8 Hydrology & Hydrogeology

8.1 Introduction

This chapter comprises an assessment of the hydrological and hydrogeological environment (collectively known as the water environment) within the site and the surrounding environs. The potential effects posed by the construction and operational phases of the Proposed Development are investigated, and suitable mitigation measures are recommended to minimise effects on the local water receptors.

In terms of Environmental Impact Assessment (EIA):

- “Hydrology” is the study of surface water features.
- “Hydrogeology” is the study of groundwater features.

The objectives of this chapter are.

- To provide a baseline assessment of the receiving water environment in terms of surface water (hydrological) and groundwater (hydrogeological) receptors.
- To identify any potential negative effects posed by the construction and operational phases of the Proposed Development.
- To propose suitable mitigation measures to prevent or reduce the significance of the negative effects identified.
- To consider any significant residual effects of cumulative effects posed by the Proposed Development.

8.2 Consultation

ORS have been commissioned to assess the potential impacts of the Proposed Development in terms of hydrology and hydrogeology during the construction and operational phases.

The principal members of the ORS EIA team involved in this assessment include the following persons:

- **Project Scientist & Co-Author:**
  Bianca Severgnini – B.Eng. (Hons) (Environmental).
  Current Role: Environmental Consultant. Experience *ca.* 3 years.

- **Project Scientist & Co- Author:**
  Anna Quaid - B.Sc. (Environmental Science), M.Sc. (Applied Environmental Science),
  Current Role: Environmental Consultant. Experience *ca.* 4 years.

- **Project Scientist & Reviewer:**
  Luke Martin – B.A. (MOD) (Natural Sciences), M.Sc. (Sustainable Energy and Green Technology), CEnv, MIEnvSc. Current Role: Chartered Environmental Consultant. Experience *ca.* 12 years.

- **Project Coordinator & Reviewer:**
  Oisín Doherty – B.Sc. (Geography with Environmental Science), MSc. (Environmental Management), CEnv, MIEnvSc. Current Role: Chartered Environmental Consultant. Experience *ca.* 14 years.

Consultation between ORS and other members of the planning/design team was made in order to obtain information required to assess the potential construction and operational phase impacts on local hydrology and hydrogeology.

8.3 Assessment Methodology & Significance Criteria

This chapter was carried out in accordance with the following guidance documents:

- EPA, (2022). *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports*.
- EPA, (2004). *Land spreading of Organic Waste – Guidance on Groundwater Vulnerability Assessment of Land*.
- European Commission, (2017). *Environmental Impact Assessment of Projects Guidance on the preparation of the Environmental Impact Assessment Report*.
- Institute of Geologists Ireland, (2013). *Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements*.
- NRA, (2008). *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*.
- CIRIA, (2001). C532 - *Control of Water Pollution from Construction Sites – Guidance for consultants and contractors*.

8.3.1 Desktop Study

A desk-based assessment method was used to assess baseline water quality for the receiving environment of the proposed site. The baseline information that is detailed in this section of the assessment was obtained from publicly available information.

The following documents and sources were referenced:

- Aquifer classification and vulnerability identification from the Geological Survey of Ireland (GSI web page)
- Search of GSI and Limerick County Council files to determine the location of groundwater wells within a 2km radius
- 1:50,000 Discovery Series Maps and 6” maps (Geohive)
- Water Quality in Ireland 2010-2015 (EPA)
- Water Quality in Ireland 2013-2018 (EPA)
- Water Quality in Ireland 2016-2021 (EPA)
- Water Action Plan 2024: A River Basin Management Plan for Ireland.
- Meteorological data from Met Eireann and hydrometric data from the Office of Public Works (OPW)
- Limerick City & County Strategic Flood Risk Assessment 2022
- Limerick City & County Development Plan 2022 - 2028
- Reports, maps and data published by the Geological Survey of Ireland (GSI) and the National Soil Survey of Ireland
- General Soil Map of Ireland 2nd Edition, (1980), The National Soil Survey, An Fóras Taluntais
- An Foras Talúntais (1966). Soils of County Limerick
- Reports, maps and data published by the Environmental Protection Agency (EPA).
- UK CIRIA report C552 (2001). (Contaminated Land Risk Assessment: A Guide to Good Practice.

- IFI (2016), Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Watercourses.
- OPW and DoEHLG (2009), The Planning System and Flood Risk Management - Guidelines for Planning Authorities.
- EPA (2022), River Quality Surveys: Biological - Hydrometric Area 24
- Möller, K., & Müller, T. (2012). Effects of anaerobic digestion on digestate nutrient availability and crop growth: a review. Engineering in Life Sciences, 12(3), 242-257.

The following technical reports completed in support of the planning application for the Proposed Development were also consulted to further assess baseline water quality.

- Civil Engineering Design Report
- Site Specific Flood Risk Assessment
- Site Suitability Assessment for onsite domestic wastewater treatment system

8.3.2 Field Survey

Fieldwork commissioned November 2024 consisted of the following elements:

- Trial Pit Excavations
- BRE Digest 365 Percolation/Soakaway Testing

A site walk-over was conducted by ORS geotechnical consultants on the 22nd of November 2024 to identify hydrological features on site including:

- Drainage patterns and distribution
- Exposures
- Drainage Infrastructure
- Wet ground

8.3.3 Impact Assessment Methodology

Chapter 1: Introduction of the EIAR outlines the impact assessment rationale applied to each chapter of the study. This section describes some further criteria applied to the assessment of hydrological and hydrogeological receptors.

Risk Appraisal Methodology

The Conceptual Site Model (CSM) identifies potential contaminants, receptors and exposure pathways that may be present based on the construction and operational phase of the Proposed Development. The identification of potential “contaminant linkages” is a key aspect of the evaluation of potentially contaminated land. An approach based on this methodology has been adopted within this report. For each of the contaminant linkages, an estimate is made of:

- The potential severity of the risk.
- The likelihood of the risk occurring.

Hydrological and Hydrogeological Receptor Criteria

The level of sensitivity of hydrological and hydrogeological receptors are based on a number of factors which are summarised in **Table 8.1** overleaf.

Table 8.1: Criteria for rating importance of hydrological and hydrogeological attributes (NRA, 2008)

Importance	Criteria	Receptors	
		Hydrological	Hydrogeological
Extreme	Attribute has a high quality or value on an international scale	River, wetland, or surface water body ecosystem protected by EU legislation	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	River, wetland or surface water body ecosystem protected by national legislation – NHA status. Regionally important potable water source supplying >2500 homes. Quality Class A (Biotic Index Q4, Q5) Flood plain protecting more than 50 residential or commercial properties from flooding. Nationally important amenity site for wide range of leisure activities.	Regionally Important Aquifer with multiple wellfields Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – 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	Locally important potable water source supplying >1000 homes Quality Class B (Biotic Index Q3-4) Flood plain protecting between 5 and 50 residential or commercial properties from flooding Locally important amenity site for wide range of leisure activities	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	Local potable water source supplying >50 homes Quality Class C (Biotic Index Q3, Q2-3) Flood plain protecting between 1 and 5 residential or commercial properties from flooding	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	Locally important amenity site for small range of leisure activities Local potable water source supplying <50 homes Quality Class D (Biotic Index Q2, Q1) Flood plain protecting 1 residential or commercial property from flooding	Poor Bedrock Aquifer Potable water source supplying <50 homes

River Water Quality Assessment Criteria

Under the Water Framework Directive and SI 722 of 2003 European Communities (Water Policy) Regulations, the EPA carries out water quality assessments of rivers, transitional and coastal water bodies as part of a nationwide monitoring programme. Data is collected from physico-chemical and biological surveys, sampling both river water and the benthic substrate (sediment). **Table 8.2** overleaf summarises the quality classes used to assess the condition of rivers throughout the country.

Table 8.2: Biotic Indices Classification for River Water Quality

Biotic Indices	Community Diversity	Quality	Condition	Quality Status	Quality Class
Q5	High	Good	Satisfactory	Unpolluted	Class A
Q4	Reduced	Fair	Satisfactory	Slightly Polluted - Unpolluted	Class B-A
Q3	Low	Doubtful	Unsatisfactory	Moderately – Slightly Polluted	Class C-B
Q2	Very Low	Poor	Unsatisfactory	Seriously – Moderately Polluted	Class C-D
Q1	Little/None	Bad	Unsatisfactory	Seriously Polluted	Class D

'Biotic Indices' or Quality (Q) Values are indicative of specified groups of macro-invertebrates' sensitivity to pollution. Q-Values are assigned to a waterbody based on the presence or absence of particular species with the Q5 biotic index indicating the least polluted waters and the Q1 biotic index indicating the most polluted waters.

Quality Class relates to the potential beneficial use of a water body as summarised in **Table 8.3**.

Table 8.3: Quality Class Descriptions

Quality Class	Description	BOD (mg/l)	Orthophosphate (mg/l)	Dissolved Oxygen (% Sat)
A	Highest water quality with very high amenity value Suitable for abstraction Suitable for game fisheries	<3	~0.015	~100%
B	Variable water quality with considerable amenity value Potential abstraction issues Game fish 'At Risk'	Occasionally exceeds 3mg/l	~0.045	<80% or >120%
C	Doubtful Water Quality with reduced amenity value Advanced Treatment of abstracted water required Coarse fisheries – Fish kills likely	Regularly Exceeds 3mg/l	~0.070	v. unstable
D	Poor to bad water quality with no amenity value Low grade & limited abstraction Fish absent	Levels regularly far in exceedance of 3mg/l	>0.1	Low, approaching 0%

Groundwater Vulnerability Assessment Criteria

Groundwater Vulnerability is a term used to represent the intrinsic geological and hydro geological characteristics that determine the ease with which groundwater may be contaminated by human activities. It is usually dependent on the nature (sandy, gravely, clay, etc.,) and depth of soil/subsoil overlying an aquifer (i.e., its shallowness). The travel time, attenuation capacity of the subsoils (i.e., ability to filter contaminants) and the nature of the contaminants are also important elements in determining the vulnerability of groundwater.

In the context of groundwater protection, Groundwater Vulnerability is the most important factor in determining control measures in areas where potentially hazardous discharge to groundwater might take place. This is because the type, permeability and thickness of the soil and subsoil play a critical role in preventing groundwater contamination by acting as a protecting filtering layer over the groundwater.

The extent of site investigation works required to accurately assess the groundwater vulnerability at a site is determined by the sensitivity of hydrogeological receptors within the site vicinity. The extent of sampling requirements as defined by the hydrogeological sensitivity of the site is defined in **Table 8.4**.

Table 8.4: Summary of Sampling Requirements

Ground Water Protection Scheme (GWPS) exists	**Vulnerability**	**Sampling Requirements**
	LOW	Simple walkover survey to confirm what has been established in the GWPS, i.e., no evidence of outcrop, depth to bedrock information from wells, etc.[1] If walkover survey indicates that the lands do not have sufficient thickness of subsoil (i.e. rock outcrops) then site specific information may be required.
	MEDIUM	
	HIGH	
	EXTREME[2]	Regionally Important Aquifers - Prove that 2m depth of soil/subsoil cover exists. Minimum of 1 data point per hectare is required.
		Locally Important and Poor Aquifers – Prove that 1m depth of soil/subsoil cover exists. Minimum of 1 data point per 5 hectares is required.
Ground Water Protection Scheme (GWPS) does not exist	**Aquifer Type**	**Sampling Requirements**
	Locally Important / Poor Aquifers	Prove that 1m depth of soil/subsoil cover exists. Minimum of 1 data point per 5 hectares is required. Site investigation points can be based on existing information. New information only required where existing information is insufficient.
	Regionally Important Aquifers	Prove that 2m depth of soil/subsoil cover exists. Minimum of 1 data point per hectare is required. Site investigation points can be based on existing information. New information only required where existing information is insufficient.
Source Protection Areas[3]	**Source Protection Zone**	**Sampling Requirements**
	Outer	A minimum thickness of 3m of subsoil should be demonstrated at a minimum depth to rock data point frequency of one point per hectare.
	Inner	It is not generally acceptable to land-spread unless there is no alternative area available, and that the area has been defined as having moderate vulnerability (i.e. > 10m of moderate permeability subsoil or > 5m of low permeability subsoil) overlying the aquifer. The depth to rock should be demonstrated at a minimum frequency of one point per hectare.

[1] The classification to Low / Medium / High class as part of GWPS indicates that minimum of 3m soil/subsoil depth can be anticipated
[2] To give a rough picture of “extreme vulnerability” areas we can use: GSI Outcrop data & Teagasc Shallow Rock data
[3] In general land-spreading of organic wastes should not be carried out within the source protection area (SPA) of a water supply. However, there are cases where if the subsoil is sufficiently thick it may be deemed acceptable subject to conditions

8.4 Description of the Receiving Environment

8.4.1 Background

This section of the chapter provides the baseline information in relation to geology, hydrogeology and hydrology that exists in the vicinity of the Proposed Development. The Proposed Development occupies a total area of 5.29 ha and is situated in the townland of Cappanihane, Bruree, Co. Limerick. The Proposed Development is situated on a greenfield site to the north of the R518 regional road with extensive agricultural lands to the north, east, west and south of the site. The R518 regional road is a two-lane road located adjacent to the southern boundary of the site and runs from east to west. The R518 road is adjoined at the southwest corner of the Proposed Development by the L8658, a two-lane local road which runs from north to south along the western boundary of the Proposed Development. A facility access road will be constructed along the western boundary of the site. The access road will connect the facility to the local road to the west and the wider road network of the surrounding area. The Proposed Development lies approximately 9.5km northwest of Charleville town centre.

The underlying geology has a major influence on topographical, hydrogeological and hydrological features within the site vicinity, hence this chapter is closely linked to the previous chapter (**Chapter 7 – Soils & Geology**).

The receiving environment is described below under the following headings:

- Topography
- Drift (Quaternary) Geology
- Bedrock Geology
- Hydrology
- Hydrogeology

8.4.2 Topography

Co. Limerick possesses a varied landscape which is important not just for its intrinsic value and beauty, but also because it provides for local residents and visitors, both in terms of a place to live and for recreational and tourism purposes. The range of different landscapes found in Co. Limerick each have varying visual and amenity values, topography, exposure and contain a variety of habitats. Each landscape type also has varying capacity to absorb development relative to its overall sensitivity. The landscape in Co. Limerick contains views and prospects worthy of protection.

The Landscape Character Assessment undertaken to inform the review of the Limerick County Development Plan 2022-2028 has divided the county into 14 no. Landscape Character Units based on the local landscape features which include:

1. Agricultural Lowlands
2. Ballyhoura / Slieve Reagh
3. Galtee Uplands
4. Knockfierna
5. Lough Gur
6. Shannon ICZM
7. Slieve Felim
8. Southern Uplands
9. Tory Hill

10. Western Uplands
11. Caherdavin
12. Southern Environs
13. Castletroy
14. City

The proposed site is located in the Agricultural Lowlands character area. See **Figure 8.1** below.

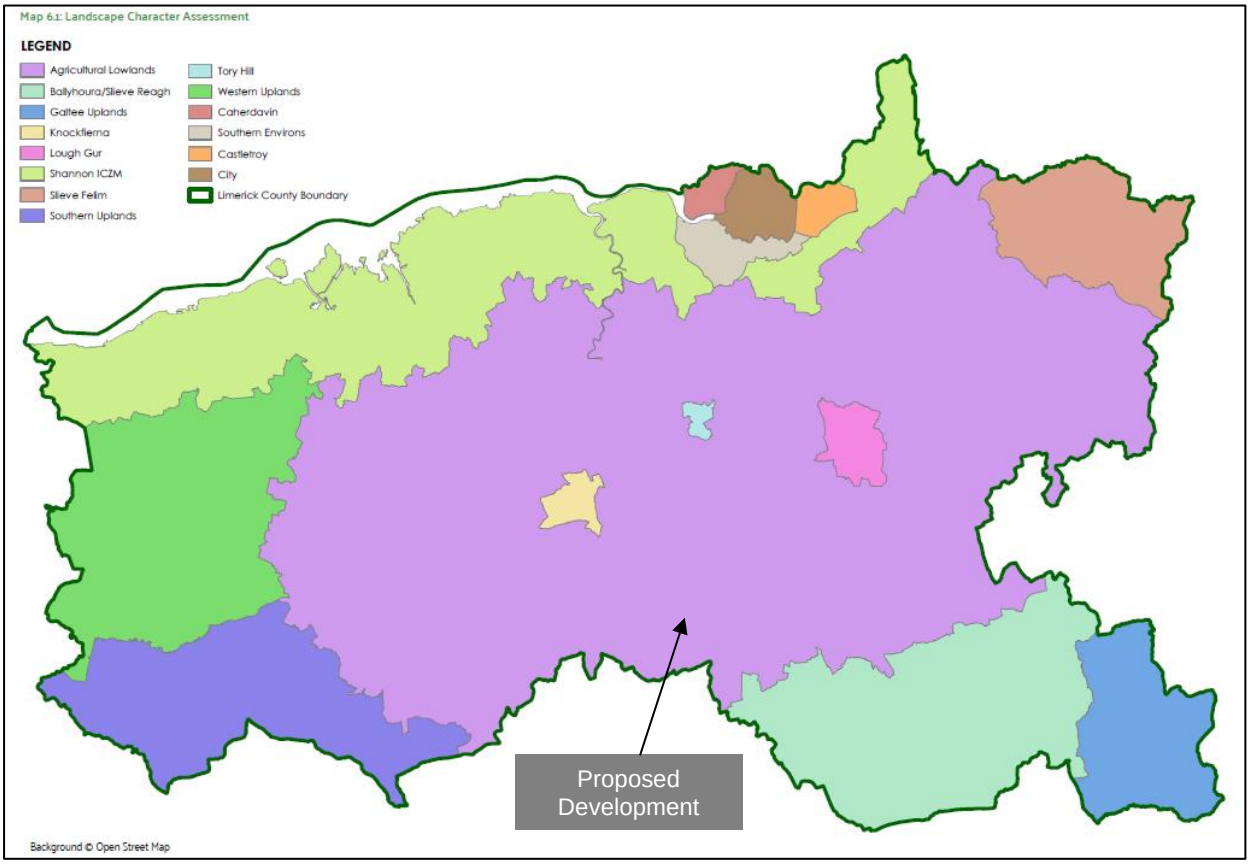

Figure 8.1: Landscape Types (Map 6.1 of Chapter 6 of the Limerick County Development Plan 2022-2028, Vol. 1)

This landscape character area is described within the CDP as "*the largest of the Landscape Character Areas in Limerick and comprises almost the entire central plain. This landscape is a farming landscape and is defined by a series of regular field boundaries, often allowed to grow to maturity. This well-developed hedgerow system is one of its main characteristics. In terms of topography, the landscape is generally rather flat with some locally prominent hills and ridges. The pastoral nature of the landscape is reinforced by the presence of farmyards*."

According to the GSI Viewer the physiographic unit in which the Proposed Development is located is characterised as "*flat to gently undulating glacial sediments*", in keeping with the Landscape Character Type description for the area.

The topography of the site is relatively uniform, as can be seen in **Figure 8.2**. The highpoint on site is *ca.* 92.53m AOD which occurs at the northwestern corner of the site. A slight gradient from here exists, falling to the southeast. Along the western site boundary, there is a slight gradient from north to south and the topography varies from 92.47m in the northwest boundary to 92.31m AOD at the southwestern boundary of the site. The land initially rises from 91.91m AOD at the northeastern corner of the site to 92.37m AOD at central part of the eastern site boundary before falling to 92.14m AOD at the southeastern boundary. Across the centre of the Proposed Development there are two existing drains, dividing the site and connecting to the drainage network along the boundary to the east of the site; here at the centre the topography drops to a low of 90.62m AOD. The site is heavily vegetated along the eastern boundary beyond which occurs a stream. The topography of the region to the east of the site begins to rise again beyond the banks of the adjacent watercourse.

Figure 8.2: Topographical map of the landscape surrounding the site (topographic-map.com)

8.4.3 Drift Geology

Drift is a general term applied to all mineral material (clay, silt, sand, gravel and boulders) transported by a glacier and deposited directly by or from the ice or as fluvioglacial deposits deposited by water from the ice. It generally applies to deposits laid down during the Pleistocene (Quaternary) glaciations. Drift can also be included under Holocene (Quaternary) deposits. The drift geology of the area principally reflects the depositional process of the last glaciation. Typically, during the ice advance, boulder clays were deposited subglacially as lodgement till over the eroded rock head surface, whilst moraine granular deposits were laid down at the glacier margins. Subsequently, with the progressive retreat of the ice sheet from the region, granular fluvio-glacial deposits were laid down in places by melt waters discharging from the front of the glacier.

The Proposed Development is located within a wider lowland landscape which comprises the largest landscape character unit of county Limerick, covering almost all of the central plain of the county. This agricultural lowland region extends towards the edge of Limerick City in the north, towards the County Cork border in the south, the County Tipperary border in the east, and to the uplands region beyond Newcastle West in the western extent of the county. The uplands in the region occur in the western, southwestern and southeastern extents of Limerick. The Western Uplands and Southern Uplands landscape character areas rise along the Kerry border region to the west and southwest. In the southeast of the county the Ballyhoura / Slieve Reagh uplands and Galtee Uplands landscape character areas rise along the border with County Cork and County Tipperary. The Slieve Felim Uplands occur in the northeastern extent of the county. Knockfierna and Tory Hill are distinct hill features, rising in the centre of the agricultural lowland plain, at the centre of County Limerick. The Shannon Coastal zone comprises a large area of northern Limerick and is bounded on its northern side by the Shannon Estuary, while its southern boundary is defined by the gradually rising ground, which leads onto the agricultural zone and the western hills to the southwest. The landscape in the immediate vicinity of the Proposed Development site is a lowland region ringed by rounded mountains and a mountain ice-sculpted ridge

Much of County Limerick is underlain by Carboniferous limestone, which contributes to the region's karst landscape. While the drift layer often masks the bedrock, its composition (calcareous or non-calcareous) can reflect the underlying geology. Cappanihane, like much of County Limerick, features extensive glacial till, a mix of clay, silt, sand, gravel, and boulders deposited by the retreat of glaciers. These deposits are often poorly sorted and represent the material carried and deposited directly by ice sheets during the Midlandian glaciation.

The Quaternary Drift of the Proposed Development is described as till derived from Devonian sandstones (TDSs), as shown in **Figure 8.3** overleaf. The subsoils at the majority of the site are described as being of low permeability and are overlain by poorly drained gley soil (mainly acidic). The National Soil Survey of Ireland describes this region as comprising Clayey drift with limestones. GSI online mapping indicates the predominant soil underlying the site is a poorly drained mineral (mainly acidic) (AminPD) derived mainly from non-calcareous parent materials. The soil groups associated with this category are Surface Water Gleys and Ground Water Gleys.

In view of the Proposed Development, the soils which are likely to be affected by the development are characteristic in the local and regional context and occur in abundance.

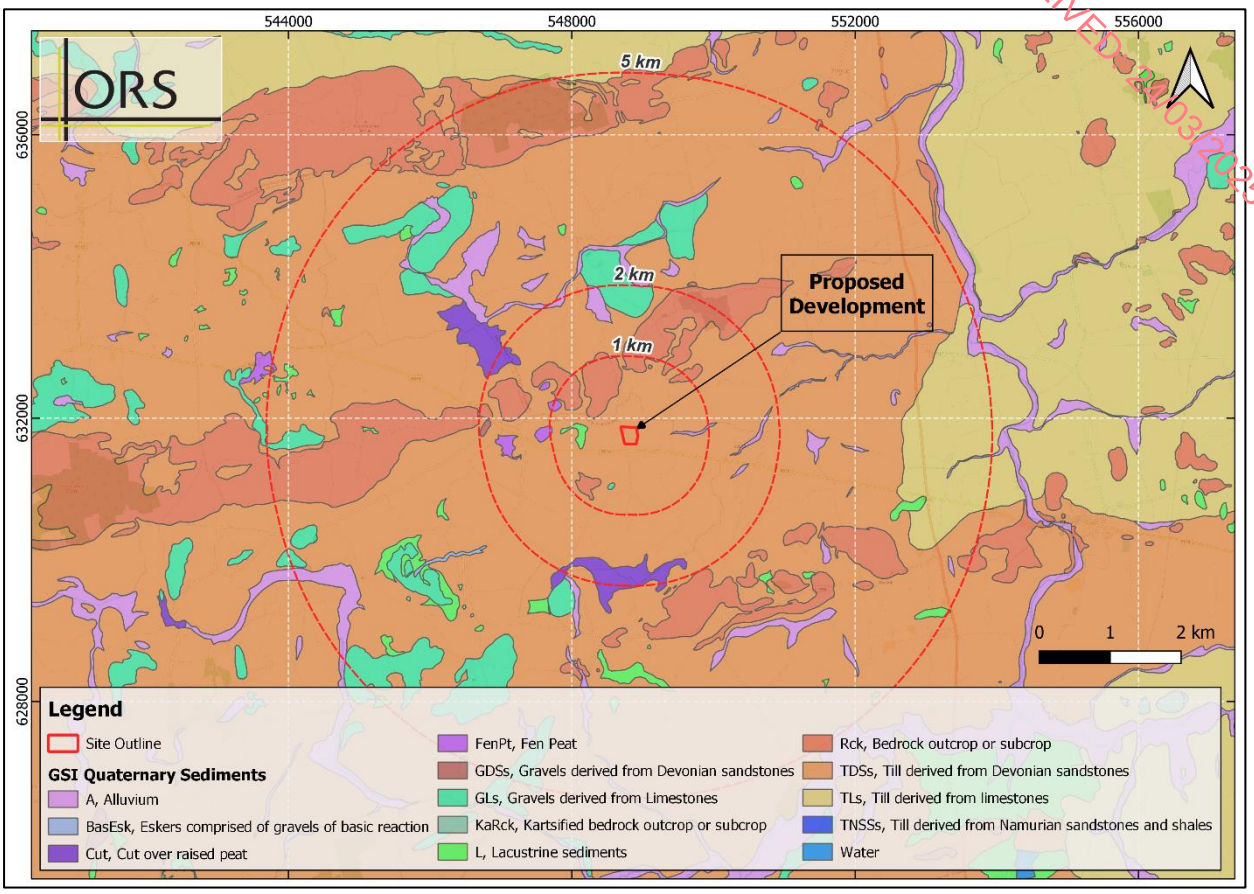

Figure 8.3: Quaternary Sediments for the Proposed Site vicinity based on GSI data.

