Appendix 7-1 Hydrological and Hydrogeological Risk Assessment

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Hydrological and Hydrogeological Risk Assessment Report

PRESENTED TO

Liscove Limited
Large-Scale Residential Development on Lands at Wayside, Enniskerry Road and Glenamuck Road, Kilternan, Dublin 18

DATE

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Environmental Consultancy Services

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1 INTRODUCTION

Enviroguide Consulting (hereafter referred to as EGC) was appointed by Liscove Limited (hereafter referred to as the Applicant) to prepare a hydrological and hydrogeological risk assessment for the proposed large-scale residential development (LRD) on lands at Wayside, Enniskerry Road and Glenamuck Road, Kilternan, Dublin 18 (referred to hereafter as the 'Proposed Development' and 'site').

1.1 Project Objective

The project objective was to establish the baseline hydrological and hydrogeological conditions at the site and to identify the potential for any impacts on receptors associated with the site and the Proposed Development:

- Establish the hydrological and hydrogeological regime and Conceptual Site Model at the Proposed Development site.
- Determine if there are any potential impacts on the receiving water environmental receptors including those at the site and adjoining downgradient of the site.
- Determine if the Proposed Development could impact on any designated and protected Natura 2000 sites hydraulically connected with the site.
- Determine if the Proposed Development could impact on the water quality status assigned by the EPA of the receiving water bodies hydraulically connected with the site for the purposes of the Water Framework Directive.

1.2 Project Scope

The scope of the hydrological and hydrogeological assessment included the following tasks:

- A desk-based review of published information and information pertaining to the site and Proposed Development provided by the Applicant.
- Develop a hydrogeological Conceptual-Site-Model and identify any potential source-pathway-receptor linkages.
- Identify and assess any potential impacts associated with the Proposed Development on sensitive receptors associated with the receiving water environment.

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

1.3 Professional Competency

The report was prepared by Gareth Carroll BA BAI MIEnvSc, a Principal Consultant of Enviroguide Consulting with over 11 years' experience of preparing environmental and hydrogeological and assessments and reviewed and approved by Patrick Higgins BSc, MSc, MIEnvSc CEnv who is Technical Director with Enviroguide Consulting, and is professionally competent and accredited to undertake environmental risk assessments.

2 METHODOLOGY

2.1 Standards and Regulations

The methodology adopted for this assessment takes cognisance of the relevant standards and regulations pertinent to undertaking a hydrological and hydrogeological assessment in particular the following:

- Council Directive 2006/118/EEC, 2006. On the protection of groundwater against pollution and deterioration. European Parliament and the Council of European Communities.
- Commission Directive 2014/80/EU of 20 June 2014 amending Annex II to Directive 2006/118/EC of the European Parliament and of the Council on the protection of groundwater against pollution and deterioration.
- Dún Laoghaire-Rathdown County Development Plan 2022-2028 (Dún Laoghaire Rathdown County, 2022).
- EU Water Framework Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy with amendments.
- European Communities (Water Policy) Regulations 2003 (S.I. No. 722/2003).
- Environmental Protection Agency, December 2011. Guidance on the Authorisation of Discharges to Groundwater.
- Department of the Environment, Heritage and Local Government, Environmental Protection Agency and Geological Survey of Ireland, 1999. Groundwater Protection Schemes (Groundwater Protection Schemes, 1999).
- Local Government, July 1990. No. 21 of 1990. Local Government (Water Pollution) (Amendment) Act, 1990.
- S.I. No. 9/2010 - European Communities Environmental Objectives (Groundwater) Regulations 2010 and as amended.
- S.I. No. 272/2009 - European Communities Environmental Objectives (Surface Waters) Regulations 2009 and as amended.

2.2 Desk-based Study

A desk-based study was undertaken including a review of relevant information from the following publicly available sources and information provided by the Applicant:

- Ordnance Survey Ireland Online mapping (OSI, 2024).
- Geological Survey of Ireland Online mapping (GSI, 2024).
- Environmental Protection Agency Online mapping (EPA, 2024).
- National Parks & Wildlife Services, Protected Sites Webmapping (NPWS, 2024).
- Relevant drawings and design reports for the Proposed Development provided by the Applicant.

2.3 Risk Based Impact Assessment

A risk-based and receptor-focussed approach was adopted to include an 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, as well as EPA guidelines on the protection of groundwater and surface water resources including associated aquatic ecosystems and human health receptors (e.g., groundwater supply users), the EPA Guidance on the Authorisation of Discharges to Groundwater (EPA, 2011) and the EPA Guidance on the Management of Contaminated Land and Groundwater at EPA Licensed Sites (EPA, 2013) on the protection of groundwater and surface water resources including associated aquatic ecosystems and human health receptors (e.g., groundwater supply users).

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. This is informed by the assessment of potential for viable pollutant linkage(s) to be present. A pollutant linkage is established when there is a viable or potentially viable **S**ource, a **P**athway and a **R**eceptor (refer to Section 2.4 below).If one or more of the three elements are missing, the exposure pathway is considered incomplete and there is no risk associated with the activity or contaminant source (i.e., a viable means of exposure is not considered to be present or is unlikely to be present).

The objective of the Water Framework Directive (WFD) is no deterioration of the water quality status, and the “prevent or limit” objective is a key element of achieving that WFD status for all water bodies regardless of the water quality status of the water body. The ‘prevent or limit’ objective is a key element to achieving the WFD status and water quality objectives and in principle, prevent or limit measures (i.e., avoidance and mitigation) are the first line of defence in restricting inputs of pollutants from a development (i.e., ‘source’ removal) and any potential impact or deterioration of water quality status or WFD status of the receiving water body.

In this assessment all three elements of the Source-Pathway-Receptor model will be identified to develop a Conceptual Site Model (CSM), and any potential linkages evaluated and assessed to determine if the development could potentially impact upon any identified receptors including Natura 2000 sites as well as the WFD Status of the water bodies associated with the Site.

2.4 Conceptual Site Model

A CSM represents the characteristics of the Site and identifies the possible relationship and potential risk between contaminant sources (i.e., characteristics of the Proposed Development), pathways and receptors (receiving environment) . 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 preliminary CSM for the site of the Proposed Development is initially defined and this is then revised throughout the risk-based assessment process.

3 CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

The Applicant intends to apply for permission for a Large-Scale Residential Development on 2No. sites, measuring approximately 14.2 Ha., which will be separated by the future Glenamuck Distributer Link Road (GLDR). The western site principally comprises lands at Wayside, Enniskerry Road and Glenamuck Road, Kilternan, Dublin 18, which include a derelict dwelling known as 'Rockville' and associated derelict outbuildings, Enniskerry Road, Kilternan, Dublin 18, D18 Y199 and the former Kilternan Country Market, Enniskerry Road, Kilternan, Dublin 18, D18 PK09. The western site is generally bounded by the Glenamuck Road to the north; the Sancta Maria property to the north, west and south; a recently constructed residential development named "Rockville" to the north-east; the Enniskerry Road to the south-west; dwellings to the south; and the future GLDR to the east. The eastern site is generally bound by dwellings to the south; the future GLDR to the west; and greenfield land to the north and east.

Road works are proposed to facilitate access to the development from the Enniskerry Road; to the approved Part 8 Enniskerry Road/Glenamuck Road Junction Upgrade Scheme on Glenamuck Road (DLRCC Part 8 Ref. PC/IC/01/17); and to the approved Glenamuck District Roads Scheme (GDRS) (ABP Ref. HA06D.303945) on the Glenamuck Link Distributor Road (GLDR). Drainage and potable water infrastructure is proposed to connect to services on the Glenamuck Road, Enniskerry Road and the GLDR.

At the 'Rockville access point', works are proposed to provide a multi-modal access, including a vehicular connection between the Proposed Development and the Rockville development (permitted under DLR Reg. Ref. D18A/0566). The new access will require the removal of the existing as-built hammerhead turning area at Rockville to create this new connection. The residual hammerhead area will be landscaped to tie into the adjoining landscape strategy. The above works are inclusive of all necessary tie-in works such as new kerbs, drainage details, road marking, signage, and public lighting.

The Proposed Development will principally consist of: the demolition of approximately 740m^2 of existing structures on site comprising a derelict dwelling known as 'Rockville' and associated derelict outbuildings (approximately 573m^2) and the former Kilternan Country Market (wooden structure) (approximately 167m^2); and the provision of a mixed-use development principally consisting of 487 No. residential units (196 No. houses, 201 No. duplex units and 90 No. apartments) and a Neighbourhood Centre. The western site will comprise 362 No. residential units and the Neighbourhood Centre, which will provide an anchor retail store (approximately 1,310m^2), retail/commercial (approximately 3,284m^2), a restaurant (approximately 182m^2), a creche (approximately 691m^2), café (approximately 326m^2), and a community facility (approximately 332m^2), and the eastern site will comprise 125 No. residential units. The 487 No. residential units will consist of 53 No. 1 bedroom units

(35 No. apartments and 18 No. duplexes), 150 No. 2 bedroom units (38 No. houses, 16 No. apartments and 96 No. duplexes), 236 No. 3 bedroom units (110 No. houses, 39 No. apartments and 87 No. duplexes) and 48 No. 4 bedroom units (48 No. houses). The Proposed Development will range in height from 2 No. to 4 No. storeys (including podium/undercroft level in Apartment Blocks 1, 2 and 3 and Duplex Block T and U on the eastern site).

The Proposed Development also provides: a pedestrian/cycle route through the Dingle Way from Enniskerry Road to the future Glenamuck Link Distributor Road; 854 No. car parking spaces (125 No. in the undercroft of Apartment Blocks 1, 2 and 3 and Duplex Blocks T and U and 729 No. at surface level) including 28 No. mobility impaired spaces, 87 No. electric vehicle spaces, 2 No. car share spaces, and 4 No. drop-off spaces/loading bays; motorcycle parking; bicycle parking; bin storage; provision of new telecommunications infrastructure at roof level of the Neighbourhood Centre including shrouds, antennas and microwave link dishes (18 No. antennas, all enclosed in 9 No. shrouds and 6 No. transmission dishes, together with all associated equipment); private balconies, terraces and gardens; hard and soft landscaping; sedum roofs; solar panels; boundary treatments; lighting; substations; plant; and all other associated site works above and below ground. The Proposed Development has a gross floor area of approximately 60,504m^2 above ground, in addition to an undercroft/basement (approximately 4,485m^2) containing car parking, bike storage, bin storage and plant under Apartment Blocks 1, 2 and 3 and Duplex Blocks T and U on the eastern site.

The Proposed Development site layout is provided in Figure 3-1.

