10.0 WATER - HYDROLOGY

This chapter provides; a description of the project (in connection with hydrology, water and hydrogeology); the baseline hydrology and hydrogeology environments for the project site; and a statement of the likely significant impacts associated with both the construction and operation phases of the development. A 'do nothing' scenario has also been considered. Mitigation measures are proposed in the form of avoidance, prevention, reduction, offsetting, and reinstatement or remedial measures and recommendations for monitoring are included where appropriate. Predicted residual effects are described. Assessments for the site are detailed in this Chapter with relevant technical information includedin:

- A Site Specific Flood Risk Assessment (SSFRA)
- Engineering Service Report (ESR)

This chapter has been prepared by Mark Killian, Associate with O'Connor Sutton Cronin Consulting Engineers with over 14 years' experience (MSc, Chartered Engineer, CEng MIEI). Mark has been involved in the drainage design process for several large scale urban mixed-use developments, similar to the proposed development, such as:

- Belgard Gardens Phase 1, Tallaght (438 residential units, 403 units student accommodation, and 632m² retail);
- Lansdowne Place, Ballsbridge (215 residential units)
- Dublin Landings, Dublin Docklands (300 residential units, 70,000m² commercial, 1600m² retail).

The information contained within this chapter should be read in conjunction with the design drawings and suite of reports, which accompany this EIAR.

10.1 Proposed Development Description

A comprehensive description of the proposed development is presented in Chapter 3 of this EIAR. In summary, the development, which will have a Gross Floor Area of 49,342 sq m, will principally consist of: the demolition of the existing structures on site and the provision of a Build-to-Rent residential development comprising 564 No. apartments (46 No. studio apartments, 205 No. one bed apartments, 295 No. two bed apartments and 18 No. three bed apartments) in 6 No. blocks as follows: Block A (144 No. apartments); Block B (68 No. apartments); Block C (33 No. apartments); Block D (103 No. apartments); Block E (48 No. apartments); and Block F (168 No. apartments).

The development provides communal amenity spaces (1,095 sq m) in Blocks A and D including concierge, gymnasiums, working from home areas, lounges, games room and a panoramic function room at Roof Level of Block D; a creche (354 sq m); café (141 sq m); a pedestrian thoroughfare from Carmanhall Road to Blackthorn Drive also connecting into the boulevard at Rockbrook to the west; principal vehicular access off Carmanhall Road with servicing and bicycle access also provided off Blackthorn Drive; 285 No. car parking spaces (254 No. at basement level and 31 No. at ground level); 21 No. motorcycle spaces; set-down areas; bicycle parking; bin storage; boundary treatments; hard and soft landscaping; lighting; plant; ESB substations and switchrooms; sedum roofs; and all other associated site works above and below ground.

The site is currently an open yard in the northern and central section with an industrial/commercial building located in the southern section. The southern section is more elevated than the central and northern sections with a ramp located along the eastern boundary linking the areas. The site has a shallow fall from Carmanhall Road to Blackthorn Drive of approximately 4m.

10.2 Receiving Environment

The site is situated in the catchment of the Carysfort Maretimo stream in Dún Laoghaire and drains to the Dublin Bay which flows in a north easterly direction passing under Stillorgan and Blackrock to join the sea at Blackrock west of Dún Laoghaire Harbour West Pier Wall.

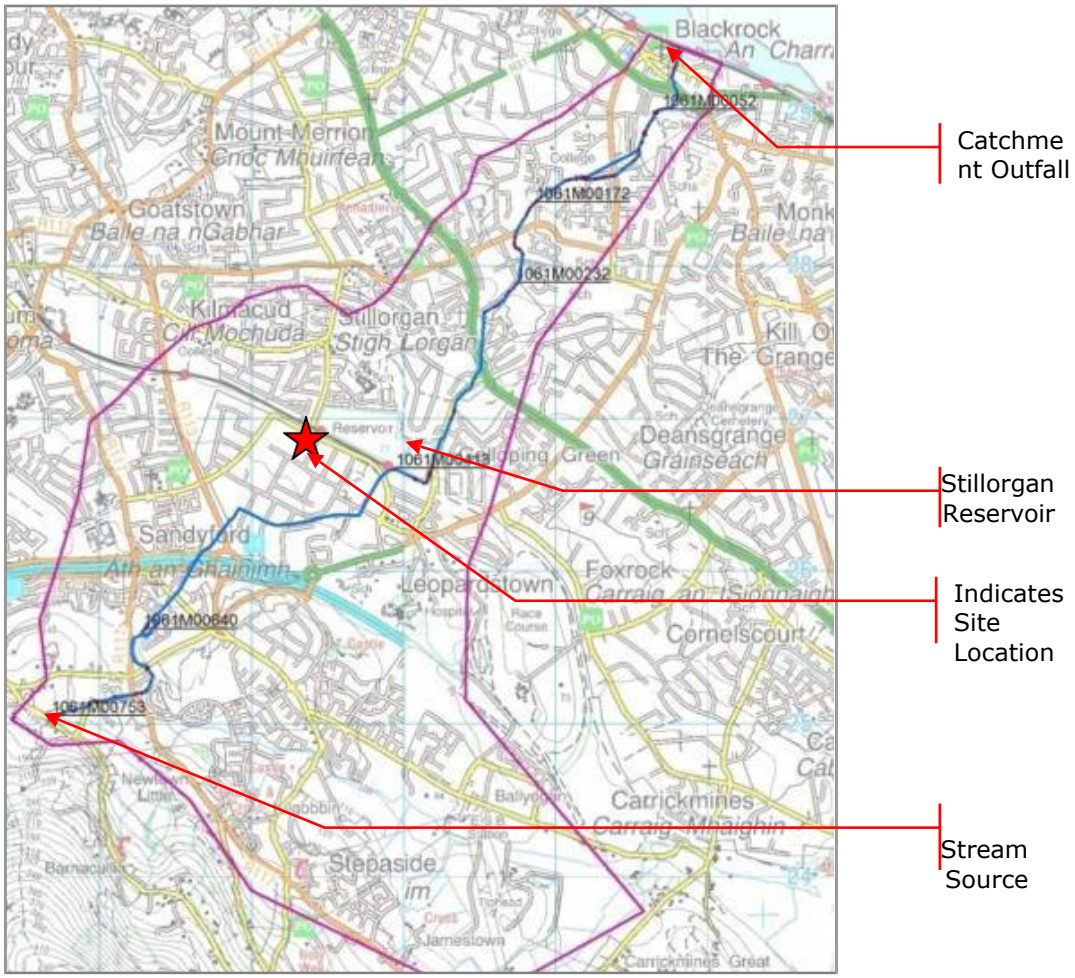

Figure 10.1: Site Catchment.

Source: CFRAMS.

A preliminary flood risk assessment was undertaken as part of the site selection process and concluded that the site lies within the Zone B flood risk area, which is an area with 0.1% Annual Exceedance Probability (less than 1 in 1000 chance in any year).

This section identifies the receiving waters, which could be impacted.

It should be noted that impacts on groundwater and hydrogeology has been assessed in detail in the land and soils chapter.

The site is within an extensively investigated and studied region of the country and a wealth of hydro-environmental data sources are available (see Figure 10.7 for an extract EPA Mapping). The hydrology of the Dublin region, including the properties and characteristics of the soil, subsoil and bedrock have been well studied and there are several resources including;

- Greater Dublin Strategic Drainage Study (2005);
- River Basin Management Plan 2009-2015 (2010) – ERBD Eastern River Basin District;
- Eastern River Basin Management Plan 2009-2015 – Coastal waters; Programme of measures; Summary Report (2010) - ERBD Eastern River Basin District;
- Eastern River Basin Management Plan 2009-2015 – Transitional water bodies; Programme of measures; Summary Report (2010) - ERBD Eastern River Basin District.

Additional sources of information include databases held by Geological Survey of Ireland (GSI), Environmental Protection Agency (EPA), Ordnance Survey of Ireland (OSI) and National Parks and Wildlife Service (NWPS). Existing services information was obtained from Irish Water records i.e. surface water sewer, water main and foul water sewer. Additional sources of information include mapping, site visits and records as noted in Section 10.1. A full list of references is included in Section 10.17.

10.2.1 Topography & Setting

The regional topography of Dublin City is generally flat being on a low lying coastal plain, and the flood plain of the River Liffey. The regional highpoints are the Dublin Mountains (elev. 540 meters above Ordnance Datum (mOD)) located circa 5.0km to the south of the city and the hills to the north-west (elev. 230mOD). To the west of the site the elevation increases gradually to merge with the midlands plain while to the east land within the city falls towards Dublin Bay and the Irish Sea. The topography of the inner city is dominated by the River Liffey which flows through the middle of the city centre.

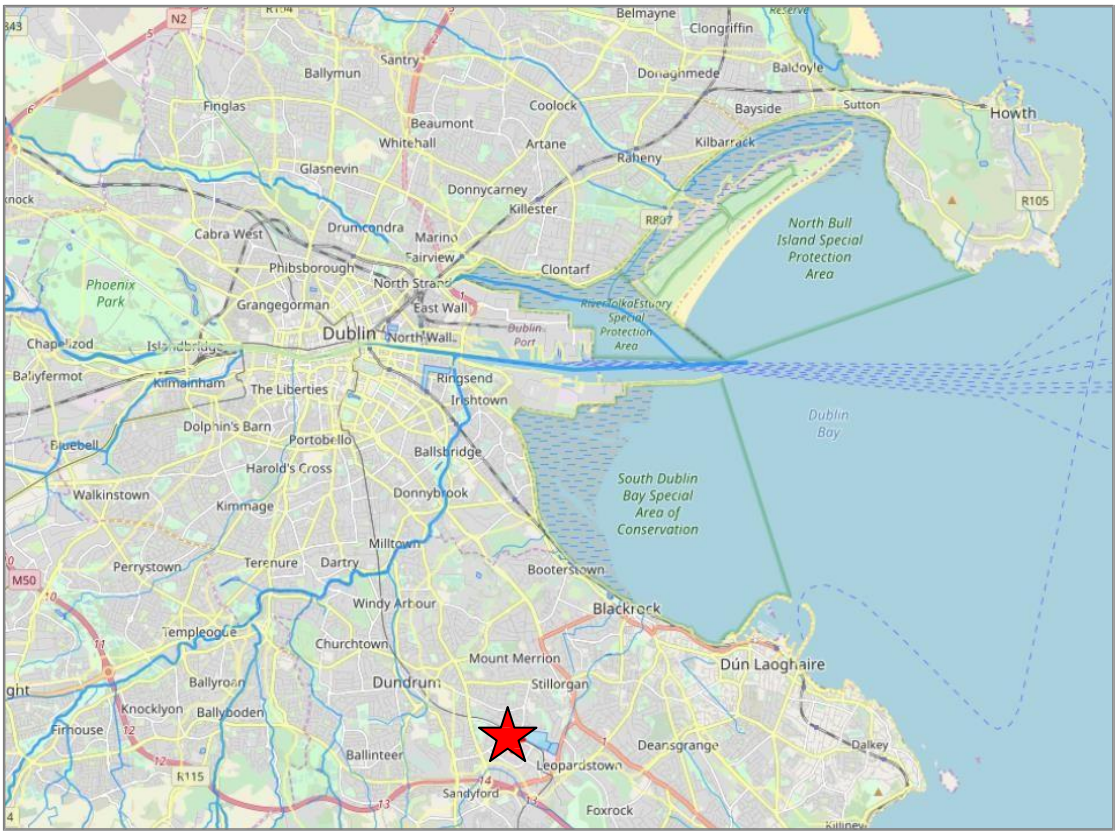

Figure 10.2: Site Location.