8.4.4 Bedrock Geology

This sub-section deals with bedrock underlying the area. Bedrock is defined as a consolidated aggregate of minerals underlying the ground surface and any soils present. Above the bedrock is usually an area of broken and weathered unconsolidated rock in the basal subsoil. Sedimentary rock lies in beds which may comprise different rock types and which may be horizontal or inclined, so that the rock encountered at the ground surface may change over a short distance.

According to the Geological Survey of Ireland and the National Draft Generalised Bedrock Map, the bedrock within the 2km study area of the Proposed Development consists of sandstones, shales, and limestones from the early Dinantian period. This formation extends southwest and northeast. To the south, the area is underlain by impure limestones of the same period, which continue beyond the study area to the southwest and east.

Within this region of impure limestone, a formation of Dinantian sandstones, shales, and limestones emerges, beyond which lies an area of Devonian Kiltorcan-type Sandstones. These Old Red Sandstones also appear to the north and northeast of the study radius, where several bedrock outcrops are present. In the northeastern section of the study area, a portion of the bedrock consists of basalts and other volcanic rocks, alongside additional bedrock outcrops.

The bedrock underlying the Proposed Development belongs to the “Lower Limestones and Shales” formation. The 1:100,000 Bedrock Solid Geology Map identifies the primary rock types

within this formation as sandstone, mudstone, and thin limestone. Lithologically, the formation includes the Mellon House, Ringmoylan, Ballyvergin, and Mallymartin formations, as documented in the Limerick Province, particularly along the Shannon Estuary and in the Pallaskenry borehole (LI-68-10).

To the north, the Lower Limestones and Shales formation is bordered by an Old Red Sandstone Formation, described as “red clastics,” with several exposures, the closest located approximately 450m to the northeast. Beyond this, a broad terrane of Lower Limestone Shales extends further northeast. Within the Old Red Sandstone formation, a Volcaniclastic Formation is present, described as volcaniclastics interspersed among the Dinantian limestones.

To the south, the Ballysteen Formation is present. The 1:100,000 Bedrock Solid Geology Map describes this bedrock type as fossiliferous dark grey muddy limestone. Lithologically, the Ballysteen Formation consists of irregularly bedded and nodular argillaceous bioclastic limestones (wackestones and packstones), interbedded with fossiliferous calcareous shales. This formation is widely distributed throughout Westmeath and Longford, with exposures occurring approximately 750m southwest of the Proposed Development.

The regional bedrock formations and geological features within the 2km study area, as well as the surrounding region, are illustrated in **Figure 8.4**.

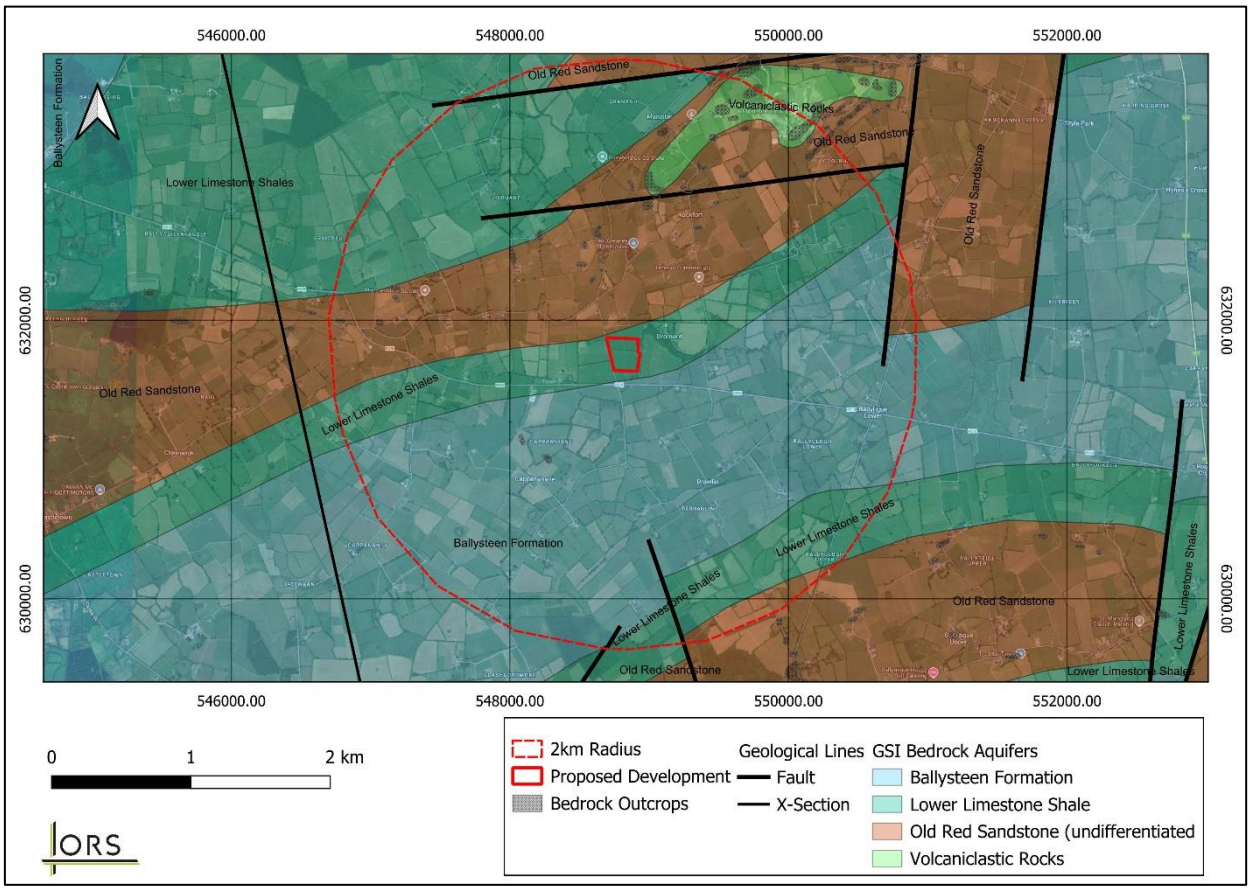

Figure 8.4: Regional Bedrock Formation (GSI).

8.4.5 Hydrology

Regional Hydrology

A river basin is the area of land drained by a river, its tributaries, and their associated groundwaters and coastal waters. The Water Action Plan 2024, part of Ireland's third River Basin Management Plan, builds on lessons from previous initiatives and incorporates both immediate and long-term goals to meet EU and international environmental obligations. The plan outlines a comprehensive approach to restoring and protecting the country's water bodies, such as rivers, lakes, estuaries, coastal waters, and groundwater. This initiative aligns with the EU Water Framework Directive, aiming to achieve "good" ecological status for water bodies by 2027. The newly adapted Plan covers a single national River Basin District (RBD), which also includes two international RBDs shared with Northern Ireland.

The Irish RBD spans 70,273 km² and is divided into 46 catchment management units, further broken down into subcatchments. Agriculture dominates land use within the RBD, with 55% dedicated to pastures, 7% to agricultural land, 5% to arable land, and 1% to complex cultivation. Forestry makes up 6% of the land use, while Urban fabric represents only 2% of the area.

A catchment is a land area where all surface water converges toward a single point, such as a river. The proposed site is located within the Shannon Estuary South Catchment (Hydrometric Area 24), which spans an area of 2,033 km². This catchment encompasses the regions drained by the River Deel, the River Maigue, and smaller streams flowing into the Shannon Estuary between Kilconly Point and Thomond Bridge, Co. Limerick. The southern part of Limerick City serves as the catchment's largest urban centre, with other significant towns including Newcastle West, Charleville, Kilmallock, Rathkeale, and Mungret.

The catchment is characterised by predominantly low-lying, flat terrain underlain by limestone, with occasional isolated hills. This geology supports a significant groundwater resource, reflected in the presence of 46 groundwater bodies. The catchment is further divided into 18 sub-catchments (illustrated in **Figure 8.5**) and contains 95 river water bodies, 2 lake water bodies, 7 transitional water bodies, and 1 coastal water body in addition to the groundwater bodies.

The two primary rivers in the catchment are the River Deel and the River Maigue. The River Deel drains the western part of the catchment, originating near Dromina in north County Cork and flowing approximately 60 km northward through County Limerick before entering the Shannon Estuary. The River Maigue begins 2 km north of Milford and flows eastward, where it meets the River Loobagh, which drains the southeastern part of the catchment. North of Bruree, the Maigue is joined by the Morningstar River, which drains the western end of the Glen of Aherlow. Further downstream, the Camoge River, draining areas from Emly and Hospital to Lough Gur, also joins the Maigue. The river continues northward through Croom and Adare, becoming tidal near Adare. It is subsequently joined by the Greanagh River from the west and the Barnakyle River from the east before emptying into the southern side of the Shannon Estuary opposite Bunratty.

The primary land use within the Shannon Estuary South Catchment is agriculture, with forested areas concentrated in the northwest and scattered wetlands primarily along the southern bank of the Shannon Estuary.

The proposed development site, located in Cappanihane, Bruree, Co. Limerick, falls within sub-catchment 24_8 of the Shannon Estuary South Catchment, also known as the Maigue_SC_040 sub-catchment, as shown in **Figure 8.5**.

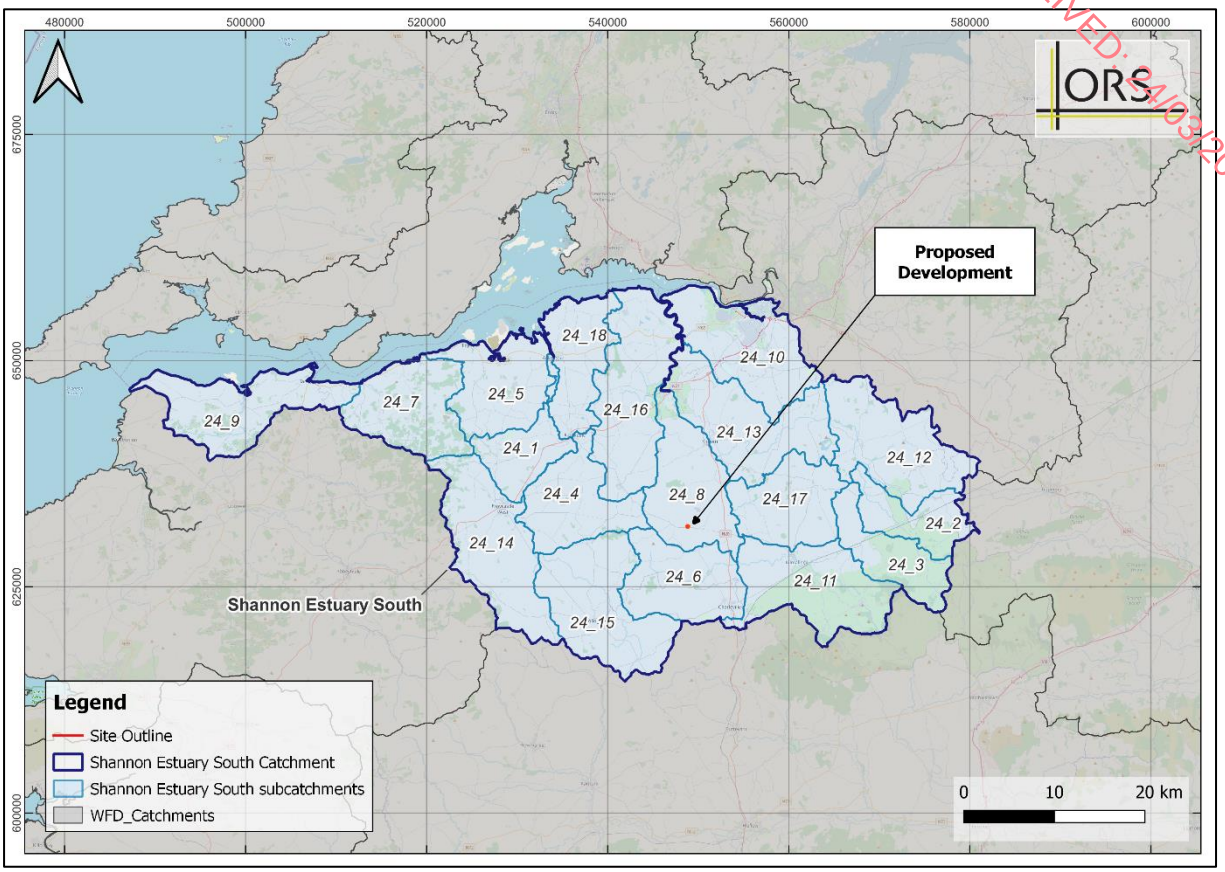

Figure 8.5: Shannon Estuary South Catchment and Sub-Catchments (EPA maps).

Local Hydrology

The Lower Ballyteige Stream is the primary hydrological feature near the site. The site naturally follows the surrounding topography and is drained by this watercourse, which originates approximately 500 meters upstream, as shown on EPA maps. The stream's source is a combination of natural springs and runoff from elevated lands to the west.

Flowing along the eastern boundary of the site, the Lower Ballyteige Stream continues downstream for about 2 km before discharging into the River Glenma. The River Glenma flows northeast until it joins the River Maigue between Bruree and Croom, approximately 3 km northeast of the site. From there, the River Maigue flows onward to the Shannon Estuary, west of Limerick City, a total hydrological distance of *ca.* 40 km from the site.

Two drainage ditches are present in the centre of the site, perpendicular to each other. These serve the surrounding areas and present irregular and low water levels with periods of dryness due to minimal or non-existent hydrological input. The ditches' direction follows the local topography, connecting the drainage network along the road to the Lower Ballyteige Stream. They operate solely as a drainage feature to manage surface runoff from the site and its surrounding area, therefore, does not meet the criteria to be classified as a watercourse. Without appropriate mitigation measures, they could serve as a pathway for pollution from the Proposed Development, especially during wetter periods.

The area surrounding the site is primarily characterised by agricultural land, predominantly used as pastures, with some sections classified as heterogeneous agricultural areas. Scattered

patches of forest and semi-natural areas are also present in the vicinity. The nearest wetland is located *ca.* 5.6 km northwest of the site, while the closest urban centre lies *ca.* 5.8 km to the southeast.

The subject site local hydrology is illustrated in **Figure 8.6** below.

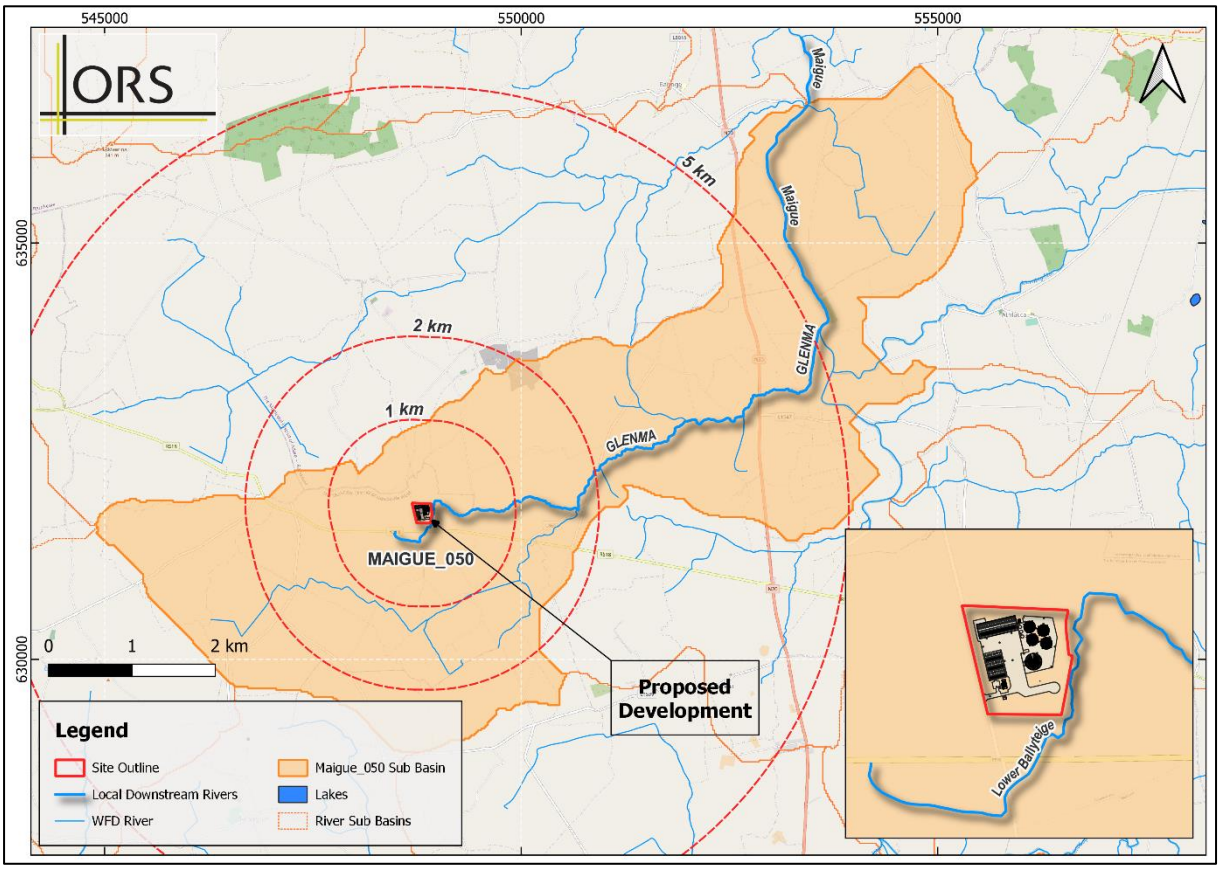

Figure 8.6: Local Hydrology (EPA).

Protected Areas

The proposed site is not within or immediately adjacent to any site that has been designated as a Special Area of Conservation (SAC) or a Special Protection Area (SPA) under the EU Habitats or EU Birds Directive. There are three Natura 2000 sites within the Zone of Influence of this Proposed Development site.

Figure 8.7 displays the spatial distribution of the Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Natural Heritage Areas (NHA) within the wider region. SAC are prime wildlife conservation areas in the country which are considered to be important on a country and European scale. Sites are selected and designated under the EU Habitats Directive and have been transposed into Irish law under EC (Birds and Natural Habitats) Regulation 2011 (S.I. No. 477/ 2011). Likewise, an SPA is an area selected for conservation due to its importance in the protection of rare or vulnerable bird species, migratory species, and wetlands. Sites are selected and protected under the EU Birds Directive.

The closest designated sites to the Proposed Development include the Heathfield Wood pNHA (Site Code:001434) located *ca.* 8.7km west of the site and the Tory Hill SAC (Site Code:

000439) *ca.* 11.2km northeast of the site. There are no designated sites within a 2km radius of the site.

Taking into consideration the 'Source-Pathway-Receptor' model, the closest waterbody is a stream located beyond the eastern boundary of the Proposed Development. The stream runs south to north, eventually curving and continuing to flow eastwards where it joins the Glenma stream *ca.* 2km downstream. The Glenma stream adjoins the Maigue stream *ca.* 3km downstream. The Maigue stream is hydrologically connected to the Lower River Shannon SAC, discharging into this designated site *ca.* 17km downstream. Thus, there is hydrologic connectivity between the site and the aforementioned SAC.

Given the topography of the site, where a slight gradient exists to the southeast, the surrounding lands drain into the adjacent watercourse. Therefore, the stream will receive discharge of surface-water runoff from site. This stream is likely to act as a pathway or receptor of pollution associated with the site. An appraisal of the potential effects of the Proposed Development on the constitutive characteristics of European sites identified within 15km of the Proposed Development is set out in the Natura Impact Statement which accompanies the planning application for this project.

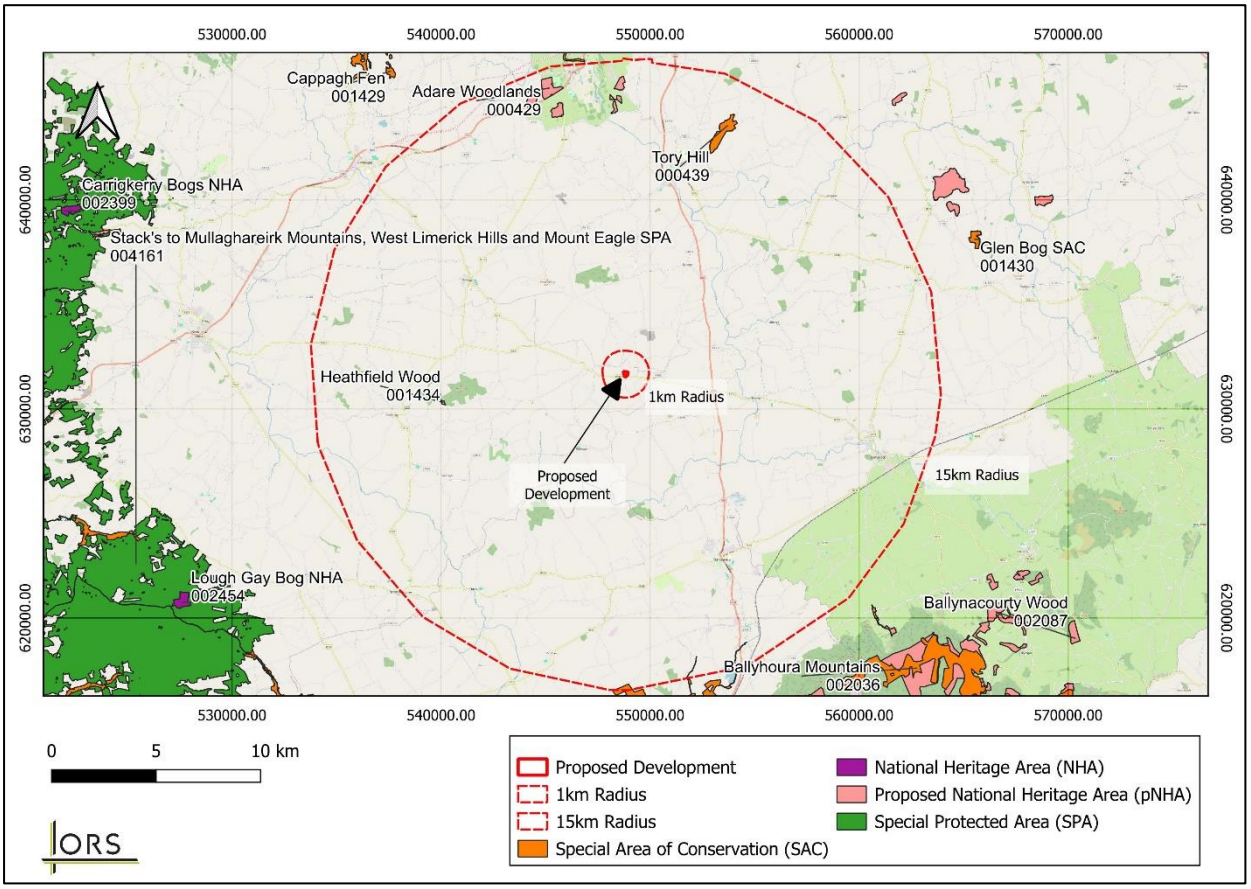

Figure 8.7: SPA, SAC and NHA sites within a 1km and 15km radius of site

Site Drainage

Arterial Drainage Schemes are those that the Office of Public Works (OPW) is legally obligated to maintain. These schemes were established under the Arterial Drainage Act of 1945,

primarily to enhance agricultural land and mitigate flooding. The works involved modifications to rivers, lakes, weirs, and bridges to improve water conveyance, the construction of embankments to control floodwater movement, and various other activities outlined in Part II of the Act. The main objectives of the schemes were to improve agricultural land, ensure that flood levels up to a 3-year return period were contained within banks, and reduce waterlogging in adjacent lands (known as callows) by lowering water levels during the growing season. As a result, flood protection in the affected areas was significantly enhanced.

In addition, local authorities are responsible for maintaining Drainage Districts, with provisions for their management outlined in Part III and Part VIII of the Arterial Drainage Act, 1945.

According to the Arterial Drainage Scheme (ADS) and Drainage District (DD) maps, the proposed site is not located in close proximity to any drainage schemes or their benefitted lands. The nearest Arterial Drainage Scheme channels, associated with the Maigue, lie beyond a 2 km radius from the site. There is no Drainage District in close proximity to the site.

Although the site is not immediately adjacent to these schemes, it is hydrologically connected to the Maigue Drainage Scheme's main channel, located along the River Maine *ca.* 6.75 km downstream of the site. The locations of these schemes relative to the site are illustrated in **Figure 8.8** below.

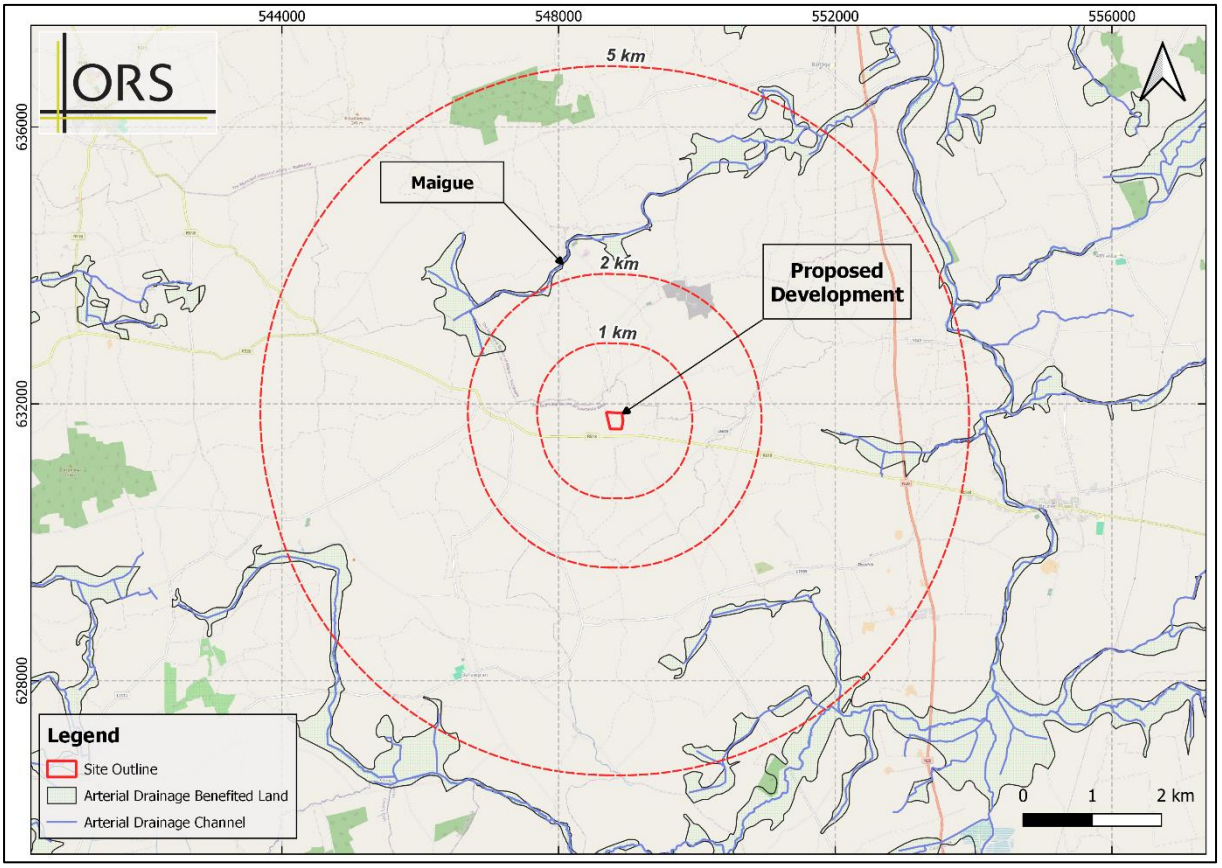

Figure 8.8: Site drainage catchments (OPW)

The site's drainage follows its natural topographical gradient, with surface water primarily flowing from northwest to southeast. During the site investigation, drainage ditches were identified in the centre of the site, perpendicular to each other, as shown in **Figure 8.9**. These ditches act as drainage channels during rainfall events, redirecting runoff toward the Lower

Ballyteige Stream and do not display consistent or regular flow; therefore, not meeting the criteria to be classified as watercourses. Instead, they function as surface drainage features to manage runoff from the site and its surroundings.

