HYDROLOGICAL & HYDROGEOLOGICAL RISK ASSESSMENT REPORT

FOR

PROPOSED MIX-USE DEVELOPMENT

AT

EMMET ROAD,

DUBLIN 8

October 2022

ON BEHALF OF

DUBLIN CITY COUNCIL

Prepared by
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1 INTRODUCTION

Enviroguide Consulting (hereafter referred to as Enviroguide) was appointed by Dublin City Council (hereafter referred to as the Client) to prepare a hydrological and hydrogeological risk assessment for the Proposed Development at Emmet Road, Dublin 8 (referred to hereafter as the Proposed Development Site or Site).

1.1 Project Objective

The project objective was to establish the baseline hydrological and hydrogeological conditions at the Proposed Development and to identify the potential for any impacts on receptors and specifically designated and Protected sites (refer to Section 3.14 for definition) hydraulically connected with the Proposed Development Site.

1.2 Project Scope

The scope of the assessment undertaken to meet the project objective included:

- A desk-based review of published information and information pertaining to the Proposed Development provided by the Client;
- Develop a hydrological and hydrogeological conceptual site model (CSM) for the Proposed Development identifying potential Source-Pathway-Receptor (SPR) linkages; and
- Undertake a risk assessment to identify and assess any potential risk associated with the Proposed Development to the following:
    - the receiving water environment; and
    - Protected and Designated sites and areas including Natura 2000 sites, Natural Heritage Areas (NHAs) and proposed Natural Heritage Areas (pNHAs).

This assessment is reliant on the design information for the Proposed Development provided by the Client.

1.3 Quality Assurance & Competence

This report was written by Fionnuala Joyce BSc., MSc., Hydrogeologist with Enviroguide Consulting and Claire Clifford BSc., MSc., PGeo., EurGeol., Technical Director - Contaminated Land and Hydrogeology with Enviroguide Consulting who has extensive experience in preparing hydrogeological and environmental risk assessments for a range of project types and geological and hydrogeological settings.

2 DESCRIPTION OF THE PROPOSED DEVELOPMENT

2.1 Site Location and Description

The Site of the Proposed Development comprises brownfield lands located at Emmet Road, Dublin 8. The Site is bound to the north by Emmet Road, to the south by Goldenbridge Cemetery, to the east by the former Richmond Barracks and the pedestrian link to the Bulfin Estate adjacent to St. Michael's Church, and to the west by Saint Vincent Street West.

The Proposed Development location is presented in Figure 2-1.

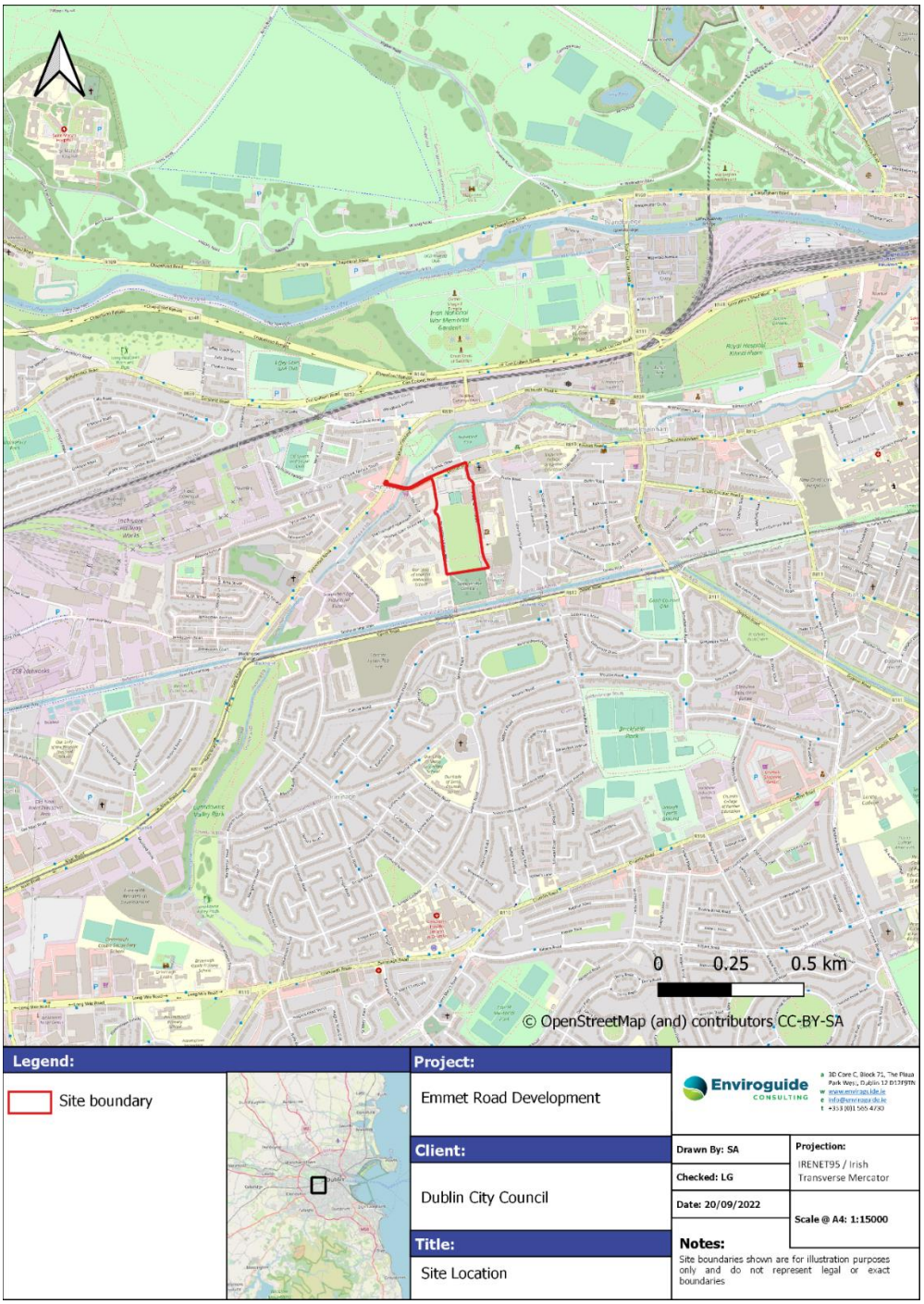

Figure 2-1: Site Location

2.2 Proposed Development

The Client intends to apply for permission for the Proposed Development of approximately 4.68 hectares (Ha) at Emmet Road, Dublin 8.

The Proposed Development will consist of the construction of 578 no. apartments (110 no. studio apartments, 172 no. 1 bedroom apartments, 250 no. 2 bedroom apartments (including 10 no. duplex apartments) and 46 no. 3 bedroom apartments (all apartments to have balconies or terraces), Library/Community Hub, Creche, Supermarket, 5 no. units (retail/café/restaurant/class 2 financial services floorspace) & 2 no. Café/restaurant units), a public plaza fronting onto Emmet Road and the installation of a new watermain c 200m in length along Emmet Road to the junction with Tyrconnell Road/Grattan Crescent. The proposal includes works to a protected structure (8705 - Richmond/Keogh Barracks, relating to works to rubble stone boundary wall).

To accommodate the Proposed Development infrastructure upgrades the connection to the existing watermains infrastructure will be decommissioned at the Proposed Development including approximately 180m of existing watermains along Emmet Road during the construction phase of the development and will require the watermain connections to be diverted through or around the Proposed Development Site.

The Proposed Development Site layout is presented in Figure 2-2 (OCSC, 2022 DWG Reference: B967-OCSC-ZZ-GFDR-C-0500).