Source: EPA-Website.

The subject site comprises approximately 1.54 hectares. The site is bounded to the northwest by an existing apartment block and remaining vacant parcel of land forming part of the Rockbrook Development, to the north by Blackthorn Drive, to the east by commercial developments zoned for "mixed use inner core" and to the southwest by Carmanhall Road.

The site has a shallow fall from Carmanhall Road to Blackthorn Drive of approximately 4.0m. A detailed topographical survey has been carried out for the site and has informed the EIAR and design. The site topography is generally level with an existing concrete slab from a previous warehouse building at a level of approx. 81.3m.

As shown on Figure 10.3, the site's immediate surrounding area is mixed use in nature. The site is located on the junction of Saint Raphaela's Road and Blackthorn Drive in Sandyford, Dublin 18. The site is bounded to the west, south and east by mixed use, commercial and residential buildings, which form part of the Sandyford Business District. The site is bounded the north by Blackthorn Drive and the Luas Green Line and residential properties beyond. The Stillorgan Reservoir is located to the north east of the site beyond Blackthorn Drive. Refer to Figure 10.4 for an aerial photograph of the site.

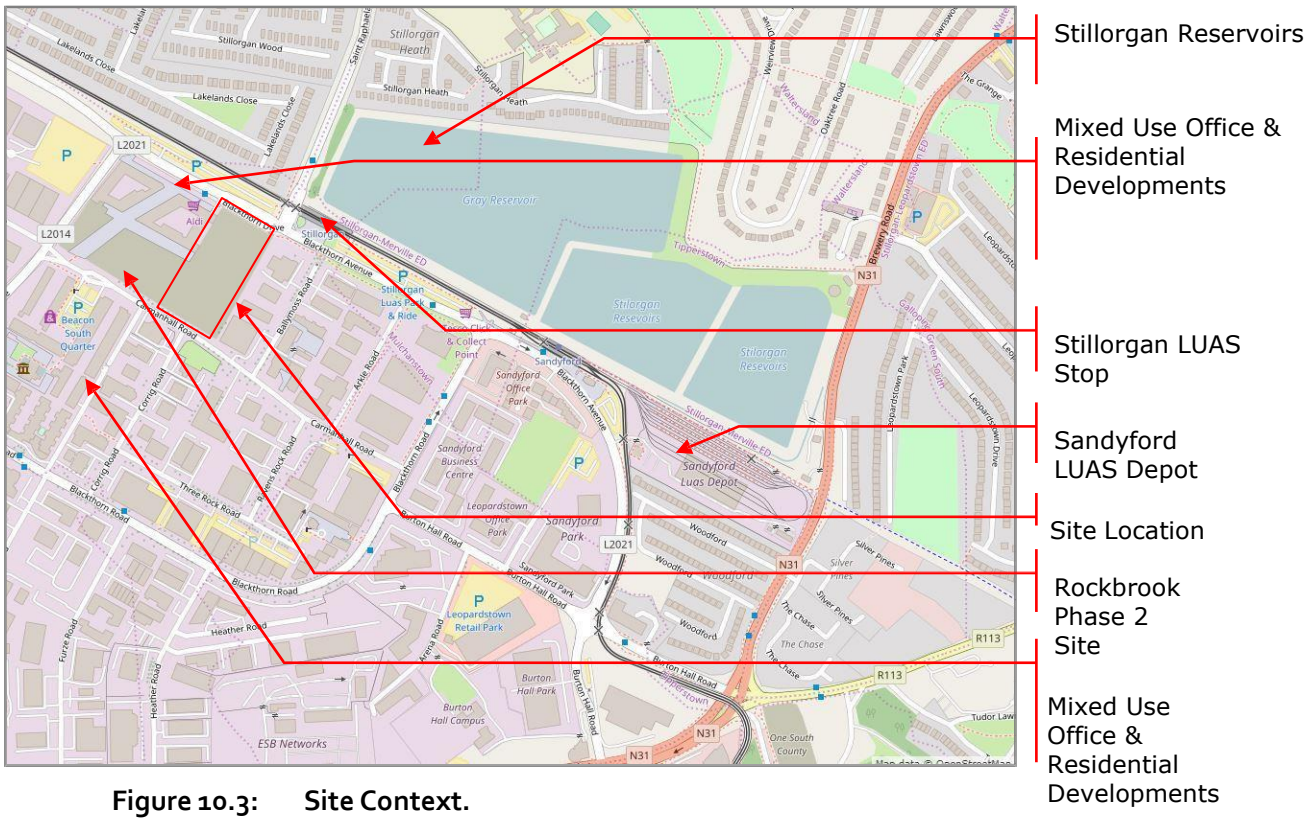

Figure 10.3: Site Context.

Source: Bing Maps.

The site is bounded to the west by Rockbrook Phase 1, a mixed use residential development including a retail unit, Aldi and the Rockbrook Phase 2 site. A Strategic Housing Development (SHD) application has recently been granted by An Bord Pleanála (Reg Ref ABP-304405-19) for Phase 2 of the Rockbrook Site.

Figure 10.4: Aerial Image of Site.

Source: Bing Maps.

10.2.2 Areas of Hydrological / Hydrogeological Interest & Historic Land-Use

Details of the site history and previous land use are included in Chapter 6 Archaeology and Cultural Heritage. Currently the site consists of a concrete slab associated with the former warehouse buildings. The assessment of site history through the years confirms the site had been primarily used as agricultural / pastures.

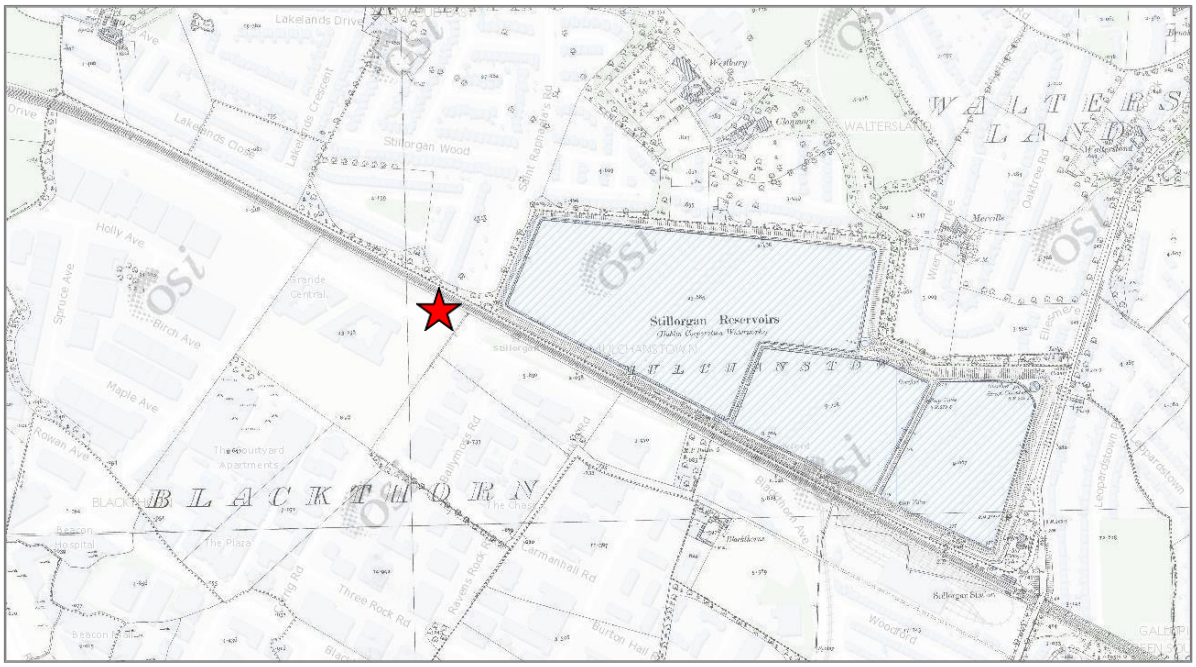

Figure 10.5: 6" historical map (1837-1842).

Source: Geohive-Website.

10.2.3 Regional Hydrology

Dublin City Drainage network is made up of local authorities that make up the Greater Dublin Area, which are:

- Dublin City Council, the lead Client Council;
- South Dublin County Council;
- Dún Laoghaire County Council;
- Fingal County Council;
- Kildare County Council;
- Meath County Council,
- Wicklow County Council.

The boundaries of the Study and the seven County Councils are shown in Figure 10.6. Storm water drainage systems are sparse in the established urban areas including the City Centre, Docklands and Dún Laoghaire, which are served by foul/combined or partially separate sewerage. Most storm water systems have been constructed as part of the separate systems serving post 1960's developments.

