9. WATER

9.1 Introduction

9.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by MKO to carry out an assessment of the potential effects of the Proposed Repowering of the Existing Kilgarvan Wind Farm on the hydrological and hydrogeological environment.

A full description of all elements of the Proposed Development is detailed in Chapter 4 of this EIAR. For the purposed of the EIAR, the various project components are described in Section 1.1.1 in Chapter 1.

The Existing Kilgarvan Wind Farm currently comprises 28 no. operational turbines as part of 2 no. phases, Kilgarvan I and Kilgarvan II. In summary, the proposed Repowering of the Existing Kilgarvan Wind Farm (i.e. the Proposed Development) comprises the removal of the existing 28 no. operational turbines and the erection of 11 no. larger turbines. The Proposed Development also includes upgrades to the existing site access road network, new site access roads, the expansion of an existing onsite borrow pit, temporary construction compounds and underground cabling between the proposed turbines and the existing onsite 110kV substation at Coomagearlahy. The Proposed Development uses as much of the existing infrastructure as possible. The existing overhead grid connection will not be altered and will be used for the Proposed Development.

This chapter provides a baseline assessment of the environmental setting of the Proposed Development, in terms of hydrological and hydrogeological environment and discusses the potential likely significant effects that the construction, operation and decommissioning of the Proposed Development will have. Where required, appropriate mitigation measures to avoid any identified significant effects to the hydrological and hydrogeological environment are recommended and the residual effects of the Proposed Development post-mitigation are assessed. Potential cumulative effects on the hydrological and hydrogeological environment are also assessed in this chapter.

9.1.2 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 upland hydrology and windfarm 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, Conor McGettigan and Jennifer Law.

Michael Gill (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 22 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms and renewable projects in Ireland. He has substantial experience in surface water drainage design and SUDs design and surface water/groundwater interactions. For example, Michael has worked on the EIS for Oweninny WF, Cloncreen WF, Derrinlough WF, and Yellow River WF, and over 100 other wind farm-related projects.

Conor McGettigan (BSc, MSc) is an Environmental Scientist with over 3 years' experience in the environmental sector in Ireland. Conor holds an M.Sc. in Applied Environmental Science (2020) and a B.Sc. in Geology (2016) from University College Dublin. Conor has prepared the hydrology and hydrogeology chapter of environmental impact assessment reports for several wind farm development on peatlands. Conor also routinely prepares hydrological and hydrogeological assessment reports, WFD compliance assessment reports and flood risk assessments for a variety of development types including wind farms.

Jenny Law (BSc, MSc) is an Environmental Geoscientist holding a first honor's degree in Applied Environmental Geosciences from the University College Cork in 2022. Jenny has assisted in the preparation of the hydrology and hydrogeology 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 and strategic housing developments.

9.1.3 Scoping and Consultation

The scope for this assessment has been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties as summarised in Section 2.6 of Chapter 2 of the EIAR. Consultation responses relating to the water environment were received from the Geological Survey of Ireland (GSI), the Health Services Executive (HSE) and Inland Fisheries Ireland (IFI). Matters raised by consultees in their responses with respect to the water environment are summarised in **Table 9-1** below.

Table 9-1: Summary of Water Environment Related Scoping Responses

Consultee	Description	Addressed in Section
Geological Survey of Ireland (GSI)	› Assessment of any potential effect on groundwater abstractions and on groundwater resources in general. › Identify areas of High to Extreme Groundwater Vulnerability and 'Rock at or near surface', as groundwater – surface water interactions would be greatest in these areas.	› Groundwater abstractions are identified in Section 9.3.14 and the potential effect of the Proposed Development on these resources is assessed in Section 9.5.2.9. › Groundwater vulnerability is addressed in Section 9.3.8.
Health Service Executive (HSE)	› All drinking water sources, both surface and groundwater, must be identified. Measures to ensure that all sources and supplies are protected should be described. Any potential impacts to these drinking water sources shall be assessed.	› All drinking water sources are identified in Section 9.3.14. › Mitigation measures are detailed in Section 9.5.2.9 and Section 9.5.2.10.
Inland Fisheries Ireland (IFI)	› All receiving waters within the Roughty River catchment are significant salmonid fisheries and the Roughty river is of high status. IFI would require high water quality to be maintained with no interference to the fisheries habitat. › IFI require that there will be no drainage, crossing, bridging, culverting or other physical	› Mitigation measures for the protection of surface water quality during the construction phase are detailed in Sections 9.5.2.1 to 9.5.2.8. › Please refer to Section 9.5.2.8 for the mitigation measures to be applied at watercourse crossings. › Mitigation measures in relation to suspended solids are detailed in Section 9.5.2.1.

Consultee	Description	Addressed in Section
	interference with the bed or bank of any watercourses, even those not on the OSI, without prior consultation with IFI. › Suspended solids and or hydrocarbon contaminated site run-off waters must be controlled. › Set out a plan for the control of silt in the event that a peat movement occurs. › For watercourse crossings the free passage of fish must not be obscured, IFI should be consulted at the planning stage and instream works should be completed in July-September period.	› Mitigation measures for hydrocarbons are detailed in Section 9.5.2.5. › A plan for the control of silt in the event of a peat movement is outlined in the CEMP.

9.1.4 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. 349/1989: European Communities (Environmental Impact Assessment) Regulations, and subsequent Amendments (S.I. No. 84/1994, S.I. No. 101/1996, S.I. No. 351/1998, S.I. No. 93/1999, S.I. No. 450/2000 and S.I. No. 538/2001, S.I. No. 134/2013 and the Minerals Development Act 2017), the Planning and Development Act, and S.I. No. 600/2001 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 Acts, 2000 (as amended);
- Planning and Development Regulations, 2001 (as amended);
- S.I. No 296/2018: European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 which transposes the provisions of the EIA Directive as amended by the Directive 2014/52/EU into Irish Law;
- S.I. No. 94/1997: 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. 293/1988: Quality of Salmon Water Regulations;
- S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009, as amended, and S.I. No. 722/2003 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 (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. 722/2003);
- S.I. No: 122/2010: European Communities (Assessment and Management of Flood Risks) Regulations, resulting from EU Directive 2007/60/EC;
- S.I. No. 684/2007: Waste Water Discharge (Authorisation) Regulations, 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. 9/2010: European Communities Environmental Objectives (Groundwater) Regulations 2010, as amended; and,
- S.I. No. 296/2009: European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009, as amended.

9.1.5 Relevant Guidance

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

- 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;
- DoE/NIEA (2015): Wind farms and groundwater impacts - A guide to EIA and Planning considerations";
- OPW (2009) The Planning system and Flood Risk Management;
- National Roads Authority (2008) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Wind Farm Development Guidelines for Planning Authorities (2006);
- Inland Fisheries Ireland (2016): Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Watercourses;
- Good Practice During Wind farm Construction (Scottish Natural Heritage, 2010);
- PPG1 - General Guide to Prevention of Pollution (UK Guidance Note);
- PPG5 – Works or Maintenance in or Near Water Courses (UK Guidance Note);
- CIRIA (Construction Industry Research and Information Association) *Guidance on 'Control of Water Pollution from Linear Construction Projects'* (CIRIA Report No. C648, 2006);
- CIRIA (Construction Industry Research and Information Association) Control of Water Pollution from Construction sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2001.
- Land Types for Afforestation (Forest Service, 2016b);
- Forest Protection Guidelines (Forest Service, 2002);
- Forest Operations and Water Protection Guidelines (Coillte, 2013);
- Forestry and Water Quality Guidelines (Forest Service, 2000b); and,
- Forests and Water, Achieving Objectives under Ireland's River Basin Management Plan 2018-2021 (DAFM, 2018).

9.2 Methodology

9.2.1 Desk Study

A desk study of the Proposed Development site was completed in the Summer of 2022 to collect all relevant hydrological, hydrogeological and meteorological data for the Proposed Development site and the surrounding area. The desk study was completed to supplement site walkover surveys and site investigations. The desk study information has been checked and updated, where necessary, in February and March 2023.

The desk study involved consultation with the following sources:

- 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 & 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 21 (Geology of Kerry-Cork); Geological Survey of Ireland (GSI, 1999);
- Geological Survey of Ireland - Groundwater Body Characterisation Reports; and,
- OPW Flood Mapping (www.floodmaps.ie).

9.2.2 Baseline Monitoring and Site Investigations

Hydrological walkover surveys, including detailed drainage mapping, were undertaken by HES on 7th July 2022 and 25th January 2023. These surveys were completed by Conor McGettigan and Jenny Law (please refer to Section 9.1.2 for qualifications and experience). Hydrological monitoring on these dates included surface water flow monitoring, field hydrochemistry and grab sampling. The monitoring and sampling completed in July 2022 occurred during a dry period with minimal rainfall. Meanwhile the sampling completed in January 2023 was preceded by a mixture of dry and wet days.

A comprehensive geological, hydrological and hydrogeological dataset has been collected as part of this EIAR study. HES also completed a detailed review of the previous planning applications and associated planning files and site investigations prior to completing further site investigations for the current application.

In summary, the recent site investigations to address the hydrology and hydrogeology chapter of this EIAR included the following:

- HES completed site walkover surveys and drainage mapping at the Proposed Development site on 7th July 2022 and 25th January 2023 whereby water flow directions and drainage patterns were recorded. These surveys included field hydrochemistry monitoring and stream flow monitoring of watercourses draining the site;
- A total of 36 no. surface water grab samples were undertaken to determine the baseline water quality of the primary surface waters originating from the Proposed Development site;
- HES completed a total of 64 no. peat probes at Proposed Development infrastructure locations on 7th July 2022 and 25th January 2023. All peat probes were characterised to Von Post Humification Scale;
- Completion of 466 no. peat probes by MKO and GDG (Gavin and Doherty GeoSolutions) in 2022;
- GDG completed 54 no. shear vane analysis in May and August 2022;
- GDG excavated 13 no. trial pits in August 2022;

- A Peat Stability Risk Assessment (PSRA) was completed for the Proposed Development by GDG (GDG, 2023) (refer to **Appendix 8-1**); and,
- GDG completed a Peat Management Plan for the Proposed Development (GDG, 2023) (**Appendix 4-2**).

Previous to the site investigations completed specifically for the Proposed Development, 3 historic ground investigations have been completed at the Proposed Development site. This data was used to supplement the recent site investigations detailed above. These historic site investigations comprised:

- Completion of 18 no. trial pits at the existing Kilgarvan Phase I turbine and substation locations (Malone O'Regan, 2004);
- Completion of 75 no. trial pits in October and November 2007 at the Kilgarvan Phase II turbine locations (within the townlands of Lettercannon and Inchincoosh) and along the site access roads (Malachy Walsh and Partners (MWP), 2007); and,
- Completion of 27 no. peat probes and 47 no. gouge cores within the Lettercannon Wind Farm in 2008 (Malachy Walsh and Partners, 2008).

In summary, a large geological dataset, comprising of a total of 764 no. site investigation locations (recent and historic), was used in this assessment.

9.2.3 Impact Assessment Methodology

The EPA's Guidelines on the Information to be contained in Environmental Impact Assessment Reports (EPA, 2022) states that there are 7 no. steps in the preparation of the EIAR. The initial steps relate to screening, scoping, the consideration of alternatives and the description of the project. Step 5 related to the description of the baseline environment which is presented in Section 9.3 for the hydrological and hydrogeological. Step 6 relates to the assessment of impacts and is presented in Section 9.5.

The guideline criteria (EPA, May 2022) require that the baseline environment is described in terms of the context, character, significance and sensitivity of the existing environment.

The assessment of effects follows the description of the baseline environment and is Step 6 of the information which must be included in an EIAR. The guideline criteria for the assessment of effects states that the purpose of an EIAR is to identify, describe and present an assessment of the likely significant effects. The likely effects are described with respect to their quality (positive, neutral or negative), significance (imperceptible to profound), extent (i.e. size of area or number of sites effected), context (is the effect unique of being increasingly experienced), probability (likely or unlikely), duration (momentary to permanent), frequency and reversibility. The descriptors used in this environmental impact assessment are those set out in the EPA (2022) Glossary of effects as shown in Chapter 1 of this EIAR.

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 importance which are defined in **Table 9-2** for hydrology and **Table 9-3** for hydrogeology are used to assess the potential effect that the Proposed Development may have on them.

Table 9-2: Estimation of Importance of Hydrology Criteria (NRA, 2008)

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale	River, wetland or surface water body ecosystem protected by EU legislation, e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.

Importance	Criteria	Typical Example
Very High	Attribute has a high quality or value on a regional or national scale	River, wetland or surface water body ecosystem protected by national legislation – NHA status. Regionally important potable water source supplying >2500 homes. Quality Class A (Biotic Index Q4, Q5). Flood plain protecting more than 50 residential or commercial properties from flooding. Nationally important amenity site for a wide range of leisure activities.
High	Attribute has a high quality or value on a local scale	Salmon fishery Locally important potable water source supplying >1000 homes. Quality Class B (Biotic Index Q3-4). Flood plain protecting between 5 and 50 residential or commercial properties from flooding.
Medium	Attribute has a medium quality or value on a local scale	Coarse fishery. Local potable water source supplying >50 homes Quality Class C (Biotic Index Q3, Q2-3). Flood plain protecting between 1 and 5 residential or commercial properties from flooding.
Low	Attribute has a low quality or value on a local scale	Locally important amenity site for small range of leisure activities. Local potable water source supplying <50 homes. Quality Class D (Biotic Index Q2, Q1) Flood plain protecting 1 residential or commercial property from flooding. Amenity site used by small numbers of local people.

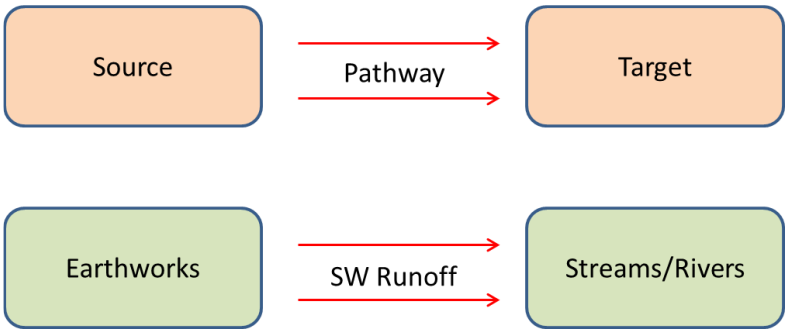
Table 9-3: Estimation of Importance of Hydrogeology Criteria (NRA, 2008)

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation, e.g. SAC or SPA status.
Very High	Attribute has a high quality or value on a regional or national scale	Regionally Important Aquifer with multiple wellfields. Groundwater supports river, wetland or surface water body ecosystem protected by national legislation - NHA status. Regionally important potable water source supplying >2500 homes Inner source protection area for regionally important water source.

Importance	Criteria	Typical Example
High	Attribute has a high quality or value on a local scale	Regionally Important Aquifer Groundwater provides large proportion of baseflow to local rivers. Locally important potable water source supplying >1000 homes. Outer source protection area for regionally important water source. Inner source protection area for locally important water source.
Medium	Attribute has a medium quality or value on a local scale	Locally Important Aquifer. Potable water source supplying >50 homes. Outer source protection area for locally important water source.
Low	Attribute has a low quality or value on a local scale	Poor Bedrock Aquifer Potable water source supplying <50 homes.

9.2.4 Overview of Impact Assessment Process

The conventional source-pathway-target model (see below, top) was applied to assess potential effects 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 effect source, namely its character, magnitude, duration, likelihood and whether it is of a direct or indirect nature.

The assessment of effects is Step No. 6 of 7 in the EIAR process. In order to provide an understanding of the stepwise impact assessment process applied below (Sections 9.4.2 to 9.4.4), a summary guide is presented below, which defines the steps (Steps 6a to 6g) 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 wind farm construction, operation and decommissioning activities (including the existing onsite 110kV Coomagearlahy substation and grid connection) which have the potential to generate a source of significant adverse impact on the geological and hydrological/ hydrogeological (including water quality) environments.

Table 9-4: Impact Assessment Process Steps

Step 6a	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 6b	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 6c	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 6d	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 6e	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 6f	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 6g	Significance of Effects:	Describes the likely significant post-mitigation effects of the identified potential impact source on the receiving environment.

9.2.5 Study Area

The study area for the hydrological and hydrogeological impact assessment is defined by the regional surface water catchments and groundwater bodies within which the Proposed Development is located.

9.2.6 Limitations and Difficulties Encountered

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

9.3 Receiving Environment

9.3.1 Site Description and Topography

The Proposed Development site is located ~5.5km northeast of the village of Kilgarvan, Co. Kerry and ~6km west of Coolea, Co. Cork. The Proposed Development site has a total area of 775 hectares (ha).

The Proposed Development site is located in an upland setting on the western slopes of the Derrynasaggart Mountain Range, Co. Kerry. The Proposed Development site is characterised by mountainous terrain with moderate to steep slopes in places. The land is characterised by abundant protruding ridges of bedrock outcrop, separating localised pockets of peat. Ground elevation contours within the Proposed Development site range from ~190 to 500mOD (metres above Ordnance Datum). Within the Proposed Development site, the local topography generally slopes to the south and southwest towards the Roughty River. The site is characterised by areas of coniferous forestry, transitional woodlands scrub and upland blanket bog. The Proposed Development site is drained by several mountain streams which flow to the southwest. These watercourses include the Glanlee River in the east, the Thureehouma stream to the west and several other unnamed tributaries of the Roughty River.