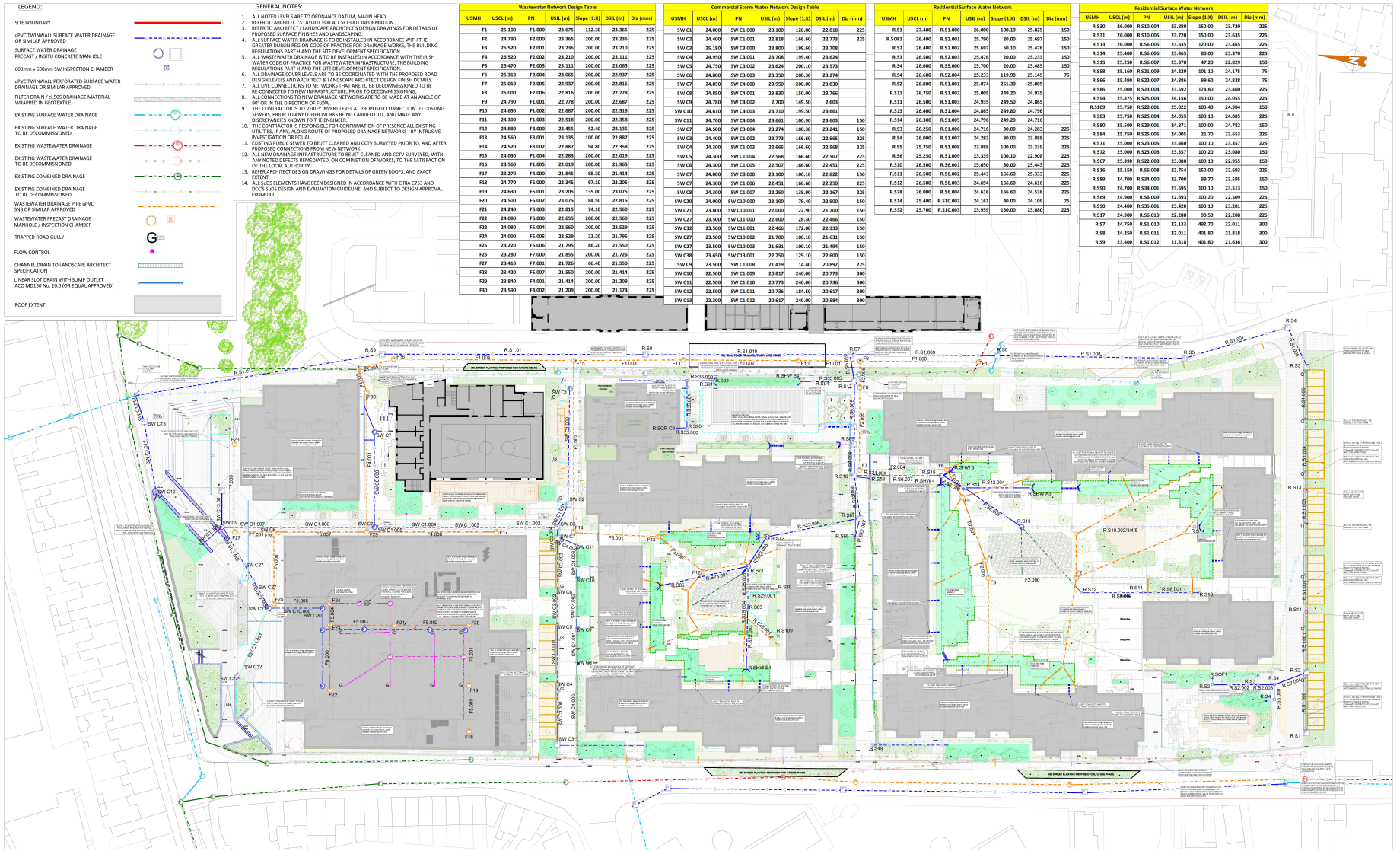

Figure 2-2: Proposed Development Site Layout (Source: OCSC, 2022 DWG Reference: B967-OCSC-ZZ-GFDR-C-0500)

2.2.1 Foul Water Drainage

Foul water from the Proposed Development Site will be directed to the existing foul sewer network located at St Michael's Estate to the east of the Proposed Development Site and will ultimately discharge to Ringsend Waste-Water Treatment Plant (WWTP) (Waste-Water Discharge Licence Ref.: D0034-01) located approximately 9.1km east of the Site in Poolbeg (GSI, 2022).

Surface water runoff from the undercroft car parking areas will also be discharged to the to the existing foul sewer network located at St Michael's Estate to the east of the Site via class1 petrol interceptors.

Irish Water (IW) have provided a Confirmation of Feasibility (COF Ref: CDS22003279 dated 8th June 2022), that confirms the proposal for foul drainage connection to the Irish water network is "feasible without infrastructure upgrade" by IW.

The foul water drainage infrastructure at the Proposed Development will be designed and constructed in accordance with current IW Code of Practice for Wastewater Infrastructure (OCSC, 2022a).

2.2.2 Surface Water Drainage

As documented in the Engineering Services Report (O' Connor Sutton Cronin (OCSC), 2022a), the surface water drainage for the Proposed Development has been divided into three (3No.) catchment areas as described below.

- Catchment A – Road and paving alongside Goldenbridge Cemetery within the south of the Proposed Development;
- Catchment B – Two (2No.) residential blocks and associated paving / landscaping in the centre of the site; and
- Catchment C – Commercial area, and associated paving / landscaping in the north of the Site.

Surface water runoff from the site will be managed in accordance with the principles and objectives of Sustainable Drainage Systems (SuDS) and the Greater Dublin Sustainable Drainage System (GDSDS) to treat and attenuate water prior to the outfall points from the site (OCSC, 2022a).

Attenuated and treated surface water from Catchment A, Catchment B and Catchment C will outfall at three separate locations to the existing public surface water network within St Michael's Estate to the east of the Proposed Development and will ultimately discharge to the Camac River at an outfall point located approximately 0.2km north-west of the Proposed Development in Inchicore (OCSC, 2022a).

2.2.3 Water Supply

It is proposed to serve the Proposed Development through a new connection from the public infrastructure to a centralised water storage tank located at the Energy Centre adjacent to Richmond Barracks to the east of the Proposed Development. From here water will be metered and distributed to each block and individual units.

Irish water have advised in a Confirmation of Feasibility (COF Ref: CDS22003279 dated 8th June 2022), that upgrades from a 150mm to a 200mm diameter pipe of approximately 180m of existing watermain at Emmet Road will be required for the works to include the replacement

of the existing watermain in place on the bridge-deck over the Camac River. No in-stream works will be required for this/

The water supply infrastructure at the Site will be designed and constructed in accordance with current IW Code of Practice for Water Infrastructure (Revision 2 – July 2020).

2.2.4 Subsurface structures

Excavation will be required to reduce levels to construct the foundations, undercroft levels and install drainage infrastructure. The finished floor levels of the foundation level range from 23.75mOD to 24.25 mOD with an approximate maximum excavation depth of 2.5m and the installation of the water and sprinkler tank constructed as a 4.1m deep tank. Piling for foundations will be required to a maximum depth of 9mbGL.

3 SITE SETTING

3.1 Topography

The topography at the Site slopes to the north and with elevations ranging from 28.7 meters above Ordnance Datum (mOD) in the southwest of the Site to 22.81maOD in the north of the Site (APEX Surveys, 2020).

3.2 Rainfall

Monthly rainfall data for the Site is available for 1km x 1km grids (for the period 1981 to 2010) was sourced from Met Éireann (Walsh, 2012) and is presented in Table 3-1. The closest synoptic meteorological station to the Site is at the Casement Aerodrome, Co. Dublin which is located approximately 8.72km southwest of the Site. The average annual potential evapotranspiration (PE) from the Casement Aerodrome station for the period 2021 to 2022 is recorded as 563.8mm (Met Éireann, 2022).

Table 3-1: Long-term mean monthly rainfall data (mm) (Walsh, 2012)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
61	48	52	50	56	61	50	65	57	75	72	72	719
Note: 1km x 1km Irish Grid Coordinates selected for the Site = X (Easting): 312000, Y (Northing): 233000 Mean monthly rainfall data recorded in millimetres (mm)												

3.3 Regional Hydrology and Catchment

The Site is located in the Liffey and Dublin Bay Catchment (Catchment I.D 09), the Liffey and Dublin Bay Hydrometric Area (HA09), the Liffey_SC_090 Sub-catchment (Sub-catchment I.D.09_15) and the Camac_040 WFD River Sub-basin (EPA, 2022).

The EPA (EPA, 2022) records a number of surface waterbodies with a potential hydraulic connection to the Site which include the following:

- The Grand Canal Main Line (EU code: IE_09_AWB_GCMLE) is located approximately 0.12km to the south of the Site however, there is no identified hydraulic connection t from the Site;
- The Camac River (EU Code: IE_EA_09C020500) is located approximately 0.2km north-west of the Site and flows in a northeast direction where it joins the Liffey Estuary Upper transitional waterbody located approximately 1.8km northeast of the Site; and
- The River Liffey is located approximately 0.63km to the north of the Site and flows eastwards to the Liffey Estuary Upper transitional waterbody (EU Code: IE_EA_090_0400), to the Liffey Estuary Lower transitional waterbody (EU Code: IE_EA_090_0300) and to Dublin Bay coastal waterbody (EU Code: IE_EA_090_0000).

All relevant watercourses to the Proposed Development Site are presented in Figure 3-1.

