8. HYDROLOGY AND HYDROGEOLOGY

8.1 Introduction

8.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by MKO acting on behalf of Newtown Farming Ltd, to prepare an Environmental Impact Assessment Report (EIAR) for the likely and significant effects of proposed sand and gravel extraction (Proposed Development) at Lomaunaghbaun, Tuam, Co. Galway on water aspects (hydrology and hydrogeology) of the receiving environment.

The objectives of the assessment are:

- Produce a baseline study of the existing water environment (surface water and groundwater) in the area of the Proposed Development and associated works;
- Identify likely effects of the Proposed Development on surface water and groundwater during construction, operational/extraction and restoration phases of the development;
- Identify mitigation measures to avoid, reduce or offset likely negative effects;
- Assess likely residual effects; and
- Assess cumulative effects of the Proposed Development and other local developments.

8.1.2 Statement of Authority

Hydro-Environmental Services (HES) are a specialist hydrological, hydrogeological and environmental practice which delivers a range of water and environmental management consultancy services to the private and public sectors across Ireland and Northern Ireland. HES was established in 2005, and our office is located in Dungarvan, County Waterford.

Our core areas of expertise and experience include hydrology and hydrogeology. We routinely complete environmental impact assessments for land, soils, geology, hydrology and hydrogeology for a large variety of project types including quarries and sand and gravel pits.

This chapter of the EIAR was prepared by David Broderick, Jenny Law and Michael Gill.

David Broderick P.Geo (BSc, H. Dip Env Eng, MSc) is a Hydrogeologist with over 17 years' experience in both the public and private sectors. Having spent two years working in the Geological Survey of Ireland working mainly on groundwater and source protection studies David moved into the private sector. David has a strong background in groundwater resource assessment and hydrogeological/hydrological investigations in relation to quarry and sand and gravel pit developments. David has completed numerous geology and water sections for input into EIARs for a range of commercial developments.

Michael Gill P. Geo (B.A.I., MSc, Dip. Geol., MIEI) is an Environmental Engineer with over 22 years' environmental consultancy experience in Ireland. Michael has completed numerous geological, hydrological and hydrogeological impact assessments for the extractive industry in Ireland. He has also managed EIAR assessments for infrastructure projects and private residential and commercial developments. In addition, he has substantial experience in wastewater engineering and site suitability assessments, contaminated land investigation and assessment, wetland hydrology/hydrogeology, water resource assessments, surface water drainage design and SUDs design, and surface water/groundwater interactions.

Jenny Law (BSc, MSc) is an Environmental Geoscientist holding a first honours degree in Applied Environmental Geosciences from the University College Cork (2022). Jenny has assisted in the

preparation of the land, soils and geology and hydrology chapters for various environmental impact assessment reports, hydrological impact assessments, Water Framework Directive Assessment reports and Flood Risk Assessment reports for a variety of projects including wind farm developments, strategic housing developments and quarries.

8.1.3 Scoping and Consultation

The scope for this chapter of the EIAR has also been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties. This consultation process and the List of Consultees is outlined in Chapter 2 of this EIAR. Matters raised by Consultees in their responses with respect to the water environment are summarised in **Table 8-1** below.

Table 8-1: Summary of Water Related Scoping Responses

Consultee	Matters Raised - Description	Addressed in Section
Geological Survey of Ireland (GSI)	*"Our records show that the proposed Sand Quarry is in the Gallagh Group Water Scheme (GWS) source protection area. Key to groundwater protection in general, and protection of specific drinking water supplies, is preventing ingress of runoff to the aquifer. Design of drainage will need to be cognisant of the group water scheme and the interactions between surface water and groundwater as well as run-off. Appropriate design should be undertaken by qualified and competent persons to include mitigation measures as necessary, such as SUDs or other drainage mitigation measures".* *"Note that there could be other groundwater abstractions in the locality for which Geological Survey Ireland has not undertaken studies, and a robust assessment should be undertaken by qualified and competent persons including a survey of all current wells and water abstractions within the vicinity".*	Sections 8.3.7 & 8.3.15
Health Service Executive (HSE)	*"The proposed development has the potential to have a significant impact on the quality of both surface and ground water.* *All drinking water sources, both surface and ground water, must be identified. Public and Group Water Scheme sources and supplies should be identified in addition to any private wells supplying potable water to houses in the vicinity of the proposed development. Measures to ensure that all sources and supplies are protected should be described".*	Sections 8.3.7 & 8.3.15
Department of Housing, Local Government and Heritage	*"The proposed quarry site, which is located nearby other quarried areas, is not covered by any nature conservation designations. However, consideration will have to be given to potential indirect or cumulative effects on nearby and more distant nature conservation sites. Levally*	Sections 8.3.14 & 8.5.2.4

Consultee	Matters Raised - Description	Addressed in Section
	Lough Special Area of Conservation (SAC) is located 2.7km to the south, and Lough Corrib SAC is approx 3km to the south-east of the proposed site. Drumbulcaun Bog proposed Natural Heritage Area (pNHA) is located 0.6km west of the proposed site location. The focus should be on realistic impacts arising from construction and operation of the quarry over its lifetime including, for example, from impacts on or emissions to surface water, groundwater or air".	

8.1.4 Relevant Legislation

The EIAR is prepared in accordance with the requirements of European Union Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the 'EIA Directive') as amended by Directive 2014/52/EU.

The requirements of the following legislation are complied with:

- S.I. No. 349 of 1989: European Communities (Environmental Impact Assessment) Regulations, and subsequent Amendments (S.I. No. 84 of 1994, S.I. No. 101 of 1996, S.I. No. 351 of 1998, S.I. No. 93 of 1999, S.I. No. 450 of 2000 and S.I. No. 538 of 2001, S.I. 134 of 2013 and the Minerals Development Act 2017), the Planning and Development Act, and S.I. 600 of 2001 Planning and Development Regulations and subsequent Amendments. These instruments implement EU Directive 85/337/EEC and subsequent amendments, on the assessment of the effects of certain public and private projects on the environment;
- Directives 2011/92/EU and 2014/52/EU on the assessment of the effects of certain public and private projects on the environment, including Circular Letter PL 1/2017: Implementation of Directive 2014/52/EU on the effects of certain public and private projects on the environment (EIA Directive);
- Planning and Development Act, 2000, as amended;
- S.I. No 296 of 2018: European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 which transposes the provisions of Directive 2014/52/EU into Irish law;
- S.I. No. 94 of 1997: European Communities (Natural Habitats) Regulations, resulting from EU Directives 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) and 79/409/EEC on the conservation of wild birds (the Birds Directive);
- S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations, resulting from EU Directive 78/659/EEC on the Quality of Fresh Waters Needing Protection or Improvement in order to Support Fish Life;
- S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy) and S.I. No. 722 of 2003 European Communities (Water Policy) Regulations which implement EU Water Framework Directive (2000/60/EC) establishing a framework for the Community action in the field of water policy and provide for implementation of 'daughter' Groundwater Directive (2006/118/EC) on the protection of groundwater against pollution and deterioration. Since

2000 water management in the EU has been directed by the Water Framework Directive (2000/60/EC) (as amended by Decision No. 2455/2011/EC; Directive 2008/32/EC; Directive 2008/105/EC; Directive 2009/31/EC; Directive 2013/39/EU; Council Directive 2013/64/EU; and Commission Directive 2014/101/EU ("**WFD**"). The WFD was given legal effect in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003);

- S.I. No. 684 of 2007: Waste Water Discharge (Authorisation) Regulations 2017, resulting from EU Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances (the Groundwater Directive);S.I. No. 106 of 2007: European Communities (Drinking Water) Regulations 2007and S.I. No. 122 of 2014: European Communities (Drinking Water) Regulations 2014, arising from EU Directive 98/83/EC on the quality of water intended for human consumption (the "Drinking Water Directive") and EU Directive 2000/60/EC;
- S.I. No. 349 of 1989: European Communities (Environmental Impact Assessment) Regulations, and subsequent Amendments (S.I. No. 84 of 1995, S.I. No. 352 of 1998, S.I. No. 93 of 1999, S.I. No. 450 of 2000 and S.I. No. 538 of 2001), S.I. No. 30 of 2000, the Planning and Development Act, and S.I. 600 of 2001 Planning and Development Regulations and subsequent Amendments. These instruments implement EU Directive 85/337/EEC (EIA Directive) and subsequent amendments, on the assessment of the effects of certain public and private projects on the environment;
- S.I. No. 9 of 2010: European Communities Environmental Objectives (Groundwater) Regulations 2010 (as amended by S.I. No. 389/2011; S.I. No. 149/2012; S.I. No. 366/2016; the Radiological Protection (Miscellaneous Provisions) Act 2014; and S.I. No. 366/2016); and,
- S.I. No. 296 of 2009: The European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 (as amended by S.I. No. 355 of 2018).

8.1.5 Relevant Guidance

The Hydrology and Hydrogeology chapter of the EIAR is carried out in accordance with guidance contained in the following:

- Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU);
- Environmental Protection Agency (May 2022): Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;
- National Roads Authority (2008): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Inland Fisheries Ireland (2016): Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters;
- PPG1 - General Guide to Prevention of Pollution (UK Guidance Note);
- PPG5 – Works or Maintenance in or Near Watercourses (UK Guidance Note);
- CIRIA (Construction Industry Research and Information Association) (2006): Guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006);
- CIRIA 2006: Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors (CIRIA C532, 2006).
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (DoHPLG, 2018);
- Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU), (European Union, 2017);
- Department of the Environment, Heritage and Local Government; Quarries and Ancillary Activities – Guidance for Authorities (April, 2014); and,
- Environmental Protection Agency (2006): Environmental Management in the Extractive Industry (Non-Scheduled Minerals).

8.2 Methodology

8.2.1 Desk Study

A desk study of the Proposed Development site and receiving water environment (described below) was completed prior to the undertaking of field mapping, site investigations and walkover assessments. The desk study involved collecting all relevant geological, hydrological, hydrogeological and meteorological data for the area. This included consultation of the following:

- Environmental Protection Agency databases (www.epa.ie);
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks and Wildlife Services Public Map Viewer (www.npws.ie);
- EPA/Water Framework Directive Map Viewer (www.catchments.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 14 (Geology of Galway Bay). Geological Survey of Ireland (GSI, 2004);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 12 (Geology of Longford/Roscommon). Geological Survey of Ireland (GSI, 2003);
- Geological Survey of Ireland (2003) – Clare - Corrib Groundwater Body Initial Characterization Reports;
- OPW Past Flood Event mapping (www.floodinfo.ie);
- OPW Flood Maps (www.floodinfo.ie/map/floodmaps);
- Envirologic (2020) Hydrogeological Assessment & Flood Risk Assessment; and,
- Remedial EIS for Quarry at Shanvally (October 2013).

8.2.2 Baseline Monitoring and Site Investigations

Site walkovers, hydrological investigations and baseline monitoring was undertaken by David Broderick of HES on 19th and 20th May, 28th June, 24th October 2022 and 6th June 2023.

Investigations to address the Hydrology and Hydrogeology chapter of the EIAR included the following:

- Walkover surveys and hydrological mapping of the Proposed Development site and the surrounding area were undertaken whereby surface water flow directions and drainage patterns were recorded;
- Trial pit investigation (5 no. locations) to assess overburden lithology and quality/quantity of extractable material;
- Investigation drilling (4 no.) to determine the full geological profile at the Proposed Development site as well as establishment of a groundwater monitoring network;
- Continuous groundwater level monitoring by means of in-situ dataloggers between June 2022 to June 2023;
- Baseline groundwater sampling for laboratory analysis was completed in 2 no. onsite boreholes on 8th June 2023;
- 3 no. rounds of baseline surface water sampling for laboratory analysis were completed at 1 no. monitoring location (22nd June 2021, 7th April 2022 and 9th June 2023); and,
- Field hydrochemistry measurements (electrical conductivity, pH and temperature) were taken to characterise the origin and nature of groundwater and surface water flows.

8.2.3 Impact Assessment Methodology

Table 1-1 of the EIAR presents the glossary of impacts as published in EPA guidance documents for the completion of Environmental Impact Assessment Reports (EIAR) where standard definitions are

provided in this glossary, which permit the evaluation and classification of the quality, significance, duration and type of impacts associated with a proposed development on the receiving environment.