The topography along the main access road, which runs from the N22 to the site entrance, generally slopes to the north. Ground elevations in this area of the Proposed Development site range from ~140mOD in the vicinity of the N22 to ~465mOD at the entrance to the existing wind farm site. This area drains towards the Flesk River via the Coomagearlahy River and the Owgarriv River. A small area of the main access road in the vicinity of the existing wind farm site slopes to the southwest towards the Sullane River. The lands surrounding the main access road are characterised by upland blanket bog, coniferous forestry and abundant rock outcrops.

The Proposed Development site consists of the Existing Kilgarvan Wind Farm, comprising a total of 28 no. operational wind turbines. These existing turbines are supported by a network of access roads, underground cabling, a meteorological mast and the existing on-site 110kV Coomagearlahy Substation. The existing wind farm is connected to the national grid at this substation in Coomagearlahy and then onwards via an overhead line connection to the existing Clonkeen Substation located ~4.7km northeast of the existing wind farm in the vicinity of the N22.

In terms of Proposed Development infrastructures, a total of 4 no. turbines are located within the townland of Inchee in the east of the Proposed Development site (T1–T4). An additional 4 no. turbines are proposed within the townland of Lettercannon in the southwest of the Proposed Development site (T8-T11). 3 no. turbines are proposed in the townland of Inchincoosh in the northwest of the Proposed Development site (T5-T7).

9.3.2 Water Balance

Long term rainfall and evaporation data were sourced from Met Éireann. The 30-year annual average rainfall recorded at the M. Ballyvourney (Knockacommeen) rainfall station, located ~6.5km northeast of the Proposed Development site are presented in **Table 9-5**. The average annual rainfall at M. Ballyvourney is 2,034mm/yr.

Met Éireann also provide a grid of average annual rainfall for the entire country for the period of 1991 to 2020. Based on this more site-specific modelled rainfall values, the average annual rainfall at the Proposed Development site ranges from 2,129 to 2,343mm/year. The average annual rainfall is 2,236mm/yr (this is considered to be the most accurate estimate of average annual rainfall from the available sources).

Table 9-5: Local Average long-term Rainfall Data (mm)

Station		X-Coord		Y-Coord		Ht (MAOD)		Opened		Closed		
M. Ballyvourney (Knockacommeen)		116000		80700		415		1948		N/A		
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
233.1	172.9	168	125.8	127.7	119.2	123.2	144.9	156.6	222.5	207.4	222.3	2,023.6

The closest synoptic station where the average potential evapotranspiration (PE) is recorded is at Valentia Observatory, ~60km west of the Proposed Development site. The long-term average PE for this station is 528.6mm/yr. This value is used as the best estimate of the Proposed Development site PE. Actual Evaporation (AE) at the Proposed Development site is estimated as 502.1mm/yr (which is 0.95 × PE).

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

Effective rainfall (ER) = AAR – AE

= 2,236mm/yr – 502mm/yr

ER = 1,734mm/yr

Groundwater recharge coefficient estimates are available from the GSI (www.gsi.ie). Within the Proposed Development site, recharge coefficients range from 22.5% in areas of blanket peat to 85% in areas where rock is close to or at the ground surface.

An estimate of ~433mm/year average annual groundwater recharge is given for the Proposed Development site. This calculation is based on a recharge coefficient of 25%. A recharge coefficient at the lower end of the GSI scale (22.5-85% recharge) was chosen due to the coverage of blanket peat, the sloping nature of the local area and the low permeability of the underlying bedrock aquifer. This means that the hydrology of the Proposed Development site is characterised by high surface water runoff rates and relatively low groundwater recharge rates. This is supported by on-site observations made during the site walkover surveys whereby a high density of headwater streams were recorded within the Proposed Development site.

Therefore, conservative annual recharge and runoff rates for areas of the Proposed Development site which are covered in peat are estimated to be 433mm/yr and 1,301mm/yr respectively.

Climate change projections for Ireland are provided by Regional Climate Models (RCM's) downscaled from larger Global Climate Models (GCM's). Projections for the period 2041-2060 (mid-century) are available from Met Eireann. The data indicates a projected decrease in summer rainfall from 0 to 13% under the medium-low emission range scenario and an increase in the frequency of heavy precipitation events of ~20%. In total the projected annual reduction in rainfall near the Proposed Development site ~8% under the medium-low emission scenario and ~4% under the high emissions scenario. As stated above the local average long term rainfall data for the Proposed Development site is estimated to be 2,236mm/yr. Under the medium-low emissions scenario this may reduce to ~2,057mm/yr, while under the high emissions scenario this figure may reduce to 2,147mm/yr.

In addition to average rainfall data, extreme value rainfall depths are available from Met Éireann. A summary of various return periods and duration rainfall depths for the Proposed Development site are presented in **Table 9-6**.

Table 9-6: Return Period Rainfall Depths (mm)

Return Period (Years)				
Storm Duration	1	5	30	100
5 mins	4.0	5.7	8.3	10.5
15 mins	6.5	9.4	13.6	17.2
30 mins	9.2	13.0	18.6	23.2
1 hour	12.8	18.0	25.3	31.4
6 hours	30.6	41.4	56.4	68.3
12 hours	42.9	57.2	76.8	92.3
24 hours	60.0	79.0	104.7	124.6
2 days	78.1	100.5	130.2	152.8

9.3.3 Regional Hydrology

On a regional scale, the Proposed Development site is located in 3 no. surface water catchments. To the southwest, the vast majority of the Proposed Development site, is located within the Dunmanus-Bantry-Kenmare surface water catchment within Hydrometric Area 21. A small area in the northwest and the majority of the main access road are located in the Laune-Maine-Dingle Bay catchment within Hydrometric Area 22. Meanwhile, a small section of the main access road is located within Lee, Cork Harbour and Youghal Bay surface water catchment within Hydrometric Area 19. All 3 no. surface water catchments are situated within the South Western River Basin District.

The Dunmanus-Bantry-Kenmare catchment includes the area drained by all streams entering the tidal water in Dunmanus, Bantry and Kenmare Bays, between Mizen Head and Glanearagh Head, Co. Kerry. The catchment drains a total area of 1,898km^2. The catchment is characterised by a series of east-west trending sandstone ridges and limestone valleys, with the limestone valleys nearly completely submerged by the sea (EPA, 2021).

On a more local scale within the Dunmanus-Bantry-Kenmare surface water catchment, the Proposed Development site is located within the Roughty River sub-catchment (Roughty_SC_010) and the Roughty_030 river WFD sub-basin. This area is drained by several tributaries of the Roughty River

which flow to the southwest before discharging into the northwesterly flowing Roughty River. The main tributaries include the Garrow Stream in the southeast which discharges into the Glanlee River to the south of the Proposed Development site. Further downstream, the Glanlee River confluences with the Roughty River ~600m south of the Proposed Development site. To the north, the Thureehouma Stream flows to the southwest ~100m west of the Proposed Development site, and drains several lake waterbodies, including Lough Nabirria and Doo Lough, before it confluences with the Roughty River ~720m to the southwest of the Proposed Development site. OSI and EPA mapping also record the presence of several additional unnamed mountain streams which flow from the Proposed Development site to the southwest before discharging into the Roughty River and its larger tributaries. The Roughty River flows to the northwest before it veers to the southwest near the R569. The Roughty River then flows past Kilgarvan Town before it discharges into the Roughty River Estuary.

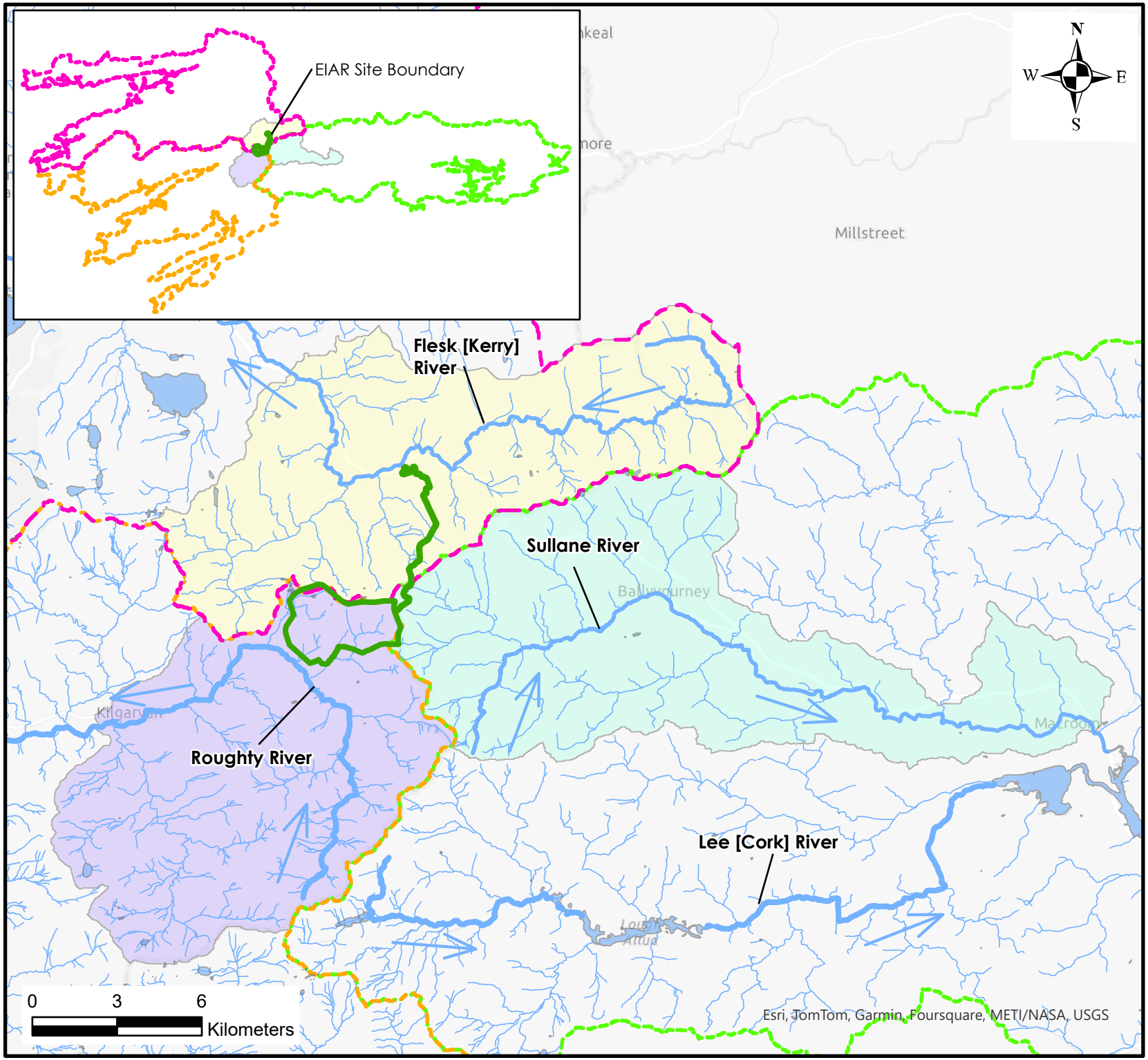
The Laune-Maine-Dingle Bay catchment includes the area drained by the Laune and Maine Rivers and all streams entering the tidal water between Glanearagh Head and Clogher Head, Co. Kerry. The catchment drains a total area of 2,036km^2 (EPA, 2021).

On a more local scale within the Laune-Maine-Dingle Bay surface water catchment, the Proposed Development site is located within the Flesk River sub-catchment (Flesk[Kerry]_SC_010) and 3 no. WFD river sub-basins. The northwest of the Proposed Development site is located in the Loo_010 river WFD sub-basin. An unnamed tributary of the Loo River rises immediately to the northwest of the Proposed Development site and flows to the north before discharging into the Loo River. The Loo River continues to the northeast and confluences with the Flesk River ~3.6km to the north. However, no Proposed Development infrastructure is located within the catchment of the Loo River. Meanwhile, the majority of the main access road from the N22 is located within the Flesk [Kerry]_040 and Flesk [Kerry]_030 river sub-basins. This area of the Proposed Development site is drained by the Coomagearlahy River and the Owgarriv River which merge before discharging into the Flesk River to the west of Clonkeen 110kV Substation. The Flesk River continues to flow to the northwest before discharging into Lough Leane to the south of Killarney Town.

The Lee, Cork Harbour and Youghal Bay surface water catchment includes all areas drained by the River Lee and all streams entering the tidal water in Cork Harbour and Youghal Bay. This catchment drains a total area of 2,153km^2 (EPA, 2021).

On a more local scale within the Lee, Cork Harbour and Youghal Bay surface water catchment, a small section of the Proposed Development site, along the main access road, is located within the Sullane River sub-catchment (Sullane_SC_010) and the Sullane_010 river WFD sub-basin. This area is drained by the Inchamore Stream which flows to the southeast before discharging into the Bardinch River. The Bardinch River confluences with the Sullane River ~4.5km southeast of the Proposed Development site.

A regional hydrology map showing the surface water catchments, sub-catchments and main regional watercourses is shown as **Figure 9-1**. The WFD river sub-basins are shown on the local hydrology map, **Figure 9-2**, below.



Legend

- EIAR Site Boundary
- Watercourses
- Lakes

WFD Subcatchments

- Flesk[Kerry]_SC_010
- Roughty_SC_010
- Sullane_SC_010

WFD Catchments

- Dunmanus-Bantry-Kenmare
- Laune-Maine-Dingle Bay
- Lee, Cork Harbour and Youghal Bay

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Client: Ørsted

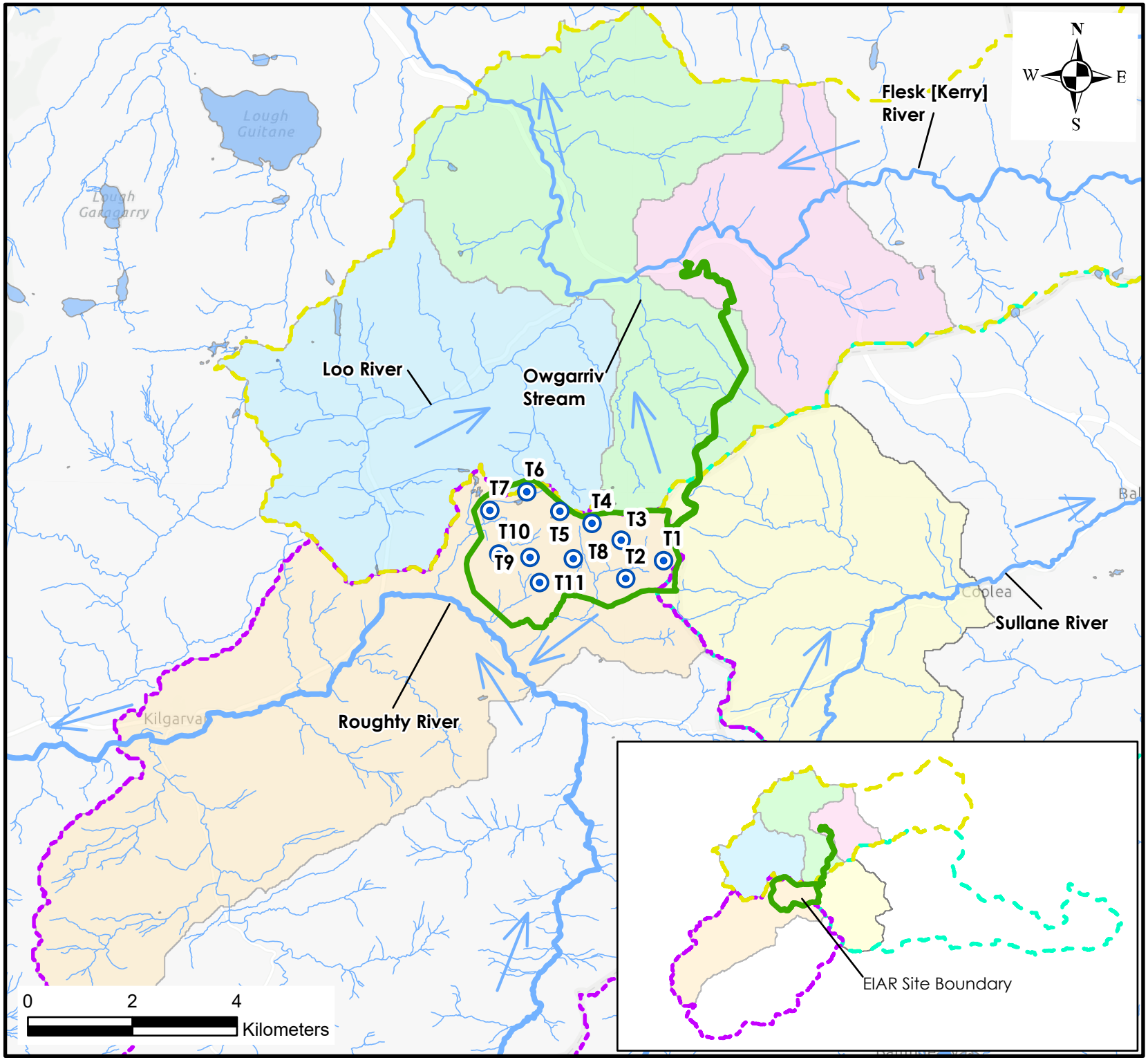
Job: Proposed Repowering of the Existing Kilgarvan Wind Farm

Title: Regional Hydrology Map

Figure No: 9-1

Drawing No: P1585-0-0424-A4-901-00A

Sheet Size: A4	Project No: P1585-0
Scale: 1:185,000	Drawn By: GA
Date: 10/04/2024	Checked By: MG



Legend

- EIAR Site Boundary
- Proposed Turbine Locations
- Watercourses
- Lakes

WFD Subcatchments

- Flesk[Kerry]_SC_010
- Roughty_SC_010
- Sullane_SC_010

WFD River Sub-Basins

- FLESK (KERRY)_030
- FLESK (KERRY)_040
- LOO_010
- ROUGHTY_030
- SULLANE_010

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Job: Proposed Repowering of the Existing Kilgarvan Wind Farm

Title: Local Hydrology Map

Figure No: 9-2

Drawing No: P1585-0-0424-A4-902-00A

Sheet Size: A4	Project No: P1585-0
Scale: 1:100,000	Drawn By: GA
Date: 10/04/2024	Checked By: MG

9.3.3.1 Surface Water Flows

There are no OPW gauging stations located downstream of the Proposed Development site in the Dunmanus-Bantry-Kenmare surface water catchment for which flow data is available (www.waterlevel.ie). Therefore, the EPA's hydrotool, available on www.catchments.ie, was consulted in order to estimate baseline flow volumes in the local area. The Hydrotool dataset contains estimates of naturalised river flow duration percentiles. Several nodes were consulted in the vicinity and downstream of the Proposed Development site and **Figure 9-3** below presents the estimated flow duration curves for each of the consulted Hydrotool Nodes.

