7 LAND, SOILS, GEOLOGY & HYDROGEOLOGY

7.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) provides an assessment of the existing environmental setting and the likely significant impacts on land, soil, geological and hydrogeological aspects, associated with the proposed residential development at Portmarnock South Phase 1D in the townlands of Drumnigh, Maynetown and Portmarnock, Portmarnock, Co Dublin. The characteristics of the potential and predicted impacts during the Construction and Operational Phase of the development are assessed and evaluated. Where an impact is identified, appropriate mitigation measures to avoid any identified significant effects to land, soils and geology are recommended and the residual impacts of the Proposed Development post-mitigation are assessed.

The Proposed Development (Phase 1D) which consists of 172no. residential units, described in detail in Chapter 3: Description of Proposed Development and in Section 7.4 below are situated on lands designated for new residential communities in accordance with the Portmarnock South Local Area Plan 2013 (as extended).

This assessment was drafted by Kieran O'Dwyer who is an Associate Director with J. B. Barry and Partners and has over 40 years' experience in the field of environmental and hydrogeological consultancy. He was formerly a director with K. T. Cullen and Co. Ltd (Environmental Consultants) and a Regional Director with WYG Ireland. Kieran has been responsible for the Land Soils and Hydrogeology element of numerous Environmental Impact Assessments (including TII tranche 4 motorway service areas (3 No.), NRA Tranche 4 Motorway Service Areas (5 No. oral hearings) and Ringsend Wastewater Treatment Plant Upgrade Project) and has presented specialist evidence at numerous oral planning hearings.

7.2 Assessment Methodology

The assessment has been carried out generally in accordance with the following guidelines: -

- Construction Industry Research and Information Association (CIRIA, 2001). Control of Water Pollution from Construction Sites.
- Construction Industry Research and Information Association (CIRIA, 2000). Environmental Handbook for Building and Civil Engineering Projects.
- Environmental Protection Agency (EPA, 2017). Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports.
- Environmental Protection Agency (EPA, 2015). Draft Advice Notes on Current Practice in the Preparation of Environmental Impact Statements.
- Institute of Geologists of Ireland (IGI, 2013). Guidelines for the preparation of Soils Geology and Hydrogeology Chapters of Environmental Impact Statements.
- National Roads Authority (NRA, 2009). Guidelines on Procedures for the Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.

The principal attributes and impacts to be assessed in the vicinity of the Proposed Development include the following: -

- Land classification and cover.
- Soil and subsoil classification, the quality, drainage characteristics and range of agricultural uses of soil, the extent of topsoil and subsoil cover and the potential use of this material on-site as well or requirement to remove it off-site as waste for disposal or recovery.
- Bedrock geology.
- Geological heritage sites.

- Landfills, industrial sites and the potential risk of encountering contaminated ground.
- Quarries or mines in the vicinity, the potential implications (if any) for existing activities and extractable reserves.
- Aquifer classification and extent of aquifers underlying the development perimeter area and increased risks presented to them by the proposed project e.g. removal of subsoil cover, removal of aquifer (in whole or part), drawdown in water levels, alteration in established flow regimes, change in groundwater quality.
- High-yielding water supply springs / wells in the vicinity of the Proposed Development to within a 2km radius and the potential for increased risk presented by the proposed project.
- Natural hydrogeological / karst features and potential for increased risk presented by the activities at the proposed site.
- Groundwater dependent terrestrial ecosystems and the increased risk presented by operations.

The assessment approach follows the methodology set out in Appendix C2 NRA Guidance of the Institute of Geologists of Ireland (IGI, 2013). Guidelines for the preparation of Soils Geology and Hydrogeology Chapters of Environmental Impact Statements, namely: -

- **Step 1** – Quantify the importance of the feature for geology and for hydrogeology (Tables 7.1 and 7.2 respectively).
- **Step 2** – Estimate the magnitude of the impact on the feature from the Proposed Development (Tables 7.3 and 7.4).
- **Step 3** – Determine the significance of the impact on the feature (Table 7.5).

Importance	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a regional or national scale. Degree or extent of soil contamination is significant on a national or regional scale. Volume of peat and/or soft organic soil underlying route is significant on a national or regional scale.	Geological feature rare on a regional or national scale (NHA). Large existing quarry or pit. Proven economically extractable mineral resource.
High	Attribute has a high quality, significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and/or soft organic soil underlying route is significant on a local scale.	Contaminated soil on site with previous heavy industrial usage. Large recent landfill site for mixed wastes. Geological feature of high value on a local scale (County Geological Site). Well drained and/or high fertility soils. Moderately sized existing quarry or pit. Marginally economic extractable mineral resource.
Medium	Attribute has a medium quality, significance or value on a local scale. Degree or extent of soil contamination is moderate on a local scale. Volume of peat and/or soft organic soil underlying route is moderate on a local scale.	Contaminated soil on site with previous light industrial usage. Small recent landfill site for mixed wastes. Moderately drained and/or moderate fertility soils. Small existing quarry or pit. Sub-economic extractable mineral resource.
Low	Attribute has a low quality, significance or value on a local scale.	Large historical and/or recent site for construction and demolition wastes.

	Degree or extent of soil contamination is minor on a local scale. Volume of peat and/or soft organic soil underlying route is small on a local scale.	Small historical and/or recent landfill site for construction and demolition wastes. Poorly drained and/or low fertility soils. Uneconomically extractable mineral resource.

Table 7.1: Criteria for Rating Site Importance of Geological Features.

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale.	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g. SAC or SPA status.
Very High	Attribute has a high quality or value on a regional or national scale.	Regionally Important Aquifer with multiple wellfields. Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – e.g. NHA status. Regionally important potable water source supplying >2500 homes. Inner source protection area for regionally important water source.
High	Attribute has a high quality or value on a local scale.	Regionally Important Aquifer. Groundwater provides large proportion of baseflow to local rivers. Locally important potable water source supplying >1000 homes. Outer source protection area for regionally important water source. Inner source protection area for locally important water source.
Medium	Attribute has a medium quality or value on a local scale.	Locally Important Aquifer. Potable water source supplying >50 homes. Outer source protection area for locally important water source.
Low	Attribute has a low quality or value on a local scale.	Poor Bedrock Aquifer. Potable water source supplying <50 homes.

Table 7.2: Criteria for Rating Site Importance of Hydrogeological Features.

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute.	Loss of high proportion of future quarry or pit reserves. Irreversible loss of high proportion of local high fertility soils. Removal of entirety of geological heritage feature Requirement to excavate / remediate entire waste site. Requirement to excavate and replace high proportion of peat, organic soils and/or soft mineral soils beneath alignment.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute.	Loss of moderate proportion of future quarry or pit reserves. Removal of part of geological heritage feature. Irreversible loss of moderate proportion of local high fertility soils. Requirement to excavate / remediate significant proportion of waste site.

		Requirement to excavate and replace moderate proportion of peat, organic soils and/or soft mineral soils beneath alignment.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute.	Loss of small proportion of future quarry or pit reserves. Removal of small part of geological heritage feature. Irreversible loss of small proportion of local high fertility soils and/or high proportion of local low fertility soils. Requirement to excavate / remediate small proportion of waste site. Requirement to excavate and replace small proportion of peat, organic soils and/or soft mineral soils beneath alignment.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity.	No measurable changes in attributes
Minor Beneficial	Results in minor improvement of attribute quality.	Minor enhancement of geological heritage feature
Moderate Beneficial	Results in moderate improvement of attribute quality.	Moderate enhancement of geological heritage feature
Major Beneficial	Results in major improvement of attribute quality.	Major enhancement of geological heritage feature

Table 7.3: Criteria for Rating Impact Significance at EIS Stage – Geology Attribute.

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute and/or quality and integrity of attribute.	Removal of large proportion of aquifer. Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems. Potential high risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >2% annually.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute.	Removal of moderate proportion of aquifer. Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems. Potential medium risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >1% annually.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute.	Removal of small proportion of aquifer. Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems. Potential low risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >0.5% annually.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity.	Calculated risk of serious pollution incident <0.5% annually.

Table 7.4: Criteria for Rating Impact Significance at EIS Stage – Hydrogeology Attribute.

Importance of Attribute	Magnitude of Impact			
	Negligible	**Small Adverse**	**Moderate Adverse**	**Large Adverse**
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant / Moderate	Profound / Significant	Profound
High	Imperceptible	Moderate / Slight	Significant / Moderate	Profound / Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight / Moderate

Table 7.5: Rating of Significant Environmental Impacts.