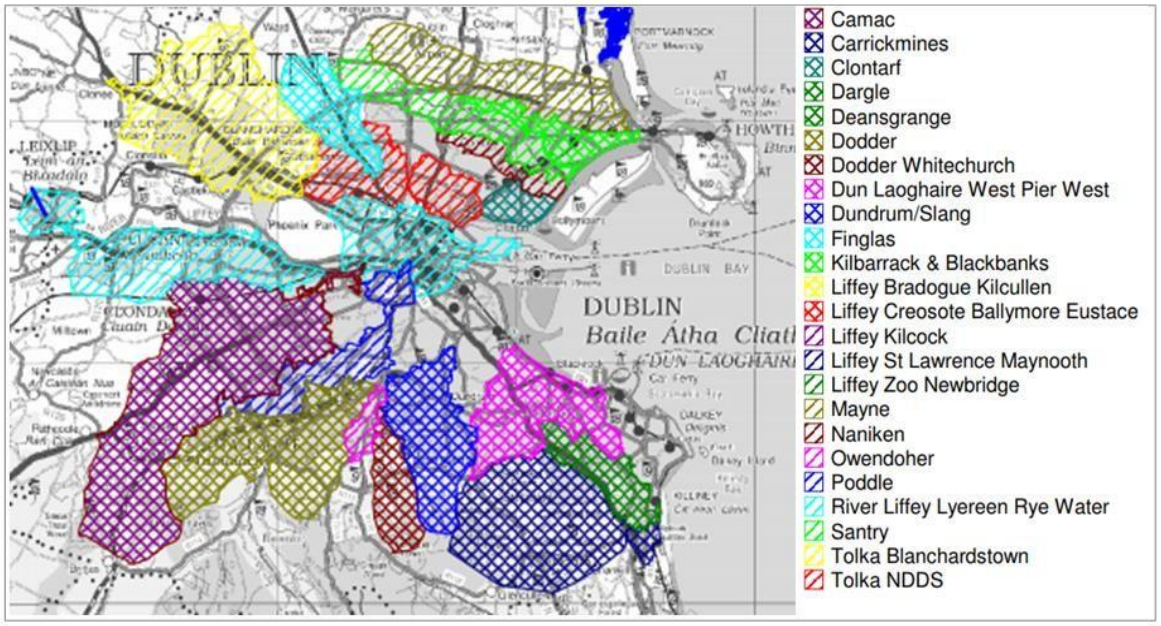

Figure 10.6: Dublin City Surface Water

Catchments. Source: GDSDS Website.

Dublin City and the greater region is split into 33 river and storm water catchments which discharge into the Irish Sea. Regional surface water bodies that are considered to be relevant to the Proposed Project include the River Liffey and The South Dublin Bay SAC and South Dublin Bay & Tolka Estuary SPA.

The River Liffey rises in the Wicklow Mountains, and flows for approximately 125km through counties Wicklow, Kildare and Dublin before entering the Irish Sea at its mouth at the mid-point of Dublin Bay. The Liffey enters the Bay approximately 2.0km from the subject site. There are a number of ESB hydroelectric power stations and reservoir facilities along the river including Poulaphouca in the Wicklow Mountains, Golden Falls and Leixlip in Kildare which regulate the river flow.

The Liffey is classified as a nutrient sensitive water body and is considered to be at high risk from diffuse pollution through groundwater and urban run-off and from point sources located within its catchment (ERBDA, 2005). According to EPA mapping, the River Liffey has Water Framework Directive (WFD) status of 'Good' (2010 – 2012). It has also been classified as being "at risk of not achieving good status in 2015". The South Dublin Bay SAC and South Dublin Bay & Tolka Estuary SPA covers an area between the River Liffey and Dún Laoghaire, and the estuary of the River Tolka to the north of the River Liffey.

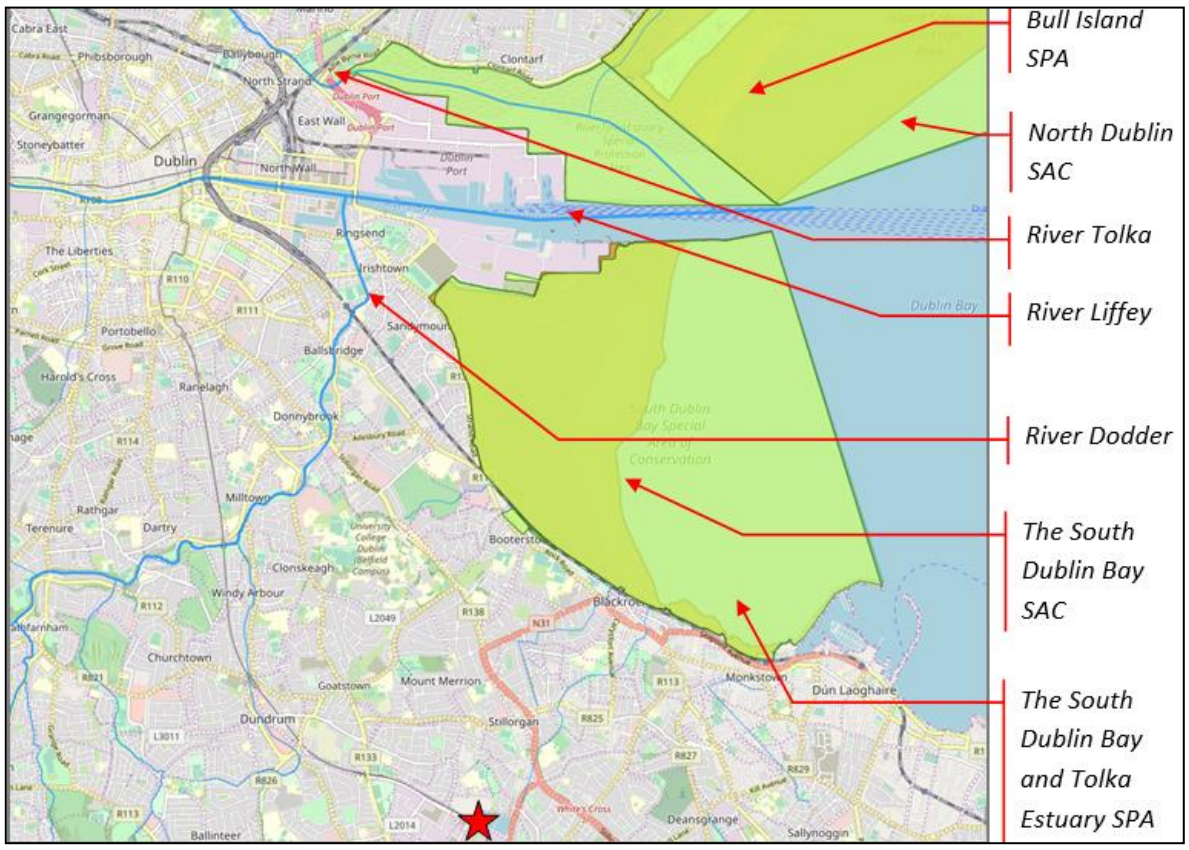

Figure 10.7: Regional Hydrological Features.

Source: EPA Mapping.

The South Dublin Bay SAC (site code: 0210) is predominately located at Sandymount Strand, as well as Booterstown Marsh and is designated for a range of coastal habitats including mudflats and sandflats not covered by seawater at low tide. There is a bird sanctuary in Booterstown adjacent to the DART station, which is designated as a Natural Heritage Area (NHA). This is an area of high national and international significance.

The South Dublin Bay and Tolka Estuary SPA (side code: 4024) are located 2.0Km to the north east of the site, it is designated both as a Special Area of Conservation (SAC) and a Special Protection Area (SPA). The features of interest of the South Dublin Bay SAC include mudflats, sandflats and shifting Dúnes (NPWS, 2015). Wintering birds in particular are attracted to these areas and it is the aim of the SPA conservation objectives preserve these natural habitats for a number of species (NPWS, 2015).

Figure 10.8: Site Proximity to SPA/SAC.

Source: Geohive Mapping.

The water quality of the Bay has been classified as moderate under the WFD for the 2010-15 reporting period. This classification indicates that water quality in the estuary is of an insufficient standard to meet the requirements of the WFD. The largest contributory factor is identified as wastewater. Physical modifications and dangerous substances (physico- chemical) such as run-off are also identified as pressures on the system.

10.2.4 Regional Hydrogeology

The primary Groundwater Body (GWB) in the region is the Dublin Urban GWB. The Dublin Urban GWB covers 837km² and includes most of Dublin City to the eastern seaboard and extends west to include parts of Kildare and Meath. In addition to the Carboniferous limestones and shales, there are also some sandstones present. The bedrock aquifer is a fracture system i.e. it is dominated by secondary (fracture or fissure) flow with very little to no flow within the matrix i.e. the bedrock is largely impermeable. The limestone aquifer has low storage capacity in the order of 1 – 2%. The Dublin Urban GWB comprises:

- Ll: Locally important aquifer, moderately productive only in local zones, and;
- Pl: Poor aquifer, generally unproductive except for local zones.

The site is separated from the northern limestones along the Donnybrook-Tallaght syncline. In the south of the GWD we find till derived from Granite (Northern and Upper Liffey Valley Plutons) and Lower Paleozoic rocks in the Dublin Mountains. The Granite (Igneous Intrusive rocks - Pale grey fine to coarse-grained granite) in the vicinity of the site is classified by the GSI as a Poor aquifer (Pl), generally unproductive except for local zones. In general, permeability is poor below 1-10m²/day (Creighton et al). Between the coast and the site there are deposits of Irish Sea Till, which is the least permeable of the subsoils.

In general, fracture flow dominates and there is a distinct reduction in permeability with depth. Packer tests show permeabilities reduce an order of magnitude for each five metres of depth in the limestone (Aspinwall & Company, 1979). The majority of flow is in the upper weathered bedrock and is common within fractures and fissures at depths of up to 50metres below ground level (mBGL). Regional groundwater flow is towards Dublin Bay and the Irish Sea to the east.

Groundwater Vulnerability

Vulnerability mapping of the study area have been published by the GSI and ranges from extreme to low. Vulnerability ratings are related to a function of overburden thickness and permeability which might offer a degree of protection and / or attenuation to the underlying aquifer from surface activities and pollution. A rating of extreme indicates a very thin overburden depth or highly permeable strata such as gravels. A rating of low indicates a thick overburden depth (<10m) of low permeability strata such as clay or glacial till.

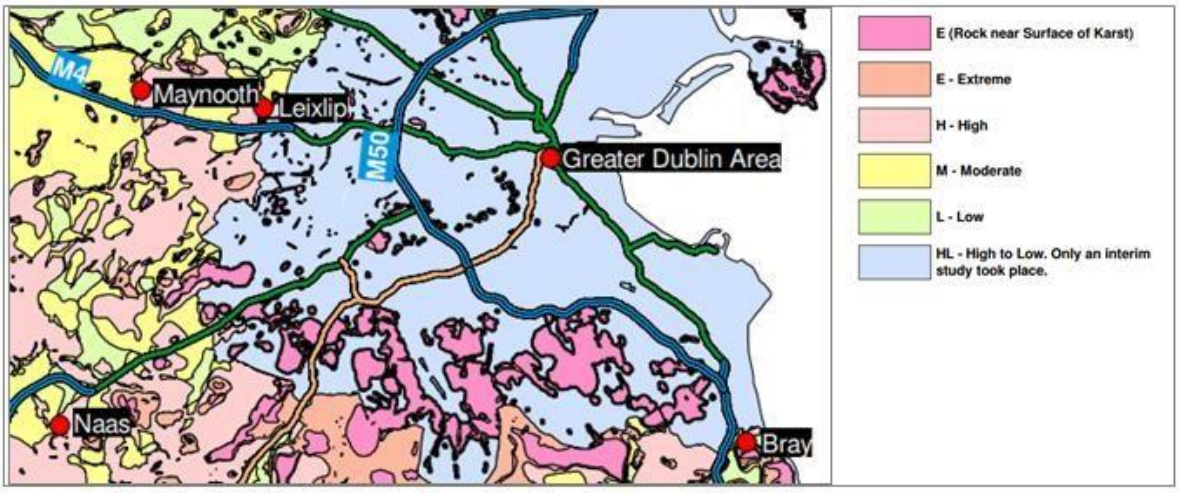

Figure 10.9: Regional Groundwater Vulnerability.