A 95%ile flow relates to the flow which will be exceeded within the river 95% of the time. For example, the 95%ile flow at Node 21_5755 on the Glanlee River in the immediate vicinity of the Proposed Development site is estimated to be 0.027m^3/s (27l/s). This indicates that 95% of the time, the flow at this location is estimated to be at or above 0.027m^3/s. Due to the increased catchment size, the 95%ile flow at the nodes along the Roughty River are significantly larger. For example at Node 21_6757, to the south of Kilgarvan Town, the 95%ile flow in the Roughty River is estimated to be 0.465m^3/s (465l/s). The progressively increasing flow volumes downstream of the Proposed Development site are associated with the increased upstream catchment of the respective waterbodies.

Within the Laune-Maine-Dingle Bay catchment, flow volumes on the Owgarriv River downstream of the Proposed Development site are representative of a small local river with the 95%ile flow being 0.035m^3/s (34l/s). As seen in **Figure 9-4**, flow volumes are significantly larger in the Flesk River further downstream, with the 95%ile flow modelled as being 1.59m^3/s (159l/s) near Killarney.

Similarly, within the Lee, Cork Harbour and Youghal Bay surface water catchment, flow volumes are small in the Bardinch River downstream of the Proposed Development site. As seen in **Figure 9-5**, flow volumes increase further downstream on the Sullane River with the 95%ile flow modelled to be 0.743m^3/s (74l/s) near Macroom.

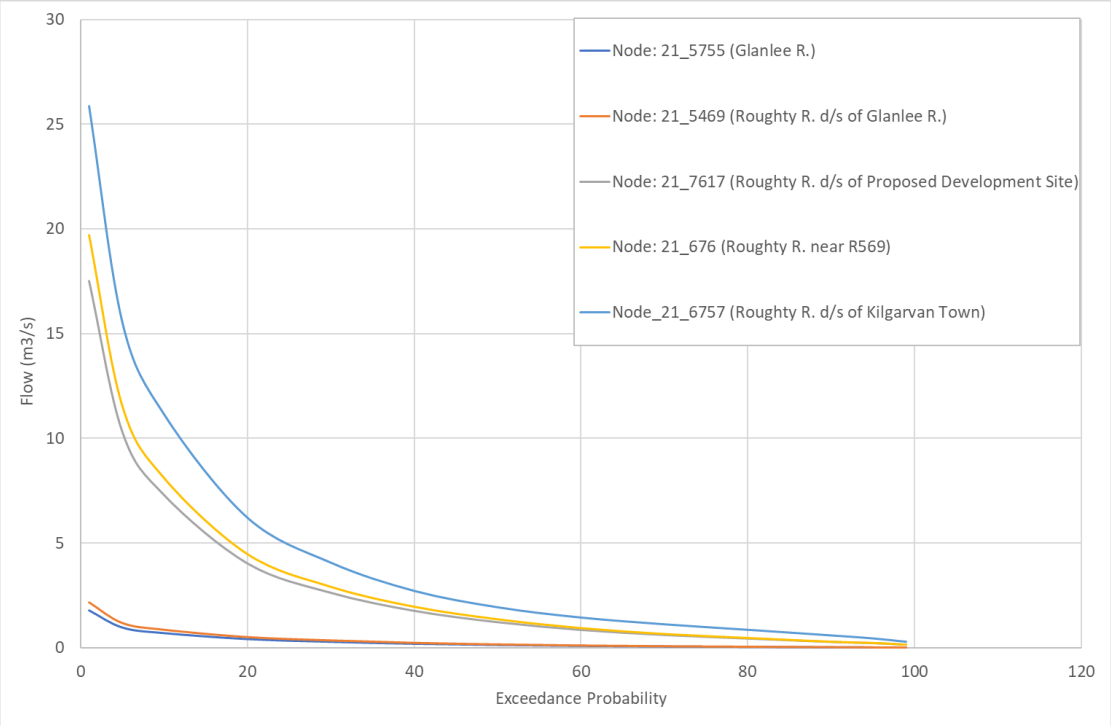


Figure 9-3: EPA HydroTool Node Flow Duration Curves in the Roughty River Catchment

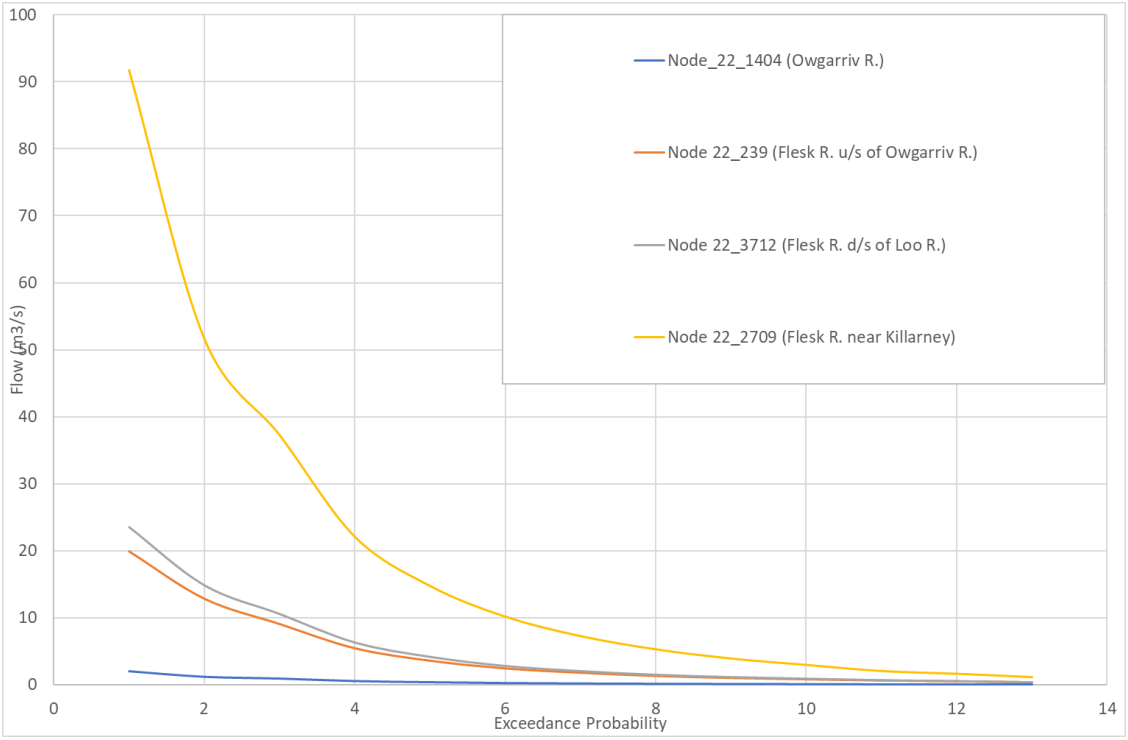


Figure 9-4: EPA HydroTool Node Flow Duration Curves in the Flesk River Catchment

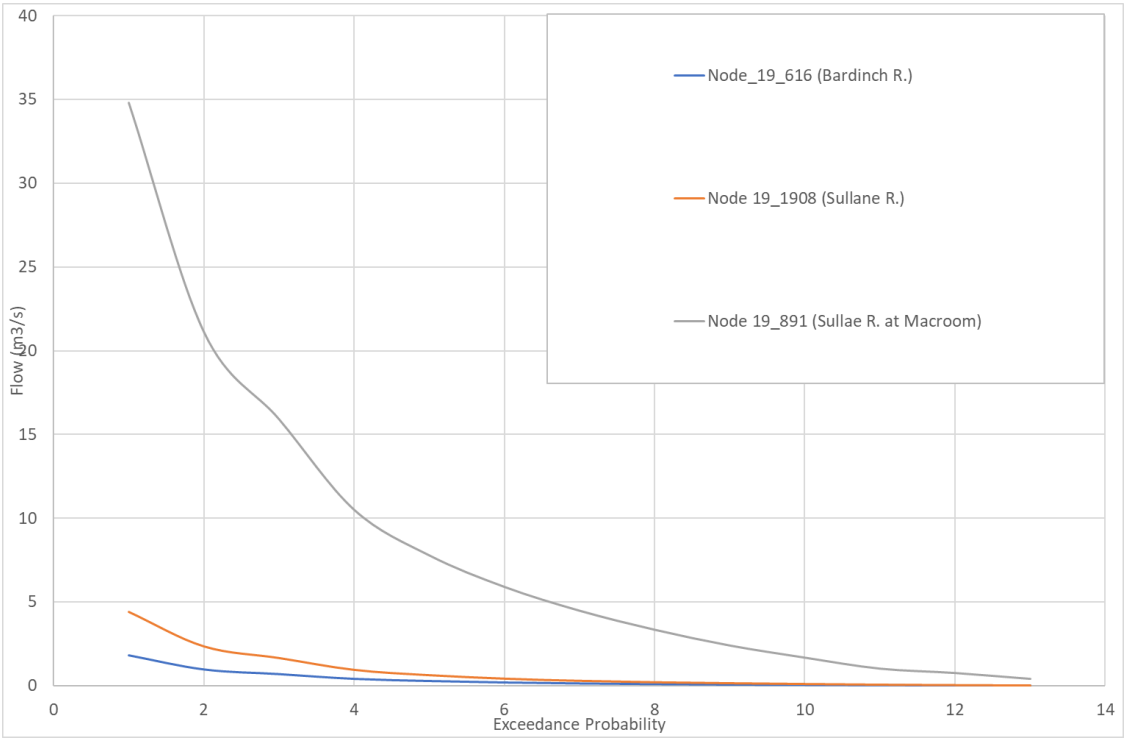


Figure 9-5: EPA Hydrotool Node Flow Duration Curves in the Sullane River Catchment

9.3.4 Site Drainage

As stated above, the Proposed Development site is located across 3 no. surface water catchments. Table 9-7 below presents the location of the Proposed Development infrastructure with respect to WFD regions and the closest EPA mapped watercourses.

The topography of the Proposed Development site is mountainous, with protruding ridges of bedrock outcrop separating areas of peat. Ground elevations slope to the southwest and range from ~190 to 500mOD (metres above Ordnance Datum). Due to the local topography, the coverage of peat and low permeability of the underlying bedrock aquifer (refer to Section 9.3.7), the hydrology of the Proposed Development site is characterised by a high rates of surface water runoff.

During site walkover surveys a high density of surface water features were recorded within the Proposed Development site. The Proposed Development site is drained by several 1st and 2nd order streams. Many of these natural watercourses originate within the site boundaries and flow downslope before discharging into the Roughty River. These watercourses include the Glanlee Stream, the Thureehouma Stream and several additional unnamed local streams.

In places the natural drainage is further facilitated by a network of manmade drains. These manmade drains are concentrated within the areas of coniferous forestry and along sections of the existing site access roads.

The forest plantations are generally drained by a network of mound drains which typically run perpendicular to the topographic contours of the site and feed into collector drains, which discharge to interceptor drains down-gradient of the plantation. Mound drains and ploughed ribbon drains are generally spaced approximately every 15m and 2m respectively. Interceptor drains are generally located up-gradient (cut-off drains) and down-gradient of forestry plantations. Interceptor drains are also located up-gradient of forestry access roads. Culverts are generally located at stream crossings and at low points under access roads which drain runoff onto down-gradient forest plantations. A schematic of a typical standard forestry drainage network and one which is representative of the site drainage network is shown as **Figure 9-6.** The forestry drains are the primary drainage routes towards the natural streams, but the flows in the higher elevated drains are generally very low or absent most of the time.

2 no. rounds of surface water flow monitoring were carried out in the main streams draining the Proposed Development site and the results are shown in **Table 9-8** below. The measured flows are typical of seasonal flows for 1st and 2nd order streams. Meanwhile, SW4 is located on the Roughty River to the southwest of the site and the recorded flows are more typical of a large regional river with a significant upstream catchment. The locations of these monitoring points are shown on **Figure 9-8** below.

Table 9-7: Proposed Development and WFD Regions

Proposed Development Infrastructure	Nearest Mapped Watercourses	WFD River Sub-Basin	WFD River Sub-Catchment	WFD Catchment
11 no. turbines, borrow pit, 2 no. temporary construction compounds, existing on-site 110kV Coomagearlahy substation, roads to be upgraded and new proposed roads	Tributaries of the Roughty River which drain the Proposed Development site	Roughty_030	Roughty_SC_010	Dunmanus-Bantry-Kenmare surface water catchment
Main site access road upgrades	Owgarriv River and associated tributaries	Flesk (Kerry)_030	Flesk[Kerry]_SC_010	Laune-Maine-Dingle Bay surface water catchment
Main site access road upgrades	Small unnamed tributary of the Flesk River	Flesk (Kerry)_040		
None	Unnamed tributary of the Loo River	Loo_010		
Main site access road upgrades	Bardinch River	Sullane_010	Sullane_SC_010	Lee, Cork Harbour and Youghal Bay surface water catchment

Table 9-8: Surface Water Flow Monitoring

Location	Easting (ITM)	Northing (ITM)	Watercourse	Round 1 (l/s) 07/07/2022	Round 2 (l/s) 25/01/2023
SW1	509888	576904	Unnamed Trib. of Glanlee R.	4	5
SW2	507097	577578	Unnamed Trib. of Thureehouma Str.	2	3
SW3	508646	576660	Unnamed Trib. of Glanlee R.	8	10
SW4	506008	575720	Roughty River	~1,500	~5,000
SW5	507626	576133	Unnamed Trib. of Roughty R.	3	5
SW6	507107	577265	Unnamed Trib. of Thureehouma Str.	5	5

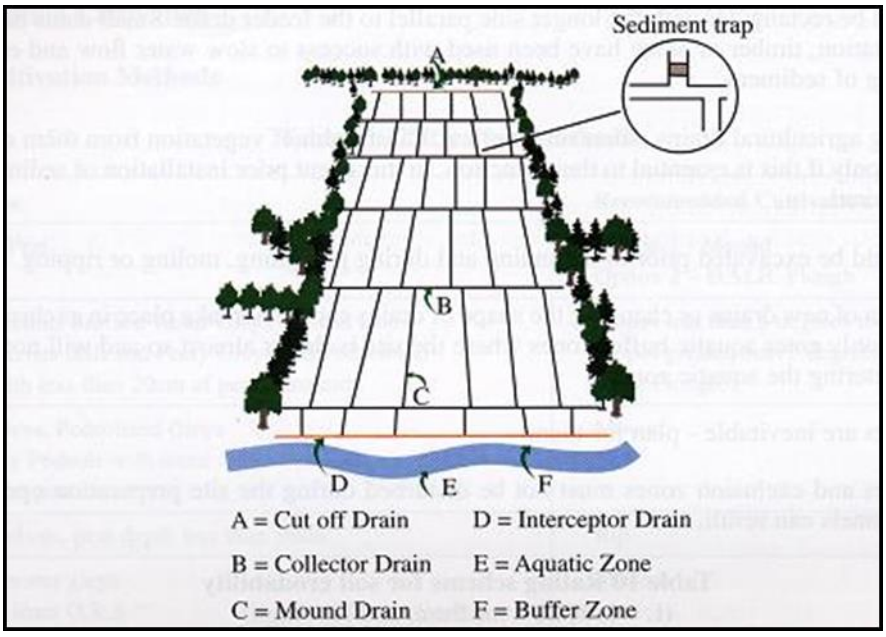


Figure 9-6: Schematic of Existing Forestry Drainage

9.3.5 Summary Flood Risk Assessment

A Flood Risk Assessment of the Proposed Development site has been carried out by HES, the findings of which are presented in full in **Appendix 9-1** and are summarised below.

To identify those areas as being at risk of flooding, the OPW's Past Flood Events Maps, the National Indicative Fluvial Mapping, CFRAM River Flood Extents, historical mapping (i.e. 6" and 25" base maps) and the GSI Groundwater Flood Maps were consulted. These flood maps are available to view at Flood Maps - Floodinfo.ie.

The OPW Past Flood Events Maps have no records of recurring or historic flood instances within the Proposed Development site (refer to **Figure 9-7**). Similarly, identifiable text on local available historical 6" or 25" mapping does not identify any lands that are "liable to flood".

