7. WATER

7.1 Introduction

7.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by MKO to carry out an assessment of likely and significant effects of proposed sand/gravel extraction and restoration (Proposed Development) at Ballyquin (and surrounding townlands), Co. Clare on water aspects (hydrology and hydrogeology) of the receiving environment. The Proposed Development being applied for under this planning application also includes for the construction of a soil inspection shed, refuelling area, settlement ponds, road improvements, drainage network and environmental berms.

Where the 'Proposed Development' is referred to, this relates to all the project components described in in detail in Chapter 3 of this EIAR. The Proposed Development site is defined EIAR Study Area boundary.

The objectives of the assessment are:

- Produce a baseline study of the existing water environment (surface water and groundwater including connectivity with locally designated sites) in the area of the Proposed Development site;
- Identify likely negative effects of the Proposed Development on surface water and groundwater during construction, operational and restoration phases of the development;
- Identify mitigation measures to avoid, remediate or reduce significant negative effects; and,
- Assess significant residual effects and cumulative effects of the Proposed Development along with other local developments of a similar scale.

7.1.2 Statement of Authority

Hydro-Environmental Services (HES) are a specialist hydrological, hydrogeological and environmental practice that 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 drainage design. We routinely complete impact assessments for hydrology and hydrogeology for a large variety of project types.

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

Michael Gill P.Geo (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer with over 22 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of quarry extraction and infill projects in Ireland. He has worked on the following quarry infill assessments: Clasheen Pit (Killarney), Garyhesta (Cork), Middleton (Cork), Killarney East, Kilmeague (Kildare), and Kilmessan (Meath).

David Broderick P.Geo (BSc, H. Dip Env Eng, MSc) is a Hydrogeologist with 17 years environmental consultancy experience in Ireland. David has completed numerous hydrological and hydrogeological assessments for various developments across Ireland. David has also significant experience in surface water drainage issues, SUDs design, flood risk assessment and modelling.

Jenny Law (BSc, MSc) is an Environmental Geoscientist holding a first honours degree in Applied Environmental Geosciences from the University College Cork. 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 quarries and strategic housing developments.

7.1.3 Relevant Legislation

The EIAR is carried out in accordance with the following Irish legislation:

- 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 85/373/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. 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: Quality of Salmon Water Regulations 1988;
- S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009, as amended, and S.I. No. 722 of 2003 European Communities (Water Policy) Regulations, as amended, which implement EU Water Framework Directive (2000/60/EC) and provide for the implementation of 'daughter' Groundwater Directive (2006/118/EC). Since 2000 water management in the EU has been directed by the Water Framework Directive (WFD). The key objectives of the WFD are that all water bodies in member states achieve (or retain) at least 'good' status by 2015. Water bodies comprise both surface and groundwater bodies, and the achievement of 'Good' status for these depends also on the achievement of 'good' status by dependent ecosystems. Phases of characterisation, risk assessment, monitoring and the design of programmes of measures to achieve the objectives of the WFD have either been completed or are ongoing. In 2015 it will fully replace a number of existing water related directives, which are successively being repealed, while implementation of other Directives (such as the Habitats Directive 92/43/EEC) will form part of the achievement of implementation of the objectives of the WFD;
- S.I. No. 684 of 2007: Waste Water (Authorisation) Regulations 2007;
- S.I. No. 294/1989: Quality of Surface Water Intended for Abstraction (Drinking Water), resulting from EU Directive 74/440/EEC concerning the quality required of surface water intended for the abstraction of drinking water in the Member States (repealed by 2000/60/EC in 2007);
- S.I. No. S.I. No. 99/2023: European Communities Environmental Objectives (Drinking Water) (Amendment) Regulations 2023;
- S.I. No. 366/2016: European Communities Environmental Objectives (Groundwater) (Amendment) Regulations 2016; and,
- S.I. No. 77/2019: European Communities Environmental Objectives (Surface Water) (Amendment) Regulations 2019.

7.1.4 Relevant Guidance

The Water Chapter of the EIAR is carried out in accordance with the 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 (2022): Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;
- Institute of Geologists Ireland (2013): Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements;
- 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. London, 2006;
- EPA Guidance on Soil Recovery Waste Acceptance Criteria (2020);
- Consultation Paper Regulation 27(7) National By-Product Criteria for Greenfield Soil and Stone used in Developments" (2022).

7.1.5 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 is outlined in Section 2.5 of this EIAR. Matters raised with respect to the water environment are summarised in Table 7-1 below.

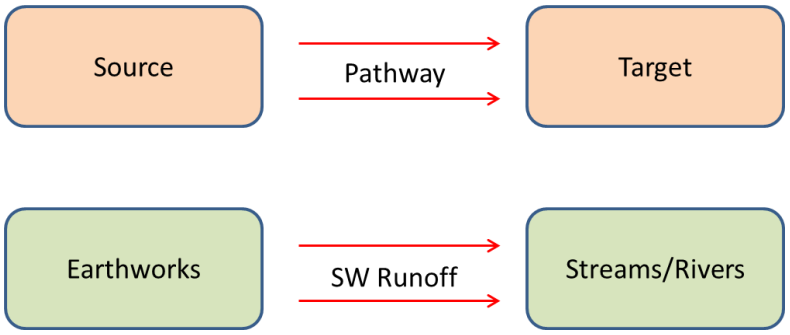
Table 7-1: Scoping responses for the Proposed Development.

Consultee	Matters raised	Reference in text
Inland Fisheries Ireland (IFI)	"*Our main concerns in relation to this development will be the protection of the aquatic resource and the associated riparian habitat. In particular, IFI are concerned about the protection of streams flowing at the southeast of the site into the Black River and flowing north into the Glenomra/Broadford rivers, both of which are salmonid rivers. Current flow regimes must not be changed".*	Sections 7.3.16 and 7.4.5.1
HSE	*"Settlement lagoons should be of sufficient size to cope with flooding and periods of heavy rain and should be adequately sealed with an impermeable material to prevent leaching to groundwater.* *Hard standing areas used for refuelling vehicles should drain to Class 1 Hydrocarbon Interceptors prior to discharge.* *Details of the fuels and chemicals used and stored on site and the method proposed for the bunding of fuel and chemical storage tanks should be outlined in the EIAR. Provision should be made for*	Sections 7.3.16, 7.4.6.5, 7.4.6.3, 7.3.6 and 7.3.9.

Consultee	Matters raised	Reference in text
	the inspection and monitoring of bunding structures. *In order to minimise the wastage of water, surface water should be used for activities such as wheel washing and dust suppression.* *It is recommended that detailed information is gathered on the location of private wells (which are used as a drinking water supply) serving properties within a 2km radius of the quarry. Reference should be made in the EIA to the Geological Survey of Ireland's (GSI) Groundwater Protection Scheme to determine if there are vulnerable groundwater sources or aquifers in the vicinity of the proposed development.* *Details of all potential impacts of the proposed quarry extension on groundwater quality, including any potential increase in ammonia levels which may be attributable to blasting, must be included in the EIAR.* *Mitigation measures aimed at the protection of groundwater and public health should be described. As indicated, water monitoring results associated with the existing quarry should also be included in the EIAR".*	
Geological Survey of Ireland (GSI)	No specific matters were raised relating to hydrogeology or hydrology	

7.1.6 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 impacts are identified, the classification of impacts 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):

- Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2022);
- Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (EPA, 2003).

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 7.4.3), we have first presented below a summary guide that defines the steps (1 to 7) taken in each element of the impact assessment process (refer to Table 7-2). 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 the development construction, operational 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 7-2 Impact Assessment Methodology

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 a potential impact is 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.

7.2 Methodology

7.2.1 Desk Study

A desk study of the Proposed Development and receiving environment was completed prior to the undertaking of field mapping and site investigations. The desk study involved collecting all relevant geological, hydrological, hydrogeological and meteorological data for the relevant areas. This included consultation with the following:

- Environmental Protection Agency database (www.epa.ie);
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks & Wildlife Services Public Map Viewer (www.npws.ie);
- Water Framework Directive Map Viewer (www.catchments.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 17 (Geology of the Shannon Estuary). Geological Survey of Ireland (GSI, 1999);
- Geological Survey of Ireland - Groundwater Body Characterisation Reports; and
- OPW Flood Maps (www.floodinfo.ie).

7.2.2 Site Investigations

Site walkovers, investigations and baseline monitoring was undertaken by David Broderick and Jenny Law of HES (refer to Section 6.1.2 above for qualifications and experience) on 27th October 2022 and on 9th February, 6th July, 27th September and 13th November 2023.

In summary, site investigations to address the Water Chapter of the EIAR included the following:

- Walkover surveys to assess the ground conditions and mapping of drainage;
- Geophysical surveys of the Proposed Development site were previously carried out by APEX Ltd in October 2013 and December 2019 which informed this assessment;
- 4 no. investigations boreholes/monitoring wells were drilled in October 2022;
- Continuous groundwater level monitoring in the 4 no. monitoring wells by in-situ data loggers; and,
- Surface water and groundwater quality monitoring for baselines assessment purposes.

7.2.3 Impact Assessment Methodology

Please refer to Chapter 1 of the EIAR for details on the impact assessment methodology (EPA, 2022). In addition to the above methodology, the sensitivity of the water environment receptors was assessed on completion of the desk study and baseline study.

Table 7-3 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.

Sensitivity of Receptor	
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

7.2.4 Limitations and Difficulties Encountered

No limitations or difficulties were encountered during the preparation of the Water Chapter of the EIAR.

7.3 Receiving Environment

7.3.1 General Site Description

The Proposed Development site is located on the south-western facing foothills of the Lackareagh Mountains at Ballyquin (and surrounding townlands), approximately 1.5km to the northwest of Bridgetown, Co. Clare. Furthermore, it is situated 8km southwest of the town of Killaloe.