7.2.1 Sources of Information

The information on land, soils and geology underlying the Proposed Development has been compiled from a desk study assessment of available published information from national databases and site archives. The following sources were reviewed for collection of baseline regional data: -

- Geological Survey of Ireland (GSI) – data and maps.
- Teagasc- soils and subsoils database.
- Ordnance Survey Ireland (OSI) – 1:50,000 Discovery Series Map and historical mapping.
- Environmental Protection Agency (EPA) – data and maps.
- National Parks and Wildlife Services (NPWS) – Protected Site Register.

Site specific information was derived from site investigations carried out on the Proposed Development area and include: -

- Site Investigations Ltd (2018). Site Investigation Report, Portmarnock South-Phase 1B, Portmarnock, Co. Dublin,
- Glover Site Investigations Ltd. (2006). Site Investigation, Proposed Development at Portmarnock, Co. Dublin.

7.3 Receiving Environment

The proposed site is located within Portmarnock South Growth Area 1, Phase 2, in the townlands of Drumnigh, Maynetown and Portmarnock, Portmarnock, Co Dublin, c. 11km north-east of the city centre. The total site area is c. 11.05 hectares (Ha). The site is on lands north of Moyne / Mayne Road and south of Station Road, east of the Dublin-Belfast / (DART) Railway Line, and to the west of the Coast Road. Access to the development will be from Station Road to the north and Moyne Road to the south.

The proposed site is immediately south of previous Phases 1A, 1B and 1C of the development. Currently, Phase 1C is under construction and Phases 1A and 1B have been completed and are fully occupied. Refer to Figure 7.1.

The site is undeveloped and historically greenfield in nature. There is a temporary construction compound associated with the on-going development of Phase 1C to the north of the proposed development. The Portmarnock South Growth Area 1 Phase 1 and Growth Area 2 lie adjacent to the proposed lands. The Portmarnock Golf Club and Portmarnock Beach are located c. 1.6km south-east and c. 1.9km east of the proposed development. There is also a residential development 50m north-east of the proposed development, one-off house 180m south and a residential estate c. 420m south-east of the site. The area surrounding the site is predominately residential in nature.

The surrounding land to the site is a mix of remnant agricultural, parkland and residential development. The site is zoned as RA – 'New Residential'. The objective for these zoned lands is to *"Provide for new residential communities in accordance with approved local area plans and subject to the provision of the necessary social and physical infrastructure."*

Figure 7.1: Site Location.

7.3.1 Topography and Setting

The lands slope to the north towards the Sluice River, to the east towards the Mayne Estuary and to the south towards the Mayne River. The site generally falls from a high contour of 15m mid-way (and within the Proposed Development) along the western boundary adjoining the rail line to a 12m contour in the centre of the site. The ground levels around the perimeter are typically; 10m contour in the northwest by the railway station, 4.5m contour in the northeast adjoining Station Road, falling to 2m contour toward the estuary and 2m contour in the southeast along Moyne Road.

7.3.2 Land, Soils and Geology

7.3.2.1 Land

Current land uses for the Proposed Development according to Corine 2018 is non-irrigated arable lands (Code_18_211) and comprises of agricultural areas. The land adjacent to the north-east is described as discontinuous urban fabric (Code_18_112) and comprises of artificial surfaces. The areas to c. 600m south of the development are described as construction site and artificial surfaces. The area c. 330m east of the site comprises of salt marshes and intertidal flats. Refer to Figure 7.2.

There are no National Parks & Wildlife Services (NPWS) protected sites within the study area. However, the protected sites in immediate vicinity of the development are summarised in Table 7.1. These include Special Areas of Conservation (SAC), Special Protection Areas (SPA) and proposed National Heritage Sites (pNHA).

We note the Natura Impact Statement which accompanies this SHD Planning Application includes the Malahide Estuary (004025) and North Bull Island (004006) for appraisal as well as the protected sites listed in Table 7.1 below, however they go on to note that *"there is no potential for habitat loss within the SPA or for impacts via emissions to surface water".* Therefore, they are not included in this assessment.

Site Code	Site Name	Distance from the Proposed Development	Features of Interest
000199	**Baldoyle Bay SAC**	600m east	[1140] Tidal Mudflats and Sandflats [1310] Salicornia Mud [1330] Atlantic Salt Meadows [1410] Mediterranean Salt Meadows
004016	**Baldoyle Bay SPA**	600m east	A046 Brent Goose (*Branta bernicla hrota)* A048 Shelduck (*Tadorna tadorna)* A137 Ringed Plover (*Charadrius hiaticula)* A140 Golden Plover (*Pluvialis apricaria)* A141 Grey Plover (*Pluvialis squatarola)* A157 Bar-tailed Godwit (*Limosa lapponica)* A999 Wetlands
000199	**Baldoyle Bay pNHA**	600m east	Designated pNHA
001763	**Sluice River Marsh pNHA**	720m north	Designated pNHA

Table 7.6: NPWS Sites identified in close proximity of the Proposed Development.

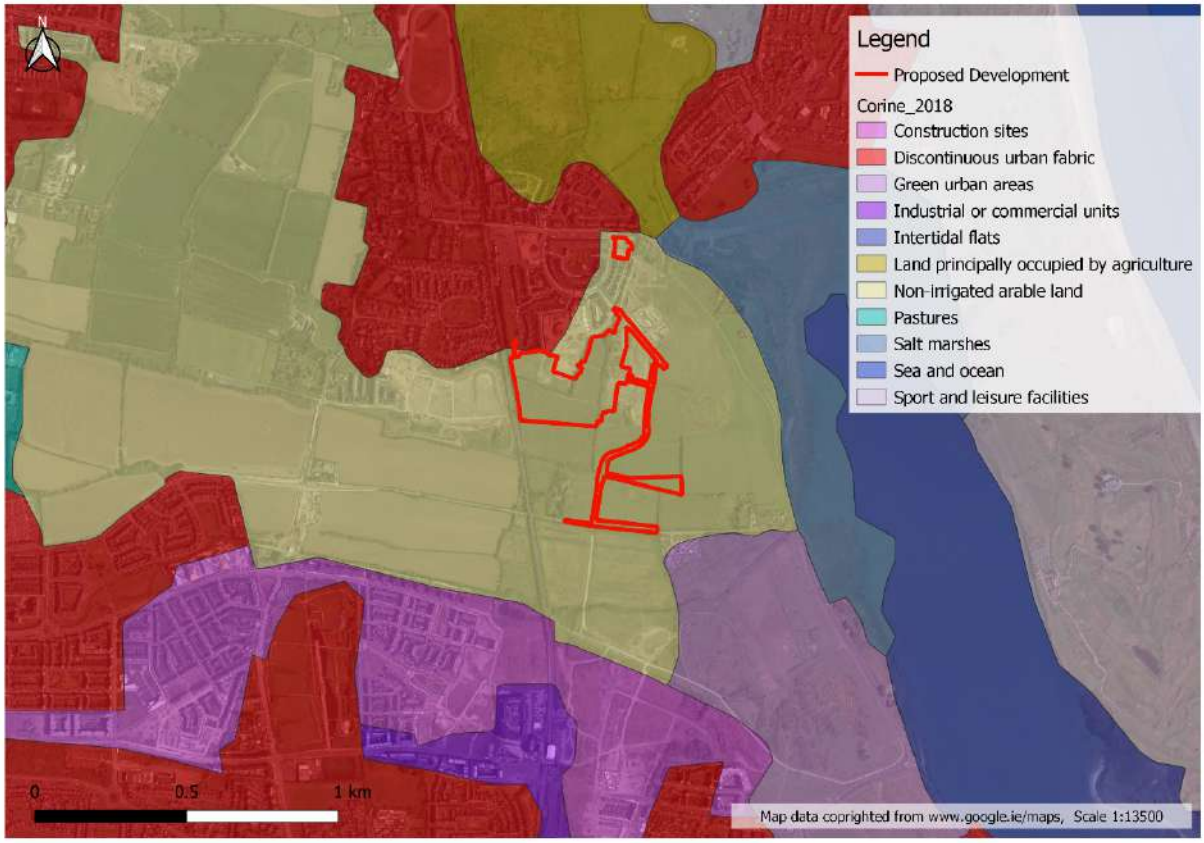

Figure 7.2: Corine Landcover 2018.