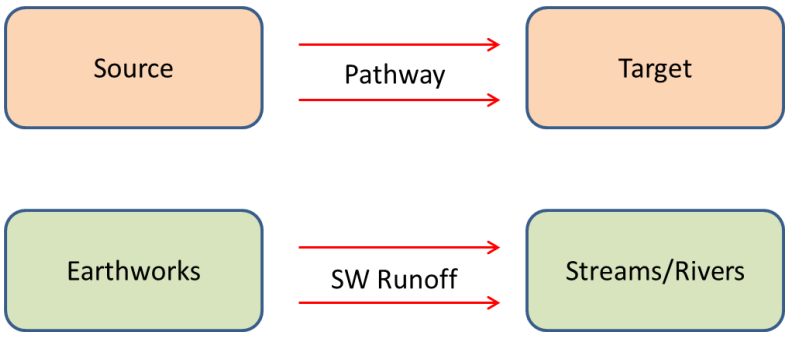
In addition to the above methodology, the sensitivity of the water environment receptors was assessed on completion of the desk study and baseline study. Levels of sensitivity which are defined in **Table 8-2** are used to assess the potential effect that the proposed development may have on them.

Table 8-2: Receptor Sensitivity Criteria (Adapted from www.sepa.org.uk)

Sensitivity of Receptor	
Not sensitive	Receptor is of low environmental importance (e.g. surface water quality classified by EPA as A3 waters or seriously polluted), fish sporadically present or restricted). Heavily engineered or artificially modified and may dry up during summer months. Environmental equilibrium is stable and is resilient to changes which are considerably greater than natural fluctuations, without detriment to its present character. No abstractions for public or private water supplies. GSI groundwater vulnerability "Low" – "Medium" classification and "Poor" aquifer importance.
Sensitive	Receptor is of medium environmental importance or of regional value. Surface water quality classified by EPA as A2. Salmonid species may be present and may be locally important for fisheries. Abstractions for private water supplies. Environmental equilibrium copes well with all natural fluctuations but cannot absorb some changes greater than this without altering part of its present character. GSI groundwater vulnerability "High" classification and "Locally" important aquifer.
Very sensitive	Receptor is of high environmental importance or of national or international value i.e. NHA or SAC. Surface water quality classified by EPA as A1 and salmonid spawning grounds present. Abstractions for public drinking water supply. GSI groundwater vulnerability "Extreme" classification and "Regionally" important aquifer

8.2.4 Overview of Impact Assessment Process

The conventional source-pathway-target model (see below, top) was applied to assess potential impacts on downstream environmental receptors (see below, bottom as an example) as a result of the Proposed Development.



Where potential effects are identified, the classification of effects in the assessment follows the descriptors provided in the Glossary of Impacts contained in the following guidance documents produced by the Environmental Protection Agency (EPA):

- Environmental Protection Agency (May 2022): Guidelines on the Information to be Contained in Environmental Impact Assessment Reports.

The description process clearly and consistently identifies the key aspects of any potential impact source, namely its character, magnitude, duration, likelihood and whether it is of a direct or indirect nature.

In order to provide an understanding of the stepwise impact assessment process applied below (Section 8.5), a summary guide is presented below, which defines the steps (Steps 1 to 7) taken in each element of the impact assessment process. The guide also provides definitions and descriptions of the assessment process and shows how the source-pathway-target model and the EPA impact descriptors are combined.

Using this defined approach, this impact assessment process is then applied to all construction and operation and restoration activities which have the potential to generate a source of significant adverse impact on the geological and hydrological/ hydrogeological (including water quality) environments.

Table 8-3: Impact Assessment Process Steps

Step 1	Identification and Description of Potential Impact Source This section presents and describes the activity that brings about the potential impact or the potential source of pollution. The significance of effects is briefly described.	
Step 2	Pathway / Mechanism:	The route by which a potential source of impact can transfer or migrate to an identified receptor. In terms of this type of development, surface water and groundwater flows are the primary pathways, or for example, excavation or soil erosion are physical mechanisms by which potential impacts are generated.
Step 3	Receptor:	A receptor is a part of the natural environment which could potentially be impacted upon, e.g. human health, plant / animal species, aquatic habitats, soils/geology, water resources, water sources. The potential impact can only arise as a result of a source and pathway being present.
Step 4	Pre-mitigation Impact:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impact before mitigation is put in place.
Step 5	Proposed Mitigation Measures:	Control measures that will be put in place to prevent or reduce all identified significant adverse impacts. In relation to this type of development, these measures are generally provided in two types: (1) mitigation by avoidance, and (2) mitigation by (engineering) design.
Step 6	Post-Mitigation Residual Impact:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impacts after mitigation is put in place.
Step 7	Significance of Effects:	Describes the likely significant post-mitigation effects of the identified potential impact source on the receiving environment.

8.2.5 Limitations and Difficulties Encountered

No limitations or difficulties were encountered during the preparation of the Hydrology and Hydrogeology Chapter of the EIAR.

8.3 Receiving Environment

8.3.1 Site Description and Topography

The Proposed Development site is located approximately 8.6km to the north-east of Tuam and approximately 7km to the south-east of Dunmore in Co. Galway. The village of Clonberne is located approximately 4.7km to the east. The Proposed Development site, which is a greenfield site comprising several fields separated by hedgerows or stone walls, is ~6.2ha in area.

The Proposed Development site has an elevation range of between approximately 96 metres above Ordanance Datum (mOD) and 84mOD. Highest elevations are found near the western boundary with the land sloping to the east, towards the L2232 local road which defines the eastern boundary. The Proposed Development site is bounded by grassland on all other sides. The local surrounding area, including the Proposed Development site itself has an undulating topography.

The Proposed Development site is currently accessed directly off the L2232 road via an existing entrance. It is proposed to install a new access point slightly further north of the existing access spont as part of the site enabling works. This is outlined further in Chapter 4 of the EIAR. A disused sand and gravel pit is

located on the opposite side of the L2232 road immediately to the east. There is an active quarry located at Shanvally 0.8km to the southwest of the Proposed Development site.

8.3.2 Water Balance

Long term rainfall and evaporation data was sourced from Met Éireann. The 30-year annual average rainfall recorded at the closet rainfall station to the site, Glenamaddy (Gortnagier) rainfall station, located approximately 11.5km northeast of the Proposed Development site are presented in **Table 8-4.**

Table 8-4 Local Average long-term Rainfall Data (mm)

Station		X-Coord		Y-Coord		Ht (MAOD)		Year Start		Year End		
Glenamaddy (Gortnagier)		162900		261600		84		1944		N/A		
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
108	72	87	62	72	71	65	93	95	114	109	110	1058

The closest synoptic[1] station where the average potential evapotranspiration (PE) is recorded is at Claremorris, approximately 25km northwest of the Proposed Development site. The long-term average PE for this station is 407mm/yr. This value is used as a best estimate of the site PE. Actual Evaporation (AE) at the site is estimated as 387mm/year (which is 0.95 × PE).

The effective rainfall (ER) represents the water available for runoff and groundwater recharge. The ER for the site is calculated as follows:

$$\text{Effective rainfall (ER)} = \text{AAR} - \text{AE}$$

$$= 1{,}058 \text{ mm/year} - 387\text{mm/year}$$

$$\text{ER} = 671\text{mm/year}$$

The GSI groundwater recharge coefficient estimate (www.gsi.ie) for the Proposed Development site is 85% ("*Sand and gravels aquifer overlain by well drained soil*"). Based on this estimate the average annual recharge rate and surface water runoff rates for the Proposed Development site is 570mm/year and 101mm/year respectively. This means that the hydrology of the Proposed Development site is characterised by high groundwater recharge rates and low rates of surface water runoff.

Based on the Proposed Development area of 6.2ha, the estimated groundwater recharge and runoff volumes for the site are 35,340m^3/year and 6,262m^3/year.

In addition to average rainfall data, extreme value rainfall depths are available from Met Eireann. **Table 8-5,** below presents return period rainfall depths for the area of the Proposed Development site. These data are taken from https://www.met.ie/climate/services/rainfall-return-periods and they provide rainfall depths for various storm durations and sample return periods (1-year, 5-year, 30-year, 100-year).

[1] Meteorological station at which observations are made for synoptic meteorology and at the standard synoptic hours of 00:00, 06:00, 12:00, and 18:00.

Table 8-5: Return Period Rainfall Depths (mm) for the Proposed Site

	Return Period (Years)			
Duration	**1**	**5**	**30**	**100**
5 mins	3.6	6.1	10.6	14.9
15 mins	5.8	10.0	17.3	24.4
30 mins	7.6	12.8	21.7	30.2
1 hours	9.9	16.3	27.2	37.3
6 hours	19.7	30.8	48.7	64.6
12 hours	25.7	39.3	60.9	79.9
24 hours	33.5	50.3	76.3	98.9
2 days	42.1	60.4	87.6	110.3

8.3.3 Regional and Local Hydrology

In terms of regional hydrology, the Proposed Development site is located in the Lough Corrib (Corrib_030) surface water catchment within Hydrometric Area 30 of the Western River Basin District (WRBD). A regional hydrology map is shown as **Figure 8-1**.

Locally, the Proposed Development site is located in the River Clare sub-catchment (2 no. WFD sub-catchments: Clare[Galway]_SC_040 and Clare[Galway]_SC_030). The River Clare is located approximately 23km downstream (southwest) of the Proposed Development site, via the Grange River. The downstream distance to Lough Corrib in the River Clare sub-catchment is approximately 50km.

The area of the Proposed Development site drains to the east towards the Levally Stream which is tributary of the Grange River. The Levally Stream flows in a southerly direction approximately 0.7km to the east of the Proposed Development site. Levally Lough is located 2.7km to the south of the Proposed Development site. There is no surface water connection between Levally Lough and the Proposed Development site.

The northwestern corner of the site is mapped within the Nanny (Tuam)_010 river sub basin, with the Nanny stream located ~2.4km to the southwest. However site walkover surveys and drainage mapping has shown that the mapping of the WFD river sub-basins in this area is inaccurate. All potential surface water from the Proposed Development site will flow to the east towards the Levally Stream due to the local topography. A local hydrology map is shown as **Figure 8-2.**