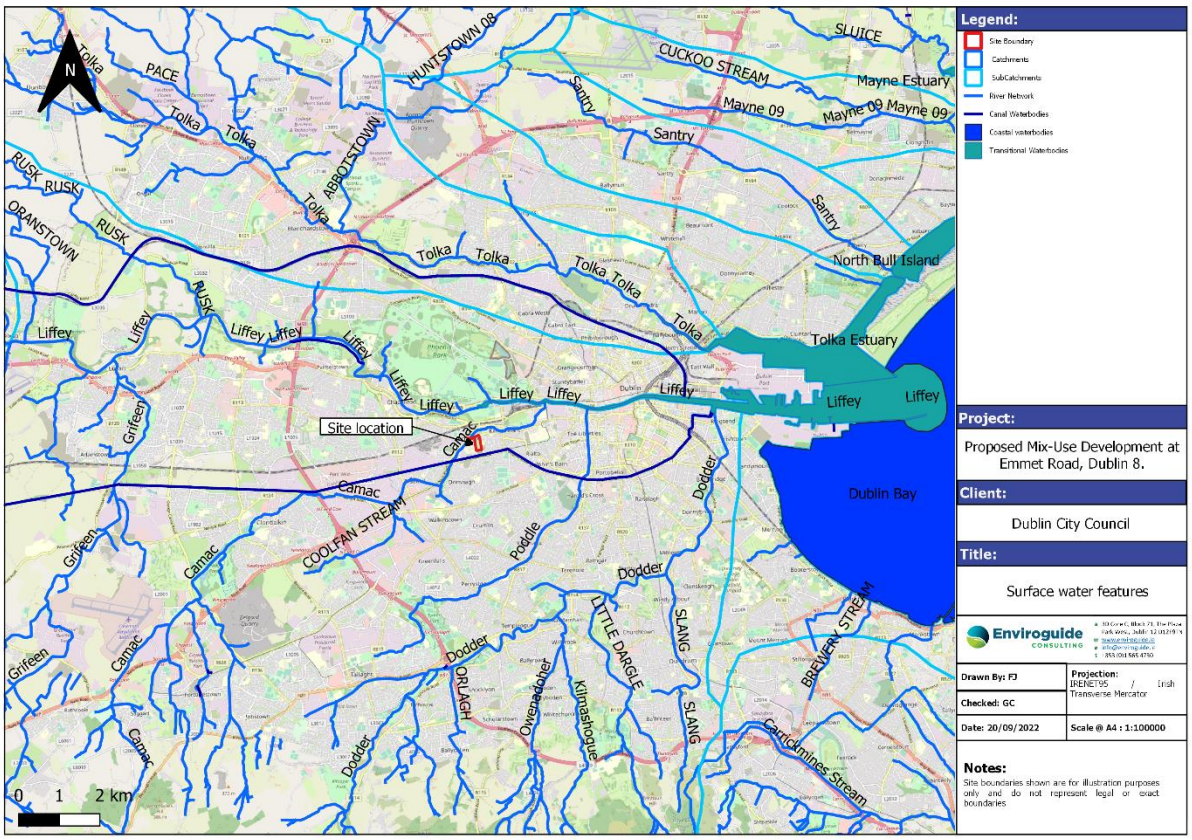

Figure 3-1: Surface Water Features

3.4 Existing Surface Water Drainage

There are a number of surface water drains identified across the Site which outfall to the existing public surface water infrastructure located to the west along St. Vincent's Street West and to the east at St Michael's Estate and ultimately discharge to the Camac River located approximately 0.2km north-west of the Site (OCSC, 2022a). However, it is understood that these connections may have been removed (OCSC, 2022a).

3.5 Flood Risk

A site-specific flood risk assessment report (SSFRA) was produced (OCSC, 2022b) for the Proposed Development Site which assessed the potential flood risk associated with fluvial, groundwater, coastal and pluvial flooding.

The SSFRA identifies that the Site is not considered at risk from Coastal Flooding (OCSC, 2022b). It is concluded that the Site does not appear to be at risk of groundwater flooding (OCSC, 2022b).

The SSFRA identifies that the Site is to be designed with a storm water management system in place to mitigate any resulting potential pluvial flood risk (OCSC, 2022b).

The SSFRA concludes that the Site is located within Flood Zone C, where the probability of flooding from rivers and sea is low (less than 0.1% AEP for both fluvial and coastal flooding) (OCSC, 2022b).

Overall, the SSFRA concludes that the Site is considered “Less Vulnerable” in accordance with the guidance set out in The Planning System and Flood risk Management (FRM), Guidelines and that the Site is considered “appropriate” for development.

3.6 Soil and Subsoil

The soil beneath the majority of the Site is mapped as “Made ground” (MADE) described as “Made/ built land” (GSI, 2022). The quaternary sediments beneath the majority of the Site are mapped as Till derived from limestones (TLs) while a those mapped beneath the north-western boundary of the Site are mapped as “Urban” (GSI, 2022).

The underlying soils quaternary sediments are presented in Figure 3-2 and Figure 3-3.

