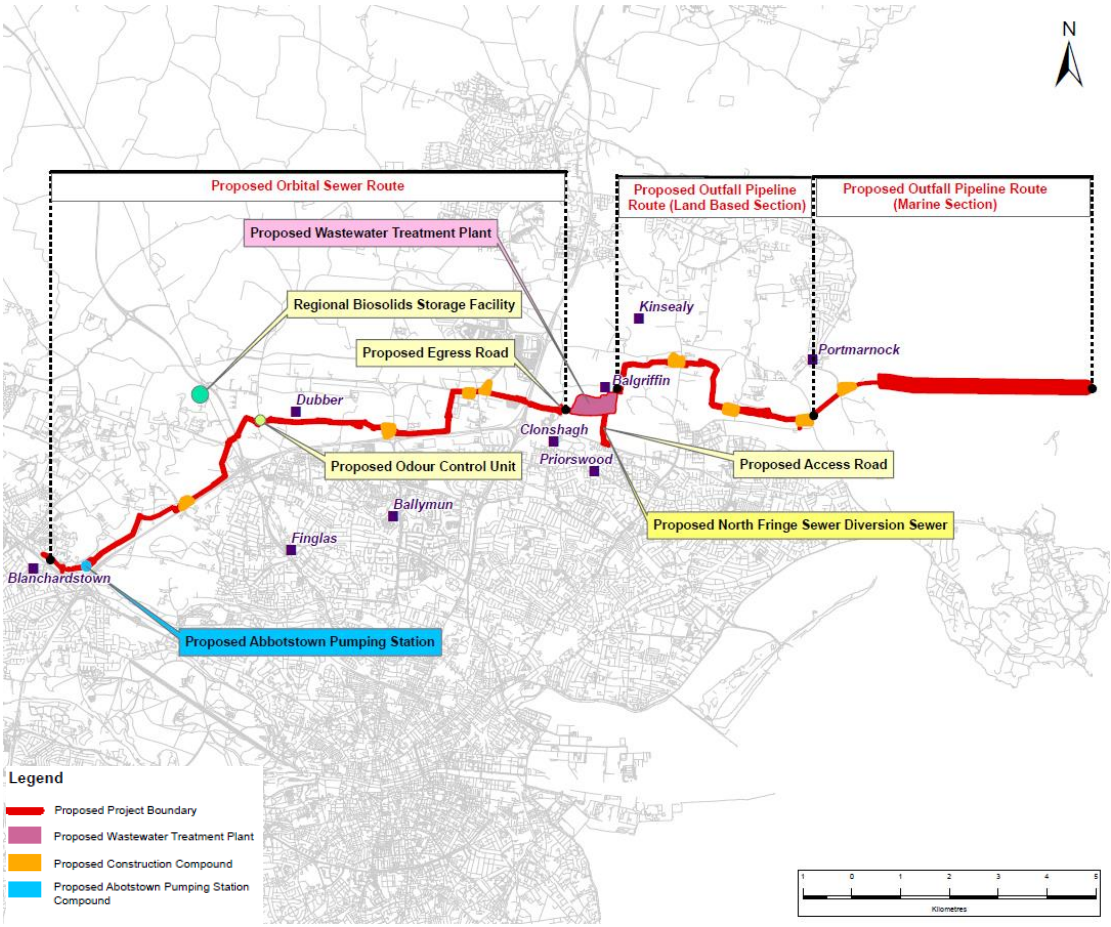

Figure 1.1: The Proposed Project

The WwTP site has an area of 29.8Ha, is located in open agricultural land and is situated in the townland of Clonshagh which is located in the Mayne River catchment. This site is located approximately 2.5km to the east south east of Dublin Airport and 1.5km to the east of the M1/M50 junction. The site is bounded by the Cuckoo Stream (a tributary of the Mayne River) to the north. The Mayne River is located approximately 200m to the south of the site. The Mayne River discharges into Baldoyle Estuary (approximately 6km downstream).

No development will occur within 20m of the Cuckoo Stream, to provide space for the river. The access to the site is from the west and does not require culverting of any watercourse. The Mayne River discharges to Baldoyle Estuary (SPA, cSAC and pNHA site).

The proposed Abbotstown pumping station site is located near the M50/M3 junction. It is located 150m north of the Tolka River. There will be a proposed

orbital sewer route connecting the proposed Abbotstown pumping station to the proposed WwTP.

The proposed marine outfall generally proceeds in an easterly direction, underneath Baldoyle estuary and Portmarnock golf course and discharges to the Irish Sea.

This report primarily investigates the flood risk to the main infrastructure proposed, namely the proposed WwTP and the proposed Abbotstown pumping station as these could be adversely affected or damaged by flooding. Reference is also made to the proposed orbital sewer route and the outfall pipeline route (land based section) but pipelines are considered to be water compatible/less vulnerable to flood risk as these are located below ground level and therefore will not be susceptible to flooding. However, there could be some flood risk associated with the construction of the pipelines which is addressed in Chapter 5 of this report.

2 FLOOD RISK ASSESSMENT METHODOLOGY

2.1 Methodology

The methodology used for the flood risk assessment for the Proposed Project 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 Project site (Section 2.23 of the FRM Guidelines);
- Step 2: Identification of the vulnerability of the type of the Proposed Project (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[1] for the Proposed Project

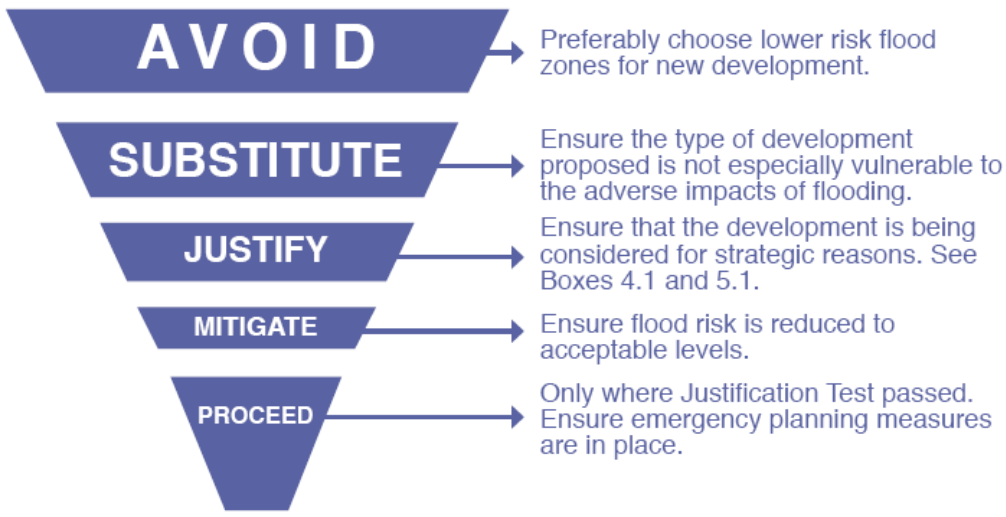

Fig. 3.1: Sequential approach principles in flood risk management

[1] The Justification Test has been designed to rigorously assess the appropriateness, or otherwise, of particular developments that are being considered in areas of moderate or high flood risk i.e. Flood Zones B and A respectively.

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.

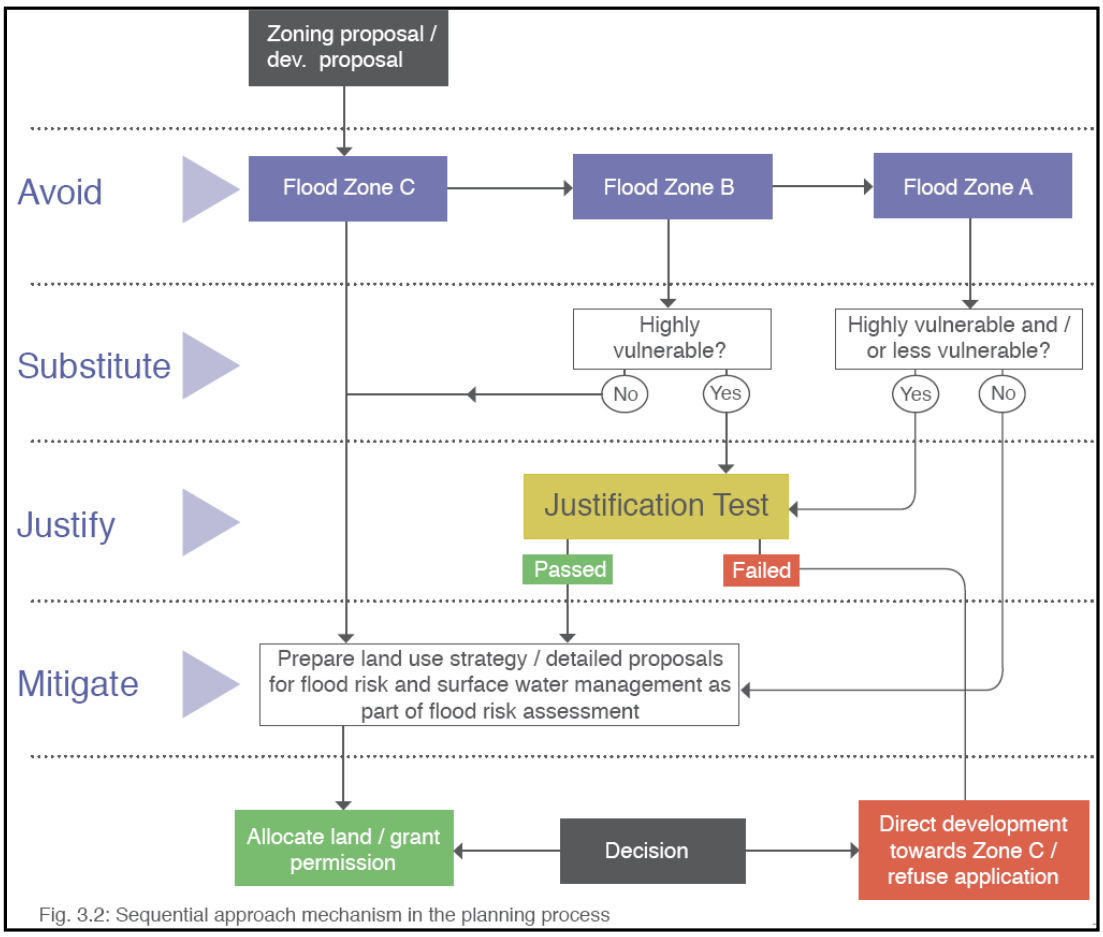

Fig. 3.2: Sequential approach mechanism in the planning process

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% 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).

It is important to note that Flood Zone C covers all areas which are not in Flood Zones A or B.