Within the Dunmanus-Bantry-Kenmare catchment the closest mapped recurring flood event (Flood ID: 4707) is located at Insheese, ~2.35km southeast and upstream of the Proposed Development site. Here a section of the roadway was washed away by floods in 1991. There are no recurring or historic fluvial flood events recorded downstream of the Proposed Development site on the Roughty River.

The closest mapped downstream flood events are situated near Kenmare Town and are associated with coastal and estuarine flooding. Meanwhile, within the Laune-Maine-Dingle Bay catchment a historic flood event is mapped ~800m downstream of the Proposed Development site along the Flesk River (Flood ID: 4677). Further downstream, a recurring flood event is also recorded on the Flesk River at Loo Bridge (Flood ID: 4727) where heavy rainfall is reported to have resulted in the Flesk River overflowing its banks. Recurring flood events are also noted on the Flesk River at Garries (Flood ID: 3481) and at Glenflesk (Flood ID: 4676). A report from the local area engineer in 1995 stated that "*the River Flesk is a fast flowing river from a catchment containing high mountains. During floods the water cannot be contained within the river banks and there is extensive overland flow*". Within the Lee, Cork Harbour and Youghal Bay surface water catchment, the closest mapped historic flood event is located in the townland of Coolea on the Sullane River, ~5km southeast of the Proposed Development site.

The GSI Winter 2015/2016 Surface Water Flood Map shows surface water flood extents for this winter flood event. This flood event is recognised as being the largest flood event on record in many areas. The flood map for this event does not record any flood zones long the streams and watercourses which drain the Proposed Development site. However, an area of surface water flooding occurs in the northwest of the Proposed Development site and coincides with the location of Lough Nabirria. To the north and downstream of the Proposed Development site, flooding was recorded along the Flesk River near Garries and Glenflesk.

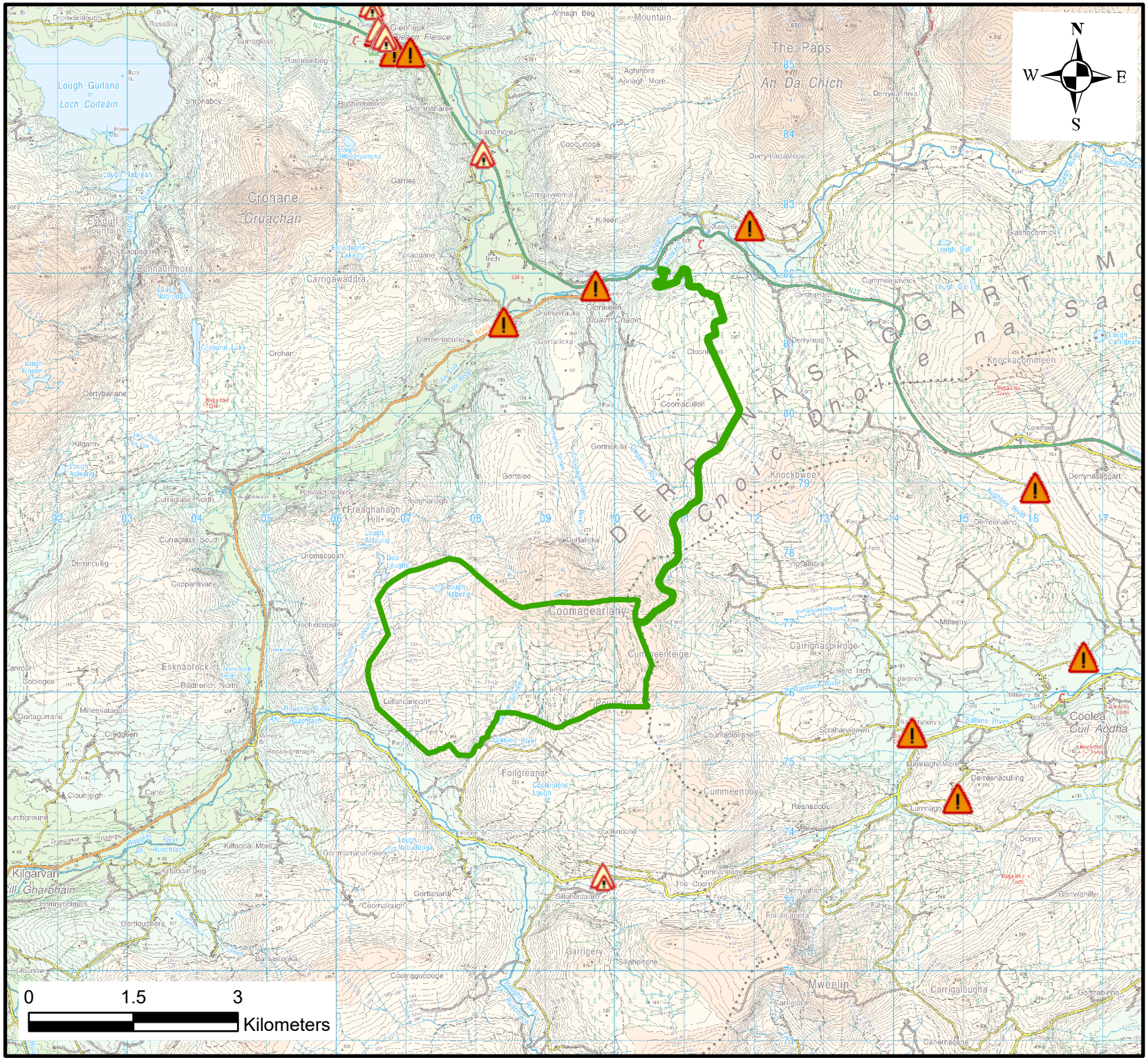
No CFRAM mapping has been completed for the area of the Proposed Development site. The closest mapped CFRAM fluvial flood zones are located on the Flesk River ~850m west of the Proposed Development site. Within the Dunmanus-Bantry-Kenmare catchment, the closest CFRAM mapping is located at Kenmare where fluvial and coastal flood zones have been modelled.

The National Indicative Fluvial Flood Map for the Present-Day Scenario shows flooding along the Roughty River and the Glanlee River to the south of the Proposed Development site. Fluvial flood zones are also mapped along the Loo River to the northwest and the Owgarriv River downstream of the main site access road. However, the medium (1% AEP, 1 in 100yr) and low (0.1% AEP, 1 in 1,000yr) probability flood zones do not encroach upon the Proposed Development site (refer to **Figure 9-8**). The Mid-Range and High-End scenarios model potential flood zones associated with climate change and an increase in rainfall of 20% and 30% respectively. These modelled flood zones do not differ significantly from the Present-Day Scenario with flooding limited to the immediate vicinity of river channels.

Furthermore, the Proposed Development site is not mapped within any historic or modelled groundwater flood zones.

The main risk of flooding at the Proposed Development site is via pluvial flooding. This risk is limited to local flat areas within the Proposed Development site due to the mountainous nature of the local area. Surface water ponding/pluvial flooding may occur in some flat areas of the site due to the presence of low permeability peat at the surface. Mostly the risk of pluvial flooding is low.

In general, the risk of flooding at the Proposed Development site is very low due to the elevated and sloping nature of the site and the high density of mountain streams which flow rapidly downslope.



Legend

- EIAR Site Boundary
- Single Flood Event
- Recurring Flood Event

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Job: Proposed Repowering of the Existing Kilgarvan Wind Farm

Title: OPW Past Flood Event Map

Figure No: 9-7

Drawing No: P1585-0-0424-A4-907-00A

Sheet Size: A4	Project No: P1585-0
Scale: 1:75,000	Drawn By: GA
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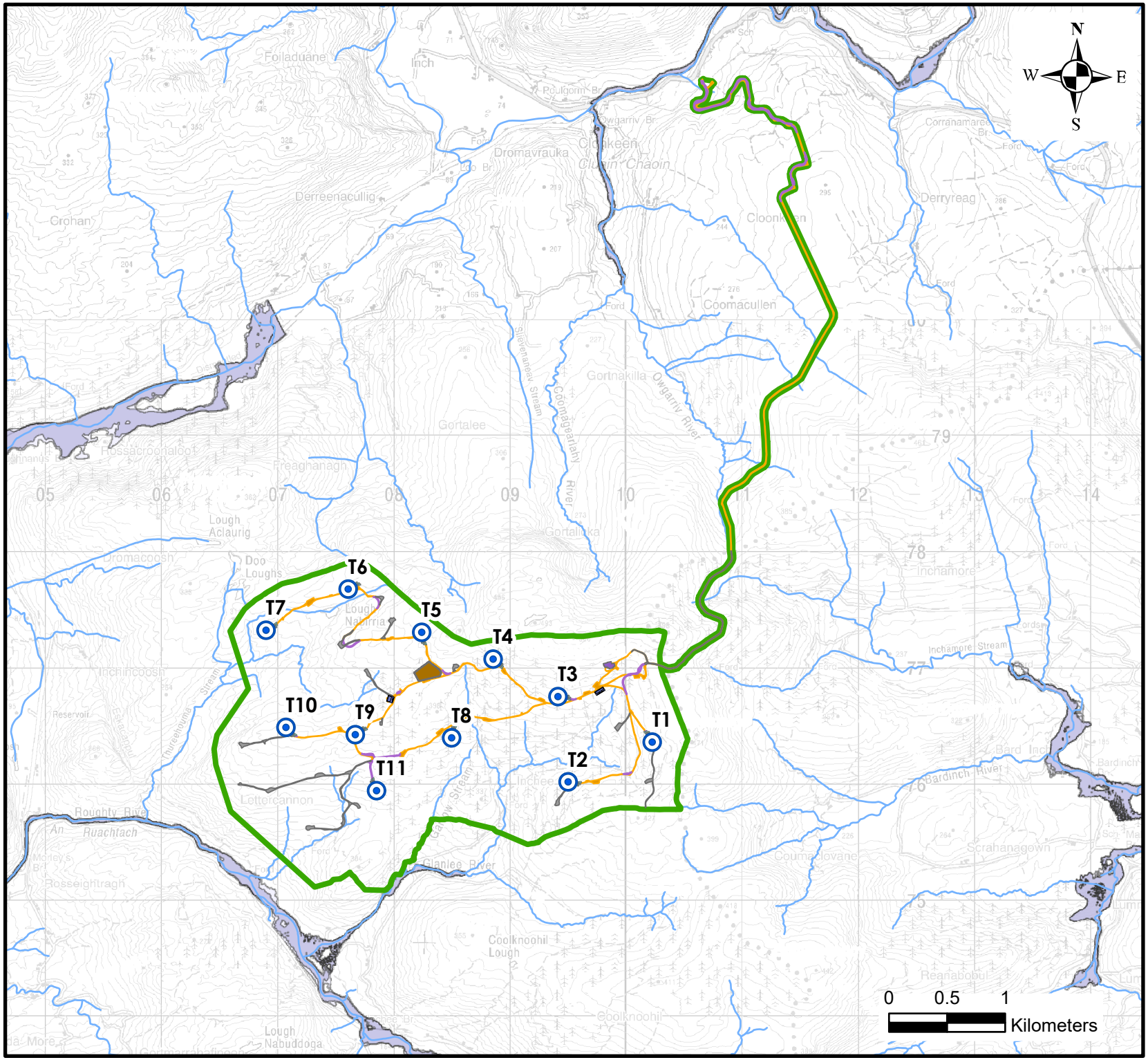

Legend

- EIAR Site Boundary
- Proposed Turbine Locations
- Proposed Hardstands
- As Built Coomagearlahy Substation
- Proposed Borrow Pit Location
- Proposed Construction Compounds
- Proposed Road Upgrade Works
- Proposed New Roads and Widening
- Existing Site Roads
- Watercourses

National Indicative Fluvial Mapping

- Medium Probability
- Low Probability

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Job: Proposed Repowering of the Existing Kilgarvan Wind Farm

Title: National Indicative Fluvial Flood Zone Mapping

Figure No: 9-8

Drawing No: P1585-0-0424-A4-908-00A

Sheet Size: A4	Project No: P1585-0
Scale: 1:45,000	Drawn By: GA
Date: 10/04/2024	Checked By: MG

9.3.6 Surface Water Quality

Biological Q-rating data for EPA monitoring points on the Roughty, Loo, Flesk and Sullane rivers are shown in **Table 9-9** 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).

Within the Dunmanus-Bantry-Kenmare surface water catchment, Q-ratings are not available for the 1st or 2nd order streams which directly drain the Proposed Development site. To the southeast and upstream of its confluence with the Glanlee River (*i.e.* upstream of the Proposed Development), the Roughty River achieved an EPA Q-Rating of Q4-5 in the 2020 EPA monitoring round at Inchee Bridge (Station Code: RS21R010070). Downstream of Kilgarvan village, the Roughty River also achieved 'High' status downstream of its confluence with the Slaheny River (Station Code: RS21R010250).

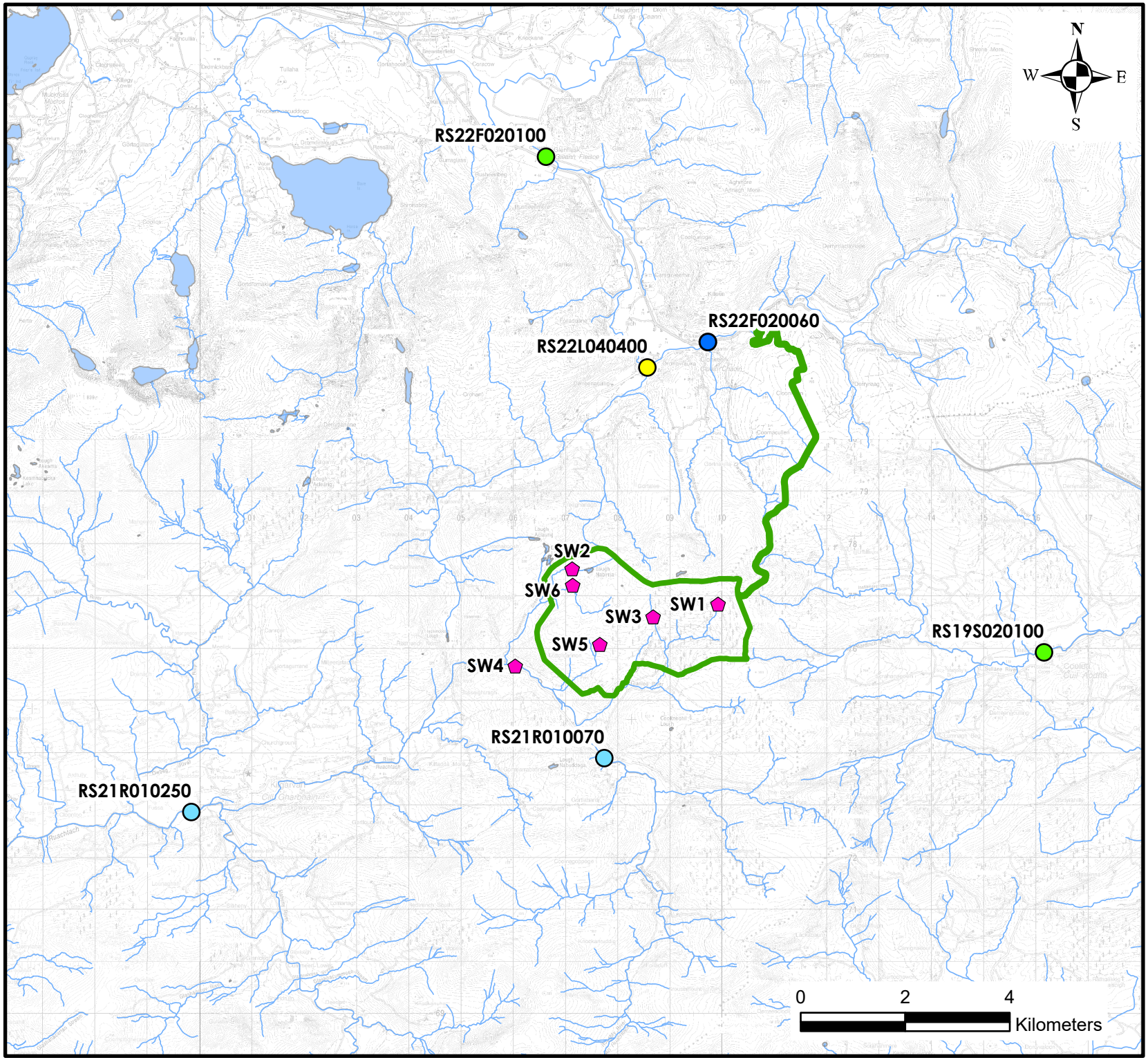
Within the Laune-Maine-Dingle Bay surface water catchment, the Flesk River achieved 'High' status in the latest EPA monitoring round (2022) immediately upstream of its confluence with the Owgarriv River (Station Code: RS22F020060). The Loo River achieved a Q-rating of Q3-4, *i.e.* 'Moderate' status, at Loo Bridge upstream of its confluence with the Flesk River (Station Code: RS22L040400). Further downstream the Flesk River achieved a Q-rating of Q4, *i.e.* 'Good' status, at a bridge near Glenflesk (Station Code: RS22F020100).

Within the Lee, Cork Harbour and Youghal Bay surface water catchment, the Sullane River achieved 'Good' status (Q4) downstream of its confluence with the Bardinch River (Station Code: RS19S020100).

A map of local EPA monitoring stations is attached as **Figure 9-8** below.