The Proposed Development site, which has an area of 97.5ha, is located within an existing sand and gravel pit which has a total landholding of 105ha. Previous extraction was focused along the more elevated eastern half of the Proposed Development site where natural ground levels are between 90 and 100 metres above Ordnance Datum (m OD) along the eastern boundary.

The western half of the Proposed Development site, where natural ground levels reduce to 46m OD at the western boundary, is heavily vegetated with trees and scrub. There is a wetland area/fen at the southwestern corner of the Proposed Development site near the existing site entrance as well as some agricultural land at the far southeastern end of the Proposed Development site. The existing extraction areas have floor levels of between 86m OD and 53m OD at the eastern and central areas of the site respectively.

The Proposed Development site is accessed from the R466 Regional Road which runs to the west of the site. The Proposed Development site has existing high quality vehicular access and intends to utilise this access road for the purpose of the Proposed Development. There are also existing quarry facilities such as reception building, weigh bridge, aggregate processing areas, wheelwash, welfare facilities and settlement ponds/lagoons. There are also two no. production wells on-site.

The proposed areas for aggregate extraction and infilling are located mainly in the existing extraction areas or processing areas, with the exception of the southeastern end of the Proposed Development site which is grassland.

7.3.2 Water Balance

Long term rainfall and evaporation data were sourced from Met Éireann. The 30-year annual average rainfall (1981 - 2010) recorded at Ardnacrushan station, located ~8km southwest of the Proposed Development site, are presented in Table 7-4 below. This is the closest station to the Proposed Development site.

Table 7-4: Local Average long-term Rainfall Data (mm)

Station		X-Coord (IG)		Y-Coord (IG)		Ht (MAOD)		Opened		Closed		
Ardnacrushan (GEN.STN.NO.2)		192,933		96,220		28		1952		N/A		
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
113.1	86.7	92.2	68.0	71.4	81.5	75.4	100.5	90.1	122.5	109.5	117.2	1128.1

The closest synoptic station[1] where the average potential evapotranspiration (PE) is recorded is at Shannon Airport station, approximately 15 kilometres southwest of the Proposed Development site. The long-term average PE for this station is 543.2mm/yr. This value is used as the best estimate of the site PE. Actual Evaporation (AE) at the site is estimated as 516mm/yr (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:

Effective rainfall (ER) = AAR – AE

= 1,128mm/yr – 516mm/yr

ER = 612mm/yr

Based on groundwater recharge coefficient estimates at the Proposed Development site, which is mapped at ~85% by the GSI (www.gsi.ie), an estimate of 520.3mm/year average annual recharge is given for the study area. This means that the hydrology of the study area is characterised by low surface water runoff rates and high groundwater recharge rates.

Therefore, annual recharge and runoff rates for the site are estimated to be 520.3mm/yr and 91.8mm/yr respectively. The presence of the underlying high permeability sand and gravel deposits means recharge rates will dominate over surface water flows.

7.3.3 Regional and Local Hydrology

On a regional scale, the Proposed Development site is located in the River Shannon catchment with the northern portion mapped in the Shannon Estuary North (Catchment ID 27) within the Owenogarney_SC_010 sub-catchment.

The southern portion of the Proposed Development site is located in the Lower Shannon (Catchment ID 25A) within the Shannon[Lower]_SC_080 sub-catchment.

[1] *A station at which meteorological observations are made for the purposes of synoptic analysis.*

The proposed extraction area is located in the Lower Shannon Catchment while the proposed restoration/infill area is located in both.

A regional hydrology map is shown as Figure 7-1.

In the Owenogarney_SC_010 sub-catchment, the Proposed Development site drains locally to the Broadford River (Broadford_010 river waterbody). The Broadford River flows through Loch an Dún, approximately 10km downstream of the site, prior to entering the Owenogarney River. Only infilling/restoration is proposed in the Owenogarney_SC_010 sub-catchment.

In the Shannon[Lower]_SC_080 sub-catchment, the Proposed Development site drains locally to the Bridgetown(Clare)_010 river waterbody (referred to as the Black River on OSI mapping). The Bridgetown River flows into the River Shannon approximately 6km downstream of the Proposed Development site. Aggregate extraction and infilling/restoration are proposed in the Shannon[Lower]_SC_080 sub-catchment.

A local hydrology map is shown as Figure 7-2.

7.3.4 Site Drainage / Water Management

Headwater streams of the Bridgetown River flow along the southwestern and southeastern boundaries of the Proposed Development site while a headwater stream of the Broadford River flows along the northern boundary of the site. A site drainage map is shown as Figure 7-3.

However, due to the presence of the underlying high permeability sand and gravel deposits, there is limited runoff from the site towards these rivers due to high groundwater recharge rates. Runoff rates are likely to be highest at the southwestern corner of the site (near site entrance) where a wetland/fen exists. The wetland/fen is drained by the western tributary of the Bridgetown River.

There is some runoff generated from the processing /yard areas (former concrete plant area) to the north of the reception building and this flows westerly under gravity towards an existing settlement pond/lagoon system located close to the western boundary where it percolates to ground. This discharge to ground is permitted by an existing discharge licence (WP 170). The discharge rate is limited to 113m^3/hour.

There is no overflow to the headwater stream of the Bridgetown River which flows immediately to the west of the settlement pond/lagoon system.

There is also manmade pond located on the west of the Proposed Development site that was previously used as a source of wash water for aggregate processing.

Water from the manmade pond was previously recycled back to the washing plant via pumps and a pipe network. The settlement ponds/lagoons and manmade pond is a closed system as there is no overflow to local watercourses. The pond is also receiving localised runoff from nearby access roads and previous processing areas located upslope to the east.