Flood Zones A, B and C are based on the current assessment of the 1% and the 0.1% fluvial events and the 0.5% and 0.1% 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. The table classifies sewage treatment as a highly vulnerable development (including essential infrastructure).

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. Since sewage treatment is classified as highly vulnerable development (including essential infrastructure) the section highlighted in Table 3.2 presents the required actions for each flood zone.

	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 Project site that may warrant further investigations.

Stage 2: Initial flood risk assessment – to confirm sources of flooding that may affect the Proposed Project 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.

As a number of detailed flood studies have already been carried out in the vicinity of the Proposed Project, no detailed hydrological analysis or hydraulic modelling is required as part of this flood risk assessment.

2.2 Data Collection

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

- The historic flood data was obtained from the National Flood Hazard Mapping website www.floodmaps.ie (See in Appendix A).
- The Subsoil and Aquifer vulnerability data was obtained from the Geological Survey of Ireland website www.gsi.ie
- Information on predicted tidal flood level was obtained from different reports and maps published by various flood studies in the area (refer to Section 3 for details of these studies).
- JBB, as part of Halcrow Barry, carried out the Fingal East Meath Flood Risk Assessment and Management Study (FEM FRAMS) on behalf of the OPW, Fingal County Council and Meath County Council. Under FEM FRAMS flood maps were prepared for significant portions of Fingal and East Meath and used in this assessment.
- The existing conditions flood risk and the future scheme flood maps (including development to 2031) for the River Tolka Flooding Study were obtained from Dublin City Council.
- The Preliminary Flood Risk Assessment (PFRA) maps were obtained from the Eastern Catchment Flood Risk Assessment and Management study website http://www.eastcframstudy.ie/ (See in Appendix D).

3 EXISTING HYDROLOGICAL ENVIRONMENT

3.1 Existing Drainage

The existing hydrological environment for the proposed WwTP site, Abbotstown pumping station and the orbital sewer route are discussed in this section of the report.

WwTP Site

The 29.8ha Clonshagh site is located in the Mayne River catchment. Surface water from the northern part of the site drains to the Cuckoo Stream (a tributary of the Mayne River). Surface water from the southern part drains to the Mayne River, which is located approximately 200m to the south of the site. A small area on the eastern part drains into a minor tributary of the Mayne River. The Mayne River discharges into Baldoyle Estuary (approximately 6km downstream), which is an SPA, cSAC and pNHA site.

Abbotstown Pumping Station Site

The proposed Abbotstown pumping station site is located in the River Tolka catchment. Surface water from the site drains to the River Tolka which is located approximately 150m south of the site. The River Tolka discharges into Dublin Bay at the western end of Clontarf approximately 10.8km downstream. The area proposed for the Pumping Station is located at an elevation significantly higher than the Tolka River (in excess of 6m).

Orbital Sewer Route and Outfall Pipeline Route

The proposed orbital sewer and outfall pipeline route is will be constructed within a number of river catchments. The western portion of the sewer will be constructed within the River Tolka catchment. As the pipeline crosses the N2 to the east, the pipeline will be located within the River Mayne catchment. The proposed pipeline will cross three watercourses, namely the Santry River, the Mayne River and the Cuckoo Stream. Construction of the pipeline will also occur close to the Tolka River and the Sluice River as shown in Figure 3.1 overleaf.

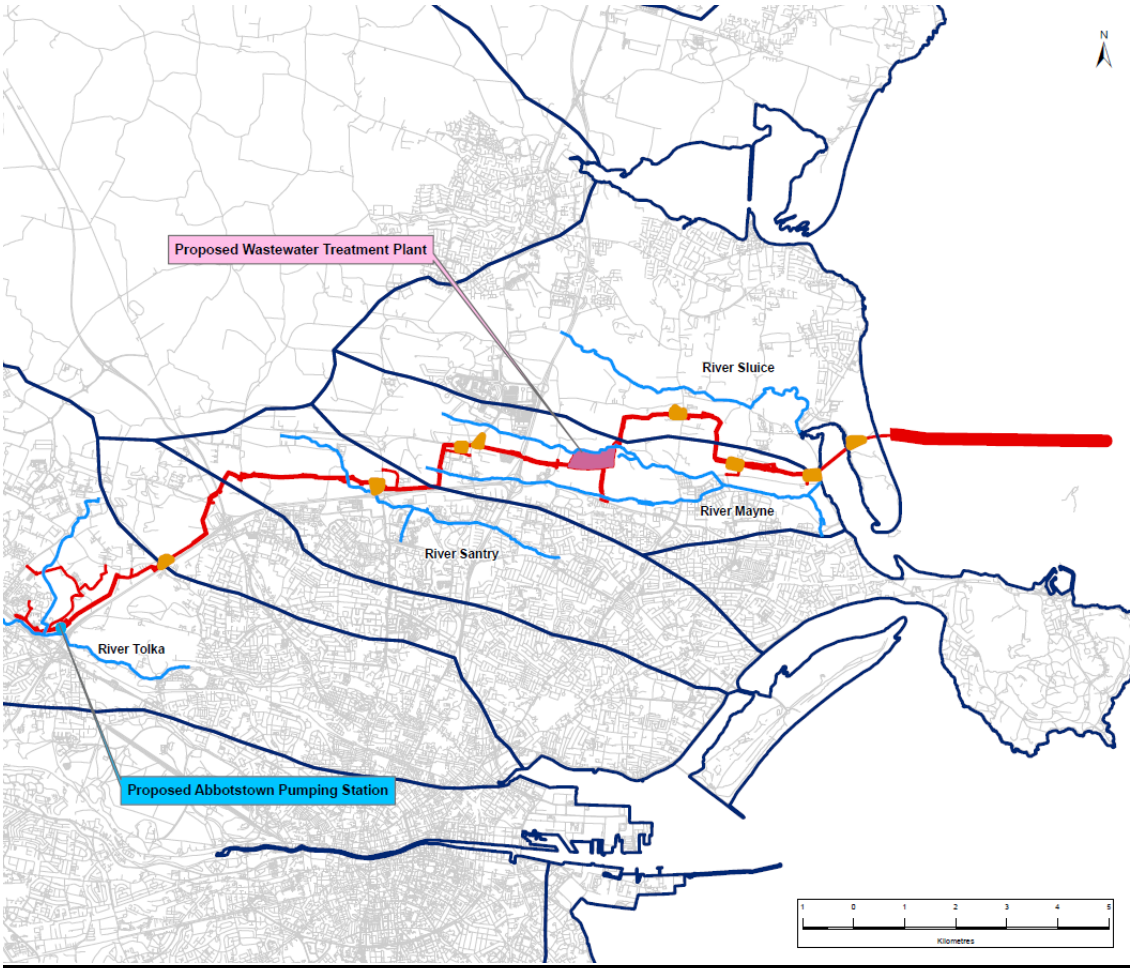

Figure 3.1: Rivers Within The Vicinity of The Proposed Project

3.2 Existing Geology and Hydrogeology of Area

The Geological Survey of Ireland (GSI) website provides information on their public online mapping service at www.gsi.ie on subsoil and aquifer vulnerability. The maps for the proposed WwTP and associated pipelines are presented in Figure 3.2 and 3.3.

WwTP Site

It is observed from the GSI subsoil mapping in Figure 3.1 that the subsoil in the vicinity of the proposed WwTP Site is primarily Limestone till (Carboniferous). The GSI mapping indicates that the proposed WwTP site at Clonshagh is primarily classified as having a low vulnerability aquifer. However, immediately east of the site there is a region which ranges from a moderate to an extreme vulnerability classification.

Abbotstown Pumping Station Site

The GSI subsoil mapping (Figure 3.2) indicates that the subsoil within the environs of the proposed Abbotstown pumping station site is primarily till derived chiefly from Limestone with some small pockets of bedrock outcrop and subcrop (bedrock at the surface). Furthermore, the interactive web mapping site classifies the aquifer vulnerability in this region as ranging from high to extreme

vulnerability (Figure 3.3). Aquifers which are classified as having extreme vulnerability indicate that rock is present at or near the surface; likewise a karst environment may exist.

Orbital Sewer Route and Outfall Pipeline Route

The GSI subsoil mapping for the selected pipeline route (see Figure 3.2) is primarily that of Limestone till (Carboniferous). However, the route passes through some small pockets of land which are classified as made ground. A small area of Marine/estuarine silts and clays is found adjacent to the western side of the Baldoyle Estuary. Where the route corridor crosses the Baldoyle Estuary, the subsoil is beach sands/gravels and windblown sands (Figure 3.2).

It is apparent from the aquifer vulnerability mapping (Figure 3.3) that the pipeline corridor goes from extreme to high vulnerability north-east of the proposed Abbotstown pumping station until it reaches the vicinity of Dubber Cross. The remaining route travels principally through land having a low aquifer vulnerability classification except for a small region of land to the east of the proposed WwTP site, where the aquifer vulnerability ranges from moderate to extreme. The remaining pipeline corridor heads east towards Baldoyle Estuary where the aquifer vulnerability is classified as low.