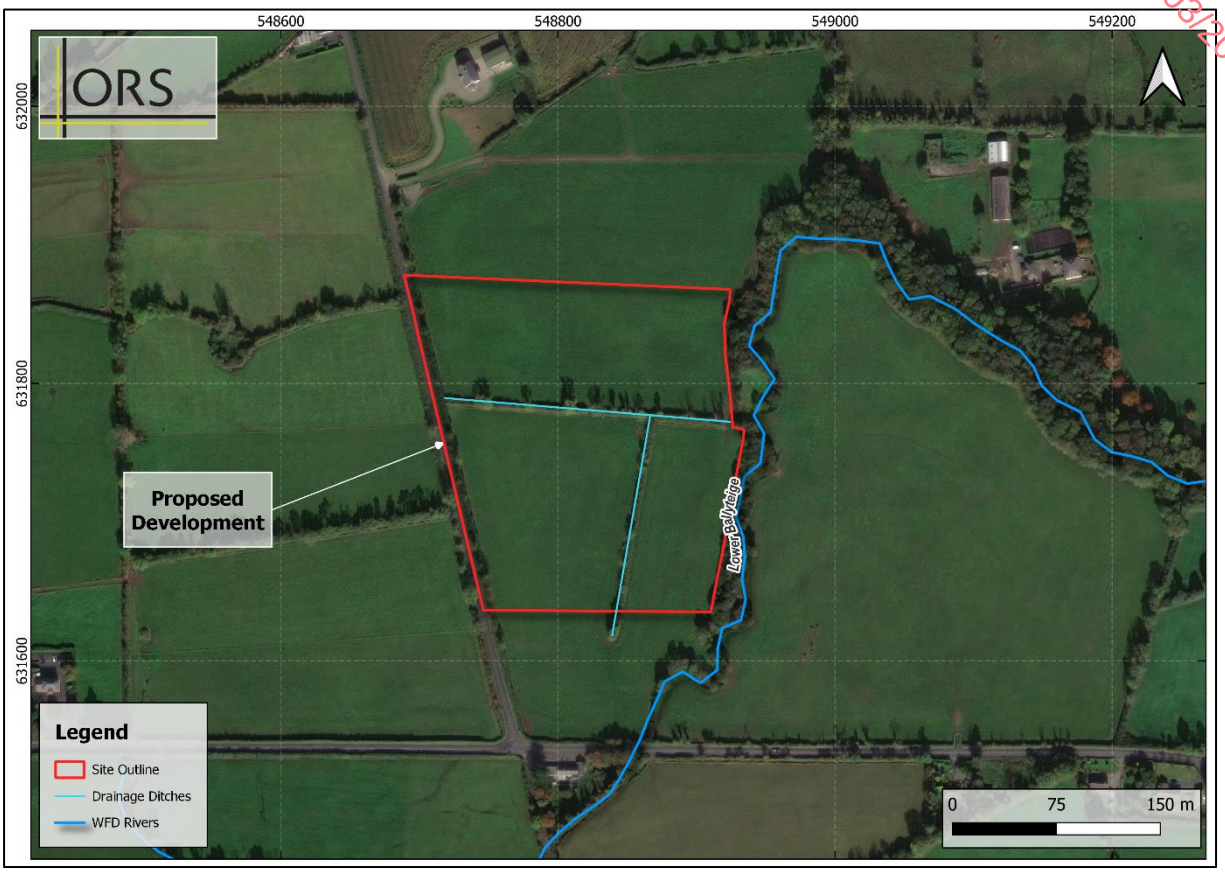

Figure 8.9: On-site drainage ditches.

As part of the proposed development, both ditches will be decommissioned. The runoff they currently collect will be effectively managed through the new drainage systems to be installed as part of the project.

Surface Water Rate of Discharge

The permissible rate of discharge of surface water from the site is determined in accordance with criteria set out in the Greater Dublin Strategic Drainage Study and the CIRIA Suds Manual. The site will operate with two separate surface water networks which will discharge to two proposed underground attenuation facilities. Post-attenuation, the runoff will be discharged at the greenfield runoff rate calculated for each catchment via means of a Hydrobrake or similar approved flow control device. This approach maintains the existing topographical discharge route from the site to the existing stream which traverses the western boundary of the site as noted in section 1 above. Attenuation and rainwater harvesting volumes have been sized based on a 95% runoff rate from all impermeable surfaces throughout the site.

Application of the following criterion ensures the Proposed Development will not impact the flood regime in the receiving watercourse:

- Maximum rate of discharge to be Qbar or 2.0 l/s/ha, whichever is greater;

- The Site area is 5.29 hectares, equivalent to 10.58 l/s.
- Qbar, calculated in accordance with IH 124, is
  - Upper level (service yard): 14.97 l/s
  - Lower level (sump): 7.10 l/s

Accordingly, the maximum permissible rate of discharge of surface water from the Proposed Development will follow the Qbar calculated with IH 124.

Limerick City & County Development Plan 2022 – 2028 – Flood Risk Management

A review of the Limerick City & County Development Plan was conducted to identify policies and objectives pertinent to flood risk management across the region. **Chapter 9**, titled ***Climate Action, Flood Risk, and Transition to a Low Carbon Economy***, is particularly relevant in this context. This chapter emphasises Limerick's commitment to transitioning to a low-carbon economy and becoming climate-resilient, with a strong focus on reducing energy demand and greenhouse gas emissions. Additionally, it addresses the increased intensity of rainfall and storm events across Ireland due to climate change and their role in exacerbating flood events in certain areas. The County policies & objectives related to Flood Risk management are the following:

- ***Policy CAF P5 – Managing Flood Risk:*** *It is a policy of the Council to protect Flood Zone A and Flood Zone B from inappropriate development and direct developments/land uses into the appropriate lands, in accordance with The Planning System and Flood Risk Management Guidelines for Planning Authorities 2009 (or any subsequent document) and the guidance contained in Development Management Standards and the Strategic Flood Risk Assessment (SFRA). Where a development/land use is proposed that is inappropriate within the Flood Zone, but that has passed the Plan Making Justification Test, then the development proposal will need to be accompanied by a Development Management Justification Test and Site-Specific Flood Risk Assessment in accordance with the criteria set out under The Planning System and Flood Risk Management Guidelines for Planning Authorities 2009 and Circular PL2/2014 (and any subsequent updates). This will need to demonstrate inclusion of measures to mitigate flood and climate change risk, including those recommended under Part 3 (Specific Flood Risk Assessment) of the Site-Specific Plan Making Justification Tests detailed in the SFRA. In Flood Zone C, the developer should satisfy themselves that the probability of flooding is appropriate to the development being proposed and should consider other sources of flooding, residual risks and the implications of climate change*.

- ***Objective CAF O20 – Flood Risk Assessments:*** *It is an objective of the Council to require a Site-Specific Flood Risk Assessment (FRA) for all planning applications in Flood Zones A and B and consider all sources of flooding (for example coastal/tidal, fluvial, pluvial or groundwater), where deemed necessary. The detail of these Site-Specific FRAs (or commensurate assessments of flood risk for minor developments) will depend on the level of risk and scale of development. The FRA will be prepared taking into account the requirements laid out in the SFRA, and in particular in the Plan Making Justification Tests as appropriate to the particular development site. A detailed Site-Specific FRA should quantify the risks, the effects of selected mitigation and the management of any residual risks. The assessments shall consider and provide information on the implications of climate change with regard to flood risk in relevant locations.*

- ***Objective CAF O21 – Identified Flood Risk:*** *It is an objective of the Council to:*

a) *Ensure that no development shall commence on the lands identified as being at flood risk adjacent to the Raheen Business Park in the townlands of Ballycummin/ Rootiagh, zoned for High Tech/ Manufacturing, until a Site-specific Flood Risk Assessment, including hydraulic model has been prepared for the lands, which demonstrates that the flood risk for the lands can be mitigated or that a less vulnerable use can be accommodated on site.*
b) *Ensure that on the Enterprise and Employment lands located to the northwest of the M20/M7/N18 junction to the south of Toppin's field, that no encroachment onto, or loss of the flood plain occurs at this location and that only water compatible development should be permitted for the lands that are identified as being at risk of flooding.*
c) *Ensure any planning application, including proposals for water compatible uses, on the lands in Flood Zones A and B adjacent to the Coonagh TUS campus, zoned for Education and Community, shall include a comprehensive Site-specific Flood Risk Assessment, incorporating a drainage assessment for the lands, which demonstrates that the flood risk can be mitigated and that water compatible uses can be accommodated without adversely impacting on the flood risk of neighbouring residential properties.*
d) *No works including the undertaking of ground level changes shall commence on the lands in the National Technology Park subject to flood risk, until all flood mitigation measures proposed on the site to facilitate future development of the IDA lands have been put in place. These measures shall form part of a project specific flood risk assessment being completed as part of any planning application.*
e) *Any planning application on the lands zoned Data Centre at Rossbrien shall include a comprehensive Site-specific Flood Risk Assessment, which demonstrates that the flood risk can be mitigated, and that access/egress, roads and water compatible uses can be accommodated without adversely impacting on the flood risk off site.*
f) *Implement the flood mitigation measures included under the Justification Test including to ensure that vulnerable uses, including that of a residential nature, shall not be permitted at ground floor level on the District Centre zoned lands at Jetland/ Ennis Road/ Ennis Road Retail Park, at Caherdavin/Moyross.*

- ***Objective CAF O22 – Cooperation with Other Agencies:*** *It is an objective of the Council to work with other bodies and organisations, as appropriate, to help protect critical infrastructure, including water and wastewater, within Limerick, from risk of flooding. Any subsequent plans shall consider, as appropriate any new and/or emerging data, including, when available, any relevant information contained in the CFRAM Flood Risk Management Plans and as recommended in the SFRA for the Plan.*

- ***Objective CAF O23 – Flood Relief Schemes:*** *It is an objective of the Council to support and facilitate the development of Flood Relief Schemes as identified in the CFRAM 10 Year Investment Programme and ensure development proposals do not impede or prevent the progression of these measures.*

- ***Objective CAF O24 – Minor Flood and Mitigation Works and Coastal Protection Schemes:*** *It is an objective of the Council to support and facilitate the Office of Public Works Minor Flood and Mitigation Works and Coastal Protection Schemes and ensure development proposals do not impede or prevent the progression of these measures.*

- ***Objective CAF O25 – Strategic Flood Risk Assessment:*** *It is an objective of the Council to have regard to the recommendations set out in the Strategic Flood Risk Assessment prepared to support the Plan.*

Limerick Development Plan 2022-2028 – Strategic Flood Risk Assessment

A Strategic Flood Risk Assessment (SFRA) has been undertaken as part of the Limerick City & County Development Plan 2022–2028. The report provides guidance for the preparation of site-specific Flood Risk Assessments and aims to deliver a broad assessment of all types of flood risk to inform strategic land-use planning decisions. The overall objective of the SFRA is to enable the local authority to apply the sequential approach, including the Justification Test, allocate suitable sites for development, and identify measures to reduce flood risk as part of the development planning process.

For developments located within Flood Zone C, the document emphasises the need to address all potential sources of flooding, including groundwater, stormwater issues arising from deficiencies, restrictions, or blockages, as well as fluvial and coastal flooding. It also notes that even in Flood Zone C, developments may still face flood risks when accounting for factors such as climate change, blockages of bridges or culverts, and other residual risks, particularly for sites near or adjacent to watercourses.

All proposed developments in County Limerick, including those in Flood Zone C, must take surface water flood risks into account in drainage design. Special consideration should be given to low-lying areas that may function as natural collection points for runoff. The drainage design must ensure there is no increase in flood risk either on-site or downstream within the catchment.

Flood Risk

According to OPW, the main sources of flooding are rainfall (Inland flooding) or higher sea levels (Coastal Flooding). The principal pathways include rivers, drains, sewers, overland flow and river and coastal floodplains. The receptors may include people, their property, and the environment. To accurately determine the potential consequences of flooding, it is essential to assess these three elements – sources, pathways, and receptors - alongside the vulnerability and exposure of receptors.

The Office of Public Works (OPW) and Department of Environment, Heritage and Local Government (DoHLG) published ‘The Planning System and Flood Risk Management Guidelines for Planning Authorities’ in 2009 (The Guidelines). The Guidelines define the likelihood of flooding is the probability or frequency of a flood of a specific magnitude or severity occurring or being exceeded in any given year. It is generally expressed as the chance of a particular flood level being exceeded in one year. This return period is described as the Annual Exceedance Probability (AEP). For example, a 1 in 100 or 1% flood is that which would, on average, be expected to occur once in 100 years, though it could happen at any time.

Flood zones are geographical areas within which the likelihood of flooding is in a particular range. There are three types or levels of flood zones defined for the purposes of the Guidelines:

- **Flood Zone A** – where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal flooding);
- **Flood Zone B** – where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding); and

- **Flood Zone C** – where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding). Flood Zone C covers all areas of the plan which are not in zones A or B.

In 2018, the Office of Public Works (OPW) launched a new online flood map viewer to provide information on the likelihood of flood risk and the extent of flooding across Ireland. This viewer includes flood risk data derived from several sources including:

1. ***Catchment Flood Risk Assessment and Management (CFRAM) Programme:*** 300 communities at potentially significant flood risk, referred to as Areas for Further Assessment (AFA's).
2. ***National Indicative Fluvial Mapping (NIFM):*** Predictive flood maps showing indicative areas predicted to be inundated during a theoretical fluvial flood event with an estimated probability of occurrence. Indicative flood maps have been produced for all watercourses that are on the EPA watercourse layers, have a catchment area greater than 5km^2 and for which flood maps were not produced under the National CFRAM Programme.
3. ***Geological Survey Ireland Groundwater Flooding:*** Probabilistic flood extent of groundwater flooding in limestone regions. These maps are focused primarily (but not entirely) on flooding at seasonally flooded wetlands known as turloughs.
4. ***Past Flood Events:*** A Past Flood Event is defined as the occurrence of recorded flooding at a given location on a given date or on a recurring basis. The event is derived from available flood information documentation including flood event reports, news articles, archive information and photos.

The Preliminary Flood Risk Assessment (PFRA) conducted a national screening exercise using available and readily derivable information to identify areas with significant flood risks, referred to as Areas for Further Assessment (AFAs). The PFRA report has not identified any locations with a significant risk of groundwater or pluvial flooding near to the proposed site. Regarding fluvial flooding, the proposed site is not within the flood mapping extent to the East (where Croom, at 10km away, has a flood risk index of 835 due to the River Maigue) and to the West (where Newcastle West, at 20km away and Rathkeale at 15km away have flood risk indices of 4781 and 2372 respectively, due to flooding from the river Deel). Considering the proximity of these areas, it can be concluded that the risk of fluvial flooding at the site is low. Coastal flooding is not applicable to this project.

Based on this assessment, Cappanihane is not designated as an Area or potential Area for Further Assessment (AFA). Consequently, there is no modelled flooding data available for its surroundings and the project area is not included within a CFRAM study map. The nearest modelled flood extensions are along the River Maigue, *ca.* 5 km east of the site, and the River Deel, *ca.* 15 km northwest of the site.

The National Indicative Fluvial Maps (NIFM) have been created to identify areas where further assessment would be required if development is being considered within or adjacent to the flood extents shown on the maps. These maps are 'predictive' flood maps showing indicative areas predicted to be inundated during a theoretical fluvial flood event with an estimated probability of occurrence.

The NIFM fluvial flood extents for the Present-Day scenario, covering annual exceedance probabilities of 0.1% and 1%, indicate areas prone to flooding *ca.* 550m south and 2km northwest of the site, respectively. The mid-range and high-end future scenario maps do not show a significant extension of these floods towards the site. Therefore, it can be concluded

that the proposed site is situated in an area with less than a 0.1% probability of flooding, classifying it as Flood Zone C.

A summary of the above-noted flood risk data as derived from the OPW map viewer within the vicinity of the site is presented in **Figure 8.10**.

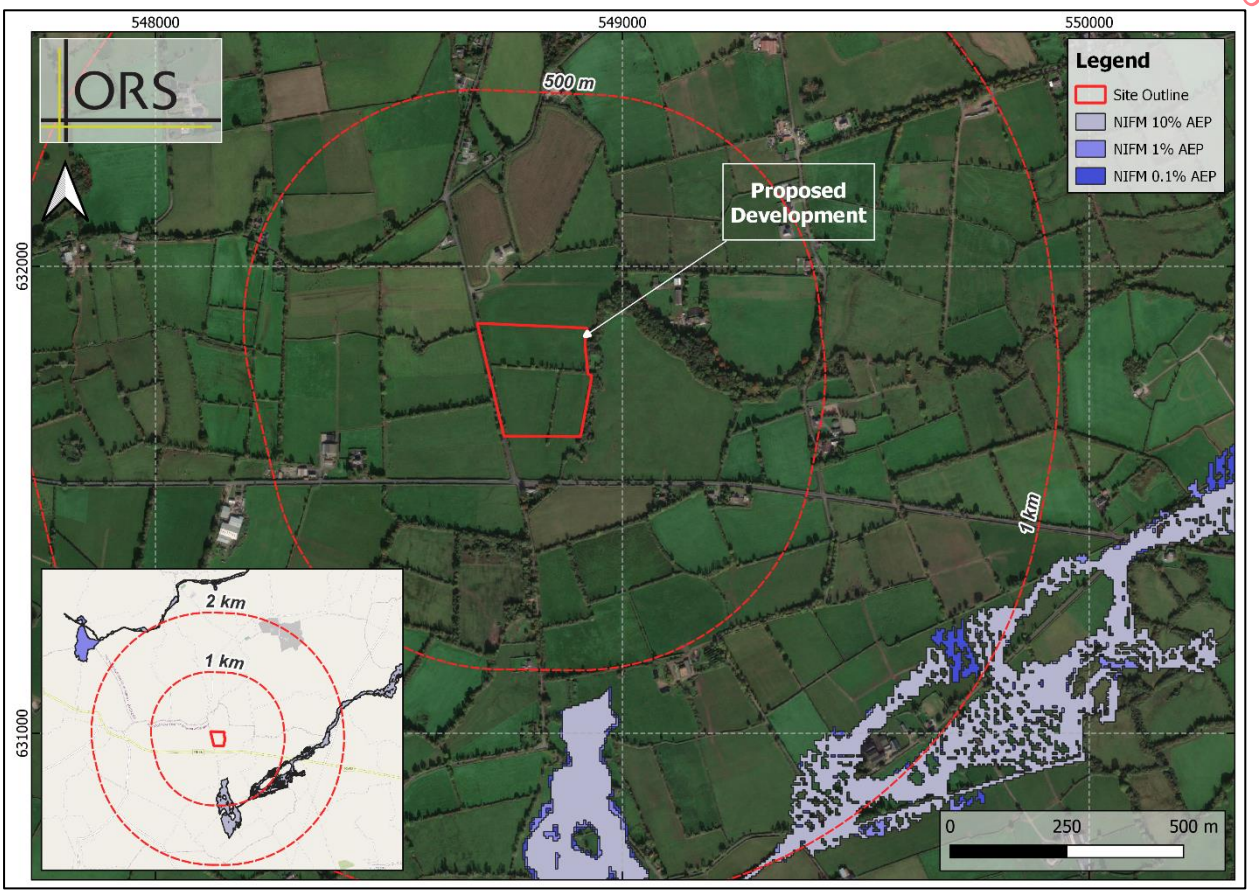

Figure 8.10: NIFM Flood extends in relation to the Proposed Development (Source: OPW).

Limerick City & County Development Plan 2022 – 2028 – Water Quality

A review of the Limerick City & County Development Plan was carried out to determine the policies and objectives relevant to the preservation and protection of water quality throughout the region.

Chapter 5 – A Strong Economy Policy Objectives:

- ***ECON O35 – Rural Development:*** *It is an objective of the Council to facilitate the development of acceptable rural enterprises and to minimise pollution from agricultural and industrial sources by means of development management and water pollution legislation.*

Chapter 6 – Environment, Heritage, Landscape and Green Infrastructure Policy & Objectives:

- ***Policy EH P6 – Water and Air Quality:*** *It is a policy of the Council to ensure that water and air quality shall be of the highest standard, to ensure the long term economic, social*

and environmental well-being of Limerick's resources. The World Health Organisation Air Quality Guidelines will be the basis for the air quality guidance in Limerick.

- **Objective EH O12 – Blue and Green Infrastructure:** *It is an objective of the Council to:*
  a) Promote a network of blue and green infrastructure throughout Limerick.
  b) Promote connecting corridors for the movement of species and encourage the retention and creation of features of biodiversity value, ecological corridors and networks that connect areas of high conservation value such as woodlands, hedgerows, earth banks, watercourses, wetlands and designated sites. In this regard, new infrastructural projects and linear developments, will have to demonstrate at design stage, sufficient measures to assist in the conservation of and dispersal of species. Projects which would be detrimental to existing blue and green infrastructure features will not be permitted.

- ***Objective EH O15 – Ground Water, Surface Water Protection and River Basin Management Plans:*** *It is an objective of the Council to:*
  a) Protect ground and surface water resources and to take into account the requirement of the Water Framework Directive when dealing with planning and land use issues.
  b) Implement the provisions of the River Basin Management Plan 2022 – 2028 and any succeeding plan. The filling of wetlands, surface water features and modifications and drainage of peatlands shall generally be prohibited. […]

- ***Objective EH O16 - Septic Tanks and Proprietary Systems:*** *It is an objective of the Council to ensure that septic tanks/proprietary treatment systems, or other waste water treatment and storage systems which are required as part of a development, comply with the standards set out under EPA 2021 etc. and that they are constructed only where site conditions are appropriate.*

- ***Objective EH O17 - Water Quality****: It is an objective of the Council to support commitments to achieve and maintain 'At Least Good' status, except where more stringent obligations are required. There shall be no deterioration of status for all water bodies under the Marine Strategy Framework Directive and its programme of measures, the Water Framework Directive and the River Basin Management Plan. Key challenges include, inter alia, the need to address significant deficits in urban waste-water treatment and water supply, addressing flooding and increased flood risks from extreme weather events and increased intense rainfall because of climate change.*

- ***Objective EH O18 - Riparian Buffers:*** *It is an objective of the Council to maintain riverbank vegetation along watercourses and ensure protection of a 20m riparian buffer zone on greenfield sites and sites are maintained free from development. Proposals shall have cognisance of the contents of the Inland Fisheries Ireland document Planning for Watercourses in Urban Environments.*

Chapter 8 – Infrastructure Policy Objectives:

- ***Objective IN O6 - Water Services:*** *It is an objective of the Council to:*
  a) Support Irish Water in the provision of water and wastewater infrastructure and services in accordance with the Service Level Agreement, until such time as the Agreement is terminated.
  b) Collaborate with Irish Water in the protection of water supply sources to avoid water quality deterioration and reduce the level of treatment required in the production of drinking water, in accordance with Article 7(2) of the WFD. Protection and restoration of

drinking water at the source can have co-benefits for biodiversity and climate change. […]

c) *[…] Ensure that development proposals connecting to the public water and/or wastewater networks, now or in the future comply with Irish Water Standard Details and Codes of Practice. Where relevant, ensure developments comply with the EPA Code of Practice for Domestic Waste Water Treatment Systems 2021.*
d) *Require future developments to connect to public water services and wastewater if available to the site. Combined water and wastewater systems will not be permitted. Consent to connect to Irish Water assets will be requested as part of the planning application process.*
e) *Have regard to Section 28 Guidelines – Draft Water Services Guidelines for Planning Authorities, DHPLG, 2018 and any subsequent guidelines when carrying out the forward planning and development management functions of the Planning Authority.*

- ***Objective IN O7 - Drinking Water Source Protection:*** *It is an objective of the Council to protect both ground and surface water sources, to avoid water quality deterioration and reduce the level of treatment required in the production of drinking water, in accordance with Article 7(2) of the Water Framework Directive.*
  a) *New developments which could pose an unacceptable risk to drinking water sources will not be permitted.*
  b) *New development should not conflict with the protection guidelines set out in the Limerick Groundwater Protection Scheme and/ or Groundwater Source Protection Zone reports.*

- ***Objective IN O8 - Private Water Supply:*** *It is an objective of the Council to require that in locations where a connection to an existing public water supply is not possible, or the existing supply system does not have sufficient capacity, the provision of a private water supply may be considered. The development must demonstrate that the proposed water supply meets the standards set out in EU and national legislation and guidance, would not be prejudicial to public health, or would not affect the source of an existing supply, particularly a public supply/well. Such information will be required as part of the planning application process.*

- ***Objective IN O9 - Public Wastewater:*** *It is an objective of the Council to:*
  a) *Ensure adequate and appropriate wastewater infrastructure is available to cater for existing and proposed development, in collaboration with Irish Water, to avoid any deterioration in the quality of receiving waters and to ensure that discharge meets the requirements of the Water Framework Directive.*
  b) *Require all new developments to connect to public wastewater infrastructure, where available and to encourage existing developments that are in close proximity to a public sewer to connect to that sewer. These will be subject to a connection agreement with Irish Water and evidence of this agreement will be required as part of any planning application.*
  c) *Require all new development to provide separate foul and surface water drainage systems, to maximise the capacity of existing collection systems for foul water.*
  d) *Apply a presumption against any development that requires the provision of private wastewater treatment facilities (i.e. Developer Provided Infrastructure) other than single house systems and in very exceptional circumstances.*