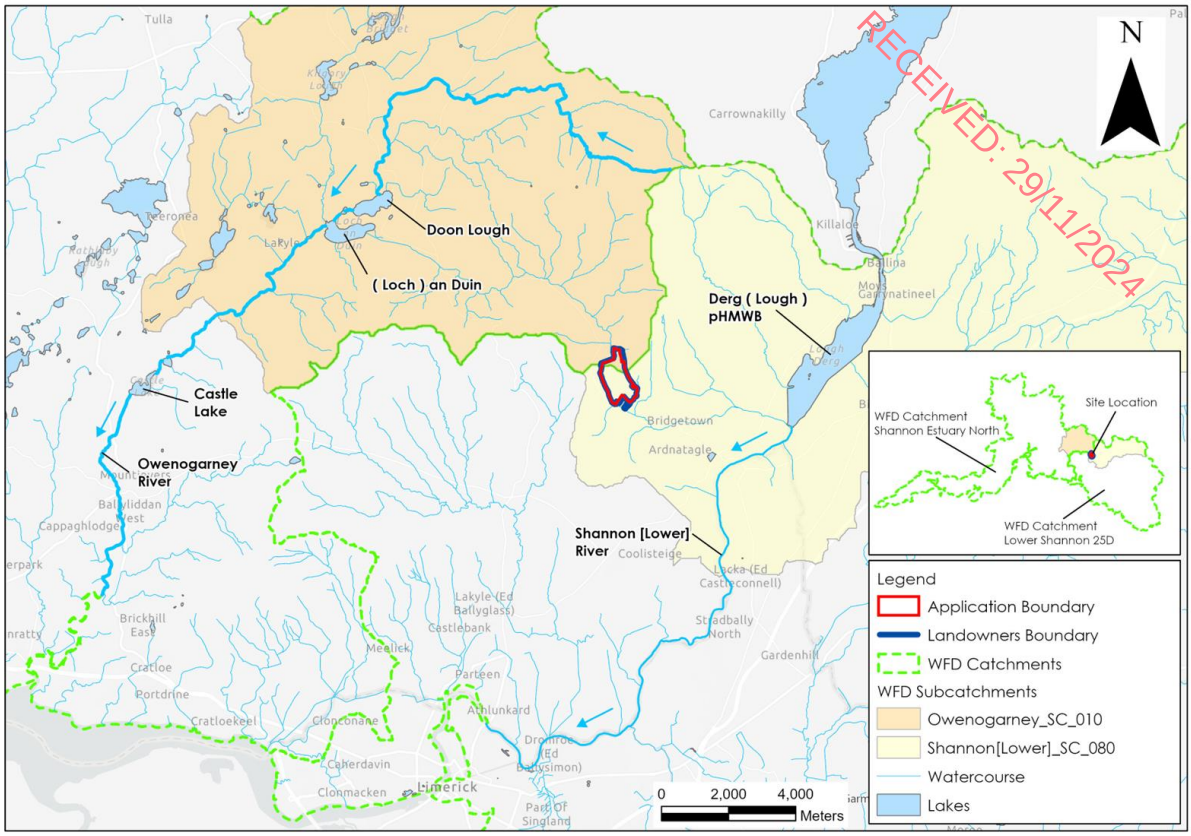


Figure 7-1: Regional Hydrology Map

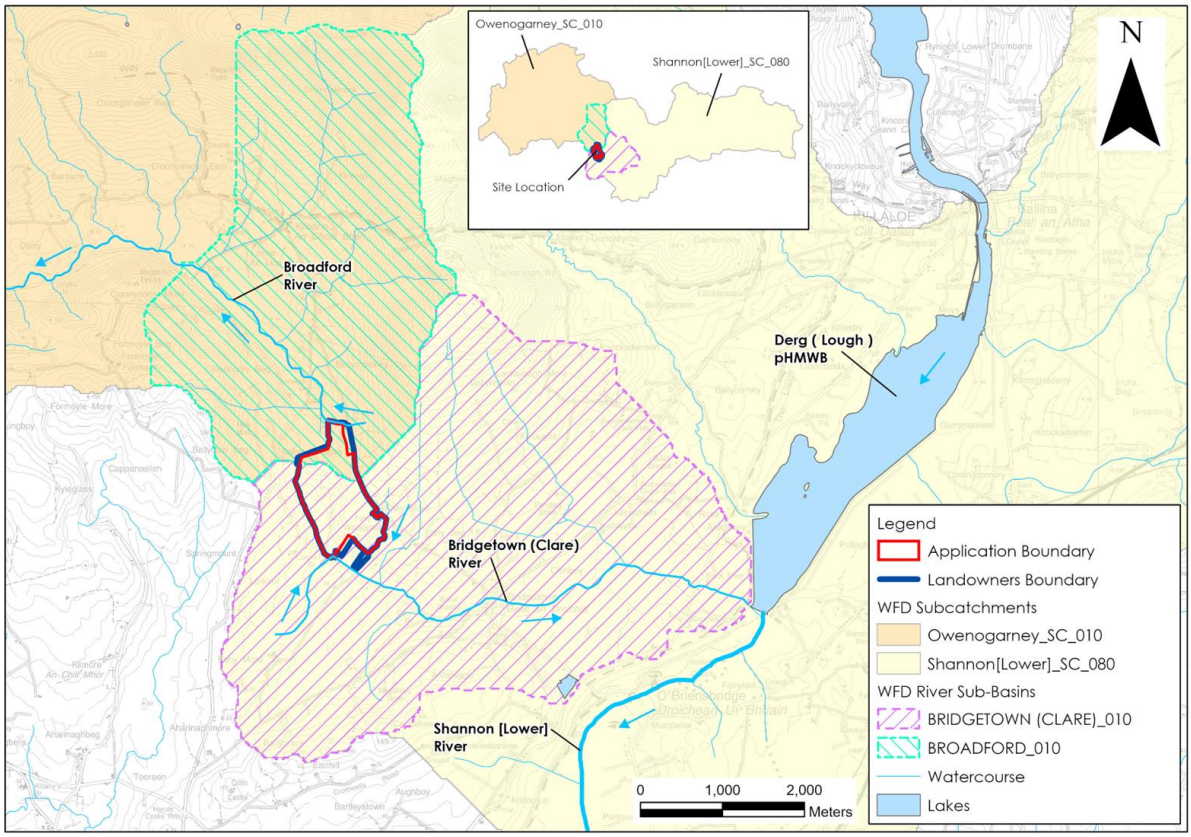


Figure 7-2: Local Hydrology Map

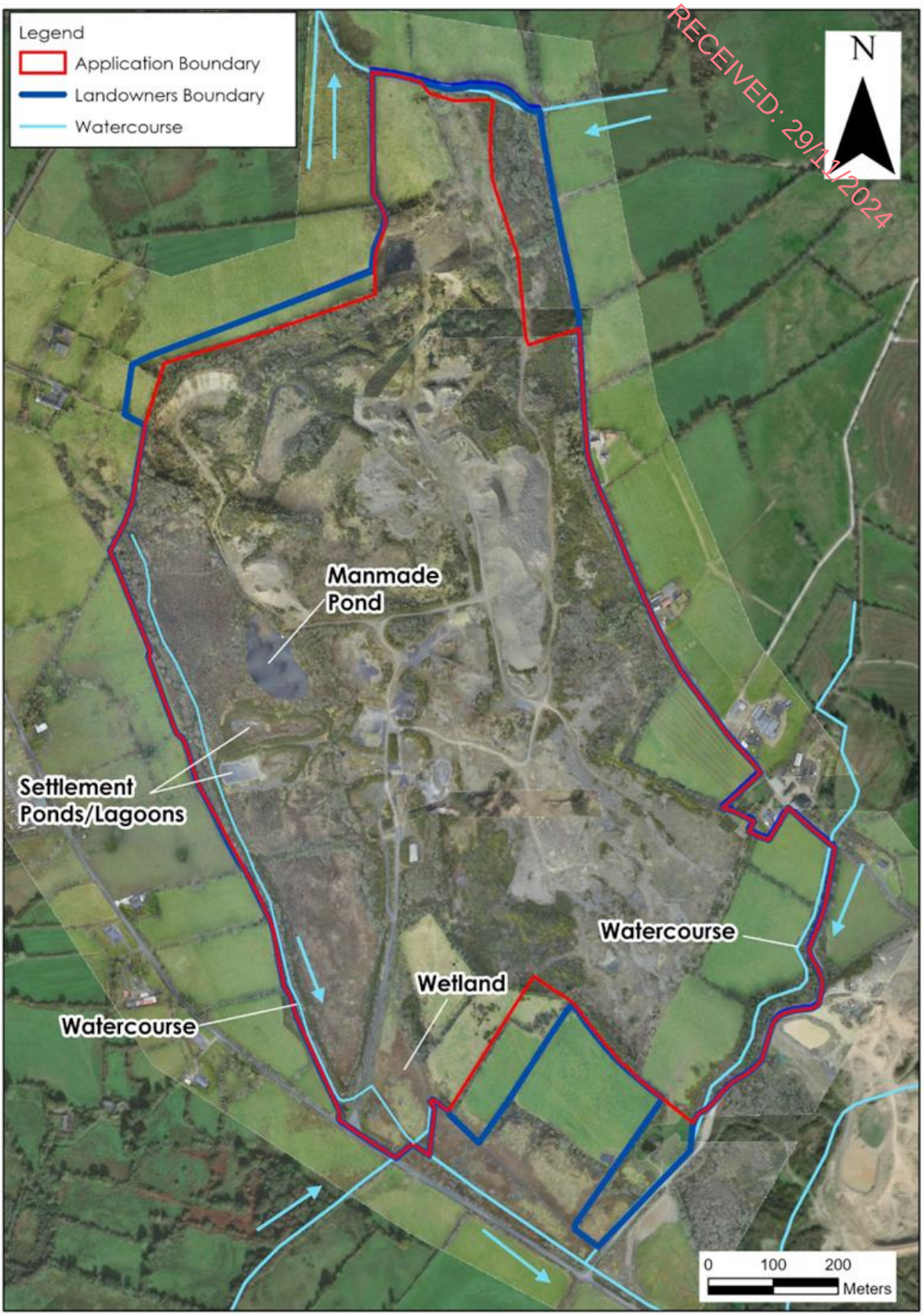


Figure 7-3: Site Drainage Map

7.3.5 Flood Risk Identification

This section is a summary of a site-specific flood risk assessment completed for the Proposed Development which is attached as Appendix 7-1.

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 site potentially 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 7-4).

The closest mapped recurring flood event is on the Bridgetown River immediately downstream of the Proposed Development site (Flood ID: 4696) where the R466 road is affected. According to the OPW Flood Hazard Mapping area engineer notes "*The R466 is flooded and impassable once every two years. Maximum depth of up to 300mm. Surrounding land is also flooded. Cause is rainfall/runoff and back up of stream due to poor maintenance of stream downstream".*

There is also a recurring flood event on the Broadford River approximately 3.5km downstream of the Proposed Development site (Flood ID: 4695) that's also affects the R466. *"Land on North side of R466 floods over an extensive area on average twice per year. Cause is rainfall/runoff causes stream running by road to overflow. Stream is in need of maintenance. Problem has only occurred in last 10 to 15 years since maintenance work on the stream was discontinued".*

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 OPW River Flood Extents Mapping available for the area of the Proposed Development site. The closest Flood Extents Mapping is located along the River Shannon.

OPW National Indicative Fluvial Mapping (NIFM) is available for Bridgetown River and Broadford River but no fluvial flood zones are mapped in the upper catchment areas where the Proposed Development site is located. NIFM mapping is shown as Figure 7-5 below.

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 or nearby.