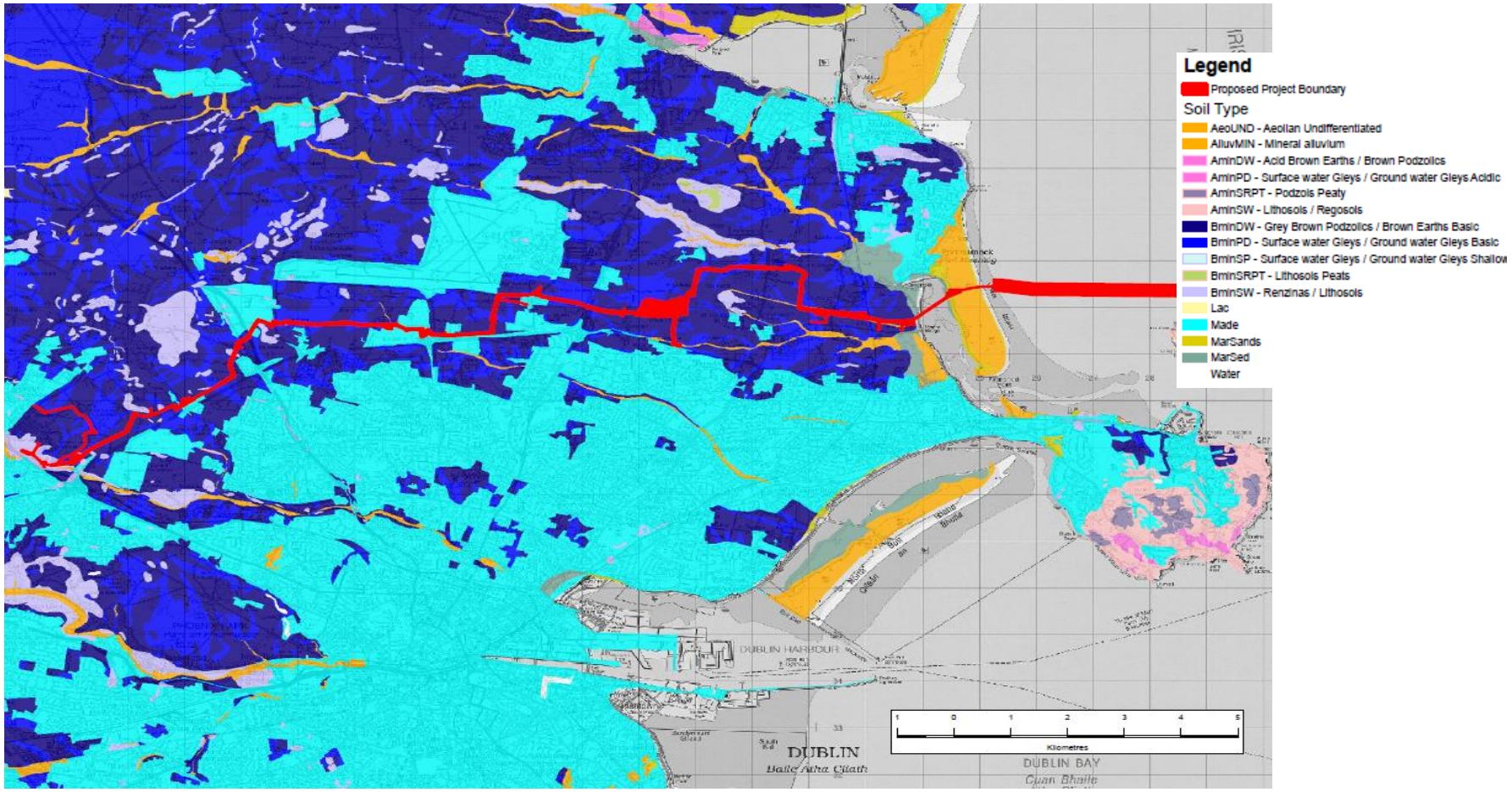

Figure 3.2 GSI Subsoil Mapping (source: www.gsi.ie)

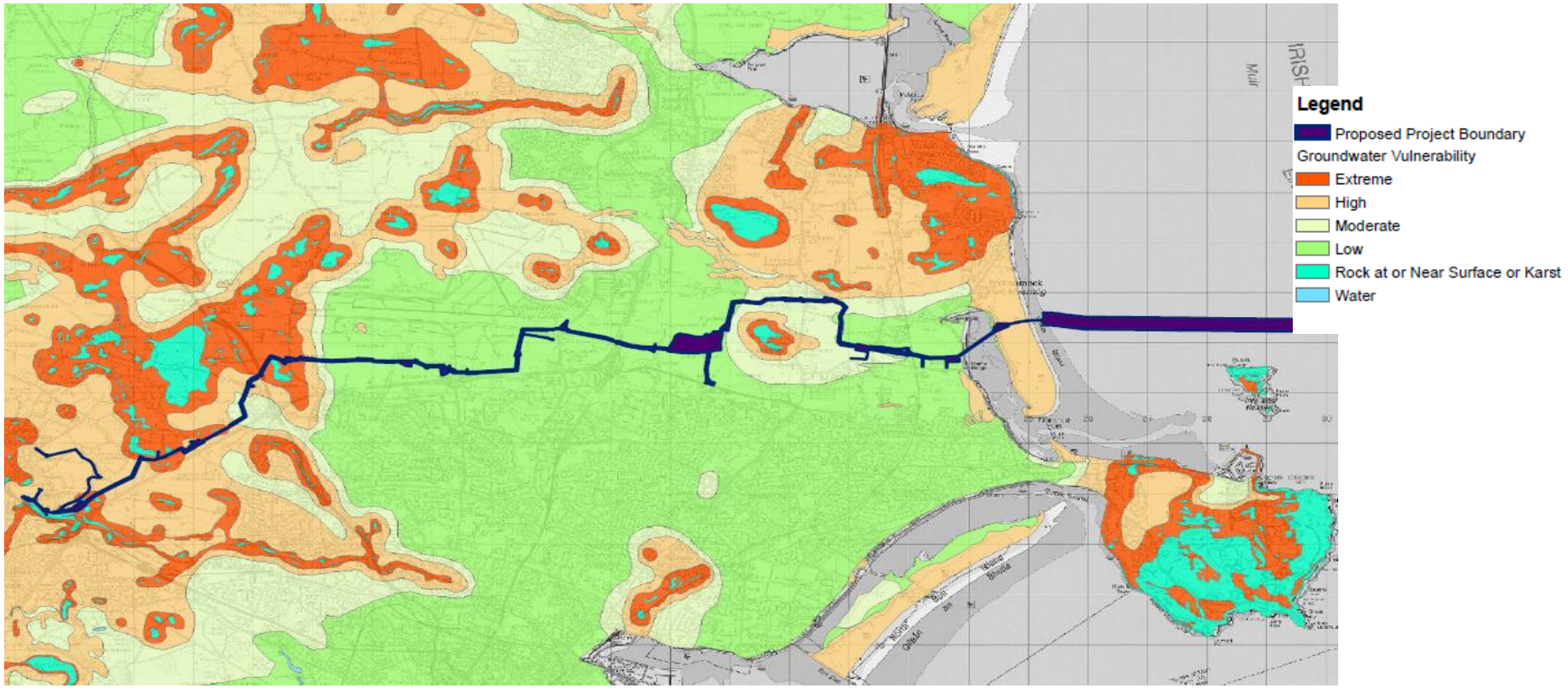

Figure 3.3 Aquifer Vulnerability (source: www.gsi.ie)

3.3 Existing Flood Regime of the Area

WwTP Site

The National Flood Hazard Mapping Website www.floodmaps.ie shows no record of historic flooding (from tidal/coastal or groundwater flooding) at the proposed WwTP Site, however seven locations of historic flooding were recorded in nearby areas (as shown in Appendix A and Figure 3.4 below).

The nearest recurring historic flooding location is approximately 1.1 km to the north-west of the proposed WwTP site, at Stockhole Lane (near Dublin Airport). There is also a record of historical flooding at Balgriffin (November 1993) which is approximately 1.5 km to the east-southeast of the site. The website also states that a number of defence assets were put in place post the November 1993 flood event.

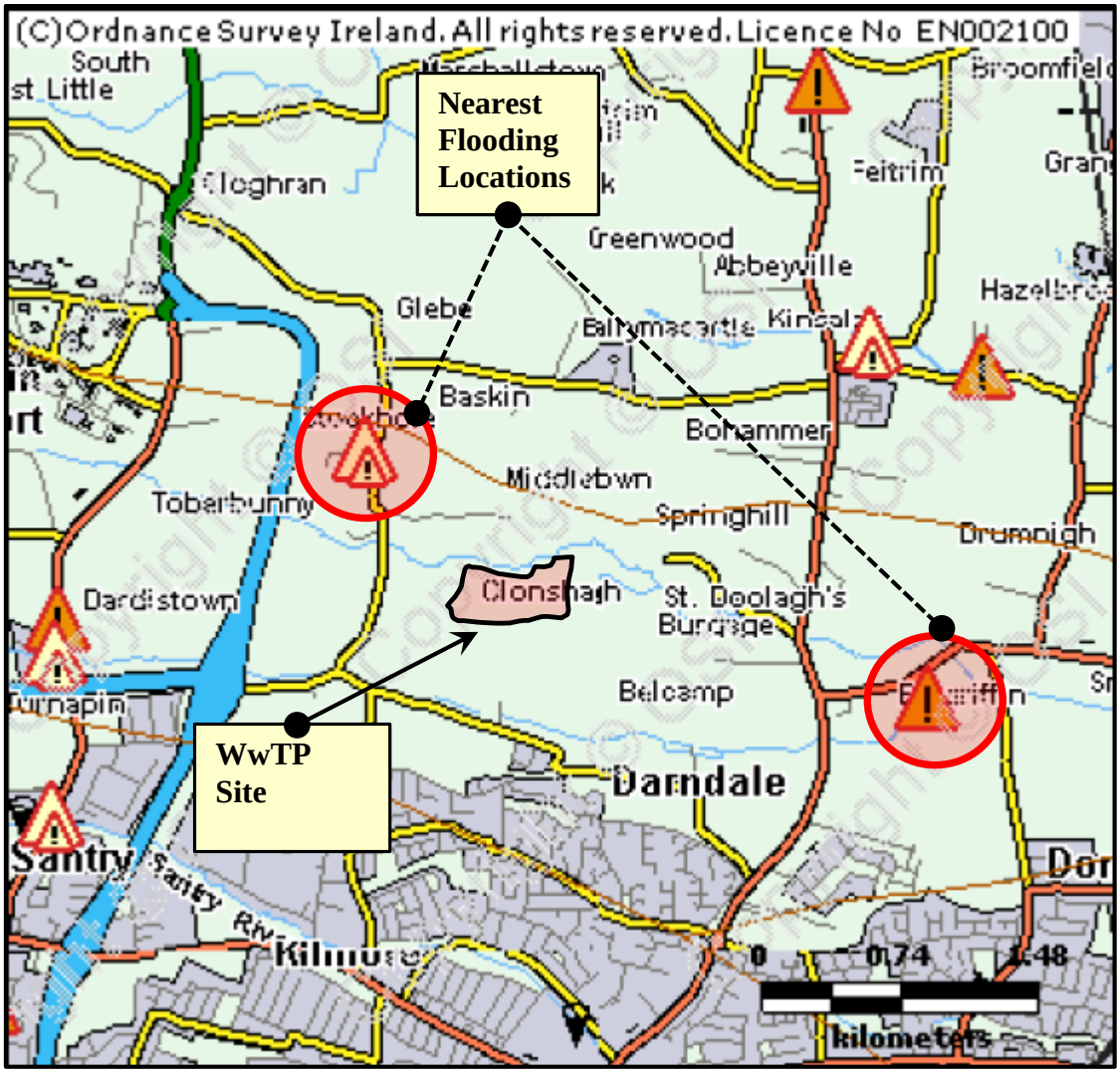

Figure 3.4: Locations of Historic Flooding in the Vicinity of the Proposed WwTP Site (source: www.floodmaps.ie)

Abbotstown Pumping Station

The National Flood Hazard Mapping website www.floodmaps.ie shows no records of historic flooding at the proposed Abbotstown pumping station site. However, the website shows two historic flooding events nearby (Figure 3.5 and Appendix A). One historic flood event occurred on the M50 at the N3 interchange in November 2002. A report, compiled by Fingal County Council, identified that remedial measures to the road drainage had been undertaken at that location as a result of the flood event. The other historic flood event occurred at Herbert Road, Abbotstown which was previously identified by Fingal Drainage Section as prone to flooding. A meeting held by Fingal County Council on 18th April 2005 reported that gardens of houses along a cul-de-sac were flooded including the sub floor of one house. The meeting noted that a protective berm was constructed in 2004 to help prevent flooding of these properties. Figure 3.5 depicts the flood extent of a major flood event that occurred on the River Tolka in November 2002. The pumping station is located outside of the flood extent.