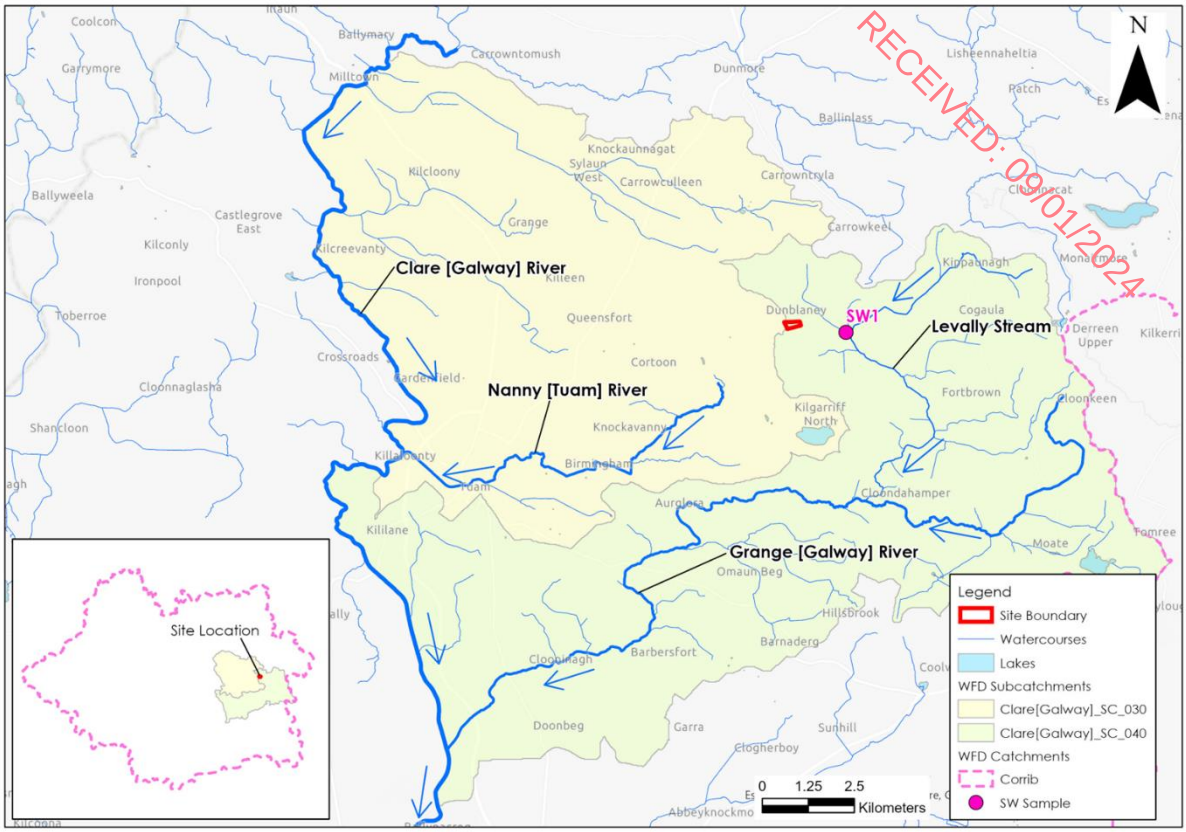


Figure 8-1: Regional Hydrology Map

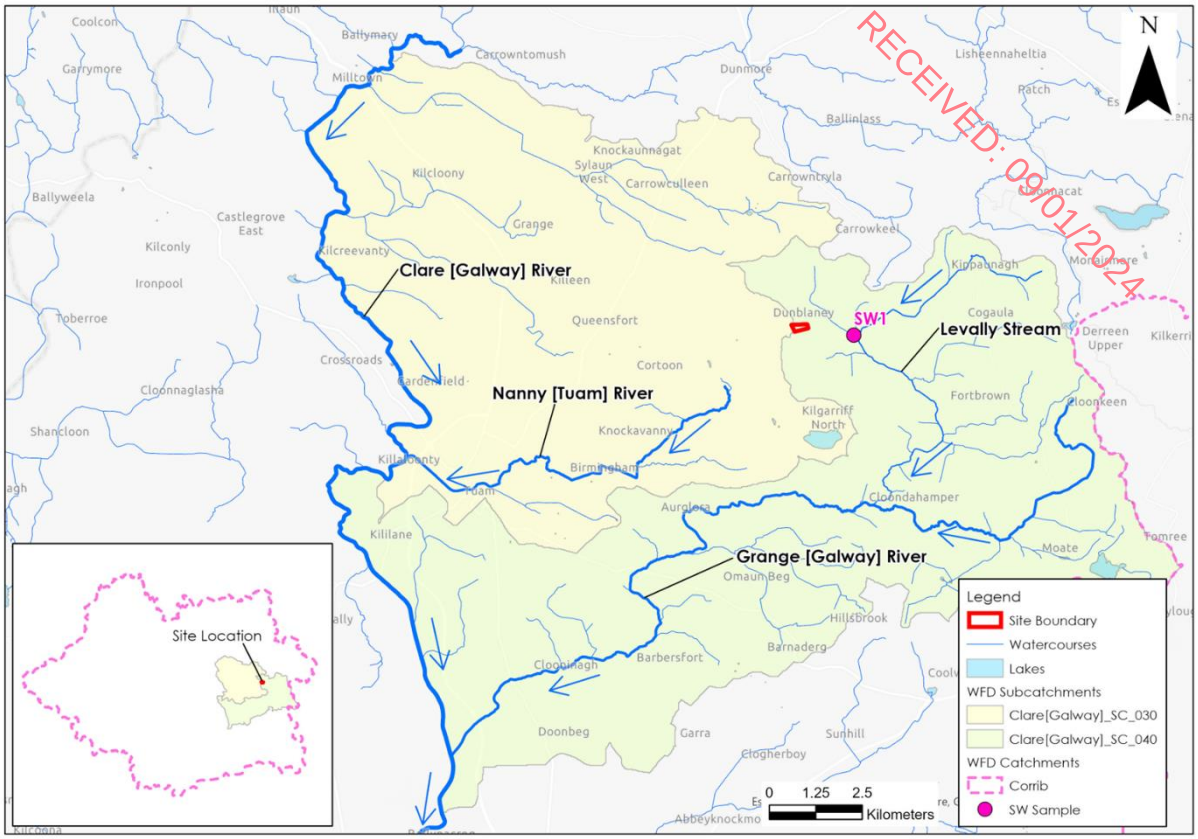


Figure 8-2: Local Hydrology Map

8.3.4 Proposed Development Site Drainage

There are no natural or manmade surface water features within the Proposed Development site. All rainfall/runoff infiltrates to ground. The site is underlain by freely draining sand and gravel deposits. The Proposed Development site does not drain to the Levally Stream via surface water flow paths. All drainage from the proposed site to the Levally Stream is via recharge and groundwater flow (see Section 8.3.9 below).

8.3.5 Flood Risk Assessment

OPW's River Flood Extents Mapping, National Indicative Fluvial Mapping, Past Flood Event mapping (https://www.floodinfo.ie/map/floodmaps/), historical mapping (i.e. 6" & 25" base maps) and GSI Groundwater/Surface Water Flood Maps were consulted to identify those areas of the Proposed Development as being at risk of fluvial, pluvial and surface water flooding.

No recurring flood incidents within the Proposed Development site boundary were identified from OPW's Past Flood Event Mapping (Refer to **Figure 8-3).**

The closest mapped recurring flood event is at the location of Gortagarraun Turlough, 1.3km to the northeast of the Proposed Development site where "*low lying land floods after heavy rain every year*". The flooding is caused by rising groundwater levels over the winter period.

There are no mapped recurring fluvial flood events downstream of the site along the Levally Stream within 10km of the Proposed Development site.

The GSI's Winter 2015/2016 Surface Water Flood Map shows surface water flood extents for this winter flood event. The flood event is recognised as being the largest flood event on record in many areas. This flood map does not record any flood zones in the area of the Proposed Development site.

Identifiable map text on local available historical 6" or 25" mapping for the Proposed Development site area do not identify any lands that are "liable to flood".

There is no CFRAM River Flood Extents Mapping available for the area of the Proposed Development site. The closest CFRAM flood mapping is located in the vicinity of Tuam.

The National Indicative Fluvial Mapping (NIFM) for the Present Day Scenario was consulted which has estimated the 100-year and 1000-year fluvial flood zones for the Levally Stream. As seen in **Figure 8-4** the Proposed Development site is outside the 100-year (medium probability) and 1,000-year (low probability) fluvial flood zones. The nearest flood zones mapped 0.7km to the east of the Proposed Development site along the Levally Stream. The Proposed Development site is therefore located in Flood Zone C (Low Risk).

The site is not susceptible to pluvial flooding (surface water ponding) due to the permeable nature of the soils and subsoils and no such pluvial flood zones are mapped within the Proposed Development site or in the surrounding lands.

Furthermore, the Proposed Development site is not mapped within any historic or modelled groundwater flood zone. The GSI Maximum Historic Groundwater Flood Map, produced based on flood extents for the 2015/2016 winter flood event, does not record any groundwater flood zones within the Proposed Development site. However, several historic groundwater flood zones are located in the surrounding lands, the closest being mapped ~270m to the southeast in the townland of Lomaunaghroe. The closest mapped groundwater flooding probability flood zone is located ~2km northwest of the Proposed Development site. Groundwater flood zones are also mapped by the GSI around Levally Lough, ~2.7km to the south.

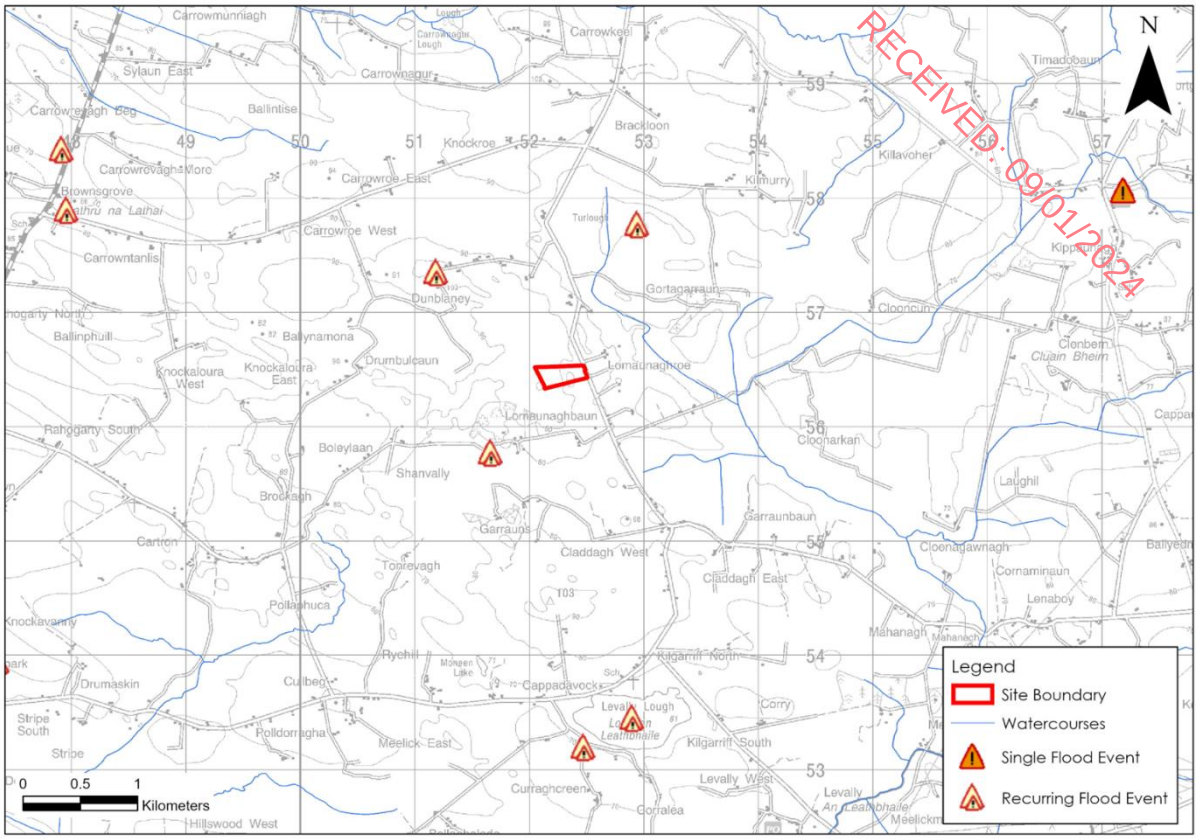


Figure 8-3: OPW Past Flood Event Mapping

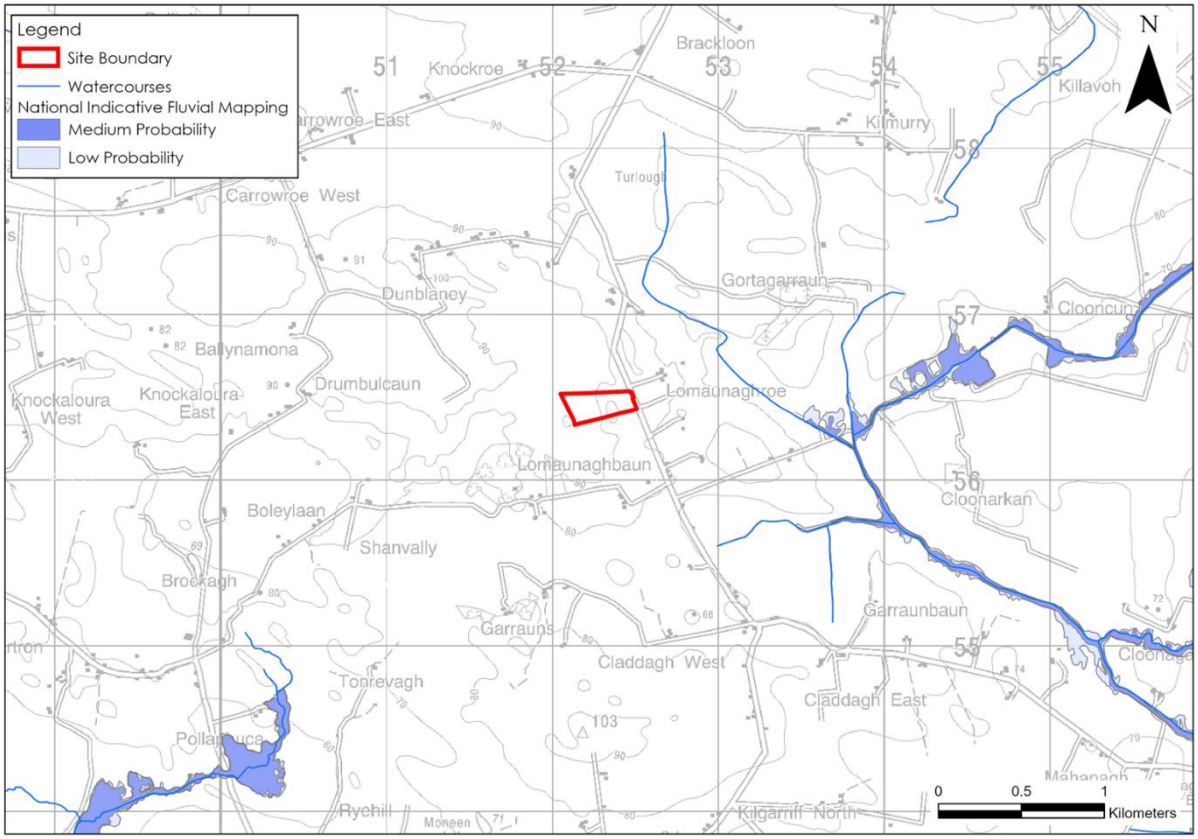


Figure 8-4: National Indicative Fluvial Mapping

8.3.6 Surface Water Quality

Biological Q-rating[2] data for EPA monitoring points in the local catchments downstream of the Proposed Development site are shown in **Table 8-6** below. The Q-Rating is a water quality rating system based on both the habitat and the invertebrate community assessment and is divided into status categories ranging from Q1 (Bad) to 4-5 (High).