- ***Objective IN O11 - Private Wastewater:*** *Treatment It is an objective of the Council to:*
  a) *Promote the changeover from septic tanks to the public foul water collection networks*

where feasible and to strongly discourage the provision of individual septic tanks and domestic wastewater treatment systems, in order to minimise the risk of groundwater pollution.

b) *Ensure single house wastewater treatment systems in those areas not served by a public foul sewerage system comply with the EPA Code of Practice for Domestic Waste Water Treatment Systems 2021 as may be amended or updated.*
c) *Require non-domestic wastewater treatment systems in those areas not served by a public foul sewerage system to demonstrate full compliance with EPA Wastewater Treatment Manuals (Treatment Systems for Small Communities, Business, Leisure Centres and Hotels) as maybe amended or updated.*
d) *Ensure all private wastewater treatment systems shall be located entirely within the site boundary. […]*
e) *Ensure that private wastewater treatment facilities, where permitted, are operated in compliance with their wastewater discharge license, in order to protect water quality.*

- ***Objective IN O12 - Surface Water and SuDS**: It is an objective of the Council to:*
  a) *Ensure the separation of foul and surface water discharges in new developments through the provision of separate networks within application site boundaries.*
  b) *Work in conjunction with other public bodies towards a sustainable programme of improvement for riverbanks, back drains, etc.*
  c) *Maintain, improve and enhance the environmental and ecological quality of surface waters and groundwater, including reducing the discharges of pollutants or contaminants to waters, in accordance with the National River Basin Management Plan for Ireland 2018-2021 (DHPLG) and the associated Programme of Measures and any subsequent River Basin Management Plan.*
  d) *Ensure adequate storm water infrastructure to accommodate the planned levels of growth within the Plan area and to ensure that appropriate flood management measures are implemented to protect property and infrastructure.*
  e) *Cater for the future developments through public and private driven initiatives where discharge capacity permits.*
  f) *Address the issue of disposal of surface water generated by existing development in the area, through improvements to surface water infrastructure, including for example attenuation ponds, the application of sustainable urban drainage techniques, or by minimising the amount of hard surfaced areas, or providing porous surfaces as the opportunity arises.*
  g) *Protect the surface water resources of the Plan area and in individual planning applications request the provision of sediment and grease traps and pollution control measures where deemed necessary.*
  h) *Require all planning applications to include surface-water design calculations to establish the suitability of drainage between the site and the outfall point and require all new developments to include SuDS, to control surface water outfall and protect water quality […].*
  i) *Promote SuDS and grey water recycling in developments and responsible use of water by the wider community, to reduce the demand for water supply.*
  j) *Require SuDS schemes to be designed to incorporate the four pillars of water quality, water quantity, biodiversity and amenity to the greatest extent possible within the constraints of a given site.*
  k) *Allow sufficient land take for SuDS when planning the site and consider the region as a whole, in association with adjoining lands and their requirements in designing SuDS. Developers may be required to set aside lands to cater for not only their own SuDS but also regional SuDS.*

l) *Promote the provision of suitable blue and green infrastructure and Nature Based Solutions to the surface water disposal in new development, as a means to provide urban flood resilience. This approach capitalises on the potential of urban green spaces and natural water flows, subject to the other planning considerations such as amenity, maintenance, traffic safety, proper planning and sustainable development and environmental requirements.*

m) *To prohibit the discharge of additional surface water to combined (foul and surface water) sewers in order to maximise the capacity of existing collection systems for foul water. In areas where street scape enhancement or resurfacing is planned, seek to introduce NbSUDS to cater for rainfall run-off at source in order to maximise the capacity of existing collection systems for foul water.*
   - *Encourage green roofs for the following types of development:*
   - *Apartment developments;*
   - *Employment developments;*
   - *Retail developments;*
   - *Leisure facilities;*
   - *Education facilities.*

- ***Objective IN O20 - Agricultural Waste:*** *It is an objective of the Council to:*

a) *Encourage the development of new alternatives and technological advances in relation to waste management on the farm and waste infrastructure such as Organic Waste to Energy/Combined Heat and Power schemes, subject to compliance with normal planning and environmental criteria.*

b) *Require that the disposal of agricultural waste is carried out in a safe, efficient and sustainable manner, having regard to protection of the environment and public health and in compliance with the Nitrates Directive, Good Agricultural Practice for the Protection of Waters) Regulations 2017 (SI 605 of 2017), the Habitats Directives and any other relevant statutory provisions.*

Chapter 9 – Climate Action, Flood Risk and Transition to Low Carbon Economy Policy & Objectives:

- ***Objective CAF O11 - Nature Based Solutions:*** *It is an objective of the Council to promote integration and delivery of nature-based solutions and infrastructure in new developments, including surface water management, public realm and community projects as a means of managing flood risk and enhancing the natural environment.*
- ***Policy CAF P6 - Renewable Energy****: It is a policy of the Council to support renewable energy commitments outlined in national and regional policy, by facilitating the development and exploitation of a range of renewable energy sources at suitable locations throughout Limerick, where such development does not have a negative impact on the surrounding environment landscape, biodiversity, water quality or local amenities, to ensure the long-term sustainable growth of Limerick.*

8.4.6 Biological Water Quality

National surveys of Irish rivers have taken place on a continuous basis since 1971. The National Rivers Monitoring Programme was replaced by the Water Framework Monitoring Programme from 22 December 2006. As part of the Water Framework Directive (WFD) Monitoring Programme approximately one third of our major rivers and their more important tributaries are surveyed and assessed each year by EPA ecologists. A complete survey cycle is completed every three years. The sites are scored on a five-point system developed by the EPA called the

Biological Q-Rating system. Macroinvertebrate data is utilised to ascertain the biological quality of a given river or stream as detailed in **Table 8.2** at the beginning of this chapter.

Biological Q-value and physico-chemical data are not available for the Lower Ballyteige Stream or its receiving waterbody, the River Glenma. The most relevant EPA monitoring stations in the area are situated along the River Maigue, both upstream and downstream of its confluence with the River Glenma. This lack of monitoring data in the immediate vicinity of the proposed site means that the current water quality status of these waterbodies may not be accurately reflected, both upstream and downstream of the proposed development.

Table 8.5 provides details of the monitoring stations relevant to the proposed development, including their associated Q-Ratings, while their locations relative to the site are shown in **Figure 8.11**.

Table 8.5: Biological Q-Ratings for waterbodies hydraulically connected to the River Maigue (EPA)

Station ID (EPA)	Station Name	Year								
		1971-1999	2002	2006	2008	2011	2014	2017	2020	2023
RS24M010400	Howardstown Br (M41)	3	3-4	3-4	4	4	3-4	3-4	3-4	3-4
RS24M010500	Br nr Rosstemple Station	3-4	3-4	3-4	4	4	4	3-4	4	3-4

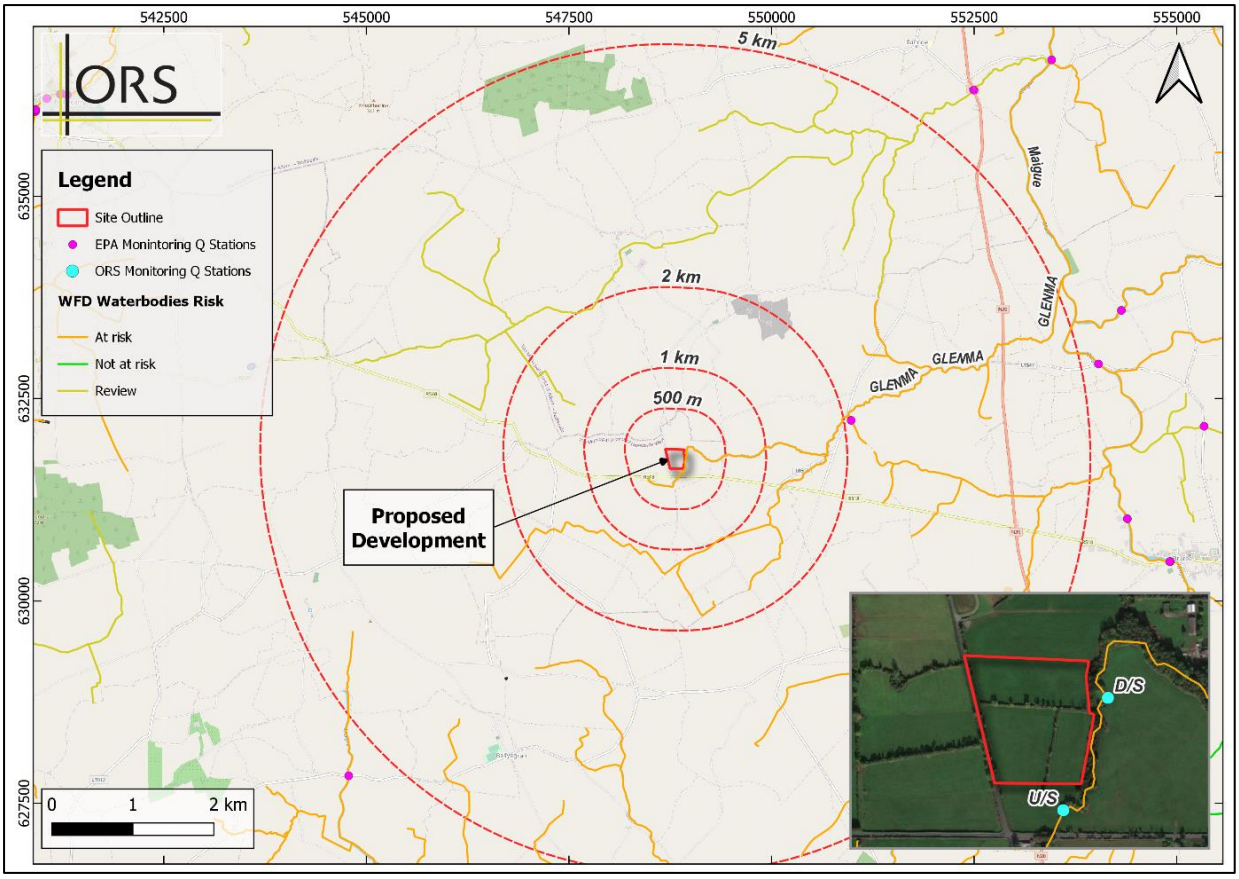

Figure 8.11: Water Framework Directive Risk and locations of water quality monitoring stations (EPA maps)

The **RS24M010400** and **RS24M010500** EPA water monitoring stations are located on the River Maigue, *ca.* 1.4 km upstream and 3.1 km downstream, respectively, from the point where the

River Glenma connects hydrologically with the River Maigue. Historical Q-value data from these stations indicate consistent trends, generally fluctuating between 3-4 and 4, with a single occurrence of a Q-value of 3 in each station, recorded in 1999 and 1996, respectively. The most recent Q-rating for both stations, recorded in August 2023, was 3-4. This corresponds to a *Moderate* status under the Water Framework Directive (WFD) and categorises the water as *Slightly Polluted* according to EPA standards, reflecting unsatisfactory water quality.

The River Glenma, including all its tributaries (such as the Lower Ballyteige Stream) and the section of the River Maigue downstream of their confluence (EPA designation: MAIGUE_050), is classified as having a *Good* status under the WFD and is not considered at risk according to EPA maps (River Waterbody WFD Status 2016–2021). While the Cycle 3 HA 24 Shannon Estuary South Catchment Summary, published in May 2024, does not identify any specific pressures affecting this waterbody, the 3rd Cycle Draft Shannon Estuary South Catchment Report (HA 24), published in August 2021, identifies agriculture as the primary pressure impacting waterbodies in the vicinity of the proposed development.

Based on the available information, waterbodies near the site have shown slight variations in quality over multiple monitoring cycles, fluctuating between the *Good* and *Moderate* status. Compared to the previous monitoring cycle, the waterbody showed an improvement in water quality, leading to its classification as "not at risk." However, the most recent data collected in 2023 (not included in the EPA assessment published in May 2024) suggests a decline in water quality, indicating a potential deterioration from the earlier improvement.

8.4.6.1 On-Site Q-Value Assessment

An evaluation of water monitoring stations hydrologically of relevance to the proposed site revealed a lack of biological Q-value data for the receiving waterbody, the Lower Ballyteige Stream. To address these data deficiencies, ORS conducted a site-specific Q-Value assessment in November 2024.

Sampling was conducted at two locations, upstream and downstream along the Lower Ballyteige stream as presented in **Figure 8.12** overleaf. Sampling was conducted using kick sampling with a sweep net and of standard 1mm fine mesh to catch macroinvertebrates. At each site, three samples were taken to provide a representative profile of each downstream and upstream section. Vegetative characteristics, including macrophytes, were compiled during sampling to provide additional ecological context. Substrate composition and water body characteristics including flow type on the date of sampling, and water depth and width were also measured. Collected specimens were identified to the lowest taxonomic level possible using a taxonomic key and stereoscopic microscope, following standard procedures. Q-values were assigned to identify taxa based on their sensitivity to pollution.

Figure 8.12: Locations of ORS Q rating monitoring points.

The downstream site exhibited a higher proportion of moderately sensitive and pollution-tolerant taxa, including Gammaridae, Bloodworm, and Chironomidae. While some highly sensitive taxa such as Trichoptera and Hydropsychidae were present, their relative abundance was lower compared to upstream. This suggests that the downstream site is subject to moderate pollution pressures, likely due to anthropogenic impacts or localised sources of nutrient enrichment.

The upstream site demonstrated a healthier ecological balance, with a higher relative abundance of highly sensitive taxa such as Trichoptera, alongside a balanced presence of moderately sensitive groups like Hydrobiidae. Pollution-tolerant taxa were present but in lower proportions compared to downstream, indicating reduced pollution impact.

The results of the biological water quality assessment from the Lower Ballyteige stream at points upstream and downstream are presented below in **Table 8.6**

Table 8.6: Biological Q-Ratings for the Lower Ballyteige stream, hydrologically connected to the Proposed Development

ORS monitoring point	Q value result	Ecological Status
Station 1 (D/S)	3-4	Moderate
Station 2 (U/S)	4	Good

8.4.7 Hydrochemistry Data

On November 1st, 2024, ORS conducted a site visit and collected baseline water samples from the Lower Ballyteige Stream at locations upstream (U/S) and downstream (D/S) of the proposed development. The samples were analysed at an accredited laboratory (Eurofins), with the results presented in **Table 8.7**.

Under the Water Framework Directive (WFD), the Lower Ballyteige Stream, along with the River Glenma, its tributaries, and the relevant section of the River Maigue (EPA designation: MAIGUE_050), is classified as having a *Good* WFD status and is considered *Not at Risk*. However, there is currently no EPA hydrochemical data available for the Lower Ballyteige Stream. While hydrochemical data exists for the Coolrus Stream, another tributary of the River Glenma located downstream of the hydrological connection between the Lower Ballyteige Stream and the River Glenma, this data is outdated, with the most recent records from 2017.

As a result, the evaluation of local water quality and the assessment of potential impacts from the proposed development on the receiving hydrological environment were based solely on site-specific hydrochemical data collected by ORS. Despite the absence of long-term EPA data for the Lower Ballyteige Stream, the site-specific dataset provides a valuable reference point for assessing water quality.

Table 8.7: Hydrochemistry results (U/S and D/S of the Proposed Development – Lower Ballyteige stream)

Sampling Location	Parameter	Unit	Result
Upstream – Lower Ballyteige Stream	Ammonia	mg/l as N	0.016
	BOD	mg/l	2.00
	COD	mg/l	23.0
	Nitrate	mg/l as N	1.15
	Nitrite	mg/L as N	<0.01
	Nitrogen (Total)	mg/l	2.00
	pH	pH units	7.5
	Orthophosphate	mg/l as P	0.134
	Total Suspended Solids	mg/l	25.00
Downstream – Lower Ballyteige Stream	Ammonia	mg/l as N	0.013
	BOD	mg/l	1.9
	COD	mg/l	24.0
	Nitrate	mg/l as N	1.28
	Nitrite	mg/L as N	<0.01
	Nitrogen (Total)	mg/l	2.20
	pH	pH units	7.60
	Orthophosphate	mg/l as P	0.138
	Total Suspended Solids	mg/l	18.0

The results indicate that the waterbody does not meet the criteria for 'Good' status as defined in the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019. This aligns with the on-site Q-value assessment conducted by ORS, particularly for the downstream (D/S) sample, where the ecological status was classified as Moderate. However, it is important to note that this assessment represents a single measurement and may not fully reflect the current overall water quality of the surface water body.

Additionally, as there will be no process discharges from the Proposed Development, no negative impact is expected on the Lower Ballyteige Stream or downstream receptors.

Detailed information or current data specific to the Lower Ballyteige Stream is not available on

Catchments.ie. Instead, this stream is included as part of the broader Maigue_050 overview, as summarised in **Table 8.8**.

Table 8.8: Description of Receiving Waters – Maigue_050 (Catchments.ie)

Characteristic	Classification	Status	Interpretation
Receiving Waterbody Name	Maigue_050	Not at risk	Receiving Waterbody is the MAIGUE_060, which has a Moderate WFD Status. Inputting Surface Waterbodies include the MAIGUE_040, MORNINGSTAR_060 and West Liskennett_010, which have a Moderate, Good and Poor WFD Status, respectively.
Waterbody Type	River	-	-
WFD Status	SW 2016-2021	Good	The waterbody demonstrates an improvement in water quality compared to the previous monitoring cycle (2013–2018), during which it was classified as 'Moderate.' However, the most recent data collected in 2023 suggests a decline in water quality, indicating a potential deterioration from the earlier improvement. As per past Catchment Reports, the stream is mostly impacted by agricultural activities in the surrounding area.
Resource	Not Classified		No drinking water abstractions and no abstractions pressures registered for Maigue_050.
Hydromorphological Conditions	Not classified	N/A	Hydromorphological Conditions is not included in the Planned Monitoring for this station.
Chemical SW Status	Not classified	N/A	Chemical Surface Water Status is not included in the Planned Monitoring for this station.
Biological Status	Macrophyte Status or Potential	N/A	The Maigue_050 has been tested for Invertebrate Status or Potential once every three years since 1984. Historical Q-value data indicate a consistent trend, generally fluctuating between 3-4 and 4, with a single occurrence of a Q-value of 3 recorded in 1996. The most recent Q-rating for both, recorded in August 2023, shows a decline in water quality in relation to the previous monitoring cycle. Macrophyte, Phytobenthos, and Fish Status are not included in the Planned Monitoring for this station.
	Invertebrate Status or Potential	Good	
	Phytobenthos Status or Potential	N/A	
	Fish Status or Potential	N/A	
Supporting Chemistry Conditions	Oxygenation Conditions	N/A	Chemical monitoring is not included in the Planned Monitoring for this station.
	Nitrogen		
	Phosphorus		
	Other Nutrients		
	Specific Pollutant Conditions		

8.4.8 Hydrogeology

Regional & Local Hydrogeology

Hydrogeology is the study of groundwater, including its origin, occurrence, movement and quality. Rocks which store and transmit groundwater are known as bedrock aquifers. Different bedrock types have differing abilities to store and transmit water, depending on their permeability and fracture intensity. The Geological Survey of Ireland has classified all aquifers in Ireland in three main categories based on potential yield and extent:

- Regionally Important
- Locally Important
- Poor

County Limerick's hydrogeology is largely influenced by its limestone bedrock, which forms extensive karst systems that facilitate groundwater movement through interconnected fractures and fissures. Upland regions with sandstone and shale formations exhibit lower permeability, restricting groundwater flow and recharge. The county contains both regionally and locally aquifers, with karst areas, characterised by shallow soil cover, being particularly susceptible to contamination. Groundwater interactions with major rivers, including the Shannon, Maigue, and Deel, influence river flow, baseflow contributions, and water levels. Aquifers are classified into three categories: regionally important (34%), locally important (43%), and poor aquifers (23%).

The subject site is located above the Ballingarry Groundwater Body, which spans 94 km² in the uplands of County Limerick. This is adjacent to the Hospital Groundwater Body which is designated by the Geological Survey of Ireland (GSI) National Draft Bedrock Aquifer Map as a Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (Classification reference - Ll) and it is located *ca.* 90m south of the site.

Provisional information on the hydrogeological classification of the bedrock beneath the subject site was obtained from the Geological Survey of Ireland (GSI). The Devonian sandstone till parent material comprised of dark grey slates which are massive and frequently contain thin white silty mudstones beneath the site is considered by the GSI to be a Regionally Important Aquifer - Fissured Bedrock. These aquifer categories have been assigned taking account of the following:

- The overall potential groundwater resources in each rock unit
- The area of each rock unit
- The localised nature of the higher permeability zones (e.g. fractures) in the bedrock unit
- The fact that all bedrock types give enough water for domestic supplies (therefore are called aquifers)

The majority of the Ballingarry groundwater body (GWB) is underlain by regionally important fissured bedrock aquifers (Rf). The volcanic rock is classified as a locally important bedrock aquifer (Lm), generally moderately productive. Between the ridges, small areas of the GWB are underlain by Dinantian Lower Impure Limestones, classified as locally important (Ll) aquifers with moderate productivity in localised zones. Additionally, small areas along the ridges are underlain by Old Red Sandstone, which also falls under the Ll classification. The proposed site is located entirely within a ***Rf: Regionally important fissured bedrock aquifer*** area, as

shown in **Figure 8.13** below.

Groundwater in this area flows through fractures, joints, and major faults, with water levels varying based on topography, ranging from near-surface to depths exceeding 20 m. The folding of rock units creates both confined and unconfined conditions within the aquifer. Initially, groundwater flow is unconfined, but as it moves beneath thickening subsoils and the Dinantian Lower Impure Limestones (Ballysteen Formation), it becomes confined. Flow paths in unconfined areas can extend over thousands of meters, though they may be shorter depending on the topography, while confined flow paths are considerably longer, with slower groundwater movement. Evidence suggests some perching of groundwater within the system.

The general direction of groundwater flow is downhill, radiating outward in all directions, primarily north, south, and east, where it discharges into rivers crossing the aquifer. In the eastern part of the GWB, groundwater flows towards the River Maigue. Recharge occurs mainly in upland areas where rock outcrops or thin subsoils are present. The combination of confined and unconfined flow systems, along with varying flow path lengths, indicates a complex groundwater movement regime that is influenced by both geological structure and topography.

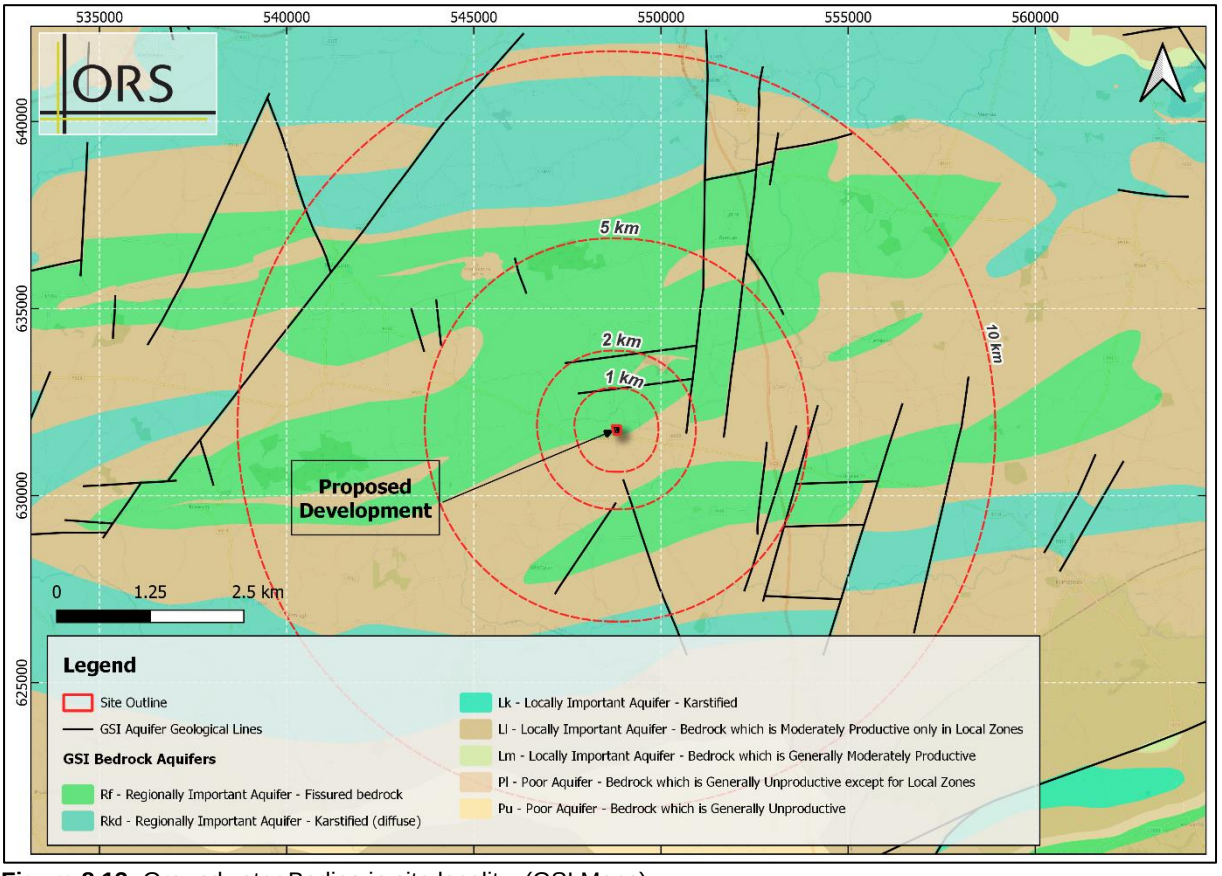

Figure 8.13: Groundwater Bodies in site locality. (GSI Maps)

The proposed site is underlain by low-permeability subsoil and covered by waterlogged soil, classified as Hydrogeological Setting 3.iii. The average annual groundwater recharge in the area is estimated to range from 80 mm to 86 mm.