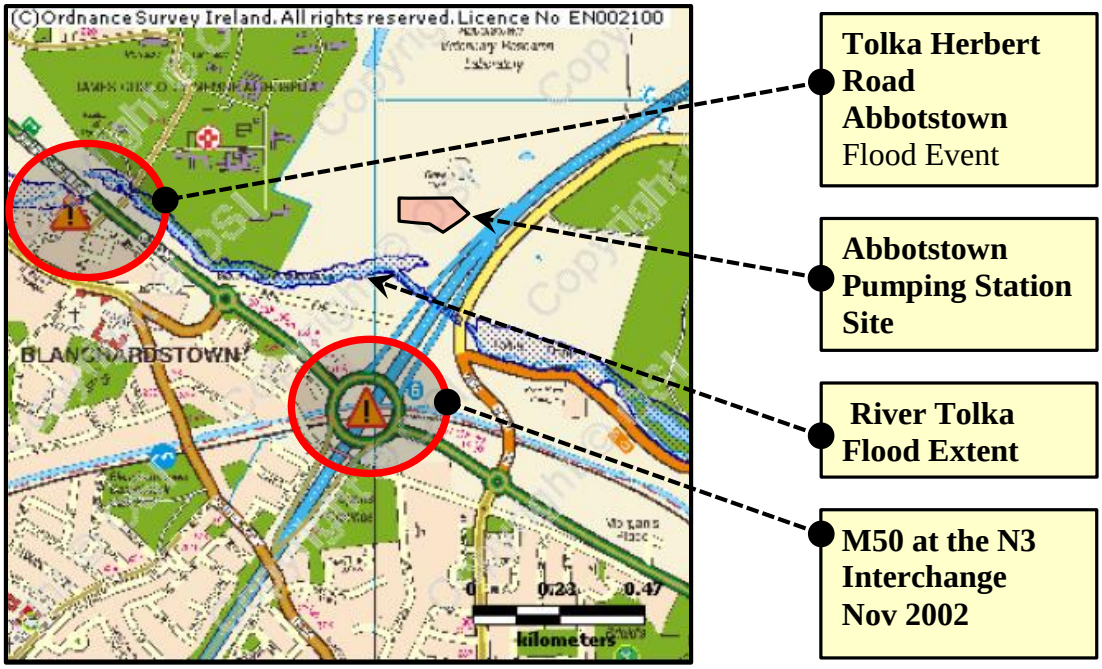

Figure 3.5: Locations of Historic Flooding in the Vicinity of the Proposed Abbotstown Pumping Station Site (source: www.floodmaps.ie)

Orbital Sewer Route and Outfall Pipeline Route

The Proposed Project requires the construction of approximately 26km of land based pipeline routes (including 5.5 km of the land based outfall pipeline). The route crosses three watercourses, the Santry River, the Mayne River and the Cuckoo Stream (Refer to Figure 1.1 previously). The OPW flood mapping website www.floodmaps.ie shows records of two historic floods which occurred along the pipeline route near the Dubber Cross area (Figure 3.6) and near the M50 Ballymun exit in November 2002. In addition, a further two locations on the M1 north to M50 flyover in the Mayne catchment were identified. Figure 3.6 identifies the historic flood events where the marine outfall passes Baldoyle Estuary.

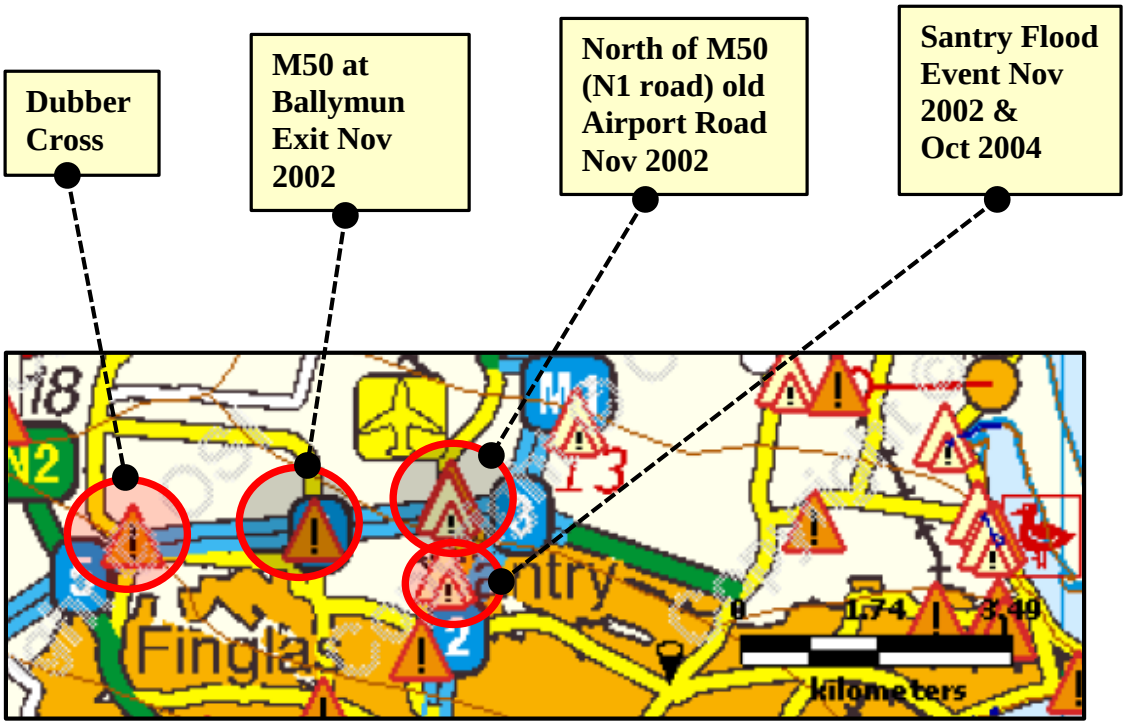

Figure 3.6: Locations of the Historic Flooding in the Vicinity of the Proposed Orbital Sewer Route (source: www.floodmaps.ie)

3.4 Fingal East Meath Flood Risk Assessment and Management Study (2011)

Fingal County Council, in association with Meath County Council and the Office of Public Works (OPW), commissioned Halcrow Barry to undertake the Fingal-East Meath Flood Risk Assessment and Management Study (FEM FRAMS) in 2008. The main objective of the study was to assess and map the existing and potential future flood risk in the study area, identify viable structural and non-structural measures for managing the flood risk and to develop an economically, socially and environmentally appropriate long-term strategy for the management of flood risk in the study area.

For the Proposed Project, the 100 (Flood Zone A) and 1,000 (Flood Zone B) year fluvial and the 200 (Flood Zone A) and 1,000 (Flood Zone B) year tidal flood maps of the proposed WwTP site, and part of the proposed orbital sewer route and outfall pipeline route were obtained from the FEM – FRAMS project. The FEM FRAMS fluvial maps are presented in Appendix B and the tidal maps in Appendix C with extracts provided below.

WwTP Site

An extract from the fluvial flood maps in the vicinity of the proposed WwTP site is presented in Figure 3.7. It can be observed from the map that a small portion of the proposed WWTP site lies within the 100 and 1000 year fluvial flood extents. Similarly, the tidal flood zones, presented in Figure 3.8, also show that a small northern portion of the proposed WwTP site is within the 200 and 1000 year tidal flood extent. However, there will be no development in this portion of the site. All highly essential infrastructure will be constructed in areas of the site that are

outside of the 1000 year tidal and fluvial flood extents. The portion of the site within the 100 year fluvial and 200 year tidal will be used for landscaping purposes and will not have any impact on the flood regime of the area. Therefore, in accordance with the Planning System and Flood Risk Management Guidelines, the proposed WwTP site is located in **Flood Zone C** where the probability of fluvial and tidal flooding is low risk (i.e. less than 0.1% AEP or 1 in 1000 for both river and coastal flooding). An indicative plan of the proposed WwTP is included in Appendix B.

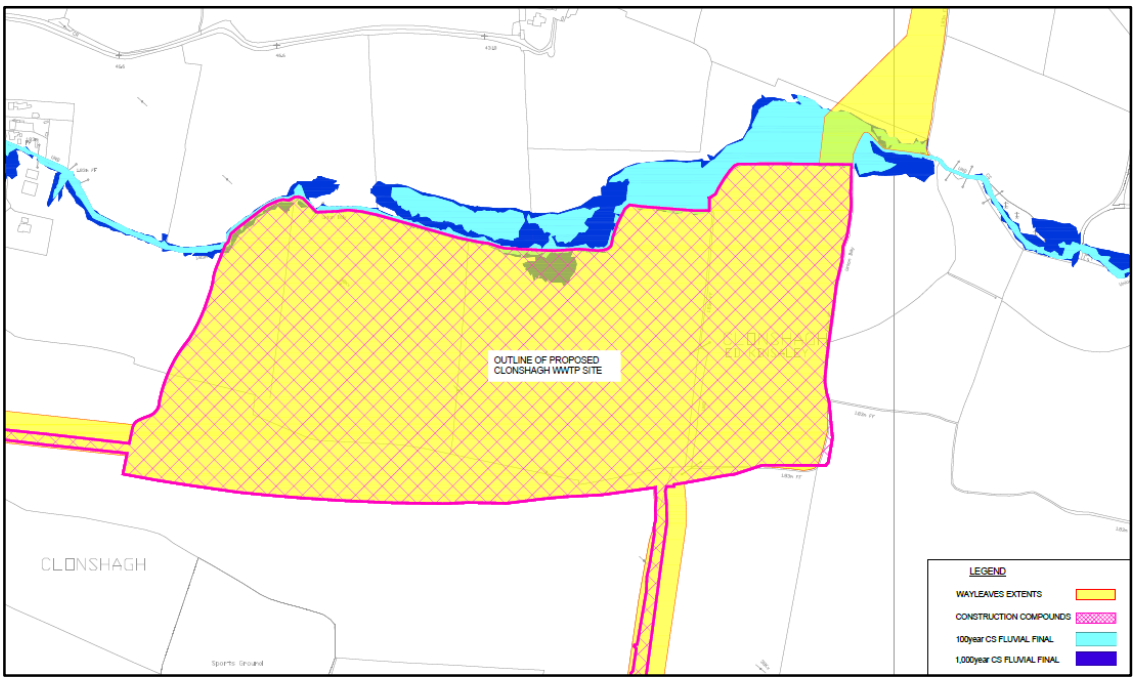

Figure 3.7: Extract from the Fluvial Flood Map (Appendix B) in the Vicinity of the Proposed WwTP Site