Source: GIS Website.

Groundwater Status

An assessment carried out under the Water Framework Directive has concluded that the groundwater within the Dublin Urban GWB is presently of "Good status". The objective to the end of 2015 is to protect the "Good status" by recognising that the quality of the groundwater in the Dublin Urban GWB is at risk due to point and diffuse sources of pollution which are normally found in an urban environment such as contaminated land and leaking sewer networks.

Groundwater Recharge

Dublin City is a highly urbanised area. The ground is generally made up of a cement and tarmacked impermeable cap which limits recharge to the bedrock. The only open areas where recharge may occur are at parks and gardens. It is conservatively estimated that 10% of the city area is available for recharge. Some recharge occurs from leaking sewers, mains and storm drains. Elsewhere diffuse recharge will occur via rainfall percolating through the subsoil. The proportion of the effective rainfall that recharges the aquifer is largely determined by the thickness and permeability of the soil and subsoil, and by the slope. Due to the generally low permeability of the aquifers within the Dublin Urban GWB, a high proportion of the recharge will run off and discharge rapidly to surface watercourses via the upper layers of the aquifer, effectively reducing further the available groundwater recharge to the aquifer.

Based on the GSI website the effective rainfall in the vicinity of the site is 83mm/year. Recharge to the aquifer can only occur where rainfall can percolate through any subsoil to the aquifer. However, given the thickness of low permeability boulder clay, any water which percolates through the subsoil is likely to be perched on the significant thickness of Dublin Boulder Clay and consequently it is likely that recharge to the Northern and Upper Liffey Valley Plutons is minimal to insignificant in the area of the site. The GSI have designated that the recharge coefficient in the immediate area of the site as 20%. Based on the GSI's Recharge Model the total recharge would be equivalent to approximately 100mm/year.

Groundwater Abstractions

There is one recorded well on the GSI database which is located c. 1.8km east of the site (see Figure 10.10). This groundwater monitoring well is associated with a commercial site. There are no recorded groundwater abstractions / users within the study area and the there are no source protection zones mapped in the area.

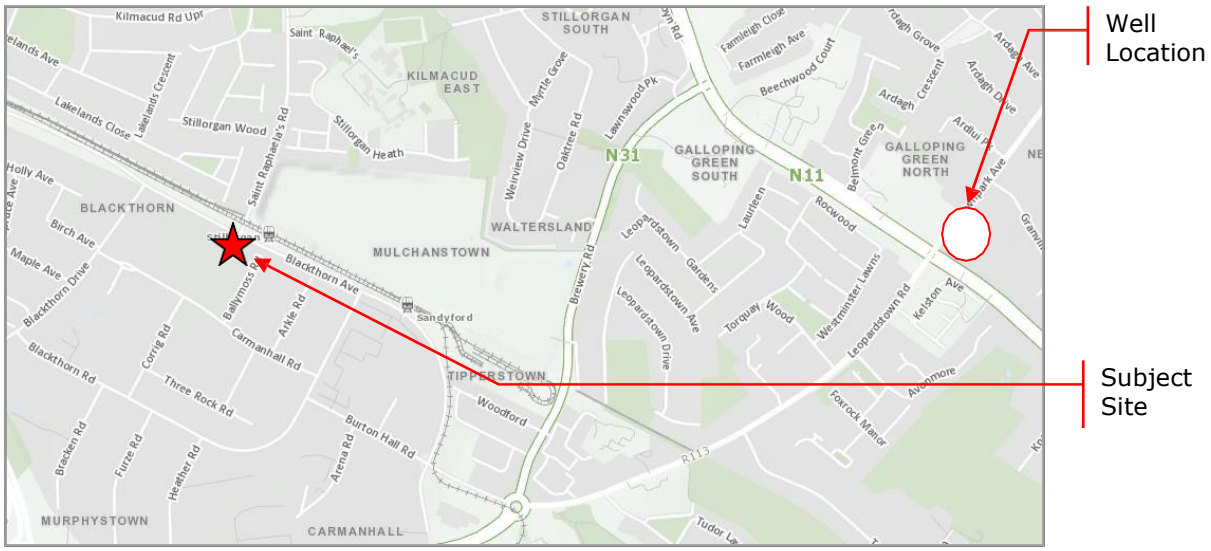

Figure 10.10: Recorded Groundwater Abstractions.

Source: GIS Website.

All groundwater users in the vicinity are serviced by the mains water supply and the proposed development will also rely on mains water.

Groundwater Dependent Terrestrial Ecosystems

Groundwater dependent terrestrial ecosystems (GWDTE's) are those ecosystems which are dependent on the groundwater either partially or completely for survival. They are designated for protection under Article 1 of Water Framework Directive. The closest GWDTE is the Booterstown Marsh (1206) and is part of the South Dublin Bay SAC (site code: 0210) which is located c.2.0km north east of the site.

10.2.5 Describing Baseline Information

Local Hydrology

The site is located within the Dún Laoghaire Rathdown County Council local authority. Dún Laoghaire Rathdown County Council is responsible for the operation and maintenance of both surface water sewer networks within the county. This flows in a south and northern direction through Sandyford, Stillorgan, and Blackrock before discharging to Dublin Bay at Blackrock east of Dún Laoghaire West Pier Wall.

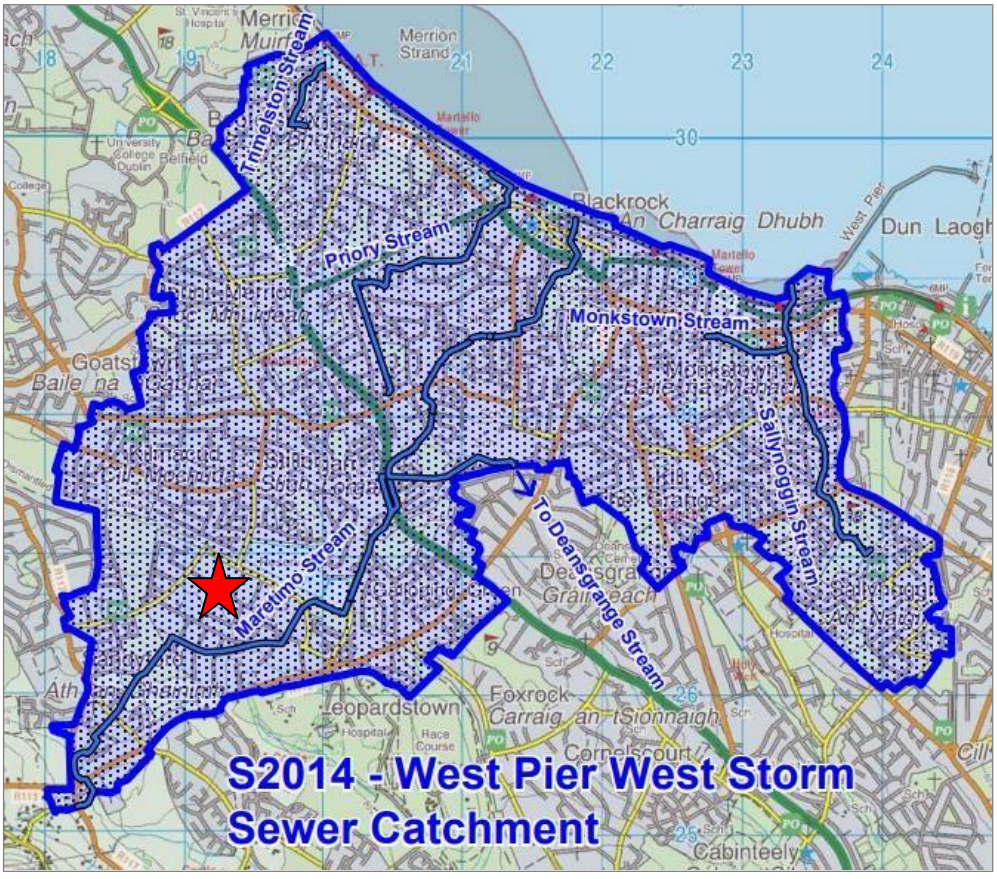

Figure 10.11: Storm Water Catchment / Maretimo Stream Route.

Source: GDSDS Mapping.

The existing site is brownfield covered with 100% hardstanding, surface water currently drains to the existing site drainage via 300mm surface water pipe before discharging the site to the 900mm public surface water sewer on Blackthorn Drive. This sewer drains to Carysfort Maretimo stream, which is located approx. 880m east of the site at Brewery Road before traveling north towards Blackrock. The Carysfort Maretimo stream flows in a south and northern direction through Sandyford, Stillorgan, and Blackrock before discharging to Dublin Bay at Blackrock east of Dún Laoghaire West Pier Wall. The site location related to the Carysfort Maretimo stream is shown in Figure 10.11.

The Carysfort Maretimo Stream is a highly modified High Priority Watercourses (HPWs) urban watercourse. High priority watercourses (HPWs) are urban areas which are subject to fluvial flood risk, coastal flood risk or both Information as designated by Eastern Catchment Flood Risk Assessment Mapping (CFRAM). Information available from the EPA suggests that the Carysfort Maretimo stream is "at risk of not achieving good water status" in terms of the WFD. The water quality within the designated water courses will be particularly affected by the quantity and quality of surface water run-off from the adjacent lands.

South Dublin Bay is part of the Eastern River Basin District (ERBD, 2010a). The water quality of the Bay has been classified as moderate under the Water Framework Directive for the 2010-15 reporting period. This classification indicates that water quality in the estuary is of an insufficient standard to meet the requirements of the WFD. The largest contributory factor is identified as wastewater. Physical modifications and dangerous substances (physico-chemical) such as run-off are also identified as pressures on the system.

The existing surface water sewer serving the site is the 300mm diameter sewer which connects to the existing 900mm public surface water sewer located along Blackthorn Drive.