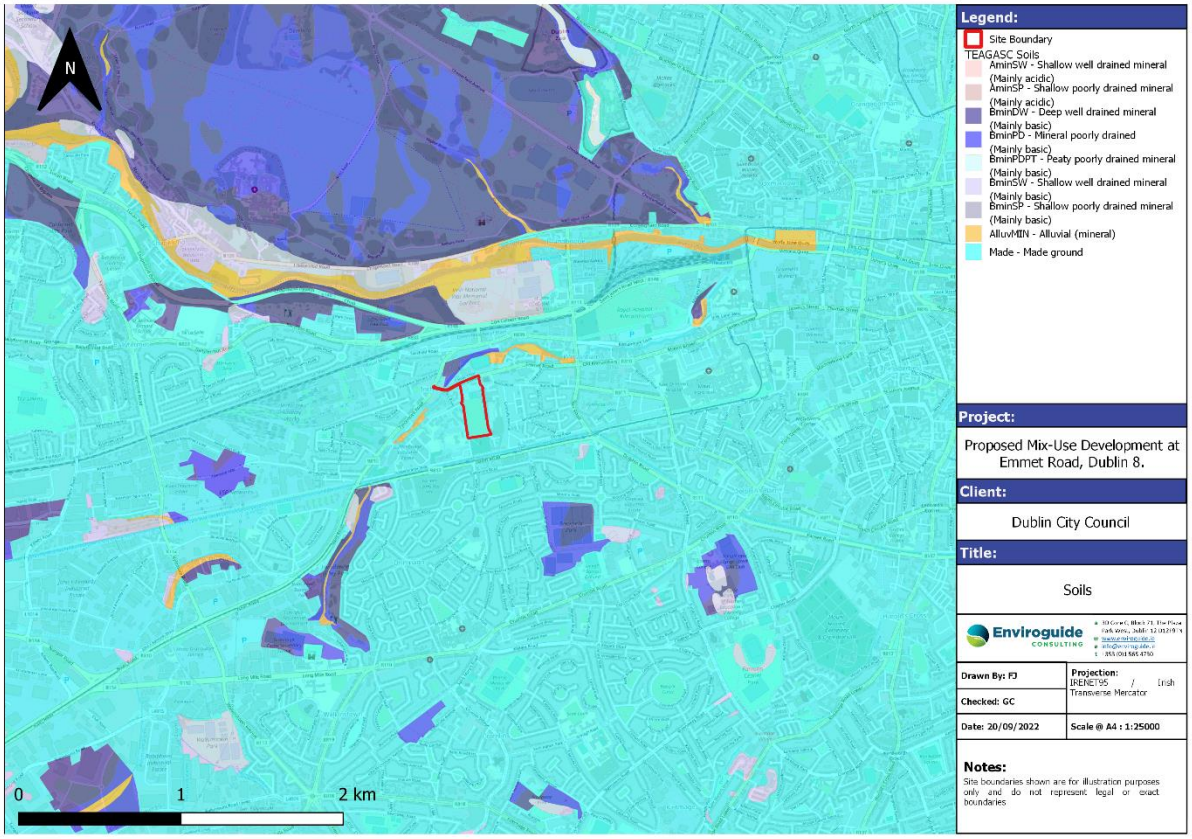

Figure 3-2: Soils

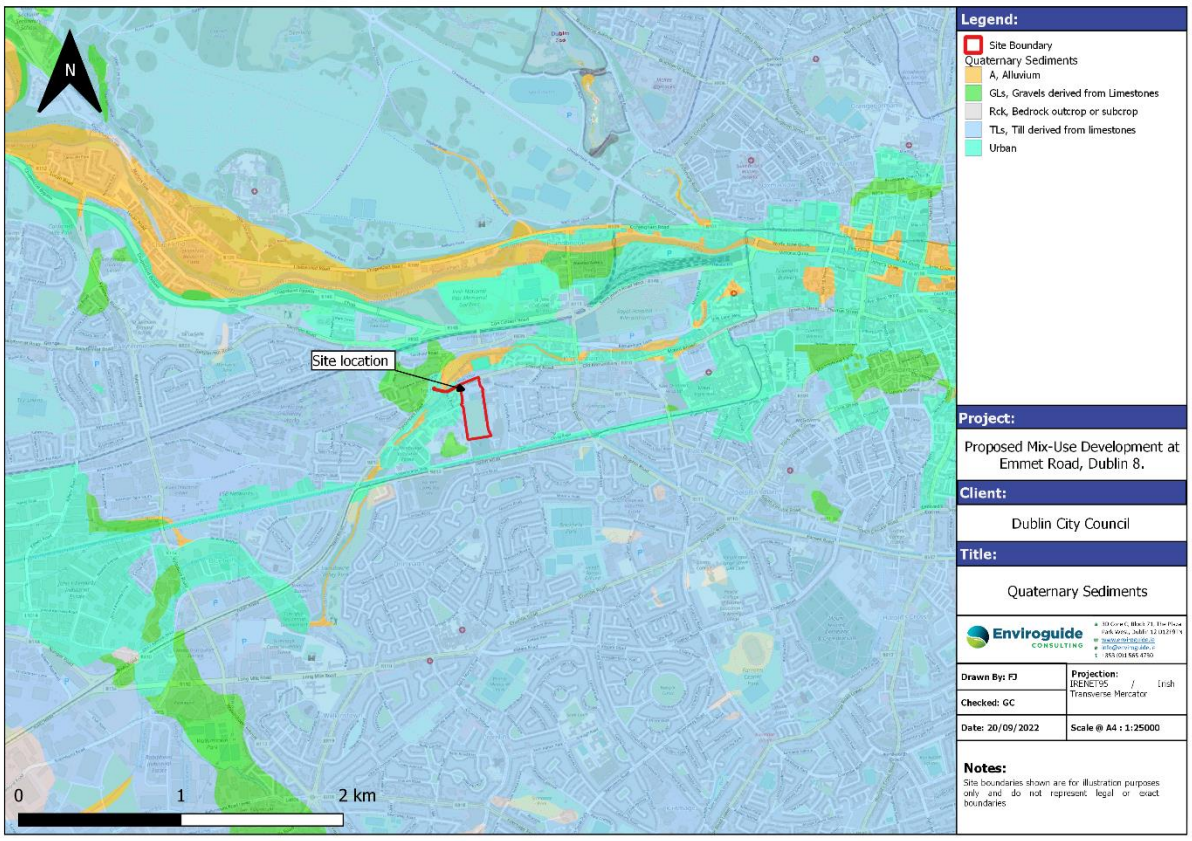

Figure 3-3: Quaternary Sediments

3.6.1 Site Investigation Results

The soils and ground conditions encountered during previous site investigations undertaken at the Site are generally consistent with the published data on the soils and subsoils underlying the site and are detailed in the site investigation reports including Ground Investigations Ireland, 2020 Emmet Road Ground Investigation Report (GII, 2020) and O'Connor, Sutton Cronin, 2021 Emmet Road Inchicore Waste Soil Classification Report (OCSC, 2021)The soils and ground conditions encountered are summarised as follows:

- Topsoil was encountered at the Site from ground level to a maximum depth of 0.3mbGL;
- MADE GROUND described as brown or grey slightly sandy, slightly gravelly CLAY or brown, slightly sandy, clayey GRAVEL, both with occasional cobbles and boulders and containing fragments of concrete, red brick, glass and plastic were encountered below topsoil to a maximum depth of 3.5mbGL; and
- Varying strata of cohesive clays and granular deposits were encountered at the Proposed Development site below made ground to a maximum depth of 12.6mbGL as follows:
    - Cohesive clays are described as brown slightly sandy, gravelly CLAY and stiff, brown slightly sandy, gravelly CLAY with occasional cobbles and boulders; and
    - Granular deposits described as Grey/ brown, slightly sandy, subangular to subrounded GRAVEL and dark grey clayey fine to coarse SAND with occasional cobbles and rare boulders.

3.6.2 Soil Analytical Results

Soil analytical results for the 183 No. soil samples collected from trial pit and borehole locations at the Site are provided in OCSC, 2021 includes an assessment of soil and stone samples collected from the Site.

Total Petroleum Hydrocarbons (TPH) was reported in fifty-one of the 183 samples collected across the Site with a maximum concentration of reported 6808mg/kg in location WS39 1.2-1.45m along the eastern boundary of the Site.

Reported concentrations of MTBE and BTEX (benzene toluene, ethylbenzene and xylene) were reported in twenty-three samples from locations across the Site with a maximum concentration of BTEX reported at 0.689mg/kg at sample location TP33 1-2m in the centre portion of the Site.

Asbestos identified as Chrysotile was reported in two samples at location WS09 0-1m (at 0.176%) as Asbestos containing material and at TP19 2-3m (0.003%) as loose unbound fibres.

Samples with identified TPH, BTEX, MTBE and asbestos were identified within soils that were described as made ground and native sands and clays to a maximum depth of 3.2mbGL.

3.7 Bedrock Geology

The GSI has mapped the bedrock beneath the Site as the Lucan Formation (New Code: CDLUCN; Stratigraphic Code: LU) which is described as “Dark limestones & shale” and is recorded as having a thickness ranging from 300m to 800m (GSI, 2022). The GSI bedrock geology map is presented in Figure 3-4.

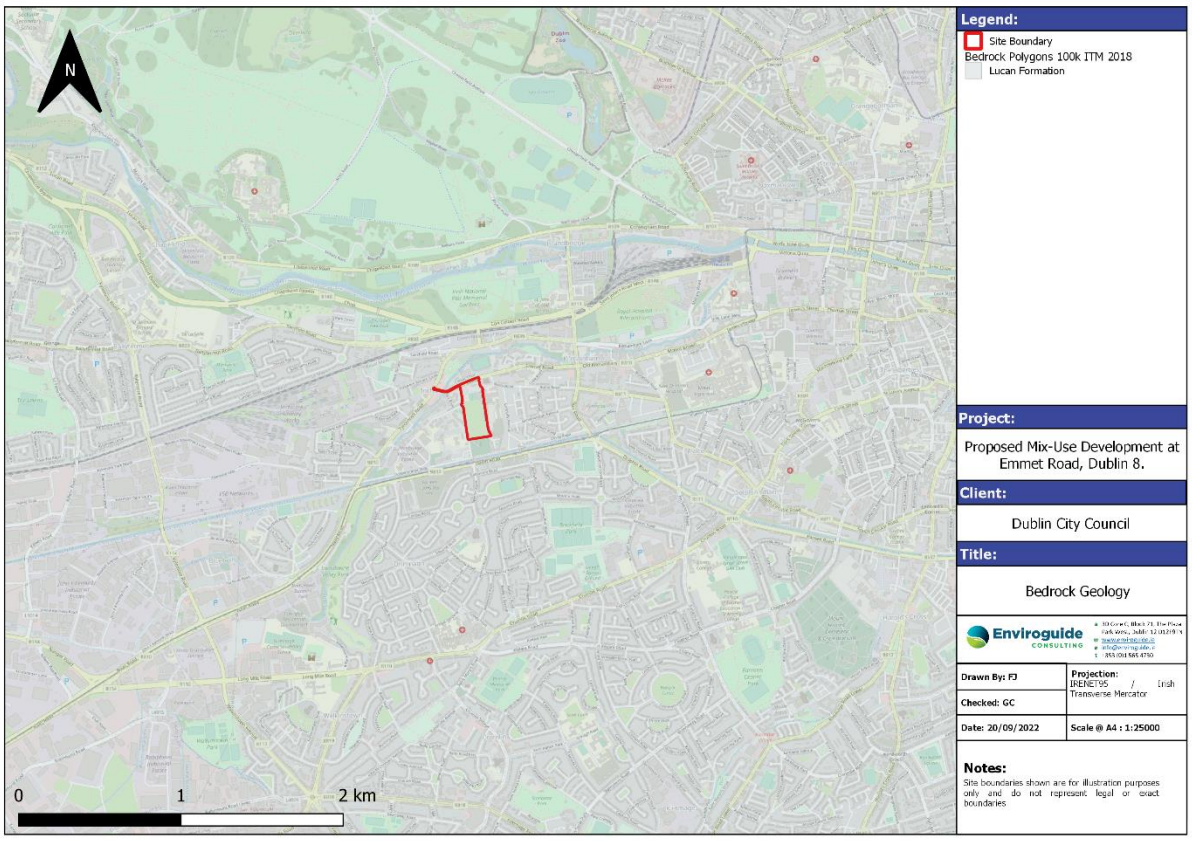

Figure 3-4: Bedrock Geology

As reported in the site investigation reports (GII, 2020 and OCSC, 2021) the bedrock encountered beneath the Site was recorded as comprised of interbedded grey thinly-laminated, fine-grained Limestone and dark grey, fine-grained Mudstone was encountered at all borehole locations and was recorded at depths below 3.05mbGL (BH11 in the south-western portion of the Site) to a maximum depth of 12.6mbGL (BH03 in the north-eastern portion of the Site) (GII, 2020). It is noted that weathered bedrock described as dark grey, clayey, gravelly boulders was encountered in specific borehole locations (BH02, BH06, BH07, BH12 and BH13) above bedrock between depths of 3.3mbGL and 12.45mbGL.