EPA Q-rating data[3] (https://www.catchments.ie/data) is available for the Levally Stream, Grange River and Clare (Galway) River downstream of the Proposed Development site. Most recent data (2021) show that the downstream EPA monitoring point on the watercourses downstream of the Proposed Development site have a Q4 rating (i.e. Good Status).

Table 8-6: EPA Water Quality Monitoring Q-Rating Values

Waterbody	Station ID	Easting	Northing	EPA Q-Rating (Status)
Levally Stream	RS30L070100	154648	252475	Q4 (Good)
Grange River	RS30G020400	148003	249913	Q4 (Good)
Grange River	Rs30G020500	147706	247623	Q4 (Good)
Clare (Galway) River	RS30C010800	142639	243390	Q4 (Good)

Surface water sampling and field hydrochemistry (measurements of electrical conductivity (µS/cm), pH (pH units) and dissolved oxygen (%) were taken from the Levally Stream at 1 no. location (SW1) downstream of the Proposed Development site on 22nd June 2021, 7th April 2022 and 9th June 2023 (refer to **Figure 8-2** for the monitoring location). Field hydrochemistry results as shown in **Table 8-7** below.

Electrical conductivity values for the local streams ranged between 620µS/cm and 650µS/cm which would be typical of streams in a catchment underlain pure bedded limestones. pH values which were all slightly basic ranged from 7.3 to 7.5 which is typical for this area.

Dissolved oxygen saturation ranged between 98% and 103%. The dissolved oxygen levels would be normal for a Good or High Status watercourse and exceed the required dissolved lower limit of 80% (Surface Water Regulations S.I. No. 272/2009).

Table 8-7: SW1 Field Hydrochemistry

Field Parameter	Sample Location SW1		
	22/06/2021	07/04/2022	09/06/2023
EC (µS/cm)	650	627	620
pH (pH Units)	7.5	7.5	7.3

2 The Q-Rating scheme method is used whereby a Quality-index is assigned to a river or stream based on macroinvertebrate data.

3 Q values (Q1-Q5) are a classification system given to waterbodies, determined by the EPA, which relate to their biotic and chemical condition. A high value (Q4-5) indicates a high status, unpolluted waterbody.

Dissolved Oxygen %	98	102	103

Surface water grab samples were also taken from the Levally Stream (SW1) on 22nd June 2021, 7th April 2022 and 9th June 2023. Results of laboratory analysis are show in **Table 8-8** below alongside relevant Environmental Quality Standards (EQS) values for surface water. The original laboratory reports are attached as **Appendix 8-1.**

Table 8-8: SW1 Sample Results for the Levally Stream

Parameter	EQS	Sample Date		
		22/06/2021	07/04/2022	09/06/2023
Total Suspended Solids (mg/L)	25(+)	<5	<5	6
Ammonia (mg/L)	Good Status: ≤0.065 High Status ≤ 0.04(*)	0.03	0.03	0.06
Nitrite NO_2 (mg/L)	-	<0.05	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	Good Status ≤ 0.035 to High Status: ≤0.025(*)	0.03	<0.02	<0.02
Nitrate - NO_3 (mg/L)	-	6	10	<5
Phosphorus (mg/L)	-	<0.10	<0.10	<0.10
Chloride (mg/L)	-	15.9	18.2	15
BOD	Good Status: ≤ 1.5 High Status: ≤ 1.3(*)	<1	<5	3

(+) S.I. No. 293 of 1988: Quality of Salmon Water Regulations.
(*) S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009.

Total suspended solids ranged between <5mg/L and 6mg/L for the three sampling rounds which is below the 25mg/l standard set out in S.I. 293/1988.

The concentrations of nitrate, nitrite, phosphorus and orthophosphate were generally low with all the results for nitrite and phosphorus below the laboratory detection limit (<0.05mg/L and 0.1mg/L respectively).

For ammonia, 2 no. of the 3 no. samples were below the "High Status" threshold of ≤0.04mg/L. Meanwhile, 1 no. sample exceeded the "High Status" threshold and was below the "Good Status" threshold of ≤0.04mg/L with respect the Surface Water Regulations (S.I. 272/2009).

Orthophosphate was reported as <0.02mg/L in 2 no. samples which is below the "High Status" threshold of ≤0.025. Meanwhile, 1 no. sample exceeded the "High Status" threshold and was found to be below the "Good Status" threshold of ≤0.035mg/L with respect the Surface Water Regulations (S.I. 272/2009).

Biological Oxygen Demand (BOD) was reported as between <1 and <5mg/L over the 3 no. sampling rounds which confirms 1 no. sample below the "High Status" and 1 no. sample exceeding both the "High Status" and "Good Status" thresholds.

8.3.7 Regional and Local Hydrogeology

The Proposed Development Site is underlain by Dinantian Pure Bedded Limestones of the Burren Formation. The underlying bedrock is classified as being a Regionally Important Aquifer – Karstified (conduit). The sand and gravels are mapped as Locally Important. An aquifer map is shown as **Figure 8-5.**

The Proposed Development site is located in the Clare-Corrib Groundwater Body (GWB) which has a mapped area of 1,344km^2. The bedrock type of the Clare-Corrib GWB is predominantly Dinantian Pure Bedded Limestone which also underlies the Proposed Development site.

According to the GSI's Initial GWB Characterisation Report (GSI, 2004). these pure limestone rocks are generally devoid of intergranular permeability. Groundwater flows through fissures, faults, joints and bedding planes. In pure bedded limestones these openings are enlarged by karstification, which significantly enhances the permeability of the rock. Karstification can be accentuated along structural features such as fold axes and faults. Groundwater flow directions through karst areas can be very variable due to the heterogenous nature of karstification/weathering within a rock that is otherwise devoid of groundwater. Groundwater flows through a network of solutional enlarged bedding planes, fissures and conduits. Overall, groundwater flow directions within the GWB are expected to be to the southwest, with all groundwater discharging to Lough Corrib (GSI, 2004). However, karstified aquifers can have variability in flow patterns.

Both point recharge and diffuse recharge occur in this GWB. Diffuse recharge occurs over the GWB via rainfall percolating through the permeable subsoil. In areas of peat and low permeability till, recharge to the underlying aquifer is limited to point recharge such as swallow holes, collapse features/dolines and losing streams.

There are 2 no. mapped groundwater Source Protection Areas (SPA's) within ~5km of the Proposed Development site (i.e. Gurteen/Cloonmore GWS and Gallagh GWS) and all have karst spring sources. Refer further below to **Figure 8-10**.

The mapped SPA's are based on estimated groundwater Zones of Contributions (ZoCs) for each source and the overall alignment of the individual ZoCs suggest some variability in groundwater flow directions in the local area of the Proposed Development.

The Proposed Development is mapped inside the northern fringes of the Gallagh GWS SPA. The location of the karst spring source (3.5km to the southwest of the site) suggests a south-westerly groundwater flow direction.

The down-gradient extent of the Gurteen/Cloonmore GWS SPA is located 1.5km to the east of the Proposed Development site where a karst spring is located at Gortagarraun townland. The Proposed Development is not located inside the Gurteen/Cloonmore GWS SPA.

The Proposed Development site and Gurteen/Cloonmore GWS SPA spring source are separated by the Levally Stream. The orientation of the ZoC suggests a general westerly groundwater flow direction towards the Levally Stream. The Gallagh GWS and Gurteen/Cloonmore GWS are discussed further in Section 8.3.16 below.

Its also worth noting that surface water drainage pattern of the Levally Stream and its tributaries in the area of the Proposed Development is southerly. The hydrochemistry of the surface water (high electrical conductivity) suggests that there is a large groundwater component to the flow in the tributaries of the Levally Stream which drains the local area. This suggests there is groundwater discharge (baseflow) from the underlying bedrock aquifer to the streams/rivers which drain the Proposed Development site and therefore surface water flows patterns are likely to influence groundwater flow patterns.

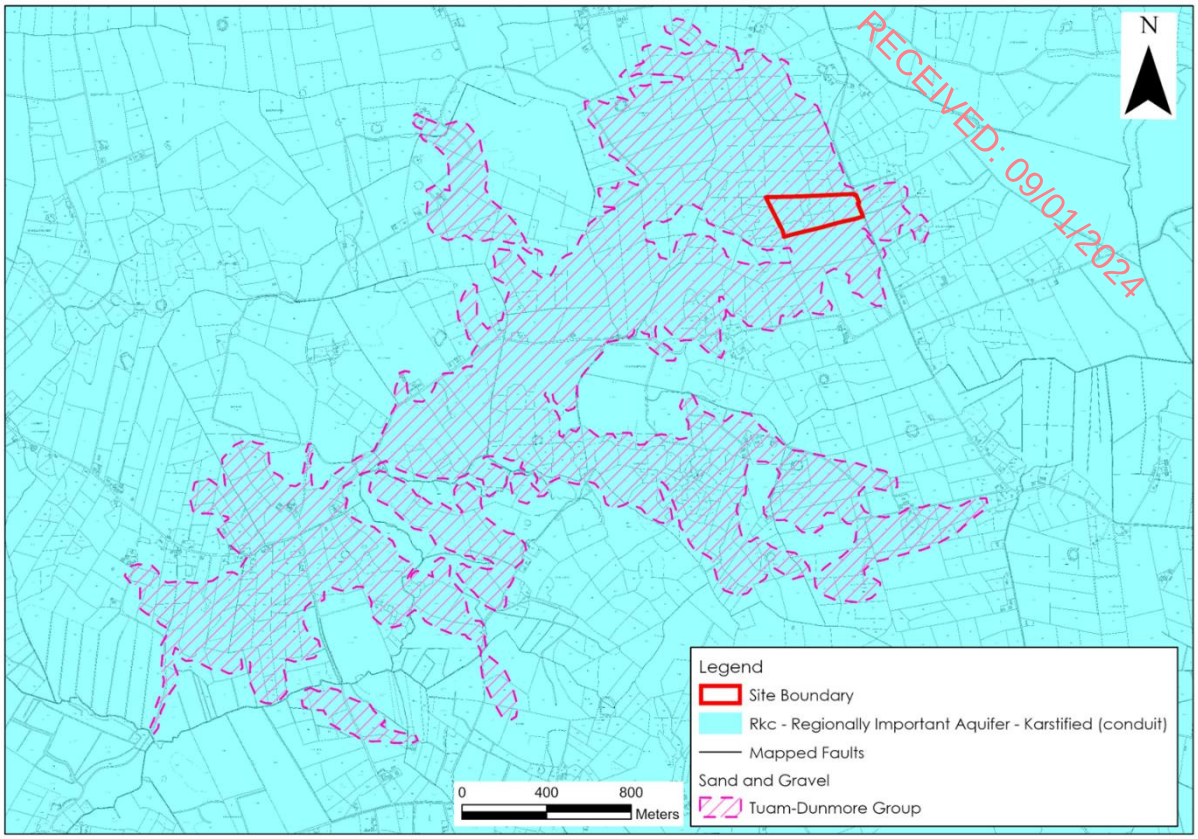


Figure 8-5: GSI aquifer map

8.3.8 Karst Features

Karst features are mapped by the GSI and available through the GSI online viewer (www.gsi.ie). The GSI karst database does not record the presence of any karst features within the Proposed Development.

However several karst features are mapped in the lands surrounding the Proposed Development site. The closest mapped feature is an enclosed depression, located 0.43km to the northwest. 2 no additional enclosed depressions are also located further to the northwest in the townland of Dunblaney. Another enclosed depression is mapped ~0.44km west of the Proposed Development site. Several depressions are also recorded in the wider area.

The closest mapped turlough is Gortagarraun Turlough, located 1.3km to the northeast of the Proposed Development Site. Levally Lough, ~2.7km to the south, is also mapped as a turlough.

Several springs are also mapped in the wider area. The closest mapped spring is ~1.54km to the northeast. This spring is the source of the Gurteeen Cloonmore Group Water Scheme (GWS). 3 no. additional springs are located to the southeast of the Proposed Development site, the closest being ~1.6km from the site boundary.

Despite the mapping of several karst features within the surrounding lands, no features were recorded within the Proposed Development site during the walkover surveys. Furthermore, as discussed below in Section 8.3.9, the limestone encountered during the site investigations was predominantly strong and there was no evidence of significant karstification of the underlying bedrock.