Figure 3-1: Proposed Development Site Layout Plan (McCrossan O'Rourke Manning Architects (MCORM), 2024. Site Layout - Drawing No. PL1000)

3.1 Construction Phase

The construction phase of the Proposed Development will include:

- The demolition of approximately 740m^2 of existing structures onsite.
- Foundation design will consist of pad and strip foundations with no requirement for piling.
- The stripping of existing topsoil at the Site.
- Excavation of soil and subsoil for the construction of building foundations, drainage and other infrastructure to depths of between 0.6m and 3.0m for foundations and 1.5m to 3.0mbGL for drainage and infrastructure with excavation of 95,250m^3 of soils. It is anticipated that there will be no requirement for the excavation of bedrock during the construction phase of the Proposed Development.
- Where possible, it is intended to reuse suitable excavated soil and subsoil for landscaping and engineering use. However, it is anticipated that up to 66,400m^3 of surplus materials will require removal offsite in accordance with all statutory legislation.
- It is anticipated that excavations for foundations will be above groundwater however, locally groundwater may be encountered during deeper excavations for drainage.
- The importation of 77,750m^3 of aggregate fill materials will be required for the construction of the Proposed Development (e.g., granular material beneath road pavement, under floor slabs and for drainage and utility bedding / surrounds etc.).
- Construction of new surface water drainage (refer to Section 3.2.1) designed in accordance with the principles and objectives of Sustainable Drainage Systems (SuDS) and the Greater Dublin Sustainable Drainage System (GDSDS) and the requirements of Dún Laoghaire-Rathdown County Council (DLRCC).
- Construction of new foul and mains water connections (refer to Section 3.2.2 and Section 3.2.3) in accordance with UE Code of Practice for Wastewater Infrastructure (IW-CDS-5030-03) and UE's Code of Practice for Water Infrastructure (IW-CDS-5020-03).

3.2 Operational Phase

3.2.1 Surface Water Drainage

As documented in the Engineering Infrastructure Report (Roger Mullarkey & Associates, 2024a submitted with the planning application), the surface water drainage for 12.6Ha of the 14.2Ha site (i.e., the drained site area) has been divided into three (4No.) catchment areas as follows:

- Catchment 1 (9.99Ha) outfalls into the existing piped infrastructure constructed as part of the existing Rockville development (D17A/0793) to the northeast of the site. This connection point of the attenuated flow will be downstream of the existing Rockville attenuation system into the existing 300mm surface water drain. It is understood that this surface water drain currently discharges to the existing roadside drainage channel located in Glenamuck Road which in turn flows approximately 1.4km downstream in a north-easterly direction along Glenamuck Road before discharging to the Glenamuck North Stream. It is noted that the existing 300mm surface water drain will eventually be diverted to the regional attenuation pond located beside the Glenamuck

Road/GDRS junction permitted as part of the DLRCC GLDR/GDRS roads project. (Roger Mullarkey & Associates, 2024a).

- Catchment 2 (0.21Ha) outfalls into the 225mm surface water drain to be constructed as part of the GDRS upgrade. It is understood that this drainage channel flow north along Enniskerry Road before discharging to the Glenamuck North Stream approximately 0.42km north of the Site.
- Catchment 3 (0.56Ha) outfalls into the existing 300mm surface water drain in Enniskerry Road at the Glenamuck Road junction.
- Catchment 4 (1.80Ha) outfalls into the 300mm surface water drain to be constructed as part of the GLDR project.
- Surface water from all remaining areas of the Proposed Development (i.e., undeveloped / landscaped areas) will continue to discharge to ground.

It was confirmed by DLRCC consultants that the GDRS infrastructure has been designed to cater for the attenuated run-off from the Proposed Development (subject to grant of planning) and that the regional pond in that project has capacity to intercept and store the surface water outfall from the site (Roger Mullarkey & Associates, 2024a).

Attenuated and treated surface water from the GLDR/GDRS roads project will ultimately outfall to the watercourses within the catchments of the Carrickmines Stream (River Waterbody Code: IE_EA_10C040350) and the Shanganagh River (River Waterbody Code: IE_EA_10S010600). The Environmental Impact Assessment Report (EIAR) for the GDRS project (DBFL, 2019) that assess the overall scheme including surface water drainage concluded that 'the significance of the identified impacts will be reduced to a "not significant" residual impact on the identified hydrological/ hydrogeological receptors'.

Surface water runoff from the Proposed Development 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 attenuated water prior to discharge to the outfall point. A full SuDS treatment train approach has been implemented in accordance with the CIRIA SuDS Manual, as detailed in Engineering Infrastructure Report (Roger Mullarkey & Associates, 2024a) and includes:

- Filter drains to the rear of the housing.
- Permeable paving to all parking spaces.
- Rainwater butts (200l) to the rear downpipes.
- Swales adjacent to roads where practically feasible.
- Tree pits where practically feasible.
- Extensive Green Roofs and Blue Roof.
- Bio-Retention areas and Rain Garden areas.
- Silt-trap/catchpit manholes.
- Hydrobrake limiting flow to the drained area Qbar greenfield rate.
- Petrol interceptors.
- Stone lined voided arch retention storage devices.

The proposed surface water drainage for the Proposed Development is provided in Figure 3-2.

Figure 3-2. Drainage Masterplan (Roger Mullarkey & Associates, 2024. 2104C/313 Drainage Masterplan)

3.2.2 Foul Water Drainage

As documented in the Engineering Infrastructure Report (Roger Mullarkey & Associates, 2024a), the foul drainage from the Proposed Development has been divided into three (4No.) catchment areas as follows:

- Catchment 1 (308No. residential units, 5,434m^2 commercial / retail and 619m^2 creche) outfalls into the existing 225mm foul sewer constructed as part of the existing Rockville development (D17A/0793 and D18A/0566) to the northeast of the site. The existing
- Rockville foul sewer has been submitted by the Rockville developer for taking-in-charge by Uisce Éireann (hereafter referred to as UE) and the Applicant has a wayleave agreement for the connection into this foul pipe. This existing infrastructure in turn outfalls downstream into the existing UE owned 300mm foul drainage piped infrastructure on Glenamuck Road.
- Catchment 2 (18No. residential units) outfalls into the 225mm foul sewer to be extended as part of the Glenamuck Road upgrade.
- Catchment 3 (36No. residential units) outfalls into the existing 300mm UE owned foul sewer in Enniskerry Road at the Glenamuck Road junction.
- Catchment 4 (125No. residential units) outfalls into the 225mm foul sewer to be constructed as part of the GLDR project.

It was confirmed by DLRCC consultants that the GDRS infrastructure has been designed to cater for the foul water from the Proposed Development (subject to grant of planning) (Roger Mullarkey & Associates, 2024a). The foul outfalls from Catchment 2 and Catchment 4 are dependent on the construction of the foul drainage infrastructure as part of the GLDR/Glenamuck Road project. This roads project has already commenced as of May 2024 and it has been stated by DLRCC that it will be completed by Q1 2026. Therefore, the above noted Catchment 2 and Catchment 4 will be phased to coincide with the GLDR completion (Roger Mullarkey & Associates, 2024a).

The estimated peak wastewater loading generated by the Proposed Development's Dry Weather Flow is estimated at 2.51l/s residential and 1.5l/s commercial with a Design Flow of 7.57l/s residential and 6.9l/s commercial.

The proposed foul drainage for the Proposed Development is provided in Figure 3-2.

Construction of new foul drainage connection will in accordance with UE's Code of Practice for Wastewater Infrastructure (IW-CDS-5030-03).

The UE Confirmation of Feasibility (CoF) letter dated the 14th June 2024 (UE Reference: CDS24004528) states that the proposed foul water connection is feasible without infrastructure upgrade by UE. A Statement of Design Acceptance (SODA) was subsequently received from UE on the 17th June 2024 (UE Reference: CDS24004528) confirming that UE has no objections to the foul water design proposals.

Foul water from the Proposed Development will be treated in the Shanganagh Wastewater Treatment Plant (WWTP) (Discharge Licence No. D0039-02) before ultimately discharging to the Southwestern Irish Sea - Killiney Bay coastal waterbody.

3.2.3 Water Supply

Water supply to the western portion of the Proposed Development (i.e., to the west of the GLDR) will be from the existing 300mm UE mains water supply located on Enniskerry Road. While water supply to the eastern portion of the Proposed Development (i.e., to the east of the GLDR) will be via the 280mm watermain currently under construction as part of the GLDR roads project. As part of the land acquisition agreements for the GLDR between the Applicant and DLRCC, it has already been agreed that a spur watermain connection from this new water main into the eastern portion of the site will be constructed as part of the GLDR project.

The estimated peak hour water demand for the Proposed Development is 14.45l/s residential and 8.6l/s commercial / retail and creche. In accordance with best practice, the use of water conservation appliances in the buildings will be employed as part of the Proposed Development to reduce the water demand (i.e., water saving tap valves, eco-flush, toilet system and water saving appliances). As a further measure of demand reduction, it is proposed to provide approximately one hundred and eighty-five (185No.) 200 litre rainwater butts to the rear of each gabling property. This will collect rainwater from the house roofs for use in garden irrigation, therefore reducing drinking water demand and decreasing run-off from the site (Roger Mullarkey & Associates, 2024a).

The proposed water supply network for the Proposed Development is provided in Figure 3-2.

Construction of new water supply connection will in accordance with UE's Code of Practice for Water Infrastructure (IW-CDS-5030-02).

The UE CoF letter dated the 14th June 2024 (UE Reference: CDS24004528) states that the proposed water supply connection is feasible without infrastructure upgrade by UE. A SODA was subsequently received from UE on the 17th June 2024 (UE Reference: CDS24004528) confirming that UE has no objections to the water supply design proposals.

4 SITE SETTING

4.1 Site Location and Description

The site of the Proposed Development, measuring approximately 14.2Ha, is located on lands at Wayside, Enniskerry Road and Glenamuck Road, Kilternan, Dublin 18. The site is located approximately 1.9km southwest of the M50 and the Carrickmines Retail Park. The Proposed Development site location is presented in Figure 4-1.

The site, which comprises largely undeveloped grasslands, includes a derelict dwelling known as 'Rockville' and associated derelict outbuildings in the north and the former Kilternan Country Market in the south.

The site is divided into two parcels of land which will be separated by the future Glenamuck Distributer Link Road (GLDR). The western portion site is generally bounded by the Glenamuck Road to the north; the Sancta Maria property to the north, west and south; a recently constructed residential development named "Rockville" to the north-east; the Enniskerry Road to the south-west; dwellings to the south; and the future GLDR to the east. The eastern site is generally bound by dwellings to the south; the future GLDR to the west; and greenfield land to the north and east.

The current site layout is presented in Figure 4-2.