3.8 Recharge

The GSI groundwater recharge map provides an estimate of the average amount of rainwater that percolates and recharges the underlying aquifer unit.

The GSI (GSI, 2022) has calculated an Effective Rainfall (ER) value of 301.5mm/year for the Site. The GSI (GSI, 2022) calculated recharge coefficient of 20% applied to the lands within the Proposed Development Site. A recharge cap of 60mm/year has been applied to groundwater aquifer beneath Site (GSI, 2022).

3.9 Aquifer Classification and Vulnerability Rating

The bedrock aquifer identified beneath the Site is mapped as “Locally Important Aquifer – Bedrock which is Moderately Productive only in Local Zones” (Ll) (GSI, 2022).

The Groundwater Vulnerability Rating assigned to groundwater beneath the Site is mapped as "*High" (H)* where it is indicated that the depth to bedrock from the ground surface is between 3m to 5m and has a "Low" subsoil Permeability (GSI, 2022). While the top of bedrock encountered at depths below 3.05mbGL in the south-western portion of the Site the GSI classification of permeability does not appear to be consistent with all the site investigation findings as elsewhere top of bedrock was recorded at 12.6mbGL (BH02) in the north-eastern portion of the Site which was recorded beneath cohesive clays in the overburden (GII, 2020) which indicates that there may be a lower vulnerability to groundwater beneath the Site. The GSI Groundwater Aquifer Classification map is provided in Figure 3-5 and the Groundwater Vulnerability map is presented in Figure 3-6.

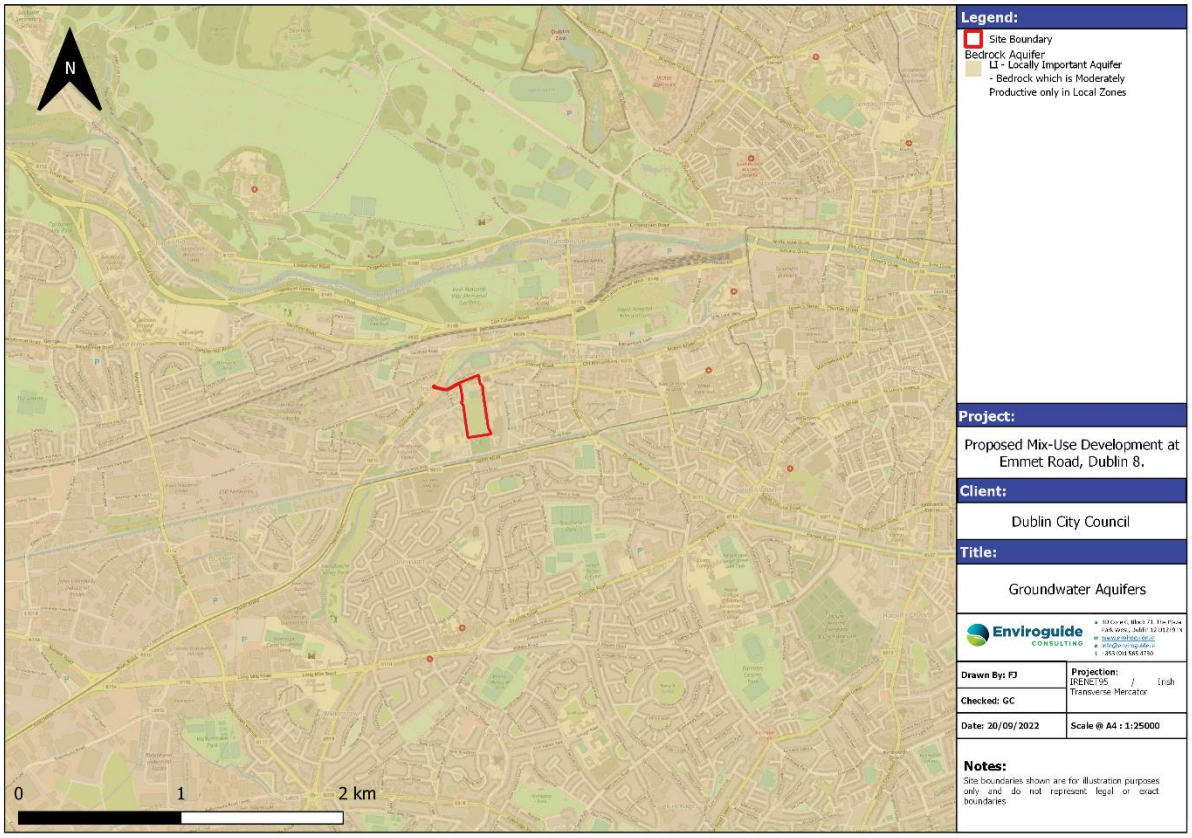

Figure 3-5: Groundwater Aquifers

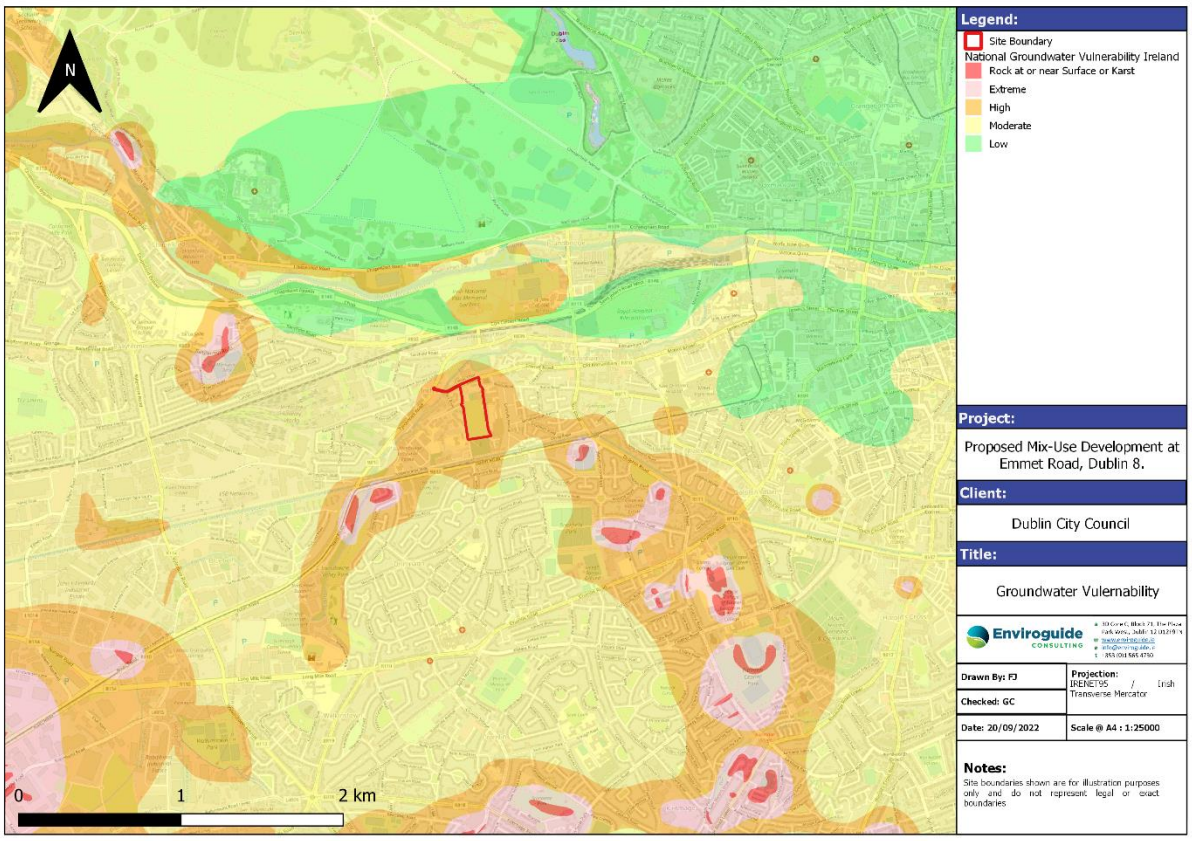

Figure 3-6: Groundwater Vulnerability

3.10 Regional Hydrogeology

The bedrock aquifer beneath the Site is within the Dublin GWB (EU Code: IE_EA_G_008). The Dublin GWB covers some 837km2 and occupies an area across Co. Dublin, Co. Kildare, and Co. Meath (GSI, 2022).