8.3.9 Site Hydrogeology

Site investigations carried out at the Proposed Development site (refer to the Land, Soils and Geology Chapter 7) show that between 1.4 and 6.1m of predominantly sand and gravel deposits overly overlie limestone bedrock. The deepest confirmed sand and gravel deposits (6.1m) are located on the lower lying eastern side of the Proposed Development site. Refer to **Figure 8-6** for borehole locations.

Investigation drilling at the Proposed Development site encountered limestone bedrock in all boreholes at depths varying from 1.1 (BH2) 6.1mbgl (BH1). Bedrock in the east of the site (BH1) was encountered at 76.84m OD while on the elevated western side of the site (BH3) it was met at 90.8m OD. Towards the centre of the Proposed Development site (BH2 & BH4) the top of rocks stands at an elevation of approximately 86.5m OD.

The limestone encountered during the drilling was noted to be strong to very strong with only rare to occasional fractures. Fractures were generally small with the exception of a very weathered section between 30 – 30.5mbgl in BH2 where clay in filling was noted. Overall, the bedrock below the Proposed Development shows very little karstification.

Continuous groundwater level monitoring was carried out in 2 no. of the boreholes (BH1 and BH3) between June 2022 and June 2023. BH1 and BH3 are positioned at the lowest (east) and highest (west) part of the Proposed Development site respectively. Additional manual dip measurements were carried out in all 4 no. boreholes during this period and the levels are shown in **Table 8-9** below.

Summary data of the continuous groundwater level monitoring in BH1 and BH3 are shown in **Table 8-10** below and groundwater level plots are shown in **Figure 8-7** below.

Table 8-9: Manual Groundwater Level Measurements

BH ID	G.L (m OD)	Top of Bedrock (m OD)	28/06/2022		24/10/2022		08/06/2023	
			mbgl	m OD	mbgl	mOD	mbgl	m OD
BH1	82.964	76.846	7.896	75.05	5.146	77.8	9.366	73.580
BH2	87.963	86.836	10.87	77.093	5.310	82.653	10.60	77.363
BH3	92.591	90.791	14.039	78.552	7.539	85.052	12.892	79.762
BH4	88.199	86.599	10.764	77.453	4.886	83.313	10.036	78.163

Table 8-10: Summary of Continuous Groundwater Level Monitoring

BH ID	G.L (m OD)	Top of Bedrock (m OD)	Minimum WL		Maximum WL	
			mbgl	m OD	mbgl	mOD
BH1	82.964	76.846	10.496	72.441	4.098	78.848
BH3	92.591	90.791	15.501	77.681	6.483	86.70

Figure 8-6: BH Locations

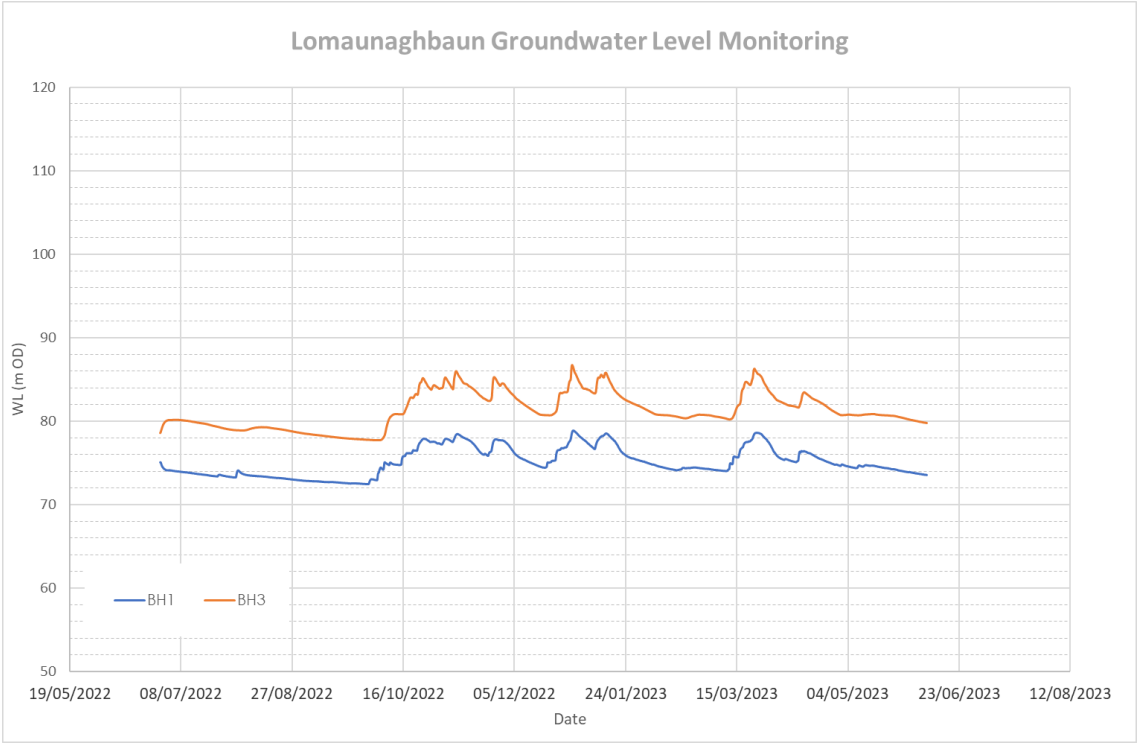


Figure 8-7: Groundwater Level Monitoring

The highest groundwater levels were recorded on the west of the Proposed Development site (BH3) and the lowest on the east of the site (BH1). This is consistent with the local topography which slopes from west to east towards the Levally Stream and indicates the groundwater flow direction is also in an easterly direction.

Across the Proposed Development site, there is a groundwater level difference of approximately 5m in summer and 8m in winter. The seasonal groundwater level variation across the site is between 6 and 9m.

With the exception of the deepest sand and gravels on the east of the site, the deposits across the rest of the site are unsaturated all year round. Monitoring data for BH1 on the east of the site shows that the groundwater rises approximately 2m above the top of bedrock during the winter period. The maximum groundwater level elevation recorded in BH1 was 78.848m OD which is a level of 4.1mbgl (4.1m of unsaturated deposits).

The opposing groundwater flow patterns locally (i.e. easterly towards the Levally Stream at the Proposed Development site and westerly towards the Gurteen/Cloonmore GWS SPA spring) suggests that the Levally Stream is a groundwater discharge zone for the underly limestone aquifer in this area. The Levally Stream follows a prominent valley to the east of the Proposed Development site and may suggest the presence of a north-south trending geological feature such as a fault or other structural feature.

Given the very competent nature of the limestone below the Proposed Development site, groundwater flowpaths between the Proposed Development site and the Levally Stream are likely to be mainly along the top of bedrock (i.e. bedrock / subsoil interface) rather than rapid flow via solutional enlarged bedding planes, fissures and conduits.

There are published reports available regarding other permitted and proposed quarries in the local area that give insight into local groundwater flow patterns.

Investigations carried out by Envirologic (2022) with regard a proposed sand and gravel pit (Planning Ref 20/1447) at Dunblaney, located approximately 0.8km to the northwest of the Proposed Development site, show a westerly groundwater gradient at that location. The Envirologic report is attached as **Appendix 8-4**.

A remedial EIS for an existing quarry at Shanvally (October 2013), located 0.8km to the southwest, determined the groundwater flow direction to be southerly at that location.

The easterly groundwater flow direction at the Proposed Development site, the westerly direction in the area of at Dunblaney townland and southerly direction at Shanvally, indicates the presence of a groundwater divide immediately to the west of the Proposed Development site location. The groundwater divide therefore appears to align with topography and a surface water sub-catchment divide which runs immediately to the west of the Proposed Development site.

8.3.10 Groundwater Vulnerability

Groundwater vulnerability is a term used to represent the natural ground characteristic that determine the ease with which groundwater may be contaminated by surface activities (refer to **Figure 8-8** below).

Based on the GSI groundwater vulnerability online mapping (www.gsi.ie), the Proposed Development site is mapped as having “High” groundwater vulnerability. The groundwater vulnerability rating assumes high permeability for the subsoils which is consistent with sand and gravels encountered during the site investigations. During the recent site investigations, the depth of sand and gravels was found to be mainly less than 3m with the exception of the lower lying eastern portion of the site which had ~6m of overburden.

Therefore, based on the investigation data, the vulnerability rating for the Proposed Development site varies from “High” in the east where the overburden sands and gravels are thickest to “Extreme” vulnerability over the rest of the Proposed Development site.

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

Notes: (1) N/A = not applicable.
(2) Precise permeability values cannot be given at present.
(3) Release point of contaminants is assumed to be 1-2 m below ground surface.

Figure 8-8: GSI Groundwater Vulnerability Rating Criteria

8.3.11 Groundwater Hydrochemistry

Groundwater sampling of BH1 and BH3 was carried out by HES on 8th June 2023. In terms of groundwater flow direction, BH1 is at a down-gradient location and BH3 is at an up-gradient location within the Proposed Development site.

Tabulated groundwater quality data are attached as **Appendix 8-2**. Results of analysis are shown alongside relevant groundwater regulation and drinking water regulation values (S.I. No. 9 of 2010 and S.I. No. 122 of 2014). Laboratory certificates are shown in **Appendix 8-1.**

There was no exceedance with regard to the groundwater regulation values. Commonly elevated metals in groundwater such as iron and manganese were below or close to the laboratory detection limit in both samples (i.e. very low concentrations). Its also worth noting that there was no detection of hydrocarbons.

Nutrients such as nitrate, nitrite, phosphorus and ammonia were also low with results been close to the laboratory detection limit.

Ranges for electrical conductivity (500 - 600µS/cm), pH (7.1 – 7.4) and hardness 300 – 400mg/L) values are typical for a limestone aquifer.

8.3.12 Water Framework Directive Water Body Status & Objectives

The River Basin Management Plan was adopted in 2018 and has amalgamated all previous river basin districts into one national river basin management district. The River Basin Management Plan (2022 - 2027) objectives, which have been integrated into the design of the Proposed Development, include the following:

- Ensure full compliance with relevant EU legislation;
- Build on the achievements of the 2nd Cycle;
- Prevent deterioration and maintain a 'high' status where it already exists;
- Protect, enhance and restore all waters with aim to achieve at least good status by 2027;
- Ensure waters in protected areas meet requirements; and,
- Implement targeted actions and pilot schemes in focused sub-catchments aimed at restoring impacted waters and protecting waters from deterioration.

Our understanding of these objectives is that surface waters, regardless of whether they have 'Poor' or 'High' status, should be treated the same in terms of the level of protection and mitigation measures employed, i.e. there should be no negative change in status at all. Furthermore any development must not in any way prevent a waterbody from achieving at least good status by 2027.

A WFD Assessment Report for the Proposed Development is attached as **Appendix 8-3**.

8.3.13 Groundwater Body Status

Local Groundwater Body (GWB) and Surface water Body (SWB) status reports are available for download from (www.catchments.ie).

The Clare-Corrib GWB (IE_WE_G_0020) directly underlies the Proposed Development site. This GWB is assigned 'Good' status, which is defined based on the quantitative status and chemical status of the GWB.

The Clare-Corrib GWB has been deemed to be "at risk" and is under significant pressure from agricultural activities in the surrounding catchment.

8.3.14 Surface Water Body Status

A summary of the WFD status and risk result for Surface Water Bodies (SWBs) in the vicinity and downstream of the Proposed Development site are shown in **Table 8-11** below.

The Levally Stream (Levally Stream_010 SWB) and the downstream Grange River (Grange(Galway)_020) achieved "Good" status in the latest WFD cycle (2016-2021). Further downstream the Grange River (Grange(Galway)_030 and _040 SWBs) is also of "Good" status whilst the Clare (Galway) River (Clare(Galway)_060) downstream of its confluence with the Grange River is of "Poor" status.

In terms of the WFD risk result, the Levally Stream and the Grange River have been deemed to be not at risk" of failing to meet their respective WFD objectives. Meanwhile, the Clare (Galway)_060 SWB has been deemed to be "at risk" and is listed as being under significant pressure due to hydromorphological effects.

Table 8-11: Summary WFD Information for Surface Water Bodies

SWB Code	Water Body	Overall Status (2016 – 2021)	Risk Status	Pressures
IE_WE_30L070100	Levally Stream_010	Good	Not at Risk	None
IE_WE_30G020200	Grange(Galway)_020	Good	Not at Risk	None
IE_WE_30G020500	Grange(Galway)_030	Good	Not at Risk	None
IE_WE_30G020700	Grange(Galway)_040	Good	Not at Risk	None
IE_WE_30C010800	Clare (Galway)_060	Poor	At risk	Hydromorphology

8.3.15 Designated Sites and Habitats

Within the Republic of Ireland designated sites include Natural Heritage Areas (NHAs), Proposed Natural Heritage Areas (pNHAs), candidate Special Areas of Conservation (SAC) and Special Protection Areas (SPAs). A map of designated sites in the local area is shown as **Figure 8-9** below.