7.3.2.2 Soils

The Teagasc soil mapping indicates that the soils beneath the proposed site are comprised primarily of deep well drained mineral soil derived from calcareous parent material (BminDW) and poorly drained mineral soil derived from calcareous parent materials (BminPD). A narrow section of Alluvial soils (AlluvMIN) also traverses the proposed site access (following a ditch line) in the southern half close to Moyne/Mayne Road.

The Corine 2018 classifies this area as agricultural land used for pastural farming and as a non-irrigated arable land. However, soils have been previously stripped and part of the area is now in use as a construction compound and a temporary haul road south towards Moyne Road. The soil mapping for the site is presented below in Figure 7.3.

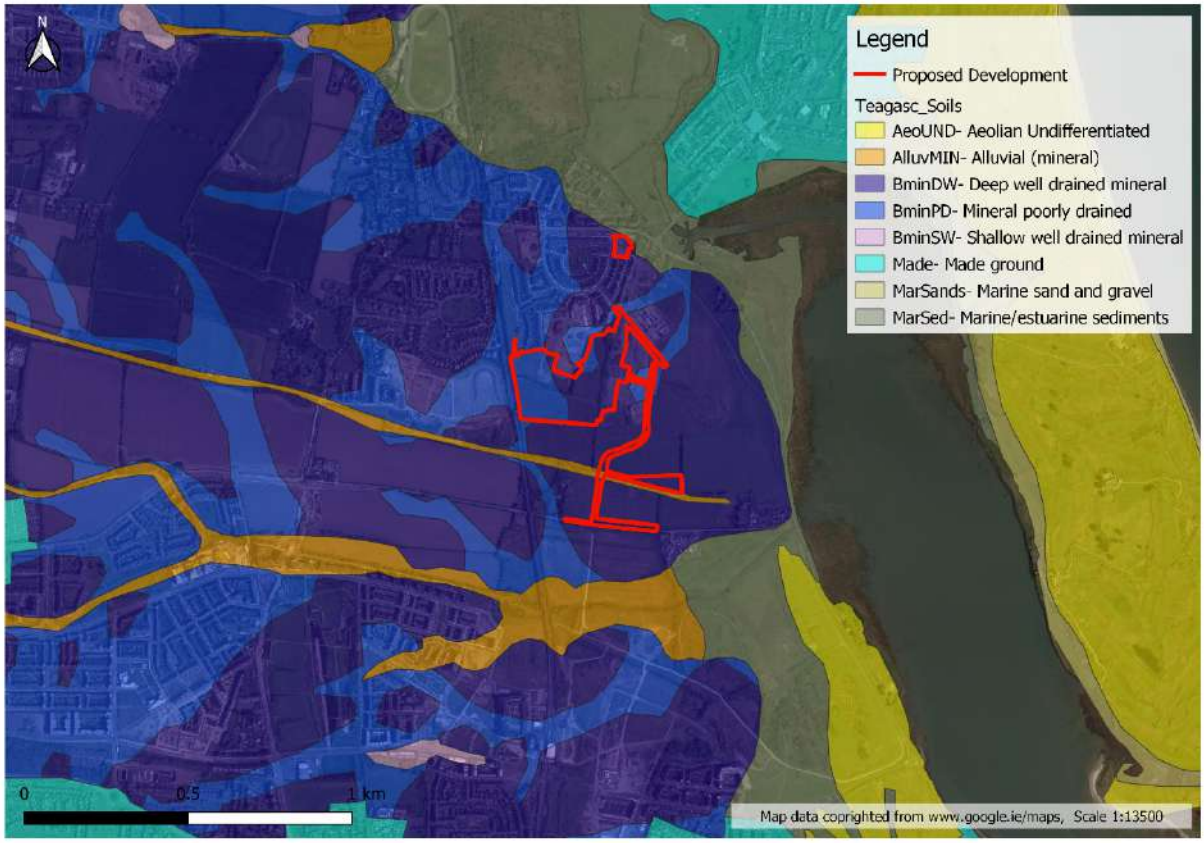

Figure 7.3: Teagasc Soil Cover.

7.3.2.3 Quaternary Sediments

The Quaternary geological period extends from about 1.5 million years ago to the present day and can be sub-divided into the Pleistocene Epoch, which covers the Ice Age period, and which extended up to 10,000 years ago and the Holocene Epoch, which extends from that time to the present day.

The GSI and Teagasc subsoil mapping database indicates that the Proposed Development is underlain by Till derived from limestones. Till is unsorted sediment derived from the transportation and deposition by or from a glacier. A small section of the site access close to the Moyne/Mayne Road is traversed by Alluvium deposits, as shown in Figure 7.4.

Ground Investigations were carried out in 2006 by Glover Site Investigations Ltd and again in 2018 by Site Investigations Ltd, as shown in Figure 7.5. The scope of the works included cable percussive boreholes, trial pits with plate tests and soakaway tests. During the 2006 investigations 6no. cable percussive boreholes were dug to a depth of 10.00m below existing ground level. However, during the 2018 investigation 4no. cable percussive boreholes were terminated at depth ranging between 6.80mbgl – 8.30mbgl due to obstruction from boulder. An overall subsoil sequence recorded during site investigations includes: -

- **0.00 – 0.40m:** Topsoil.
- **0.10 – 2.00m:** Firm brown sandy slightly gravelly silty CLAY with low cobble content. Gravel is fine to coarse, subangular to subrounded of limestone.
- **1.70 – 10.0m:** Stiff black slightly sandy gravelly silty CLAY with low cobble content. Gravel is fine to coarse, subangular to subrounded of limestone.

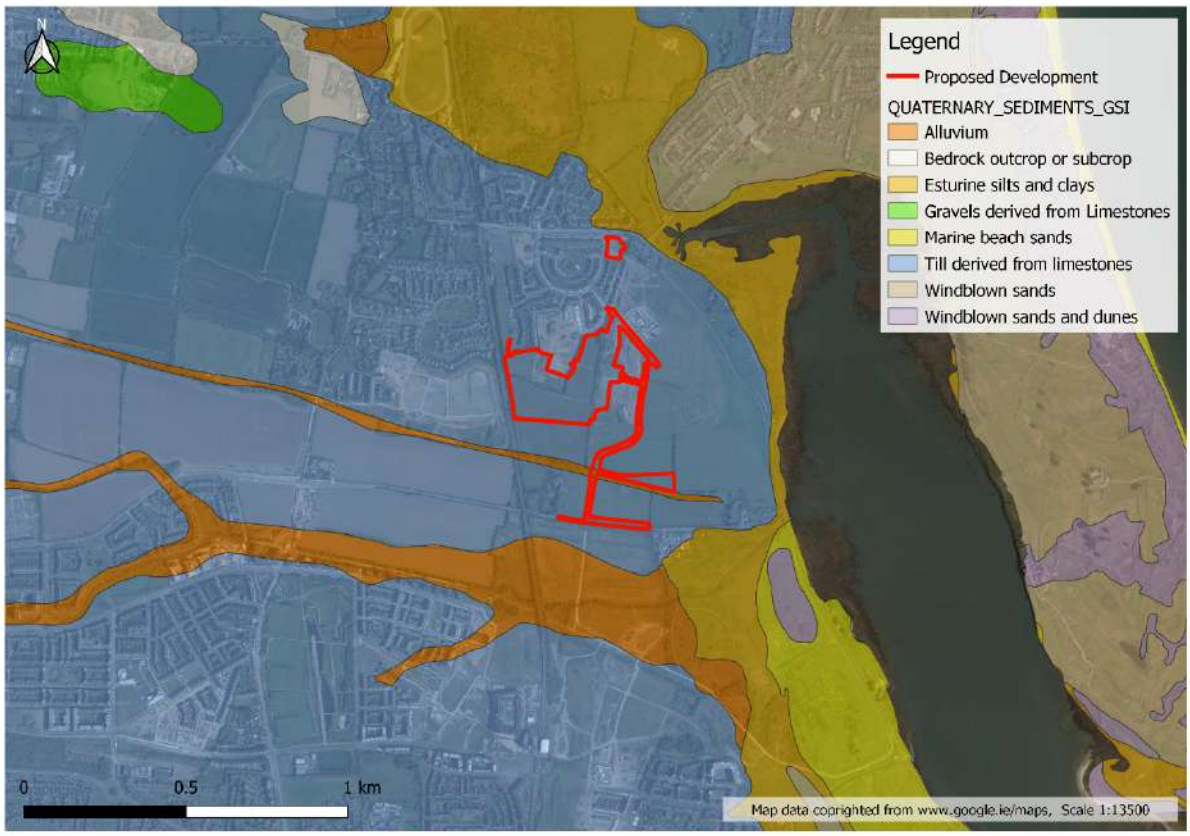

Figure 7.4: Quaternary Sediments.