The GSI description of the Dublin GWB identifies that the dominant recharge process in the Dublin City area will be from leaking sewers, mains and storm drains where the ground has been surfaced, while elsewhere recharge will occur via rainfall percolating through the subsoil. Due to the generally low permeability of the aquifers in the groundwater body, a high proportion of the recharge will then discharge rapidly to surface watercourses via the upper layers of the aquifer, effectively reducing further the available groundwater resource in the aquifer.

The GSI (Dublin GWB Report) identifies that the general groundwater flow direction in the aquifer is towards the coast and also towards the River Liffey. This aquifer is not expected to maintain regional groundwater flow paths. Groundwater circulation from recharge to discharge points will more commonly take place over a distance of less than a kilometre and the majority of groundwater flow will be in the upper weathered zone.

3.11 Onsite Groundwater Levels

During previous site investigations (OCSC, 2021; and GII, 2020) groundwater was encountered between 0.4mbGL and 3.5mbGL (20.91mOD and 25.56mOD respectively) at trial pits, trenches and borehole locations at the Site.

Four (4No.) groundwater wells were installed at the Site for the purposes of groundwater monitoring however, limited groundwater level data is available for the Site following the installation of the wells in both the GII, 2020 and OCSC, 2021 reports.

The regional groundwater flow direction is reported as being from the southwest to the north and to the east of the Site (GII, 2020) however, there is no further observations included in regards to the observed groundwater levels at the Site (GII, 2020; OCSC, 2021).

3.12 Groundwater Use and Source Protection

A search of the GSI groundwater well database was conducted to identify registered wells, springs and groundwater sources in the surrounding area.

There are a total of three (3 No.) groundwater sources recorded within a 2km radius of the Site; one located approximately 1.48km southwest of the Site which is recorded as being used for Industrial use, one located approximately 1.29km south of the Site which is recorded for unknown use and one located approximately 1.28km east of the Site which is recorded as being used for Industrial use (GSI, 2021).

There are no groundwater source protection areas recorded within a 2km radius of the Site and the closest recorded source protection area is recorded as the Dunboyne Water Supply Groundwater Source Protection Area which is located approximately 13.8km north-west of the Site.

3.13 EPA Water quality data

3.13.1 Surface water quality

The EPA monitor water quality on the Camac River at the Camac Close Emmet Road station (Station Code: RS09C020500) which is the closest to the Site and is located approximately 0.88km north-west of the Site and is located downstream from the proposed surface water drainage outfall point on the Camac River. The data indicates that there is an upward trend in Total Ammonia, total Oxidised Nitrogen and Ortho-phosphate (as P) for the water course for the period 2013-2018, while an upward trend in the concentration of Chloride was observed from 2018 to 2022 (EPA, 2022).

The EPA Q-Value is a system of water quality rating based on the biological quality of the water body and abundance for specific invertebrate species. A summary of the Q-value for the Camac Close Emmet Road station (Station Code: RS09C020500) is summarised in Table 3-2.

Table 3-2: EPA monitoring station and assigned Q values

EPA Monitoring Station name	Station Code	Location from Site	Distance from Site	Assigned Q value
Camac Close Emmet Rd	RS09C020500	North-west (Downstream of the surface water drainage outfall point)	0.88	3 “Poor”

3.13.2 Groundwater Quality

There are no groundwater monitoring stations located within the vicinity of the Site (2km). The closest groundwater monitoring station to the Site for which there is available data which is located in the Dublin Groundwater Body is the Ryewater RW1 groundwater monitoring station which is located approximately 17km north-west of the Site (EPA, 2022) and within a different sub-catchment to the Site.

3.14 Designated and Protected Sites (Natura 2000, NHAs and pNHAs)

The Habitats Directive (92/43/EEC) seeks to conserve natural habitats and wild fauna and flora by the designation of Special Areas of Conservation (SACs) and the Birds Directive (2009/147/EC) seeks to protect birds of special importance by the designation of Special Protection Areas (SPAs). SACs and SPAs are collectively known as Natura 2000 or European sites (referred to hereafter as Natura 2000 site).

The Designated and Protected Sites including Natura 2000 sites including those with a potential hydraulic connection to the Site are presented in Figure 3-7.

National Heritage Areas (NHAs) are designations under the Wildlife Acts to protect habitats, species, or geology of national importance. The boundaries of many of the NHAs in Ireland overlap with SAC and/or SPA sites. Although many NHA designations are not yet fully in force under this legislation (referred to as 'proposed NHAs' or pNHAs), they are offered protection in the meantime under planning policy which normally requires that planning authorities give recognition to their ecological value and are therefore considered in this assessment

The NHAs and pNHAs with a potential hydraulic connection to the Site are presented in Figure 3-8.

As the surface water drainage and groundwater flow from the Site ultimately discharges to the Camac River, the River Liffey, Liffey Estuary Upper and the Dublin Bay there is a potential hydraulic connection with identified Natura 2000 sites and NHA/pNHA sites associated with these water bodies. The Grand Canal pNHA located immediately to the south of the Site is not hydraulically connected and therefore not considered. Similarly, the Liffey Valley pNHA [000128] is located hydraulically upgradient and upstream of the Site and therefore not considered to be connected with the Site. The designated and protected sites with a potential hydraulic connection to the Site are summarised in Table 3-3.

Table 3-3: Designated and Protected Sites and Areas with a potential hydraulic connection to the Proposed Development Site

Site Code	Site Name	Distance from Proposed Development Site (km)
Special Areas of Conservation (SAC)		
000206	North Dublin Bay SAC	9.3
003000	Rockabill to Dalkey Island SAC	15.1
000210	South Dublin Bay SAC	6.8

Site Code	Site Name	Distance from Proposed Development Site (km)
Special Protection Areas (SPA)		
004006	North Bull Island SPA	9.3
004024	South Dublin Bay and River Tolka Estuary SPA	6.2
Natural Heritage Areas (NHA)		
There are no NHAs located with a potential hydraulic connection to the Proposed Development		
Proposed Natural Heritage Areas (pNHA)		
000206	North Dublin Bay	5.9
000201	Dolphins, Dublin Docks	7.9
000210	South Dublin Bay	6.8
001205	Booterstown Marsh	8.2