Groundwater vulnerability is influenced by factors such as subsoil, recharge type (point or

diffuse) and thickness of the unsaturated zone, through which potential contaminants can move. The Geological Survey of Ireland (GSI) uses a matrix comprising four categories - extreme, high, moderate and low - for mapping purposes and in the assessment of risk to groundwater. These categories are determined by the thickness of the overburden, as shown in **Table 8.9**, which acts as a barrier to contaminants moving toward the groundwater table. For instance, when the overburden is less than 3 m thick, the vulnerability is classified as extreme, indicating a very high risk of contamination reaching the aquifer. Conversely, with an overburden greater than 10 m thick and low permeability, vulnerability is considered low. In County Limerick, groundwater vulnerability varies from low to extreme, with the highest vulnerability occurring where rock is at or near the surface or where karst features are present. The majority of the County is classed as having either extreme or high vulnerability (75% of the area) while areas of moderate or low vulnerability are much less common. The proposed site is classified as having "Moderate" vulnerability. Refer to **Figure 8.14**.

Table 8.9: Vulnerability Mapping Criteria

Subsoil Thickness	Hydrogeological Requirements				
	Diffuse Recharge (Subsoil Permeability & Type)			Point Recharge	Unsaturated Zone
	High (Sand & Gravel)	***Moderate (Sandy Subsoil)***	***Low (Clay & Peat)***	***Swallow Holes***	***Sand & Gravel Aquifers***
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

There are no wells located within the boundaries of the proposed site. However, the GSI database identifies 19 no. groundwater wells within a 2 km radius of the site, the majority of which are boreholes. Groundwater wells within the wider area have a varying yield class ranging from excellent to poor. The lands on which the site location has been proposed have been assigned variety of vulnerability rating of moderate. The recorded depth to bedrock encountered for the corresponding wells are generally between 0.6 to 40.2 metres below ground level (bgl). A detailed summary of this data is provided in **Table 8.10** overleaf, and the locations of these wells in relation to the proposed site are illustrated in **Figure 8.14**.

Table 8.10: Groundwater Wells with 2km of the site (GSI Well Database)

GSI Reference	Easting Northing	Well Type	Depth (mbgl)	DTB (m)	Well Use	Yield (m^3/d)	Proximity to site
1413SWW065	149320, 130890	Dug well	3.4	3.4	Unknown	55.0	0.25km SE
1413SWW050	149590, 130920	Borehole	17.7	-	Unknown	33.0	0.9km SE
1413SWW047	149420, 130240	Borehole	24.4	12.2	Unknown	28.0	1.34km SE
1413SWW096	150700, 131200	Borehole	45.1	3.1	Unknown	-	1.27km E
1413SWW067	150700, 131370	Dug well	9.1	-	Unknown	-	1.27km E
1413SWW126	150580, 131140	Borehole	62.2	24.4	Domestic use only	54.5	1.66km E
1413SWW127	148800, 133600	Borehole	73.2	40.2	Domestic use only	545.0	1.38km N
1413SWW075	242320, 118000	Borehole	15.5	-	Unknown	28.0	1.0km NW
1413SWW061	146870, 132590	Borehole	46.3	6.1	Unknown	27.3	1.6km NW
1413SWW062	146870, 132640	Dug well	1.8	0.6	Unknown	43.6	1.6km NW
1413SWW132	147740, 131290	Borehole	25.0	-	Unknown	44.0	0.57km W
1413SWW076	147320, 131280	Borehole	13.4	-	Unknown	44.0	1.0km W

1413SWW058	146500, 131250	Borehole	38.1	9.1	Unknown	27.3	1.82km W
1413SWW059	146500, 131300	Borehole	21.3	-	Unknown	27.3	1.82km W
1413SWW060	146500, 131350	Borehole	30.5	30.5	Unknown	21.8	1.82km W
1413SWW078	148130, 130370	Borehole	29.3	-	Unknown	39.0	0.85km SW
1413SWW069	148130, 130320	Dug well	5.5	5.5	Unknown	27.0	0.87km SW
1413SWW123	148500, 130480	Borehole	36.6	13.4	Unknown	43.6	1.04km SW
1413SWW017	148000, 129500	Dug well	1.8	1.8	Unknown	77.00	1.72km SW

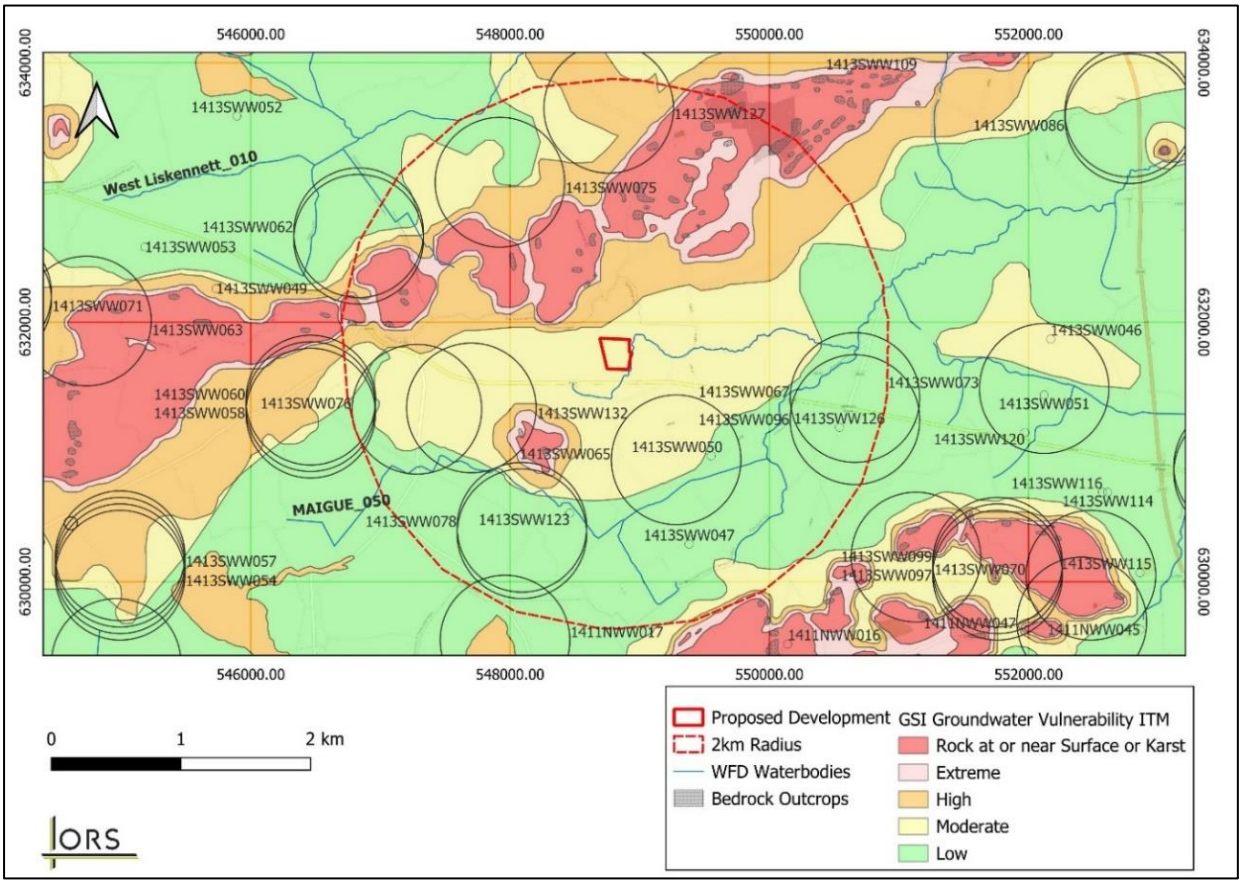

Figure 8.14: Groundwater Vulnerability and location of Groundwater Wells

Karst areas, characterised by unique dissolution landforms, often contain aquifers that are highly susceptible to pollution and can contribute to flooding risks. There are no karstic features located within the proposed boundaries of the Proposed Development or within the immediate vicinity of the Proposed Development. The closest feature is a “Cave” located *ca.* 7.11km southwest of the proposed site.

Groundwater sources are vital for public water supply, industry, agriculture, and domestic use, especially in rural areas. To safeguard these resources, Source Protection Areas (SPAs) have been established, enforcing stricter controls within the Zone of Contribution (ZOC). There are two main types: **Group Water Scheme (GWS) Preliminary Source Protection Areas (PSPAs) ZOCs** and **Public Water Supply (PWS) SPAs**.

GWS PSPAs are designated around groundwater sources supplying community-run schemes, primarily in rural areas. These zones help landowners and stakeholders understand

groundwater risks and are mapped using preliminary hydrogeological data, often without detailed field studies. Protection in these areas is largely voluntary and focused on risk assessment, rather than strict regulatory enforcement.

In contrast, PWS SPAs are formally designated for public water supplies managed by Irish Water or local authorities. These areas undergo scientific hydrogeological assessments, including groundwater flow modelling and contamination risk analysis, ensuring strict regulatory controls to prevent pollution from agriculture, wastewater discharge, and industrial activities. Their ZOCs are further divided into two zones: the Inner Protection Area (SI), which defends against immediate human and microbial contamination, and the Outer Protection Area (SO), covering the remaining ZOC to mitigate long-term risks.

According to the GSI Source Protection Area map, no SPAs are located in the immediate vicinity of the proposed site. The nearest Source Protection Area, the Group Scheme Preliminary Source Protection Area IE1191, is located *ca.* 1.5km north of the proposed site. 2 no. Public Supply Source Protection areas are located within 5km of the site, namely the 'BALLYAGRAN PWS' located *ca.* 3.0 km southwest of the proposed site and the 'ROCKHILL PWS' located *ca.* 3.25km southeast of the proposed site. The location of the nearby SPAs in relation to the Proposed Development can be seen in **Figure 8.15**.

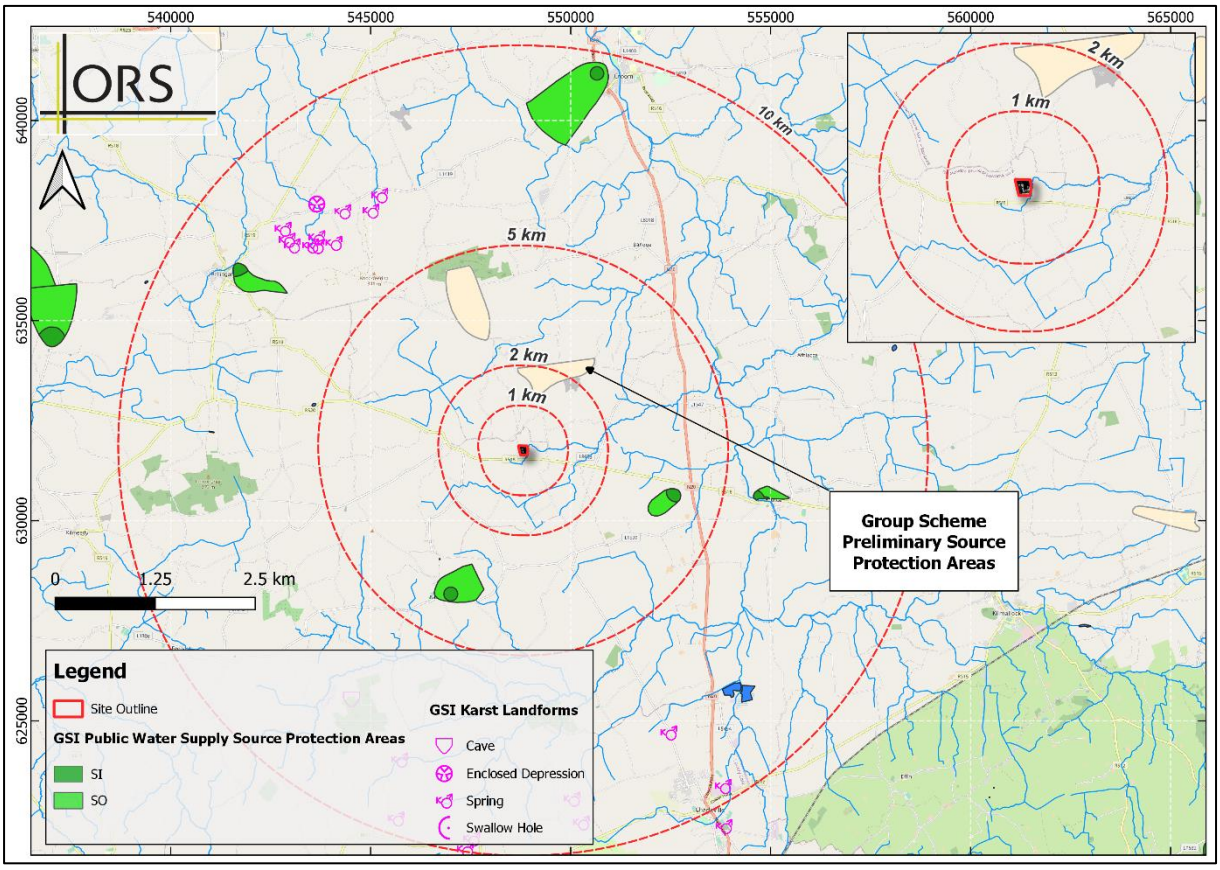

Figure 8.15: Karstic Features and Source Protection Areas (SPAs) location (GSI Maps)

Ground Investigations

Ground investigation works were carried out by a chartered ORS environmental scientist for the Proposed Development at Cappanihane on the 22nd of November 2024. These investigations

confirmed the general geology and subsoil conditions corresponded to the conditions indicated in the geological mapping. The location and depth of the trial pits is shown on **Figure 8.16**, and details of each investigation location is presented in **Table 8.11**. Conditions on site were dry with snowfall on the ground during the time of trial pit investigations.

The trial pit depths ranged from 2.4 m to 3.4 m below ground level (bgl), with no bedrock encountered in any of the six trial pits (TP01–TP06). As outlined in **Section 8.4.2**, the site's topography peaks at 92.53m AOD along the northwestern boundary, gradually sloping south-eastward to 90.62m AOD at TP02. The gradient remains relatively uniform across the site but increases slightly towards the eastern boundary.

Soil profiles varied slightly across the trial pits. The topsoil in all pits was dark brown, with TP04 containing a proportion of gravel. Beneath this, layers of clay (observed in TP01, TP03, and TP06) or gley soils (found in TP04 and TP05) were present, with increasing compaction and cobble content at greater depths. The lower clay layers exhibited low permeability, and soil mottling was observed in TP01, TP02, and TP06, with minor mottling in TP03. The site investigation findings align with the GSI soil and subsoil database, indicating that the predominant soil type is mineral, poorly drained, and primarily acidic, derived from non-calcareous parent materials. The site is characterised by poorly draining bedrock (sandstone, mudstone, and thin limestone) and low-permeability subsoil, overlain by poorly drained topsoil.

The GSI groundwater vulnerability matrix suggests soil depths between 5 m and 10 m. The underlying bedrock consists of Dinantian sandstone, mudstone, and shale, though it was not encountered within the trial pits. Cobbles were observed at depths of 1.6 m to 1.7 m, with TP06 containing small boulders at 2.4 m bgl. Groundwater infiltration was noted at 1.0 m bgl in TP04. Given the significant compaction observed in the subsoils across the area, along with the precipitation conditions prior to the site investigation, the elevated water table may indicate perched groundwater. This phenomenon is characteristic for the local aquifer, as noted by the GSI. According to the EPA database, groundwater vulnerability at the site is classified as moderate.

A site characterisation assessment (percolation assessment) was conducted by Coyle Environmental on the 22nd of November 2024. The assessment was conducted in TP-05 and has concluded that the Proposed Site has an R1 groundwater protection response, which is acceptable to normal good practice. The complete report is available in **Appendix 8.2**.

Table 8.11: Ground profile for each Trial Pit

Location	Depth (m)	Ground Profile	Comments
TP-01	0.0 – 0.3 0.3 – 1.8 1.8 – 2.4 2.4	Topsoil – Dark Brown Earths. LOAMY/CLAY. Gravel abundant, lighter brown colouring. Dark CLAY (more compact), mottling evident throughout the layer, abundant rounded large cobbles. End of TP.	Trial Pit located at proposed tank farm area. Fluctuating water table likely, evident through signs of mottling and saturated impermeable CLAY. Proximity to drainage, seasonal changes and lack of recent rainfall may contribute to not observing Groundwater strike. No Bedrock encountered.
TP-02	0.00 – 0.2 0.2 – 1.7	Topsoil – Dark Brown Earths. Dark brown gravelly CLAY / Gley soils with higher silt content than other locations. Mottling (grey/orange) present throughout.	Fluctuating water table likely, evident through signs of mottling and saturated impermeable CLAY. Proximity to drainage, seasonal changes and lack of recent rainfall may contribute to not observing Groundwater strike.

	1.7 – 2.75 2.75	Compacted impermeable CLAY with grey mottling throughout suggesting gleying of soils, evidence of seasonal high-water table. Occasional rounded large cobble present. The river to the east likely contributes to high water table & recharged by groundwater. End of TP.	No Bedrock encountered.
TP-03	0.00 – 0.3 0.3 – 2.1 2.1 – 2.4 2.4	Topsoil - Dark Brown Earths Compacted gravelly CLAY, mottling evident but not as much as other locations. High Large Rounded/ angular Cobble content, impermeable CLAY. End of TP	Fluctuating water table likely, however determined to be lower than TP01/TP02, evident through weak signs of mottling and saturated impermeable CLAY/ Groundwater Gley soils. Proximity to drainage, seasonal changes and lack of recent rainfall (last 3 months below LTA) may contribute to not observing Groundwater strike. No Bedrock encountered.
TP-04	0.00 – 0.2 0.2 – 2.8 2.8	Topsoil – Dark Brown Gravelly Earths. GROUNDWATER observed @ 1.0mbgl. Impermeable sticky Groundwater Gley (characterised by grey colour and upper layers are oxidised & typical brown). End of TP.	Groundwater observed @ 1.0mbgl. Gleying is prominent in the subsoil, with greyish-blue colors throughout. Gleying typically caused by prolonged or permanent saturation from a high water table (with seasonal variation). No bedrock encountered.
TP-05	0.0 – 0.2 0.2 – 1.6 1.6 – 3.4 3.4	Topsoil – Dark Brown Earths Saturated Groundwater Gley soils, evident through grey colouring and lighter brown mottling (anaerobic soils). Compacted darker brown impermeable CLAY, small cobbles present End of TP.	Fluctuating water table likely evident through signs of gleys, mottling and saturated impermeable CLAY/ Groundwater Gley soils. Proximity to drainage Glossy sheen & mottled grey/ orange colour – evidence of saturated gley soils. Proximity to drainage (river to east), seasonal changes and lack of recent rainfall (last 3 months below LTA) may contribute to not observing Groundwater strike. No Bedrock Encountered.
TP-06	0.0 – 0.3 0.3 – 2.4 2.4 – 2.7 2.7	Topsoil – Dark Brown Earths Gravelly impermeable brown CLAY, small signs of mottling. Compacted darker brown impermeable CLAY, cobbles/ small boulders present End of TP.	Fluctuating water table likely evident through signs of saturated impermeable CLAY/ Groundwater Gley soils. Proximity to drainage (river to east), seasonal changes and lack of recent rainfall (last 3 months below LTA) may contribute to not observing Groundwater strike. No Bedrock Encountered.

Figure 8.16: Location and depth of Trial Pits (TP) and Site Characterisation Assessment

Limerick County Development Plan 2022 – 2028 – Groundwater Protection

A review of the Limerick County Development Plan was carried out to determine the policies and objectives relevant to the preservation and protection of groundwater quality throughout the region.

Core Strategy Policy Objectives (Environmental. Heritage, Landscape and Green Infrastructure)

The Limerick County Development Plan (2022-2028) states that: "*One of the most effective ways of ensuring the protection of ground water is to use ground water protection schemes as part of land use planning. The Groundwater Protection Scheme is an essential tool in enabling Planning Authorities to take into account both geological and hydrogeological factors, in locating potentially polluting developments, so that the chances of ground water contamination is reduced to a minimum*."

The following objectives, taken from the CDP, were deemed to be relevant in the area of Groundwater Protection.

Objective EH 015 (Ground Water, Surface Water Protection and River Basin Management Plans)

It is an objective of the Council to:

a) Protect ground and surface water resources and to take into account the requirement of the Water Framework Directive when dealing with planning and land use issues.

b) Implement the provisions of the River Basin Management Plan 2022 – 2028 and any succeeding plan. The filling of wetlands, surface water features and modifications and drainage of peatlands shall generally be prohibited.

c) Implement the measures put forward in the Limerick Groundwater Protection Plan, in assessing planning applications and their consequences for ground water.

d) The Blue Dot Catchments programme is a key action under the River Basin Management Plan for Ireland 20222028. The aim of the programme is to protect and restore high ecological status to a network of rivers and water bodies in Limerick. In Limerick, the following rivers and water bodies are Blue Dot Catchments, Bleach Lough, the Ogeen River and the Behanagh River. The Council will take a precautionary approach to development which might affect water quality in these areas in line with requirements of the Water Framework Directive.

Objective EH O16 (Septic Tanks and Proprietary Systems)

It is an objective of the Council to ensure that septic tanks/proprietary treatment systems, or other waste water treatment and storage systems which are required as part of a development, comply with the standards set out under EPA 2021 etc. and that they are constructed only where site conditions are appropriate. In respect of groundwater, it is a requirement that as part of the required site assessments the local groundwater conditions as identified in the groundwater protection scheme and the River Basin Management Plan 20222028 are properly assessed in informing the Groundwater Protection Response.

Objective EH O17 (Water Quality)

It is an objective of the Council to support commitments to achieve and maintain ‘At Least Good’ status, except where more stringent obligations are required. There shall be no deterioration of status for all water bodies under the Marine Strategy Framework Directive and its programme of measures, the Water Framework Directive and the River Basin Management Plan. Key challenges include, inter alia, the need to address significant deficits in urban waste-water treatment and water supply, addressing flooding and increased flood risks from extreme weather events and increased intense rainfall because of climate change.

Policy Objectives:

Policy EH P1 – Protection of Natural Heritage and Biodiversity

Biodiversity It is a policy of the Council to: a) Protect and conserve Limerick’s natural heritage and biodiversity, in particular, areas designated as part of the European Sites Natura 2000 network, such as Special Protection Areas (SPAs) and Special Areas of Conservations (SACs), in accordance with relevant EU Directives and national legislation and guidelines. b) Maintain the conservation value of all Natural Heritage Areas and proposed Natural Heritage Areas (pNHAs) for the benefit of existing and future generations.

Policy EH P6– Water and Air Quality

It is a policy of the Council to ensure that water and air quality shall be of the highest standard, to ensure the long term economic, social and environmental Policy EH P7 Environmental Noise

well-being of Limerick's resources. The World Health Organisation Air Quality Guidelines will be the basis for the air quality guidance in Limerick.

Limerick County Council Groundwater Protection Scheme (GWPS)

Groundwater protection schemes play a vital role in enabling planning and regulatory authorities to consider both geological and hydrogeological factors when determining the location of developments. As a result, they are a crucial tool in preventing groundwater pollution.

The Geological Survey of Ireland (GSI), the Department of Environment and Local Government (DELG) and the Environmental Protection Agency (EPA) have jointly developed a methodology for the preparation of groundwater protection schemes (DELG/EPA/GSI, 1999). The publication ***Groundwater Protection Schemes*** was launched in May 1999. A groundwater protection scheme has two main components, as illustrated in **Figure 8.17**.

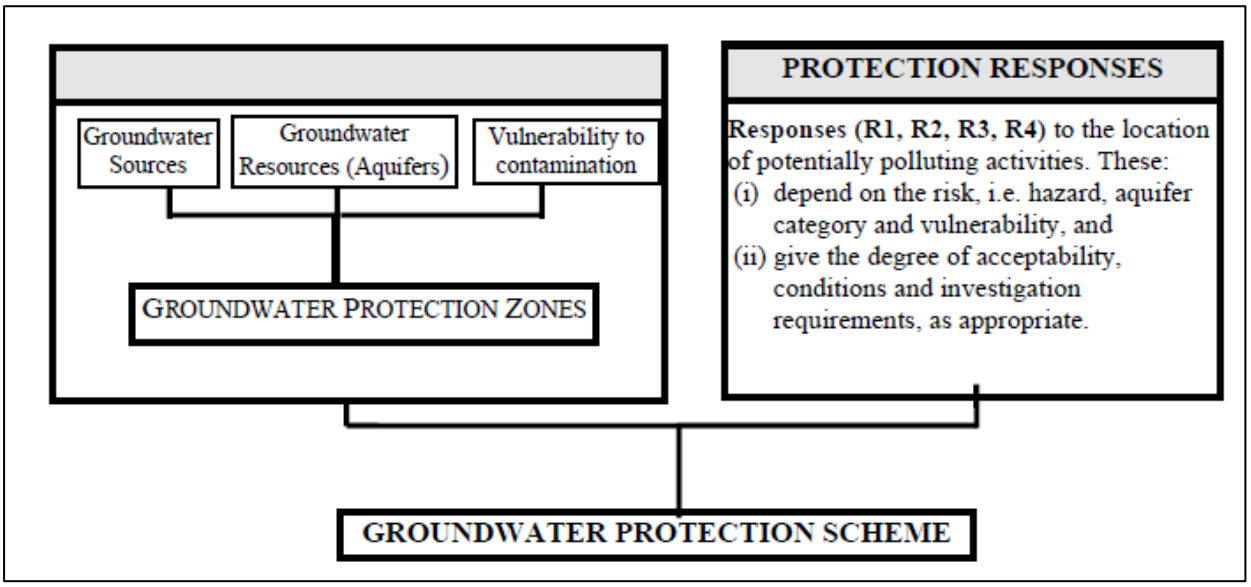

Figure 8.17: Summary of Components of a Groundwater Protection Scheme (County Limerick Groundwater Protection Scheme, Main Report, 2018).

Land surface zoning provides the general framework for a groundwater protection scheme. The outcome is a map that divides any chosen area into several groundwater protection zones based on the degree of protection required. There are three main hydrogeological elements to land surface zoning:

- Division of the entire land surface according to the vulnerability of the underlying groundwater to contamination.
- Delineation of areas contributing to groundwater sources (usually public supply sources), referred to as source protection areas.
- Delineation of areas based on the value of the groundwater resources or aquifer category, referred to as resource protection areas.

In 2018, Limerick County Council, together with the Geological Survey of Ireland (GSI), published the County Groundwater Protection Scheme Main Report. The report underscores the critical importance of groundwater protection, highlighting its role in enabling the balance of interests between development and environmental protection. While the primary focus of the

report was groundwater protection, its overarching objective was to collect, compile and assess all readily available data on geology, hydrogeology, and groundwater quality to facilitate both groundwater resource management and public planning.