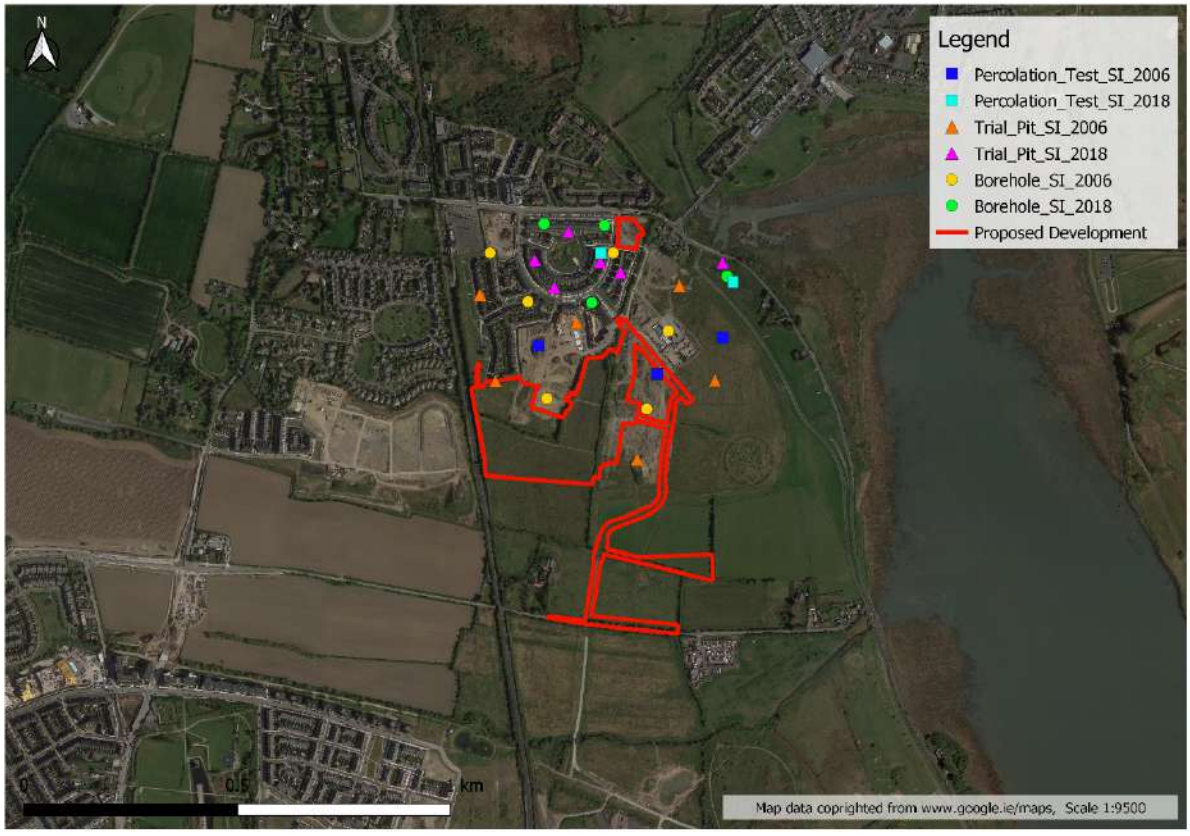

Figure 7.5: Site Investigations.

7.3.2.4 Bedrock Geology

The GSI Bedrock Geology Map indicates that the Proposed Development is underlain by Lower Carboniferous (Courceyan Stage) Limestones which is referred to as Malahide Formation (Rock Unit code: CDMALH). This geological formation comprises argillaceous bioclastic limestone, shale. The Bedrock Geology Map is shown in Figure 7.6 below.

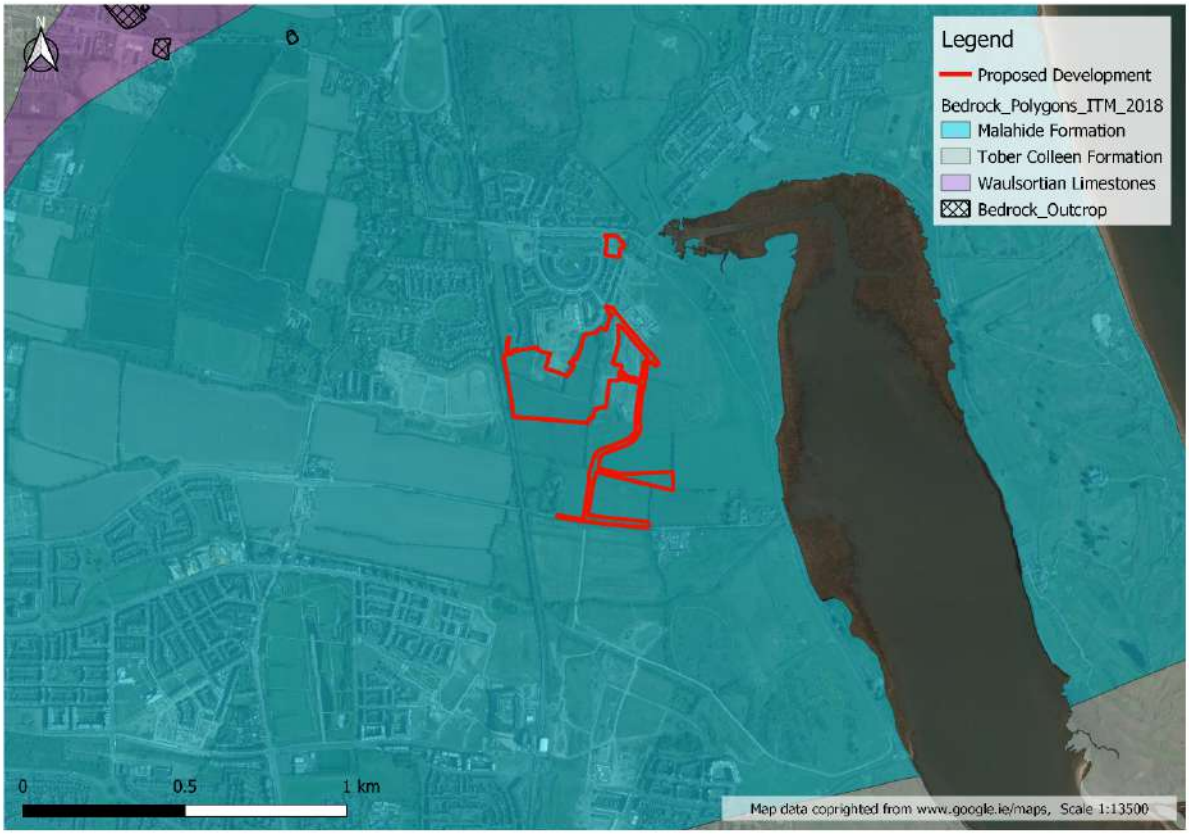

Figure 7.6: Bedrock Geology.

7.3.2.5 Geological Heritage and Historical Land Use

The GSI on-line mapping was reviewed to identify sites of geological heritage for the site and surrounding area. There are no Geological recorded sites on / at the proposed site, or which could be considered suitable for protection under this programme or recorded in the Fingal Development Plan 2017 – 2023.

The nearest Geological Heritage Sites are North Bull Island and Malahide Coast, which are located c. 3km south and c. 3km north-east to the Proposed Development respectively. Feltrim Quarry is also a geological site located c. 3.2km to the north-west of the development. There is no risk envisaged on the heritage sites due to the project.

Details of the site history and previous land use are included in Chapter 16: Cultural Heritage (Archaeological & Architectural). The assessment of site history confirms that until recently, the proposed site has been in agricultural use since the earliest mapping available from 1837 – 1842 and 1888 – 1913.

According to the EPA data and maps there are no integrated pollution prevention and control or industrial emission licensed (IPPC or IED) facilities in the vicinity of the Site. There is no record of any landfills or licenced waste facilities in the vicinity of the Site.

7.3.2.6 Economic Geology

The GSI mineral database and EPA Extractive Industry Register were consulted. There are no active or historic quarries within the Proposed Development area. The nearest active quarries in the area include Feltrim Quarry, c. 4 km to the north-west and Huntstown Quarry, c. 11.3 km to the south-west of the development area. Two mineral sites were identified the vicinity. A non-metallic locality is identified in Portmarnock, c. 0.8 km to the north. The site is described as an old brick works that supplied good class red bricks to Dublin. Another one is also a non-metallic locality in Beechwood, c. 1.2km to the north-west and is described as a brick field noted on the 6-inch map.