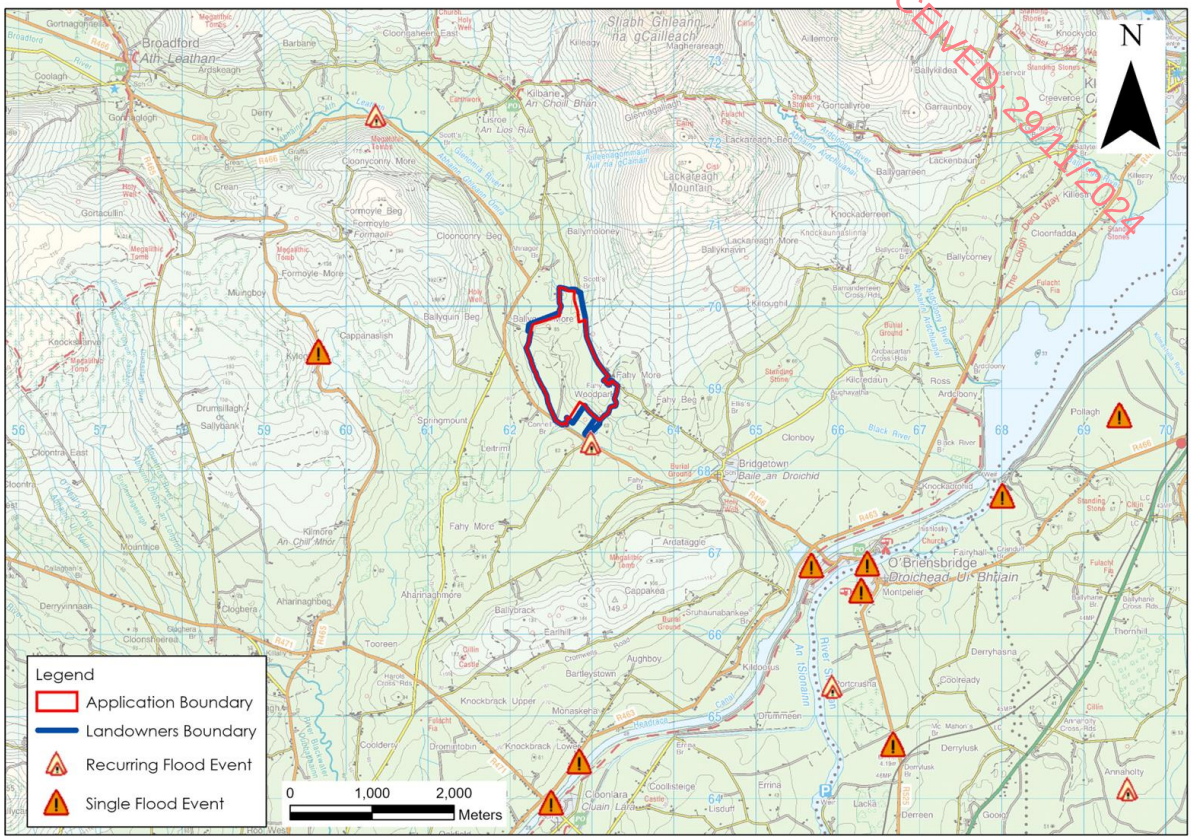


Figure 7-4: OPW Past Flood Event Mapping

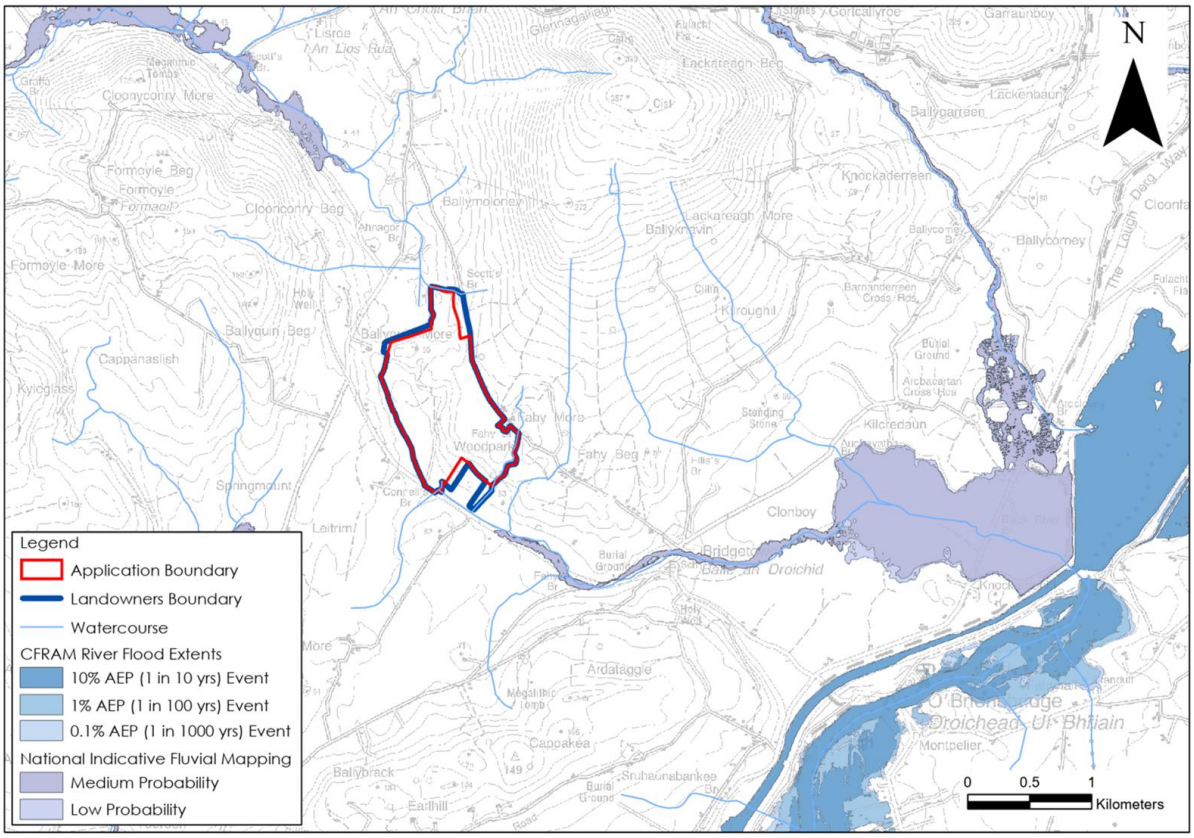


Figure 7-5: OPW NIFM and CFRAM Mapping

7.3.6 Surface Water Hydrochemistry

EPA Q-rating status data is available for both the Bridgetown (Clare)_010 and the Broadford_010 river waterbodies downstream from the Proposed Development site which range from Good to Moderate respectively. Summary information is shown in Table 7-5 below.

Table 7-5: EPA Q Rating Status for surrounding river bodies

WFD River Body	Station Name ID	Station Code	Q Value Score	Q Value Status
Bridgetown (Clare)_010	Fahy Br	RS25B230100	4	Good
Broadford_010	Scott's Bridge	RS27B020500	3-4	Moderate

Surface water sampling and field hydrochemistry (measurements of electrical conductivity (µS/cm), pH (pH units) and dissolved oxygen (%) were taken from the Bridgetown River (SW1) and Broadford River (SW2) downstream of the Proposed Development site on 27th September 2023 and 13th November 2023 (refer to Figure 7-2 for the monitoring location). Field hydrochemistry results as shown in Table 7-6 below.

Electrical conductivity values for the local streams ranged between 203µS/cm and 278µS/cm which would be typical of streams in a catchment underlain by non-calcareous bedrock (i.e. sandstone, mudstones etc). pH values ranged from 7.3 to 7.4 which is also typical for this geological setting.

Dissolved oxygen saturation ranged between 82% and 89%. 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 7-6: Field Hydrochemistry

Field Parameter	SW1		SW2	
	27/09/2023	13/11/2023	27/09/2023	3/11/2023
EC (µS/cm)	278	230	203	220
pH (pH Units)	7.4	7.3	7.3	7.3
Dissolved Oxygen %	86	85	82	89

Surface water grab samples were also taken on the dates mentioned above. Results of laboratory analysis are show in Table 7-7 below alongside relevant Environmental Quality Standards (EQS) values for surface water. The original laboratory reports are attached as Appendix 7-2.

Table 7-7: Surface Water Sample Results

Parameter	EQS	SW1		SW2	
		27/09/2023	13/11/2023	27/09/2023	13/11/2023
Total Suspended Solids (mg/L)	25(+)	6	<5	6	<5
Ammonia N (mg/L)	Good Status: ≤0.065 High Status ≤ 0.04(*)	0.04	0.02	0.03	0.03
Nitrite NO_2 (mg/L)	-	<0.05	<0.05	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	Good Status ≤ 0.035 to High Status: ≤0.025(*)	<0.02	<0.02	<0.02	<0.02
Nitrate - NO_3 (mg/L)	-	<5	<5	<5	<5
Phosphorus (mg/L)	-	<0.1	<0.01	0.1	<0.01
Chloride (mg/L)	-	12.9	12.3	11.2	13.4
BOD	Good Status: ≤ 1.5 High Status: ≤ 1.3(*)	1	1	1	1

(+) 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 two 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 results being equal or below the laboratory detection limit.

For ammonia, orthophosphate and BOD, all results for both rounds achieved "High Status" threshold with respect the Surface Water Regulations (S.I. 272/2009).

7.3.7 Regional and local Hydrogeology

According to WFD mapping, the Proposed Development site straddles 3 no. groundwater bodies (GWBs). The Proposed Development site sits within the Broadford Gravels GWB (EU_CD: IE_SH_G_095) which in turn is underlain by 2 no. bedrock GWBs, namely the Tulla-Newmarket on Fergus GWB (E_SH_G_229) and Lough Graney GWB (IE_SH_G_157). GSI aquifer mapping for the area is shown as Figure 7-6 below.

The Broadford Gravels GWB, which is referred to as the Bridgetown GWB by the GSI, is classified as a Locally Important Gravel Aquifer (Lg) while the Tulla-Newmarket on Fergus GWB and Lough Graney GWB, which are both bedrock GWBs, are listed as "Poorly Productive" by the WFD and comprises Locally Important Aquifer and Poor Aquifers according to GSI classification.

The Tulla-Newmarket on Fergus GWB and Lough Graney GWB in the area of the Proposed Development site comprises variations of sandstone, mudstone and greywacke.

The bedrock aquifers are devoid of intergranular permeability; groundwater flow occurs in fractures and faults. In the main, the rocks are dependent on fracturing and fissuring to enhance their permeability. Most of the flow originates in the shallow zone near the top of the aquifer, although faulting in certain areas can act as both high transmissivity zones that concentrate groundwater flow and as groundwater flow barriers.

Permeabilities in the upper few metres are often high although they decrease rapidly with depth. In general, groundwater flow is concentrated in the upper 15 m of the aquifer. Evidence of the relatively

low permeabilities is provided by the drainage density and flashy runoff response to rainfall in areas underlain by Devonian rocks.

Groundwater flow paths are generally short, with groundwater discharging to springs, or to the streams and rivers that traverse the aquifer. Flow directions are expected to approximately follow the local surface water catchments and to be determined by local topographic variations. There is no regional groundwater flow.