The Proposed Development site is not located within or immediately adjacent to any designated site.

The closest designated site to the Proposed Development site is Drumbulcan Bog pNHA (Site Code: 000263), located ~0.6m to the northwest. Given that the groundwater flow direction at the Proposed Development site is in an easterly direction and westerly at Dunblaney/Drumbulcan, there is no potential hydrological/hydrogeological linkage between the Proposed Development site and this pNHA.

Levally Lough SAC/pNHA (Site Code: 000295) is located ~2.7km south of the Proposed Development site. The Site Synopsis (NPWS, 2013) description of Levalley Lough is as follows:

> *"Levally Lough is a fluctuating lake, or turlough, situated 9 km east of Tuam and to the north of the Grange River in Co. Galway. It is overlooked by a low rise on the north side, with some esker or drift mound to the south. The land is flat at the eastern and western ends. A stream enters the turlough from the north-east corner".*

Based on the groundwater investigations carried out at the Proposed Development site and the local surface water drainage regime, there are no hydrological or hydrogeological connections between the Proposed Development and Levalley Lough. All surface water and groundwater drainage at the Proposed Development site flows in an easterly direction towards the Levally Stream which has no surface water connection with Levalley Lough.

Meanwhile, Lough Corrib SAC (Site Code: 000297) is located ~3km southeast of the Proposed Development site. This SAC includes the Grange River and a section of the Levally Stream downgradient of the Proposed Development site. As stated above, there are no direct surface water connections between Proposed Development site and Levally Stream, however groundwater flow/recharge at the Proposed Development site is expected to discharge into the Levally Stream and can therefore potentially reach Lough Corrib SAC.

Other Designated sites within 10km of the Proposed Development site include:

- Knockavanny Turlogh pNHA (site code 000289) approximately 5.0km southwest of the Proposed Development site
- Richmond Esker Nature Reserve pNHA (Site Code: 000323), approximately 5.4km southeast of the Proposed Development site;
- Derrynagran Bog and Esker NHA (Site Code: 001255), approximately 6.3km southeast of the Proposed Development site;
- Derrinlough (Cloonkeenleananode) Bog NHA (Site Code: 001254) and SAC (Site Code: 002197), approximately 7.5km southeast of the Proposed Development site.
- Slieve Bog NHA (Site Code:000247), approximately 7.7km northeast of the Proposed Development site;
- Summerville Lough pNHA (Site Code: 001319) approximately 9.8km southeast of the Proposed Development site.

A summary of potential hydrological pathways (surface water connections) and hydrogeological pathways (groundwater connections) between these designated sites and the Proposed Development site is included below as **Table 8-12.**

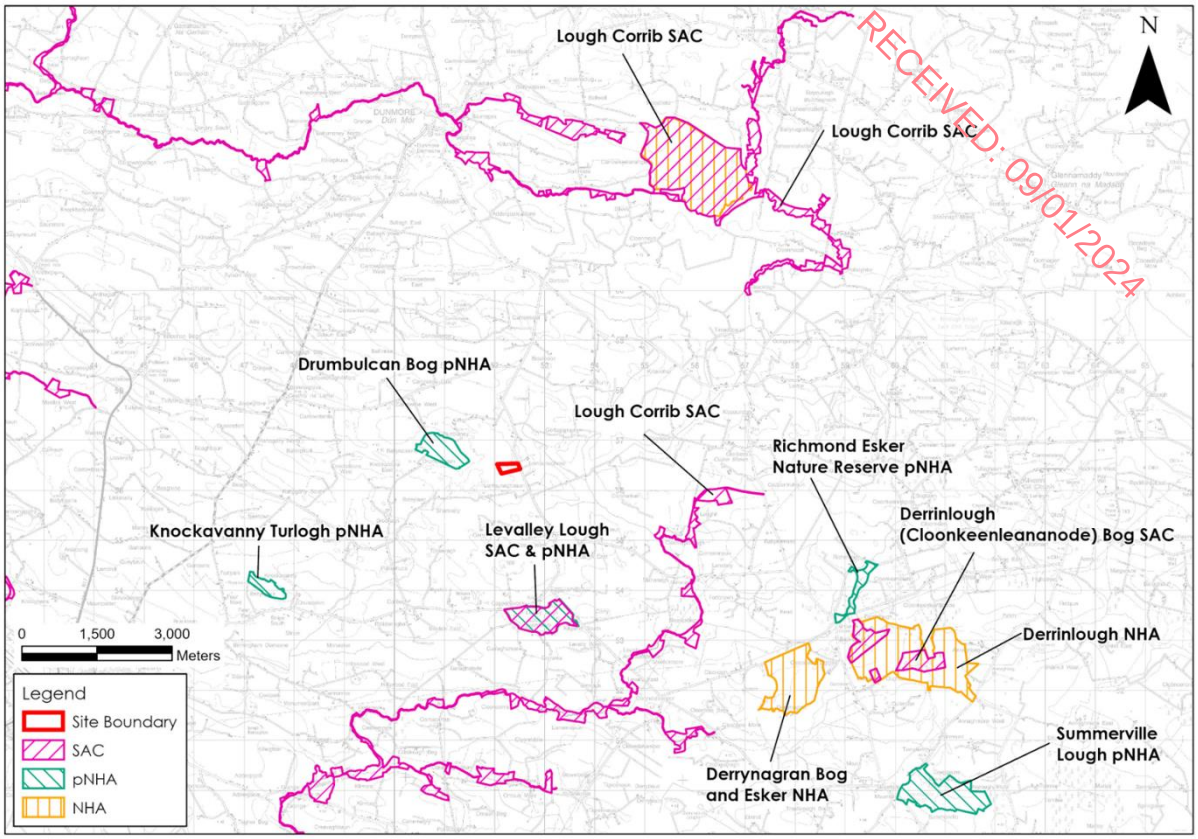


Figure 8-9: Designated Sites

Table 8-12: Relative distances and connectivity to designated sites

Designated Site	Distance to European Site	Hydrological connectivity to European Sites	Groundwater connectivity to Designated / European Sites
Drumbulcan Bog pNHA	~0.6km	No direct or indirect surface water pathway to this pNHA	None as Proposed Development site is located is separate groundwater catchment. Groundwater at the Proposed Development site flows to the east and west in the area of the pNHA
Levalley Lough SAC and pNHA	~2.7km	No direct or indirect surface water pathway to this designated site	None as Proposed Development site is not located up-gradient of the lough Groundwater at the Proposed Development site flows to the east and not southerly towards Levalley Lough
Lough Corrib SAC	~3km	No direct surface water pathway to this designated site	Yes, indirect pathway via groundwater flow form the Proposed Development site discharging as baseflow into the Levalley Stream
Knockavanny Turlough pNHA	~5.0km	No direct or indirect surface water pathway to this pNHA	Groundwater connectivity unlikely due to; 1) separation distances; 2) elevation differences; and 3) groundwater flow direction from the Proposed Development site to the east
Richmond Esker Nature Reserve pNHA	~5.4km	No direct or indirect surface water pathway to this pNHA	Groundwater connectivity unlikely due to; 1) separation distances; 2) the Levally Stream acts as a hydrological barrier with groundwater discharging as baseflow into the Levally Stream.
Derrynagran Bog and Esker NHA	~6.3km	No direct or indirect surface water pathway to this NHA	Groundwater connectivity unlikely due to; 1) separation distances; 2) the Levally Stream acts as a hydrological barrier with groundwater discharging as baseflow into the Levally Stream.
Derrinlough (Cloonkeenleana node) Bog NHA (Site Code: 001254) and SAC	~7.5km	No direct or indirect surface water pathway to this NHA and SAC	Groundwater connectivity unlikely due to; 1) separation distances; 2) the Levally Stream acts as a hydrological barrier with groundwater discharging as baseflow into the Levally Stream.
Slieve Bog NHA	~7.7km	No direct or indirect surface water pathway to this pNHA	Groundwater connectivity unlikely due to; 1) separation distances; 2) presence of intermediate rivers acting as hydraulic boundaries; 3) elevation differences; and 4) shallow depth of proposed extraction works.
Summerville Lough pNHA	~9.8km	No direct or indirect surface	Groundwater connectivity unlikely due to; 1) separation distances; 2) presence of intermediate rivers (Levall7 Stream)

Designated Site	Distance to European Site	Hydrological connectivity to European Sites	Groundwater connectivity to Designated / European Sites
		water pathway to this pNHA	acting as hydraulic boundaries; 3) elevation differences; and 4) shallow depth of proposed extraction works.

8.3.16 Water Resources

8.3.16.1 Surface Water Resources

No surface watercourses in the vicinity or downstream of the Proposed Development Site are identified as Drinking Water Protected Areas (DWPAs). The closest surface water DWPA is Clare(Galway)_020 SWB which is located approximately 2.5km to the northwest. Due to the local easterly groundwater flow direction, there is no potential for the Proposed Development to impact this DWPA.

8.3.16.2 Groundwater Resources

There are 2 no. mapped groundwater Source Protection Areas (SPA's) within ~5km of the Proposed Development site (i.e. Gurteen/Cloonmore GWS and Gallagh GWS) and all have karst spring sources. Refer further below to **Figure 8-10**.

The Proposed Development site is mapped by the GSI to be inside Gallagh GWS SPA. However, hydrogeological investigations completed at the Proposed Development site have revealed that local groundwater flow is to the east towards the Levally Stream. Groundwater from the area of the Proposed Development site will not flow towards the source of the GWS which is to the southwest. Therefore, the Proposed Development site is not located inside the Gallagh GWS SPA and can be ruled out for further assessment.

The down-gradient extent of the Gurteen/Cloonmore GWS SPA is located 1.5km to the east of the Proposed Development site where a karst spring is located at Gortagarraun townland. Groundwater flow to the spring is from the east/northeastThe Proposed Development is not located inside the Gurteen/Cloonmore GWS SPA. The Levalley Stream, which flows between the Gurteen/Cloonmore spring and the Proposed Development site, also appears to act as a groundwater discharge zone. This reinforces the fact that there is no groundwater flowpath continuity between the Gurteen/Cloonmore spring and the Proposed Development site. Therefore, the Gurteen/Cloonmore source can be ruled out for further assessment.

The Geological Survey of Ireland (GSI) well database (www.gsi.ie) has no private wells (<50m accuracy) mapped within ~3km of the Proposed Development site. In additional there are no private dwelling houses located to the east (i.e. down-gradient) which is the direction of groundwater at the Proposed Development site towards the Levalley Stream.

GSI mapped source protection areas are shown on **Figure 8-10**.