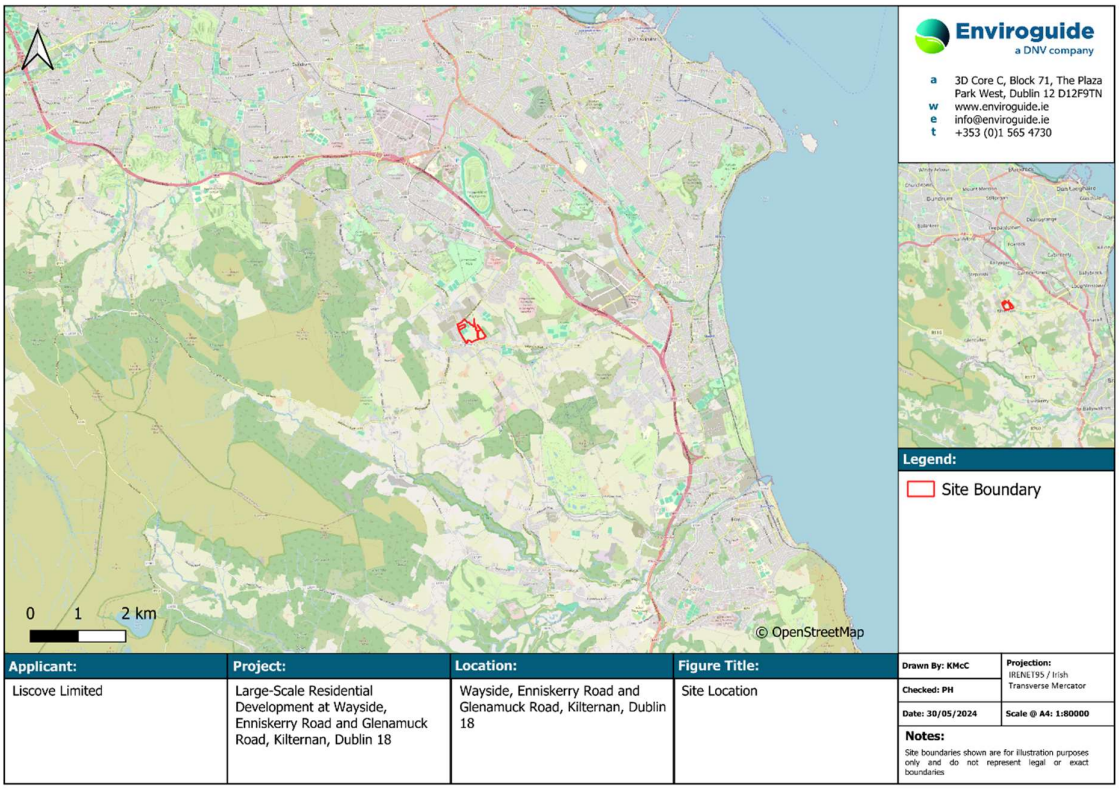

Figure 4-1. Site Location

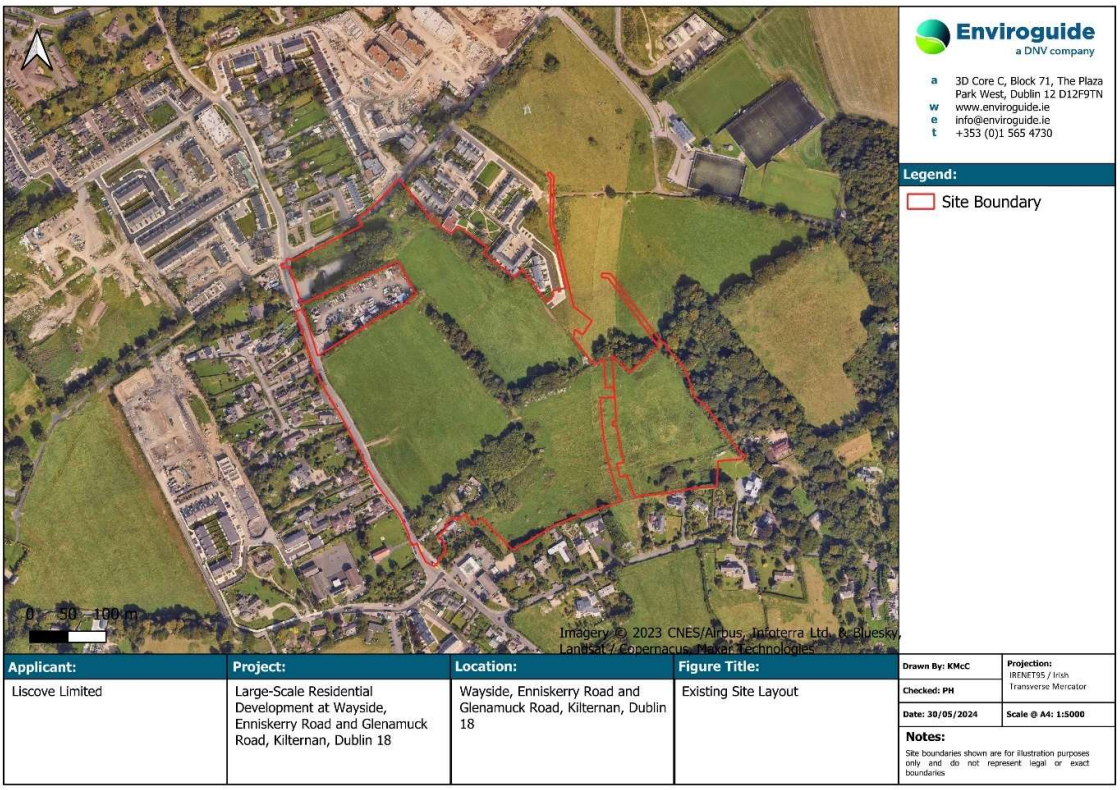

Figure 4-2. Current Site Layout

4.2 Topography

The topography surrounding the site of the Proposed Development is generally sloping toward the east and northeast towards the coast.

As documented in the Engineering Infrastructure Report (Roger Mullarkey & Associates, 2024a. Engineering Infrastructure Report and Storm Water Impact Assessment for a Residential/Commercial project at Kilternan Village LRD, Kilternan, Dublin 18), the topography at the Site is generally a gradually increased slope downwards from the Enniskerry Road along the western boundary in an easterly and north-easterly direction and falling off sharply towards the eastern boundary at a gradient of approximately 10%. Ground elevations at the site range from approximately 141.5 meters above Ordnance Datum (mOD) in the southwest to 122.5mOD in the northeast. The topographic survey with the elevation changes denoted is presented in Figure 4-3.

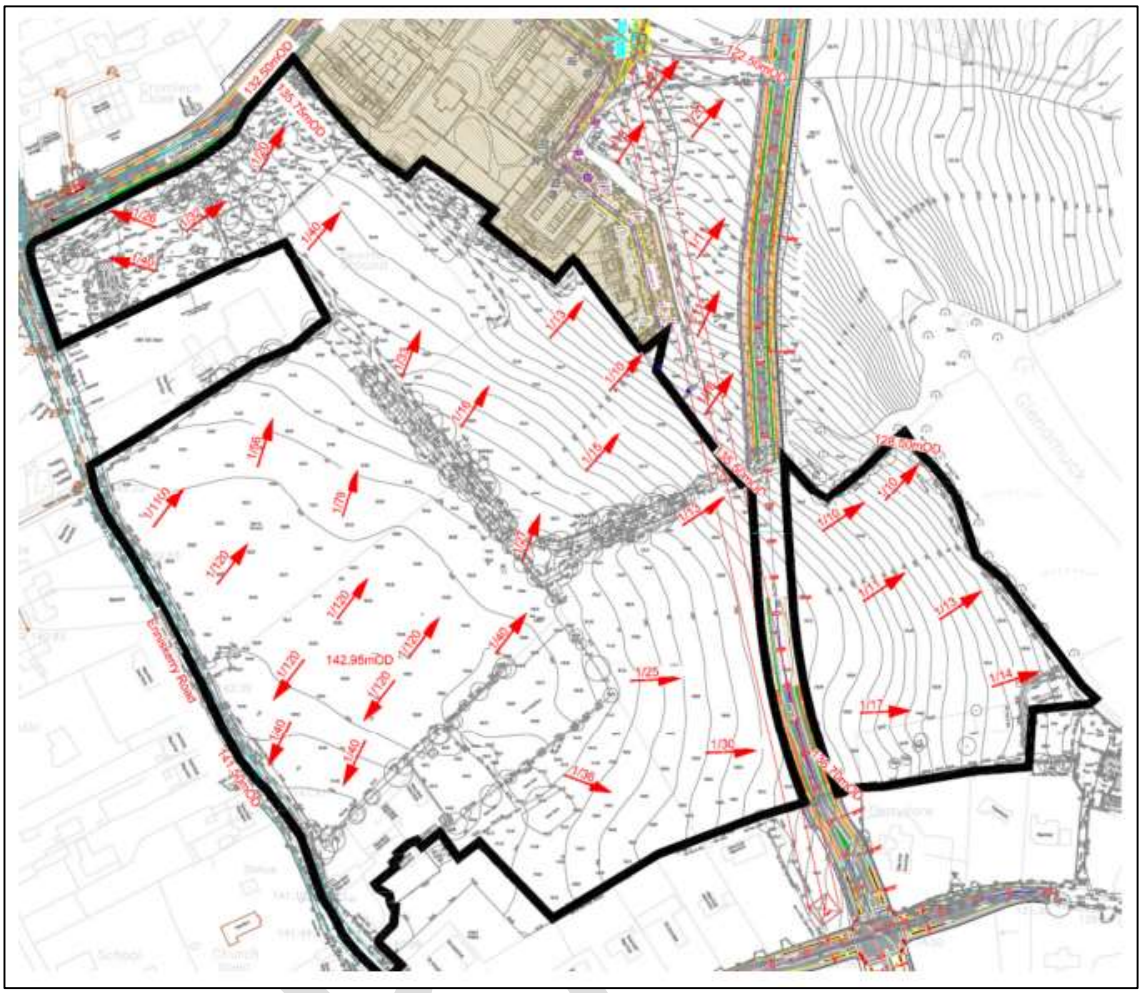

Figure 4-3: Topographic Survey (Roger Mularkey & Associates, 2024a)

4.3 Soil and Geology

The soils beneath the majority of the site are mapped by Teagasc (Teagasc, 2024) as deep well drained mineral (mainly acidic), Acid Brown Earths, Brown Podzolics (IFS Soil Code: AminDW) derived from mainly non-calcareous parent materials described as till derived chiefly from granite (TGr). While the soils beneath the northwest and southern portions of the site are mapped by Teagasc (Teagasc, 2024) as made ground (IFS Soil Code: Made).

The subsoil or quaternary sediments beneath the majority of the site are mapped by the GSI (GSI, 2024) as till derived from granites (TGr). While the subsoil or quaternary sediments beneath the northern portion of the Site and along a small section of the southern site boundary are mapped by the GSI (GSI, 2024) as bedrock outcrop or subcrop.

The bedrock beneath the Site is mapped by the GSI (GSI, 2024) as Type 3 Muscovite Porphyritic (New Code: IDNLGR3) described as granites with muscovite phenocrysts. While no bedrock outcrops are mapped within the site boundary, a cluster of bedrock outcrops is located approximately 0.04 km off the southeast corner of the site (GSI, 2024).

4.3.1 Previous Site Investigation Results

The soils and geology encountered during the previous site investigations (Site Investigations Ltd. (SIL), 2006, Ground Investigations Ireland (GII), 2010, GII, 2017 and GII, 2024 included in the Roger Mullarkey & Associates, 2024a Drainage Infrastructure Report submitted with the planning application) are summarised as follows:

- Topsoil (engineers description) was encountered at all site investigation locations from ground level to depths ranging between 0.2 meters below ground level (mbGL) and 0.3mbGL.
- Brown slightly gravelly sandy CLAY and light yellowish brown slightly gravelly sandy SILT (described as possible weathered bedrock) was encountered below the topsoil to depths ranging between 0.9mbGL and 3.0mbGL.
- Yellowish brown weathered granite was encountered below to CLAY / SILT unit at depths between 0.9 mbGL to 2.4mbGL.

4.4 Hydrogeology

4.4.1 Site Investigation and Groundwater Levels

Groundwater strikes were recorded during drilling of boreholes at the site (SIL, 2006 included in the Roger Mullarkey & Associates, 2024a Drainage Infrastructure Report submitted with the planning application). The groundwater strikes were recorded at depths ranging from 2.5mBGL to 2.9mBGL and typically within the sandy gravelly clays/silts above the granite bedrock. It is noted that a location map for boreholes is not included in the SIL, 2006 report.