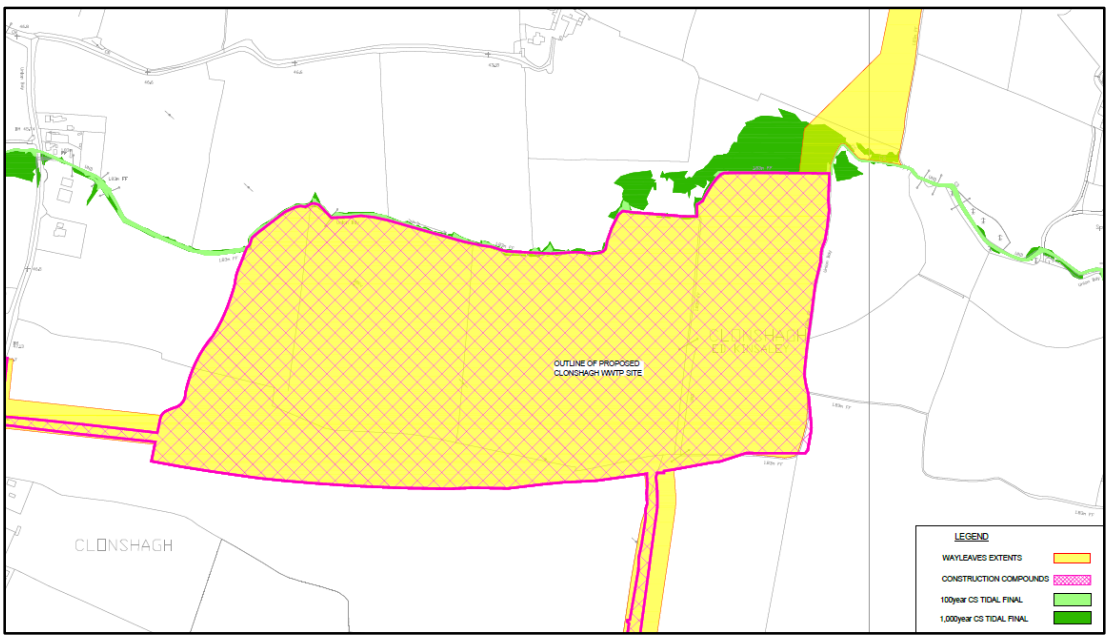

Figure 3.8: Extract from the Tidal Flood Map (Appendix C)

Abbotstown Pumping Station Site

The proposed Abbotstown pumping station site was outside the scope of the FEM-FRAMS project, however, the site was included in the River Tolka Flooding Study in 2001 (see Section 3.5 for further details). The findings of this study are sufficient and we do not require Hydraulic Modelling at this location.

Orbital Sewer Route and Outfall Pipeline Route

As mentioned in Section 1.2 pipelines are considered to be water compatible/less vulnerable to flood risk as these are located below ground level and therefore will not be susceptible to flooding. However, an odour control unit is located at the interface of the rising main and gravity sewer along the proposed orbital sewer route and is susceptible flooding, therefore the risk of flooding of the odour control unit must be assessed.

Figures 3.9 and 3.10 show extracts of the FEM FRAMS fluvial and tidal flood extent maps. Observation of the figures demonstrate that the odour control unit is located outside of both the 0.1% AEP fluvial and tidal flood extents and therefore is located in **Flood Zone C** where the probability of fluvial and tidal flooding is low risk.

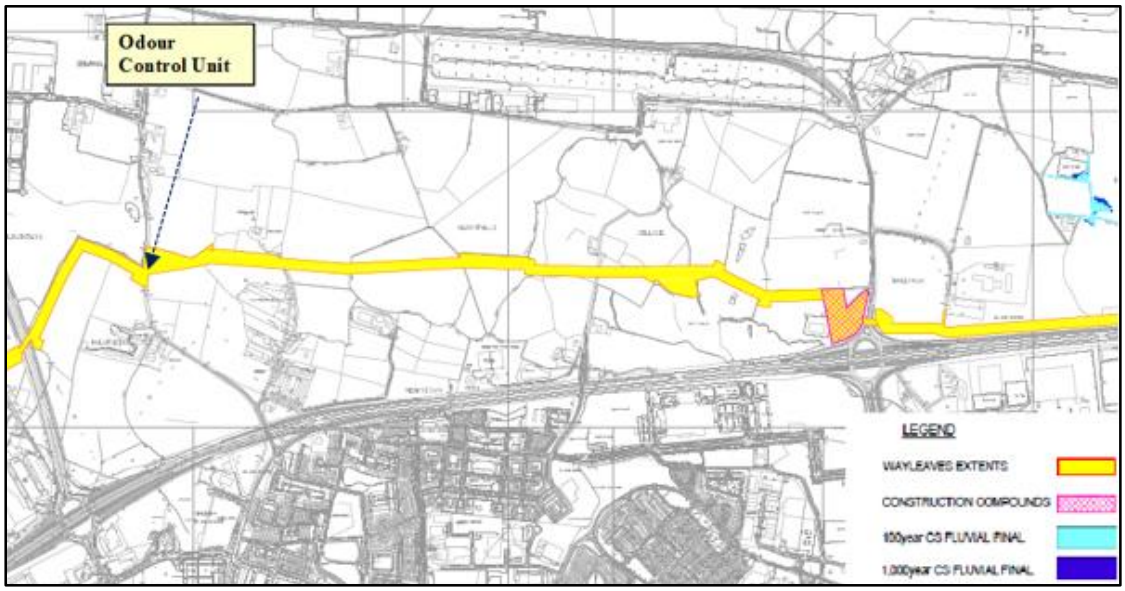

Figure 3.9: Extract from the Fluvial Flood Map (Appendix B) in the Vicinity of the Proposed Odour Control Unit

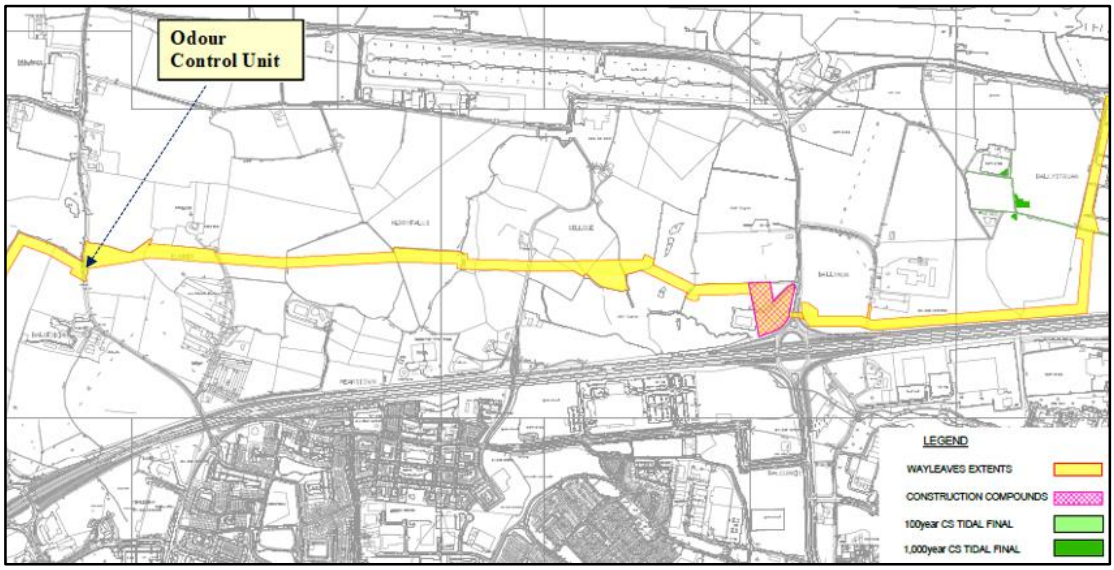

Figure 3.10: Extract from the Tidal Flood Map (Appendix C) in the Vicinity of the Proposed Odour Control Unit

3.5 River Tolka Flooding Study

Dublin City Council has provided copies of the River Tolka Flood Risk Maps which were generated by RPS-MCOS (in association with HR Wallingford) as part of the Greater Dublin Strategic Drainage Study (GDSDS) that was commissioned in 2001. Extracts from the existing flood risk maps and the future flood risk maps are presented in Figures 3.11 and 3.12 (see Appendix E for full size maps), respectively.

Abbotstown Pumping Station Site

Figure 3.11 and Appendix E depicts the existing fluvial flood extents at that time for the 10, 25, 50, 100 and 200 year return periods. This map shows that the proposed Abbotstown pumping station is located outside the 100 and 200 year return periods. The proposed Abbotstown pumping station site is located in an area which is significantly higher than the water surface level of the Tolka River (in excess of 6m). Considering the elevation of the pumping station site and the 100 and 200 year flood extents, it is assumed that this infrastructure is in **Flood Zone C** – where the probability of fluvial flooding is low risk.

The future flood risk maps incorporate development to 2031 (Figure 3.12 and Appendix E), this map shows that the proposed Abbotstown pumping station is situated above the 100 year future flood levels. As previously stated the pumping station site is at a substantially higher elevation that the level of the River Tolka. From observation of the future flood risk map and considering the elevated topography of the pumping station site, it is expected that this development is in **Flood Zone C** – where the probability of fluvial flooding is low risk.

Since the section of the Tolka River adjacent to the pumping station site is approximately 10.8km upstream of its discharge location to the Irish Sea, consequently it is not tidally influenced and the risk of tidal flooding at the pumping station site is considered negligible.