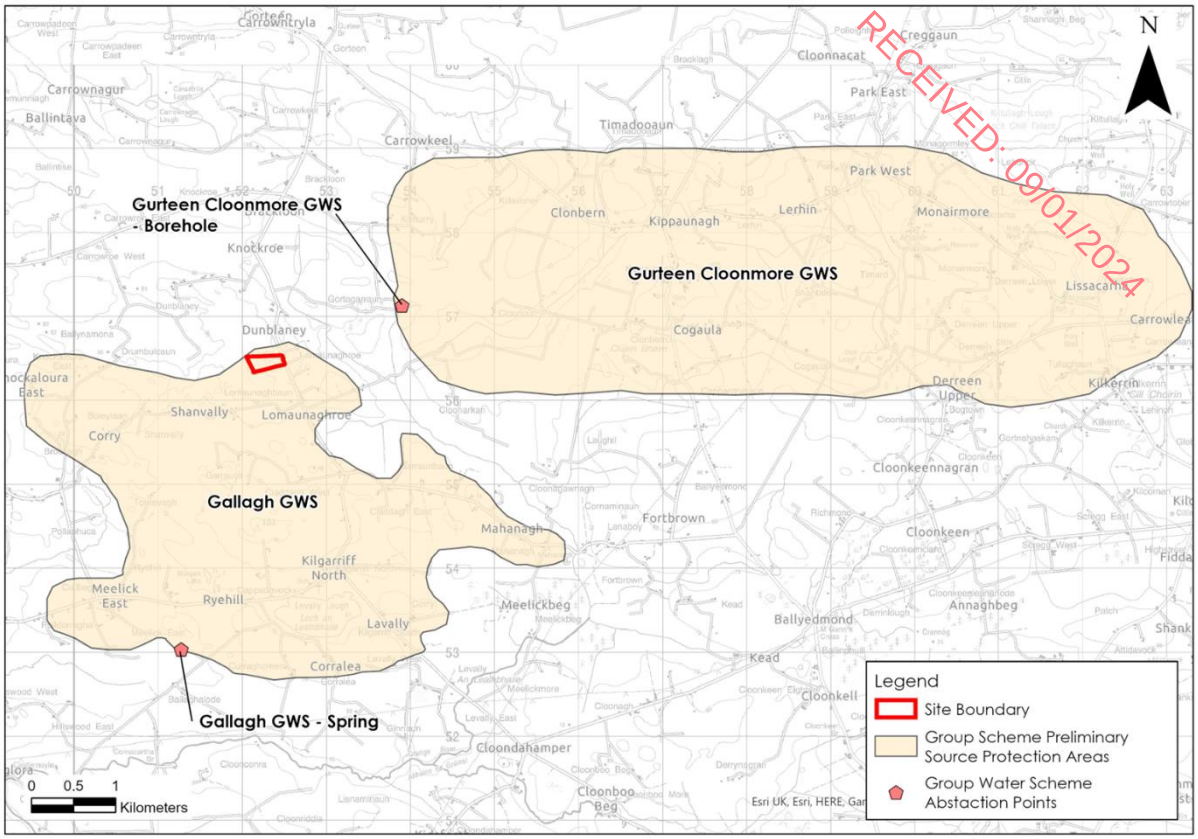


Figure 8-10: GSI Mapped Source Protection Areas

8.3.17 Receptor Sensitivity

Based on criteria set out in **Table 8-1** above, groundwater at the site is classed as High Importance due to the fact that the Clare-Corrib GWB is classified as a Regionally Important Aquifer Karstified (Rkc). Due to the nature of the Proposed Development (extraction above the groundwater table with no requirement for dewatering) no impacts on groundwater quantity (levels or flows) are expected. Groundwater quality impacts and recharge effects are discussed further below.

Surface waters such as the Levally Stream are considered to have an Extremely High Importance due to its designation as a SAC further downstream from the Proposed Development site. Whilst there are no direct hydrological connections between the Proposed Development site and the Levally Stream an indirect hydrological link may exist via lateral groundwater flow, with groundwater discharging into the Levally Stream as baseflow.

Groundwater quality will be the main sensitive receptor with respect of potential oil/fuel leaks and spills from plant and machinery.

All potential contamination sources are to be carefully managed at the site during all phases of the development and mitigation measures are proposed within the EIAR to deal with these potential minor impacts.

8.4 Characteristics of the Proposed Development

8.4.1 Construction Phase

Initial preparation/construction work requirements at the site will be minimal and will mainly be site enabling works that will last approximately 1 month.

The construction phase will include:

- Preparation of site for construction.
- Pouring of concrete for refuelling area foundation and foundation for processing plant and associated components;
- Erection off the processing plant and water treatment/recycling tanks;
- Construction of new drainage network and fuel/oil interceptor at refuelling area;
- Installation of a new site entrance on the L2232;
- Road paving/improvements; and
- Installation of a weighbridge and wheelwash and wastewaterholding tank.

It is proposed that any excavated topsoil material will be reused onsite for the construction of berms which will be installed along the perimeter of the site for screening purposes.

8.4.2 Operational/Extraction Phase

The Proposed Development being applied for under this current planning application includes for the extraction of sand and gravel over almost the full site area (i.e. 6.2ha). There will be no extraction of the limestone bedrock below the sand and gravel deposits.

It is proposed to excavate the site down by an average depth of 3 metres from the existing ground levels which range from 84m OD to 96m OD. It has been calculated that approximately 152,000m^3 (291,840 tonnes) of material will be extracted over 10 years. The aggregate will be extracted in three phases and will be washed and processed on-site.

Water usage for the washing element of the sand processing plant during the operational phase will be contained within a closed loop system. As all water will be reused on a continuous basis within the material processing plant there will be no requirement for the installation of settlement ponds within the site as is the commonly the case with many other sand extraction sites. The system will be topped up using a proposed on-site groundwater well.

Water used for dust suppression and at the wheel wash will also be sourced from the proposed on-site groundwater well.

The total daily demand for aggregate washing, wheel wash and dust suppression is expected to be under 25m^3/day.

The EPA consider that abstraction volumes below 25 cubic meters (25,000 litres) of water each day are unlikely to have a significant negative impact on the water environment. Therefore, abstractions below 25 cubic meters per day would not require consideration when assessing the cumulative impact of abstractions on rivers, lakes and groundwater levels. Proposed abstraction of groundwater has been screened out for further assessment.

The spoil/fines from the aggregate processing will be stored in cells constructed in in-situ sand and gravel deposits.

All domestic wastewater will be contained and taken off-site for treatment.

8.4.3 Restoration Phase

Once quarry operations have ceased within the proposed extraction area, all site infrastructure including the processing plant, wheelwash, weighbridge and site office would be disassembled/demolished and removed off-site for disposal/recycling and /or sale unless a new permission is granted which would allow for the retention of these components on-site

It is then proposed to reinstate the site with processed spoil and topsoil material set aside during the enabling works, extraction and processing, reseed it and return it to agricultural grassland.

8.5 Likely Effects and Associated Mitigation Measures

8.5.1 Construction Phase - Likely Effects and Mitigation Measures

8.5.1.1 Entrainment of Suspended Sediment in Runoff/Groundwater Recharge

The removal of any topsoil from the proposed extraction areas or other works areas has the potential for the generation of suspended solids in surface water runoff. Earthworks and the stockpiling of such material)creating of the proposed boundary berms) will be a potential source of sediment laden water.

Such activities can result in the release of suspended solids to nearby surface waters. However, as described above, there are no direct hydrological connections between the Proposed Development site and nearby surface waters. The only potential for surface water quality effects is through groundwater recharge and the lateral migration of groundwater and its eventual discharge as baseflow into local streams.

Given the permeable nature of the subsoil sands and gravels present at the Proposed Development site, all water generated within the site will infiltrate to ground. The subsoil sand and gravels are an excellent natural filter and will remove any suspended solids before the water reaches the underlying groundwater table.

Therefore, there is no potential for significant effects.

Pathway: Groundwater recharge, lateral groundwater flow and discharge into downgradient surface watercourses.

Receptor: Local groundwater quality (Clare-Corrib GWB) and downstream surface water quality in the Levally Stream, Grange River and associated dependent ecosystem.

Pre-Mitigation Potential Effect:

Negative, imperceptible, direct, temporary, unlikely effect on underlying groundwater quality.

Negative, imperceptible, indirect, temporary, unlikely effect on downstream surface water quality.

Proposed Mitigation Measures:

Due to the local hydrogeological characteristics no specific mitigation measures are required. Due to the permeable nature of the local subsoils, and the lack of surface watercourses in the area of the Proposed Development site, any water will infiltrate to ground.

Post Mitigation Residual Effect: Earthworks could result in elevated suspended solid concentrations entering groundwater. However, given the nature of the sand and gravel subsoils which provide filtration and will remove any suspended solids. The post mitigation potential residual effect is considered to be a:

Negative, indirect, imperceptible, temporary, unlikely effect on groundwater quality; and,

Negative, imperceptible, indirect, temporary, unlikely effect on downstream surface water quality.

Significance of Effects: No significant effects will occur.

8.5.1.2 Contamination of Waterbodies by Oil/Fuel Spillages and Leakages

Enabling works at the Proposed Development site will be completed using machinery. Such machinery are powered by diesel engines and operated using hydraulics. Unless managed carefully such plant and machinery have the potential to leak hydraulic oils or cause fuel leaks during refueling operations.

Only small volumes of fuel/oils will be present on-site and therefore no significant effects are expected as long as standard mitigation is implemented.

Pathway: Groundwater recharge, lateral groundwater flow and discharge into downgradient surface watercourses.

Receptor: Local groundwater quality (Clare-Corrib GWB) and downstream surface water quality in the Levally Stream, Grange River and associated dependent ecosystem.

Pre-Mitigation Potential Effect:

Negative, moderate , indirect, long-term, unlikely effect on underlying groundwater quality.

Negative, slight, indirect, long-term, likely effect on surface water quality.

Proposed Mitigation Measures:
The following mitigation measures are proposed:

- All plant and machinery will be serviced before being mobilised to the site;
- Refuelling will be completed in a controlled manner using drip trays (bunded container trays) at all times;
- Drip-trays will be used for fixed or mobile plant in order to retain oil leaks and spills;
- Only designated trained operators will be authorised to refuel plant on site;
- Procedures and contingency plans will be set up to deal with emergency accidents and spills; and,
- An emergency spill kit with oil boom, absorbers etc. will be kept on site for use in the event of an accidental spillage.

Post Mitigation Residual Effect: The use and storage of hydrocarbons and small volumes of chemicals is a standard risk associated with all construction sites. Proven and effective measures to mitigate the risk of spills and leaks have been proposed above and will break the pathway between the potential source and the receptor. The residual effect will be negative, reversible, imperceptible, direct, short-term, unlikely effect on waterbodies.

Significance of Effects: No significant effects on waterbodies are anticipated.

8.5.1.3 Release of Cement-Based Products

Concrete and other cement-based products are highly alkaline and corrosive and can have significant negative effects on water quality. They generate very fine, highly alkaline silt (pH 11.5) that can physically damage fish by burning their skin and blocking their gills. A pH range of ≥ 6 ≤ 9 is set in S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations, with artificial variations not in excess of ± 0.5 of a pH unit. Entry of cement-based products into the site drainage system, into surface water runoff, and hence to surface watercourses or directly into watercourses represents a risk to aquatic species and habitats.

Batching of wet concrete on site and washing out of transport and placement machinery are the activities most likely to generate a risk of cement-based pollution.

Pathway: Recharge and groundwater flow.

Receptor: Local groundwater quality (Clare-Corrib GWB) and downstream surface water quality in the Levally Stream and associated dependent ecosystem.

Pre-Mitigation Potential Effect:

Negative, indirect, slight, short-term, unlikely effect on surface water quality.

Negative, indirect, moderate, short-term, likely effect on local groundwater quality.

Proposed Mitigation Measures:
Proposed mitigation measures are outlined as follows:

- No batching of concrete will occur on site. Ready-mixed supply of wet concrete products and where possible, emplacement of pre-cast elements, will take place.
- Raw or uncured waste concrete shall be disposed of by removal from the site;
- Wash down water from exposed aggregate surfaces, cast-in-place concrete and from concrete trucks shall be impounded in lined lagoons and treated in accordance with the dewatering discussed above.
- Only the chute of the concrete delivery truck will be permitted to be cleaned on site, using the smallest volume of water necessary;
- Concrete trucks will be directed back to their batching plant for full washout; and,
- Concrete pour sites shall be free of standing water to mitigate the risk of run-off being polluted with cementitious material. Furthermore, concrete pours shall be avoided where prolonged periods of heavy rain are forecast, and covers shall be available and used for freshly placed concrete to avoid the surface washing away in heavy rain.

Post-Mitigation Residual Effect: The potential for the release of cement-based products or cement truck wash water to groundwater and watercourse receptors is a risk to surface water and groundwater quality, and also the aquatic quality of the surface water receptors. Proven and effective measures to mitigate the risk of releases cement-based products or cement truck wash water have been proposed above and will break the pathway between the potential source and each receptor. The residual effect will be - Negative, imperceptible, indirect, short-term, unlikely effect on groundwater quality and the hydrochemistry of downstream surface watercourses including the Levally Stream.

Significance of Effects: For the reasons outlined above, and with the implementation of the listed mitigation measures, no significant effects on surface water or groundwater quality will occur.

8.5.2 Extraction Phase - Likely Effects and Mitigation Measures

8.5.2.1 Impacts on Groundwater Vulnerability Rating due to Aggregate Extraction

The removal of subsoil overburden from the extraction area will increase the groundwater vulnerability rating of the underlying bedrock aquifer. This will result in a likely and permanent effect on the local groundwater vulnerability rating.

However, the groundwater vulnerability rating of the Proposed Development Site currently ranges from "Extreme" to "High". The Proposed Development will involve the extraction of aggregate which will increase groundwater vulnerability which is rated predominately "Extreme" across most of the site with the exception of the eastern portion which is "High" based on the actual site hydrogeological condition.

Pathways: Aggregate extraction

Receptors: Groundwater vulnerability rating (Clare-Corrib GWB).

Pre-Mitigation Potential Effect: Negative, irreversible, slight, direct, likely effect on groundwater vulnerability rating.

Impact Assessment/Mitigation

Albeit there will be a slight increase in groundwater vulnerability due to the removal of overburden, there will be no actual change in the current greenfield/baseline vulnerability rating which is "High" to "Extreme". Post extraction the vulnerability rating will still remain as "High" to "Extreme".