Table 9-9: Latest EPA Water Quality Monitoring Q-Rating Values (2020-2022)

Watercourse	Station ID	Easting	Northing	Year	EPA Q-Rating Status
Dunmanus-Bantry-Kenmare catchment					
Roughty River	RS21R010070	107742	73890	2020	Q4-5 (High)
Roughty River	RS21R010250	99841	72859	2020	Q4-5 (High)
Laune-Maine-Dingle Bay catchment					
Flesk River	RS22F020060	109724	81848	2022	Q5 (High)
Loo River	RS22L040400	108566	81361	2022	Q3-4 (Moderate)
Flesk River	RS22F020100	106627	85392	2022	Q4 (Good)
Lee, Cork Harbour and Youghal Bay catchment					
Sullane River	RS19S020100	116155	75912	2021	Q4 (Good)



Legend

- EIAR Site Boundary
- Watercourses
- Lakes
- SW Sample points

EPA Monitoring Stations

- Q5 (High)
- Q4-5 (High)
- Q4 (Good)
- Q3-4 (Moderate)

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Job: Proposed Repowering of the Existing Kilgarvan Wind Farm

Title: Map of EPA Monitoring Stations and Surface Water Sampling Locations

Figure No: 9-9

Drawing No: P1585-0-0424-A4-909-00A

Sheet Size: A4	Project No: P1585-0
Scale: 1:100,000	Drawn By: GA
Date: 10/04/2024	Checked By: MG

Field hydrochemistry measurements of unstable parameters, electrical conductivity (µS/cm), pH (pH units) and temperature (°C) along with turbidity (NTU) were taken at 6 no. surface water sampling locations over 2 no. monitoring rounds completed on 7th July 2022 and 25th January 2023 within surface watercourses draining and directly downstream of the Proposed Development site within the Roughty River catchment. The results are listed in **Table 9-10**. The monitoring locations were typically in small mountainous streams, while SW4 is located on the Roughty River itself. The monitoring locations are shown in **Figure 9-9** below.

Electrical conductivity values at the monitoring locations ranged between 58.2 and 95.5µS/cm, with an average conductivity value of 74µS/cm. Turbidity ranged from <0.01 to 2.9NTU. The highest turbidity value of 2.9NTU was recorded at SW1 on 7th July 2022. Dissolved Oxygen ranged from 8.24 to 9.82mg/l. The pH values were generally neutral or slightly basic, ranging between 6.42 and 7.95, with an average pH of 7.4.

Table 9-10: Field Parameters - Surface Water Chemistry Measurements (07/07/2022 and 25/01/2023)

Location ID	Temp °C	DO (mg/l)	SPC (µS/cm)	pH	Turbidity (NTU)
SW1	7.2 - 14.2	9.27 – 9.5	95.3 – 95.5	7.06 – 7.87	0.94 - 2.9
SW2	7.3 - 17.7	8.24 - 8.88	61 – 81	6.95 – 7.95	<0.01 – 0.91
SW3	7.0 - 176	8.9 - 9.25	58.2 - 68.9	7.39 - 7.41	<0.01
SW4	7.8 - 19.7	9.25 - 9.33	80 - 82.3	7.46 - 7.86	<0.01 - 0.07
SW5	7 - 15.8	9.54 - 9.82	67.2 – 68.3	6.42 - 7.08	<0.01 - 0.8
SW6	8.2 - 17.2	9.17 - 9.55	64.1 - 72.1	7.5 - 7.63	0.5 – 1.07

Surface water grab samples were also taken at these locations for laboratory analysis. Results of the laboratory analysis are shown alongside relevant water quality regulations in **Table 9-11** below. In addition, the European Communities Environmental Objectives (Surface Waters) Regulations (S.I. No. 272 of 2009) are shown in Table 9-12. Original laboratory reports are attached as **Appendix 9-2**.

Suspended solid concentrations ranged from 0.6 to <5mg/l. Suspended solid concentrations were below the S.I 293 (of 1988) threshold limit of 25 mg/l in all 12 no. samples.

Ammonia was found to be at or below the level of detection of the laboratory (0.02mg/l) in all samples during both monitoring rounds. All samples were below the threshold value for High status (≤0.04 mg/l) as set out in SI 272 of 2009.

BOD ranged between <1 and 2 mg/l. A total of 5 no. samples were above the Good status[1] threshold value of 1.5 mg/l. Nitrate concentrations were found to be below the level of detection of the laboratory in all samples. Meanwhile, chloride concentrations ranged from 10.2 to 17.8mg/l.

In comparison to S.I. No. 272 of 2009, 5 of 12 no. results for BOD exceeded the "Good Status" and "High Status" threshold values. In relation to ammonia, all samples were found to be of "High" status and below the threshold of -≤0.04mg/l. For orthophosphate, all samples were found to be of "High" status and below the threshold of -≤0.025mg/l.

Table 9-11: Surface water quality data (07/07/2023 and 25/01/2023)

Location ID	Suspended Solids (mg/l)	BOD_5 (mg/l)	Orthophosphate (mg/l)	Nitrate (mg/l NO_3)	Ammonia (mg/l)	Chloride (mg/l)
EQS	≤25([1])	≤ 1.3 to ≤ 1.5([2])	-≤ 0.035 to ≤0.025([2])	-	-≤0.065 to ≤ 0.04([2])	-
SW1	2.2 - <5	<1 - 2	<0.02	<1 - <5	0.02	10.6 - 11.0
SW2	3.2 - <5	<1 - 2	<0.02	<1 - <5	<0.02 – 0.02	10.4 – 11.3
SW3	0.2 - <5	<1 - 2	<0.020	<1 - <5	<0.02 – 0.02	10.9
SW4	0.8 - <5	<1 - 2	<0.02 – 0.02	<1 - <5	<0.02	11.1 – 11.2
SW5	1.4 - <5	<1 - 2	<0.02	<1 - <5	0.02	13.2 – 17.8
SW6	0.6 - <5	<1 - 1	<0.02	<1 - <5	<0.02 – 0.02	10.2 – 10.4

9.3.7 Hydrogeology

The bedrock geology underlying the Proposed Development site is mapped by the GSI as Devonian Old Red Sandstones (www.gsi.ie). The local bedrock is classified as being a Locally Important Aquifer – Bedrock which is Moderately Productive only in Local Zones (Ll). A bedrock geology aquifer map is attached as **Figure 9-10**.

The southwest of the Proposed Development site is underlain by the old red sandstones of the Gun Point Formation. This bedrock geological formation forms part of the Beara Sneem Groundwater Body (GWB) which is characterized by poorly productive bedrock. According to the GSI's GWB characterisation report, the Beara Sneem is a large GWB which comprises the southern part of the Iveragh, Beara and Sheeps Head peninsulas and has very rugged topography and a very indented coastline (GSI, 2004). The Proposed Development site is located on the eastern margin of this GWB where topographic highs separate it from other GWBs. The Beara Sneem GWB is comprised of rocks with very low groundwater transmissivity and storativity. These rocks have been heavily folded and faulted during the Variscan Orogeny which has given rise to zones of enhanced permeability near faults or along fold axes. Groundwater flow will generally be concentrated in a thin zone at the top of the rock, although deeper flow can occur along fault zones. Diffuse recharge occurs to this GWB through subsoils and rock outcrops. However, due to the low permeability of the bedrock aquifer and the mountainous topography, a high proportion of effective rainfall will runoff or discharge rapidly to surface watercourses. As a result, groundwater flowpaths are short (30-300m), with groundwater flow directions controlled by the local topographic regime. The overall regional groundwater flow direction

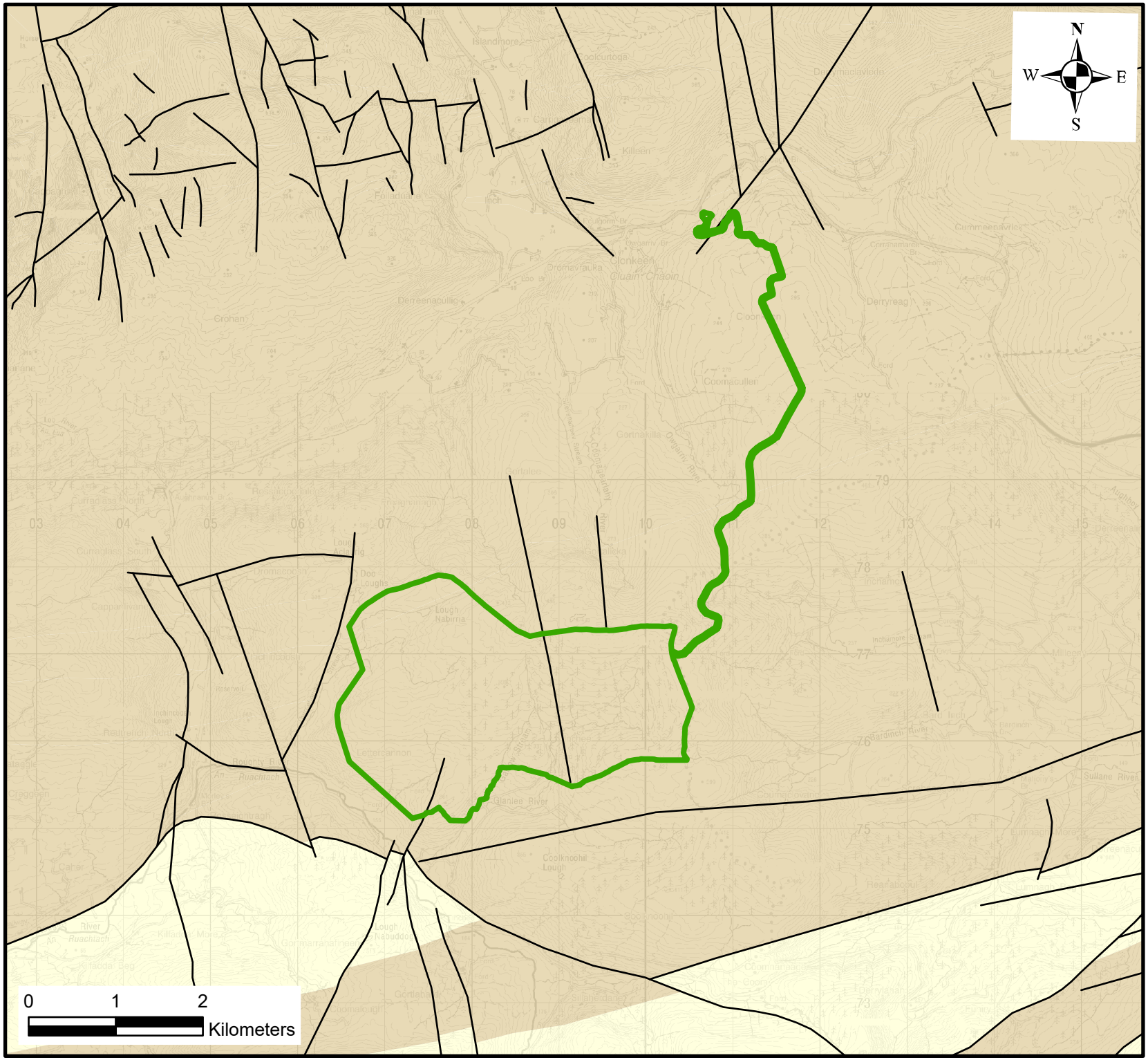
[1] S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations

[2] *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).*

is to the southwest (GSI, 2004). In terms of the key Proposed Development infrastructure, all 11 no. wind turbines are underlain by the Beara Sneem GWB.

Meanwhile, the north of the Proposed Development site, including a small section in the northwest and the vast majority of the main access road, are underlain by the Cahersiveen GWB. According to the GSI's GWB characterisation report, this GWB is characterised by poorly productive bedrock and occupies sections of the Iveragh Peninsula and is elongated east-west along the north side of the ridge formed by the Macgillycuddy's Reeks Mountains. The Proposed Development site is located along the southern margin of this GWB, which is formed by a topographic high. This GWB is comprised of rocks with low transmissivity and storativity. Similar to the Beara Sneem GWB these rocks have been deformed by the Variscan Orogeny and groundwater flow can occur along fractures, joints and faults. In general, the flow is concentrated in the upper weathered zone of the rock. Diffuse recharge occurs to this GWB through subsoils and rock outcrops. However, due to the low permeability of the bedrock aquifer and the mountainous topography a high proportion of effective rainfall will runoff or discharge rapidly to surface watercourses. As a result, groundwater flowpaths are short (30-300m), with groundwater flow directions controlled by the local topographic regime. The overall groundwater flow directions is northwards towards the coast (GSI, 2004).

In addition, a small section of the main access road is underlain by the Ballinhassig West GWB, which is also characterised by poorly productive bedrock. According to the GSI's GWB characterisation report, the Ballinhassig West GWB occupies the uplands of the Lee surface water catchment and is characterised by very rugged topography (GSI, 2004). The rocks comprising this GWB typically have low transmissivity and storativity, although localised zones of enhanced permeability occur along fault zones. Flows in the aquifer are generally concentrated in a thin zone at the top of the rock, although deeper groundwater flows also occur in fault zones. Groundwater flowpaths will be short and discharge to nearby surface watercourses (GSI, 2004).



Legend

- EIAR Site Boundary
- LI - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
- PI - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones
- Mapped Faults

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Client: Ørsted	
Job: Proposed Repowering of the Existing Kilgarvan Wind Farm	
Title: Bedrock Aquifer Map	
Figure No: 9-10	
Drawing No: P1585-0-0424-A4-910-00A	
Sheet Size: A4	Project No: P1585-0
Scale: 1:60,000	Drawn By: GA
Date: 10/04/2024	Checked By: MG

9.3.8 Groundwater Vulnerability

The GSI describe groundwater vulnerability as a term used to represent the natural ground characteristics that determine the ease with which groundwater may be contaminated by human activities. Groundwater vulnerability embodies the characteristics of the intrinsic geological and hydrogeological features at a site that determine the ease of groundwater contamination. Groundwater vulnerability is related to recharge acceptance, whereby in areas where recharge occurs more readily, a higher quantity of contaminants will have access to groundwater.

The vulnerability rating of the bedrock aquifer underlying Proposed Development site ranges from Extreme-X in areas where rock is mapped at or near the ground surface. Where blanket peat is present the vulnerability is mapped as Extreme-E, reflecting the relatively thin coverage of peat in this area (i.e. <3m)

In term of the proposed key wind farm infrastructures, a total of 4 no. turbines (T1, T3, T6 and T7) are mapped in areas of Extreme-E vulnerability. The remaining 7 no. turbines are mapped in areas of Extreme-X vulnerability.

Groundwater vulnerability along the main site access road from the N22 to the site entrance ranges from High to Extreme-X. Groundwater vulnerability is greatest at higher elevations in the vicinity of the existing wind farm and in the north adjacent Clonkeen substation.

Site investigations comprising of peat probes trial pits have revealed that the depth to rock is typically shallow. Bedrock outcrop and subcrop is prevalent throughout the site with ~92% of site investigation locations indicating a peat thickness of less than 2m, 72% less than 1m, and 51% of peat probes identifying less than 0.5m of peat thickness. Given the shallow depth to rock, the vulnerability at the Proposed Development site is Extreme in accordance with **Table 9-12**.

However, due to the low permeability nature of the underlying bedrock aquifers, groundwater flowpaths are likely to be short (30 – 300m), with recharge emerging close by and discharging into local surface water streams. This means there is a low potential for groundwater dispersion and movement within the aquifer, therefore surface water bodies such as drains and streams/rivers are more vulnerable (to contamination from human activities) than groundwater at the Proposed Development site.

Table 9-12: Groundwater Vulnerability and Subsoil Permeability and Thickness

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.

9.3.9 Groundwater Hydrochemistry

There are no groundwater quality data for the Proposed Development site and groundwater sampling would generally not be undertaken for this type of development in terms of EIAR reporting, as groundwater quality impacts would not be anticipated.

The GSI's Beara Sneem GWB characterisation report (GSI, 2004) notes that hydrochemical data for this GWB is sparse. The limited available data shows that the groundwater is moderately soft to moderately hard, with total hardness ranging from 0-360mg/l and total alkalinity averaging 110mg/l. Electrical conductivity values range from 100-700µS/cm while total dissolved solids range from 60-475mg/l. Nitrate concentrations are low, averaging 5.7mg/l NO_3. The GSI also note that iron and manganese can often be a problem in this GWB. These hydrochemical characteristics reflect the peaty soils and iron-rich sandstone rocks of this GWB.

The GSI's Cahersiveen GWB characterisation report (GSI, 2004) notes that the Old Red Sandstone rocks largely contain calcium bicarbonate water and moderately soft to moderately hard. Alkalinity ranges from 14-200mg/l and hardness ranges from 50-250mg/l. pH values generally range from 6-7, however lower pH values can occur. Conductivities are low to medium, ranging from 150-450µS/cm. The GSI note that high iron and manganese concentrations can occur due to the minerals present in the bedrock.

Meanwhile, the GSI's Ballinhassig West GWB characterisation report (GSI, 2004) states that alkalinity in this GWB ranges from 10-300mg/l and hardness ranges from 40-220mg/l. The Old Red Sandstone formation forming this GWB largely contain calcium bicarbonate type water with relatively low to medium conductivities (125-600 µS/cm).

9.3.10 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.

9.3.11 Groundwater Body Status

Local Groundwater Body (GWB) and Surface Water Body (SWB) status reports are available for view from (www.wfdireland.ie).

The Beara Sneem (IE_SW_G_019), Cahersiveen (IE_SW_G_022) and Ballinhassig West (IE_SW_G_005) GWBs, achieved 'Good' status in all 3 no. WFD cycles (2010-2015, 2013-2018 and 2016-2021) (**Table 9-13**).