7.3.2.7 Radon

According to the EPA data the Proposed Development is located in an area where between 1-5% of the homes in this 10km grid is estimated to be above reference level.

7.3.2.8 Geohazards

The Proposed Development area is in a low landslide vulnerability area. The majority of the Earth's surface is covered by unconsolidated sediments which can be prone to instability. Whilst landslides have occurred in Ireland in recent years in upland peat areas due to disturbance of peat associated with construction activities, this is not perceived to be an issue for this Proposed Development given the nature of the underlying strata, the topography and the type of development and construction, furthermore the GSI landslide database was consulted and there are no recorded landslides in the vicinity of the Proposed Development.

7.3.3 Hydrogeology

7.3.3.1 Aquifer

The Geological Survey of Ireland has devised a system for classifying the aquifers in Ireland based on the hydrogeological characteristics, size, and productivity of the groundwater resource. The three main classifications are Regionally Important Aquifers, Locally Important Aquifers and Poor Aquifers. Each of these types of aquifers is further subdivided and has a specific range of criteria such as the transmissivity (m^2/day), productivity, yield and potential for springs associated with it. The sub-divisions are summarised in Table 7.2 below.

GSI Aquifer Classification	Sub-division
Regionally Important (R)	Karstified bedrock with diffuse flow (Rkd)
	Karstified bedrock with conduit flow (Rkc)
	Fissured Bedrock (Rf)
	Extensive sand and gravel (Rg)
Locally Important Aquifers (L)	Generally moderately productive bedrock (Lm)
	Moderately productive bedrock only in local zones (Ll)
	Smaller sand and gravel aquifers (Lg)
	Karstified (limited degree/area) (Lk)
Poor Aquifers (P)	Bedrock unproductive except for local zones (Pl)
	Generally unproductive (Pu)

Table 7.7: GSI Aquifer Classifications and Sub-Divisions.

By the very nature of Regionally Important Aquifers and their importance as groundwater resources, there is a risk of significant impacts (both qualitative and quantitative) by locating a development in such an area. Examples of impacts which may occur are the disruption of groundwater flow paths during construction earthworks and also during Operational Phase where cuts below the water table alter water levels and hydrogeological flow regimes, deterioration of water supplies if dewatering is necessary, disruption of baseflow to groundwater fed rivers or fens, or contamination of the aquifer through accidental spillage and removal of the overburden which protects the aquifer. If the development is located on an area classified as a Regionally Important Aquifer, then mitigation measures will need to be put in place at the design and Construction Phases of the development in order to minimise potential impacts on the environment.

There is also potential for environmental impact if the development is located on a Locally Important Aquifer. In these aquifers there is the potential for contamination and the deterioration of local water supplies and springs through changing groundwater flow paths during earthworks and dewatering. These impacts should be mitigated through effective design scheme.

Poor Aquifers generally provide little groundwater for water supply or for baseflow to surface water bodies, however, they are sometimes used for local supply for individual houses/farms. While the impact on the environment of locating a development on a Poor Aquifer will be significantly less than that on a Regionally Important Aquifer, it may still require consideration and mitigation against impacts during the design and Construction Phases.

The Bedrock Aquifers within the Proposed Development area are shown in Figure 7.7 below. The Proposed Development is underlain by **Locally Important Aquifer (LI)** that is bedrock which is moderately productive only in local zones and is composed of argillaceous bioclastic limestone and shale of Malahide Formation.

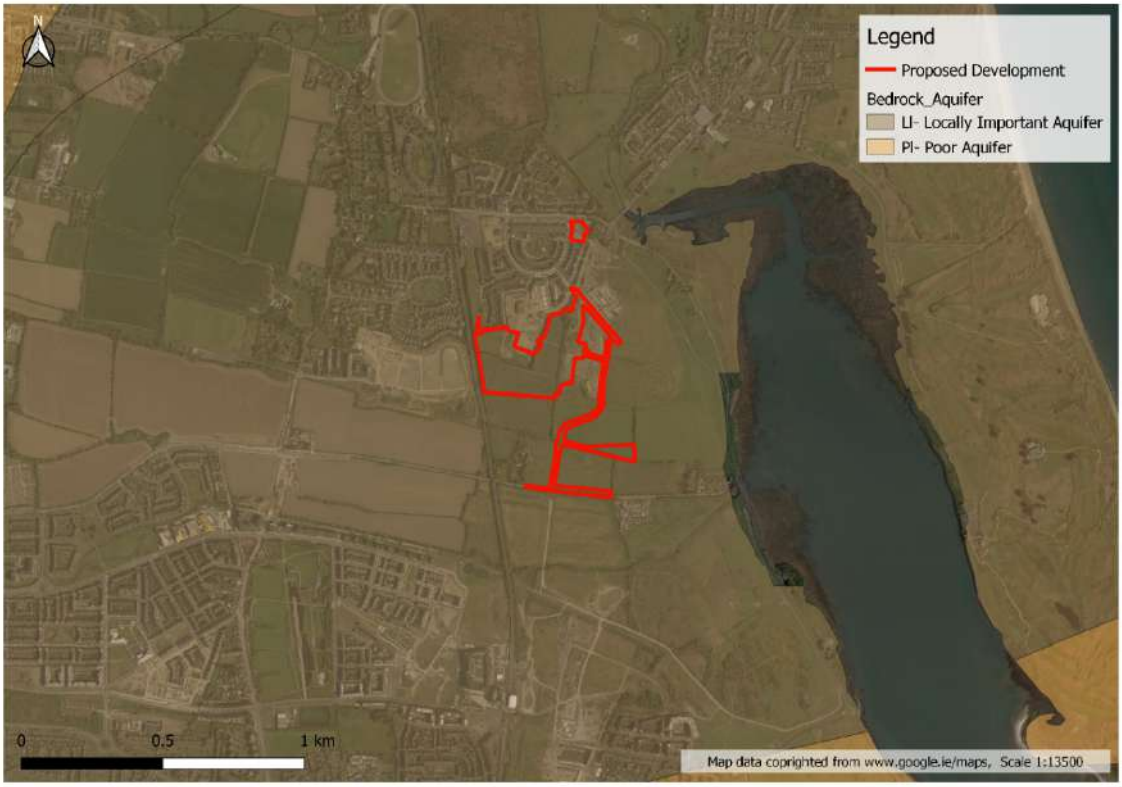

Figure 7.7: Bedrock Aquifer.

7.3.3.2 Groundwater Vulnerability

Vulnerability of a groundwater body is the term used to describe the intrinsic geological and hydrogeological characteristics which determine the ease with which a groundwater body may be contaminated by human activities. The vulnerability is determined by the travel time and quantity of contaminants and the attenuation capacity of the overlying deposits. These are based on the thickness of the unsaturated zone, permeability of overlying soils and the type of recharge (point or diffuse) in the area. For example, bedrock with a thick, low permeability clayey overburden is less vulnerable than bedrock with a thin high permeability, gravel overburden. Groundwater vulnerability may increase where the future scheme proposes road cuttings, due to removal or reduction of protective layers.

The classification guidelines, as published by the GSI, are given in Table 7.8 below which demonstrates that bedrock groundwater is most at risk in areas where subsoils are thin or absent and where karst features such as swallow holes are present. This is due to the ability of potential contaminants to reach the aquifer following a low travel time and with little or no contaminant attenuation due to the thin or absent overburden.

Groundwater vulnerability maps have been produced by the GSI and these have five classifications 'Extreme (X) Rock Near Surface or Karst' and 'Extreme (E)' are those areas most at risk from contamination and mitigation measures should be put in place for their protection. Areas classified as having 'High (H)' vulnerability are less vulnerable to contamination; however, they still need a certain measure of protection. Likewise, for those classified as 'Moderate (M)' which have a lower risk of contamination due to natural conditions, a degree of protection is still required. 'Low (L)' vulnerability areas have natural protection in place and mitigation measures do not need to be put in place here.