4.4.2 Groundwater Body and Flow Regimes

The bedrock aquifer beneath the site is within the Wicklow Groundwater Body (GWB) (EU Code: IE_EA_G_076) that covers some 1396km^2 and occupies an area across Co. Dublin, Co. Wicklow and Co. Wexford (GSI, 2024).

Recharge in the vicinity of the site is diffuse through overlying tills into the aquifer. The granite aquifer beneath the site is classified as a poor aquifer which is characterised by a lower capacity to accept recharge via infiltration of rainfall. A recharge coefficient of between 20% and 60% effective rainfall with a capped recharge value of 100mm/year has been assigned to the aquifer at the site (GSI, 2024).

The GSI (Wicklow GWB Report) identifies that the majority of groundwater flow direction in the aquifer will take place in the upper 3m of the rocks. Site investigation results indicate that shallow groundwater, where encountered, was recorded at depths ranging from 2.5mbGL to 2.9mbGL and typically within the sandy gravelly clays / silts above the granite bedrock (SIL, 2006, GII, 2010, GII, 2017 and GII, 2024 included in the Roger Mullarkey & Associates, 2024a Drainage Infrastructure Report submitted with the planning application). Groundwater flow is considered to recharge and discharge on a local scale, with regional groundwater flow directed towards the Irish Sea and local flow towards nearby streams and rivers. Typical groundwater flow paths are on the order of a few hundred meters, with discharge occurring to the closest surface water feature (GSI, 2024).

Locally, groundwater flow within the vicinity of the site is likely to be towards the Carrickmines Stream and the Shanganagh River although baseflow contributions are noted to be low within the Wicklow GWB.

4.4.3 Aquifer Classification

The bedrock aquifer of the Type 3 Muscovite Porphyritic beneath the Site and surrounding areas is mapped by the GSI (GSI, 2024) as a Poor Aquifer which is generally unproductive except for local zones (Pl). Poor aquifers are capable of supplying 'moderate' to 'low' yields (<100m^3/day) and groundwater flows occurs predominantly through a limited and poorly connected network of fractures, fissures and joints (GSI, 2017). The bedrock aquifer map is presented in Figure 4-4 below.

There are no gravel aquifers mapped by the GSI (GSI, 2024) at the site or within a 2.0km radius of the site (GSI, 2024).

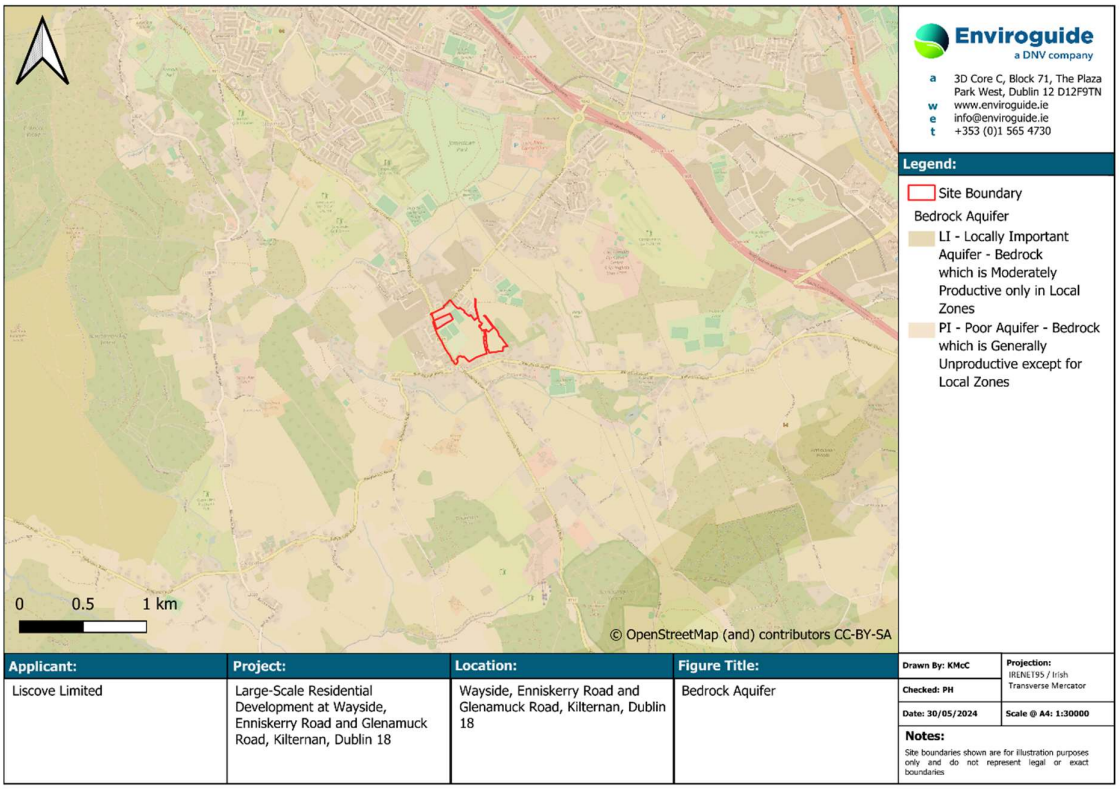

Figure 4-4. Aquifer Classification

4.4.4 Groundwater Vulnerability

The vulnerability categories, and methods for determination, are presented in the Groundwater Protection Schemes publication (DEHLG/EPA/GSI, 1999) and summarised in Table 4-1. The publications state that 'as all groundwater is hydrologically connected to the land surface, it is the effectiveness of this connection that determines the relative vulnerability to contamination. Groundwater that readily and quickly receives water (and contaminants) from the land surface is considered to be more vulnerable than groundwater that receives water (and contaminants) more slowly and in lower quantities. The travel time, attenuation

capacity and quantity of contaminants are a function of the following natural geological and hydrogeological attributes of any area.

Table 4-1. Vulnerability Mapping Criteria (DEHLG/EPA/GSO, 1999)

Subsoil Thickness	Hydrogeological Requirements				
	Diffuse Recharge			Point Recharge	Unsaturated Zone
	Subsoil Permeability & Type			(Swallow holes, losing streams)	(sand & gravel aquifers only)
	High permeability (sand & gravel)	Moderate permeability (sandy subsoil)	Low permeability (clayey subsoil, clay, peat)		
0-3m	Extreme	Extreme	Extreme	Extreme (30m radius)	Extreme
3-5m	High	High	High	N/A	High
5-10m	High	High	Moderate	N/A	High
>10m	High	Moderate	Low	N/A	High
Notes: (i) N/A = not applicable (ii) Permeability classifications relate to the material characteristics as described by the subsoil description and classification method.					

The GSI has assigned a groundwater vulnerability rating of 'High' (H) for the groundwater beneath the majority of the site (GSI, 2024). While the groundwater beneath the eastern boundary of the site is mapped as 'Extreme' (E). The subsoil permeability classification beneath the Site is 'moderate' (GSI, 2024). Based on the moderate permeability and high rating, the depth to bedrock beneath the site is anticipated to be between 0.0mbGL and 10.0mbGL. However, based on the depth to bedrock observed during the site investigations it is considered to be present between 0.9mbGL and 2.4mbGL across the site (SIL, 2006, GII, 2010, GII, 2017 and GII, 2024 included in the Roger Mullarkey & Associates, 2024a Drainage Infrastructure Report submitted with the planning application). Therefore, the groundwater vulnerability can be considered to be 'Extreme' locally beneath the site.

The groundwater vulnerability map is provided in Figure 4-5.

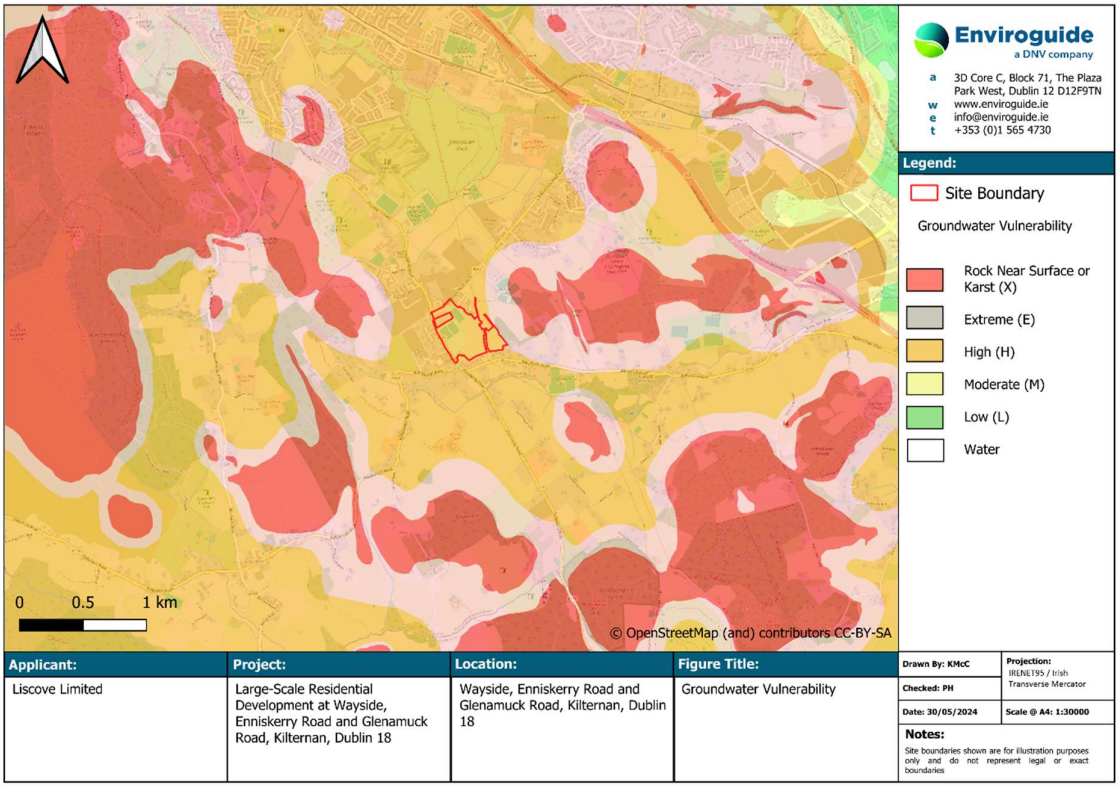

Figure 4-5: Groundwater Vulnerability

4.5 Hydrology

4.5.1 Surface Water Drainage

The site has been mapped by the EPA (EPA, 2024) to be within the Ovoca-Vartry WFD Catchment (ID: 10), the Ovoca-Vartry Hydrometric Area (HA10) and the Dargle_SC_010 Sub-Catchment, (Sub-Catchment ID: 10_5). The majority of the site has been mapped by the EPA (EPA, 2024) to be within the Carrickmines Stream_010 WFD River Sub Basin (IE_EA_10C040350), while the southern portion of the site is mapped within the Shanganagh_010 WFD River Sub Basin (IE_EA_10S010600).