Figure 3-7: European Sites within 15km of the Proposed Development Site

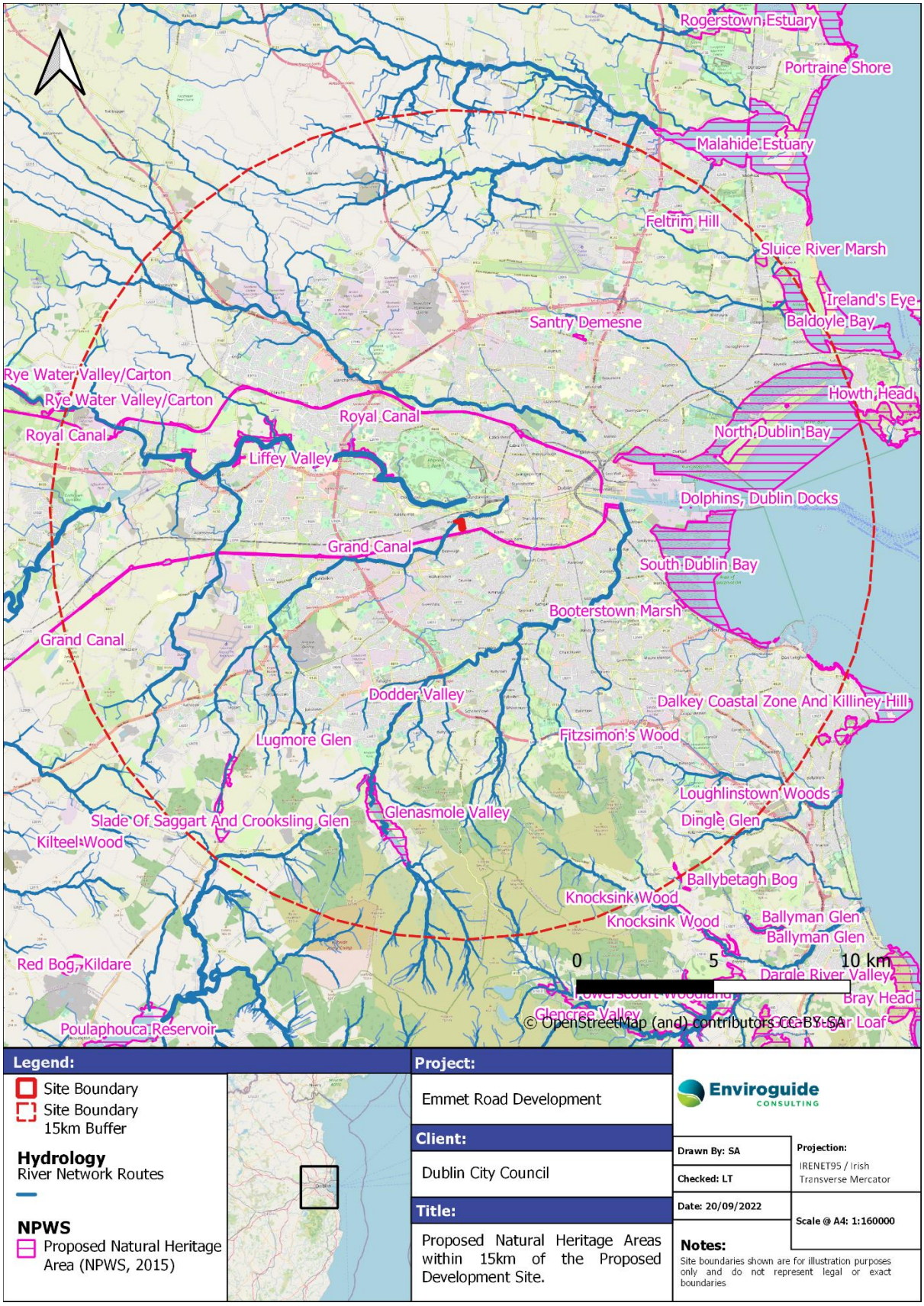

Figure 3-8: Proposed Natural Heritage Areas within 15km of the Proposed Development Site.

4 RISK ASSESSMENT

4.1 Risk Assessment Method

A risk-based and receptor-focussed approach was adopted for this assessment of any impact to the receiving hydrological and hydrogeological (water) environment associated with the Proposed Development. The basis for a risk assessment is the Conceptual Site Model (CSM) or Source-Pathway-Receptor (SPR) model which underpins the Directive 2000/60/EC (Water Framework Directive) amended by Directives 2008/105/EC, 2013/39/EU and 2014/101/EU that has been transposed to Irish legislation as European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003) as amended on which both surface water and groundwater regulations are based as well as EPA guidelines on the protection of water resources.

A risk assessment is undertaken to provide an understanding of the risk associated with the presence of any potentially contaminating materials and/or activities on a site. If one or more of the three elements of the pollutant linkages are missing, the exposure pathway is considered incomplete and there is no risk associated with the activity or contaminant source (i.e., it does not present a means of exposure).

The preliminary CSM was developed to describe potential source-pathway-receptor linkages for the Proposed Development.

In this assessment all three elements of the Source-Pathway-Receptor model or CSM will be considered, and any potential linkages evaluated and assessed to determine if the development could potentially impact, on any Natura 2000, NHA or pNHA sites in the absence of any design avoidance and mitigation measures.

4.2 Conceptual Site Model

A conceptual site model (CSM) represents the characteristics of the Proposed Development and identifies the possible relationships and potential risks between contaminant sources, pathways and receptors. These three essential elements of the CSM are described as:

- A **source** – a substance that is in, on or under the land and has the potential to cause harm or pollution;
- A **pathway** – a transport route or means by which a receptor can be exposed to, or affected by, a contaminant source; and,
- A **receptor** – in general terms, something that could be adversely affected by a contaminant, such as people, an ecological system, property, or a water body.

The term pollutant linkage is used to describe a particular combination of source–pathway–receptor. Each of these elements can exist independently, but they create a risk only where they are linked together so that a particular contaminant affects a particular receptor through a particular pathway (i.e., a pollutant linkage).

The conceptualisation of the Site model for this assessment includes identifying hydraulic pathways from the Site and those receptors which are connected hydraulically with the Site, in the absence of any avoidance and mitigation measures during the Construction and Operational Phases of the Proposed Development.

4.2.1 Potential Sources

4.2.1.1 Construction Phase

Potential sources of contamination that could impact on water quality will depend on the construction activities required for the Proposed Development. Based on the design of the development and knowledge of construction activities in the absence of mitigation measures being put in place, these potential sources include:

- Encountering localised areas of contaminated soil during groundworks and discharge of potentially contaminated water or leaching from soils;
- Discharge of suspended sediment or other potentially deleterious materials (e.g. fuels) entrained in surface runoff to receiving surface water;
- Use of concrete and cementitious materials during construction in particular for construction of below ground structures and foundations;
- Works encountering shallow groundwater during works including foundation works (piling, strip or other) could introduce potentially contaminating materials to groundwater including cementitious materials;
- Accidental release of hazardous or deleterious material including fuels, chemicals and materials being used or stored at the Proposed Development;
- Release of wash water from the wheel-wash could result in localised introduction of contaminants including hydrocarbons and suspended solids to the receiving water environment; and
- Release of foul water during connection to live sewers.

4.2.1.2 Operational Phase

There will be no significant sources of contamination at the Proposed Development. The design of the Proposed Development incorporates control measures to treat and control releases from the Site and are discussed in more detail in Section 0. The potential albeit worst-case source scenarios which are considered in the absence of control and mitigation measures during the Operational Phase are outlined below:

- Discharge of entrained contaminants in surface water runoff such as fuels or other potentially hazardous materials released in the event of an accidental spill or leak from a vehicle (assumed 500 litres) from roadways and paved areas; and
- Foul water discharge from the Proposed Development including drainage from undercroft carpark areas.

4.2.2 Pathways

The following potential pathways are identified and evaluated below:

- Infiltration to the subsurface including via potentially introduced conduits (piling, excavations, etc) and vertical/ lateral migration from ground via groundwater to:
    - the underlying aquifer and groundwater; and
    - surface water (Camac River and downstream Natura 2000, NHA and pNHA sites).

- During the Construction Phase there will be a pathway for surface water runoff discharged via the existing onsite drainage network to the receiving Camac River;
- During the Operational Phase there will be a pathway for surface water runoff from roofs, hardstanding and carparking areas discharged via the proposed surface water drainage network to the receiving Camac River; and
- Foul water during the Operational phase will also be discharged to the IW foul drainage network infrastructure and ultimately discharged to Dublin Bay via Ringsend WWTP.

4.2.3 Receptors

The receptors considered in this assessment include the following:

- Natura 2000 sites:
  - North Dublin Bay SAC;
  - Rockabill to Dalkey Island SAC;
  - South Dublin Bay SAC
  - North Bull Island SPA; and
  - South Dublin Bay and River Tolka Estuary SPA.
- Proposed Natural Heritage Areas:
  - North Dublin Bay pNHA;
  - Dolphins Dublin Docks pNHA;
  - South Dublin Bay pNHA; and
  - Booterstown pNHA.

4.3 Risk Evaluation

A risk-based assessment based on the CSM, and Source-Pathway-Receptor model of the potential risk linkages associated with the construction and operational phase of the Proposed Development was undertaken assuming the absence of mitigation and control measures. The results were evaluated to determine if the Proposed Development could potentially impact on receptors associated with the Site, including onsite and offsite.

Table 4-1: Conceptual Site Model (Source-Pathway-Receptor) and Risk Evaluator

Source	Pathway	Receptor	Risk Evaluation and Avoidance
Construction Phase			
Potential for release of contaminants to ground/groundwater during Construction Phase including: potentially contaminated soil/groundwater or release of deleterious materials (fuel,	Vertical and Lateral Groundwater Migration in Bedrock Aquifer	Downgradient Aquifer; Camac River; Dublin Bay; Natura 2000 sites; and Proposed Natural Heritage Areas	Low Risk (worst-case unmitigated scenario) In the absence of mitigation measures there is a potential low risk to groundwater quality within the aquifer beneath and immediately downgradient of the Site. There is limited potential for vertical migration from surface to the aquifer due to the presence of low permeability clays

Source	Pathway	Receptor	Risk Evaluation and Avoidance
cementitious materials)			above the aquifer. Any potential impact to groundwater will be localised as groundwater flow paths (and contaminant migration paths) are expected to be less than 1km (refer to section 3.10) and not to extend to Dublin Bay. Therefore, there will be no impact on the identified Natura 2000 sites and pNHA sites hydraulically connected with the Proposed Development Site including in the absence of avoidance and mitigation. Any potential localised risk to groundwater quality will be addressed and mitigated through standard construction management practices.
Potential for Release of Suspended Sediment or other Deleterious Materials in surface runoff	Existing Surface Water Drainage Network Proposed Drainage	Downgradient Aquifer; Camac River; Natura 2000 sites; and Proposed Natural Heritage Areas	Low Risk (worst-case unmitigated scenario) In the instance of a worst-case unmitigated release of deleterious materials or suspended sediment, there is potential for discharge of contaminants to the surface water network. Surface water within the receiving Camac River may be impacted locally in the immediate vicinity of the surface water drainage outfall from Site. Taking account of the potential for assimilation within the drainage network and the Camac River and River Liffey downstream of the surface water drainage outfall point, there is a negligible risk to water quality within the River Liffey and Liffey Estuary and Dublin Bay. There is no identified risk to the Natura 2000 and pNHA sites hydraulically connected with the Site in the absence of mitigation and design avoidance measures. Appropriate design avoidance and mitigation measures will prevent any potential impact to the receiving water quality.
Operational Phase			
Discharge of entrained contaminants in surface runoff (e.g. fuel spill in paved areas and roadways)	Proposed Surface Water Drainage Network	Camac River; Dublin Bay; Natura 2000 sites; and Proposed Natural Heritage Areas	Low Risk (worst-case unmitigated scenario) The unmitigated worst-case source scenario where the treatment and attenuation of surface water via the SuDS measures and Class 1 petrol interceptor incorporated in the design was not considered in the assessment. Low Risk (worst-case unmitigated scenario) In the instance of a worst-case unmitigated release of deleterious materials (fuel) or suspended sediment, there is potential for discharge of contaminants to the surface water