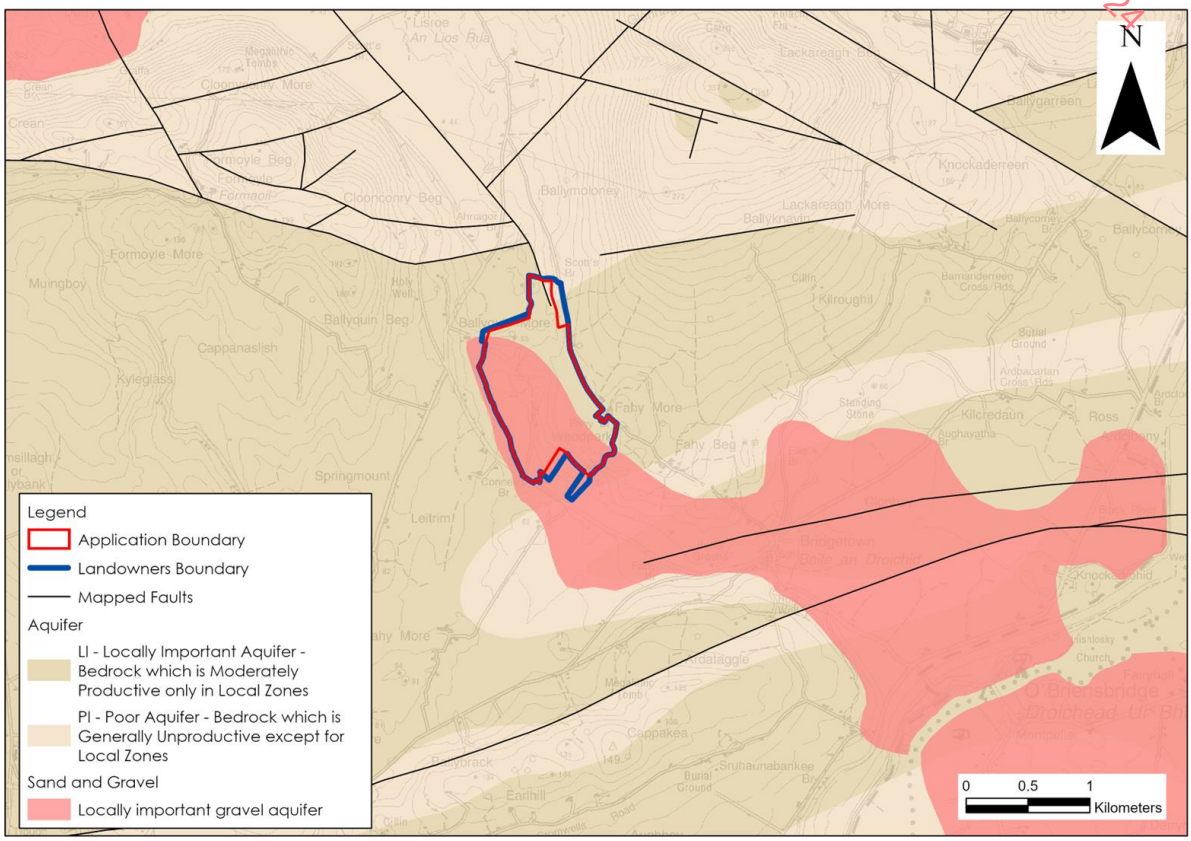


Figure 7-6: GSI Aquifer Mapping

7.3.7.1 Site Hydrogeology

Based on the GSI bedrock map of the region, the majority of the Proposed Development site is underlain by undifferentiated Old Red Sandstone (ORS). The northern edge of the Proposed Development site is mapped to be underlain by the Broadford Formation. The bedrock in turn is overlain by sand and gravels which have varying amounts of silts and clays.

The ORS are classified as a Locally Important Aquifer (bedrock which is moderately productive only in local zones), while the Broadford Formation is classified as a Poor Aquifer. The ORS underlie all the proposed sand and gravel extraction area and the majority of the proposed infill area. A small section on the north of the proposed infill area is underlain by the Broadford Formation. The sand and gravel which overlie the bedrock at the site are classified as Locally Important Aquifer by the GSI.

Site investigations carried out at the Proposed Development site (refer to the Land, Soils and Geology Chapter 6) show that between 4 and >10m of sand and gravel is present at the site. At the northern and central areas of the site, the sand and gravel is underlain directly by bedrock at the investigation locations (GW1 & GW2). While at the southern end of the Proposed Development site, the sand and gravel is underlain by gravelly CLAY at the investigation locations (GW3 & GW4).

SANDSTONE was encountered in the 3 no. boreholes that met bedrock and was typically described as light brown, medium strong to very strong. Occasional fracturing was only reported in one hole (GW1).

Continuous groundwater level monitoring was commenced in all four boreholes in February 2023 when data loggers were installed in each borehole.

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

The depth to the groundwater table at the monitoring locations ranged from approximately ~0.6m to ~35mbgl which is a reflection of the topography/site ground elevations. The deepest groundwater level was recorded in GW3 where groundwater levels were below the top of bedrock (i.e. the sand and gravels overlying the bedrock are unsaturated). GW3 is highest elevated borehole (86.5m OD) which is located on the southeast of the Proposed Development site.

The shallowest groundwater level was recorded in GW2 where a thickness of groundwater saturated sand and gravels of just under 10m were recorded (the total depth of sand and gravel over bedrock at GW2 was not confirmed). Groundwater saturated sand and gravels are also present at the location of GW1 where over 6m of saturated deposits were recorded. Ground elevations in the area of GW1 and GW2 are at approximately 53.5m OD.

Groundwater level elevations across the Proposed Development site ranged from approximately 53m OD to 47m OD and suggest a westerly / south-westerly groundwater gradient/flow direction.

Groundwater gradients appear to reflect topography which is expected in this locally/poor important aquifer type due to localised groundwater flowpaths. The seasonal groundwater level range/variation across the Proposed Development site is approximately 1 – 2.5m.

The maximum recorded groundwater level elevation across the proposed extraction area was between 53.384 (GW3) and 52.955m OD (GW2).

Table 7-8: Summary of Continuous Groundwater Level Monitoring

BH ID	G.L (m OD)	Top of Bedrock (m OD)	Base of Sand & Gravel (m OD)	Minimum WL		Maximum WL	
				mbgl	m OD	mbgl	mOD
GW1	53.529	43.029	43.029	5.153	48.376	3.887	49.642
GW2	53.587	<43.587	<43.587	2.655	50.932	0.632	52.955
GW3	86.515	76.915	82.515	35.682	50.833	32.809	53.706
GW4	51.269	44.169	47.069	5.217	46.052	4.095	47.174