The techniques used to delineate source protection zones have been applied to eighteen public supply wells in County Limerick: Ardagh, Ballingarry, Ballyagran, Bruff, Bruree, Cappaghmore Faileen, Carrigkerry, Clouncagh, Croom, Fedamore, Glin, Herbertstown, Hospital, Kilcoleman, Mortlestown, Murroe, Pallasgrean, Tobergal (South West Region). Detailed hydrogeological investigations were limited to the area around these public supply sources. Consequently, the available data are somewhat limited and do not allow for a fully comprehensive assessment of County Limerick's hydrogeology. However, the report provides a solid basis for strategic decision-making and site-specific investigations.

The assessment produced groundwater protection maps by combining vulnerability maps with aquifer maps. Each protection zone on the map was assigned a code representing both the vulnerability of the groundwater to contamination and the groundwater resource (aquifer category). Not all hydrogeological settings are present in County Limerick. The groundwater protection codes present in the county, along with the percentage of area occupied by each, are presented in **Table 8.12**.

Table 8.12: Matrix of Groundwater Resource Protection Zones and respective proportions for County Limerick (based on Limerick County Council Groundwater Protection Scheme, Main Report, 2018).

Vulnerability Rating	Resource Protection Zones					
	Regionally Important Aquifers (R)		Locally Important Aquifers (L)		Poor Aquifers (P)	
	Rk	Rf	Lm/Lg	Ll	Pl	PU
Extreme (E)	6%	7%	4%	10%	9.5%	0.6%
High (H)	1%	11.6%	4.2%	13%	7.5%	0.2%
Moderate (M)		3%		3.7%	3.5%	
Low (L)		6%		8.5%	0.5%	0.2%

The assessment has not established Groundwater Protection Responses for potentially polluting activities and developments in accordance with the EPA's Codes of Practice. As a result, no additional information was available for this study in relation to the nature of the Proposed Development.

Groundwater Vulnerability Assessment

The site is not located within a Source Protection Area. Given that a Groundwater Protection Scheme is in place for all of County Limerick, this vulnerability assessment will be carried as per excerpt of **Table 8.4**, as follows:

Excerpt of **Table 8.4:** Summary of Sampling requirements for groundwater vulnerability assessments

	Vulnerability	Sampling Requirements
Ground Water Protection Scheme (GWPS) exists	LOW	Simple walkover survey to confirm what has been established in the GWPS, i.e., no evidence of outcrop, depth to bedrock information from wells, etc.[4] If walkover survey indicates that the lands do not have sufficient thickness of subsoil (i.e. rock outcrops) then site specific information may be required.
	MEDIUM	
	HIGH	
	EXTREME[5]	Regionally Important Aquifers - Prove that 2m depth of soil/subsoil cover exists. Minimum of 1 data point per hectare is required.
		Locally Important and Poor Aquifers – Prove that 1m depth of soil/subsoil cover exists. Minimum of 1 data point per 5 hectares is required.

Groundwater resources protection zones are determined by combining the aquifer and vulnerability maps. The aquifer map boundaries, in turn, are based on the bedrock map boundaries and the aquifer categories are obtained from an assessment of the available hydrogeological data. The vulnerability map is based on the subsoils map, together with an assessment of relevant hydrogeological data, in particular indications of permeability and karstification.

The location and management of potentially polluting activities in each groundwater protection zone is calculated by means of a groundwater protection response matrix. The level of response depends on the different elements of risk: the vulnerability, the value of the groundwater (with sources being more valuable than resources and regionally important aquifers more valuable than locally important and so on) and the contaminant loading. By consulting the Response Matrix, it can be determined:

- Development's suitability of purpose
- what kind of further investigations may be necessary to reach a final decision; and
- what planning or licensing conditions may be necessary for that development.

The groundwater protection responses are a means of ensuring that good environmental practices are followed.

The matrix in **Table 8.13** gives the result of integrating the two regional elements of land surface zoning (vulnerability categories and resource protection areas) – a possible total of 24 resource protection zones. In practice this is achieved by superimposing the vulnerability map on the aquifer map. Each zone is represented by a code e.g. Rf/M, which represents areas of regionally important fissured aquifers where the groundwater is moderately vulnerable to contamination. In land surface zoning for groundwater protection purposes, regionally important sand/gravel (Rg) and fissured aquifers (Rf) are zoned together, as are locally important sand/gravel (Lg) and bedrock which is moderately productive (Lm).

Table 8.13: Matrix of Resource Protection Zones from EPA Guidance Notes on Groundwater Protection

Vulnerability Rating	Resource Protection Zones					
	Regionally Important Aquifers (R)		Locally Important Aquifers (L)		Poor Aquifers (P)	
	Rk	Rf/Rg	Lm/Lg	Ll	Pl	PU
Extreme (E)	Rk/E	Rf/E	Lm/E	Ll/E	Pl/E	Pu/E

[4] The classification to Low / Medium / High class as part of GWPS indicates that minimum of 3m soil/subsoil depth can be anticipated
[5] To give a rough picture of "extreme vulnerability" areas we can use: GSI Outcrop data & Teagasc Shallow Rock data

High (H)	Rk/H	Rf/H	Lm/H	Ll/H	Pl/H	Pu/H
Moderate (M)	Rk/M	Rf/M	Lm/M	Ll/M	Pl/M	Pu/M
Low (L)	Rk/L	Rf/L	Lm/L	Ll/L	Pl/L	Pu/L

Combining the proposed site vulnerability rating of Moderate, and the underlying aquifer classification of 'Regionally Important Aquifer - Fissured bedrock', the site is classified as Rf/M.

Groundwater Protection Responses

The Groundwater Protection Responses for the land spreading of organic wastes (DoE/GSI/EPA publication, 1999) are relevant to this study given the proposed nature and operational phase of the development. According to the DoE/GSI/EPA guidelines, a Regionally Important Aquifer with a moderate vulnerability rating is deemed acceptable for land spreading, provided standard best practices are followed.

Table 8.14: Vulnerability Rating Summary

Vulnerability Rating	SOURCE PROTECTION AREA		Resource Protection (Aquifer Category)					
			Regionally Important Aquifers (R)		Locally Important (L)		Poor Aquifers(P)	
	Inner	Outer	Rk	Rf/Rg	Lm/Lg	Ll	Pl	Pu
Extreme (E)	R4	R4	R3[2]	R3[2]	R3[1]	R3[1]	R3[1]	R3[1]
High (H)	R4	R2[1]	R1	R1	R1	R1	R1	R1
Moderate (M)	R3[3]	R2[1]	R1	R1	R1	R1	R1	R1
Low (L)	R3[3]	R2[1]	R1	R1	R1	R1	R1	R1

R1 Acceptable, subject to normal good practice.
R2[1] Acceptable subject to a maximum organic nitrogen load (including that deposited by grazing animals) not exceeding 170 kg/hectare/yr.
R3[1] Not generally acceptable, unless a consistent minimum thickness of 1 m of soil and subsoil can be demonstrated.
R3[2] Not generally acceptable, unless a consistent minimum thickness of 2 m of soil and subsoil can be demonstrated.
R3[3] Not generally acceptable, unless no alternative areas are available and detailed evidence is provided to show that contamination will not take place.
R4 Not acceptable

Site Vulnerability Assessment

From desktop and field investigations it can be determined that the site is located overlying a Regionally Important Aquifer – Fissured Bedrock. The Groundwater Vulnerability of the site is classified as 'moderate'. In relation to resource protection zones the site is classified as Rf/M. Based on the groundwater protection response matrix, the site is assigned a vulnerability rating of "**R1**," indicating that the development is acceptable from a groundwater protection perspective.

Given the existence of a Groundwater Protection Scheme for the County, a site walkover would be enough to confirm the information provided by GSI maps. Nevertheless, an intrusive site investigation was conducted by ORS in November 2024. This involved excavating six trial pits across the site of a minimum depth of 2.4mbgl. Bedrock was not encountered in any of them, while water was found only in trial pit TP-04, located in the central-southern part of the site, at a depth of 1.0 mbgl.

The GSI well data has indicated a high density of wells within the immediate area predominantly designated as domestic use. However, as no land spreading will occur on site, the Proposed Development will not have any detrimental impact on the underlying aquifer or more importantly any wells in the area. The farms of the customer farmers have been identified. All farmers will use the biobased fertiliser on lands that have an agronomic requirement for fertiliser.

It is not anticipated that the proposed facility's operation will have any adverse effects on the underlying aquifer or nearby wells. Further trial pits are recommended to determine soil depth around TP-04 location before work commences on site.

8.5 Likely Significant Effects

Using data from the desk study, intrusive site investigation, and anecdotal evidence, a risk assessment was conducted to evaluate the predicted impacts on hydrology and hydrogeology during both the construction and operational phases of the development. This assessment identifies relevant sources, pathways, and receptors (pollutant linkages) and assigns a qualitative risk classification—'low,' 'moderate,' or 'high'—to each identified Potential Pollutant Linkage (PPL).

For a risk of surface water and groundwater contamination to exist, a contaminant source, pathway for migration and viable receptor must exist. The presence of all three of these elements is known as a 'pollutant linkage'. The likely potential pollutant linkages identified as a result of this assessment and specific for the site have been provided in the initial CSM. The model has been based upon the site setting at the time of the assessment, the land use (current and reasonably foreseen future use) of the surrounding area and the state what the proposal is (i.e. development, ongoing use, etc.).

As well as identifying the potential pollutant linkages the model includes a preliminary assessment of risk based upon the probability of impact and the likely severity of impact in the context of the site setting and proposed future site use.

The criteria used for the risk assessment classifications as detailed in the CSM table are based on those presented in *CIRIA Report 552*.

The likely significant effects identified in this section do not take proposed mitigation measures into account, as these will be addressed in **Section 8.6**. The actual effects anticipated following the implementation of these measures are presented as Residual Effects and can be found in **Section 8.8**.

8.5.1 Do-Nothing Scenario

The proposed site is a greenfield area currently used for agriculture. If the proposed development does not proceed, surface water percolation and runoff would continue as part of the natural processes. The land would remain in its current agricultural use, which could potentially result in ongoing soil pollution and contamination of the local groundwater system, primarily due to suboptimal agricultural practices.

8.5.2 Receptor Sensitivity

The sensitivity of the receptors identified during the study of hydrological & hydrogeological

features within the vicinity of the site are summarised in **Table 8.15** overleaf.

Table 8.15: Receptor Sensitivity

Receptor	Receptor Importance	Receptor Sensitivity	Rationale
Groundwater Ballingarry Groundwater Body	Regional Level	High	The site is underlain by the Ballingarry Groundwater Body, which is a Regionally Important Aquifer – Fissured Rock. This classification reflects regional hydrogeological importance. Groundwater vulnerability is rated as "Moderate" across the site, as per the GSI map viewer. Trial pits excavated to 2.4 m below ground level (bgl) did not encounter bedrock, confirming a minimum of 2 m of soil/subsoil cover. Seasonal variations in the groundwater table are expected due to the presence of gley soils. Groundwater infiltration was observed at 1.0 mbgl in TP-04, while TP-05 exhibited soil mottling, indicating a fluctuating water table. Based on the response matrix (**Table 8.14**), the site is classified as "R1 Acceptable, subject to normal good practice", meaning the proposed development is considered suitable in terms of groundwater protection.
Surface Water Lower Ballyteige Stream and downstream receptors, River Glenma & River Maigue.	Local Level	High	The Lower Ballyteige Stream, along with downstream receptors—the River Glenma and River Maigue (designated as MAIGUE_050 by the EPA)—currently hold a "Good" status under the Water Framework Directive (WFD) 2016–2021 assessment and are not classified as at risk. However, the most recent Q-value (Q3-4) indicates a Moderate status under the WFD, categorizing the water as Slightly Polluted, suggesting existing pressures on the local hydrological system. Although a hydrological pathway exists to the Lower River Shannon SAC and the River Shannon and River Fergus Estuary SPA, both protected under EU legislation, significant effects from the Proposed Development are not anticipated. The considerable downstream distance (approximately 20 km and 30 km, respectively) is expected to allow for dispersion and dilution of any potential pollutants, minimising the impact on these protected areas.

8.5.3 Sources - Construction Phase

The construction phase is likely to yield the most potentially significant effects on the surrounding water environment. A summary of these potential effects is provided in **Table 8.16** overleaf, with a detailed analysis below.

Table 8.16: Construction Phase Effects (Unmitigated)

Receptor	Potential Environmental Effects	Quality	Significance	Duration
Groundwater Ballingarry Groundwater Body	Increased Run-off and Sediment Loading	**Negative**	**Moderate**	**Temporary**
	Accidental Spillages of Harmful Substances	**Negative**	**Moderate**	**Short-Term**
	Increased Groundwater Vulnerability	**Negative**	**Significant**	**Long-Term**
	Excavation of Bedrock Aquifer	**Negative**	**Significant**	**Long-Term**
	Excavation of Contaminated Soils	**Unlikely**	**Negligible**	**Unlikely**
Surface Water Lower Ballyteige Stream and downstream receptors, River Glenma & River Maigue	Increased Run-off and Sediment Loading	**Negative**	**Moderate**	**Temporary**
	Accidental Spillages of Harmful Substances	**Negative**	**Moderate to Significant**	**Temporary**
	Excavation of Contaminated Soils	**Unlikely**	**Negligible**	**Unlikely**
	Conversion of Permeable Soils to Hard standing	**Negative**	**Moderate**	**Long-Term**

Increased Run-off and Sediment Loading

During the initial stages of the construction phase, enabling works will consist of stripping and removal of a layer of topsoil in some areas throughout the site. Earthworks will then follow to level the site and to facilitate the construction of foundations and the installation of services/drainage infrastructure which will also lead to the removal of some vegetation cover. The resulting stockpiles of the displaced soils and sediments, in the absence of suitable mitigation, will be susceptible to erosion during this period. This can create a potential pathway for silt and sediment to migrate off-site into surrounding water courses via wind-blown dust or run-off in times of heavy rain. The potential consequence for surface water receptors in this circumstance is elevated levels of silt, suspended solids, and nutrients, what can lead to water quality degradation, decline in fisheries resources and serious ecological degradation of aquatic biota.

Site investigations revealed that the topsoil is composed of dark brown earth, which is prone to erosion, making the soil particles easily transportable by water or wind, with the potential to reach nearby water sources. The subsoil primarily consists of sandstone drift with a high proportion of clay-sized particles. The gravelly clay is also prone to erosion and sediment transport, contributing to runoff that can carry fine particles and contaminants. This presents a significant risk of these materials being entrained in surface water runoff and migrating into adjacent waterbody or being dispersed by moderate to strong winds from stockpiles.

The poorly drained subsoils across the site offer some protection to the underlying Regionally Important aquifer, reducing the risk of runoff contamination infiltrating into the Ballingarry Groundwater Body. However, localised vulnerabilities remain. Specifically, water seepage and groundwater observed at TP-04, located in the site's central area, along with signs of a seasonally varying water table at TP-05 in the southwestern portion, suggest heightened susceptibility in certain zones. These conditions could increase the risk of contamination in those localised areas. Nevertheless, the significant compaction observed in the subsoils,

coupled with the precipitation conditions prior to the site investigation, suggests that the elevated water table may represent perched groundwater.

The predicted groundwater flow follows the local topography toward the northeast, where no groundwater wells have been recorded. Furthermore, geological faults to the north and east, along with the less permeable bedrock of the Hospital GWB to the south, potentially act as natural barriers. These factors collectively make it highly unlikely that any Source Protection Areas or wells would be affected by potential groundwater contamination from the site.

Considering the natural topography of the proposed site and the surrounding areas along with the hydrological connection with the adjacent Lower Ballyteige Stream***, in the absence of mitigation***, uncontrolled releases of sediment run-off would result in a ***negative, moderate, temporary effect*** on the water quality of the local hydrological system.

In the absence of mitigation, uncontrolled releases of sediment run-off would result in a ***negative, moderate, temporary effect*** on the water quality of the Ballingarry Groundwater Body underlying the proposed site.

Accidental Spillages of Harmful Substances

During the construction phase, there is a possibility of a spillage of contaminants such as fuels, oils, chemicals and cement material, posing a potential risk to surface and groundwater quality. Fuels, oils and chemicals have a number of hazardous properties, and the constituents of concrete are alkaline and corrosive. Each one of these substances can have a significant deleterious effect on water quality and aquatic life should any become entrained in the receiving water environment.

The drainage characteristics of the site area outlined in **Section 8.4.5** concluded that the Qbar value for the site is 14.97 l/s for the Upper level (service yard), and 7.10 l/s for the Lower level (sump). In the event of any spillages, contamination would likely be carried by the site run-off and migrate into the adjacent drainage ditch and subsequent downstream receptors.

The groundwater vulnerability assessment in **Section 8.4.8** concluded that groundwater vulnerability at the site was classed as ‘moderate’ due to the low permeable subsoils beneath the site. These conditions offer some protection to groundwater receptors providing a natural barrier between the potential release of harmful substances and the groundwater bodies below and impeding vertical migration throughout the soils. However, water seepage and groundwater observed at TP-04, and indications of a seasonally varying water table at TP-05 are noted, as such suitable mitigation measures must be implemented to prevent any potential adverse impacts on the groundwater bodies.

The predicted groundwater flow follows the local topography toward the northeast, where no groundwater wells have been recorded. Furthermore, geological faults to the north and east, along with the less permeable bedrock of the Hospital GWB to the south, potentially act as natural barriers. These factors collectively make it highly unlikely that any Source Protection Areas or wells would be affected by potential groundwater contamination from the site.

In the absence of mitigation, uncontrolled releases of hydrocarbons, chemicals or cement would result in a ***negative, moderate to significant, temporary effect*** on the adjacent stream. This would lead to impacts on the water quality of the River Glenma and River Maigue, and, although unlikely, the contamination could extend to downstream receptors, including the

Lower River Shannon SAC and the River Shannon and River Fergus Estuary SPA.

In the absence of mitigation, uncontrolled releases of hydrocarbons, chemicals or cement would result in a ***negative, moderate, short-term effect*** on the water quality of the Ballingarry Groundwater Body underlying the proposed site. Due to the high level of interaction between this GWB and the local surface water bodies, the potential for contamination to cause particularly complex environmental impacts exists but is unlikely.

Increased Groundwater Vulnerability

The removal and disturbance of a significant amount of soil required in order to level the site is anticipated during the construction phase which carries the potential to increase the vulnerability of a groundwater body to incidences of contamination at surface level.

The preliminary Cut and Fill analysis for the Proposed Development estimates that approximately 19,408.46 m³ of subsoil will be excavated, with 5,759.07 m³ repurposed as fill material. To minimize the volume of material removed from the site, the excavated soil will be used to construct a 1.2m-high berm with 1:4 graded sides and a 2m-wide flat top along the northern, eastern, and southern boundaries. This will provide both acoustic and visual screening for the site.

Additional reuse of excavated material may be possible for landscaping, as well as for backfilling existing drainage ditches and proposed drainage lines, provided it meets the necessary classification for backfill material. However, any surplus soil that cannot be reused will be transported to licensed disposal facilities. These volume estimates are subject to change pending further ground investigations before construction begins.

The deepest excavation points will be at the locations of the proposed attenuation tanks and the rainwater harvesting tank. Excavations of up to 3.30 mbgl will be required to reach the FFL beneath the attenuation tank within the Bunded Area in the northeast of the site. To the south of the CO_2 Liquefaction area, excavation depths of up to 2.54 mbgl are expected for the installation of the second proposed underground attenuation tank. Additionally, excavation up to 2.63 mbgl will be required for the rainwater harvesting tank, which will be located east of the office building.

When excavation to FFL has been achieved, further earthworks will then follow to facilitate the construction of foundations and the installation of services/drainage infrastructure, which will be limited to 3.30 mbgl. Foundations of up to 0.5m below the FFL will be required along the structural outline of buildings.

GSI maps indicate the groundwater vulnerability throughout the site was classed as ‘moderate’. The groundwater protection response matrix (**Rg/M**) assigns the site a vulnerability rating of "**R1**," indicating that the development location is acceptable with respect to groundwater protection.

Desktop study suggests a subsoil depth of 5-10m throughout the area, given the moderate groundwater vulnerability on the site. Geotechnical investigations conducted on-site support this, as no bedrock was encountered during the excavation of trial pits. However, as water was observed at 1.0 mbgl at TP-04 and the seasonally variable water table observed at the TP-05, possibility of encountering groundwater during the works still exists. An excavation depth of 2.95 mbgl could increase the vulnerability in these areas from ‘moderate’ to ‘high’ or ‘extreme’.

Further trial pits pre-construction are recommended to determine soil depth around TP-04 locations.

In the absence of mitigation, the removal of soil/subsoil cover during the construction phase would have a ***negative, significant, long-term effect*** on groundwater vulnerability at the Proposed Development site.

Excavation of Bedrock Aquifer

As depicted in **Table 8.10**, groundwater wells in the surrounding area typically encounter bedrock at depths ranging from 0.6 m to 73.2mbgl. A desktop study indicates subsoil depths across the area to be approximately 5–10 meters, consistent with the site's moderate groundwater vulnerability. This assessment is supported by the site investigation carried out by ORS, which involved the excavation of six trial pits, ranging from 2.4m to 3.4mbgl, where none of which encountered bedrock. Since the maximum excavation depth required to level the site is expected to reach 3.30 mbgl, interaction with bedrock is possible, but unlikely to happen. Nevertheless, installation of impermeable liners under the attenuation tanks are recommended.

If excavation into bedrock is necessary and ***control and mitigation measures are not implemented***, predicted effects will have ***negative, significant and long-term effect*** on hydrogeology.

Excavation of Contaminated Soils

The excavation and construction activities will cause quantities of excavated materials to be reused on site or removed from site for disposal or recovery. The site is a greenfield site, and historical mapping does not suggest any incidences of land use which might result in the contamination of soils. Furthermore, a geotechnical site investigation conducted at the site in November 2024 did not detect any evidence of contaminated soils. It is not anticipated contaminated soils will be encountered during construction activities hence no adverse effects on the groundwater or surface water quality are expected as a result of contaminated soils.

The Outline Construction Environmental Management Plan (**Document Ref: 231240-ORS-XX-XX-RP-EN-13d-010**) will include a set of procedures to be implemented in the incidence of contaminated soils encountered nonetheless despite ***negligible impact or lack of significance*** to hydrogeology and hydrology

Conversion of Permeable Soils to Hard standing

The construction phase will involve the gradual conversion of the existing greenfield site to areas of hardstanding. The two drainage ditches will require decommissioning and infilling within the proposed development boundary. Given the proximity of the river and the ground conditions encountered during initial site investigation, it will be necessary to divert these drainage ditches and continue to provide an open channel for the collection of runoff from the undeveloped areas to the north of the proposed development.

Under this scenario, the risk of flooding within the receiving catchment will increase due to an increase in impervious land area and associated drainage systems, which leads to a large increase in volume and intensity of surface water run-off within a given catchment.

The increase in impervious area means that a greater proportion of the incident rainfall will

appear in the drainage system as surface run-off. The provision of sealed pipes to convey run-off from the site to existing watercourse will result in larger (concentrated) volumes being discharged at point locations within a shorter duration, thereby increasing flood risks.

In the absence of mitigation, the predicted effects of the Proposed Development resulting in an increase of flood risk to the receiving catchment are ***negative, moderate and long-term.***

8.5.4 Sources - Operational Phase

A summary of the potential operational phase effects is provided in **Table 8.17**, with a detailed analysis below.

Table 8.17: Operation Phase Effects Summary (Unmitigated)

Receptor	Potential Environmental Effects	Quality	Significance	Duration
Groundwater Ballingarry Groundwater Body	Contaminated Run-off	**Negative**	**Moderate**	**Short-Term**
	Foul Water	**Negative**	**Moderate to Significant**	**Short-Term**
	Increased Groundwater Vulnerability	**Negative**	**Significant**	**Temporary**
	Uncontrolled Releases & Spillage of Digestate and Feedstocks	**Negative**	**Slight to Moderate**	**Temporary**
	Fire and Resultant Firewater	**Negative**	**Significant**	**Short-Term**
	Landspreading of Biobased Fertiliser	**Negative**	**Slight**	**Short-Term**
	Attenuation Tanks	**Negative**	**Moderate**	**Temporary**
Surface Water Lower Ballyteige Stream and downstream receptors, River Glenma & River Maigue	Contaminated Run-off	**Negative**	**Moderate to Significant**	**Temporary**
	Foul Water	**Negative**	**Moderate to Significant**	**Short-Term**
	On-Site Flooding	**Negligible**	**Not significant**	**Unlikely**
	Conversion of Permeable Soils to Hard standing	**Negative**	**Moderate**	**Long-Term**
	Uncontrolled Releases & Spillage of Digestate and Feedstocks	**Negative**	**Slight to Moderate**	**Temporary**
	Fire and Resultant Firewater	**Negative**	**Slight to Moderate**	**Temporary**
	Landspreading of Biobased Fertiliser	**Negative**	**Slight**	**Temporary**
	Attenuation Tanks	**Neutral**	**Moderate**	**Long-Term**

Contaminated Run-off

Run-off from impermeable areas within the Proposed Development site such as roads and car parking areas are likely to contain potentially polluting substances such as hydrocarbons, heavy metals and sodium chloride arising from de-icing of these surfaces during winter months.

Discharge of stormwater from the Proposed Development is to the attenuation tank located at

the southeast of the site which will discharge to the Lower Ballyteige Stream.

The risk of failure in the runoff collection and discharge system should be considered; however, it remains unlikely. In the event of a failure, there is a potential for contaminated runoff to reach the underlying aquifer system. ***In the absence of suitable design & mitigation measures***, there would be a ***negative, moderate, short-term effects*** on the water quality of the Ballingarry Groundwater Body.

In the absence of suitable design & mitigation measures, there would be a ***negative, moderate to significant, temporary effects*** on the water quality of the Lower Ballyteige Stream. The contamination could extend to downstream receptors, including River Glenma & River Maigue.

Foul Water

A domestic scale wastewater treatment plan is proposed to cater for the foul water arising from staff facilities on-site only (Population Equivalent 'PE' of 6). The accompanying site suitability assessment has concluded that the site is suitable to provide treatment for domestic sewage via discharge to groundwater.

The inherent risk associated with wastewater treatment systems is leakage of untreated foul water. This situation can arise from poor construction methods, inadequate maintenance and failure to scale the system to an appropriate projected population equivalent.