The closest surface water feature is recorded on the EPA database (EPA, 2023) as the Shanganagh River (IE_EA_10S010600), named locally as the Loughlinstown River, which is located approximately 0.3km south / southeast of the site and flows eastwards, discharging to the Irish Sea (South Western Irish Sea - Killiney Bay - IE_EA_G_076), approximately 5.3km east of the site.

The Glenamuck North Stream (IE_EA_10C040350) is located approximately 0.4km north of the site and flows eastwards before converging with the Carrickmines Stream (IE_EA_10C040350) approximately 2.0km northeast of the site. The Carrickmines Stream flows approximately 3.2km downstream in a south-easterly direction before converging with the Shanganagh River approximately 3.9km east of the site (EPA, 2023). The Shanganagh River flows approximately 1.8km downstream in a south-easterly direction before discharging to the Irish Sea approximately 5.3km east of the site.

The surface water features mapped by the EPA within a 2km radius of the site are presented in Figure 4-6.

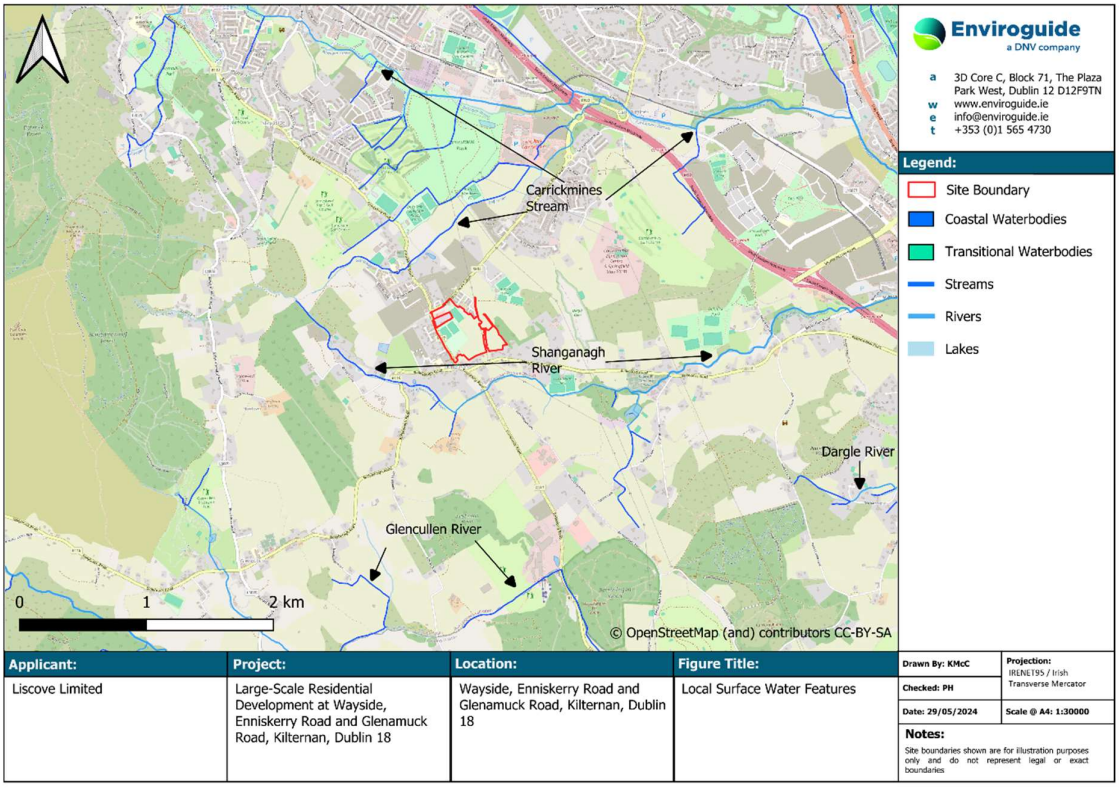

Figure 4-6. Surface Water Features within a 2km Radius of the Site

4.5.2 Existing Surface / Storm Drainage

There is no surface water drainage at the site and no direct hydraulic connection with any water courses.

There is an existing roadside drainage channel located approximately 0.02km north of the site along Glenamuck Road. It is understood that this drainage channel flows approximately 1.4km downstream in a north-easterly direction along Glenamuck Road before discharging to the Glenamuck North Stream. The Glenamuck North Stream flows approximately 0.6km downstream in a north-easterly direction before converging with the Carrickmines Stream.

4.6 Flood Risk

A site-specific flood risk assessment (SFRA) was produced for the subject site and Proposed Development (Roger Mullarkey & Associates, 2024b submitted with the planning application). It assessed the potential flood risk associated with fluvial, groundwater, coastal and pluvial flooding.

The SFRA, which takes into account the impacts of climate change by allowing a 10% increase in rainfall to drainage, 20% increase in flood flow to rivers and a 0.5m sea level rise, identifies that the Site of the Proposed Development is located within Flood Zone C where there is a low risk of flooding (Roger Mullarkey & Associates, 2024b).

The SFRA concludes that the Proposed Development is appropriate at the site and with an overall low risk of fluvial, groundwater, coastal and pluvial flooding (Roger Mullarkey & Associates, 2024b).

4.7 Water Use and Source Protection

The site of the Proposed Development is located within an area serviced by mains water supply. The GSI groundwater wells and springs database (GSI, 2024) lists one (1No.) source within a 2km radius of the site as follows:

- Borehole TW 4 (GSI name: 3221NWW002) is located approximately 0.9km south of the site. The well was drilled to 55mbGL in August 1990 and bedrock was encountered at 11.0mbGL. The source use for the well is domestic, the yield classified is poor with a daily yield of 5.4m^3/day.

The site of the Proposed Development is located in an area serviced by mains water supply. There is an existing 300mm water supply main located along the Enniskerry Road and an existing 250mm water supply main located along Glenamuck Road (refer to Figure 3-2).

There are no Groundwater Source Protection Areas (SPAs) mapped by the GSI (GSI, 2024) within a 2km radius of the site. The closest Groundwater SPAs is the Ballyfolan Spring source located 15.1km southwest of the site.

The Shanganagh River which is located approximately 0.3km south of the site, at its closest point, is mapped by the EPA (EPA, 2024) as a surface water drinking water source under Article 7 of the Water Framework Directive. There are no other surface water drinking sources identified by the EPA (EPA, 2024) within a 2km radius of the site.

4.8 Water Quality

4.8.1 EPA Water Quality- Q Values

The EPA Q-Value assessment 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 values for the operational and historical EPA monitoring locations along the Carrickmines Stream and the Shanganagh River (EPA, 2024) is presented in Table 4-2.

Table 4-2. Relevant EPA Monitoring Stations and Q-Values

River I.D. & Locations	Sample Locations	Monitoring Station	Q-Value & Year
Shanganagh River (0.63km upstream)	Shanganagh Middle Bridge Cabinteely Park	RS10S010100	3 (Poor) in 1990
Shanganagh River (0.27km downstream)	Shanganagh Kilternan Bridge Enniskerry Road	RS10S010440	3-4 (Moderate) in 2000
Shanganagh River (1.45km downstream)	Shanganagh Bridge North of Ballycorus Lead Works	RS10S010450	4 (Good) in 1994
Shanganagh River (4.6km downstream)	At Commons Road	RS10S010600	4 (Good) in 2020
Shanganagh River (5.3km downstream)	SHANGANAGH - Br E of Glebe Ho	RS10S010500	3-4 (Moderate) in 1990
Carrickmines Stream (2.0km downstream)	Carrickmines Stream Glenamuck Road Bridge (Friarsland / Priorsland)	RS10C040200	3 (Poor) in 2003

River I.D. & Locations	Sample Locations	Monitoring Station	Q-Value & Year
Carrickmines Stream (2.9km downstream)	Carrickmines Stream Bridge near Glendruid House	RS10C040300	3-4 (Moderate) in 1990
Carrickmines Stream (3.7km downstream)	Carrickmines Stream Upstream Overpass	RS10C040350	4 (Good) in 2020
Carrickmines Stream (3.9km downstream)	Carrickmines Stream Bridge at Loughlinstown	RS10C040400	3 (Poor) in 2003

4.8.2 EPA Water Quality

The EPA surface water quality monitoring database (EPA, 2024) was consulted. A summary of the most recent published EPA water quality monitoring data (EPA, 2024) for waterbodies which have a potential hydraulic connection to the Site is presented in Table 4-3. It is noted that there is no listed surface water quality data for the Carrickmines Stream river waterbody.

Table 4-3. Surface Water Quality

River Waterbody	Location	EPA WFD Parameter Quality Trend Analysis			
		Parameter	Indicative Quality	Trend	Baseline Concentration (2017) (mg/l)
Shanganagh_010	Br at Friarsland (0.5km upgradient)	Ammonia- Total (as N)	High	Upwards	0.032
		Total Oxidised Nitrogen (as N)	Good	Downwards	1.427
		Ortho-phosphate (as P) – unspecified	Poor	Upwards	0.069
	Br SSW at Carns (Heron Ford Lane) (2.4km downs gradient)	Ammonia- Total (as N)	High	Upwards	0.022
		Total Oxidised Nitrogen (as N)	Good	Downwards	1.310
		Ortho-phosphate (as P) – unspecified	Moderate	Upwards	0.056
	At Commons Road (4.6km downgradient)	Ammonia- Total (as N)	High	None	0.015
		Total Oxidised Nitrogen (as N)	Good	Downwards	1.380
		Ortho-phosphate (as P) – unspecified	Poor	Upwards	0.061

4.8.3 Receiving Water Quality – Shanganagh WWTP (Wastewater Treatment Plant)

Foul water from the site will discharge via the Shanganagh WWTP to the Southwestern Irish Sea - Killiney Bay (HA10). The WWTP is operated under relevant statuary approvals. The most recent available Annual Environmental Report (AER) for the Shanganagh WWTP is 2023 (Irish Water, 2024). The AER identified that the final effluent was compliant with the Emission Limit Values (ELV) specified in the discharge license (D0039-02).

The AER confirms the capacity of the plant will not be exceeded in the next three years. Importantly, the AER notes the following in relation to significance of results:

'The coastal/transitional ambient monitoring results meet the required EQS. The EQS relates to the Oxygenation and Nutrient Conditions set out in the

Surface Water Regulations 2009.

The discharge from the wastewater treatment plant does not have an observable impact on the water quality.

The discharge from the wastewater treatment plant does have an observable impact on the coastal/transitional water quality.

The discharge from the wastewater treatment plant does not have an observable impact on the bathing water quality.

The discharge from the wastewater treatment plant does not have an observable negative impact on the Water Framework Directive status.'

4.9 Water Framework Directive

The WFD status for river, lake, groundwater, transitional and/or coastal water bodies that have a potential hydraulic connection to the subject site as recorded by the EPA (EPA, 2024) in accordance with European Communities (Water Policy) Regulations 2003 (SI no. 722/2003) are provided in Table 4-4 and the locations shown in Figure 4-7.

It is noted that the Glenamuck North and Carrickmines rivers are both part of the Carrickmines Stream_010 WFD sub-catchment.