Vulnerability Rating	**Hydrogeological Conditions**				
	Subsoil Permeability (Type) and Thickness			Unsaturated Zone	Karst Features
	High Permeability (e.g. sand/gravel)	Medium Permeability (e.g. sandy subsoil)	Low Permeability (e.g. clayey subsoil, clay, peat)	Sand/gravel aquifers only)	(<30m radius)
Extreme (X)*	0-1 m	0-1 m	0-1 m	0-1 m	
Extreme (E)	1-3.0 m	1-3.0 m	1-3.0 m	1-3.0 m	-
High (H)	>3.0 m	3.0-10.0 m	3.0-5.0 m	>3.0 m	N/A
Moderate (M)	N/A	>10.0 m	5.0-10.0 m	N/A	N/A
Low(L)	N/A	N/A	10.0 m	N/A	N/A

Notes: N/A = not applicable

Precise permeability values cannot be given at present

Release of point contaminants assumed to be 1-2 m below ground surface

*X = rock at or near surface, also associated with a point recharge feature and for a 15m radius around a swallow hole, and 10m buffer of a sinking stream

Table 7.8: GSI Vulnerability Mapping Guidelines (adapted from DoELG, EPA and GSI, 1999).

Groundwater Vulnerability maps for the Proposed Development are presented in Figure 7.8 below. The GSI online database was consulted for groundwater vulnerability and the underlying aquifer type for the Proposed Development. The groundwater vulnerability at the site is classified as **'low'** which indicates an overburden depth of c. 10m of low permeability soil is present. This was confirmed in the site investigations undertaken in 2006. The boreholes dug during site investigations undertaken in 2018 were terminated at 6.8 – 8.30mbgl due to obstruction from boulder.

The underlying bedrock aquifer is well protected from the downward migration of potential contaminants.

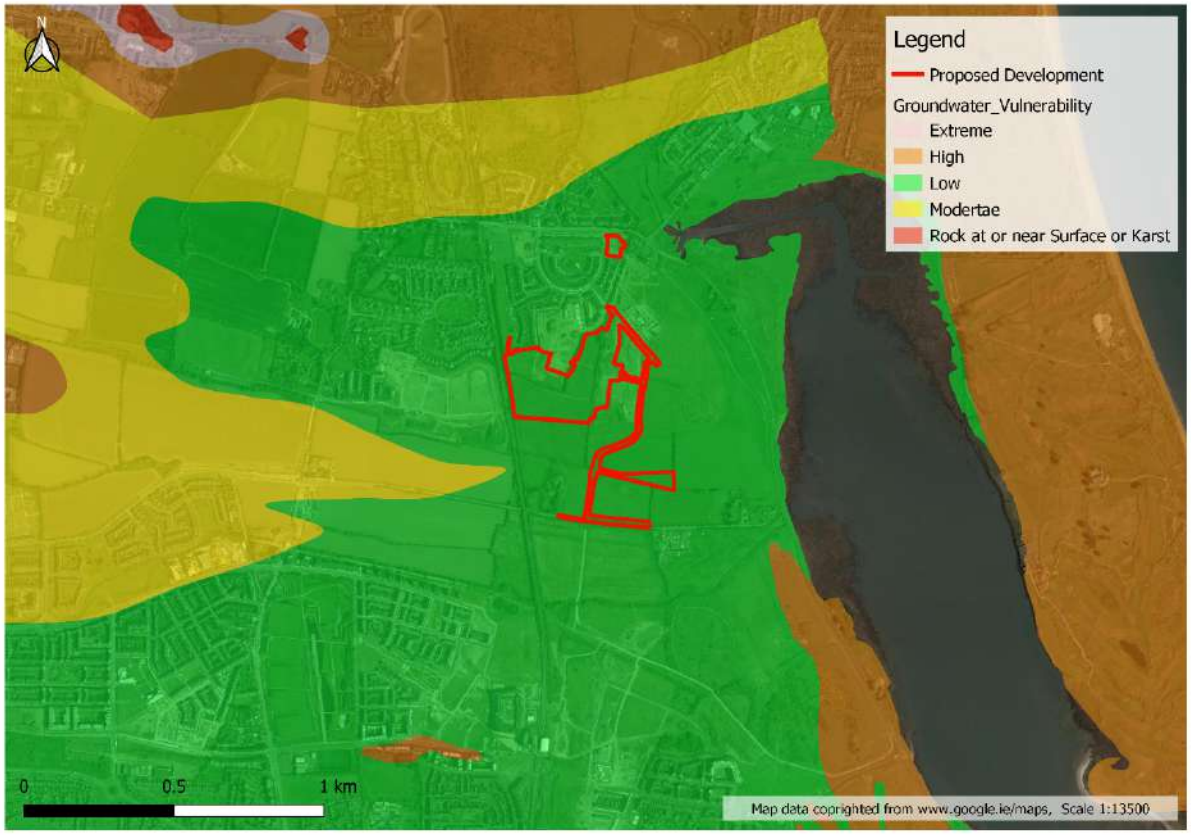

Figure 7.8: Groundwater Vulnerability.

7.3.3.3 Groundwater Resources and Flow

Groundwater supplies are vulnerable to impacts from a development both through alteration of local supplies through below ground cuttings, dewatering and potentially through drainage and accidental contamination of the groundwater resource. The Proposed Development should avoid public water supplies, high yielding industrial and commercial wells and source protection areas. Holy wells are considered in the Cultural Heritage chapter if deemed significant as a heritage asset. Care should be taken to minimise and mitigate any potential impacts (e.g. on yield and quality) which may occur at the abstraction point.

Groundwater resources refer to any large springs or groundwater abstractions supplying public water supply schemes for Local Authorities, or private Group Water Supply Schemes. Groundwater sources, particularly public, group scheme, are of critical importance in many regions. The Source Protection Areas have an Inner and Outer Protection zone associated with them which are defined by the travel time of potential contaminants to the abstraction well.

Groundwater wells and springs as identified by GSI are presented in Figure 7.9. The nearest borehole is located c. 1.65 km to the south-west of the development. The well is under industrial use and has a good yield as per the GSI data viewer. The nearest drinking water protection area is located 22km west of the Site in Co. Meath at the Dunboyne public water supply.

The Water Framework Directive (WFD) Directive 2000/60/EC was adopted in 2000 as a single piece of legislation covering rivers, lakes, groundwater and transitional (estuarine) and coastal waters. Along with protecting these waters, the WFD objectives include the attainment of 'Good' Status in waterbodies that are of lesser status at present and retaining 'Good' status or achieving better where such status exists at present. The EPA Water Maps indicate that the groundwater body WFD status 2013-2018 for all groundwater bodies across the development area is 'Good'. Currently, the groundwater body risk status is classified 'At review' for the area as per the EPA data.

Groundwater Dependent Terrestrial Ecosystems (GWDTE) are habitats / species that rely upon groundwater to maintain their required environmental conditions. Groundwater may have a direct input, for example in the case of turloughs, fens, petrifying springs, or alternatively the groundwater may have an indirect influence in maintaining high and stable water levels for the habitat/ species, for example in the case of raised bogs.

The European Water Framework Directive (WFD) (2000/60/EC) requires that member states provide protection for GWDTE. To date, GWDTEs within Special Areas of Conservation (SAC) as designated under the European Habitats Directive (92/43/EEC) have been the main priority of work. The EPA have developed the report, *A Framework for the Assessment of Groundwater – Dependent Terrestrial Ecosystems under the Water Framework Directive 2007-2013* which has identified Annex I habitats, and Annex II species that are considered to be GWDTE.

There are no GWDTE within the qualifying interests for Baldoyle Bay SAC hence they will not be affected by the Proposed Development.

During the site investigation works no water was encountered in any of the boreholes and trial pits during the fieldwork period in 2018. However, during 2006 site investigations groundwater was encountered in one out of six boreholes at 7.40m. The area where this borehole was dug has already been built over as part of Phase 1A of the development.