Orbital Sewer Route

Observation of Figures 3.11 and 3.12 demonstrate that there is no fluvial flooding north of the proposed Abbotstown pumping station site where the proposed orbital sewer route is located. Therefore, the proposed orbital sewer route which is within the extent of the River Tolka Flooding Study is located in **Flood Zone C.**

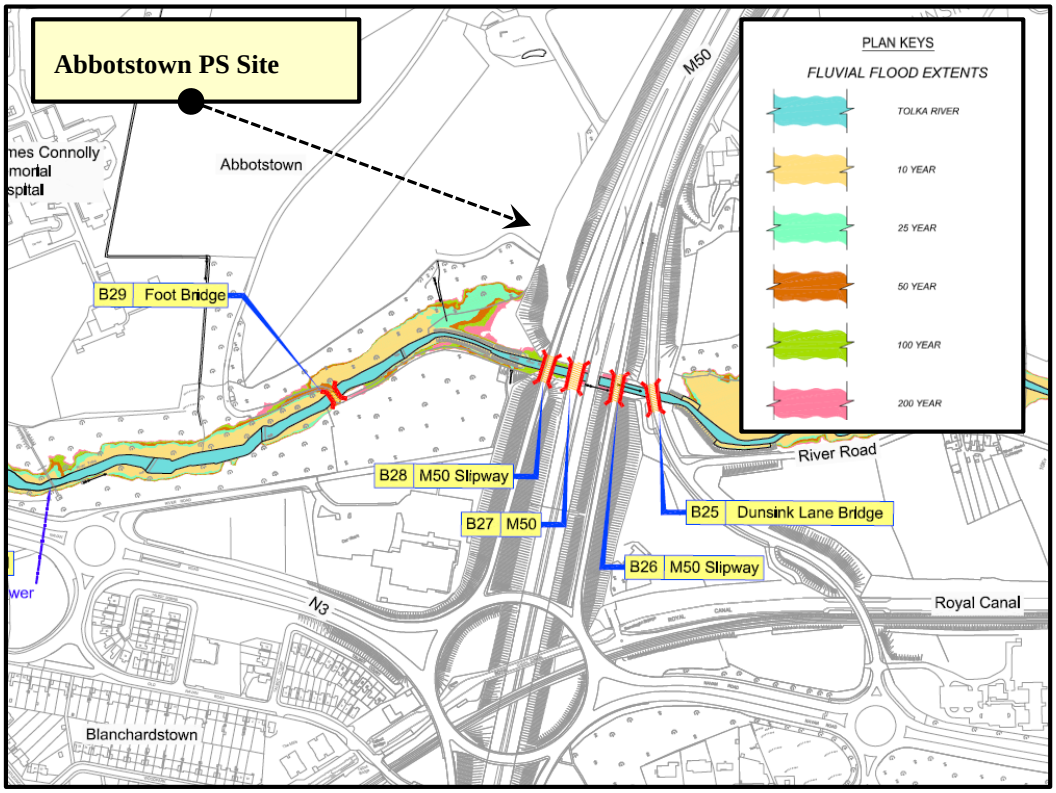

Figure 3.11: Extract of the Existing Flood Risk Map (source: Dublin City Council)

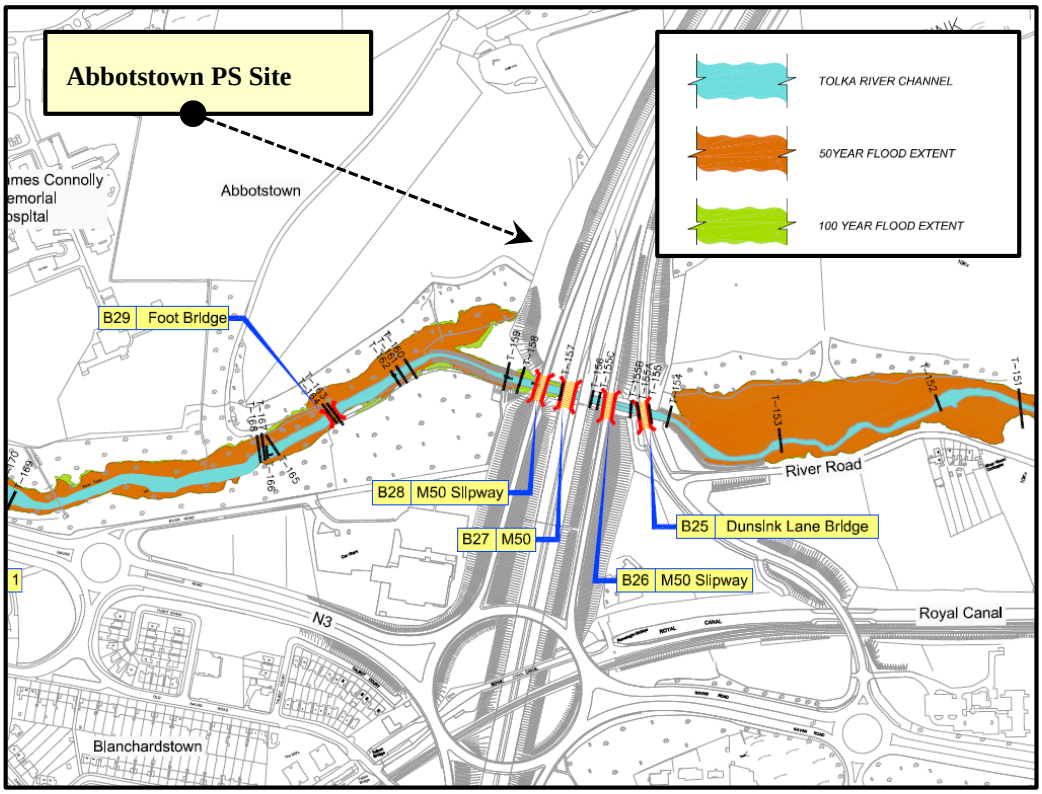

Figure 3.12: Extract of the Future Flood Risk Map (Source: Dublin City Council)

3.6 Preliminary Flood Risk Assessment Flood Maps

The OPW have published the Preliminary Flood Risk Assessment (PFRA) flood maps in December 2011, in which the country had been divided into 420 map tiles. According to the explanatory leaflet, published for public consultation at the PFRA stage, the PFRA is only a preliminary assessment, based on the available or readily deliverable information and significant caution must be applied in their use. Furthermore, it states that areas where an on-site inspection is required to investigate the issues more closely, then those inspections will be carried out as part of the CFRAM studies.

WwTP Site

The PFRA map within the vicinity of the proposed WwTP is presented in Appendix D and an extract of this map is shown in Figure 3.13. Observation of the PFRA map shows that the northern portion of the proposed WwTP is located close to the extreme fluvial flood extent. It is considered that the FEM FRAMS flood maps are more accurate than the PFRA maps, therefore the assessment of fluvial flood risk at this site will be undertaken utilising the FEM FRAMS fluvial flood extent maps rather than the PFRA flood extent map.

Abbotstown Pumping Station Site

The PFRA map of the River Tolka near the proposed Abbotstown pumping station site is presented in Appendix D and an extract of this map is shown in Figure 3.13. It is observed from these flood maps that the proposed Abbotstown pumping station site is outside of the flood extent for the River Tolka.

Orbital Sewer Route and Outfall Pipeline Route

As mentioned in Section 1.2 pipelines are considered to be water compatible/less vulnerable to flood risk as these are located below ground level and therefore will not be susceptible to flooding. However, as discussed, an odour control unit is located at the interface of the rising main and gravity sewer along the proposed orbital sewer route and is susceptible to flooding, therefore the risk of flooding of the odour control unit must be assessed.

Observation of the extract of the PFRA map in Figure 3.13 demonstrates that the odour control unit is located outside of both the 0.1% AEP fluvial and tidal flood extents and therefore is located in **Flood Zone C** where the probability of fluvial and tidal flooding is low risk.

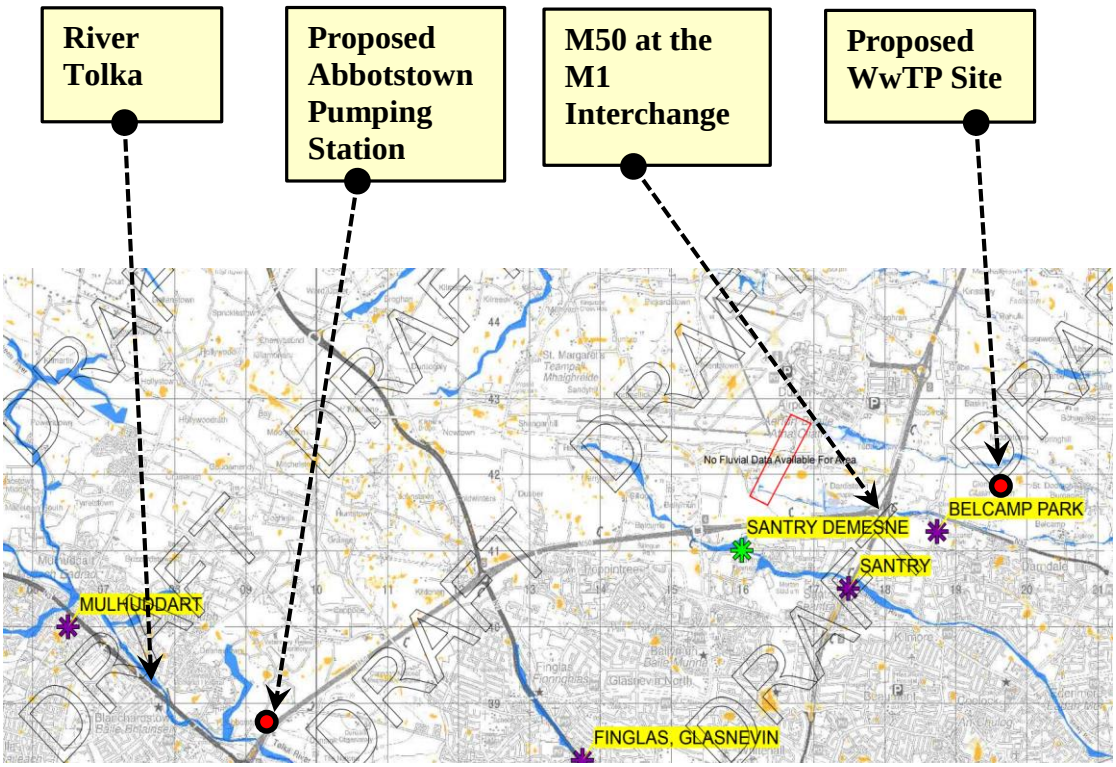

Figure 3.13: Extract of the PRFA Flood Map (Appendix D) of the River Tolka (source: www.cframs.ie)

4 FLOOD RISK ASSESSMENT – PROPOSED WWTP AND ABBOTSTOWN PUMPING STATION SITE

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

As discussed in Section 1.2 the proposed orbital sewer route and the outfall pipeline route (land based section) are considered to be water compatible/less vulnerable to flood risk as these are located below ground level and therefore will not be susceptible to flooding. The odour control unit along the proposed orbital ser route has been assessed for Flood Risk in Section 3.4 and it was determined that no flood risk exists at the odour control unit. Therefore, the flood risk assessment in this section will be focused on the proposed WwTP and proposed Abbotstown pumping station only.

4.2 Stage 1 - 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 described 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 in this Section 4. This report primarily investigates the flood risk to the main infrastructure proposed, namely the proposed WwTP and Abbotstown pumping station as these could be affected or damaged by flooding or cause pollution to the environment if they are flooded. The proposed orbital sewer route and outfall pipeline route are considered to be water compatible/less vulnerable to flood risk as these are located below ground level.