In terms of risk status, the Beara Sneem and Ballinhassig West GWBs have been deemed to be 'not at risk' of failing to meet their respective WFD objectives. Meanwhile, the risk status of the Cahersiveen

GWB is currently under review. No significant pressures have been identified for the GWBs underlying the Proposed Development site.

Table 9-13: WFD Groundwater Body Status

GWB	Overall Status 2010-2015	Overall Status 2013-2018	Overall Status 2016-2021	3rd Cycle Risk Status	WFD Pressures
Beara Sneem	Good	Good	Good	Not at risk	None
Cahersiveen	Good	Good	Good	Under Review	None
Ballinhassig West	Good	Good	Good	Not at risk	None

9.3.12 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 9-14** below.

As stated above, the vast majority of the Proposed Development site is located in the Dunmanus-Bantry-Kenmare surface water catchment and drains to the Roughty River. The Roughty River in the vicinity and downstream of the Proposed Development site (Roughty_030 SWB) achieved 'High' status in all 3 no. WFD cycles. The Roughty_030 SWB is listed as a high ecological objective status waterbody and is currently meeting this objective. Further downstream, the Roughty_040 SWB achieved 'High' status in the latest WFD cycle (2016-2021). The Inner Kenmare River transitional waterbody and the Outer Kenmare River coastal waterbody both achieved 'Good' status in all 3 no. WFD cycles. The Outer Kenmare River SWB is also listed as a high ecological status objective waterbody and is currently failing to meet this objective.

In terms of the risk status of these SWBs, the Roughty_030 and the Inner Kenmare River SWBs have been deemed to be 'not at risk' of failing to meet their respective WFD objectives. The risk status for the Roughty_040 and the Outer Kenmare River SWBs is currently under review.

The 3rd Cycle Draft Dunmanus-Bantry-Kenmare Catchment Report (EPA, 2021) states that excess nutrients and morphological impacts remain the most prevalent issues in this catchment. The significant pressure impacting the greatest number of waterbodies in this catchment is forestry, followed by hydromorphology, agriculture and peat. However, the 3rd Cycle Draft Report does not identify any significant pressures to be impacting on SWBs downstream of the Proposed Development site.

Within the Laune-Maine-Dingle Bay surface water catchment, the Flesk(Kerry)_030 SWB achieved 'High' status in all 3 no. WFD cycles. The Loo_010 SWB, which drains the northwest of the Proposed Development site, is of 'Good' status. Further downstream, the status of the Flesk River ranges from 'Good' to 'High'. Before discharging into Lough Leane, the Flesk River flows through the Laune_010 SWB which achieved 'Poor' status in the latest WFD cycle (2016-2021). Lough Leane itself achieved 'Good' status in all 3 no. WFD cycles.

In terms of the risk status of these SWBs, the Flesk(Kerry)_040 SWB has been deemed to be 'at risk' of failing to meet its WFD objectives. This SWB is listed as a high ecological status objective waterbody and is currently of 'Good' status. Further downstream, the risk status of the Flesk(Kerry)_050 SWB is currently under review. All other SWBs downstream of the Proposed Development site are considered to be 'not at risk'.

The 3rd Cycle Draft Laune-Maine-Dingle Bay Catchment Report (EPA, 2021) states that morphological impacts remain the most prevalent issues in this catchment. The significant pressure impacting the greatest number of waterbodies in this catchment is agriculture followed by hydromorphology and forestry. Hydromorphological impacts have been identified as a significant pressure on the Flesk(Kerry)_040 SWB. In relation the hydromorphology the Draft Catchment Report (EPA, 2021) states that overgrazing has been causing morphological impacts on this SWB. No other significant pressures have been identified on SWBs downstream of the Proposed Development site.

A small section in the southeast of the Proposed Development site is located in the Lee, Cork Harbour and Youghal Bay catchment. Downstream of the Proposed Development site the Sullane River (Sullane_010 and _020) achieved 'Good' status in the latest WFD cycle (2016-2021). Both of these SWBs are listed as being high ecological status objective waterbodies and have been deemed to be 'at risk' of not meeting their WFD objectives.

The 3rd Cycle Draft Lee-Cork Harbour and Youghal Bay Catchment Report (EPA, 2021) states that excess nutrients remain the most prevalent issues in this catchment. The significant pressure impacting the greatest number of waterbodies in this catchment is hydromorphology followed by agriculture and urban runoff. Hydromorphology has been listed as a significant pressure on the Sullane_010 and the Sullane_020 SWBs. In relation to hydromorphology the Draft Catchment Report states that embankments were identified to be impacting on the Sullane_010 SWB.

Table 9-14 Summary WFD Information for Surface Water Bodies

River Waterbody	Status 2010-2015	Status 2013-2018	Status 2016-2021	3rd Cycle Risk Status	WFD Pressures
Dunmanus-Bantry-Kenmare Catchment					
Roughty_030	High	High	High	Not at risk	None
Roughty_040	Unassigned	Unassigned	High	Under review	None
Inner Kenmare River	Good	Good	Good	Not at risk	None
Outer Kenmare River	Good	Good	Good	Under Review	None
Laune-Maine-Dingle Bay Catchment					
Flesk (Kerry)_030	High	High	High	Not at risk	None
Flesk (Kerry)_040	High	Good	Good	At risk	Hydromorphology
Loo_010	Good	Good	Good	Not at risk	None
Flesk (Kerry)_050	High	Good	High	Under review	None
Flesk (Kerry)_060	Good	Good	Good	Not at risk	None
Laune_010	Unassigned	Unassigned	Poor	Not at risk	None
Leane (Lake waterbody)	Good	Good	Good	Not at risk	None
Lee, Cork Harbour and Youghal Bay Catchment					
Sullane_010	High	Good	Good	At risk	Hydromorphology
Sullane_020	High	Good	Good	At risk	Hydromorphology

9.3.13 Designated Sites and Habitats

Within the Republic of Ireland designated sites include Natural Heritage Areas (NHAs), Proposed Natural Heritage Areas (pNHAs), Special Areas of Conservation (SAC) and Special Protection Areas (SPAs). A map of local designated site is attached as **Figure 9-11** below.

Within the Dunmanus-Bantry-Kenmare surface water catchment, the only designated sites with potential to be impacted by the Proposed Development will occur downstream along the Roughty River. The closest designated site is the Roughty River pNHA (Site Code: 001376). This pNHA is located ~300m

southwest of the Proposed Development site along the Roughty River. This site is hydrologically connected with the Proposed Development site via the Glanlee River, the Thureehouma stream and several other unnamed tributaries of the Roughty River.

The Sillahertane Bog NHA (Site Code:001882) exists ~3km southeast of the Proposed Development site. This designated site is located upstream of the Proposed Development site and therefore has no potential to be impacted by the Proposed Development.

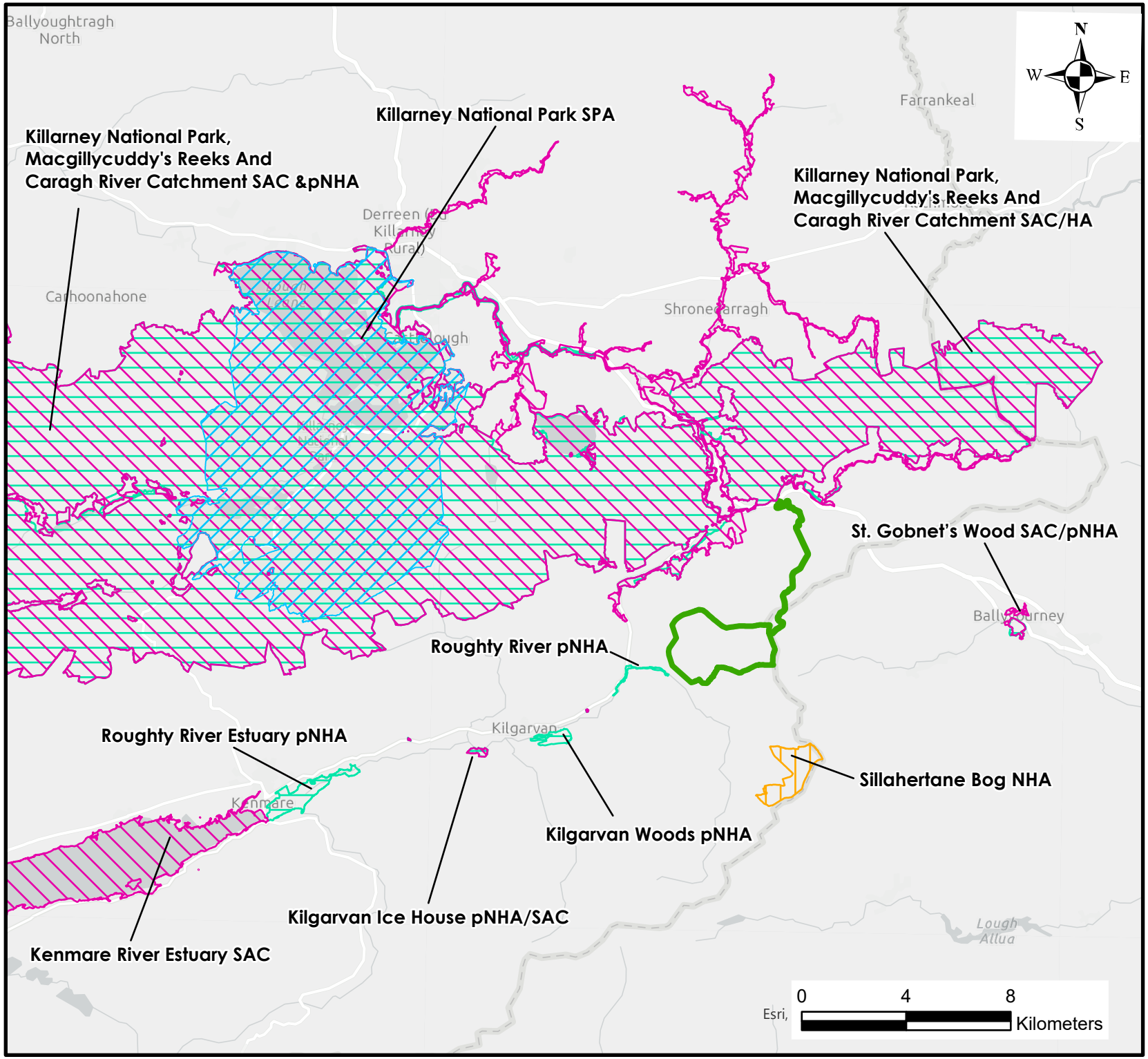
The Kilgarvan Ice House pNHA/SAC (Site Code: 000364) exists ~3.6km southwest of the Proposed Development site, in the townland of Caher and ~7.8km to the southwest in the townland of Lounaghan. This SAC is designated due to the presence of the Lesser Horseshow Bat and has no groundwater dependant interests. Despite its proximity to the Roughty River, the pNHA/SAC does not include the Roughty River and therefore is not hydrologically connected with the Proposed Development site.

The Roughty River Estuary becomes a pNHA (Site Code: 002092) ~12.6km southwest of the Proposed Development site. Further downstream in the vicinity of Kenmare town, the Kenmare River Estuary is designated as an SAC (Site Code: 002158). Kenmare River SAC is a long, narrow, south-west facing bay which contains 3 no. marine habitats listed on Annex I if the EU Habitats Directive, namely reefs, large shallow bay and marine caves. The SAC also contains a very high number of rare and notable marine species. Kenmare Bay also contains a number of islands which are designated as the Kenmare River Islands pNHA (site Code: 000363).

Within the Laune-Maine-Dingle Bay Catchment, the closest designated site to the Proposed Development site is the Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC/pNHA (Site Code: 000365). This designated site exists ~70m north of the existing Clonkeen substation along the Flesk River. This SAC contains many lowland lakes including Lough Leane which tend to be species rich. The Flesk River associated with the lake is also of importance as it supports floating vegetation, submerged vegetation and rare invertebrates. This designated site is hydrologically connected with the Proposed Development site via the tributaries of the Flesk River which drain the Proposed Development site.

Further downstream, Lough Leane also forms part of the Killarney National Park SPA (site Code: 004038) and supports a wide variety of wintering waterfowl. This designated site is hydrologically connected with the Proposed Development site via the Flesk River and its associated tributaries.

Within the Lee, Cork Harbour and Youghal Bay Catchment, the only designated sites with potential to be impacted by the Proposed Development will occur downstream along the Sullane River. The closest downstream designated site is St. Gobnet's Wood SAC/pNHA (Site Code: 000106) which is located ~7.8km east of the Proposed Development site. This site is designated due to the occurrence of Old Oak Woodlands and also supports a small area of alluvial woodland along the Sullane River.



Legend

- EIAR Site Boundary
- NHA
- pNHA
- SAC
- SPA

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Client: Ørsted

Job: Proposed Repowering of the Existing Kilgarvan Wind Farm

Title: Designated Sites Map

Figure No: 9-11

Drawing No: P1585-0-0424-A4-911-00A

Sheet Size: A4 | Project No: P1584-0

Scale: 1:200,000 | Drawn By: GA

Date: 10/04/2024 | Checked By: MG

9.3.14 Water Resources

9.3.14.1 Groundwater Resources

The GSI do not map the presence of any National Federation registered Group Water Schemes (GWS) or Public Water Schemes (PWS) or an associated Source Protection Area (SPA) within the Proposed Development site or in the surrounding lands (www.gsi.ie).

The closest mapped GWS is the Carraignadoura GWS located ~7km southeast of the Proposed Development site. This GWS is located in the Ballinghassig West GWB. There are no other GWS/PWS mapped within 20km of the Proposed Development site.

A search of private well locations (wells with location accuracy of 1–100m were only sought) was undertaken using the GSI well database (www.gsi.ie).

2 no. wells (GSI Name: 0807SEW013 and 0807SEW011) are to the south of the Proposed Development site in the townland of Inchee. These wells are mapped ~100m southwest of T2 and are listed as having agricultural and domestic uses. According to the GSI (www.gsi.ie) these wells have poor yield class of 10.9m^3/day and 16.4m^3/day respectively. The GSI also map several wells and boreholes to the southwest of the Proposed Development site in the townlands of Rosseightragh, Gortmarrahafineen and Kilfadda More. These wells are used for agricultural and domestic purposes and have poor to moderate yields and are mapped to the south of the Roughty River.

Several groundwater wells are also mapped in the vicinity of the main access road and have poor yields (www.gsi.ie).

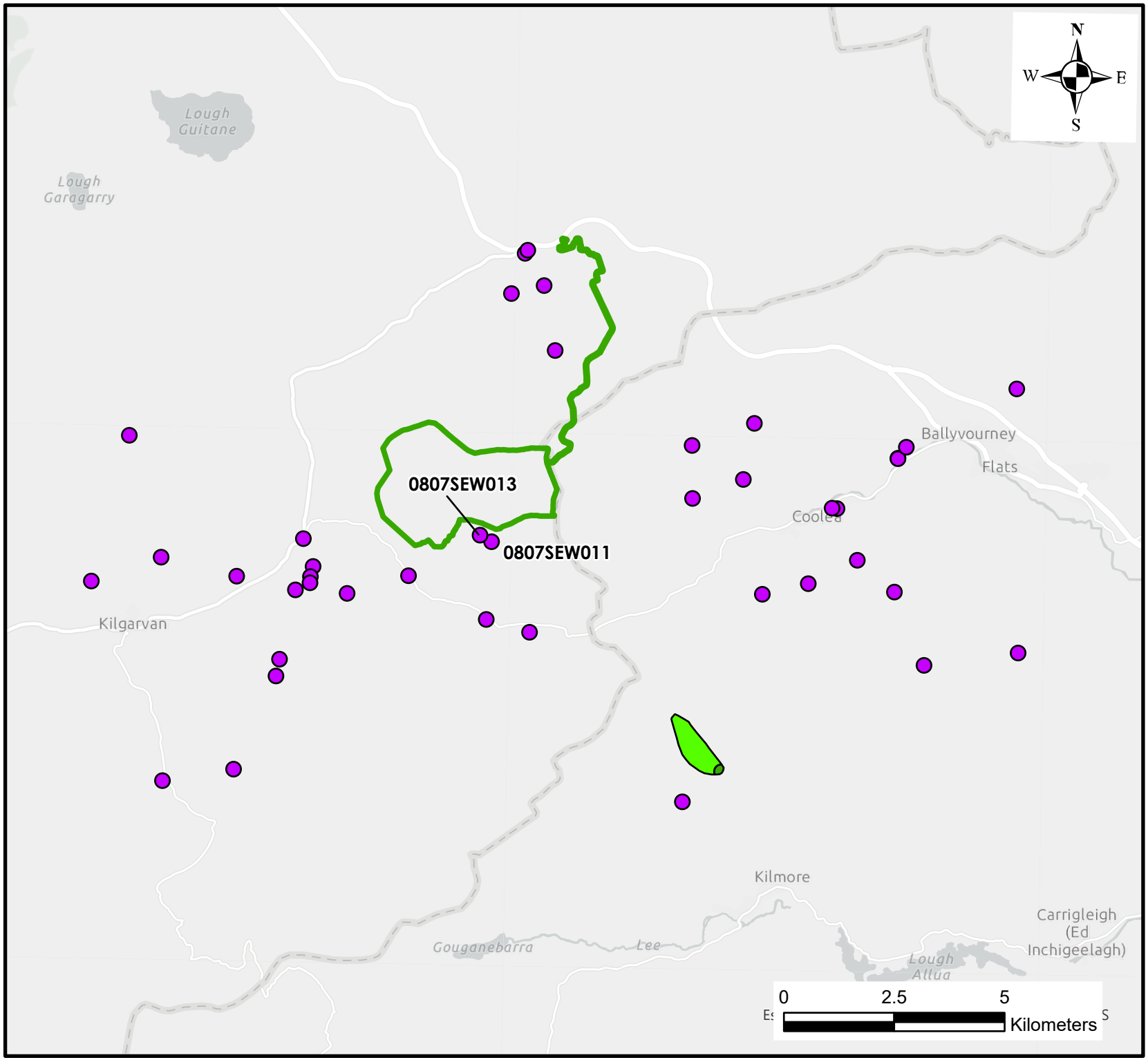
A map of local wells identified by the GSI is attached as **Figure 9-12**.