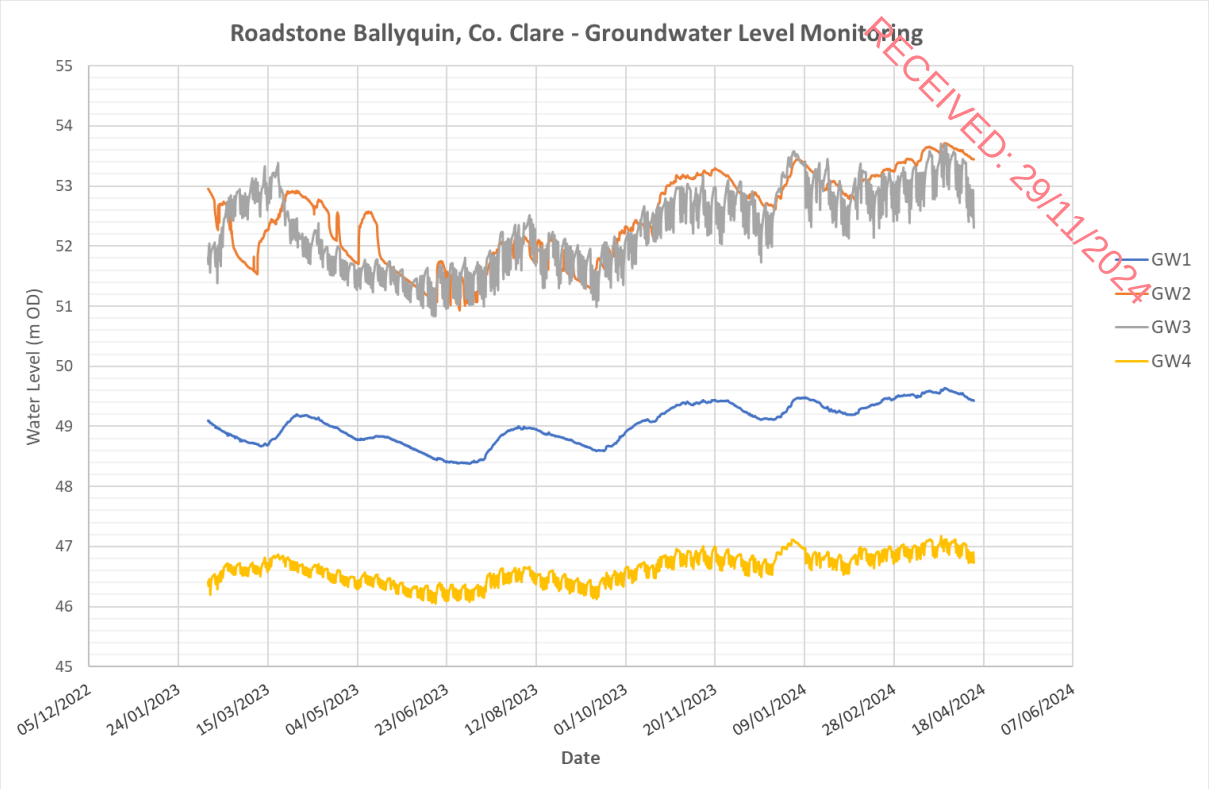


Figure 7-7 : Groundwater Level Plots

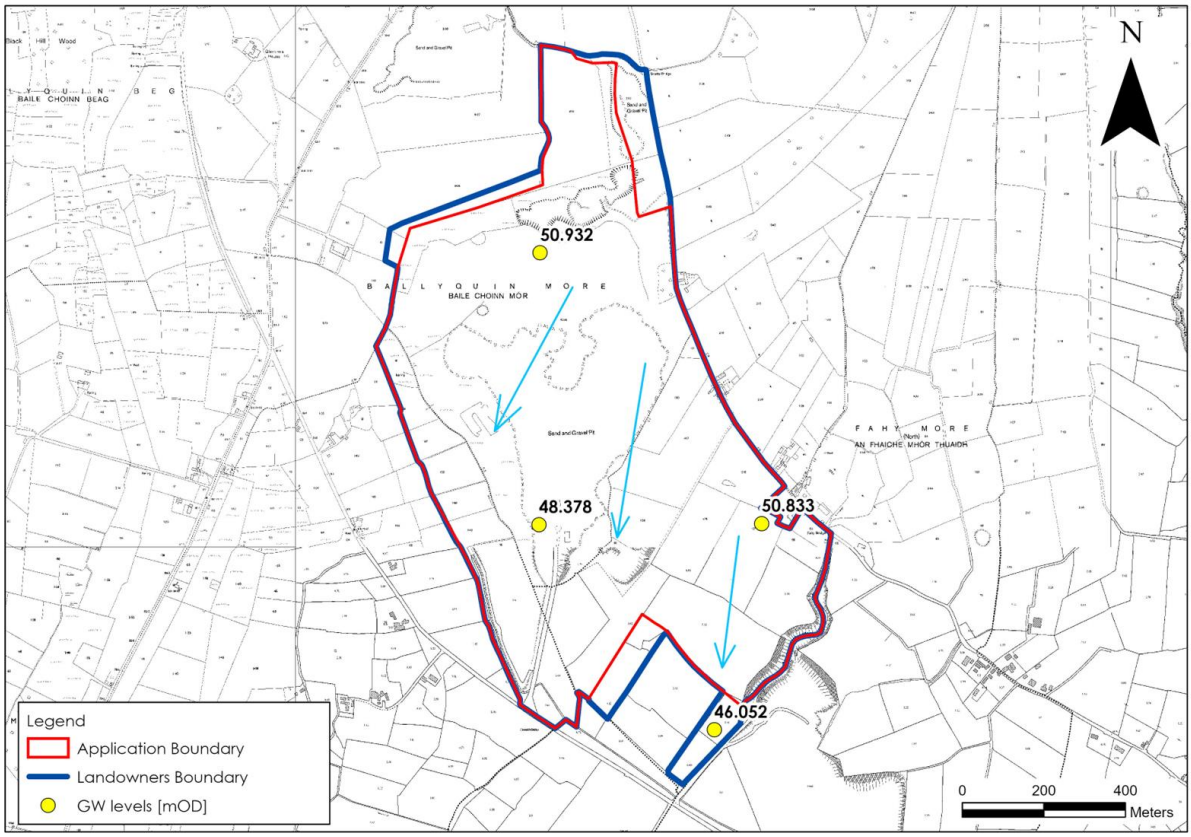


Figure 7-8 : Groundwater Levels and Flow Direction

7.3.8 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 7-9 below).

Based on the GSI groundwater vulnerability online mapping (www.gsi.ie), the Proposed Development site is mapped mainly as having "High" groundwater vulnerability which is due to presence of sand and gravel deposits. The area of wetland/fen located at the northwestern and southwestern corners of the site are rated as "Moderate" groundwater vulnerability.

The GSI groundwater vulnerability rating assumes high permeability for the subsoils which is consistent with sand and gravels encountered during the site investigations, particularly at the locations of boreholes GW1 and GW2.

During the recent site investigations, the thickness of sand and gravels was found to be between 4 and >10m. However, the presence of sandy gravelly CLAYs beneath the sand and gravels, as found at GW3 and GW4, means a "Moderate" vulnerability is more appropriate for these areas.

Therefore, based on the investigation data, the vulnerability rating for the Proposed Development site varies from "Moderate" to "High" over the Proposed Development areas.

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 7-9: GSI Groundwater Vulnerability Rating Criteria

7.3.9 Groundwater Hydrochemistry

Groundwater sampling of GW1 – GW4 was carried out by HES on 6th July 2023. In terms of groundwater flow direction, GW1 and GW4 are at a down-gradient location and GW2 and GW3 are at an up-gradient location within the Proposed Development site.

Tabulated groundwater quality data are attached as Appendix 7-3. Results of analysis are shown alongside relevant groundwater regulation and drinking water regulation values (S.I. No. 366/2016 and S.I. No. 99/2023). Laboratory certificates are shown in Appendix 7-4.

There was no exceedance with regard to the groundwater regulation values. There was one exceedance relating to the drinking water regulations and this was for manganese in GW3 which was slightly above the threshold value.

Manganese (and in many instances also Iron) are commonly naturally elevated in groundwaters. It's worth noting that there was no detection of hydrocarbons which is one of the main potential contaminants at quarry sites.

Nutrients such as nitrate, nitrite, phosphorus, orthophosphate and ammonia were typically present in low to moderate concentrations.

Ranges for electrical conductivity (186 - 297µS/cm) and pH (6.7 – 7.6) and hardness 300 – 400mg/L) values are typical for a non-calcareous aquifer (i.e. sandstone).

7.3.10 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 7-5. A summary of waterbody status and risk is shown below.

7.3.11 Surface water Body Status

Local Groundwater Body and River Waterbody status information are available (www.catchments.ie).

The Broadford_010 has a current WFD status of "Moderate" according to the latest cycle (2016-2021) and is deemed to be "at risk" of missing out on its WFD objectives by 2027, according to the WFD Risk 3rd Cycle. Downstream of this, the Broadford_020 has a "Good" status according to the WFD 2016-2021 Status and is deemed to be "at risk" according to the Risk 3rd Cycle, of missing out on the WFD objectives by 2027.

The Bridgetown (Clare) SWB has a WFD 2016-2021 Status of "Good" and is deemed by the Risk 3rd Cycle to be "Not at risk" of missing out on the WFD's 2027 objectives. This SWB flows into the Shannon Lower_050, which has a WFD 2016-2021 Status of "Poor" and is currently "At risk" of missing out on the 2027 WFD objectives, according to the Risk 3rd Cycle.

Please refer to the WFD Assessment Report (Appendix 7-5) for a review of all waterbodies in connectivity with the Proposed Development.

7.3.12 Groundwater Body Status

The Broadford Gravels GWB, Tulla-Newmarket on Fergus GWB and Lough Graney GWB have a current WFD status of "Good" and are "Not at Risk" of missing the objectives set out by the WFD by 2027.

7.3.13 Designated Sites & Habitats

Proposed Natural Heritage Areas (pNHAs), Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSAC) and Special Protection Areas (SPAs) are all considered within this section of the report. The Proposed Development site is not located within or adjacent to any designated site.

The closest designated site to the Proposed Development site is Glenomra Woods SAC and pNHA (Site Code: 001013) and is located ~1.5km to the southwest and hydrologically remote from the Proposed Development.

Glenomra Wood is a deciduous woodland located in south-east Co. Clare, about 10 km north of Limerick city. The site is a Special Area of Conservation (SAC) selected for the presence of Old Oak Woodlands. There is no surface water or groundwater interaction between the Proposed Development site and this designated site.

The Lower River Shannon SAC is located 3.5km to the southeast of the Proposed Development site.

Bridgetown River and Broadford River drain into the Lower River Shannon where the respective downstream distance to the SAC is approximately 6km and 28km.

7.3.14 Water Resources

7.3.14.1 Surface Water Resources

No surface watercourses in the vicinity or immediately downstream of the Proposed Development site are identified as Drinking Water Protected Areas (DWPAs). The closest surface water DWPA is the Shannon (Lower)_060 which is located approximately 12km downstream of the Proposed Development site via the Bridgetown River.

7.3.14.2 Groundwater Resources

There are no groundwater source protection areas mapped within the Proposed Development site or its locality.

According to the GSI well database (www.gsi.ie) there are several private wells located along the R466 to the southwest of the Proposed Development site. Groundwater flow direction in the area of the Proposed Development site is also to the southwest and therefore these wells are potentially located down-gradient of the Proposed Development.

7.3.15 Receptor Sensitivity

Due to the presence of permeable sand and gravel deposits underlying most of the Proposed Development site, groundwater will be the main sensitive receptor with respect of potential oil/fuel leaks and spills from plant and machinery. There is also an existing discharge licence which permits discharge to ground from any surface water generated from the processing areas of the site.

Based on criteria set out in Table 7-3 above, groundwater at the site is classed as Medium Importance because the bedrock and sand and gravel aquifers are classified as a Locally Important.

Nevertheless, local surface waters such as the Bridgetown River and Broadford River are considered to have a High Importance due to the presence of the Lower River Shannon SAC downstream of the site.

Whilst runoff rates to local watercourse will be low due to the presence of permeable sand and gravel deposits, an indirect hydrological link is likely to exist via lateral groundwater flow, with groundwater expected to discharge into the Bridgetown River and Broadford River as baseflow.

There is also a proposal for groundwater abstraction at the site which may have quantitative effects (i.e. levels and flows). Furthermore, there is a potential pathway to downstream receptors (private wells/designated sites) indirectly via groundwater flow in underlying sand and gravels as well as bedrock.

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.