During incidences of leakage, foul water would likely follow preferential pathways created by permeated backfill and infiltrate into the site drainage system ultimately impacting both surface water and groundwater receptors. Adverse effects associated with foul water leakages consist of contamination relating to the of the following:

- Pathogens, (E. Coli etc.)
- Elevated levels of ammonia and nitrate
- Elevated levels of phosphorus

In the absence of suitable design and mitigation measures, such leakages could lead to eutrophication within the Lower Ballyteige Stream and possibly the River Glenma and to the Ballingarry Groundwater Body leading to degradation of water quality with negative consequences for aquatic life. Overall, the predicted effects of foul water leakage on hydrological and hydrogeological receptors are ***negative, moderate to significant and short-term.***

The groundwater flow is predicted to follow the local topography toward the northeast, where no groundwater wells have been recorded. Furthermore, geological faults to the north and east, along with the less permeable bedrock of the Hospital GWB to the south, potentially act as natural barriers. These factors collectively make it highly unlikely that any Source Protection Areas or wells would be affected by potential groundwater contamination from the site.

Increased Groundwater Vulnerability

The proposed FFLs will be situated up to approximately 0.6 m below the existing site elevation, specifically at the location of the digestion tanks and bunded area. TP-04, where groundwater was encountered at 1.0 mbgl, is located near the Propane Tank Compound. Excavation depths

in this area will be minimal (<0.2 mbgl), limited to topsoil removal. Nevertheless, there is a potential for encountering groundwater during excavation, particularly after rainfall when the water table may rise above previously observed levels. Excavations on the area could increase the vulnerability in this area from 'moderate' to 'high'.

In the absence of mitigation measures, the removal of soil/subsoil cover to reach the proposed FFLs would have a ***negative, significant, temporary effect*** on groundwater vulnerability at the Proposed Development site.

On-Site Flooding

A flood event occurring on the Proposed Development would cause the Sustainable Urban Drainage Infrastructure (SuDS) to become overwhelmed, creating additional pathways for potential contaminants to migrate off-site into downstream receptors along with elevated flow rates.

The Proposed Development is not located in a Flood Zone, according to the OPW and the likelihood of flooding occurring on the site is unlikely. Please refer to Site Specific Flood Risk Assessment (Document Ref: **231240-ORS-XX-XX-RP-EN-13d-011**) which accompanies the application.

Overall, ***in the absence of suitable design and mitigation measures*** the predicted effects of the occurrence a flood event on hydrological receptors is ***negligible, not significant,*** and **unlikely** to hydrogeology and hydrology***.***

Conversion of Permeable Soils to Hard standing

The operational phase will see a significant portion of the existing greenfield site converted to areas of hardstanding. The two drainage ditches will require decommissioning and infilling within the proposed development boundary. Given the proximity of the river and the ground conditions encountered during initial site investigation, it will be necessary to divert these drainage ditches and continue to provide an open channel for the collection of runoff from the undeveloped areas to the north of the proposed development.

Under this scenario, the risk of flooding within the receiving catchment will increase due to an increase in impervious land area and associated drainage systems, which leads to an increase in volume and intensity of surface water run-off within a given catchment.

The increase in impervious area means that a greater proportion of the incident rainfall will appear in the drainage system as surface run-off. The provision of sealed pipes to convey run-off from the Proposed Development to existing watercourse will result in larger (concentrated) volumes being discharged at point locations within a shorter duration, thereby increasing flood risks.

In the absence of mitigation, the predicted effects of the Proposed Development resulting in an increase of flood risk to the receiving catchment are ***negative, moderate, and long-term.***

Uncontrolled Releases and Spillages

During the operational phase, there is a possibility of leakage or spillage of biobased fertiliser or feedstocks via vehicle movements or from a failure of a tank or feed line. While such substances are significantly less hazardous than fuels, oils, chemicals, and cement material,

the still pose a potential risk to surface and groundwater quality. Biobased fertiliser or animal slurries in high quantities can have a deleterious effect on water quality and aquatic life should any become entrained in the receiving water environment.

Uncontrolled releases of biobased fertiliser, feedstock, hydrocarbons, chemicals or cement, ***in the absence of mitigation measures***, would result in ***negative, slight to moderate, temporary effects*** on the water quality of the Lower Ballyteige Stream. The contamination could extend to downstream receptors, including River Glenma & River Maigue.

Fire and Resultant Firewater

Appropriate storage facilities will be provided for combustible and flammable materials (i.e. fuel) required for the operation of the Proposed Development. In the event of a fire, significant quantities of water resources will be utilised to quench the fire. Water used to quench a fire is known as “firewater”. Firewater is known to contain the following harmful substances:

- Products of combustion
- Extinguishing foam / fluid
- Hazardous substances (fuels, oils & chemicals)

Due to the presence of these hazardous substances, firewater poses a significant risk to surface and groundwater quality.

Uncontrolled releases of firewater ***in the absence of mitigation measures***, would result in ***negative, slight to moderate, temporary effects*** on the water quality of the Lower Ballyteige Stream. The contamination could extend to downstream receptors, including River Glenma & River Maigue.

Uncontrolled releases of firewater, ***in the absence of mitigation measures***, would result in ***negative, significant, short-term effects*** on the water quality of the Ballingarry Groundwater Body underlying the proposed site.

Landspreading of Biobased Fertiliser

The biobased fertiliser produced will be a rich source of nutrients that will be used by customer farmers for the fertilisation of their land. In the worst-case scenario and in absence of mitigation, any inappropriate land-spreading of the biobased fertiliser could lead to impacts upon the receiving waters in local catchments and it can result in eutrophication, algal blooms, fish kills and loss of biodiversity. Designated habitats and species can be impacted upon. There is a greater risk when groundwater vulnerability at the lands for spreading is high, or when land-spreading is undertaken close to drains or streams. In these situations, the Pollution Impact Potential for both phosphates and / or nitrates is high.

The farms of the customer farmers have been identified; however, these will be subject to local change on an annual basis. All farmers will use the biobased fertiliser on lands that have an agronomic requirement for fertiliser. Spreading will be done in accordance with the specific Nutrient Management Plan for the farm and in accordance with S.I. 113 of 2022. Records for the movement of all biobased fertiliser will be kept.

Inappropriate land spreading ***in the absence of mitigation measures*** would result in ***negative, slight, temporary effects*** on the water quality of the Lower Ballyteige Stream. The

contamination could extend to downstream receptors, including River Glenma & River Maigue.

The potential for contamination of the local groundwater body will depend on the specific characteristics of the land where the biobased fertiliser is applied. However, with proper management practices, contamination is unlikely to occur. If contamination is to reach the groundwater body, ***in the absence of mitigation measures***, the effects would be ***negative, slight, and short-term.***

The positive benefits of using the biobased fertiliser produced must also be considered, as this provides an alternative to the land-spreading of liquid slurry. Using biobased fertiliser presents several scientific advantages over the continued use of untreated manures, slurries, or chemical fertilisers, particularly concerning plant nutrient availability and the mitigation of nutrient leaching into watercourses. The benefits are outlined below.

- **Balanced Nutrient Availability:** Biobased fertiliser typically contains a balanced mix of essential nutrients, including nitrogen (N), phosphorus (P), potassium (K), and micronutrients crucial for plant growth. This balanced nutrient profile contrasts with chemical fertilisers, which often supply only specific nutrients. Studies have shown that the diverse nutrient composition of biobased fertiliser supports comprehensive plant nutrition, contributing to improved crop yields and overall plant health (Möller and Müller, 2012)[6].

- **Slow-Release Nutrients:** Biobased fertiliser releases nutrients gradually over time as it decomposes in the soil. This gradual release mechanism ensures a sustained supply of nutrients to plants, contrasting with untreated manures, slurries and chemical fertilisers, which can be prone to leaching or volatilisation. The slow-release nature of biobased fertiliser reduces the risk of nutrient loss and enhances nutrient uptake efficiency by plants (Yao et al., 2011)[7]. Analysis has shown that approximately 80% of the total nitrogen in biobased fertiliser is present as readily available nitrogen. Digestion of livestock slurry has also been shown to increase the plant availability of nitrogen in slurry by *ca.* 10%.

  Compared to untreated manures and slurries, biobased fertiliser poses a lower risk of nutrient leaching into watercourses. The balanced nutrient composition and slow-release nature of biobased fertiliser minimise the likelihood of excess nutrients washing away into streams or groundwater. This reduction in nutrient leaching coupled with land spreading best practice helps mitigate water pollution and eutrophication, safeguarding aquatic ecosystems and maintaining water quality (Möller and Müller, 2012).

- **Enhanced Soil Health: R**ich in organic matter, biobased fertiliser improves soil structure, promotes water retention, and stimulates microbial activity. These soil health benefits contribute to improved nutrient cycling, root development, and overall soil fertility (De Vries et al., 2015).[8]

- **Biobased Fertiliser Usage:** At full capacity the total tonnages for transportation off-site as biobased fertiliser to local agricultural operators are summarised below:

[6] Möller, K., & Müller, T. (2012). Effects of anaerobic digestion on biobased fertiliser nutrient availability and crop growth: a review. Engineering in Life Sciences, 12(3), 242-257.
[7] Yao, R., Li, G., Xie, H., Zhao, B., & Liu, H. (2011). *Release characteristics of nutrients from aerobic composted swine manure in soil. Journal of Soils and Sediments*, 11(1), 103-111.
[8] De Vries, J. W., Groenestein, C. M., & Kool, P. L. (2015). *Effects of anaerobic digestion and composting on reducing the environmental impact of pig manure*. Journal of Environmental Management, 162, 230-237.

- Digestate Fibre - 24,500 tonnes
- Digestate Liquid - 53,500 tonnes

Post-pasteurisation the biobased fertiliser will meet the standard of an EU fertilising product under Regulation (EC) No 2019/1009 under the criteria outlined for Product Function Category (PFC) 3 B: Inorganic Soil Improver. The operator will apply for End of Waste status upon grant of permission.

All biobased fertilisers will be used in accordance with S.I. 113 of 2022 European Communities (Good Agricultural Practice for Protection of Waters Regulations, 2022). The spreading of the biobased fertiliser on the customer farms will be done on accordance with the specific Nutrient Management Plan for that farm.

Attenuation Tanks

The Proposed Development includes attenuation facilities, located to the northeast and southeast of the site, designed to manage surface water runoff from roads, yards, roofs, and the impermeable bunded area. Site investigations in the area, which included the excavation of a trial pit to a depth of 3.4mbgl, found no bedrock. The proposed plan indicates that excavation for the northeast tank will be limited to a maximum depth of 3.30 mbgl, while the southeast tank is expected to reach a depth of 2.54 mbgl.

If inappropriately constructed, the attenuation tanks may pose a risk to the underlying aquifer. As such, it will be lined with an impermeable membrane to limit the risk of contaminants leaching into the underlying locally important bedrock aquifer. There is also a potential risk of contaminants to reach surface water receptors via run-off.

The predicted groundwater flow follows the local topography toward the northeast, where no groundwater wells have been recorded. Furthermore, geological faults to the north and east, along with the less permeable bedrock of the Hospital GWB to the south, potentially act as natural barriers. These factors collectively make it highly unlikely that any Source Protection Areas or wells would be affected by potential groundwater contamination from the site.

The attenuation tanks, ***if not properly constructed and in the absence of mitigation measures*** are foreseen to have potentially ***negative, moderate, and long-term effects*** on surface water bodies and on the groundwater body.

8.6 Mitigation Measures

Mitigation measures proposed in this section relate primarily to the preservation of the existing subterranean drainage regime, the protection of groundwater receptors and the protection of surface water receptors.

Mitigation Measures proposed in this section are in response to the risks identified in **Section 8.5.**

8.6.1 Construction Phase

General Mitigation Measures

A Construction Environmental Management Plan (CEMP) will be prepared and implemented by the main contractor during the construction phase. This is a practical document which will

include detailed procedures to address the main potential effects on surface water and groundwater.

Increased Run-off and Sediment Loading

The main pollutants of site water are silt, fuel/oil, concrete and chemicals. There are a number of steps outlined below to eliminate contamination of site surface water runoff. The below recommendations are advised with reference to the Western Regional Fisheries Board recommendations for protection of adjacent water courses during the construction phase:

- A temporary drainage system will be established complete with oil intercept and settlement ponds to remove contaminants from run-off, prior to discharge off-site.
- Stockpile areas for sands and gravel should be kept to minimum size, well away from storm water drains, gullies leading off-site, and the adjacent stream.
- Covers are to be provided over soil debris stockpiles when high wind and inclement weather are encountered if required.
- Harmful materials and stockpiles should be stored well away from the adjacent watercourse and the drainage ditches on-site, as these ditches provide a direct pathway to the Lower Ballyteige Stream.
- Excavations to be backfilled as soon as possible to prevent any infiltration of contaminants to the subsurface and the aquifer.
- Landscaping should be carried out as soon as possible to minimise weathering.

Accidental Spillages of Harmful Substances

The following measures will minimise the risk of a release of fuels, oils, chemicals or cement products at the site:

- Establishment of bunded oil and chemical storage areas.
- Refuelling of mobile plant in designated areas provided with spill protection.
- Fuel bowsers to be located in bunded areas which can cater for 110% of the primary vessel capacity or 25% of the total volume of the substance which could be stored withing the bunded area and to be located away from the adjacent stream.
- Only appropriately trained site operatives permitted to refuel plant and machinery on-site.
- Regular inspections carried out on plant and machinery for leaks and general condition.
- Emergency response plan.
- Spill kits readily available throughout the site.
- Use of ready-mixed supply of wet cement products.
- Scheduling cement pours for dry days.

Increased Groundwater Vulnerability / Excavation of Bedrock Aquifer

The site has been assigned a moderate vulnerability rating. An excavation depth of up to 3.30m bgl would increase the vulnerability in particular areas of the Proposed Development from ‘moderate’ to ‘high’ or ‘extreme’. Mitigation measures to ensure maximum protection of groundwater include:

- Excavations to be backfilled as soon as possible to prevent any infiltration of contaminants to the subsurface and the aquifer.
- Landscaping should be carried out as soon as possible to minimise weathering.

- Additional trial pits are recommended prior to construction in the area around TP-04 in order to verify the presence of groundwater. If possible, trial pits should aim to be excavated after periods of heavy rain.
- Installation of impermeable liner is recommended under the attenuation tanks.

Excavation of Contaminated Soils

It is not anticipated contaminated soils will be encountered during construction activities hence no adverse effects on the groundwater or surface water quality are expected as a result of contaminated soils.

- All excavated materials will be visually assessed for contamination.
- Any contaminated material detected will be sent for analysis to a suitable environmental laboratory and subsequently quantified, segregated and transported for disposal by a licenced contractor.

Conversion of Permeable Soils to Hard standing

The construction phase will involve the gradual conversion of the existing greenfield site to areas of hardstanding. The following measures will be implemented in the construction phase to minimise an increase of flood risk to the receiving catchment:

- Regrade the existing western boundary ditch to flow to the north and to turn to the east at the northeast corner of the proposed development footprint. The proposed ditch will fall from the southwest corner of the development boundary to the stream on the western boundary at a gradient of approximately 1:500.
- The rate of discharge to the stream will be restricted to a maximum permissible rate of 14.97l/s for the Upper level (service yard) and 7.10 l/s for the Lower level (sump). This rate is calculated in accordance with criteria defined in the Greater Dublin Strategic Drainage Study [‘GDSDS’] to ensure the proposed development will not affect the flow / flood regimes in the receiving environment
- Pipes are designed for small catchment areas as defined in GDSDS, based on the modified rational method and a rainfall intensity of 50mm/ hour onto impermeable surfaces.
- All surface water pipes have been designed to achieve a minimum self-cleansing velocity of 0.75m/s
- Surface water pipework will be laid to a gradient no flatter than 1:500
- Backdrop heights will be greater than 0.6m where practicable
- The GDSD requirements with respect to interception volume, long-term storage volume and treatment volume have been considered.
- Minimum surface water pipe size of 225mm
- Minimum depth of cover to pipework of 1.2m below trafficked area, or where this cannot be achieved, adequate protection will be provided.
- Maximum depth of pipework of 5m
- Roughness value for surface water pipework, ks, 0.6mm
- Attenuation tanks will accommodate the total catchment area capacity and will provide a minimum storage capacity of 461 m^3(Lower Level – Sump) and 964 m^3(Upper Level – service yard).

8.6.2 Operational Phase

General Mitigation Measures

An Environmental Management System (EMS) will be prepared and implemented by the operator during the operational phase. This is a practical document which will include detailed procedures to address the main potential effects on surface water and groundwater.

The Proposed Development will operate under an Industrial Emissions Licence (IEL) issued by the Environmental Protection Agency (EPA). The licence will contain several conditions which the operator must remain in compliance with for the entire duration of the facility's lifespan. Typical conditions relating to the protection of water receptors include:

- Site specific trigger levels will be established and agreed with the EPA.
- Monitoring requirements for surface waters
- Resource use and energy efficiency
- Waste management control and documentation
- Storage and transfer of substances
- Facility management
- Accident prevention and emergency response including fire water retention
- Operational Controls

Contaminated Run-off

Compared to untreated manures and slurries, biobased fertiliser poses a lower risk of nutrient leaching into watercourses. The balanced nutrient composition and slow-release nature of biobased fertiliser minimise the likelihood of excess nutrients washing away into streams or groundwater. This reduction in nutrient leaching coupled with land spreading best practice helps mitigate water pollution and eutrophication, safeguarding aquatic ecosystems and maintaining water quality.

The Proposed Development will include two rainwater harvesting tanks designed to collect surface water runoff from the northernmost odour abatement building, the northern half of the service yard, overflow from the interim system, and runoff from the office building and parking areas. These tanks will recirculate the harvested water for various uses, including wheelwash and washdown activities, fire suppression, washdown in the silage clamp, and treatment for potable and greywater use in office facilities.

The remaining impermeable surfaces, and overflow from the rainwater harvesting tanks, will be collected by a surface water network which discharges to two proposed attenuation facilities. Post-attenuation, the runoff will be discharged at the greenfield runoff rate calculated for each catchment via means of a Hydrobrake or similar approved flow control device.

The attenuation tank collecting runoff from the bunded area is separate from the drainage network serving the rest of the site. An automated penstock will be installed to activate in the unlikely event of a digester or digestate tank failure, ensuring any potentially contaminated water is isolated and preventing the discharge of contaminated runoff.

The rates of discharge to the stream will be restricted to a maximum permissible rate of 14.97 l/s for the Upper level (service yard) and 7.10 l/s for the Lower level (sump). These rates are calculated in accordance with criteria defined in the Greater Dublin Strategic Drainage Study

['GDSDS'] to ensure the proposed development will not affect the flow / flood regimes in the receiving environment. The $Qbar_{rural}$ calculations are outlined in the Civil Engineering report which accompanies this application.

Design criteria adopted for the development include:

- Drainage systems will be designed to attenuate excess surface water runoff with suitable storage volumes
- All surface water run-off will discharge to the attenuation tank. The floor of the basin will be shaped to allow for the retention of silts in the pond.
- Regular inspection and maintenance of all treatment measures to remove accumulated silts and disposed of to an appropriately licenced landfill
- The digestion process area will be completely bunded and constructed to Eurocode standard (BS EN 1992-3)
- Pipes are designed for small catchment areas as defined in GDSDS, based on the modified rational method and a rainfall intensity of 50mm/ hour onto impermeable surfaces.
- All surface water pipes have been designed to achieve a minimum self-cleansing velocity of 0.75m/s
- Surface water pipework will be laid to a gradient no flatter than 1:500
- Backdrop heights will be greater than 0.6m where practicable
- The GDSD requirements with respect to interception volume, long-term storage volume and treatment volume have been considered.
- Minimum surface water pipe size of 225mm
- Minimum depth of cover to pipework of 1.2m below trafficked area, or where this cannot be achieved, adequate protection will be provided.
- Maximum depth of pipework of 5m
- Roughness value for surface water pipework, k_s, 0.6mm

The proposed civil services layout, detailing the surface water drainage system is shown in drawing Ref: **231240-ORS-ZZ-00-DR-CE-400**.

Foul Water

A domestic scale wastewater treatment plant (TER 3 PACKAGED TERTIARY UNIT and a distribution attenuation layer of 100sqm placed on 144sqm of imported soil depth of 300mm) is proposed to cater for the foul water arising from staff facilities on-site only (Population Equivalent 'PE' of 6). A Site Suitability Assessment conducted by *Coyle Environmental* in line with the EPA Code of Practice for onsite domestic wastewater treatment systems (2022) has concluded that the soils at the Proposed Development have sufficient absorption capacity for the installation of a percolation area suited for this PE.

Based on the design population for the proposed 3-5 workers, the population equivalent (PE) for the Proposed Development is calculated at PE6. The volume of foul water generated from the Proposed Development was calculated at 200 litres/day for hydraulic loading and 150 litres/day for organic loading. The proposed treatment system will produce an effluent with a standard compliant with SR66 the percolation area be designed on the hydraulic loading of 6 PE.

The wastewater treatment plant will comprise a tertiary treatment system (6PE EuroTank BAF2

Wastewater Treatment System), followed by a 6PE EuroTank TER3 Percolation Unit. The system is proposed with discharge to a Ter3 packaged tertiary unit with a minimum 100m^2 attenuation layer. Distribution layer to be placed on 144m^2 of imported soil 300m depth with suitable percolation values. Imported soil to be tested for suitable percolation values as per EPA COP 2021.

The treatment plant will be specified and installed by an appropriately qualified technician and will be subject to regular desludging and maintenance, subject to manufacturers recommendations.

Increased Groundwater Vulnerability

The proposed FFL will be up to approximately 0.6 m below the existing elevation of the site in certain places, which may increase the vulnerability of the underlying regionally and locally important aquifers from 'Moderate' to 'High' or 'Extreme'. Mitigation measures to ensure maximum protection of groundwater include:

- The site bunding is designed in accordance with IPC Guidance Note on storage and Transfer of Materials for Scheduled Activities (EPA, 2004)
- The tank farm area will be bunded in its entirety to ensure enough containment is provided in the unlikely event of a leak.
- The bund will be impermeable and provide the required storage volume i.e., a minimum of 110% of the largest single tank volume.
- Dedicated hard standing for off-loading areas, with a minimum separation distance from adjacent water courses.
- Use of spill kits, bunded pallets and secondary containment units, as appropriate.
- All bunds sized to contain 110% of the volume of the primary storage vessel.
- Environmental operating plan to include site specific standard operating procedures pertaining to waste management and emergency response.
- All bunds and pipelines (foul & process) will be subject to integrity assessments every 3 years by a suitably qualified engineer.

On-Site Flooding

The existing flood risk to the Proposed Development is negligible with the proposed site located in 'Flood Zone C'. No specific mitigation measures to alleviate flood risk to the site are recommended.

The proposed stormwater management system is designed in accordance with industry standards and is projected to emulate the current greenfield runoff rates calculated at the site.

Uncontrolled Releases and Spillage

An Environmental Management System (EMS) will be implemented and accredited to ISO: 4001:2015. The Proposed Development will operate under an Industrial Emissions Licence (IEL) issued by the Environmental Protection Agency (EPA).

The licence will contain several conditions which the operator must remain in compliance with for the entire duration of the facility's lifespan. Conditions of relevance to uncontrolled releases will include:

- Use of spill kits, bunded pallets and secondary containment units, as appropriate.
- All bunds sized to contain 110% of the volume of the primary storage vessel or 25% of the total volume of the substance which could be stored withing the bunded area (in compliance with Guidance to storage and Transfer of Materials for Scheduled Activities, EPA 2004)
- EMS to include site specific standard operating procedures pertaining to waste management and emergency response.
- Impermeable membrane liner will be installed under the attenuation tanks to limit percolation of contents into the underlying regionally important aquifer.
- The entire tank farm area of the Proposed Development will be bunded.
- The Reception Hall, Digestate Treatment building a will each be self-bunded.
- All bunds and underground pipelines (foul and process) will be subject to integrity assessments every 3 years by a suitably qualified engineer.
- Ongoing monitoring of stormwater discharge to the Lower Ballyteige Stream.

Fire and Resultant Firewater

The Proposed Development will operate under an Industrial Emissions Licence (IEL) issued by the Environmental Protection Agency (EPA). The licence will contain several conditions which the operator must remain in compliance with for the entire duration of the facility's lifespan.

The conclusions and recommendations of the Firewater Risk Assessment Report will ensure that fire response and firewater retention are adequately scaled for the size of the facility. The operator of the facility will be obliged to ensure:

- A Firewater Risk Assessment will be commissioned within the first six months of operation and will determine the volume of firewater retention storage require on site.
- Adequate firewater retention capacity is installed and maintained on-site in the event of a worst-case scenario fire event.
- Firewater retention will be the containment bund and underground tank in the reception building.
- All retention infrastructure systems will be automatically activated in the event of a fire alarm being triggered.
- All retention tanks, etc., shall be maintained empty, or at least to a point where the required retention capacity is available.
- Bunds and tanks will be constructed to Eurocode standard (BS EN 1992-3:2006).

Conversion of Permeable Soils to Hard standing

The operation phase will involve the conversion of the existing greenfield site to areas of hardstanding. The following measures will be implemented to minimise an increase of flood risk to the receiving catchment during the operation phase:

- Regrade the existing western boundary ditch to flow to the north and to turn to the east at the northeast corner of the proposed development footprint. The proposed ditch will fall from the southwest corner of the development boundary to the stream on the western boundary at a gradient of approximately 1:500.
- The rate of discharge to the stream will be restricted to a maximum permissible rate of 14.97 l/s for the Upper level (service yard) and 7.10 l/s for the Lower level (sump). This rate is calculated in accordance with criteria defined in the Greater Dublin Strategic

Drainage Study ['GDSDS'] to ensure the proposed development will not affect the flow / flood regimes in the receiving environment

- Pipes are designed for small catchment areas as defined in GDSDS, based on the modified rational method and a rainfall intensity of 50mm/ hour onto impermeable surfaces.
- All surface water pipes have been designed to achieve a minimum self-cleansing velocity of 0.75m/s
- Surface water pipework will be laid to a gradient no flatter than 1:500
- Backdrop heights will be greater than 0.6m where practicable
- The GDSD requirements with respect to interception volume, long-term storage volume and treatment volume have been considered.
- Minimum surface water pipe size of 225mm
- Minimum depth of cover to pipework of 1.2m below trafficked area, or where this cannot be achieved, adequate protection will be provided.
- Maximum depth of pipework of 5m
- Roughness value for surface water pipework, ks, 0.6mm
- Attenuation tanks will accommodate the total catchment area capacity and will provide a minimum storage capacity of 461 m^3(Lower Level – Sump) and 964 m^3(Upper Level – service yard).

The Proposed Development will include two rainwater harvesting tanks designed to collect surface water runoff from the northernmost odour abatement building, the northern half of the service yard, overflow from the interim system, and runoff from the office building and parking areas. These tanks will recirculate the harvested water for various uses, including wheelwash and washdown activities, fire suppression, washdown in the silage clamp, and treatment for potable and greywater use in office facilities.