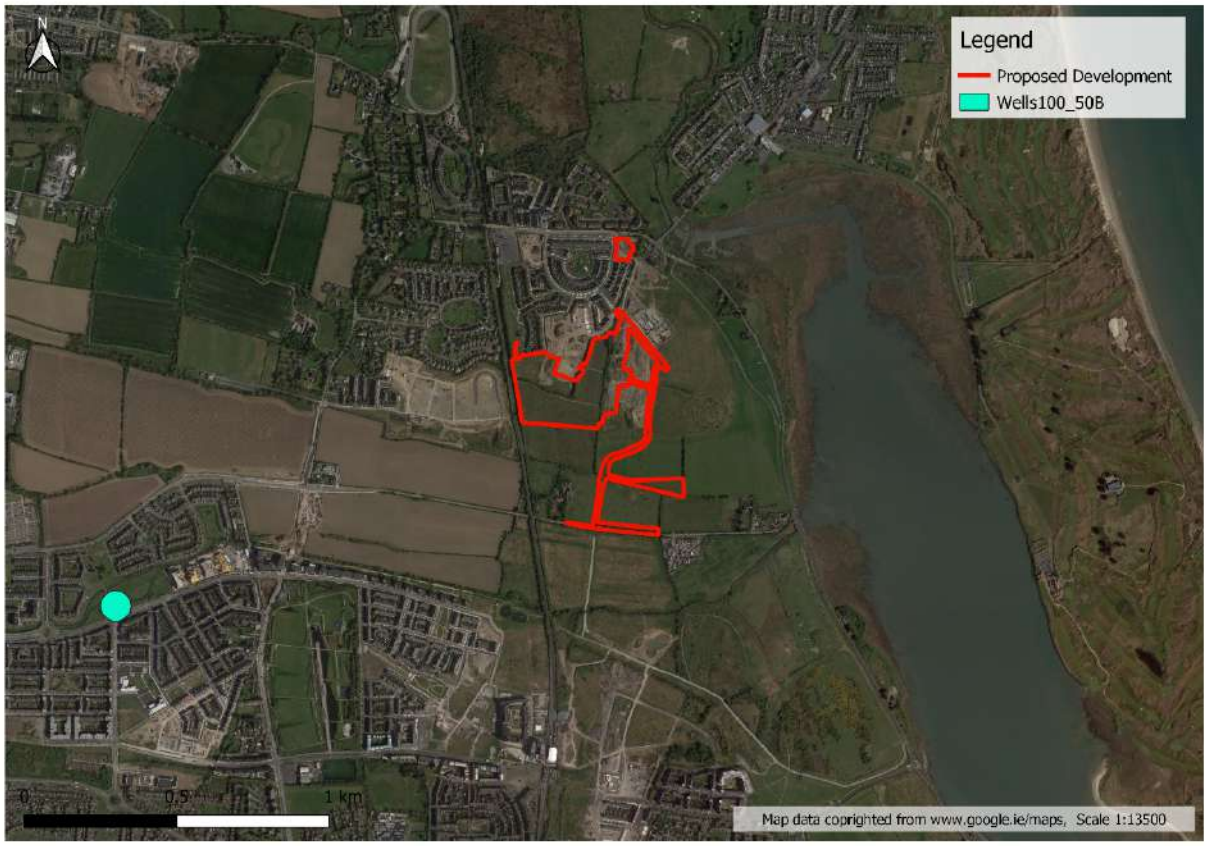

Figure 7.9: Groundwater Supply.

7.3.3.4 Karst Features

Karstic areas are those where the rock present is readily dissolved by water (relative to other rock types). Distinctive karstic features are formed along preferential groundwater flow paths such as fractures, fissures or joints. Karstic aquifers are the most common source of bedrock groundwater supplies in Ireland. In these, groundwater flow is dominated by flow related to dissolution features, leading to potentially high yields and the aquifers can extend over large areas. Features such as springs are common and provide a ready source of groundwater on at least local scale.

The vulnerability of groundwater is intrinsically linked to dissolution features; rapid groundwater recharge can take place via features such as enclosed depressions, swallow holes and sinking streams which allow the superficial deposits and soil to be bypassed. Such features are considered in vulnerability mapping and given an extreme vulnerability classification which is discussed in Section 7.3.4.2. Any pollution at the surface (including turbidity and pollution from accidental spillages or farming practices) has the potential to be carried extremely quickly to the groundwater receptor, which is a particular issue for water supplies.

There is no evidence of karstification at the vicinity of the Proposed Development according to the GSI Karst and well database. There is one spring (Saint Doolaghs Well) located c. 2.2 km west of the Site. The lithology of the spring is Limestone, clean (>=90% CaCO3) and unbedded.

7.4 Characteristics of the Proposed Development

7.4.1 Proposed Development

The Proposed Development (Phase 1D), is described in detail in Chapter 3: Description of Proposed Development, but may be summarised as follows: -

- 172no. residential units consisting of 22no. duplexs and 150no. houses ranging in heights between 1.5 and 3 storeys.
- Provision of public open space including Skylark Park and extension to Railway Linear Park and Townland Boundary Linear Park.
- Vehicular access to serve the development is proposed off the existing / under construction access points on roads serving the St. Marnock's Bay development.
- A new vehicular road is proposed to serve the Proposed Development which will connect with Moyne Road. The permanent road includes the provision of a new junction with Moyne Road and SuDS features to control surface water run-off.
- Upgrade of existing temporary foul water pumping station and storage tank to increase capacity.
- All associated and ancillary site development, infrastructural, landscaping and boundary treatment works.

The Proposed Development and future development phases, subject to relevant planning permissions being granted, will be constructed along the following timeline: -

- Phase 1D – 172no. units – Commence construction Q2 2022.
- Phase 1E – 190no. units – Commence construction Q2 2023.
- Phase 1F – 317no. units – Commence construction Q1 / Q2 2024.

7.4.1.1 Construction Phase

As noted, this development is a residential development with building heights ranging from 1.5 to 3 storeys, therefore the key construction activities involved in relation to land, soils and hydrogeology are: -

- Excavation for drainage and service infrastructure – depths vary but less than 4m.
- Excavation for strip footing foundations to residential units.
- Excavation for roads, parking and paths – typically depth to formation less than 1m.
- General excavation to facilitate final layout and level of proposed development, and although re-use of suitable material will be facilitated, it is estimated that nominally 24,000m^3 of material (incl. material excavated for drainage, services, foundations, roads, parking and paths) will be removed from site.
- Construction of new drainage and services infrastructure to facilitate the development.
- Construction of buildings (brickwork / blockwork / timber frames, precast concrete floors and frames, in-situ concrete footings, columns and beams where required, render finishes).
- Construction of boundary walls and fencing.
- Placing of fill to achieve required levels.
- Construction of roads, parking and footpaths.
- Landscaping.
- Imported fill, stone, aggregates are required to complete the development, and this is estimated at 20,200m^3.

The existing construction compound used for the current phase of the development (Phase 1C) will be retained and used for the construction of the Proposed Development also.

Figure 7.10: Construction Access (Green: Lands within Applicants control, Blue: Lands within FCC control).

Currently, construction access to and from the site is via a dedicated access off Station Road to the east of the Phase 1B access and to the west of the Portmarnock Bridge / Coast Road Junction.

In order to construct the current permitted development (Phase 1C), permission was sought and granted (FCC Reg. Ref. F20A/0700) to construct a Haul Road from the development lands heading south to connect into Moyne Road, which in turn will mitigate public safety issues and traffic congestion on Station Road for both the current development phase and future phases. This Haul Road will be operational in December 2021 and will subsequently be used for the construction of the Proposed Development (Phase 1D).

All works will be constructed in accordance with a Construction and Environmental Management Plan (CEMP), specifically prepared for this phase of the Proposed Development.

All connections to foul drainage and water supplies will be in accordance with Irish Water's relevant Code of Practice for same.

7.4.1.2 Operational Phase

On completion of the Construction Phase, the development becomes a residential estate.

7.4.2 Cumulative Development

As noted earlier the cumulative development (for assessment purposes) consists of the current phase under construction (Phase 1C) and the development of future phases to build out approximately 507no. residential units including public open space, integration of recorded monument and provision of road and drainage infrastructure.

The nature of these developments will be similar in character to the Proposed Development Phase 1D.

7.4.2.1 Construction Phases

The construction methodology for the current and future phases will be similar to that described above, with excavation depths of a similar order and cut fill volumes pro-rata to the house numbers being constructed under each future phase.

It is noted that the construction compound and marketing suite will be relocated to facilitate future development phases but will always remain within the overall development lands and be proximate to those phases.

The Haul Road will eventually be superseded by the permanent access road to Moyne / Mayne Road, to be constructed as part of the Proposed Development, which will serve the same function in the context of construction traffic i.e. reducing mitigate public safety issues and traffic congestion on Station Road.

7.4.2.2 Operational Phase

As before, on completion of the Construction Phase for each phase of the development, each phase of the development becomes a residential estate.

7.5 Potential Impact of the Proposed Development

7.5.1 Construction Phase

There are a number of elements associated with the development which have the potential to impact the land, soils, geological and hydrogeological environment.

7.5.1.1 Excavation, Earthworks, Surplus and Unsuitable Soils

Excavation and removal of subsoils will be required to accommodate the foundations of the buildings and levelling of the site. Any soft and/or organic material is not considered suitable as a bearing stratum for foundations/roads and will require excavation. Unsuitable and surplus excavated material will be reused on the site for bunding and landscaping. There will be no rock excavation on the site. Any impact resulting from excavation will be negligible in magnitude and imperceptible in significance.