7.3.16 Proposed Site Infrastructure and Drainage Management

The proposed works will include the use of the existing water management infrastructure along with some additional measures for water management:

The proposed water management infrastructure and how it will interact with existing infrastructure is described below:

- Construction of new silt lagoons (3 no.) and 1 no. settlement pond at the proposed washing plant location for management of fines/sediments and dirty water from washing process (refer to Drawing P1623-1-0524-A3-Figure1-00A);
- Water consumption rate for washing is estimated to be 320m^3/day (9hr working day) and the proposed settlement pond is sized accordingly;
- The majority of the clean water from the proposed settlement pond will be pumped back to the washing plant;
- Over flow from the proposed settlement pond at the washing plant will be diverted to the existing lagoons on the west of the site for discharge to ground as permitted by the existing discharge licence WP170;
- Water for topping up the washing plant will be sourced, as previously done, from the existing manmade pond on the west of the site where the pumps and pipework are still in place (i.e. this manmade pond intercepts the groundwater table);
- The pumped water from the pond will essentially be recycled water from the washing plant that will be discharged to ground at the nearby discharge lagoon;
- Management of surface water from the inspection area, the wheelwash area and ancillary buildings will be directed through the existing lagoons on the west of the site;
- Drainage from the refuelling area will be routed through a proposed full hydrocarbon interceptor before discharging to the existing lagoons on the west of the site for final discharge to ground as permitted under WP170. There will be an inspection chamber between the oil interceptor and lagoons for inspection/sampling;
- Runoff from the infill areas will be directed into newly constructed drains/swales situated along the perimeter of the infill areas;
- These swales will be unlined and the high permeability subsoils will allow any surface water runoff to recharge to groundwater (as is currently the case);
- Any sediment which settles at the base of the swales will be removed at regular intervals to maintain the permeability of the swales; and,
- Sanitary wastewater from the Proposed Development will be collected in sealed tanks and taken off-site for disposal at a wastewater treatment plant.

7.4 Likely and Significant Effects and Mitigation Measures

7.4.1 Do Nothing Scenario

If the Proposed Development is not permitted, the site will remain as an excavated open pit void. The site would remain largely unaltered as a result of the Do-Nothing Scenario. The opportunity to restore the quarry void to deliver high quality restoration and long-term benefits would be lost.

7.4.2 Characteristics of the Proposed Development

7.4.3 Construction Phase

Initial preparation/construction work requirements at the site will include stockpiling of topsoil removed from proposed extraction areas that will be used for future implementation of a final restoration plan. The construction phase also includes for the construction of a soil inspection shed, refuelling area, settlement ponds, road improvements, drainage network and berms.

7.4.4 Operational Phase (Extraction and Infilling concurrently)

The operational phase includes the concurrent extraction of sand and gravel and the importing of inert material for infilling.

The proposed continued extraction of sand and gravel will occur over a 16.3ha area. The majority of this area has previously been worked with the exception of 1.8ha of agricultural land located at the southeastern end of the Proposed Development site.

It is intended to extend the extraction area of the existing quarry horizontally and vertically using mechanical excavation techniques. The depth of sand varies across the extraction area, as a result levels of excavation will vary from approx. 76m OD in the north of the site to 57.5m OD in the south of the site. The zone of sand ranges from 7 to 14m in thickness. Extraction of sand will stop when rock is met. There will be no extraction of rock. It has been calculated that approximately (1,428,571 tonnes) of material will be extracted.

The aggregate that will be extracted will be washed and processed on-site. Wash water from aggregate processing/washing plant will be passed through a series of proposed settlement ponds/lagoons and existing lagoons/ponds before being recycled back to wash plant for reuse. There will be no discharge to surface waters from the washing process.

The proposed infilling/restoration of the existing and future pit voids covers an area of approximately 34 hectares. It is proposed to import approximately 4,471,200 tonnes of inert soil and stone material for the infilling purposes.

7.4.5 Final Restoration Phase

The proposed infill area will be backfilled to original land contours and restored for beneficial afteruse.

Following completion of the infilling works, topsoil will be placed (approximately 300 mm depth) and the soils will be rolled and reseeded with grasses to bring the site into agricultural use.

7.4.6 Likely Significant Effects and Mitigation Measures Construction Stage

The likely effects of the Proposed Development and mitigation measures that will be put in place to eliminate or reduce them are shown below.

There are minor construction works and site preparation works required at the construction stage to prepare the site for the proposed extraction and infill works. These construction stage works are assessed below.

7.4.6.1 Earthworks (Removal of Vegetation Cover, Excavations and Stock Piling) Resulting in Suspended Solids Entrainment in Surface Waters

Excavation of soil and subsoil will be required for site levelling and for the installation of infrastructure and new concrete hardstands for the refuelling area and quarantine building.

Potential sources of sediment-laden water include:

- Excavation of soil/subsoil and site levelling of area for refuelling area and quarantine building which may result in the generation of a source of suspended solids; and,
- Construction/upgrade of access roads, weighbridge and wheelwash resulting in the entrainment of sediment from any excavations during construction.

These activities have the potential to cause the release of suspended solids to local surface watercourses or overland flow arising on site following heavy rainfall. However, due to the presence permeable subsoils across most of the Proposed Development, runoff rates to local watercourses will be low.

Pathway: Drainage routes and overland flow.

Receptors: Down-gradient surface waters (Bridgetown River & Lower River Shannon).

Pre-Mitigation Potential Effects: Negative, indirect, slight, temporary unlikely effect on down-gradient surface waters.

Proposed Mitigation Measures:

- Drainage from the development reception area will be directed towards the existing lagoons on the west of the Proposed Development site;
- Prior to the commencement of earthworks, silt fencing will be placed down-gradient of the construction areas where surface water may drain towards local watercourses. These will be embedded into the local soils to ensure all site water is captured and filtered;
- Daily monitoring and inspections of any constructed site drainage channels during the construction phase will be completed; and
- Earthworks will take place during periods of low rainfall to reduce run-off and potential siltation of watercourses.

Residual Effects:

Construction earthworks could result in elevated suspended solid concentrations entering local watercourses. However, the fact that the majority of this runoff water from the proposed reception upgrade areas can be collected and discharged to the ground at the existing lagoons means the effect is negative, imperceptible, indirect, temporary, unlikely effect on downstream surface water quality.

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

7.4.6.2 Potential Release of Hydrocarbons during Construction Stage

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a significant pollution risk to groundwater, surface water and associated ecosystems, and to terrestrial ecology. The accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, including fish, and is persistent in the environment. It is also a nutrient supply for adapted micro-organisms, which can rapidly deplete dissolved oxygen in waters, resulting in the death of aquatic organisms.

Pathway: Surface water runoff and groundwater recharge.

Receptor: Groundwater (Broadford Gravels GWB, Tulla-Newmarket on Fergus GWB and Lough Graney GWB) and surface water (Bridgetown River, Broadford River & Lower River Shannon).

Pre-Mitigation Potential Effects: Indirect, negative, moderate, short term, unlikely effects on local groundwater quality. Indirect, negative, slight, temporary, unlikely effects on surface water quality.

Proposed Mitigation Measures:

Mitigation measures proposed to avoid the release of hydrocarbons at the Proposed Development site are as follows:

- No plant maintenance will be completed on site. Any broken-down plant will be removed from the site to be fixed;
- Refuelling will be completed in a controlled manner within the proposed refuelling area which will be served by an oil interceptor;
- Mobile double skinned bowser will used outside the refuelling area;
- A spill kit with absorbent material and pads in the event of any accidental spillages will be kept in the bowser. Drip trays and fuel absorbent mats will be used during all refuelling operations;
- Refuelling will be carried out by trained personnel only;
- Fuels stored on site during construction will be minimised. Fuel storage areas will be served by an oil interceptor; and,
- The plant used during construction will be regularly inspected for leaks and fitness for purpose.

Residual Effects: The potential for the release of hydrocarbons to groundwater and watercourse receptors is a risk. However, proven and effective measures to mitigate the risk of releases of hydrocarbons have been proposed above for the construction phase and these will break the pathway between the potential source and each receptor. The residual effect is negative, indirect, imperceptible, temporary, unlikely effect on local groundwater and surface water quality.

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

7.4.6.3 Potential Release of Cement-Based Products

Concrete and other cement-based products are highly alkaline and corrosive and can have significant negative impacts 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 $\geq 6 \leq 9$ is set in S.I. No. 293 of 1988 Quality of Salmonid Water Regulations, with artificial variations not in excess of ± 0.5 of a pH unit.

Pathway: Very limited site drainage network.

Receptor: Surface water (Bridgetown River & Lower River Shannon).

Pre-Mitigation Potential Effects: Indirect, negative, slight, temporary, unlikely effect on surface water.

Proposed Mitigation Measures:

The following mitigation measures are proposed:

- Where concrete is used on site, only the chute will be cleaned, using the smallest volume of water practicable. Washout will be into a skip or dedicated concrete washout area.
- No discharge of cement contaminated waters to the site phase drainage system or directly onto bare ground; and,
- The pour site (*i.e.* soil inspection shed floor slab) will be kept free of standing water and plastic covers will be ready in case of a sudden rainfall event.

Residual Effects: The requirement for cement use during the construction phase is minimal. Nevertheless, the proposed measures outlined above and will break the pathway between the potential source and each receptor. The residual effect is negative, imperceptible, indirect, temporary, unlikely impact to surface water and groundwater quality.

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

7.4.7 Operational Phase - Likely Significant Effects and Mitigation Measures

7.4.7.1 Impacts on Groundwater Vulnerability Rating due to Aggregate Extraction

The removal of sand and gravel from the extraction area will increase the groundwater vulnerability of the underlying bedrock aquifer. This will result in a likely and long term effect on the local groundwater vulnerability.

Pathways: Aggregate extraction.

Receptors: Groundwater vulnerability rating (Broadford Gravels GWB, Tulla-Newmarket on Fergus GWB and Lough Graney GWB).

Pre-Mitigation Potential Effect: Negative, reversible, 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 baseline vulnerability rating which is “Moderate” to “High”.

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 operational phase will be employment of best practice measures with respect to oil usage and refuelling of plant and machinery (Section 7.4.6.5 below) as well as ensuring that the imported material is suitable for inert waste infill (Section 7.4.6.2 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 similar level of protection to groundwater, if not greater, to the greenfield/baseline scenario.