Table 4-4. Water Framework Directive Status

Waterbody Name	Waterbody EU Code	Location from Site	Distance from Site (km)	WFD Status (2016-2021)	WFD Risk	Hydraulic Connection to the Site
Surface Water Bodies						
Carrickmines Stream_010	IE_EA_10C040350	North	0.50	Good	Not at risk	Yes, via groundwater and surface water drainage from the Proposed Development
Shanganagh_010	IE_EA_10S010600	South	0.31	Good	Not at Risk	Yes, via groundwater and downstream of the Carrickmines Stream_010 river waterbody
Coastal Water Bodies						

Southwestern Irish Sea - Killiney Bay	IE_EA_100_0000	East	5.4	High	Not at risk	Yes, downstream of the Shanganagh_010 and Carrickmines Stream_010 river waterbodies. Also receives treated effluent from the Shanganagh WWTP.
Groundwater Bodies						
Wicklow	IE_EA_G_076	Underlying Aquifer	n/a	Good	At risk	Yes, underlying the Site

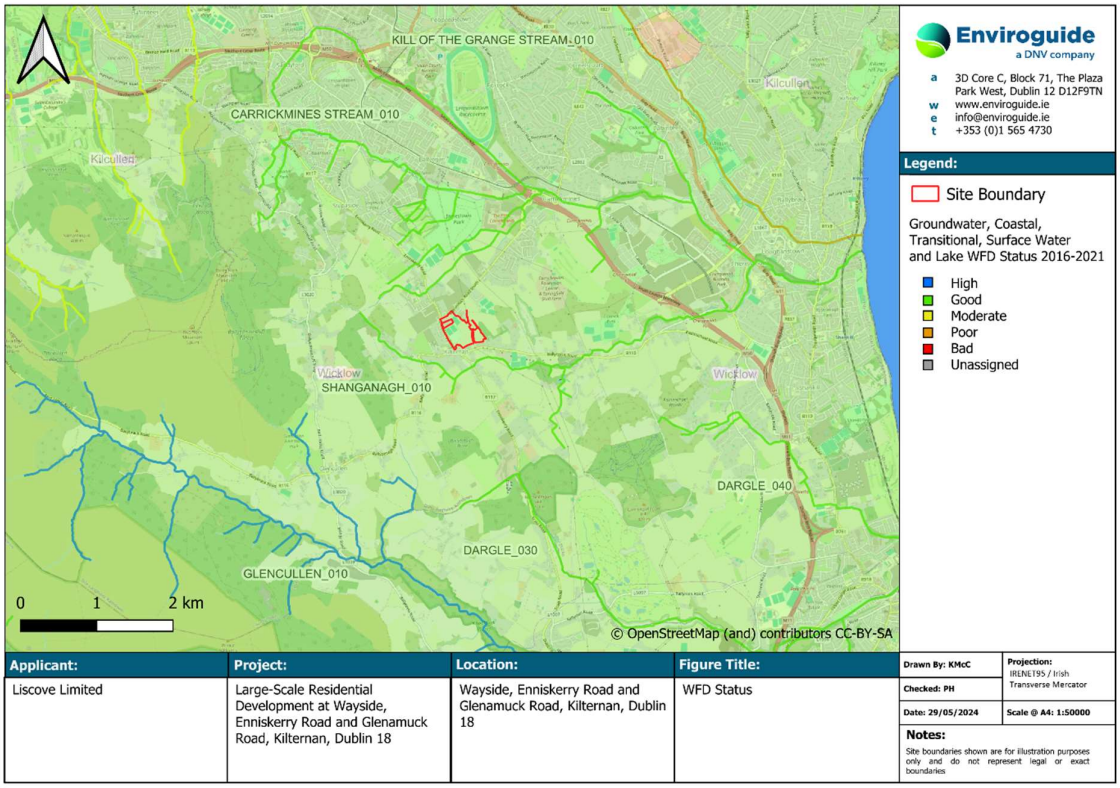

Figure 4-7. Water Framework Directive Status (2016-2021)

4.10 Designated and Protected Areas

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).

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.

The Natura 2000 sites and other protected and designated site identified with a potential hydraulic connection to the site and Proposed Development are summarised in Table 4-5 and presented in Figure 4-8.

Table 4-5. Natura 2000 sites with a Potential Hydraulic Connection to the Site

Site Code	Site Name	Distance and Direction from the Site	Potential for Hydraulic Connection
Special Areas of Conservation (SACs)			
000714	Bray Head SAC	8.01km Southeast	Potential hydraulic connection via the Irish Sea. However, located 5.92km south along the coast from the point of discharge from the Shanganagh River.
003000	Rockabill to Dalkey Island SAC	6.60km East	Potential hydraulic connection via the Irish Sea. However, located 1.50km east from the point of discharge from the Shanganagh River.
Special Protection Areas (SPAs)			
004172	Dalkey Island SPA	7.67km Northeast	Potential hydraulic connection via the Irish Sea. However, located 3.11km north along the coast from the point of discharge from the Shanganagh River.
Proposed Natural Heritage Areas (pNHAs)			
001207	Dingle Glen pNHA	0.52km East	Typical groundwater flow paths are on the order of a few hundred meters, with discharge occurring to the closest surface water feature (i.e., Carrickmines Stream and the Shanganagh River). Therefore, there is no identified hydraulic connection via groundwater.
001211	Loughlinstown Woods pNHA	3.64km East	Indirect hydraulic connection via the Shanganagh_010 and Carrickmines Stream_010 river waterbodies.
001206	Dalkey Coastal Zone And Killiney Hill pNHA	5.04km East	Indirect hydraulic connection via the Shanganagh_010 and Carrickmines Stream_010 river waterbodies and discharges of treated effluent from the Shanganagh WWTP.
000714	Bray Head pNHA	8.01km Southeast	Potential hydraulic connection via the Irish Sea. However, located 5.92km south along the coast from the point of discharge from the Shanganagh River.

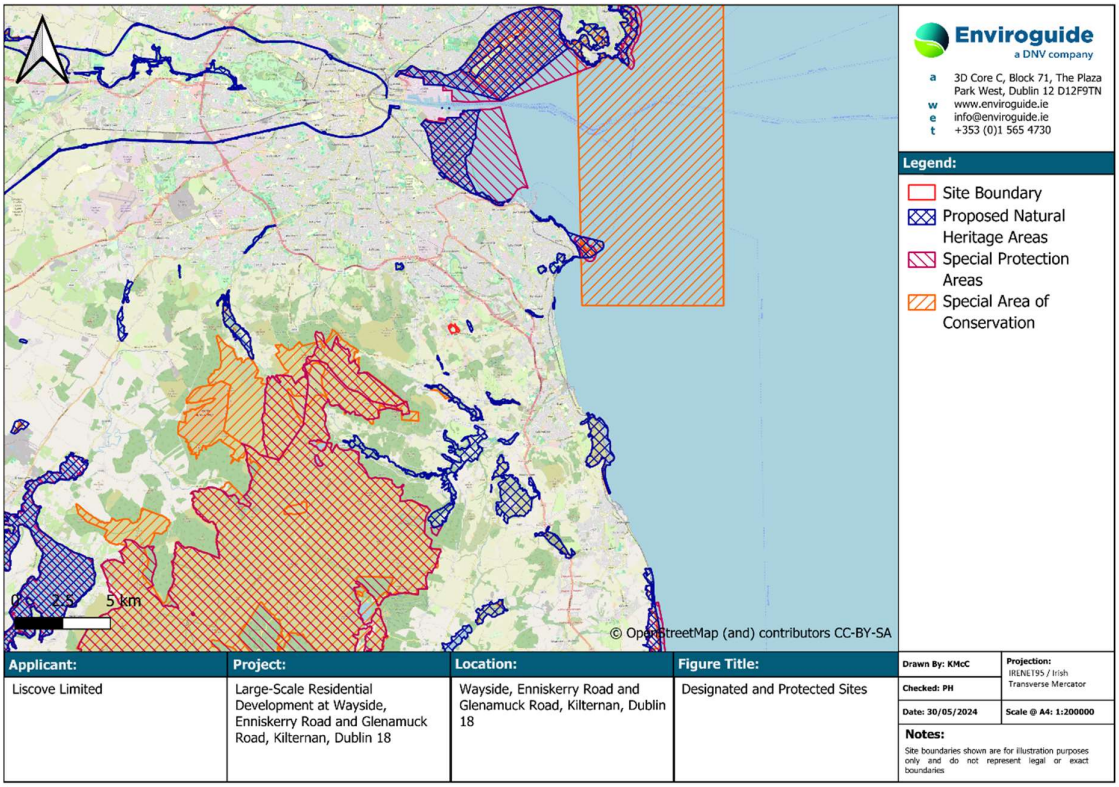

Figure 4-8. Designated and Protected Sites

5 ASSESSMENT OF POTENTIAL IMPACTS

5.1 Conceptual Site Model

As outlined in Section 2.4, the conceptual site model (CSM) represents the characteristics of the site and identified the possible relationship and potential risk between the contaminant sources, pathways and receptors.

The preliminary CSM and identified sources, pathways and receptors associated with the site and Proposed Development are outlined in Section 5.1.1, Section 5.1.2 and Section 5.1.3.

5.1.1 Potential Sources

The potential sources associated with the Proposed Development during construction and operational phase s are discussed below:

5.1.1.1 Construction Phase

During the construction phase there will be no direct discharges to surface water or groundwater at the Proposed Development with the exception of rainfall which will continue to infiltrate to ground during the construction phase.

Based on the finding of the previous site investigations (SIL, 2006, GII, 2010, GII, 2017 and GII, 2024 included in the Roger Mullarkey & Associates, 2024a Drainage Infrastructure Report submitted with the planning application), shallow groundwater is not anticipated and therefore there will be no requirement for dewatering of groundwater during the construction of building foundations and utility infrastructure. However, there may be a requirement for management of surface water (rainwater), where encountered during groundworks. There will be no unauthorised discharge of water (groundwater or surface water runoff) to ground, drains or water courses during the construction phase of the Proposed Development.

Foul water discharge from the temporary welfare units at the site during the construction phase of the Proposed Development will be either tankered offsite in accordance with waste management legislation or discharged under temporary consent to the UE mains foul network for treatment at Shanganagh WWTP subject to agreement with UE.

Potential sources of contamination that could impact on water quality during the construction phase of the Proposed Development based on the design of the site include:

- Storage and use of fuel, oils and chemicals used during construction which in the event of an accidental release through the failure of secondary containment or a materials handling accident could infiltrate to the underlying groundwater.
- Use of concrete and cementitious materials during construction in particular for installation of below ground infrastructure and foundations where shallow groundwater may be encountered.
- Suspended sediment and other contaminants entrained in runoff arising from groundworks, stockpiling of materials and other constructions works at the site.
- Sediment or other material on construction vehicles could potentially be tracked offsite to external public roads.

- Accidental release of wash-water or foul water from facilities at the subject site (e.g., wheel wash and temporary welfare facilities).
- Release of foul water from existing foul water drainage during connection to live sewers.

5.1.1.2 Operational Phase

During the Operational Phase, there will be limited recharge to ground via unpaved, permeable areas due to the low infiltration potential at the Site (GII, 2010, GII, 2017 and GII, 2024 included in the Roger Mullarkey & Associates, 2024a Drainage Infrastructure Report submitted with the planning application).

Surface water runoff from the Proposed Development will be managed in accordance with the principles and objectives of SuDS and GDSDS, surface water will be treated and attenuated prior to discharge from the site to the offsite surface water network.