It is proposed that the aggregate will not be extracted down to bare bedrock, thus leaving a protective layer over bedrock for the filtration of any surface water runoff that might be generated at the site during the extraction and following restoration phase.

The main mitigation with respect groundwater quality protection during the extraction phase will be employment of best practice measures with respect to oil usage and refuelling of plant and machinery which are dealt with in **Section 8.5.2.3** below.

Post extraction phase a landscape and restoration plan will be implemented. This will involve previously stripped overburden being placed on the pit floor to establish grassland which will provide a level of protection to groundwater similar to the greenfield/baseline scenario.

Post restoration, the site will be returned to agriculture which is the current landuse.

Post Mitigation Residual Effect:
The application of best practice methods with regard oils and fuels and the proposed restoration plan means effect on groundwater vulnerability will be negative, irreversible, imperceptible, direct, likely effect on groundwater vulnerability rating.

Significance of Effects: For the reasons outlined above, no significant effects on groundwater vulnerability rating will occur.

8.5.2.2 Groundwater Quality Effects due to Entrained Sediment in Runoff/Recharge

Excavations, aggregate extraction and storage of fines/silts have the potential to release sediments into the groundwater system, particularly in karst environments where the groundwater vulnerability rating is often "Extreme" and particularly where conduit flow pathways potentially exist.

However, the drilling investigations carried out at the site demonstrates the limestone bedrock below the site is very competent. Groundwater flowpaths between the Proposed Development site and the Levally Stream are likely to be mainly along the top of bedrock (i.e. bedrock / subsoil interface) rather than rapid flow via solutional enlarged bedding planes, fissures and conduits. Based on these finding there is not likely to be potential for rapid recharge of silt laden surface water into the groundwater system.

Pathways: Surface water runoff, recharge and karst bedrock.

Receptors: Clare-Corrib GWB.

Pre-Mitigation Potential Effect: Negative, reversible, slight, indirect, likely effect on groundwater quality

Impact Assessment /Mitigation Measures

Nevertheless, the main mitigation with regard this potential effect is that aggregate will not be extracted down to bare bedrock (i.e. the underlying bedrock will not be exposed). Thereby leaving a protective layer of natural sand and gravels over bedrock for the filtration of any surface water runoff that might be generated at the site during extraction phase or following restoration phase.

Secondly, the spoil/fines from the aggregate processing will be stored in cells constructed within in-situ sand and gravel deposits. All runoff from spoil/fine storages areas will contained and directed to ground within the cell, thereby the underlying sand and gravels filtering out any fines.

Also, the excavated soil material stored as berms will be seeded and revegetated during the extraction phase to avoid erosion and generation of fines. Drainage control measures such as collector drains will be installed at the base of the berms to capture runoff.

Post Mitigation Residual Effect:
The application of effective drainage control measures means the residual effect will be negative, reversible, imperceptible, direct, likely, temporary effect on groundwater quality.

Significance of Effects: For the reasons outlined above, no significant effects on groundwater quality will occur.

8.5.2.3 Surface Water and Groundwater Contamination from Oil / Fuel Spills and Leaks

Excavation of aggregate at the site will be completed using machinery. Such machinery are powered by diesel engines and operated using hydraulics. Unless managed carefully such plant and machinery have the potential to leak hydraulic oils or cause fuel leaks during refuelling operations.

Only small volumes of fuel/oils will be present on-site and therefore no significant effects are expected as long as standard mitigation is implemented.

Pathway: Recharge and Groundwater flowpaths.

Receptor: Groundwater (Clare-Corrib GWB) and surface water (i.e. Levalley Stream).

Pre-Mitigation Potential Effect: Negative, reversible, slight, indirect, unlikely, long term effect on surface water and groundwater quality.

Proposed Mitigation by Design:

The following mitigation is proposed for:

- All site refuelling will be carried out in a designated refuelling area in the eastern section of the site. This designated area will be marked by signage;
- The refuelling area will be comprised of concrete hardstanding. A hydrocarbon/oil interceptor will capture and treat runoff from the refuelling area;
- All plant and machinery will be serviced before being mobilised to site, and regular leak inspections will be completed during the site operations;
- No plant maintenance will be completed on site, any broken-down plant will be removed from site to be fixed;
- An emergency spill kit with oil boom, absorbers etc. will be kept on-site for use in the event of an accidental spill;
- Drip-trays will be used for fixed or mobile plant such as pumps and generators in order to retain oil leaks and spills. The drip tray will have a holding capacity of 110% of the volume contained within the machine/ generator; and,
- Only designated trained and competent operatives will be authorised to refuel plant.

Post Mitigation Residual Effects: The potential for the release of hydrocarbons to groundwater and watercourse receptors is a risk to surface water and groundwater quality, and also the aquatic quality of the surface water receptors. Proven and effective measures to mitigate the risk of releases of hydrocarbons have been proposed above and will break the pathway between the potential source and each receptor. The residual effect will be negative, indirect, imperceptible, short term, unlikely impact to local groundwater quality. Negative, indirect, imperceptible, short term, unlikely impact to surface water quality.

Significance of Effects: For the reasons outlined above, no significant effects on surface water or groundwater quality will occur.

8.5.2.4 Hydrological Effects on Downstream Designated Sites

Groundwater underlying the Proposed Development site is expected to flow in an easterly/southeasterly direction as baseflow to the (Levally Stream) which forms part of the Lough Corrib SAC approximately 3km downstream of the Proposed Development site.

Due to the fact that there are no direct surface water connections to the Levally Stream, no significant on Lough Corrib SAC are likely.

All other nearby designated sites are not hydrologically connected to the Proposed Development (i.e. Drumbulcan Bog pNHA and Levally Lough SAC). There is no hydrogeological connection to the Proposed Development site and therefore they cannot be impacted by the Proposed Development. The lack of hydrological connectivity has been demonstrated by site investigations.

Pathway: Groundwater flowpaths/site runoff/ discharge water.

Receptor: Lough Corrib SAC

Pre-Mitigation Potential Effect: Negative, imperceptible, indirect, short term, unlikely effect on Lough Corrib SAC.

Impact Assessment / Proposed Mitigation Measures:

The only pathway for potential contaminants from the Proposed Development site to reach Lough Corrib SAC is via groundwater baseflow followed by surface water flows in the Levally Stream. There are no drains or streams connecting the Proposed Development site to the Levally Stream.

The primary potential contaminants that need to be considered are sediments/fines (during extraction/excavations), oils/fuels (hydrocarbons) and cement based products.

With regard sediments/fines, the lack of conduit flow /rapid groundwater flow, means that sediments/fines will be filtered out naturally before groundwater reaches the Levally Stream. In addition, there is mitigation proposed in Section 8.5.2.2 above to prevent sediments/fines entering the groundwater system.

Oils/fuels and cement based products are potential contaminants on all quarry and construction site, but the risk can be managed and negative affects avoided if best practice measures are applied.

Mitigation measures for groundwater quality protection are summarised below: Please refer to preceding sections for the full description of these measures with respect to hydrocarbons (Section 8.5.1.1 & 8.5.2.3) and cement-based products (Section 8.5.1.2).

Post Mitigation Residual Effect: No effects on local designated sites will occur.

Significance of Effects: For the reasons outlined above, no significant effects on local designated sites will occur.

8.5.2.5 Potential Effects on Surface Water and Groundwater WFD Status

The EU Water Framework Directive (2000/60/EC) requires that all member states protect and improve water quality in all waters, with the aim of achieving good status by 2027 at the latest. Any new development must ensure that this fundamental requirement of the Directive is not compromised.

The WFD status for GWBs and SWBs underlying and downstream of the Proposed Development are defined in Section 8.3.13 and Section 8.3.14 respectively.

A detailed WFD Compliance Assessment Report has been completed in combination with this EIAR Chapter and is included in **Appendix 8-3**.

Pathway: Surface water flowpaths and groundwater flowpaths.

Receptor: WFD status of downstream surface water bodies (Levally Stream and Grange River) and the Clare-Corrib GWB GWB.

Pre-Mitigation Potential Effect: Indirect, negative, imperceptible, long term, unlikely effect on surface water and groundwater bodies status.

Impact Assessment & Proposed Mitigation Measures:

Mitigation measures for groundwater quality and surface water quality protection are summarised below: Please refer to preceding sections for the full description of these measures with respect to suspended solids (Section 8.5.1.1 & 8.5.2.2), hydrocarbons (Section 8.5.1.2 & 8.5.2.3) and cement-based products (Section 8.5.1.3).

The implementation of these mitigation measures will ensure the protection of downstream SWBs and underlying GWBs.

Post-Mitigation Residual Effect:

Mitigation for the protection of surface and groundwater during the extraction phase of the Proposed Development will ensure the qualitative and quantitative status of the receiving waters will not be significantly altered by the Proposed Development.

There will be no change in GWB or SWB status in the underlying GWB or downstream SWBs resulting from the Proposed Development. There will be no change in quantitative (volume) or qualitative (chemical) status, and the underlying GWB and downstream SWBs are protected from any potential deterioration.

No residual effect on Groundwater Body WFD status will occur.

No residual effect on Surface Water Body WD status will occur.

Significance of Effects: For the reasons outlined above, no significant effects on WFD Groundwater Bodies and Surface Water Bodies status, risk or future objectives will occur as a result of the Proposed Development.

8.5.3 Restoration Phase and Post Restoration - Likely Effects

The restoration plan involves returning the Proposed Development site to grassland by spreading/contouring previously stripped overburden over the extraction area.

No impacts on the hydrological or hydrogeological regime are expected during the restoration or post restoration phase. However, the restoration will have a positive effect in terms of reduced groundwater vulnerability.

The mitigation measures relating to oils and fuels during the restoration phase will be the same as those outlined in Section 8.5.1.2 above for the construction phase.

8.5.4 Assessment of Cumulative Effects

The potential for hydrological and hydrogeological cumulative effects of the Proposed Development is presented in the this section. Firsty, it needs to be stated that potential for the Proposed Development to contribute to cumulative effects is very low due to the absence of any discharges, the lack of surface water flowpaths/land drainage between the Proposed Development site and downstream riverwaterbodies (i.e. Levally Stream.The only pathway for potential contaminants from the Proposed Development site to reach the levally Stream is via groundwater baseflow. Groundwater cumulative effects therefore also need to be considered.

Also, the primary potential contaminant that will be on-site will be oils/fuels and considering that these sources will only be present in very small volumes, the potential for cumulative effects is very low.

Other activities in the local area include mainly agriculture, one-off housing and existing quarries. The latter is only one with the potential to contribute to significant cumulative effects. There is only one active quarry within 5km of the Proposed Development site and that is located at Shanvally, 0.8km to the southwest of the Proposed Development site.

The quarry at Shanvally is however located in a separate surface water sub-catchment and groundwater catchment (refer to Section 8.3.9) to the Proposed Development site and therefore there is no potential for cumulative effects to occur on in Levally Stream via surface water or groundwater flowpaths.

A planning search of other proposed or permitted developments within a 2km radius of the Proposed Development site was carried out as part of the assessment. This revealed that the majority of proposals

or permissions relate to small domestic or farming developments which are unlikely to contribute to significant cumulative effects.

Potential future local projects that are not currently in the planning system include Clonberne Windfarm (https://www.clonbernewindfarm.com/). This potential wind farm site is located on bogland/farmland to the east of the Proposed Development site. This area of bogland also drains into the Levally Stream.

However, cumlative effects of windfarms is typically surface weater related with the primary potential pollutant being suspended sediments in surface water runoff. Suspended sediments in runoff is not a concern for the Proposed Development at Lomaunaghbaun and therefore the potential for hydrological and hydrogeological cumulative effects is very low.

8.5.5 Human Health Effects

Potential health effects arise mainly through the potential for groundwater contamination and impacts on local wells. Hydrocarbons, in the form of fuels and oils, will be used on-site during aggregate extraction and any accidental spillage of hydrocarbons has the potential to impact the underlying groundwater quality.

The Proposed Development site is not located inside Gallagh GWS SPA as shown on the GSI mapping. Also, there is no hydrogeological between the Proposed Development site and Gurteen/Cloonmore GWS spring source.

There are also no private wells are present down-gradient of the Proposed Development site. Nevertheless, the Proposed Development design (no extraction below the groundwater table) coupled with the proposed mitigation measures will ensure that the potential for groundwater quality effects will not be significant.

There will be best practice controls in place to ensure any potential sources of contamination on the site will be managed appropriately and the volumes present will be small in the context of the scale of the project. The potential residual impacts associated with groundwater contamination and subsequent health effects are negligible.

8.5.6 Post Consent Monitoring

No hydrological or hydrogeological monitoring will be required.