Post Mitigation Residual Effect:

The application of best practice methods with regard oils and fuels, waste acceptance checks and the proposed restoration plan means effect on groundwater vulnerability will be negative, long-term, reversible, 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.

7.4.7.2 Potential Effects on Groundwater Quality due to Imported Fill Material

The Proposed Development involves importing inert soil and stone material or stone by-product. Infilling of the Proposed Development site with inert material will pose a low risk to groundwater quality regardless of the vulnerability rating as no harmful contaminants will be present. In addition, the material will not contain either organic matter or liquids that will form a source of organic contaminants of microbial pathogens, nor provide a substrate to feed microbial pathogens.

Pathway: Groundwater recharge and flowpaths.

Receptor: Groundwater (Broadford Gravels GWB, Tulla-Newmarket on Fergus GWB and Lough Graney GWB).

Pre-Mitigation Potential Effects: Negative, slight, indirect, long term, likely, effect on groundwater quality.

Proposed Mitigation Measures:

Infilling of the Proposed Development site with inert soil and stone material or stone by-product will pose a low risk as no harmful contaminants will be present.

- The following procedures will be put in place to ensure only suitable material is imported to the Proposed Development site: as per EPA Guidance on Soil Recovery Waste Acceptance Criteria (2020) and the Consultation Paper Regulation 27(7) National By-Product Criteria for Greenfield Soil and Stone used in Developments" (2022);
- Pre-agreed source sites for inert material ensuring; no pollutants, unauthorised material, invasive species;
- Testing of the imported soil material prior to arriving at site and additional testing if required within a purpose built soil inspection shed;
- The site will operate under a dedicated Environmental Management System;
- All required pollution prevention measures will be implemented at the site;
- The operator will prepare and implement an Emergency Response procedure;
- The operator will complete environmental monitoring, including local groundwater monitoring;
- Phased restoration of the site will be implemented, and it will end with the closure of site;

- The operator will have a documented recording procedure for all material entering the site; and,
- No unauthorised dumping of waste will be allowed at the Proposed Development site.

Residual Effects: The importation of soil and subsoil is an integral part of the Proposed Development. Proven and effective control measures to mitigate the risk of contaminated soils being imported to the Proposed Development site are outlined above. Application of these controls means the residual effect is considered to be negative, indirect, imperceptible, long term, unlikely effect on groundwater quality.

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

7.4.7.3 Potential Impacts on Local Well Supplies

Potential impacts on local groundwater wells can potentially occur if the imported soil/stone material does not conform to its inert status. Spills of oils and fuels have also the potential to affect groundwater quality in local supplies. There will be no potential to affect groundwater levels or flows towards the wells.

Pathway: Groundwater flowpaths

Receptor: Groundwater quality (Broadford Gravels GWB, Tulla-Newmarket on Fergus GWB and Lough Graney GWB).

Pre-Mitigation Potential Effects: Negative, indirect, slight, long term, unlikely, effect on the local groundwater quality.

Proposed Mitigation Measures:

The measures outlined in Section 7.4.6.2 above will ensure the risk to groundwater quality from inappropriate imported material will be very low.

Mitigation measures relating to the use, handling and storage of oils and fuels are shown in Section 7.4.5.2 above and Section 7.4.6.5 below.

Residual Effects: Proven and effective control measures to mitigate any risks to groundwater quality at the Proposed Development site are outlined above. Application of these controls will ensure no residual effects on local groundwater wells will occur.

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

7.4.7.4 Effects on Groundwater Vulnerability due to Infilling

As outlined above it is proposed to import either inert soil and stone material or stone by-product. The groundwater vulnerability after the infilling will be lower as the fill will provide aquifer protection at the site where aggregate extraction previously took place. The baseline groundwater vulnerability rating is currently Moderate to High.

Pathway: Groundwater recharge.

Receptor: Groundwater (Broadford Gravels GWB, Tulla-Newmarket on Fergus GWB and Lough Graney GWB).

Pre-Mitigation Potential Effects: Positive, slight, direct, permanent, likely effect on the local groundwater vulnerability rating and aquifer protection.

Proposed Mitigation Measures:

In terms of affecting the groundwater vulnerability of the site, the importing of the inert fill will have a positive effect on the site in that the groundwater vulnerability will be lower (i.e. less vulnerable) due to increased coverage. No direct mitigation measures in relation to groundwater vulnerability are required.

Residual Effects: Direct, positive, slight, direct, permanent, likely effect on groundwater vulnerability rating and improvement in aquifer protection.

Significance of Effects: For the reasons outlined above, there will be a reduced groundwater vulnerability rating through enhanced aquifer protection.

7.4.7.5 Potential Release of Hydrocarbons

Accidental spillage during refuelling of operational plant with petroleum hydrocarbons has the potential to be a significant pollution risk to groundwater, surface water and associated ecosystems, and to terrestrial ecology.

Pathway: Groundwater and surface water flowpaths.

Receptor: Groundwater and surface water.

Pre-Mitigation Potential Effects: Negative, indirect, slight, short term, unlikely effect to local groundwater quality. Negative, indirect, imperceptible, short term, unlikely effect on surface water quality.

Proposed Mitigation Measures:

Mitigation measures proposed to avoid the release of hydrocarbons at the Proposed Development site are as follows:

- On site re-fuelling of machinery will be carried out in a dedicated refuelling area, or using a mobile double skinned fuel bowser outside the refuelling area. A dedicated refuelling area will be constructed as part of the Proposed Development.
- No plant maintenance will be completed on site. Any broken down plant will be removed from the site to be fixed;
- Mobile double skinned bowser will be stored in the refuelling area
- Drainage from the refuelling areas will be routed through a full hydrocarbon interceptor and a new wetland prior to final discharge to ground within the existing lagoons on the west of the site. There will be an inspection chamber between the wetland and the lagoon for inspection/sampling.
- Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations;
- Onsite refuelling will be carried out by trained personnel only;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose;
- An emergency plan for the operational phase to deal with accidental spillages will be implemented as follows:
    - Procedures and contingency plans will be set up to deal with emergency accidents or spills. The following steps provide the procedure to be followed in the event of oil/fuel spill or leak:
    - Stop the source of the spill and raise the alarm to alert people working in the vicinity of any potential dangers;
    - If applicable, eliminate any sources of ignition in the immediate vicinity of the incident;

- Contain the spill using the spill control materials, track mats or other material as required. Do not spread or flush away the spill;
- If possible, clean up as much as possible using the spill control materials;
- Contain any used spill control material and dispose of used materials appropriately using a fully licensed waste contractor with the appropriate permits so that further contamination is limited;
- Notify the Site Manager immediately giving information on the location, type and extent of the spill so that they can take appropriate action; and,
- The Site Manager will inspect the site and ensure the necessary measures are in place to contain and clean up the spill and prevent further spillage from occurring.

Residual Effects: The potential for the release of hydrocarbons to groundwater and watercourse receptors is a risk. 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 is negative, indirect, imperceptible, short term, unlikely effect on local groundwater and surface water quality.

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

7.4.7.6 Potential Hydrological Impacts on Designated Sites

The Bridgetown River and Broadford River, which drain the Proposed Development site, flow into the Lower River Shannon where the respective downstream distance to the SAC is approximately 6km and 28km.

Pathway: Surface water.

Receptor: Lower River Shannon SAC.

Pre-Mitigation Potential Impact: Negative, imperceptible, indirect, short term, unlikely effect on surface water quality and designated sites.

Impact Assessment & Proposed Mitigation Measures:

Mitigation measures are outlined above and when implemented, will provide the necessary protection to these hydrologically sensitive areas.

The proposed mitigation measures which will include drainage control measures, infill material acceptance control measures and mitigation measures related to spills/chemical releases will ensure that no significant effects on groundwater quality. Therefore, no effects on the Lower River Shannon SAC will occur.

Residual Effects: Proven and effective measures to mitigate the risk of release of potential contaminants have been proposed above and will break the pathway between the potential source and each receptor. There will be no residual effects –as no significant effects will occur.

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

7.4.8 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 7.4.6.2 above for the construction phase.

7.4.9 Proposed Monitoring

Groundwater quality monitoring will be completed during the operational phase (extraction & infilling) and for 1 year following the closure of the Proposed Development site. Monitoring will be completed on a quarterly basis at existing wells GW1-GW4.

7.4.10 Human Health Effects

Potential health effects in relation to the water environment mainly occur due to direct and indirect contact with contaminated groundwater or surface water. However, as stated above all imported material will be inert soil and stone by-product material and no contamination risk to groundwater and surface water, and therefore human health is anticipated. There will be best practice controls in place to ensure all imported material is source checked and is suitable for the restoration works. Spot checks of incoming loads will be carried out on a daily basis.

Hydrocarbons, in the form of fuels and oils, will be used on-site during all stages of the proposed works. However, the volumes will be small in the context of the scale of the project and will be handled in accordance with best practice mitigation measures.

7.4.11 Cumulative Effects

Due to the nature of the groundwater regime and high permeability of the subsoil, there is no runoff from the operational extraction area, therefore there will be no cumulative impacts on the surface water environment. Similarly, the groundwater regime will remain unchanged, there is no proposed dewatering, and there will therefore be no potential cumulative effects on the prevailing groundwater regime.

Similar, permitted Fahy Beg Wind Farm, which will have an access road and substation located within the Proposed Development site will require some localised ground works, but the potential for hydrological/hydrogeology effects will be very low due to hydrological regime as described above.

A detailed cumulative assessment has been carried out for all planning applications (granted and awaiting decisions).

The majority of these applications are for new dwellings or renovations of existing dwellings, as well as for the erection of farm buildings. Based on the scale of the works, their proximity to the Site and the temporal period of likely works, no cumulative effects will occur as a result of the Proposed Development (construction, operation and restoration phases).