Foul water from the Proposed Development will be connected to the will eventually discharge to the Shanganagh WWTP via the UE foul drainage network, which was identified to have sufficient capacity to accept foul water from the Proposed Development. The UE CoF dated the 14th June 2024 (UE Reference: CDS24004528) notes that the foul and water supply connections are feasible without infrastructure upgrades by UE. Furthermore, the SODA subsequently received from UE on the 17th June 2024 (UE Reference: CDS24004528) confirms that UE has no objections to the foul water design proposals.

There will be no requirement for bulk storage of petroleum hydrocarbon-based fuels during the operational phase as the main operating system for heating will be air to water heat pump.

The most plausible, albeit worst case, source scenario is outlined:

- Fuels or other potentially hazardous materials released in the event of an accidental spill or leak from a vehicle (assumed 500 litres) is considered a worst-case source at the site. This potential source is considered to be a short-term event in a worst-case scenario and while unlikely to occur, this scenario is considered in this assessment.
- Suspended sediment entrained in runoff is considered a low-risk source of contamination at the site for the operational phase of the Proposed Development.

5.1.2 Pathways

The following potential pathways are identified and evaluated below:

- **Vertical Migration to the Underlying Bedrock and Lateral Migration within the Aquifer to Downgradient Receiving Surface Waterbodies**

  The site is underlain by a Poor Aquifer (Pl) within the granite bedrock with limited capacity to accept recharge and only localised flow paths in the order of a couple of hundred metres. However, groundwater flow paths and potentially contaminants could enter the aquifer and flow locally within the aquifer and migrate towards local watercourses within the catchments of the Carrickmines Stream and the Shanganagh River.

- **Surface Water Runoff and Migration Offsite via Watercourses to Downstream Surface Waterbodies**

There is no direct pathway via surface runoff (open water courses, drainage etc.) to any surface waterbody for the construction phase and operational phase of the Proposed Development. This pathway is therefore not considered further in this assessment.

- **Groundwater Discharge to Mains Sewer and Downstream Receiving Surface Waterbodies**

  Based on the finding of the previous site investigations (SIL, 2006, GII, 2010, GII, 2017 and GII, 2024 included in the Roger Mullarkey & Associates, 2024a Drainage Infrastructure Report submitted with the planning application), shallow groundwater is not anticipated and therefore there will be no requirement for dewatering of groundwater during the construction of building foundations and utility infrastructure. This pathway is therefore not considered further in this assessment.

- **Surface Water Discharge to Mains Sewer and Downstream Receiving Surface Waterbodies**

  There may be a requirement for management of surface water (rainwater) during the construction phase and operational phase of the Proposed Development. Therefore, there will be a pathway for surface water runoff (rainwater) discharged via onsite drainage network during the construction phase and operational phase of the Proposed Development.

  There will be a pathway for surface water runoff discharged via onsite drainage network during the operational phase:

  - Where required, surface water runoff (rainwater) during the construction phase will be discharged offsite in accordance with the necessary discharge licences issued by Irish Water under Section 16 of the Local Government (Water Pollution) Acts and Regulations for any water discharges to sewer (and ultimately the Irish Sea via the Shanganagh WWTP) or from DLRCC under Section 4 of the Local Government (Water Pollution) Act 1977, as amended in 1990 for discharges to surface water (and ultimately the Glenamuck North Stream, the Carrickmines Stream, the Shanganagh River and downstream receiving waterbodies).
  - During the operational phase, attenuated and treated surface water runoff from Catchment 1, Catchment 2, Catchment 3 and Catchment 4 of the Proposed Development will ultimately outfall to the watercourses within the catchments of the Carrickmines Stream and the Shanganagh River.

  Therefore, the pathways to the Glenamuck North Stream, the Carrickmines Stream, Shanganagh River and associated downstream watercourses and receptors are considered valid for this assessment.

- **Foul Water Discharge to Main Sewer and Receiving Surface Waterbodies**

  Foul water during the construction phase of the Proposed Development will be either removed by tanker in accordance with waste management legislation and managed accordingly or discharged under consent to the mains UE foul drainage network. Foul water during the operational phase of the Proposed Development will also be discharged to the UE foul drainage network infrastructure and ultimately discharged to

the South Western Irish Sea - Killiney Bay coastal waterbody via the Shanganagh WWTP. Therefore, the indirect pathway to the Irish Sea is considered in this assessment.

5.1.3 Receptors

The receptors considered in this assessment include the following:

- Groundwater Bodies
  - Underlying poor bedrock aquifer (Pl) which is part of the Wicklow (GWB)
- Surface Waterbodies:
  - Glenamuck North Stream.
  - Carrickmines Stream.
  - Shanganagh River.
- Coastal Water Bodies:
  - South Western Irish Sea - Killiney Bay.
- Natura 2000 sites:
  - Rockabill to Dalkey Island SAC.
  - Loughlinstown Woods pNHA.
  - Dalkey Coastal Zone And Killiney Hill pNHA.

It is noted that there are other Natura 2000 sites with a potential hydraulic connection to the site (refer to Table 4-5) however, those hydraulically closest to the site are considered as the most sensitive Natura 2000 sites for this assessment.

5.2 Risk Evaluation of Source-Pathway-Receptor Linkages

A risk-based assessment of the Source-Pathway-Receptor Model and the potential risk linkages associated with the construction phase and operational phase of the Proposed Development was undertaken. The results were evaluated to determine if the Proposed Development could potentially impact any potential receptors associated with the Site.

Table 5-1. Conceptual Site Model (Source- Pathway Receptor) and Risk Evaluation

Source	Pathway	Receptor	Risk Evaluation and Avoidance
Construction Phase			
Discharge of Contaminants to Ground / Groundwater	Vertical and Lateral Groundwater Migration in Bedrock Aquifer	Underlying Bedrock Aquifer Receiving surface waterbodies (i.e., the Glenamuck North Stream, the Carrickmines Stream, the Shanganagh River and the South Western Irish Sea - Killiney Bay) Natura 2000 Sites	Low to Moderate Risk (worst-case unmitigated scenario) During groundworks and excavations, the groundwater vulnerability will be increased and there will be a more direct pathway for surface contaminants to enter the underlying bedrock aquifer and migrate towards downgradient receiving surface water bodies. However, based on the relatively low recharge potential, it is considered that there is some protection of groundwater from migration of dissolved phase contaminants to the aquifer which will likely be confined to the immediate vicinity of the Site.

Source	Pathway	Receptor	Risk Evaluation and Avoidance
			In a worst-case scenario during the construction phase (e.g., accidental release of fuels, chemicals or oils through the failure of secondary containment or a materials handling accident) in the absence of any mitigation measures there is potential for discharge of contaminants to groundwater. The groundwater within the Wicklow GWB may be impacted locally in the immediate vicinity of the Site however taking account of the characteristics of the poor granite bedrock aquifer it is unlikely that there would be widespread impact within the Wicklow GWB. However, taking account of the local hydrogeological regime including the distance downgradient to the closest water courses and fact that groundwater flow paths are localised and baseflow is limited within the granite aquifer (GSI, 2023) it is considered that there is a negligible risk to watercourses within the catchments of the Carrickmines Stream and the Shanganagh River and associated waterbodies and Natura 2000 sites via groundwater flow from the Site. Appropriate design avoidance and mitigation measures in accordance with the CEMP will prevent any potential impact to the receiving water quality.
Discharge of Surface Water Runoff (i.e., Rainwater)	Discharge to Mains Sewer	Receiving surface waterbodies (i.e., the Glenamuck North Stream, the Carrickmines Stream, the Shanganagh River and the South Western Irish Sea - Killiney Bay) Natura 2000 Sites	Low Risk Surface water runoff (rainwater) during the construction phase will be discharged to the existing drainage network (foul or surface water) following appropriate treatment (e.g., settlement or hydrocarbon interceptor) in accordance with the necessary discharge licences issued by UE under Section 16 of the Local Government (Water Pollution) Acts and Regulations or by DLRCC under Section 4 of the Local Government (Water Pollution) Act 1977, as amended in 1990 and ultimately discharged to the receiving surface waterbodies (i.e., the Glenamuck North Stream or the South Western Irish Sea - Killiney Bay via Shanganagh WWTP).
Foul Water Discharge	Discharge to Mains Sewer	Receiving surface waterbodies (i.e., the South Western Irish Sea - Killiney Bay)	Low Risk Foul water during the construction phase of the Proposed Development will be either removed by tanker in accordance with waste management legislation and managed accordingly or discharged

Source	Pathway	Receptor	Risk Evaluation and Avoidance
		Natura 2000 Sites	under consent to the mains UE drainage network and ultimately discharged to the receiving surface waterbodies (i.e., the South Western Irish Sea - Killiney Bay via Shanganagh WWTP). Foul water from the site will only be discharged to the UE network under the appropriate consents from UE and therefore, the Proposed Development will not cause a potential impact at any receiving waterbody or Natura 2000 sites associated with discharges from the site.
Operational Phase			
Discharge of Surface Water Runoff	Discharge to Surface Water Drainage Network	Receiving surface waterbodies (i.e., the Glenamuck North Stream, the Carrickmines Stream, the Shanganagh River and the South Western Irish Sea - Killiney Bay) Natura 2000 Sites	Low to Moderate Risk (worst-case unmitigated scenario) During the operational phase of the Proposed Development, there is limited potential for discharge of any contaminated runoff to the receiving water courses associated with surface water runoff from the Site which will be managed and treated in accordance with SUDS and pass through petrol interceptor and attenuation tanks prior to discharging offsite. However, in a worst-case scenario during the operational phase (e.g., failure of SuDS) in the absence of any mitigation measures there is potential for discharge of contaminants from Catchment 1 and Catchment 3 impacting the receiving water quality of the roadside drainage channel on Glenamuck Road, the Glenamuck North Stream and within the Carrickmines Stream locally at the point of discharge to the Carrickmines Stream. However, it is considered that there would be no impact to water quality downstream where the Carrickmines Stream confluences with the Shanganagh River taking account of the nature of the incident, the separation distances and the potential for assimilation within the receiving water bodies. There would also be no potential impact on water quality where the Shanganagh River discharges to the Irish Sea. Accordingly, in the event of an unmitigated worst-case source scenario there is no identified potential impact on the closest hydraulically connected Natura 2000 sites. Surface water from Catchment 2 and Catchment 4 (and eventually Catchment 1) of the Proposed Development will be

Source	Pathway	Receptor	Risk Evaluation and Avoidance
			discharged to the mains drainage network within the GLDR/GDRS roads project. The EIAR (DBFL, 2019) prepared for the GLDR/GDRS roads project identified that discharges from the GLDR/GDRS incorporating connections from the Proposed Development will have no impact on the receiving water environment. Therefore, in the unmitigated worst-case source scenario, the discharge of surface water from Catchment 2 and Catchment 4 (and eventually Catchment 1) would be treated and attenuated within the GLDR/GDRS surface water drainage network prior to discharging to receiving waters and there would be no impact on the receiving water quality downstream of the site.
Discharge of Contaminants to Ground / Groundwater	Vertical and Lateral Groundwater Migration in Bedrock Aquifer	Underlying Bedrock Aquifer Receiving surface waterbodies (i.e., the Glenamuck North Stream, the Carrickmines Stream, the Shanganagh River and the South Western Irish Sea - Killiney Bay) Natura 2000 Sites	No Identified Risk Based on the design of the Proposed Development there is limited potential sources of contamination during the operational phase and there will be limited potential for discharge of contaminants associated with surface water runoff to ground via unpaved, permeable areas due to the low infiltration potential at the site. Surface water will be managed in accordance with the principles and objectives of SuDS and the GDSDS to treat and attenuate water prior to discharging offsite. Ongoing regular operational monitoring and maintenance of drainage and the SuDS measures will be incorporated into the overall management strategy for the Proposed Development. This will ensure that there are no impacts on water quality during the operational phase of the Proposed Development.
Foul Water Discharge	Discharge to Mains Sewer	Receiving surface waterbodies (i.e., the South Western Irish Sea - Killiney Bay) Natura 2000 Sites	Low Risk Foul water during the operational phase of the Proposed Development will be discharged to the UE drainage network and ultimately discharged to the South Western Irish Sea - Killiney Bay via the Shanganagh WWTP. Foul water from the site will only be discharged to the UE network under the appropriate consents from UE, and therefore, the Proposed Development will not cause a potential impact at any receiving waterbody or Natura 2000 sites associated with discharges from the site.