9.3.14.2 Surface Water Resources

The 3rd Cycle Draft Dunmanus-Bantry-Kenmare Catchment Report states that there are 19 no. SWBs identified as Drinking Water Protected Areas (DWPA) based on water abstraction data on the EPA abstraction register. However, no surface waterbodies downstream of the Proposed Development site have been identified as a DWPA.

The 3rd Cycle Draft Laune-Maine-Dingle Bay Catchment Report states that there are 20 no. SWBs identified as DWPA. The Flesk (Kerry)_040 SWB, which includes the Coomagearlahy River and the Owgarriv River, in the vicinity of the Proposed Development site, are listed in Article 7: Abstraction for Drinking Water.

The 3rd Cycle Draft Lee, Cork Harbour and Youghal Bay Catchment Report identifies 9 no. SWBs as DWPA. The Sullane River in the vicinity of the Proposed Development site is not identified as a DWPA. The closest downstream DWPA is the Sullane_060 SWB at Macroom, ~23km to the southeast of the Proposed Development site.



Legend

- EIAR Site Boundary
- Source Protection Area - Carraignadoura GWS
- SI-Inner Protection Area
- SO-Outer Protection Area
- GSI mapped wells (1-100m accuracy)

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Client: Ørsted

Job: Proposed Repowering of the Existing Kilgarvan Wind Farm

Title: Map of Groundwater Wells

Figure No: 9-12

Drawing No: P1585-0-0424-A4-912-00A

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9.3.15 Receptor Sensitivity

This section discusses the sensitivity of the receiving water environment in terms of the Proposed Development and identifies those sensitive receptors which will be carried forward into the impact assessment.

Table 9-15 below presents a screening of all hydrological and hydrogeological receptors identified.

9.3.15.1 Aquifers/Groundwater bodies

Due to the nature of wind farm developments, being near surface construction activities (i.e., shallow excavations and foundations), effects on groundwater are generally negligible and surface water is generally the main sensitive receptor assessed during water impact assessments.

However, general construction works have the potential to contaminate groundwaters with hydrocarbons and cement-based products being used at the Proposed Development site. The following sensitive groundwater receptors are identified for impact assessment:

- The Locally Important Aquifers underlying the Proposed Development site.
- The WFD status of the GWBs (Beara Sneem, Cahersiveen and Ballinahassig West GWBs) underlying the Proposed Development site.
- The local private groundwater abstractions in the lands surrounding the Proposed Development site.

9.3.15.2 Surface Waters

Surface waters are the main sensitive receptors associated with the Proposed Development due to the local hydrological regime which is characterised by high runoff rates and low rates of groundwater recharge. The primary potential for the contamination downstream surface waters is via elevated concentrations of suspended solids and nutrient enrichment associated with construction phase works.

This quantification of flow volumes presented in Section 9.3.3.1 indicates that the watercourses in the immediate vicinity of the Proposed Development site (i.e. the tributaries of the Flesk, Sullane and Roughty Rivers) will be most susceptible to potential effects. The larger regional waterbodies such as the Roughty River and Flesk River will be less susceptible to effects due to the larger flow volumes and the associated dilution effect of these increased flows. The potential for effects to occur will progressively decrease downstream of the Proposed Development site.

The tributaries of the Roughty River and the Roughty River in close proximity to the Proposed Development site are particularly vulnerable to potential effects due to the nature of the proposed works in the Roughty River Catchment. Further downstream the Roughty River Estuary is less susceptible to potential effects due to its saline nature and the large volumes of water within the waterbody.

Within the Flesk River surface water catchment, only minor works are proposed which include road widening, road upgrades and forestry felling. Due to the small-scale nature of these works, the Flesk River in the vicinity of the Proposed Development site has the potential to be affected, while further downstream the large volumes of water negate any potential effects. Similarly, within the Sullane River surface water catchment, only minor works are proposed and therefore, any potential significant effects cannot extend a significant distance downstream of the Proposed Development site.

The following surface water receptors are identified for impact assessment:

- The local surface waters downstream of the Proposed Development site, including the Roughty River and its associated tributaries as far as the Roughty River Estuary.

The Flesk River and its tributaries (Coomagearlahy and Owgarriv Rivers) and the Sullane River and its tributaries (Bardinch River) in the immediate vicinity of the Proposed Development site. These waters can be considered to be of Very High Importance (refer to **Table 9-2**) as they achieved High and Good Q-ratings values indicating that these waters are unpolluted and in satisfactory condition.
- The WFD status of the SWBs in the vicinity and downstream of the Proposed Development site.
- The Flesk (Kerry)_040 DWPA.

9.3.15.3 Designated Sites

In terms of designated sites, the only designated sites with the potential to be affected by the Proposed Development are located downstream of the Proposed Development site along the Roughty, Flesk and Sullane rivers. However, due to the increasing volumes of flow within these rivers, the potential effects decrease progressively downstream. No potential water quality effects will occur along the Roughty River downstream of Kilgarvan town, where the river becomes the estuarine. Consequently, the Kenmare River SAC can be screened out. Similarly, the Killarney National Park SPA can be screened out due to the large volumes of water within Lough Leane downstream of the Flesk River.

Within the Lee, Cork Harbour and Youghal Bay Catchment, St. Gobnet's Wood SAC/pNHA (site Code: 000106) is located ~8.7km east of the Proposed Development site. This site can be screened out of further assessment as the qualifying interests of the site *i.e.* Old Oak Woodlands are terrestrial. Therefore, the Proposed Development has no potential to affect the qualifying interests of this SAC.

Based on the above, the following designated site are identified for impact assessment:

- Roughty River pNHA.
- Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC/pNHA.

The Proposed Development has the potential to effect water quality in the Roughty and Flesk rivers and therefore effect the qualifying interest of these designated sites.

Table 9-15: Screening of Hydrological and Hydrogeological Receptors

Type	Name	Inclusion in Impact Assessment	Justification
Surface Water	Roughty River (and associated tributaries)	Yes	The Proposed Development site drains to the Roughty River. Potential effects will be greatest in the tributaries of the Roughty River which drain the site. The potential for effects progressively decreases further downstream due to the increasing flow volumes in the Roughty River. Therefore, an assessment is required to consider the potential effects of the Proposed Development on the Roughty River in the vicinity of the site and its tributaries.
	Flesk River (and associated tributaries)	Yes	The north of the Proposed Development site drains to the Flesk River. Despite works being minor in nature (road upgraded), water quality effects may occur in an unmitigated scenario on watercourses in the vicinity of the works. Therefore, an assessment is required to consider the potential effects of the Proposed Development on the Flesk River.
	Sullane River (and associated tributaries)	Yes	A small section of the Proposed Development site drains to the Sullane River. Despite works being minor in nature (road upgraded), water quality effects may occur in an unmitigated scenario on watercourses in the vicinity of the works. Therefore, an assessment is required to consider the potential impacts of the Proposed Development on this SWB.
	Loo River (and associated tributaries)	No	No works or infrastructure associated with the Proposed Development is located in the catchment of the Loo River. Therefore, the Loo River can be screened out as there is no potential for the Proposed Development to affect water quality or quantity in the Loo River.
DWPA	Flesk (Kerry)_040 DWPA	Yes	The north of the Proposed Development site drains to the Flesk_040 SWB which is a designated DWPA. Despite works being minor in nature (road upgraded), water quality effects may occur in an unmitigated scenario on watercourses in the vicinity of the works. Therefore, an assessment is required to consider the potential effects of the Proposed Development on the Flesk_040 DWPA.
Designated sites	Roughty River pNHA	Yes	The Roughty River pNHA is located directly downstream and in close proximity to the site. Th hydrological pathway between the Proposed Development site and the pNHA is ~800m in length, along an unnamed

Type	Name	Inclusion in Impact Assessment	Justification
			tributary of the Roughty River. Therefore, an assessment is required to consider the potential effects of the Proposed Development on the Flesk_040 DWPA.
	Sillahertane Bog NHA	No	This designated site is located upstream of the Proposed Development site and therefore has no potential to be impacted by the Proposed Development.
	Kilgarvan Ice House pNHA/SAC	No	The Kilgarvan Ice House pNHA/SAC does not include the Roughty River and therefore is not hydrologically connected with the Proposed Development site.
	Roughty River Estuary pNHA / SAC	No	This designated site has been screened out due to its distant location (~13km as crow flies and ~16km hydrological pathway along the Roughty River) from the Proposed Development site, the large volumes of water within this estuary and the saline nature of its waters.
	Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC/pNHA	Yes	This designated site exists immediately to the north of the Proposed Development site and is hydrologically linked with the site via several tributaries of the Flesk River. The shortest hydrological pathway between the Proposed Development site and the SAC/pNHA is ~170m via a tributary of the Flesk River. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this designated site.
	Killarney National Park SPA	No	This SPA has been screened out due to its distant location from the Proposed Development site and the large volume of water in Lough Leane. The hydrological connection between the Proposed Development site and the SPA is ~24.8km.
	St. Gobnet's Wood SAC/pNHA	No	The length of the hydrological connection along to Bardinch and Sullane rivers to this SAC is ~12.5km. However, this designated site has been screened out due to the terrestrial nature of its qualifying interests. The Proposed Development has no potential to affect the conservation objectives of this SAC/pNHA.

Type	Name	Inclusion in Impact Assessment	Justification
Groundwater	Beara Sneem GWB (Locally Important Aquifer)	Yes	The Proposed Development site is underlain by the Beara Sneem GWB. Therefore, an assessment is required to consider the potential impacts of the Proposed Development on this GWB.
	Cahirsiveen GWB (Locally Important Aquifer)	Yes	Some minor road upgrades and proposed roads overlie the Cahersiveen GWB. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this GWB.
	Ballinahassig West GWB (Locally Important Aquifer)	Yes	Some minor road upgrades and proposed roads overlie the Ballinhassig West GWB. Therefore, an assessment is required to consider the potential effects of the Proposed Development on this GWB.
	Local groundwater wells	Yes	The GSI map groundwater wells in the vicinity and downgradient of the site. Therefore, an assessment is required to consider the potential effects of the Proposed Development on these wells.

9.4 Characteristics of the Proposed Development

The Proposed Development is defined in Chapter 4.

The main characteristics of the Proposed Development that could affect the hydrological and hydrogeological environment comprise of the following:

- The removal of the existing turbines and associated turbine hardstands (those which will not be reused for the Proposed Development). Other ancillary infrastructure that will not be utilised for the Proposed Development will be left to naturally regenerate.
- Extension of the existing on-site borrow pit. Runoff and discharge from the proposed extension to the existing borrow pit have the potential to effect surface water quality.
- Establishment of the 2 no. temporary construction compounds, which will involve the excavation of peat (3,010m^3) and the emplacement of compounds. The construction will require ~22,320m^3 of material which will be sourced from the proposed extension to the existing borrow pit and cut volumes. Welfare facilities will be provided at the site compounds. Wastewater effluent will be collected in a wastewater holding tank and periodically emptied by a licensed contractor.
- Construction of the new proposed internal site access roads and upgrades of existing roads. The proposed new site access roads will be constructed using an excavate and replace technique. The volume of peat and rock requiring excavation is estimated to be 3,330m^3 and 21,800m^3 respectively. The construction will require ~4,770m^3 of material which will be sourced from the proposed extension to the existing borrow pit and cut volumes. These activities have the potential to impact on surface water quality.
- Upgrades of existing roads. The volume of peat and rock requiring excavation is estimated to be 10,180m^3 and 64,480m^3 respectively. The upgrades will require ~117,780m^3 of material which will be sourced from the proposed extension to the existing borrow pit and cut volumes. These activities have the potential to impact on surface water quality.
- Construction of the crane hardstand areas and turbine assemblage areas will utilise ground bearing foundations. This will involve the use of material sourced from the onsite borrow pit. Construction of these areas has the potential to impact on surface water quality.
- Upgrade of the existing onsite 110kV Coomagearlahy substation. Wastewater effluent will be collected in an underground concrete holding tank and periodically emptied by a licenced contractor for the operational phase of the Proposed Development.
- Construction of the foundations for the 11 no. proposed wind turbines. Volumes of peat and rock to be removed at the turbine locations is estimated to be 40,520m^3 peat and 99,060m^3 of rocks. The construction will require ~164,230m^3 of material to be sourced from the proposed extension to the existing borrow pit and cut volumes. The movement of large volumes of peat and rock have the potential to effect surface water quality. Construction of the turbine foundations will require large volumes of concrete could affect surface water and groundwater quality.
- Cabling between turbine locations and the existing onsite 110kV Coomagearlahy substation will involve the excavation of a shallow trench (approximately 1.2m deep), placement of ducting and backfilling with aggregate, lean-mix concrete, and excavated material, as appropriate (depending on the location of the cable trench). These works have the potential to impact on surface water quality.
- Settlement ponds where constructed will be volume neutral, i.e. all material excavated will be used to form side bunds and landscaping around the ponds. There will be no excess material from settlement pond construction. The material will also be reinstated during decommissioning.

- Grey water will be supplied by rainwater harvesting and water tankered to site where required. Bottled water will be used for potable supply.
- Tree felling and replanting of forestry at alternative replacement lands. It is estimated that ~8.9ha of forestry will be felled for the Proposed Development. This includes ~3.16ha to be felled along the main access road. While this work will be done with Forestry Service licences and approvals, the works could result in soil/subsoils erosion.

9.4.1 Proposed Drainage Management

Runoff control and drainage management are key elements in terms of mitigation against potential effects on surface water bodies. Two distinct methods will be employed to manage drainage water within the Proposed Development site. The first method involves 'keeping clean water clean' by avoiding disturbance to existing drainage features, minimising any works in or around artificial drainage features, and diverting clean surface water flow around excavations, reinstatement areas, construction areas and temporary storage areas. The second method involves collecting any drainage waters from works areas within the site that might carry silt or sediment, and nutrients, to route them towards new proposed silt traps and settlement ponds (or stilling ponds) prior to controlled diffuse release into the existing drainage network. There will be no direct discharges to the existing drains.

During the construction phase, all runoff from works areas (i.e., dirty water) will be attenuated and treated to a high quality prior to being released. The Proposed Development drainage will not significantly alter the existing drainage regime at the site. Any existing drains will be routed under/around the proposed access tracks using culverts as required. Runoff from access tracks, turbine bases, and developed areas (construction compounds, met masts) will be collected and treated in local (proposed) silt traps and settlement ponds/swales and then discharged over buffered outfalls. Runoff from the decommissioned areas will be treated in local swales before being discharged over buffered outfalls. These drainage measures will only need to be in place until vegetation is established in the reinstatement areas.

A schematic of the proposed site drainage management is shown as **Figure 9-13** below. A detailed drainage plan showing the layout of the proposed drainage design elements is shown in **Appendix 4-4** of the EIAR.

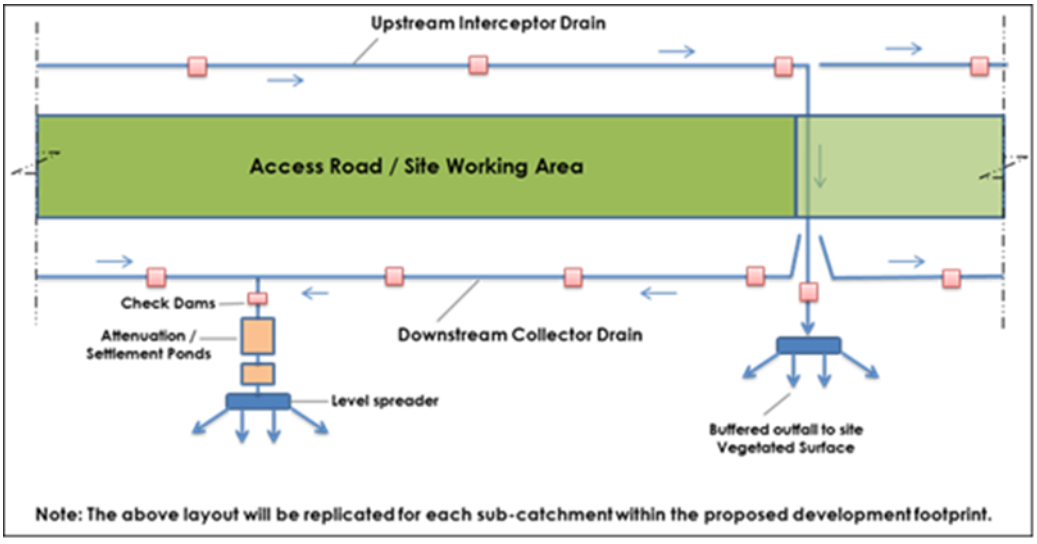


Figure 9-13: Schematic of Proposed Site Drainage Management

9.4.2 Development Interaction with the Existing Forestry Drainage Network

In relation to hydrological constraints, a self-imposed buffer zone of 50m has been put in place for on-site streams and rivers. Manmade forestry drains at the Proposed Development site are not considered a hydrological constraint and therefore no buffering of forestry drains has been undertaken.