During construction, aquifer vulnerability may be slightly increased due to a reduction in depth of overburden in areas of excavation which may increase the potential for migration of contaminants (from accidental spills) to the underlying bedrock aquifer. However, due to the thickness of low permeability overburden (>10 m)) and the "low" groundwater vulnerability classification (Low), the impact of the reduction in overburden depth on the groundwater quality will be negligible in magnitude and imperceptible in significance and highly unlikely as there are no proposed discharges to ground.

7.5.1.2 Karst Features

There will be no impact on karst features.

7.5.1.3 Groundwater Users

There are no groundwater users within 1.6 km of the Proposed Development. There is no groundwater abstraction proposed as part of the Proposed Development abstractions proposed. Consequently there will be no impact on groundwater users.

7.5.1.4 Accidental Spillages - Contamination of Soils and Groundwater

Potential impacts during the Construction Phase include the leakage or spillage of construction related materials on site. For example, raw or uncured concrete and grouts, wash down water from exposed aggregate surfaces, cast-in-place concrete from concrete trucks, fuels, lubricants and hydraulic fluids for equipment used on the development site, bitumen and sealants used for waterproofing concrete. These have the potential to impact on groundwater quality and soils.

The impact of accidental spillages on soils is negligible in magnitude and imperceptible in significance.

In relation to the groundwater quality within the underlying aquifer, the vulnerability classification of the underlying aquifer has been classified as "Low" based on site specific information. The impact on groundwater water quality is predicted to be negligible in magnitude and imperceptible in significance, temporary in duration and unlikely.

Source	Impact / Path	Potential Receptor	Significance
Earthworks	Excavation and Removal	Land, Soils Geology	Imperceptible
		LI Aquifer	Imperceptible
Accidental Spillages	Filtration	LI Aquifer	Imperceptible

Table 7.9: Summary of Potential Impacts of the Proposed Development – Construction Phase.

7.5.2 Operational Phase

There will be no direct discharges to or abstractions from the soil and hydrogeological environment during the Operational Phase.

7.5.2.1 Economic Geology

The development of the housing scheme would sterilise the potential to exploit quarry reserves beneath the site. The zoning of the lands in the area would not permit the development of a quarry. The impact on quarry reserves is assessed as negligible in magnitude and imperceptible in significance.

7.5.2.2 Geological Heritage

There are no sites of geological heritage within or in the vicinity of the proposed site the Proposed Development will have no impact on Geological Heritage.

7.5.2.3 Reduction in Recharge Area

The Proposed Development will incorporate the creation of approximately 4.1 hectares of impermeable surfaces (roofs, roads and hardstanding areas). This will result in a reduction in recharge to the aquifer. The site is underlain by >10 metres of low permeability overburden which will severely restrict recharge. When compared to the overall recharge area to the aquifer, which amounts to thousands of hectares, the reduction in recharge area is insignificant. Taking into account the fact that the aquifer is only locally important and that there are very few groundwater users, the overall impact on the groundwater resource due to loss in recharge area will be imperceptible.

Source	Impact / Path	Potential Receptor	Significance
Economic Geology	Sterilize Area against Quarrying	Quarry Reserves	Imperceptible
Reduction in Recharge	Increase in Impermeable Area	LI Aquifer	Imperceptible

Table 7.10: Summary of Potential Impacts of the Proposed Development – Operational Phase.

7.5.3 Do-Nothing Impact

In the event that the Proposed Development does not proceed, then the site will remain in its current greenfield state and as a consequence there will be no potential for any significant impact to either hydrogeological or geological features.

7.5.4 Cumulative Impacts

The potential impacts for both the Construction Phase and the Operational Phase of the Proposed Development, equally apply for future phases.

7.6 Mitigation Measures

7.6.1 Construction Phase

The following mitigation measures have been identified which form part of the CEMP which will include measures for reduction or elimination of pollution of soils and groundwater. An Outline Waste Management Plan will be produced for the project , which will include a waste forecast identifying options for reuse, recycling and avoidance of landfill and to record actual waste. Refer to CEMP prepared for this SHD Planning Application for further details.

7.6.1.1 Excavation and Earthworks, Surplus and Unsuitable Soils

Soft materials and surplus soils that are excavated will be reused, for bunds, landscaping etc.

To mitigate densification of the soil due to construction activities, all topsoil shall be removed and stored in advance of earthworks, the surface shall be scarified, and the topsoil replaced and reseeded upon completion.

7.6.1.2 Accidental Spillages - Contamination of Soils and Groundwater

Contractor Guidance set out in the Control of Water Pollution from Construction Sites (CIRIA, 2001) shall be adhered to. Good construction management practices will be employed. During the Construction Phase, all potentially harmful substances (e.g. oils, diesel, herbicides, pesticides, concrete etc.) will be stored in accordance with the manufacturer's guidelines regarding safe and secure buildings / compounds: -

- Designated impermeable cement washout areas will be provided or prohibited from site.
- All oils and fuels will be stored in bunded tanks with the provision of a storage / retention capacity of 110% of tank storage. Care and attention will be taken during refuelling and maintenance operations.
- Adequate means to absorb or contain any spillages of these chemicals will be available at all times.
- Any soil contaminated from an accidental spillage will be contained and treated appropriately and disposed of in accordance with the Waste Management Act 1996 – 2011.

Refer to CEMP prepared for this SHD Planning Application for further details.

7.6.2 Operational Phase

As there are no Operational Phase perceptible impacts on the land, soils and hydrogeological environments due to the Proposed Development, no mitigation is proposed.

7.6.3 Cumulative Mitigation

The proposed mitigation measures for this phase of the Proposed Development equally apply to the future phases and will have the same reduction in the significance of the potential impacts.

7.7 Residual Impacts

7.7.1 Construction Phase

The predicted overall residual impact of the Proposed Development land soils and hydrogeology during the Construction Phase will be neutral imperceptible.

Source	Impact / Path	Potential Receptor	Significance
Earthworks	Excavation and Removal	Land, Soils Geology LI Aquifer	Imperceptible
			Imperceptible
Accidental Spillages	Filtration	LI Aquifer	Imperceptible

Table 7.11: Summary of Residual Impacts of the Proposed Development – Construction Phase.

7.7.2 Operational Phase

The predicted overall residual impact of the Proposed Development land soils and hydrogeology during the Operational Phase will be neutral imperceptible.

Source	Impact / Path	Potential Receptor	Significance
Economic Geology	Sterilize Area against Quarrying	Quarry Reserves	Imperceptible
Reduction in Recharge	Increase in Impermeable Area	LI Aquifer	Imperceptible

Table 7.12: Summary of Residual Impacts of the Proposed Development – Operational Phase.

7.7.3 Cumulative

The predicted overall residual impact of the cumulative development on hydrogeology and geology during the Construction and Operational Phases will be imperceptible.

7.8 Monitoring

Regular inspection of surface water run-off and any sediment control measures e.g. silt traps will be carried out during the Construction Phase. Regular auditing of construction / mitigation measures will be undertaken e.g. concrete pouring, refuelling in designated areas etc.

No future soil or groundwater monitoring is proposed as part of the Proposed Development. Petrol interceptors will be maintained and cleaned out in accordance with the manufacturer's instructions. Maintenance of the surface water drainage system and foul sewers as per normal urban developments is recommended to minimise any accidental discharges to ground.

7.8.1 Proposed Development

7.8.1.1 Construction Phase

Regular inspections of the works and audits of the CEMP to determine mitigation measures are both adequate and being implemented.

Regular inspection of surface water run-off and any sediment control measures e.g. Silt traps will be carried out during the Construction Phase. Regular auditing of construction / mitigation measures will be undertaken e.g. concrete pouring, refuelling in designated areas etc.

No future soil or groundwater monitoring is proposed as part of the proposed project. Petrol interceptors will be maintained and cleaned out in accordance with the manufacturer's instructions. Maintenance of the surface water drainage system and foul sewers as per normal urban developments is recommended to minimise any accidental discharges to ground.

7.8.1.2 Operational Phase

No specific monitoring proposed, other than to note maintenance regime to be implemented.

7.8.2 Cumulative

Monitoring to continue for future phases as per this proposed phase.

7.9 Reinstatement

Not relevant.

7.10 Difficulties Encountered

No difficulties were encountered during the preparation of this chapter of the EIAR.