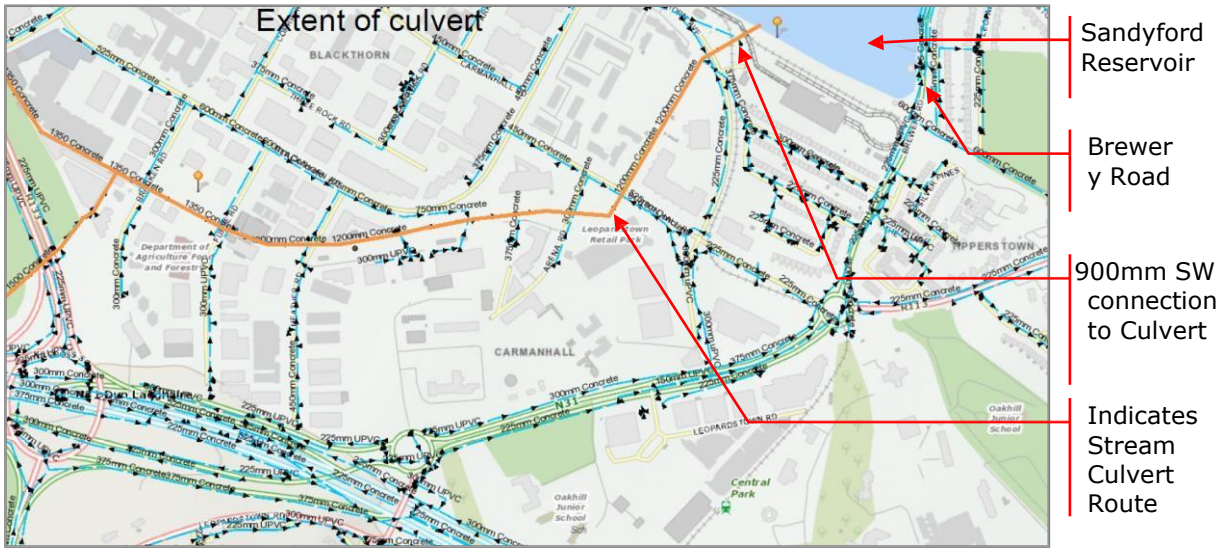

Figure 10.12: Extent of Culvert Route through Sandyford Industrial Estate.

Source: Irish Water Record.

There are flooding issues in the surrounding area for the 01.% AEP event, flooding can be seen to affect roads such as Blackthorn Drive, Corrig Road and other parts of Carnmanhall Road close to the site. In summary, this flooding relates to the surcharging of the drainage network as a result of inundation of overland flows upstream from the culverted Crayfort Martimo Stream. The Eastern CFRAMs Study HA09 Hydraulic Report describes this flooding as "low level flooding with depths of 100mm or less, as such it is unlikely that properties will be inundated". Flooding is discussed in more detail in the Site Specific Flood Risk Assessment (SSFRA). All surface water from the proposed development will discharge to the public surface water sewer which ultimately discharges to the South Dublin Bay via the Carysfort Maretimo stream.

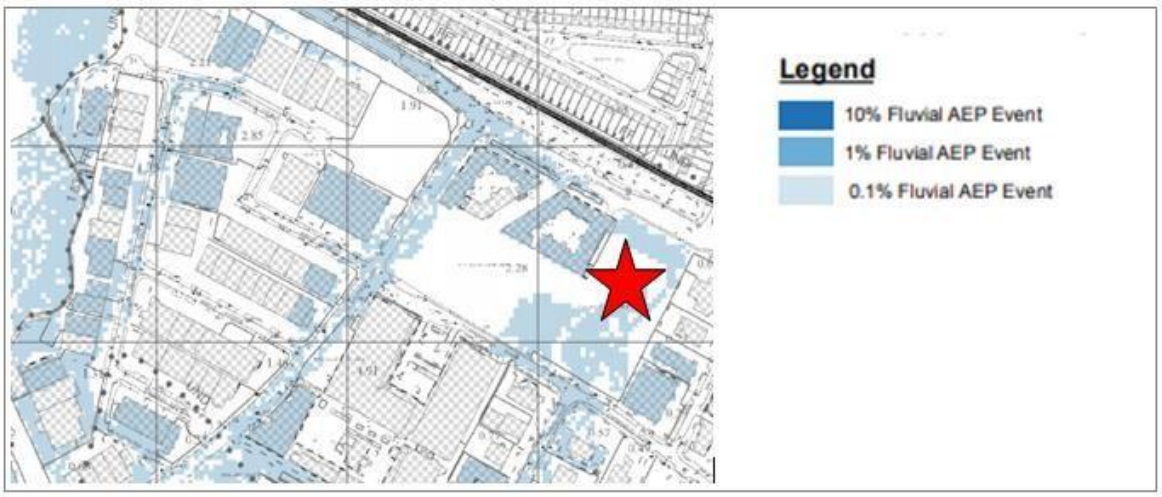

Figure 10.13: Site Flooding.

Source: Floodinfo.ie.

Local Hydrogeology

The bedrock aquifer was not encountered during the site investigations with depth to rock being greater than 10.6mBGL. There was no groundwater encountered during investigations. The GII site investigation records for the site, also indicate that the natural soils on site are generally cohesive deposits (clay), described as firm to stiff brown, grey or dark grey sandy gravelly CLAY with occasional cobbles and boulders. Gravel lenses were occasionally present in the glacial till throughout the site.

Standpipes were installed in a number of the boreholes (5 no.) and water levels were measured during February and March 2019. These installations were used to allow the equilibrium groundwater levels and measured water levels ranged from 0.7mBGL to 3.65mBGL.

The Geological Survey of Ireland (GSI) Groundwater Data Viewer indicates that the Bedrock Aquifer is poor i.e. Bedrock is Generally Unproductive except for local Zones.

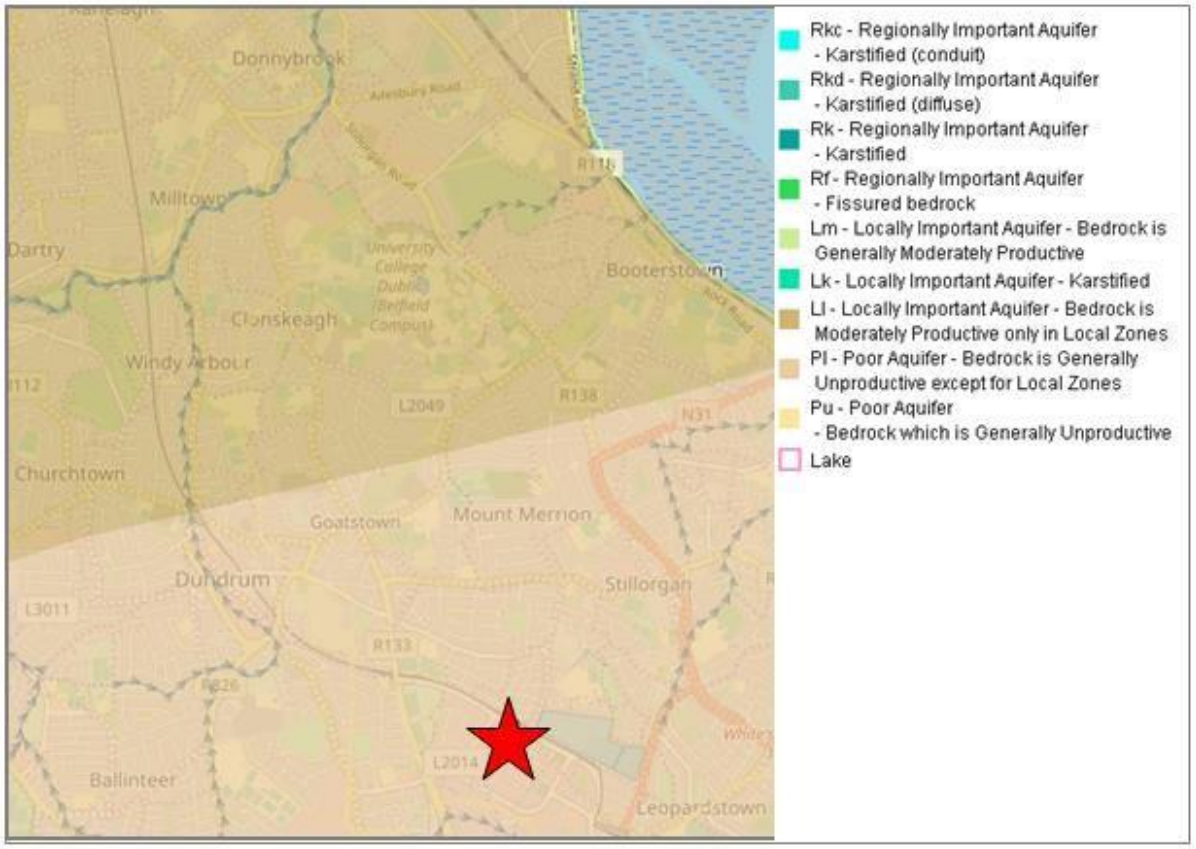

Figure 10.14: GSI Bedrock Aquifer.

Source: EPA Mapping.

The Geological Survey of Ireland (GSI) Groundwater Data Viewer indicates that the Groundwater Vulnerability is classified as moderate.

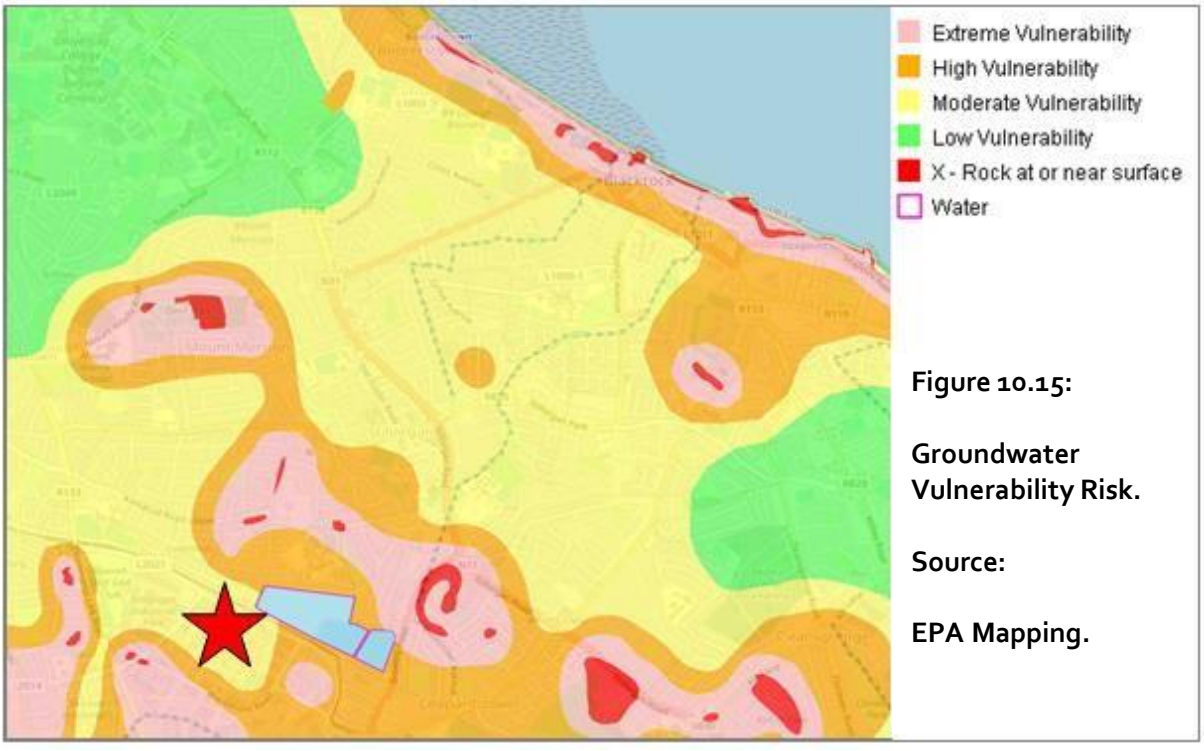

Figure 10.15:

Groundwater Vulnerability Risk.