4.2.1 Coastal Flood Risk

WwTP

The tidal flood extent maps in Appendix C confirm that there is no tidal flood risk to the proposed WwTP. A portion of the site lies within the 200 year tidal flood extent, however as discussed in Section 3.4 no development will occur in this area. All development will occur outside of the 1000 year tidal flood event. Therefore, the tidal flood maps indicate that the proposed WwTP site is in **Flood Zone C –** probability of tidal flooding is low risk low risk.

Abbotstown Pumping Station

The PFRA map in Appendix D outlines the flood extent of the River Tolka in the vicinity of the pumping station. The pumping station site is situated at an elevation approximately 6m above the banks of the River Tolka. Due to the significant elevation of the site compared to the river water level, the proposed

pumping station site is considered to be in **Flood Zone C** - probability of tidal flooding is low risk low risk.

4.2.2 Fluvial Flood Risk

WwTP

The northern boundary of the proposed WwTP site is located adjacent to the Cuckoo stream (a tributary of the Mayne River) which discharges to Baldoyle Estuary to the east. A portion of the site lies within the 100 year fluvial flood extent, however as discussed in Section 3.4 no development will occur in this area. All development will occur outside of the 1000 year tidal flood event. Therefore, the proposed site lies within **Flood Zone C –** probability of fluvial flooding is low risk (less than 0.1% AEP).

Abbotstown Pumping Station

The PFRA map in Appendix D outlines the flood extent of the River Tolka in proximity to the pumping station site. It is apparent from this map that the proposed pumping station site is located outside of the flood extent and therefore in **Flood Zone C –** probability of fluvial flooding is low risk.

4.2.3 Groundwater Flood Risk

WwTP

There is no historical evidence of groundwater flooding at the site. The aquifer Vulnerability Map (refer to Figure 3.3) classifies the proposed WwTP site as having 'Low Vulnerability', which indicates a low water table and hence a low risk of ground water related flooding. There is no indication on the maps of any springs or wells on this site and this was further confirmed by visits to the site.

Abbotstown Pumping Station

The GSI mapping in Figure 3.2 illustrates the aquifer vulnerability categories at the proposed Abbotstown pumping station which range from high to extreme. The GSI website states "*Groundwater is most at risk where the subsoils are absent or thin and, in areas of karstic limestone, where surface streams sink underground at swallow holes*" (www.gsi.ie). The sub-soil mapping in Figure 3.2 indicates that the subsoil within the environs of the proposed Abbotstown pumping station site is primarily classified as till derived chiefly from Limestone with some small pockets of bedrock outcrop and subcrop (bedrock at the surface); this would explain the high to extreme aquifer vulnerability classification. There is no indication on the maps of any springs or wells on this site and this was further confirmed by visits to the site.

4.2.4 Pluvial Flood Risk

WwTP

The proposed WwTP site is well served by drains and rivers and hence surface water flooding is unlikely to be a significant issue. Surface water from the northern part of the proposed WwTP site drains to the Cuckoo stream which is a tributary of the Mayne River. Surface water from the southern part of the site drains to the Mayne River which is located approximately 200m to the south of

the site. A small region to the east of the site drains into a minor tributary of the Mayne River. Incorporating SuDS principles into the design of the proposed WwTP layout should ensure the appropriate management of surface water during pluvial events. Pluvial flood risk is therefore not considered to be significant.

Abbotstown Pumping Station

Surface runoff from the proposed site drains to the Tolka River which is approximately 150m south of the site. There is no historical evidence that the site has been affected by pluvial flood risk. During extreme rainfall events (pluvial) the application of SuDS principles will ensure surface water is managed sufficiently and sustainably discharged to the Tolka River. Pluvial flood risk is therefore not considered to be significant.

4.2.5 Artificial Drainage Systems Flood Risk

WwTP and Abbotstown Pumping Station

No artificial drainage systems have been identified at the proposed WwTP site or the proposed Abbotstown pumping station site, and consequently artificial drainage systems flood risk is not relevant.

4.3 Stage 2 - Initial Flood Risk Assessment

The Stage 1 - Flood Risk Identification has identified that there is a low risk of flooding (Flood Zone C) to the proposed WwTP site and the proposed Abbotstown pumping station site associated with fluvial and tidal 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 Project site (Section 2.23 of the FRM Guidelines)

Therefore, 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).

It is important to note that Flood Zone C include all areas which are not Flood Zone A or B.

As previously noted, and as detailed on the fluvial & coastal flood zone maps (Appendix B & C) and the PFRA map (Appendix D) indicates that;

- The proposed development at the WwTP site at Clonshagh is located above the 1,000 year fluvial & coastal flood levels, i.e., **Flood Zone C – Low risk area**.
- The proposed Abbotstown pumping station is assumed to be located above the

1,000 year fluvial flood level, i.e., **Flood Zone C – Low risk area**.

Step 2: Identification of the vulnerability of the type of the Proposed Project (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. Table 3.1 of the FRM guidelines stipulate that the following elements of the Proposed Project are categorised as 'highly vulnerable development (including essential infrastructure)':

- The proposed WwTP.
- The proposed Abbotstown pumping station.

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 Project.

WwTP

The proposed development at the WwTP site is located in **Flood Zone C** and is categorised as 'highly vulnerable development (including essential infrastructure)'. 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 that Flood Zone Category. Figures 4.1 and 4.2 below highlights the sequential approach and the matrix of vulnerability versus flood zone.

Abbotstown Pumping Station

The site of the proposed Abbotstown pumping station is located within **Flood Zone C** and is categorised as 'highly vulnerable development (including essential infrastructure)'. Since the site is located within **Flood Zone C** the probability of flooding is low and a justification test is not required. Figure 3.2 and Table 3.2 of the FRM guidelines collectively outline the steps required under the sequential approach mechanism and the matrix of vulnerability versus flood zone to illustrate appropriate development for this pumping station site. Figures 4.1 and 4.2 clarify the steps required in accordance with Figure 3.2 and Table 3.2 of the FRM guidelines.

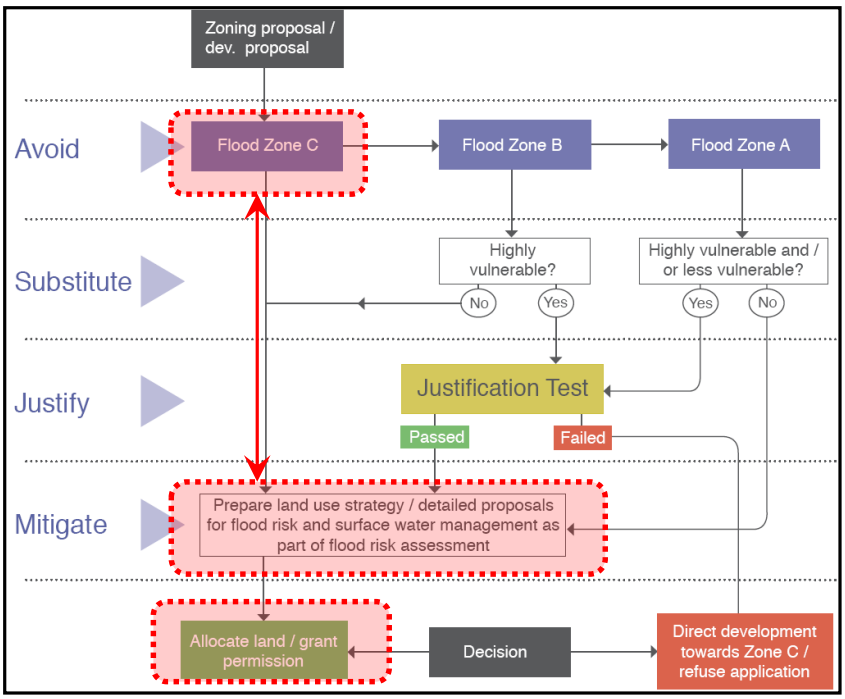

Figure 4.1: Summary of the Sequential Approach Mechanism for Flood Zone C (source: FRM Guidelines)

	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

Figure 4.2: Matrix of Vulnerability Versus Flood Zone to Illustrate Appropriate Development (source: FRM Guidelines)

5 CONCLUSION

5.1 Summary of Results

A flood risk assessment for the proposed WwTP and Abbotstown pumping station site has been undertaken following the methodology recommended in the FRM Guidelines. The proposed WwTP site is located in the Mayne River catchment, approximately 2.5km to the east-southeast of Dublin Airport and 1.5km to the east of the M1/M50 junction. The proposed site of the proposed Abbotstown pumping station is situated in the River Tolka catchment, approximately 500m north north-east of the M50/N3 Interchange. The following is a summary of the flood risk assessment:

WwTP

- The proposed WwTP site is a Greenfield site located in open agricultural ground, with an area of approximately 29.8ha. The national flooding website www.floodmaps.ie does not have any record of historic flooding at the site.
- The main potential source of flood risk to the proposed WwTP site is from fluvial flooding from the Cuckoo Stream which is a tributary of the Mayne River, however the risk of flooding is low
- A small portion of the proposed site is located within Fluvial Flood Zones A and B, however no development will take place in this area and will be used for landscaping purposes only. The entire development is located above the 1,000 year fluvial flood level, i.e., **Flood Zone C –** probability of flooding is low risk.
- A small portion of the proposed site is located within Tidal Flood Zones A and B, however no development will take place in this area and will be used for landscaping purposes only. The entire proposed WwTP is located above the 1,000 year tidal flood level, i.e., **Flood Zone C –** probability of flooding is low risk.

Abbotstown Pumping Station

- The main source of flood risk to this proposed pumping station site is fluvial flooding from the Tolka River.
- The area proposed for the pumping station is significantly higher than the Tolka River (in excess of 6m) and the site is located above the 1,000 year fluvial flood level, i.e., **Flood Zone C –** probability of flooding is low risk.

5.2 Impact of the Proposed Project on the Existing Flood Regime of the Area

WwTP

Observation of the fluvial flood maps which were obtained from the FEM-FRAMS project (Appendix B) confirms that all development occurring as part of the proposed WwTP site is located above the 1,000-year fluvial flood extent (current and future scenarios) and is in **Flood Zone C –** probability of flooding is low risk. Since the site is a Greenfield area, application of SuDS principles for the management of surface water runoff will not increase surface runoff from the Proposed Project. Herewith, it is considered that there will be indiscernible

impacts arising from the Proposed Project on the existing flood regime of the area.

Abbotstown Pumping Station

The pumping station site in Abbotstown is located within **Flood Zone C -** probability of flooding is low risk. The site drains to the Tolka River which is in excess of 6m below the existing ground level at the site. The pumping station will use SuDS principles to manage the surface water of the proposed site. Therefore, the proposed pumping site development will have an imperceptible impact on the existing flood regime of the area.