5.2.1 Design Avoidance and Mitigation

The assessment of the potential impacts on the receiving environment takes account of the embedded design avoidance measures and standard good practice construction methods to reduce the potential for impacts to the water environment. These are outlined below together with additional specific measures based on the findings of this assessment.

5.2.1.1 Construction Phase

During the construction phase, all works will be undertaken in accordance with the Construction Management Plan (CMP) (Atkins, 2024 submitted with the planning application) and the Construction Environmental Management Plan (CEMP) (EGC, 2024 submitted with the planning application). Following appointment, the contractor will be required to further develop the CMP and CEMP to provide detailed construction phasing and methods to manage and prevent any potential emissions to ground with regard to the relevant industry standards (e.g., Guidance for Consultants and Contractors, CIRIA-C532', CIRIA, 2001). The CMP and CEMP will be implemented for the duration of the Construction Phase, covering construction and waste management activities that will take place during the construction phase of the Proposed Development. Mitigation works will be adopted as part of the construction works for the Proposed Development. These measures will address the main activities of potential impact which include:

- Control and Management of surface water runoff.
- Control and management of shallow groundwater during excavation and dewatering (if required).
- Management and control of soil and materials.
- Appropriate fuel and chemical handling, transport and storage.
- Management of accidental release of contaminants at the Site.

Surface water runoff management will be required to prevent runoff entering excavations during construction. 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.

Where water must be pumped from the excavations during the construction phase of the Proposed Development, water will be discharged by the contractor, following appropriate treatment (e.g., settlement or hydrocarbon interceptor) to sewer in accordance with the necessary discharge licences issued by UE under Section 16 of the Local Government (Water Pollution) Acts and Regulations for any water discharges to sewer or from FCC under Section 4 of the Local Government (Water Pollution) Act 1977, as amended in 1990 for discharges to surface water. Under no circumstances will any untreated wastewater generated onsite (from equipment washing, road sweeping etc.) be released to ground or to drains. Where required, all public sewers will be protected to ensure that any untreated wastewater generated onsite enters the public sewers.

Pumping of concrete will be monitored to ensure that there is no accidental discharge. All work will be carried out in the dry and effectively isolated from any onsite drains. A suitable risk assessment for wet concreting will be completed prior to works being carried out. There will be no mixer washings or excess concrete discharged onsite. All excess concrete is to be removed from site and all washout of concrete chutes to be captured in a tank which shall be removed offsite for disposal at an authorised waste facility.

All below ground drainage infrastructure will be constructed in accordance with current UE requirements to ensure that there are no potential impacts to groundwater quality.

Welfare facilities have the potential, if not managed appropriately, to release organic and other contaminants to ground or surface water courses. Foul drainage from temporary welfare facilities during the construction phase of the Proposed Development will either be discharged to temporary holding tank(s), the contents of which will periodically be tankered off site to a licensed facility or discharged to public sewer in accordance with the necessary temporary discharge licences issued by UE.

The Shanganagh WWTP is operated in accordance with relevant statutory approvals issued by UE. The AER identified that the final effluent was compliant with the ELVs specified in the discharge license (D0039-02). Furthermore, the AER confirms that the WWTP does not have an observable impact on the water quality, nor does it have an observable negative impact on the Water Framework Directive status. The AER also confirms the capacity of the plant will not be exceeded in the next three years. The increase discharge to the Shanganagh WWTP as a result of the Proposed Development is considered to be insignificant in terms of the overall scale of the facility. The increased load does not have the capacity to alter the effluent released from the WWTP to such an extent as to result in likely significant effects on its receiving waters. Foul water from the Site will only be discharged to the UE network under the appropriate consents from UE and therefore, the Proposed Development will not cause a potential impact at any Natura 2000 sites associated with discharges from the site.

5.2.1.2 Operational Phase

Based on the design of the Proposed Development there is limited potential sources of contamination during the operational phase and there will be limited potential for discharge of contaminants associated with surface water runoff to ground via unpaved, permeable areas due to the low infiltration potential at the Site. Furthermore, the proposed attenuation design does not allow for infiltration due to its proximity to building foundations. Surface water will be managed in accordance with the principles and objectives of SuDS and the GDSDS to treat and attenuate water prior to discharging offsite. Ongoing regular operational monitoring and maintenance of drainage and the SuDS measures will be incorporated into the overall management strategy for the Proposed Development. This will ensure that there are no impacts on water quality and quantity (flow regime) during the Operational Phase of the Proposed Development.

Foul water during the operational phase of the Proposed Development will ultimately discharge via the Shanganagh WWTP to the South Western Irish Sea - Killiney Bay under the appropriate consents from UE. As mentioned above, the Shanganagh WWTP, does not have an observable impact on the water quality, nor does it have an observable negative impact on the Water Framework Directive status. Foul water from the site will only be discharged to the UE network under the appropriate consents from UE, and therefore, the Proposed Development will not cause a potential impact at any Natura 2000 sites associated with discharges from the site.

5.2.2 Potential Impact on Natura 2000 Sites

Based on the findings of this assessment, it is considered that in applying the precautionary principle and assessing a worst case scenario there is no identified potential negative impact associated with the Proposed Development on the closest hydraulically connected Natura

2000 sites and other protected and designated sites in particular the Rockabill to Dalkey Island SAC, and Dalkey Island SPA, Loughlinstown Woods pNHA and Dalkey Coastal Zone and Killiney Hill pNHA individually or in-combination.

5.2.3 Water Framework Directive Status

The findings of the risk-based assessment identified that in the absence of any mitigation and avoidance measures there could be a potential impact on the water quality within receiving water bodies associated with the Proposed Development, specifically within a local zone of the Wicklow Groundwater Body and with the Carrickmines Stream_010 river waterbody (i.e., within the Glenamuck North Stream and locally within the Carrickmines Stream). There is no identified potential impact to the Shanganagh_010 river waterbody, and the Southwestern Irish Sea - Killiney Bay coastal waterbody attributed to the separation distances and anticipated assimilation capacity of the receiving water bodies taking account of the existing baseline conditions and WFD Status.

The mitigation measures as outline above, including the implementation of the CEMP during the construction phase of the Proposed Development and the incorporation of SUDS in accordance with the GDSDS in the design of the operation phase of the Proposed Development, will prevent any impact on the receiving groundwater and surface water environment. Hence, the Proposed Development will not have any impact on compliance with the EU Water Framework Directive, European Communities (Environmental Objectives) Surface Water Regulations, 2009 (SI 272 of 2009, as amended 2012 (SI No 327 of 2012), and the European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010), as amended 2012 (SI 149 of 2012) and 2016 (S.I. No. 366 of 2016).

The Proposed Development will not cause a deterioration in the status of waterbodies hydraulically connected with the Proposed Development, taking account of design avoidance and mitigation measures that will be implemented. The Proposed Development will not jeopardise the objective to achieve ‘good’ surface water status or good ecological potential.

There will be no impact to the existing WFD status of water bodies associated with the Proposed Development including the Carrickmines Stream_010 and the Shanganagh_010 river waterbodies, the Southwestern Irish Sea - Killiney Bay coastal waterbody and the Wicklow GWB as a result of the Proposed Development taking account of embedded design avoidance and mitigation measures.

6 CONCLUSIONS

Enviroguide Consulting carried out a risk-based hydrological and hydrogeological impact assessment for the Proposed Development to determine if there is any potential for significant impacts on the receiving water environment and designated Natura 2000 sites in the absence of avoidance and mitigation measures.

The CSM was developed identifying plausible S-P-R linkages for the Proposed Development and receiving water environment. The CSM formed the basis of the evaluation of any potential impacts to receptors including water bodies and Natura 2000 sites associated with the Proposed Development. The assessment assumed a worst-case scenario (individually and in-combination) and in the absence of any mitigation measures intended to avoid or reduce potential harmful effects.

Based on the findings of this assessment the following can be concluded:

- Assuming a worst-case scenario (e.g., accidental release of fuels, chemicals or oils through the failure of secondary containment or a materials handling accident during the construction phase or SuDS failure during the operational phase) at the site and taking account of the local hydrogeological regime, there is a potential risk of impact to local groundwater quality, however there is no identified potential impact on the receiving surface water bodies via groundwater flow from the site.
- There are no identified direct pollutant linkages between the Site via surface water courses to receiving water bodies.
- There is a potential risk associated with the indirect (mains drainage) discharge of surface water runoff from Catchment 1 and Catchment 3 of the Proposed Development on the receiving water quality of the roadside drainage channel on Glenamuck Road, the Glenamuck North Stream and potentially locally within the Carrickmines Stream. However, considering the separation distances and the potential for assimilation within the receiving water bodies there is no identified impact to the downstream Shanganagh River and the Southwestern Irish Sea - Killiney Bay.
- There is no potential risk associated with the indirect (mains drainage) discharge of surface water runoff from Catchment 2 and Catchment 4, and eventually Catchment 1, of the Proposed Development which will be attenuated within the GDRS surface water drainage network prior to discharge to receiving surface watercourses within the catchments of the Carrickmines Stream and the Shanganagh River and associated downstream waterbodies and receptors.
- There is no identified risk to water quality via foul water drainage or discharges from the Proposed Development that will ultimately be discharged to the Southwestern Irish Sea - Killiney Bay via Shanganagh WWTP under appropriate consent from UE.
- The appropriate standard design measures for the construction phase and operational phase of the Proposed Development including implementation of the CEMP and SuDS measures within the drainage design will prevent, limit and mitigate any potential for the worst-case scenario to occur. These embedded measures will ensure there is no risk to water quality of the receiving watercourses.
- In the unmitigated worst-case scenario, there is no identified negative impact on the closest hydraulically connected Natura 2000 sites and other protected and designated

sites in particular the Rockabill to Dalkey Island SAC, and Dalkey Island SPA, Loughlinstown Woods pNHA and Dalkey Coastal Zone and Killiney Hill pNHA associated with Proposed Development individually or in-combination.

- There is no identified impact to the existing WFD status of water bodies associated with the Proposed Development including the Carrickmines Stream_010 and the Shanganagh_010 river waterbodies, the Southwestern Irish Sea - Killiney Bay coastal waterbody and the Wicklow GWB as a result of the Proposed Development taking account of design avoidance and mitigation measures that will be implemented as described.

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