Source:

EPA Mapping.

10.3 Potential Impacts

There are a number of elements associated with both the construction and operation of the proposed development which have the potential to impact on the environment with respect to hydrology and hydrogeology. The activities associated with the project which have the potential for impact are detailed in Table 10.1.

Phase	Activity	Description
Construction	Discharge to Ground	Run-off percolating to ground at the construction site.
	Earthworks: Excavation of Superficial Deposits	Minor removal of material to allow formation of subsurface structures including a basement and associated services. Volume of fill likely required. Excavated and stripped soil can be disturbed by site vehicles during the construction.
	Storage & Disposal of Hazardous Material	Fuel and chemical storage during construction phase.
	Import/Export of Materials	A degree of fill will be required during the works which will include the importation of engineering fill, concrete and aggregate. As topsoil is unsuitable for engineering fill, the majority will be exported for reuse offsite. All surplus subsoil will also be exported for reuse off site where a suitable reuse site can be identified. Soil reuse will be subject to the requirements under the Waste Management Act (e.g. Article 27 or 28). Where material cannot be reused it will be recovered or disposed of in accordance with the Waste Hierarchy and Waste Management Act. Aggregates will be required for subbase under roads, drainage and buildings. All subbase materials must meet the relevant engineering specification. The use of recycled or secondary aggregates should be considered as a replacement for primary aggregates.
	Foul Sewer & Surface Water Outfall Connections	Proposed new connections for the discharge of foul and surface water drainage.
	Surface Water & Ground Water Management	Dewatering may be required to excavate the basement and to maintain dry working conditions in the excavation (for rainfall only). Pumped water will require discharge offsite.
Construction	Construction of sub-surface structures	Construction of the single storey basement within the superficial deposits to an elevation of c.81.0mOD. As this will be founded entirely within the Boulder Clay there will be no impediment to groundwater flow which is within the bedrock.

- There will be some small source of potential contamination present on site during the construction phase (e.g. machinery oils, fuel, cement etc.);
- Run-off from construction sites can contain minor levels of pollutants (e.g. mineral oils) and high concentrations of suspended solids;
- If it is required to lower the water table it could have a negative impact on nearby buildings, as the water table is lowered as the absence of water will crated a void space and the soil particles will compress against each other to fill the void and hence settlement occurs;
- There will be no significant sources of potential contamination present on site during the operational phase of the development.

Receptors

- The bedrock aquifer constitutes a potential receptor;
- The surrounding surface water bodies constitute a receptor;
- The surrounding land, soils and geology constitute a receptor.

Pathways

- Migration of contaminants from surface spills to land, soils, geology, groundwater or surface water constitutes a potential pathway;
- Migration of contaminated run-off (e.g. during construction phase or operational phase) to groundwater, surface water or surrounding geology constitutes a potential pathway.

Potential Pollutant Linkages

An environmental risk is only present when a pathway links a source with a receptor. The potential pollutant linkage CSM is summarised in Table 10.2:

Source	Pathway	Receptor	Potential Pollutant Linkage (Y/N)	Discussion
Deleterious materials stored on site during construction	Migration of surface spills/ contaminated run-off	Surrounding Land/Soils or Groundwater in the bedrock aquifer	N	All materials stored on site will be subject to strict control measures and local containment measures (e.g. bunded tanks and pallets). The bedrock aquifer will be protected by the thick depth of clay which is in place and will remain in place post construction.

Source	Pathway	Receptor	Potential Pollutant Linkage (Y/N)	Discussion
Contaminated run-off from construction activities			N	Generation of contaminated run-off will be reduced through the Construction Management Plan and control measures implemented during the construction phase. The bedrock aquifer will be protected by the thick depth of clay which is in place and will remain in place post construction including beneath the single level basement.
Deleterious materials stored on site during construction	Migration of surface spills/ contaminated run-off	Potential surface watercourses	N	All materials stored on site will be subject to strict control measures and local containment measures (e.g. bunded tanks and pallets. Appropriate set back and protection measures to be implemented to ensure no direct discharge to river except where regulated under a Discharge Licence from the Regulating Authority.
Contaminated run-off from construction activities			N	Generation of contaminated run-off will be reduced through the Construction Management Plan and control measures implemented during the construction phase. Appropriate set back and protection measures to be implemented to ensure no direct discharge to

Source	Pathway	Receptor	Potential Pollutant Linkage (Y/N)	Discussion
				river except where regulated under a Discharge Licence from the Regulating Authority.
Illegal disposal of chemicals and oil Cleaning activities Leaks and spillages (eg from vehicles) Litter/animal faeces Vegetation/ landscape maintenance Soil erosion De-icing activities Vehicle Deposit Exhausts & Pollutants	Migration of Deleterious materials/contaminated run-off	Surrounding Land/Soils or Groundwater in the bedrock aquifer. Potential surface watercourses	N	The drainage system for this development will contain a range of SuDs treatment methods for surface water including green roofs, permeable paving, biorention, swales, filter drains and treatment via open graded crush rock (OGCR) below all SUDs measures preventing materials/contaminants discharging the site. A Petrol Interceptor will remove contaminants (oils and sediments) from surface water runoff from the carpark prior to discharge from site.

Table 10.2: Conceptual Site Model Pollutant Linkages Watercourses and Groundwater

The mitigation measures set out in Table 10.2 are discussed in further detail in later sections.

10.4 Data and Survey

The data necessary to carry out the assessment will comprise:

- A Site Specific Flood Risk Assessment (SSFRA) and Engineering Service Report (ESR) have been completed and are included as standalone reports with this submission. The SSFRA and ESR have contributed to the contents of the EIAR, and the assessment below.
- Existing services information was obtained from Irish Water records i.e. surface water sewer, Irish, water main and foul water sewer, the Geological Survey of Ireland, the Environmental Protection Agency and the Office of Public Works.
- Information provided from Site Investigations by Ground Investigations Ireland (GII).
- A topographical survey of the site was commissioned and supplied by the client (Sandyford GP Limited) in order to assist in the determination of existing topography for the site.
- Information on the surface water course running to the south of the subject lands was assembled from site inspections, 'Greater Dublin Strategic Drainage Study' (GDSDS) Data and topographical survey information.
- Information on the hydrogeology of the site was assembled from geological survey maps and GSI database information.
- Information for the unmitigated predicted surface water quality and mitigated surface water for SuDS systems from the proposed development has been obtained from the Construction Industry Research and Information Association's publication CIRIA C753-SuDS Manual (2015).
- These objectives were achieved by way of a desk study and baseline data collection. A list of sources for the desk study together with relevant legislation are included below.

The source of knowledge will be based on the following guidelines:

- Dún Laoghaire-Rathdown Council Local Authority Requirements (with liaison with technical departments);
- BS EN 752 – Drainage Outside Buildings;
- The Building Regulations – Technical Guidance Document Part 'H';
- Recommendations for Site Development works for housing Areas, Dept. of Environment, 1998;
- Greater Dublin Strategic Drainage Study (GDSDS);
- BS EN 12056-2:2000 Gravity drainage systems inside buildings;
- The SuDS Manual (Ciria C753);
- EPA Wastewater Treatment Manual, For Small Communities;
- Irish Water Code of Practice for Water Infrastructure;
- Irish Water Code of Practice for Wastewater Infrastructure.

Additional information has been compiled through consultation and feedback from stakeholders and the project / EIAR Team and from the following sources:

- Geological Survey of Ireland (GSI);
- Environmental Protection Agency (EPA);
- Site Investigation Report completed by GII Ltd.;
- Site Visit completed by OCSC;

- Geological Survey of Ireland (GSI) online maps and databases;
- ECFRAMS Flood Mapping from OPW;
- EPA online maps and databases;
- River Basin Management Plan 2009-2015 (2010) – ERBD Eastern River Basin District;
- Eastern River Basin Management Plan 2009-2015 – Coastal waters; Programme of measures; Summary Report (2010) - ERBD Eastern River Basin District;
- Eastern River Basin Management Plan 2009-2015 – Transitional water bodies; Programme of measures; Summary Report (2010) - ERBD Eastern River Basin District;
- Ordnance Survey of Ireland (OSI) and National Parks;
- Wildlife Service (NWPS)
- Correspondence and meetings with Dún Laoghaire-Rathdown Council.

10.5 Assessment Methodology

10.5.1 Approach

The assessment followed a phased approach as outlined in Chapter 4.4 of the Advice Note (EPA, 2015). A Conceptual Site Model (CSM) was developed in order to identify any likely Source-Pathway-Receptor linkages relating to the site and the proposed development. The phases of assessment are outlined below.

Phase 1: Initial Assessment

An initial assessment was carried out which; defined the project in terms of location, type and scale; established the baseline conditions; established the type of hydrology environment; established the activities associated with the project and; initial assessment and impact determination.

The information sources were utilised to establish the baseline conditions for the site and all available information was compiled into a preliminary Conceptual Site Model (CSM). The CSM is based on the accepted Source-Pathway-Receptor model for assessing environmental impacts. The CSM went through iterative reviews and was updated with site specific data obtained through site investigations and studies.

Phase 2: Direct and Indirect Site Investigations and Studies

A site investigation was carried out on site during February and March 2019. The work was undertaken, scoped and specified by an Environmental Geologist in line with the IGI Guidelines. Works were carried out relevant to hydrology by Ground Investigations Ireland Ltd. (GII) and consisted of the following work:

- Installation of 6 No. groundwater monitoring wells;
- Measurement of groundwater levels;
- Soakaway / Infiltration Tests;
- Assessment of the soil chemistry results with respect to potentially hazardous properties (HazWasteOnline Assessment);
- Assessment of the soil chemistry results with respect to the potential risk properties associated with landfilling of the material (Waste Acceptance Criteria assessment).

The site investigation is attached in Appendix 9.1 of Chapter 9 – Land and Soils.