Source	Pathway	Receptor	Risk Evaluation and Avoidance
			network. Surface water within the receiving Camac River may be impacted locally in the vicinity of the surface water drainage outfall from Site. Taking account of the potential for assimilation within the drainage network and the Camac River and River Liffey downstream of the surface water drainage outfall point there is a negligible risk to water quality within the River Liffey and Liffey Estuary and Dublin Bay. There is no identified risk to the Natura 2000 and pNHA sites hydraulically connected with the Site in the absence of mitigation and design avoidance. Appropriate design avoidance and mitigation measures will prevent any potential impact to the receiving water quality.
Foul Water Discharge (e.g. fuel spill in undercroft carpark areas)	Discharge to the IW Foul Drainage Network Infrastructure and Ultimately Ringsend WWTP	Dublin Bay; Natura 2000 sites; and Proposed Natural Heritage Areas	Low Risk Foul water from the Site will ultimately discharge via the Ringsend WWTP to the Dublin Bay. Foul water from the Site will only be discharged to the IW network under the appropriate consents from IW. The foul water from the Proposed Development will ultimately be treated at Ringsend WWTP that operates under existing statutory consents. Furthermore, Irish Water have completed the first phase of upgrade works to Ringsend WWTP in December 2021, which increased the capacity of the facility by 400,000 P.E. These works, together with the further works will ultimately increase the capacity of the facility from 1.6 million PE to 2.4 million PE. This plant upgrade will result in an overall reduction in the final effluent discharge loading to the receiving waters. IW have confirmed that there is capacity within the foul network to accept foul water from the Proposed Development (OCSC, 2022a). There are no identified potential impacts to the receiving Natura 2000 sites and pNHA sites associated with the foul discharge from the Proposed Development Site.

The findings of the risk assessment and evaluation of potential impacts on the receiving Natura 2000 sites and pNHA sites are summarised as follows including the worst-case scenario which is assessed in the absence of any proposed avoidance or mitigation measures that are embedded in the design for the Proposed Development.

There is a potential low risk to the bedrock aquifer underlying the Site however, taking account of the hydrogeological setting, separation distance from the Site it is considered that in the absence of design avoidance and mitigation that there are no identified potential impacts on

the integrity receiving Natura 2000 and pNHA sites that are hydraulically connected to the Site.

Any potential impact to surface water quality in the absence of design avoidance and mitigation measures associated with surface water drainage network during the Construction and Operational Phases and will be limited to the Camac River. There is no identified impact to the downstream River Liffey, Liffey Estuary and Dublin Bay. There is no identified potential impact to the downstream receiving Natura 2000 and pNHA sites associated with the Proposed Development.

The embedded design and avoidance measures (Refer to Section 4.4) will prevent and limit any potential impact on water quality within the receiving river basin district associated with the Proposed Development.

4.4 Design Avoidance and Mitigation

The design avoidance measures and standard good practice construction methods that will prevent or limit any potential for impacts to the water environment together with additional specific measures required to address identified potential risks are outlined below.

4.4.1 Construction Phase

The construction works will be managed with consideration of applicable regulations and standard best international practice including but not limited to:

- CIRIA, (2001), Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors;
- Construction Industry Research and Information Association (CIRIA) Environmental Good Practice on Site (C650), 2005;
- BPGCS005, Oil Storage Guidelines;
- EPA (2004) IPC Guidance Note on Storage and Transfer of Materials for Scheduled Activities;
- CIRIA 697, The SUDS Manual, 2007;
- UK Pollution Prevention Guidelines (PPG) UK Environment Agency, 2004;
- Construction Industry Research and Information Association CIRIA C648: Control of water pollution from linear construction projects: Technical guidance (Murnane et al. 2006); and
- CIRIA C648: Control of water pollution from linear construction projects: Site guide (Murnane et al. 2006).

The CEMP that will be prepared in accordance with industry best practice standards including CIRIA - C532 by the appointed contractor, will outline measures for the control and treatment of water encountered during construction and a methodology where required for the treatment of water to ensure that there are no prior to discharge from the Proposed Development to protect water quality and associated ecological habitats and receptors. The measures will address the main activities of potential impact which include:

- Control and management of water and surface runoff;
- Control and management of groundwater during excavation and dewatering;
- Management and control of imported soil and aggregates from off-site sources;

- Fuel and Chemical handling, transport and storage; and
- Accidental release of contaminants.

There will be no uncontrolled discharges to ground (groundwater) or surface water.

Only soil and other materials identified as suitable for use in accordance with regulatory standards and that will not pose a risk to the receiving environment will be used during the Construction Phase.

Surface water runoff management will be implemented to prevent runoff entering excavations during construction and to the existing surface water drainage network. Surface water will require diversion around the open excavations using standard temporary drainage methods to ensure that surface water is effectively conveyed around works areas and with no impacts to the overall existing surface water flow regime.

All below (below ground) drainage infrastructure will be constructed in accordance with current IW requirements to ensure that there are no potential impacts to groundwater quality. Further review and verification of the existing site drainage will be carried out to confirm the location and alignment of the drainage and to ensure that all services are decommissioned prior to diverting and developing the proposed drainage for the Proposed Development (OCSC, 2022a).

If shallow groundwater is encountered during excavations, dewatering methodology to be implemented where required by the contractor and will ensure that any dewatering is confined to the localised zone and does not impact offsite receptors. Discharges from the Proposed Development will be in accordance with relevant statutory approvals from Irish Water for discharges to sewer and Dublin city Council for discharges to surface water.

4.4.2 Operational Phase

There will be no significant sources of contamination at the Proposed Development during the operational phase taking account of the following embedded design considerations:

- There will be no bulk storage of petroleum hydrocarbon-based fuels used during the Operational Phase, thereby removing any potential contaminant sources associated with fuels;
- Surface water runoff from the Proposed Development will be managed in accordance with the principles and objectives of SuDS and GDSDS and treated and attenuated prior to discharge from the Proposed Development to existing public surface water infrastructure;
- Surface water runoff from the undercroft car parking areas will be discharged to the to the existing foul sewer network located at St Michael's Estate to the east of the Proposed Development via class1 petrol interceptors;
- Foul water from the Proposed Development will be discharged to and treated through the existing foul sewer network before discharge to Dublin Bay; and
- Ongoing regular operational monitoring and maintenance of drainage and the SuDS measures in accordance with CIRIA SuDS Manual C753 will be incorporated into the overall management strategy for the Proposed Development.

6 CONCLUSIONS

Enviroguide Consulting undertook a hydrogeological assessment of the Proposed Development at Emmet Road, Dublin 8.

Based on the data made available to Enviroguide Consulting pertaining to the existing hydrological and hydrogeological conditions at the Site and the design for the Proposed Development, the following can be concluded:

- Surface water drainage at the Site will be from the Proposed Development. Surface water runoff will be managed in accordance with the principles and objectives of Sustainable Drainage Systems (SuDS) and the Greater Dublin Sustainable Drainage System (GDSDS) to treat and attenuate water prior to discharge from the site and ultimate discharge to the Camac River at a point located 0.2km north-west of the Proposed Development Site.
- Foul water will be discharged to mains foul network and Irish Water issued a Confirmation of Feasibility for the proposed connection. Foul water will ultimately discharge from the Ringsend WWTP following treatment. All foul drainage will be constructed in accordance with current standards thereby eliminating any onsite risk to water quality.
- Standard construction management measures and additional project specific measures that will be implemented by the contractor will minimise any potential impact to water quality associated with the construction works at the Proposed Development. Additional project specific mitigation measures required for the Construction Phase as outlined in Section 4.4 will take account of the proximity to the Camac River and will mitigation any potential impacts on receiving water quality.
- There is no identified risk or potential impact to the quality of the receiving environment associated with the Proposed Development in the absence of avoidance and mitigation measures that would result in a significant effect on any of the Natura 2000 and pNHA sites with a potential hydraulic connection to the Site.

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