The aquifer vulnerability categories at the proposed Abbotstown pumping station ranges from high to extreme. By their nature, karstic aquifers possess specific hydrogeologic properties which are almost always vulnerable to contamination. Consequently, protection measures must be applied to preserve the quality of the karst groundwater. Specifically, appropriate protection measures must be implemented to prevent accidental spillage of pollutants which would have an adverse effect on the quality of the groundwater within the aquifer.

Construction Compounds

It should also be noted that one of the compound areas is located within Tidal Flood Zone A, as shown in Figure 5.1. However, as this compound is within the tidal flood plain there will be no increase in tidal flood levels as a result of the compound. All other compounds are located in **Flood Zone C –** probability of flooding is low risk.

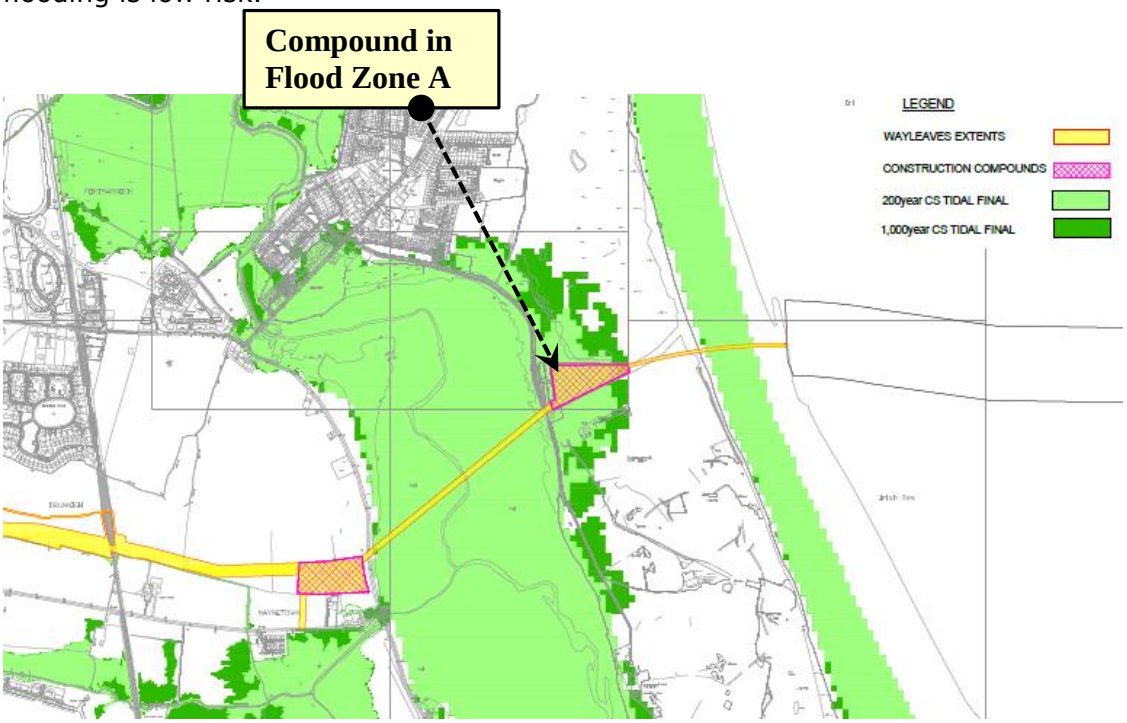

Figure 5.1: Construction Compound in Tidal Flood Zone

5.3 Vulnerability of the Proposed Project to Flooding

WwTP and Abbotstown Pumping Station

The proposed WwTP and Abbotstown pumping station are categorised as 'highly vulnerable development (including essential infrastructure)' and by taking this into consideration all the proposed infrastructure is strategically situated within **Flood Zone C - Low Risk**. Climate change (20% increase in peak flows and +500mm freeboard) was considered under the FEM FRAMS project which resulted in the generation of MRFS maps – mid-range future scenario maps, a copy of which is included in Appendix F). The proposed Abbotstown pumping station is not included since it was not within the scope of the FEM-FRAMS project. However, the proposed site is significantly higher (in excess of 6m) than the river waterline and hence, the site has a sufficient natural freeboard against flooding. The MRFS fluvial and tidal flood maps illustrates that all the main structures are above the 1,000 year flood extents and hence are in **Flood Zone C** which have a low risk of flooding (less than 0.1% AEP).

It should also be noted that one construction compound located at Portmarnock Beach Car Park is located within Tidal Flood Zone A, as shown in Figure 5.1. It is not feasible to relocate this compound so a number of measures shall be put in place to minimise flood risk. These include setting the FFL of the compound above the 0.5% AEP flood level where practical, and any materials stored shall be carefully stored to prevent spillage in the event of an extreme flood. All other site compounds and storage areas are located in **Flood Zone C –** probability of flooding is low risk.

5.4 Vulnerability of the Orbital Sewer Route and Marine Outfall to Flooding

As noted earlier, this report primarily investigates the flood risk to the main infrastructure proposed, namely the proposed WwTP and Abbotstown pumping station as these could be affected or damaged by flooding or cause pollution to the environment if they are flooded. The proposed orbital sewer route and outfall pipeline route are considered to be water compatible/less vulnerable to flood risk as these are located below ground level. However, there could be some flood risk associated with the construction of the pipelines.

The proposed orbital sewer route between the proposed Abbotstown pumping station and the proposed WwTP will cross the Santry River. All pipeline routes will also cross a number of ditches. The outfall will cross the Cuckoo stream, Baldoyle Estuary and then continue under the Irish Sea for a distance of approx. 6km.

Trenchless construction techniques will be used for the installation of the proposed orbital sewer route at any significant watercourse crossing (Figure 5.2). In such scenarios, the construction fronts/launch pits will be located beyond the floodplain of the summer peak flood of an appropriate return period (say 1 in 20 years). (For 10% risk over 2 year construction period, the required return interval for construction period flood is approximately 20 years (Ref: Thomas Telford: Flood and Reservoir Safety, Institute of Civil Engineers, UK)).

Trenchless construction techniques will be used for the installation of the Marine Outfall under Baldoyle Estuary and out to the Irish Sea. The location of the construction compounds are shown on the maps included in Appendices B and C. Observation of these maps demonstrate that the construction compounds are located outside of 0.1% fluvial and tidal flood extents, with the exception of the aforementioned compound located at Portmarnock Beach Car Park. The mitigation

measures discussed in Section 5.3 will be implemented to minimise the flood risk to this compound during construction.

Conventional open trench methods will also be adopted for the installation of the pipelines at other watercourse crossings. Any direct discharge of water from excavation trenches and groundwater dewatering to the nearby watercourse could increase the flood risk of a stream with limited discharge capacity & therefore discharges should be carefully regulated. The reinstatement of any river bank, bed and floodplain must match existing conditions as any reduction in flow capacity may affect future flood risk in the area.

The storage of materials and machinery should be outside the floodplain of the river. The capacity of any diversion channels should match existing.

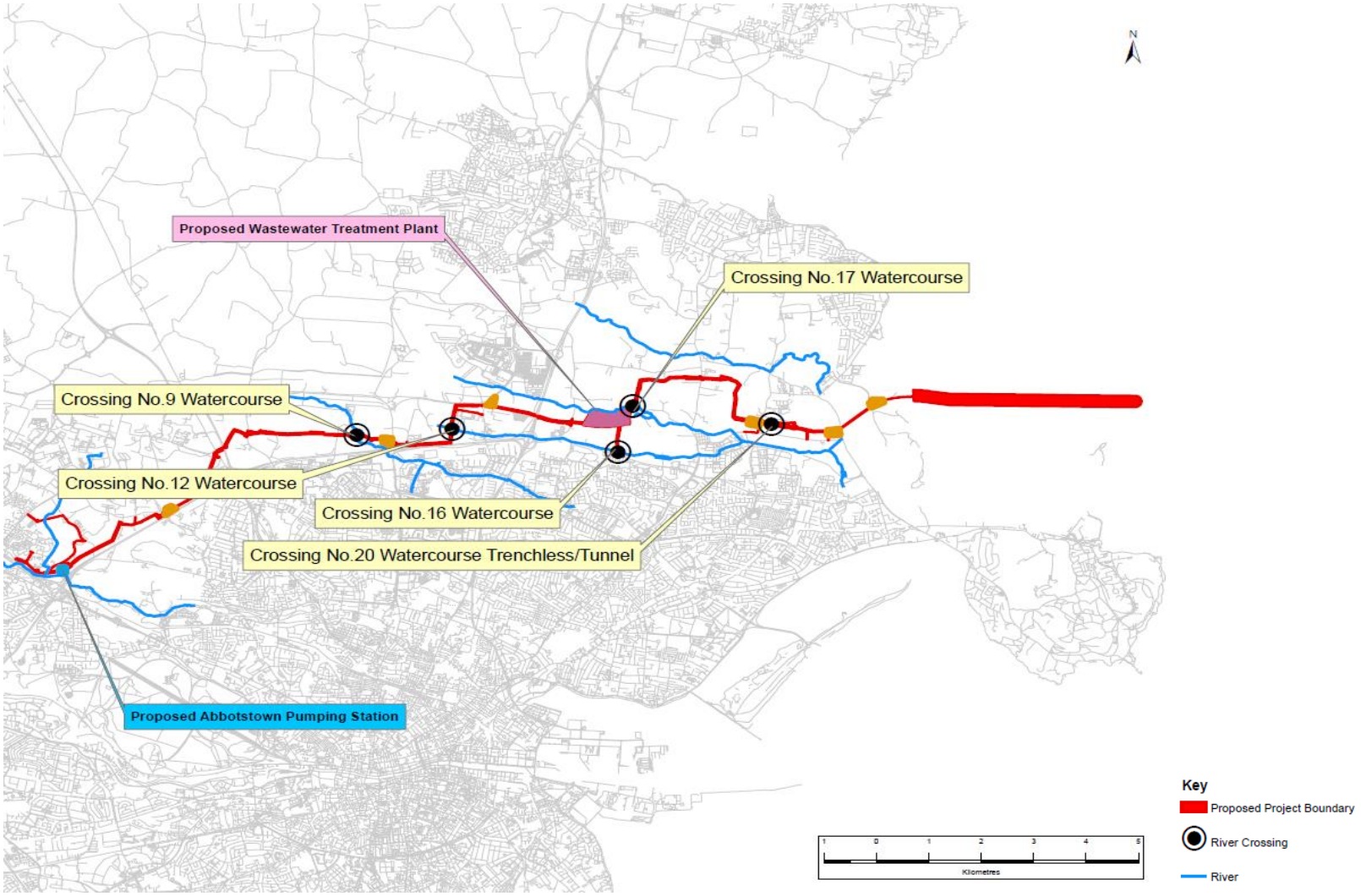

Figure 5.2: Locations of Watercourse Crossings