Phase 2: Refinement of the Conceptual Site Model

Throughout the detailed site investigations and studies the CSM was continually updated, tested and refined with new site specific information. The outcome of this refinement is presented in this Chapter and the associated figures and technical reports.

Phase 2: Detailed Assessment and Impact Determination

A Detailed Assessment and Impact Determination was carried out which incorporates the full range of site investigations and studies, the refined CSM and a full assessment of any potential impacts.

The approach adopted is as per the Construction Industry Research and Information Association's publication CIRIA C753-SuDS Manual and 'Greater Dublin Strategic Drainage Study', (GDSDS) each of the potential effects of the development have been described in terms of Quality, Significance, Extent, Probability and Duration.

The classification of impacts / effects in this chapter follows the definitions provided in the Draft Guidelines (EPA, 2017).

Additional guidance and EIA definitions are contained in NRA Guidelines (NRA, 2009). These guidelines provide useful matrices outlining how additional assessment criteria based on the Importance of a feature to be protected and the Magnitude of the potential impact. This approach has been adopted where appropriate.

Where the Initial Impact Determination concluded that the level of potential impact is capable of measureable and noticeable consequences it is carried into the next assessment phase.

Phase 3: Mitigation, Residual and Final Impact Assessment

Phase 3 builds on the outcome of the initial assessment and detailed site assessments, by identifying mitigation measures to address the identified impacts. Mitigation measures which have been built into the project design have also been considered in this process.

The development including all identified mitigation measures (assumed implemented) is then subject to impact assessment, to identify any residual impacts.

The Final Impact Assessment presented in this Chapter incorporates the outputs from the Detailed Assessment and Impact Determination, Mitigation Measures and Residual Impact Assessment.

Phase 4: Completion of the EIAR Section

The final phase of work was the completion of this EIAR Section with associated Figures and Appendices. The format follows the EPA Guidance Note and Design Team Template.

10.5.2 Assumptions and Limitations

The description of existing conditions is based on the available desk study, surveys and public service records information as outlined in Section 10.4. Given the site history and site activities it is not envisaged that any significant existing services exist within the project site.

10.6 Likelihood of Impacts

The proposed development will not give rise to any likely significant long term impacts. There are some effects on the hydrology, water and hydrogeological environments that will occur due to the proposed development namely:

- Soil excavation – removal of soil for basement construction;
- There are effects on the hydrological and hydrogeological environments which could potentially occur due to the proposed development namely, accidental spills or contaminated run-off during construction phase.

Risks to Human Health

There is no apparent risk to human health, due to changes in the geological environment, resulting from this project.

10.7 Cumulative Effects with Other Existing/Approved Developments

The cumulative impacts take into account the combined effects of the proposed development and other proposed projects in the surrounding area. Cumulative impacts occur as a result of actions taking place in the same area and within the same timeframe as the proposed 'Sandyford Central' development.

The site is located within the Sandyford Urban Framework Plan 2016-2022 which was adopted as Appendix No. 15 to the County Development Plan 2016-2022. According to the Plan, the site is zoned 'Zone 1: Mixed Core Area – Inner Core'.

Planning has been granted by An Bord Pleanála for the adjacent site (Ref. Reg ABP-304405- 19), Rockbrook, by IRES Residential Properties Limited for Strategic Housing Development. The development, which is known as RB Central comprises a total gross floor area of c. 41,347 sq m (excluding basements) will consist of 428 No. apartments comprising two blocks arranged around two courtyards ranging in height from five to fourteen storeys (including ground floor mezzanine, all over three existing part-constructed basement levels) comprising 32 No. studio apartments; 122 No. 1 bedroom apartments; 251 No. 2 bedroom apartments and 23 No. 3 bedroom apartments. The development will also include a crèche (486 sq m) with ancillary outdoor play areas; 4 No. ground floor local/neighbourhood retail units (862 sq m); communal community residents' facilities (934 sq m in total).

The nature of the proposed development and the other developments of note that have

been identified locally mean the potential impacts are similar in nature. As a result, it is considered that once the mitigation measures discussed following are employed at the proposed development combined with those set out in the assessments for the respective third party development, the potential for residual cumulative impacts on this aspect of the environment is negligible.

10.8 Interactions – General Points

- Excavated and stripped soil can be disturbed and eroded by site vehicles during the construction. Rainfall and wind can also impact on non-vegetated / uncovered areas within the excavation or where soil is stockpiled. This can lead to run-off with high suspended solid content which can impact on water bodies. The potential risk from this indirect impact to water bodies and/or habitats from contaminated water would depend on the magnitude and duration of any water quality impact.
- There is a potential for dust from excavations or stockpiles to impact on air quality. This is discussed further in Chapter 11 Air Quality and Climate.
- Construction phase dewatering may be required to excavate the basement and to maintain dry working conditions in the excavation (for rainfall only). Pumped water will require discharge offsite and will be contaminants will be managed by silt traps and petrol interceptors.
- Noise and vibration will be generated through the construction phase particularly during excavation work. Given that no rock excavation is required it is anticipated that conventional excavation techniques (i.e. hard digging) will suffice. Noise and vibration impacts are considered in detail in Chapter 12, Noise and Vibration.
- The construction phase and any import or export of material to the site (as part of excavation or infilling works) will have implications for traffic in the surrounding road network. These impacts are considered further in Chapter 14 Transportation and Population and Human Health (Chapter 5).
- As with all construction projects there is potential for water (rainfall and/or groundwater) to become contaminated with pollutants associated with construction activity. Contaminated water which arises from construction sites can pose a significant short-term risk to groundwater quality for the duration of the construction if contaminated water is allowed to pollute ground water, watercourses and soils. The potential main contaminants include:
    - Suspended solids (muddy water with increase turbidity) – arising from excavation and ground disturbance;
    - Cement/concrete (increase turbidity and pH) – arising from construction materials;
    - Hydrocarbons (ecotoxic) from oils/diesel – accidental spillages from construction plant or onsite storage;
    - Wastewater (nutrient and microbial rich) – arising from poor on-site toilet and washrooms.

10.9 Construction Phase (Systematic Description of Impacts)

In line with EIA guidance, each potential impact for the development should be described in terms of its Quality, Significance and Duration. The potential impacts, mitigation measures and resulting residual impacts have been combined in a Detailed Assessment

Table (CSM) presented in Appendix 10.1.

The potential hydrological impacts during the construction phase are presented in Table 10.1 and are outlined below. These impacts also relate to and interact with other chapters

within the EIAR specifically. These impacts also relate to and interact with other chapters within the EIAR specifically:

- Chapter 5, Population & Human Health
- Chapter 6, Archaeological and Cultural Heritage
- Chapter 7, Biodiversity
- Chapter 8, Landscaping & Visual impact
- Chapter 9, Lands, Soils & Geology
- Chapter 11, Air Quality & Climate
- Chapter 12, Noise and Vibration
- Chapter 14, Material Assets: Roads and Traffic, Transportation and Site Services

Although we acknowledge that interactions listed above occur between the aforementioned chapters the significant interaction are discussed above at Section 10.8 and within Chapter 18 – Interactions and Cumulative Impacts.

10.10 Operational Phase (Systematic Description of Impacts)

The proposed development will not give rise to any likely significant long term impacts once construction has been completed.

It is not proposed to abstract water from ground and the underlying aquifer. It is not proposed to discharge foul water to ground via percolation areas.

The existing site area is 100% impermeable surface area. The implementation of a range of SuDS methods including surface water attenuation will result in an improvement in the potential impact the surface water receiving waters being slight and long term. It is also noted discharge of runoff to ground will be facilitated as part of the SuDS strategy not to seal the interface between the SuDs components and the underlying soil (where practical / outside podium), thereby reducing discharge to surrounding watercourses and providing the natural recharge of groundwater with treated water. The proposed SUDS strategy also includes the limiting of flow from the site to Greenfield runoff levels and the storage of same within SuDs components. There will be no adverse increase in the discharge rates to receiving water bodies during and following completion of the development as there will be a decrease in surface water flows from the site and an improvement in the water quality.

10.11 Mitigation

The following mitigation measures shall be implemented with the construction of the surface water sewer network:

- The filtering of surface water that is likely to be contaminated by soil particles in order

to reduce the silting effects of these particles in the receiving downstream watercourse;
- Construction of suitable silt traps prior to the surface water out-falling to the existing watercourse;
- Locating existing services to ensure there is no conflict which could lead to a negative impact;
- Methods statements to ensure appropriate works methodologies.

It is proposed to implement the following mitigation measures for the surface water design for the operation phase in accordance with The Greater Dublin Strategic Drainage Study (GDSDS). This requires that storm water is reviewed under four Criteria.

(i) Criterion 1 – River Water Quality Protection;
(ii) Criterion 2 – River Regime Protection;
(iii) Criterion 3 – Level of Service (Flooding) site;
(iv) Criterion 4 – River Flood Protection;

Criterion 1 –River Water Quality Protection

The drainage system for this development will contain a range of treatment methods for surface water including;

- Green roofs and on podium storage will provide a first level of treatment and storage level of apartment blocks. The removal of pollutants or sediments, ecological value and a reduction of surface water runoff volumes and discharge rates for small events (Interception) will be provided;
- Raingardens & Basins will be provided downstream of the above SuDs components for attenuation during an exceedance event. All raingardens and basins are shallow and have been designed with a maximum top water level (TWL) of 150mm including 150mm freeboard to proposed ground level. Basins to be located in public areas and will be useable, maintainable and safe. Basins will be provided with a filter underdrain to enable use by the local community for non-extreme storm events;
- Infiltration to natural ground for surface water runoff will be facilitated underneath filter drains, raingardens, basins, landscaped areas and permeable paving outside of podium where practical. The scope for infiltration is limited on site due to the podium footprint and underlying rock below the surface;
- Filter drains underneath SuDS systems will likely provide attenuation, conveyance and treatment runoff;
- Swales will be used to convey and treat road runoff;
- Bio-retention Areas will be provided extensively throughout the site by tree pits and planters on podium and act as a first level of treatment for surface water run off around the site;
- Trees/planting within the soil filled tree pits / raingardens will collect, store and treat runoff for small events (Interception) while providing amenity and biodiversity;
- Permeable Paving / Open Graded Crushed Rock (OGCR) will be provided below hardstanding and landscaping on podium. The outfalls of each sub catchment will be limited / throttled to provide attenuation storage in the sub-base. The removal of pollutants at source and a reduction of surface water runoff velocities at source will be provided. The surface water flows through the stone medium at first level of

treatment of runoff before controlled release to SuDS components downstream;

- Attenuation Storage will be provided to ensure that there is adequate attenuation storage for the required limited discharge of surface water volumes. The site has been divided into sub catchments to reduce flows, volumes and provide treatment of run-off, as part of the surface water management train. Attenuation will be provided for events up to, and including, the 1.0% AEP rainfall event of each sub-catchment SuDs component.;
- Limiting discharges from attenuation tanks will ensure that discharge rates are maintained below the greenfield runoff rate for SOIL Type 4;
- Catch Pits will remove sediments and silts upstream and downstream of all SuDS systems. The storm tech isolator row will capture any sediment which is not removed by catch pits upstream;
- A Petrol Interceptor will be provided for the treatment of all surface water runoff before it is discharged from site. A full retention oil separator (NSBA020) will separate oil and silts in accordance with EN858-1 and PPG3 from surface water before it discharges to the public surface water network;
- During the operational phase of the project trapped gullies will lessen debris discharging into the surface water system.
- SuDS components reduce urban runoff contamination;
- Best management drainage policies in accordance with SuDS will be implemented and incorporated into the design of the surface water drainage.