The remaining impermeable surfaces, and overflow from the rainwater harvesting tanks, will be collected by a surface water network which discharges to two proposed attenuation facilities. Post-attenuation, the runoff will be discharged at the greenfield runoff rate calculated for each catchment via means of a Hydrobrake or similar approved flow control device.

The attenuation tank collecting runoff from the bunded area is separate from the drainage network serving the rest of the site. An automated penstock will be installed to activate in the unlikely event of a digester or digestate tank failure, ensuring any potentially contaminated water is isolated and preventing the discharge of contaminated runoff.

Land Spreading of biobased fertiliser

The operation phase will involve the production of a biobased fertiliser which will be used by customer farmers for the fertilisation of their land. Mitigation measures to ensure maximum protection of receiving environment include:

- Nutrient management plans to avoid excess fertiliser application
- Farmers to comply with the Nitrates Action Plan
- "Lay-off" period of 21 days for grazing or harvesting following application
- Biobased fertiliser will be pasteurised in accordance with Regulation (EU) 142/2011 on use of animal by products as organic fertiliser.

Attenuation Tanks

The Proposed Development includes two attenuation tanks to the northeast and southeast of the site which will be used for attenuating surface water run-off from roads, yards, roofs and the impermeable bunded area. The following mitigation measures are proposed in order to ensure maximum protection of the surface and groundwater systems:

- The attenuation tanks are designed for a 1:100 year event and well as to regulate the outflow from the site.
- Installation of Sustainable Urban Drainage Systems (SuDS) features such as Sumps in gullies and catchpits collect silts in run-off from roads, filter drains, discharge bypass separator and an attenuation tanks.

8.7 Cumulative Effects

8.7.1 Interactions

Within the European Commission - Guidelines for the Assessment of Indirect and Cumulative effects as well as Impact Interactions, dated May 1999, cumulative effects are described as "effects" that result from incremental changes caused by other development, plans, or projects together with the Proposed Development or developments".

Hydrology and Hydrogeology is linked with Land, Soils and Geology as discussed in **Chapter 7** of this EIAR. In terms of hydrogeology specifically, the recharge capacity at the Proposed Development will be diminished as a function of surface sealing, which has the potential to adversely enhance flood events downstream of the Proposed Development. This is addressed in the above sections in regard to flood risk assessment and mitigation i.e. attenuation and SUDs.

Hydrology is linked with Biodiversity as discussed in **Chapter 5**. With the successful implementation of adequate mitigation measures potential hazards will be managed and the likelihood of environmental incidents occurring is very low. Any potential impacts are therefore resolved or minimised.

Hydrology and Hydrogeology is linked with the Population and Human Health in **Chapter 6**. Specifically, in terms of hydrogeology, there is a minimal risk to human health from potential groundwater contamination. However, with the effective implementation of appropriate mitigation measures, any potential hazards will be managed, significantly reducing the likelihood of environmental incidents. As a result, any potential impacts are either resolved or minimised.

8.7.2 Potential Cumulative Impacts

Construction Phase

The phasing/commencement of any other future permitted developments in the locality could potentially result in the scenario where a number of other construction sites are in operation at the same time as the Proposed Development. Considering the mitigation measures outlined in this report and the expected residual effect pending successful implementation of those measures, the development is not considered to significantly contribute to cumulative adverse impacts to the associated hydrological network.

Operational Phase

In the absence of mitigation measures, surface sealing (paving, buildings on previously exposed ground), reduction in recharge to groundwater, and rapid transmission of runoff to surface water systems has the potential to significantly contribute to the cumulative / catchment hydrological response to rainfall.

Considering the mitigation measures outlined in this report and the expected residual effect pending successful implementation of those measures, the development is not considered to significantly contribute to cumulative adverse impacts to the associated hydrological network.

8.8 Residual Effects

According to Environmental Protection Agency guidelines, Residual Impact is described as 'the degree of environmental change that will occur after the proposed mitigation measures have taken place.' The mitigation strategy above recommends actions which can be taken to reduce or offset the scale, significance and duration of the effects on the surrounding hydrological and hydrogeological features.

The purpose of this assessment is to specify mitigation measures where appropriate to minimise the 'risk factor' to all aspects of the water environment such as to minimise the potential for hydrocarbons to contaminate the streams or groundwater, reduce the risk of erosion and run-off, etc. This 'risk factor' is reduced or offset by recommending the implementation of a mitigation strategy in each area of the study. On the implementation of this mitigation strategy, the potential for impact will be lessened.

A site-specific Construction Environmental Management Plan (CEMP) will be devised and implemented throughout the duration of the construction phase. This document will contain all the necessary procedures required to prevent and minimise any environmental risks posed by the project on the surrounding environment.

8.8.1 Construction Phase

A summary of the predicted effects associated with the construction phase in terms of quality, significance, and duration, along with the proposed mitigation measures and resulting residual effects are summarised in **Table 8.18**.

The overall impact anticipated during the construction phase of the project following the implementation of suitable mitigation measures is considered to be ***neutral*** to ***negative***, ***imperceptible*** to ***slight***, and ***temporary.***

8.8.2 Operational Phase

A summary of the predicted effects associated with the operational phase in terms of quality, significance, and duration, along with the proposed mitigation measures and resulting residual effects are summarised in **Table 8.19.**

The overall impact anticipated during the operational phase of the project following the implementation of suitable mitigation measures is considered to be ***neutral to negative***, ***slight***, and ***short-term*** to ***long-term***. There are no uncontrolled emissions anticipated as a result of the Proposed Development.

Table 8.18: Summary of predicted construction phase effects, mitigation measures and residual impact

Potential Source	Environmental Receptor	Impact Description	Quality	Significance	Duration	Mitigation	Residual Impact
Increased Run-off and Sediment Loading	**Surface Water** *Lower Ballyteige Stream and downstream receptors, River Glenma & River Maigue*	During the construction phase, groundworks, soil exposure, and erosion from stockpiles of exposed soils could result in the migration of silt, sediments, and organic matter into surface water receptors through dust dispersal and surface runoff.	***Negative***	***Moderate***	***Temporary***	• A temporary drainage system will be established complete with oil interceptors and settlement ponds to remove contaminants from run-off, prior to discharge off-site. • Stockpile areas for sands and gravel should be kept to minimum size, well away from storm water drains and gullies leading off-site, and the adjacent stream. • Covers are to be provided over soil stockpiles when high wind and inclement weather are encountered if required. • Harmful materials and stockpiles should be stored well away from the adjacent watercourse and the drainage ditches on-site, as these ditches provide a direct pathway to the Lower Ballyteige Stream.	***Neutral, Slight, Temporary***
	Groundwater *Ballingarry Groundwater Body*	Loose sediments becoming entrained in open excavations.	***Negative***	***Moderate***	***Temporary***	• Excavations to be backfilled as soon as possible to prevent any infiltration of contaminants to the subsurface and the aquifer. • Landscaping should be carried out as soon as possible to minimise weathering.	***Neutral, Slight, Temporary***
Accidental Spillages of Harmful Substances	**Surface Water** *Lower Ballyteige Stream and downstream receptors, River Glenma & River Maigue*	Spillage of contaminants such as fuels, oils, chemicals and cement material and subsequent migration into surface water receptors	**Negative**	**Moderate to Significant**	**Temporary**	• Establishment of bunded oil and chemical storage areas. • Refuelling of mobile plant in designated areas provided with spill protection. • Fuel bowsers to be located in bunded areas which can cater for 110% of the primary vessel capacity or 25% of the total volume of the substance which could be stored withing the bunded area and to be located away from the adjacent stream.	***Negative, Slight, Temporary***

Potential Source	Environmental Receptor	Impact Description	Quality	Significance	Duration	Mitigation	Residual Impact
	Groundwater *Ballingarry Groundwater Body*	Spillage of contaminants in soils and subsoils, particularly in open excavations, and subsequent migration to the underlying aquifer.	***Negative***	***Moderate***	***Short-term***	• Only appropriately trained site operatives permitted to refuel plant and machinery on-site. • Regular inspections carried out on plant and machinery for leaks and general condition. • Emergency response plan. • Spill kits readily available throughout the site. • Use of ready-mixed supply of wet cement products. • Scheduling cement pours for dry days.	***Neutral, Slight, Temporary***
Increased Groundwater Vulnerability	**Groundwater** *Ballingarry Groundwater Body*	Excavation depths of up to 3.30 mbgl could significantly increase groundwater vulnerability in certain areas from 'Moderate' to 'High'.	**Negative**	**Significant**	**Long-Term**	• Excavations to be backfilled as soon as possible to prevent any infiltration of contaminants to the subsurface and the aquifer. • Landscaping should be carried out as soon as possible to minimise weathering. • Additional trial pits are recommended prior to construction in the area around TP-04 in order to verify the presence of groundwater. If possible, trial pits should aim to be excavated after periods of heavy rain. • Installation of impermeable liner is recommended under the attenuation tanks.	***Negative, Slight, Temporary***
Excavation of Bedrock Aquifer		Potential removal of bedrock in certain parts of the site to create a uniform base.	**Negative**	**Significant**	**Long-Term**		***Negative, Slight, Long-term***
Excavation of Contaminated Soils	**Surface Water** *Lower Ballyteige Stream and downstream receptors, River Glenma & River Maigue*	There is no indication of any incidences of land use which might result in the contamination of soils; hence excavation of contaminated soils is unlikely.	***Unlikely***	***Negligible***	***Unlikely***	• All excavated materials will be visually assessed for contamination. • Any contaminated material detected will be sent for analysis to a suitable environmental laboratory and subsequently quantified, segregated and transported for disposal by a licenced contractor.	***Unlikely, Negligible, Unlikely***
	Groundwater *Ballingarry Groundwater Body*		***Unlikely***	***Negligible***	***Unlikely***		***Unlikely, Negligible, Unlikely***

Potential Source	Environmental Receptor	Impact Description	Quality	Significance	Duration	Mitigation	Residual Impact
Conversion of Permeable Soils to Hard standing	**Surface Water** *Lower Ballyteige Stream and downstream receptors, River Glenma & River Maigue*	The gradual conversion of the site to hardstanding areas may increase the volume and intensity of surface water runoff within the receiving catchment, potentially elevating the risk of flooding both upstream and downstream of the proposed site.	***Negative***	***Moderate***	***Long-Term***	• Regrade the existing western boundary ditch to flow to the north and to turn to the east at the northeast corner of the proposed development footprint. The proposed ditch will fall from the southwest corner of the development boundary to the stream on the western boundary at a gradient of approximately 1:500. • The rate of discharge to the stream will be restricted to a maximum permissible rate of 14.97 l/s for the Upper level (service yard) and 7.10 l/s for the Lower level (sump). This rate is calculated in accordance with criteria defined in the Greater Dublin Strategic Drainage Study ['GDSDS'] to ensure the proposed development will not affect the flow / flood regimes in the receiving environment • Pipes are designed for small catchment areas as defined in GDSDS, based on the modified rational method and a rainfall intensity of 50mm/ hour onto impermeable surfaces. • All surface water pipes have been designed to achieve a minimum self-cleansing velocity of 0.75m/s • Surface water pipework will be laid to a gradient no flatter than 1:500 • Backdrop heights will be greater than 0.6m where practicable • The GDSD requirements with respect to interception volume, long-term storage volume and treatment volume have been considered. • Minimum surface water pipe size of 225mm • Minimum depth of cover to pipework of 1.2m below trafficked area, or where this cannot be achieved, adequate protection will be provided. • Maximum depth of pipework of 5m • Roughness value for surface water pipework, ks, 0.6mm • Attenuation tanks will accommodate the total catchment area capacity and will provide a minimum storage capacity of 461 m3(Lower	***Negative, Slight, Temporary***

Potential Source	Environmental Receptor	Impact Description	Quality	Significance	Duration	Mitigation	Residual Impact
						Level – Sump) and 964 m3(Upper Level – service yard).	

Table 8.19: Summary of predicted operational phase effects, mitigation measures and residual impact

Potential Source	Environmental Receptor	Impact Description	Quality	Significance	Duration	Mitigation	Residual Impact
Contaminated Run-off	**Surface Water** *Lower Ballyteige Stream and downstream receptors, River Glenma & River Maigue*	Run-off from impermeable areas within the Proposed Development site discharging into surface water bodies	***Negative***	***Moderate to Significant***	***Temporary***	• Drainage systems will be designed to attenuate excess surface water runoff with suitable storage volumes • All surface water run-off will discharge to the attenuation tanks. The floor of the basin will be shaped to allow for the retention of silts in the pond. • Regular inspection and maintenance of all treatment measures to remove accumulated silts and disposed of to an appropriately licenced landfill • The digestion process area will be completely bunded and constructed to Eurocode standard (BS EN 1992-3) • Pipes are designed for small catchment areas as defined in GDSDS, based on the modified rational method and a rainfall intensity of 50mm/ hour onto impermeable surfaces. • All surface water pipes have been designed to achieve a minimum self-cleansing velocity of 0.75m/s • Surface water pipework will be laid to a gradient no flatter than 1:500 • Backdrop heights will be greater than 0.6m where practicable • The GDSD requirements with respect to interception volume, long-term storage volume and treatment volume have been considered. • Minimum surface water pipe size of 225mm • Minimum depth of cover to pipework of 1.2m below trafficked area, or where this cannot be achieved, adequate protection will be provided. • Maximum depth of pipework of 5m	***Neutral, Slight, Temporary***
	Groundwater *Ballingarry Groundwater Body*	Run-off from impermeable areas within the Proposed Development site infiltrating downwards through soils into aquifer	***Negative***	***Moderate***	***Short-term***		***Neutral, Imperceptible, Short-term***

Potential Source	Environmental Receptor	Impact Description	Quality	Significance	Duration	Mitigation	Residual Impact
						• Roughness value for surface water pipework, ks, 0.6mm • The rates of discharge to the stream will be restricted to a maximum permissible rate of 14.97 l/s for the Upper level (service yard) and 7.10 l/s for the Lower level (sump). • Two rainwater harvesting tanks designed to collect surface water runoff from the northernmost odour abatement building, the northern half of the service yard, overflow from the interim system, and runoff from the office building and parking areas. These will recirculate the harvested water for various uses, including wheelwash and washdown activities, fire suppression, washdown in the silage clamp, and treatment for potable and greywater use in office facilities. • The remaining impermeable surfaces, and overflow from the rainwater harvesting tanks, will be collected by a surface water network which discharges to two proposed attenuation facilities. Post-attenuation, the runoff will be discharged at the greenfield runoff rate calculated for each catchment via means of a Hydrobrake or similar approved flow control device. • The attenuation tank collecting runoff from the bunded area is separate from the drainage network serving the rest of the site. An automated penstock will be installed to activate in the unlikely event of a digester or digestate tank failure, ensuring any potentially contaminated water is isolated and preventing the discharge of contaminated runoff.	

Potential Source	Environmental Receptor	Impact Description	Quality	Significance	Duration	Mitigation	Residual Impact
Foul Water	**Surface Water** *Lower Ballyteige Stream and downstream receptors, River Glenma & River Maigue*	Leakage of untreated foul water and infiltration via preferential pathways to site drainage system and subsequent discharge to surface water receptors	***Negative***	***Moderate to Significant***	***Temporary***	• A domestic scale wastewater treatment plant is proposed to cater for the foul water arising from staff facilities on-site only. • The wastewater treatment plant will comprise a tertiary treatment system, followed by a 6PE EuroTank TER3 Percolation Unit. • The system is proposed with discharge to a Ter3 packaged tertiary unit with a minimum 100m2 attenuation layer. Distribution layer to be placed on 144m2 of imported soil 300m depth with suitable percolation values. • Imported soil to be tested for suitable percolation values as per EPA COP 2021. • The treatment plant will be specified and installed by an appropriately qualified technician and in accordance with EPA COP 2021. It also will be subject to regular desludging and maintenance, as per manufacturers recommendations. Pressure tests and CCTV surveys will be carried out prior to commissioning to ensure absence of defects. • Programme of inspection and maintenance to ensure any defects are repaired	***Negative, Slight, Temporary***
	Groundwater *Ballingarry Groundwater Body*	Leakage of untreated foul water and infiltration downwards through sediments into aquifer	***Negative***	***Moderate to Significant***	***Short-Term***		***Negative, Slight, Short-term***
Increased Groundwater Vulnerability	**Groundwater** *Ballingarry Groundwater Body*	The proposed FFL will be up to 0.6 m below the existing elevation of the site in certain places, which may increase the vulnerability of the underlying locally important aquifer from 'Moderate' to 'High'.	***Negative***	***Significant***	***Long-Term***	• The site bunding is designed in accordance with IPC Guidance Note on storage and Transfer of Materials for Scheduled Activities (EPA, 2004) • The tank farm area will be bunded in its entirety to ensure enough containment is provided in the unlikely event of a leak. • The bund will be impermeable and provide the required storage volume i.e., a minimum of 110% of the largest single tank volume. • Dedicated hard standing for off-loading areas, with a minimum separation distance from adjacent water courses. • Use of spill kits, bunded pallets and secondary containment units, as appropriate. • All bunds sized to contain 110% of the volume of the primary storage vessel.	***Negative, Slight, Short-term***

Potential Source	Environmental Receptor	Impact Description	Quality	Significance	Duration	Mitigation	Residual Impact
						• Environmental operating plan to include site specific standard operating procedures pertaining to waste management and emergency response. • All bunds and pipelines (foul & process) will be subject to integrity assessments every 3 years by a suitably qualified engineer.	
On-Site Flooding	**Surface Water** *Lower Ballyteige Stream and downstream receptors, River Glenma & River Maigue*	The site is located at an elevated point within its catchment and the likelihood of flooding occurring on the site are unlikely.	***Negligible***	***Not significant***	***Unlikely***	• The proposed Finished Floor Levels are above the estimated 1 in 1000-year return period fluvial flood event placing the units within Flood Zone C • The proposed stormwater management system is designed in accordance with industry standards and is projected to emulate the current greenfield runoff rates calculated at the site.	***Negligible, Imperceptible, Unlikely***
Uncontrolled Releases & Spillage of Digestate and Feedstocks	**Surface Water** *Lower Ballyteige Stream and downstream receptors, River Glenma & River Maigue*	During the operational phase, there is a possibility of leakage or spillage of biobased fertiliser or feedstocks via vehicle movements or from a catastrophic failure of a tank or feed line. While such substances are significantly less hazardous than fuels, oils, chemicals and cement material, the still pose a potential risk to surface and groundwater quality.	***Negative***	***Slight to Moderate***	***Temporary***	• Use of spill kits, bunded pallets and secondary containment units, as appropriate. • All bunds sized to contain 110% of the volume of the primary storage vessel or 25% of the total volume of the substance which could be stored withing the bunded area (in compliance with Guidance to storage and Transfer of Materials for Scheduled Activities, EPA 2004) • EMS to include site specific standard operating procedures pertaining to waste management and emergency response. • Impermeable membrane liner will be installed under the attenuation tanks to limit percolation of contents into the underlying regionally important aquifer. • The entire tank area of the Proposed Development will be bunded. • The Reception Hall, Digestate Treatment building will each be self-bunded. • All bunds and underground pipelines (foul and process) will be subject to integrity assessments every 3 years by a suitably qualified engineer.	***Neutral to Negative, Slight, Temporary***
	Groundwater *Ballingarry Groundwater Body*		***Negative***	***Slight to Moderate***	***Temporary***		***Neutral to Negative, Slight, Temporary***

Potential Source	Environmental Receptor	Impact Description	Quality	Significance	Duration	Mitigation	Residual Impact
						• Ongoing monitoring of stormwater discharge to the local hydrologic system.	
Fire and Resultant Firewater	**Surface Water** *Lower Ballyteige Stream and downstream receptors, River Glenma & River Maigue*	Given the presence of flammable substances on the site, there is a risk of fire prevalent at the facility, during the operational phase. In the event of a fire, significant quantities of water resources will be utilised to quench the fire. Water used to quench a fire is known as “firewater”. Firewater is known to contain several harmful substances, as detailed in **Section 8.5.4.**	***Negative***	***Slight to Moderate***	***Temporary***	• A Firewater Risk Assessment will be commissioned within the first six months of operation and will determine the volume of firewater retention storage require on site. • Adequate firewater retention capacity is installed and maintained on-site in the event of a worst-case scenario fire event. • Firewater retention will be the containment bund and underground tank in the reception building. • All retention infrastructure systems will be automatically activated in the event of a fire alarm being triggered. • All retention tanks, etc., shall be maintained empty, or at least to a point where the required retention capacity is available. • Bunds and tanks will be constructed to Eurocode standard (BS EN 1992-3:2006).	***Negative, Slight, Temporary***
	Groundwater *Ballingarry Groundwater Body*		***Negative***	***Significant***	***Short-Term***		***Negative, Slight, Short-Term***

Potential Source	Environmental Receptor	Impact Description	Quality	Significance	Duration	Mitigation	Residual Impact
Conversion of Permeable Soils to Hard standing	**Surface Water** *Lower Ballyteige Stream and downstream receptors, River Glenma & River Maigue*	The conversion of a significant area of the site to hardstanding areas may increase the volume and intensity of surface water runoff within the receiving catchment, potentially elevating the risk of flooding both upstream and downstream of the proposed site.	***Negative***	***Moderate***	***Long-Term***	• Regrade the existing western boundary ditch to flow to the north and to turn to the east at the northeast corner of the proposed development footprint. The proposed ditch will fall from the southwest corner of the development boundary to the stream on the western boundary at a gradient of approximately 1:500. • The rate of discharge to the stream will be restricted to a maximum permissible rate of 14.97 l/s for the Upper level (service yard) and 7.10 l/s for the Lower level (sump). This rate is calculated in accordance with criteria defined in the Greater Dublin Strategic Drainage Study ['GDSDS'] to ensure the proposed development will not affect the flow / flood regimes in the receiving environment • Pipes are designed for small catchment areas as defined in GDSDS, based on the modified rational method and a rainfall intensity of 50mm/ hour onto impermeable surfaces. • All surface water pipes have been designed to achieve a minimum self-cleansing velocity of 0.75m/s • Surface water pipework will be laid to a gradient no flatter than 1:500 • Backdrop heights will be greater than 0.6m where practicable • The GDSD requirements with respect to interception volume, long-term storage volume and treatment volume have been considered. • Minimum surface water pipe size of 225mm • Minimum depth of cover to pipework of 1.2m below trafficked area, or where this cannot be achieved, adequate protection will be provided. • Maximum depth of pipework of 5m • Roughness value for surface water pipework, ks, 0.6mm • Attenuation tanks will accommodate the total catchment area capacity and will provide a minimum storage capacity of 461 m3(Lower	***Neutral, Slight, Long-term***

Potential Source	Environmental Receptor	Impact Description	Quality	Significance	Duration	Mitigation	Residual Impact
						Level – Sump) and 964 m3(Upper Level – service yard).	
Land Spreading of biobased fertiliser	**Surface Water** *Lower Ballyteige Stream and downstream receptors, River Glenma & River Maigue*	Application of processed biobased fertiliser to agricultural land. Reduction in chemical fertiliser use, pathogen and diseases which may be contained and spread in untreated manures Discharge of contaminated materials into the attenuation tanks may have the potential to percolate into the underlying aquifer and to reach surface water receptor via run-off.	***Negative***	***Slight***	***Temporary***	• Nutrient management plans to avoid excess fertiliser application • Farmers to comply with the Nitrates Action Plan • "Lay-off" period of 21 days for grazing or harvesting following application • Biobased fertiliser will be pasteurised in accordance with Regulation (EU) 142/2011 on use of animal by products as organic fertiliser.	***Positive, Imperceptible, Temporary***
	Groundwater *Ballingarry Groundwater Body*		***Negative***	***Slight***	***Short-Term***		***Positive, Imperceptible, Short-term***

Potential Source	Environmental Receptor	Impact Description	Quality	Significance	Duration	Mitigation	Residual Impact
Attenuation Tanks	**Surface Water** *Lower Ballyteige Stream and downstream receptors, River Glenma & River Maigue*	Discharge of contaminated materials into the attenuation tank may have the potential to percolate into the underlying aquifer and to reach surface water receptor via run-off.	***Negative***	***Moderate***	***Temporary***	• The attenuation tanks are designed for a 1:100 year event and well as to regulate the outflow from the site. • Installation of Sustainable Urban Drainage Systems (SuDS) features such as Sumps in gullies and catchpits collect silts in run-off from roads, filter drains, discharge bypass separator and an attenuation tanks.	***Neutral, Slight, Long-term***

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8.9 Monitoring

The Construction Environmental Management Plan (CEMP) and Environmental Operating Plan (EOP) and the Industrial Emissions Licence (IEL) will include provision for the monitoring of construction related activities including the following:

- Water Quality Monitoring of the surface water receptors adjacent to the site boundary – Lower Ballyteige Stream U/S and D/S
- Daily inspections for housekeeping and site cleanliness
- Dust Suppression on dry days or during concrete cutting
- Risk assessment for the prevention of fuel spillages
- Monitoring of stockpiles to determine if further measures are required to prevent erosion
- Daily site inspections to ensure procedures outlined within the CEMP are adhered through throughout the Proposed Development.

The site will be subject to inspection by the Environmental Protection Agency (EPA) who will critically assess the site's compliance with Surface Water Regulations (S.I. No. 77/2019)

Monitoring for the Proposed Development will be conducted in line with BAT Waste treatment CID and conditions set out in the proposed EPA licence. Monitoring results will be reported to the EPA annually. The site will be subject to inspection by the Environmental Protection Agency who will critically assess the site's compliance with the conditions of the Industrial Emissions licence (IEL).

8.10 Summary of Significant Effects

The receptors for this assessment are considered to be local surface water receptors named the Lower Ballyteige stream, the River Glenma and River Maigue and the Regionally Important aquifer beneath the Proposed Development named the Ballingarry Groundwater Body. Whilst the development proposals have the potential to cause detrimental effects to sensitive receptors identified, the recommended mitigation measures will ensure that the risk of potential effects are reduced to negligible.

8.11 Statement of Significance

The significance of impact upon local & regional hydrology and hydrogeology systems have been assessed for both during the construction and operational phases. The results of the assessment are presented on **Table 8.18** and **Table 8.19**.

The overall impact anticipated during the construction phase of the project following the implementation of suitable mitigation measures is considered to be ***neutral*** to ***negative***, ***imperceptible*** to ***slight***, and ***temporary***.

The overall impact anticipated during the operational phase of the project following the implementation of suitable mitigation measures is considered to be ***neutral*** to ***negative***, ***slight***, and ***short-term*** to ***long-term***.