All SuDS measures will be provided in accordance with the Greater Dublin Strategic Drainage Study Regional Drainage Policy Volume 2 - New Development (GDSDS-RDP Volume 2). Specific design requirements for SuDS systems are established by the Construction Industry Research and Information Association's publication CIRIA C753-SuDS Manual (2015).

An assessment of the potential pollutants was completed in accordance with CIRIA C753-SuDS Manual. The proposed development land use is residential with covered car parking, low traffic roads (e.g. cul de sacs, home zones, general access roads). The pollution hazard level from car parking and low traffic roads is very low for discharge to surface waters and groundwater, including coasts and estuaries. All discharge to surface waters and groundwater, including coasts and estuaries requires the removal of gross solids and sediments only and this will be provided with the above SuDs features and mitigation measures.

Criterion 2 – River Regime Protection

The existing site is drained at the north of the site via 300mm connection to the 900mm public surface water network on Blackthorn Drive. It is proposed to reuse this connection and discharge attenuated flowed in accordance with the Local Authority requirements and the Greater Dublin Strategic Drainage Study (Dublin City Council, 2005). Discharge will be made to this existing public surface water sewer via the proposed attenuation and flow
control device (Hydrobrake). The proposed Hydrobrake restricts discharge as specified. The limiting discharge will restrict the discharge to a rate of 8.1l/s for the site. The proposed discharge rate takes consideration for future development on site as discussed in Criterion 4 below. The GDSDS-RDP Volume 2, Appendix E Section E2.4 states that this

ensures "that sufficient storm water runoff retention is achieved to protect the river during extreme events." No extra measures are required for discharges as the receiving surface water network does not discharge directly into a protected resource.

Surface water runoff rates have been calculated in accordance with I.S. EN752: 2008 "Drain & Sewer Systems outside Buildings", the DOE 'Recommendations for Site Development Works for Housing Areas', 'The Greater Dublin Region Code of Practice for Drainage Works' and the recommendations of the 'Greater Dublin Strategic Drainage Study', (GDSDS).

Criterion 3 – Level of Service (Flooding) Site

There are 4 sub-criteria for level of service, as set out in the GDSDS-RDP Volume 2, Section 6.3.4 (Table 6.3):

(i) No flooding on site except where planned (30-year high intensity rainfall event);
(ii) No internal property flooding (100-year high intensity rainfall event);
(iii) No internal property flooding (100-year river event and critical duration for site) and;
(iv) No flood routing off site except where specifically planned, (100-year high intensity rainfall event).

Calculations for the design of storm drains have been compiled with the Micro Drainage Micro Drainage Program using the Modified Rational Method in accordance with EN752. Calculations for the Storm networks are included in Appendix B of the Engineering Service Report.

Sub-criterion 3.1

The proposed drainage system has been analysed for a 30-year return period storm event. The analysis show that no flooding will occur in 30-year return period storm events.

Sub-criterion 3.2

The proposed drainage system has been analysed for a 100-year return period storm event. The analysis show that no flooding will occur in 100-year return period storm events.

Sub-criterion 3.3

Existing ground levels around the site at Blackthorn Drive and Carmanhall Road are 80.45mAOD and 86.59mAOD respectively. An existing concrete slab covers almost the entirety of the site, with surface levels between 77.50 – 83.64mAOD. The site is not in the vicinity of coastal flooding. The maximum water level in the proposed attenuation will not pose a risk to the proposed buildings. In accordance with the requirements of Sub-Criterion 3.3, all buildings are a minimum of 500mm above the design 100-year water level off open attenuation facility.

Sub-criterion 3.4

The performance of the proposed drainage system in the 100-year return period storm

events has been analysed. The analysis show that no flooding is expected in the 100-year return period storm event. No off-site overland flow is expected in the 100-year return period storm event, unless in specifically designated areas, i.e. detention basins.

Criterion 4 – River Flood Protection

Discharge for the development will be restricted to a rate of 8.1/s to the Greenfield Runoff for SOIL Type 4 (5.26l/s/ha). By limiting the runoff to this flow rate, the GDSDS-RDP Volume 2, Appendix E Section E2.4 states that this ensures "that sufficient stormwater runoff retention is achieved to protect the river during extreme events." Attenuation storage is provided for the 100-year return period storm event in the proposed attenuation storage facility. Control of runoff rates will be achieved through the use of a vortex control device (e.g. Hydrobrake), which reduces the risk of blockage present with other flow control devices. Calculations of attenuation volume are included in Appendix B of the Engineering Service Report, submitted as a standalone document.

No other mitigation measures are deemed to be necessary after completion of the development, other than normal maintenance of the surface water system.

Allowable surface water runoff from the development site has been calculated using the 'Greater Dublin Strategic Drainage Study', (GDSDS) and the Institute of Hydrology Report No.124 to estimate existing Greenfield runoff rates.

10.12 Monitoring

In advance of work starting on site the works Contractor will author a Construction Methodology document taking into account their approach and any additional requirements of the Design Team or Planning Regulator. The Contractor will also prepare a Construction Management Plan and Environmental Plan. The Construction Management Plan sets out the overarching vision of how the construction of the project will be management in a safe and organised manner by the Contractor with the oversight of the Developer. The Construction Management Plan is a living document and it will go through a number of iterations before works commence and during the works. It will set out requirements and standards which must be met during the construction stage and will include the relevant mitigation measures outlined in the EIAR and any subsequent conditions relevant to the project. An outline Construction Management Plan is submitted as part of this application under separate cover.

The Construction and Demolition Waste Management Plan in included as Appendix 15.1 of Chapter 15 – Waste Management. Monitoring shall be carried out as specified in any Discharge Licence associated with the construction phase of the project.

10.13 Residual Impacts

It is considered that once the mitigation measures discussed above are employed, the potential for residual impacts on this aspect of the environment is negligible.

10.14 Section Summary

10.14.1 Interactions Between Impacts on Different Factors

The completion of the proposed residential development will result in an increased discharge of surface water but it will be attenuated below Greenfield levels in accordance with GDSDS. This flow will be discharged to the existing 900mm public surface water network on Blackthorn Drive which ultimately discharges to Dublin Bay.

10.14.2 Summary of Likely Significant Environmental Effects

The proposed development will not give rise to any likely significant long term effects. Slight negative effects will be experienced during the construction phase with disruptions to supply caused by the surface water connection to the Carysfort Maretimo stream which will be temporary in nature. During the Operational Phase there will be no significant environmental effects. Unplanned events have been considered throughout this chapter.

10.14.3 Summary of Proposed Mitigation and Monitoring Measures and their Influence on Design

The total attenuation provided will be 720cubic meters will be provided with extensive SUDs structures across the site. All SUDs structures are designed to allow surface water be retained and flow through them. The total discharge from the proposed development will be 8.1l/s for a 1.0% AEP rainfall event, below Greenfield levels, to the Carysfort Maretimo stream. In addition to this and in accordance with the Greater Dublin Strategic Drainage Strategy provision for 10mm interception of surface water to ground will be facilitated through infiltration areas below all SuDs structures above the 10mm interception requirements.

It is proposed to infiltrate surface water runoff to ground underneath SuDS systems where suitable. It is determined that the risks to ground water is 'low or medium'. Analysis of groundwater risk mapping from the EPA notes that the ground water on site is 'not at risk'. No extra measures may be required for discharges to groundwater bodies as groundwater is not protected at this site.

Proposed mitigation and monitoring measures relate to the construction phase only and are summarised under the following aspects:

- Control of Soil Excavation and Export from Site;
- Sources of fill and aggregates for the project;
- Fuel and Chemical handling, transport and storage;
- Control of Water during Construction.
- Monitoring shall be carried out as specified in any Discharge Licence associated with the construction phase of the project.
- Record keeping and monitoring of import and export of materials shall be carried out in accordance with the Waste Management Act.

10.15 "Do Nothing Scenario" Impact

In the 'Do Nothing' scenario the site would not be developed therefore there would be no altering of groundwater / surface water regime by drainage. The Do Nothing scenario would result in the site remaining as hardstanding with no SuDS measures or attenuation storage provided within the site. This means that in the Do Nothing scenario, there would be more untreated surface water flows in the storm sewer during rainfall events.

10.16 Difficulties Encountered

There were no difficulties encountered in the preparation of this chapter.

10.17 References

Greater Dublin Strategic Drainage Study (2005) – Fingal County Council, Dublin City Council, Dún Laoghaire-Rathdown County Council, South Dublin County Council, Wicklow County Council, Kildare County Council, Meath County Council

The Greater Dublin Region Code of Practice for Drainage Works (2012) – Fingal County Council, Dublin City Council, Dún Laoghaire-Rathdown County Council, South Dublin County Council, Wicklow County Council, Kildare County Council, Meath County Council CIRIA C753-SuDS Manual (2015) - Construction Industry Research and Information Association's publication

I.S. EN752: 2008 Drain & Sewer Systems outside Buildings (2008) – National Standards Agency Ireland

Recommendations for Site Development Works for Housing Areas (1998) – Department of the Environment and Local Government

Guidelines on Procedures for the Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (2009) – National Roads Authority

Control of Water Pollution from Construction Sites (2001) – Construction Industry Research and Information Association

Environmental Handbook for Building and Civil Engineering Projects (2000) – Construction Industry Research and Information Association
Preliminary Hydrogeological Assessment of the ground water levels - OCSC Environmental Division (2018)

South Dublin Bay SAC Conservation objectives supporting document (2013) – National Parks and Wildlife Service

South Dublin Bay and Tolka River Estuary SPA Conservation objectives supporting document (2013) – National Parks and Wildlife Service

River Basin Management Plan 2009-2015 (2010) – ERBD Eastern River Basin District

Eastern River Basin Management Plan 2009-2015 – Coastal waters; Programme of measures; Summary Report (2010) - ERBD Eastern River Basin District

Eastern River Basin Management Plan 2009-2015 – Transitional water bodies; Programme of measures; Summary Report (2010) - ERBD Eastern River Basin District