The general design approach to wind farm layouts in existing forestry is to utilise and integrate with the existing forestry infrastructure where possible, whether it be existing access roads or the existing forestry drainage network. Utilising the existing infrastructure means that there will be less requirement for new construction/excavations, which have the potential to impact on downstream watercourses in terms of suspended solid input in runoff (unless managed appropriately). The existing forestry drains have no major ecological or hydrological value and can be readily integrated into the Proposed Development drainage scheme using the methods outlined below (Section 9.5.2.1).

In order to integrate the Proposed Development drainage with the existing forestry drainage (as per the drainage plans included in **Appendix 4-4**) the following design approach has been implemented:

- Lidar data was used to map in detail the existing forestry drainage at the site and how the proposed infrastructure interacts with this existing drainage. Using these Lidar data we have mapped potential runoff pathways that are >150m in length;
- Lidar data and available aerial photography was used to digitise existing forestry drainage and field drains within the development area;
- The Proposed Development footprint was divided up into drainage catchments (based on topography, outfall locations, catchment size) and we have calculated stormwater runoff rates for each catchment based on the 10-year return period rainfall event. These flows are used to design settlement ponds for each drainage catchment;
- Settlement pond(s) required for each development footprint catchment have been designed, and a location has been identified for each proposed pond;
- Cut-off (interceptors drains) are included to locally re-route to existing forestry drains;
- The proposed construction phase settlement ponds are designed for 11hr and 24hr retention times used to settle out medium silt (0.006mm) and fine silt (0.004mm) respectively (EPA, 2006); and,
- The proposed locations of temporary drainage measures that will be installed prior to wind farm construction commencing are identified on the drainage plans.

9.5 Likely Significant Effects and Associated Mitigation Measures

9.5.1 Do -Nothing Scenario

If the Proposed Development was not developed, the site will continue to function as it does at present, with no changes made to the current land-use of a wind farm combined with areas of commercial forestry. The impact of this is considered neutral in the context of the EIAR. If the Proposed Development were not to proceed, the Existing Kilgarvan Wind Farm turbines would eventually be decommissioned as per their existing permissions. The opportunity to capture an even greater part of County Kerry's valuable renewable energy resource would be lost, as would the opportunity to further contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. The opportunity to generate local employment and investment and to diversify the local economy would also be lost.

In terms of hydrology, the existing surface water drainage regime would continue to function and may be extended in places. In the Do-Nothing Scenario, there may be a slight decrease in average annual rainfall at the Proposed Development Site as a result of climate change. This is discussed in Section 9.3.2 above and any change in annual rainfall will result in changes in local recharge and runoff volumes.

9.5.2 Construction Phase - Likely Significant Effects and Mitigation Measures

In relation to the Proposed Development, the construction phase encompasses the removal of the 28 no. operational wind turbines, proposed roads and upgrade of existing roads, the extension of the onsite borrow pit, construction of the 2 no. temporary construction compounds and the construction of 11 no. proposed turbines/hardstands and all associated siteworks.

This section identifies the likely significant effects of the construction phase of the Proposed Development and lists the proposed mitigation measures that will be put in place to eliminate or reduce any potential effects. It should be noted that the main potential effects on the hydrological and hydrogeological environment will occur during the construction phase.

9.5.2.1 Potential Surface Water Quality Effects from Clear Felling

A total of ~8.9ha of forestry will have to be permanently felled within and around the footprint of the Proposed Development. The total area to be felled in relation to WFD river sub-basins is detailed as follows:

- ~0.15ha in the Flesk_040 river sub-basin, with this area drained by the Owgarriv River.
- ~3.01ha in the Flesk_030 river sub-basin with this area drained by an unnamed tributary of the Flesk River,
- ~5.76ha in the Roughty_030 river sub-basin, with this area drained by several tributaries of the Roughty River.

Felling is also proposed in the restoration area(~5.5ha) associated with the Blanket Bog Rehabilitation and Management Plan within the Roughty_030 river sub-basin.

The tree felling activities required as part of the Proposed Development will be the subject of a Felling Licence application to the Forest Service, in accordance with the Forestry Act 2014 and the Forestry

Regulations 2017 (SI 191/2017) and as per the Forest Service's policy on granting felling licenses for wind farm developments.

Potential surface water quality effects during tree felling occur mainly from:

- Exposure of soil and subsoils due to vehicle tracking, compaction and skidding or forwarding extraction methods resulting in a source of suspended sediment which can become entrained in surface water runoff and enter surface watercourses;
- Entrainment of suspended sediment in watercourses due to vehicle tracking through watercourses;
- Damage to roads resulting in a source of suspended sediment which can become entrained in surface water runoff and enter surface watercourses;
- Release of sediment attached to timber in stacking areas; and,
- Nutrient release.

These effects have the potential to affect the water quality and fish stocks of downstream water bodies. Potential effects on all watercourses downstream of the proposed felling areas could be significant if not mitigated.

Pathways: Drainage and surface water discharge routes.

Receptors: Surface water quality in the Roughty and Flesk rivers and their associated tributaries.

Pre-Mitigation Potential Effect: Indirect, negative, significant, temporary, likely effect on surface watercourse and associated water-dependent ecosystems.

Proposed Mitigation Measures:

All felling operations will conform to current best practice Forest Service regulations, policies and strategic guidance documents as well as Coillte and DAFM guidance documents, including the specific guidelines listed below, to ensure that felling, planting and other forestry operations result in minimal potential negative effects to the receiving environment.

- Forestry Standards Manual (Forest Service, 2015)
- Environmental Requirements for Afforestation (Forest Service, 2016a)
- Land Types for Afforestation (Forest Service, 2016b)
- Forest Protection Guidelines (Forest Service, 2002)
- Forest Operations and Water Protection Guidelines (Coillte, 2013)
- Forestry and Water Quality Guidelines (Forest Service, 2000b)
- Forestry and the Landscape Guidelines (Forest Service, 2000c)
- Forestry and Archaeology Guidelines (Forest Service, 2000d)
- Forest Biodiversity Guidelines (Forest Service, 2000e)
- Forests and Water, Achieving Objectives under Ireland's River Basin Management Plan 2018-2021 (DAFM, 2018)
- Coillte Planting Guideline SOP
- A Guide to Forest Tree Species Selection and Silviculture in Ireland (Horgan et al., 2003)
- Management Guidelines for Ireland's Native Woodlands. Jointly published by the National Parks & Wildlife Service (Cross and Collins, 2017)
- Native Woodland Scheme Framework (Forest Service, 2018)
- Code of Best Forest Practice (Forest Service, 2000)

Mitigation by Avoidance:

There is a requirement in the Forest Service Code of Practice and in the FSC Certification Standard for the installation of buffer zones adjacent to aquatic zones at planting stage. Minimum buffer zone widths

recommended in the Forest Service (2000) guidance document "Forestry and Water Quality Guidelines" are shown in **Table 9-16**.

With moderate to steep slopes existing across much of the Proposed Development site, a 10 to 15m setback will be established along all aquatic zones. Furthermore, a 5m setback will be established along all relevant watercourses and water hotspots. Buffer zone widths will be increased at vulnerable hotspots where deemed necessary. This will ensure water quality is protected during the felling operations.

The setback distance from sensitive hydrological features means that adequate room is maintained for the proposed mitigation measures (discussed below) to be properly installed and operate effectively. The buffer/setback zone will:

- Avoid physical damage (river/stream banks and river/stream beds) to watercourses and the associated release of sediment;
- Avoid peat/soil disturbance and compaction within close proximity to surface watercourses;
- Avoid the entry of suspended sediment from works into watercourses; and,
- Avoid the entry of suspended sediment from the drainage system into watercourses, achieved in part by ending drain discharge outside the buffer zone and allowing percolation across the vegetation of the buffer zone.

Table 9-16: Recommended minimum buffer zone widths

Average slope leading to the aquatic zone		Buffer zone width on either side of the aquatic zone	Buffer zone width for highly erodible soils
Moderate	(0 – 15%)	10m	15m
Steep	(15 – 30%	15m	20m
Very Steep	(>30%)	20m	25m

In addition to the application of buffer/setback zones, the following supplementary mitigation measures will be employed during felling works:

Mitigation by Design:

Mitigation measures which will reduce the risk of entrainment of suspended solids and nutrient release in surface watercourses comprise best practice methods which are set out as follows:

- Machine combinations will be chosen which are most suitable for ground conditions at the time of felling, and which will minimise soils disturbance. The harvester and the forwarder are designed specifically for the forest environment and are low ground pressure machines;
- All machinery will be operated by suitably qualified personnel;
- Checking and maintenance of roads and culverts will be on-going through any felling operations. No tracking of vehicle through watercourses will occur, as vehicles will use road infrastructure and existing watercourse crossing points. Where possible, existing drains will not be disturbed during felling works;
- These machines will traverse the site along specified off-road routes (referred to as racks);
- The location of racks will be chosen to avoid wet and potentially sensitive areas;
- Brash mats will be placed on the racks to support the vehicles on soft ground, reducing peat and mineral soil disturbance and erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will

take place when they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion occurring, extraction will be suspended during periods of high rainfall;

- Silt fences will be installed at the outfalls of existing drains downstream of felling areas. No direct discharge of such drains to watercourses will occur. Sediment traps and silt fences will be installed in advance of any felling works and will provide surface water settlement for runoff from work areas and will prevent sediment from entering downstream watercourses. Accumulated sediment will be carefully disposed of at pre-selected peat disposal areas. Where possible, all new silt traps will be constructed on even ground and not on sloping ground;
- In areas particularly sensitive to erosion it will be necessary to install double or triple sediment traps and increase buffer zone width. These measures will be reviewed on site during construction;
- Double silt fencing will also be put down slope of felling areas which are located in close proximity to streams and/or relevant watercourses;
- Drains and silt traps will be maintained throughout all felling works, ensuring that they are clear of sediment build-up and are not severely eroded;
- Timber will be stacked in dry areas, and outside watercourse buffer zones. Straw bales and check dams to be emplaced on the down gradient side of timber storage/processing sites;
- Works will be carried out during periods of no, or low rainfall, in order to minimise entrainment of exposed sediment in surface water runoff;
- Refuelling or maintenance of machinery will not occur within 50m of an aquatic zone or within 20m of any other hydrological feature. Mobile bowser, drip kits, qualified personnel will be used where refuelling is required; and,
- Branches, logs or debris will not be allowed to build up in aquatic zones. All such material will be removed when harvesting operations have been completed, but care will be taken to avoid removing natural debris deflectors.

Silt Traps:

Silt traps will be strategically placed down-gradient of felling areas within forestry drains near streams. The main purpose of the silt traps and drain blocking is to slow water flow, increase residence time, and allow settling of silt in a controlled manner.

Pre-emptive Site Drainage Management:

The works programme for the felling operations will also take account of weather forecasts and predicted rainfall in particular. Operations will be suspended or scaled back if heavy rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast.

The following forecasting systems are available and will be used on a daily/weekly basis, as required, to allow site staff to direct proposed and planned construction activities:

- General Forecasts: Available on a national, regional and county level from the Met Éireann website (www.met.ie/forecasts). These provide general information on weather patterns including rainfall, wind speed and direction but do not provide any quantitative rainfall estimates;
- MeteoAlarm: Alerts to the possible occurrence of severe weather for the next 2 days. Less useful than general forecasts as only available on a provincial scale;
- 3-hour Rainfall Maps: Forecast quantitative rainfall amounts for the next 3 hours but does not account for possible heavy localised events;
- Rainfall Radar Images: Images covering the entire country are freely available from the Met Éireann website (www.met.ie/latest/rainfall_radar.asp). The images are a

composite of radar data from Shannon and Dublin airports and give a picture of current rainfall extent and intensity. Images show a quantitative measure of recent rainfall. A 3-hour record is given and is updated every 15 minutes. Radar images are not predictive; and,
- Consultancy Service: Met Éireann provide a 24-hour telephone consultancy service. The forecaster will provide an interpretation of weather data and give the best available forecast for the area of interest.

Using the safe threshold rainfall values will allow planned works to be safely executed (from a water quality perspective) in the event of forecasting of an impending high rainfall intensity event.

Works will be suspended if forecasting suggests any of the following is likely to occur:

- >10 mm/hr (i.e. high intensity local rainfall events);
- >25 mm in a 24-hour period (heavy frontal rainfall lasting most of the day); or,
- >half monthly average rainfall in any 7 days.

Timing of Site Felling Works:

Felling will only be carried out during periods of low rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses.

Drain Inspection and Maintenance:

The following items shall be carried out during inspection pre-felling and after:

- Communication with tree felling operatives in advance to determine whether any areas have been reported where there is unusual water logging or bogging of machines;
- Inspection of all areas reported as having unusual ground conditions;
- Inspection of main drainage ditches and outfalls. During pre-felling inspections, the main drainage ditches shall be identified. Ideally the pre-felling inspection shall be carried out during rainfall;
- Following tree felling all main drains shall be inspected to ensure that they are functioning;
- Extraction tracks near drains need to be broken up and diversion channels created to ensure that water in the tracks spreads out over the adjoining ground;
- Culverts on drains exiting the site will be unblocked; and,
- All accumulated silt will be removed from drains and culverts, and silt traps, and this removed material will be deposited away from watercourses to ensure that it will not be carried back into the trap or stream during subsequent rainfall.

Surface Water Quality Monitoring:

Sampling will be completed before, during (if the operation is conducted over a protracted time) and after the felling activity. The 'before' sampling will be conducted within 4 weeks of the felling activity commencing, preferably in medium to high water flow conditions. The "during" sampling will be undertaken once a week or after rainfall events. The 'after' sampling will comprise as many samplings as necessary to demonstrate that water quality has returned to pre-activity status (i.e. where an impact has been shown).

Criteria for the selection of water sampling points include the following:

- Avoid man-made ditches and drains, or watercourses that do not have year-round flows, i.e. avoid ephemeral ditches, drains or watercourses;

- Select sampling points upstream and downstream of the forestry activities;
- It is advantageous if the upstream location is outside/above the forest in order to evaluate the impact of land-uses other than forestry;
- Downstream locations will be selected: one immediately below the forestry activity, the second at exit from the forest, and the third some distance from the second (this allows demonstration of no impact through dilution effect or contamination by other land-uses where impact increases at third downstream location relative to second downstream location); and,
- The above sampling strategy will be undertaken for all on-site sub-catchments streams where tree felling is proposed.

Also, daily surface water monitoring forms will also be utilised at every works site near any watercourse. These will be taken daily and kept on site for record and inspection. Further details on surface water monitoring is detailed in Chapter 7, Section 7.5.7.4.

Post-Mitigation Residual Effects: The potential for the release of suspended solids to watercourse receptors during tree felling is a risk to water quality and the aquatic quality of the receptor. Proven forestry best practice measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect will be negative, imperceptible, indirect, temporary, likely effect on downstream watercourses and associated water-dependent ecosystems.

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

9.5.2.2 Earthworks Resulting in Suspended Solids Entrainment in Surface Waters

Construction phase activities including access road upgrades and construction, turbine base/hardstanding construction, construction compound construction, met mast construction and cable route excavations will require varying degrees of earthworks resulting in excavation of peat and mineral subsoil where present. In addition, the removal of the Existing Kilgarvan Wind Farm will involve the covering of hardstands which will not be reused as part of the Proposed Development with spoil.

It is estimated that construction works will require the excavation of ~60,080m^3 of peat and 369,530m^3 of rock which will be a significant potential source of sediment laden water. Other potential sources of sediment laden water include:

- Drainage and seepage water resulting from excavations;
- Stockpiled excavated material providing a point source of exposed sediment;
- Erosion of sediment from emplaced site drainage channels; and,
- Placed spoil on decommissioning areas.

In addition, activities associated with the Blanket Bog Rehabilitation and Management Plan will involve the disturbance of peat through drain blocking.

These activities can result in the release of suspended solids to surface water and could result in an increase in the suspended sediment load, resulting in increased turbidity which in turn could affect the water quality and fish stocks of downstream water bodies. Potential effects on all watercourses downstream of the site could be significant if mitigation measures are not implemented.

Pathways: Drainage and surface water discharge routes.

Receptors: Down-gradient rivers (Roughty, Flesk and Sullane rivers and their associated tributaries) and associated dependent ecosystems.

Pre-Mitigation Potential Effect: Negative, significant, indirect, short-term, likely effect on the downstream watercourses including the Roughty, Flesk and Sullane rivers and their associated tributaries.

Proposed Mitigation Measures:

Mitigation by Avoidance

The key mitigation measure during the construction phase is the avoidance of sensitive hydrological features, by application of suitable buffer zones (i.e. 50m to main watercourses, and 10m to main drains).

All of the key Proposed Development areas (turbines, hardstands, construction compounds etc.) are located away from the delineated 50m watercourse buffer zones. The only works proposed within the hydrological buffer zones are the upgrade of existing watercourse crossings and at new watercourse crossings and upgrades to the existing site access tracks. Similarly, all hardstand areas to be decommissioned are located outside of the delineated 50m hydrological buffer zone.

Within the Proposed Development site, road upgrades are proposed over a total of 10 no. existing watercourse crossings.

- 5 no. crossings are located on tributaries of the Roughty River within the site:
  - An unnamed stream ~500m east/northeast of T3;
  - An unnamed stream ~250m west/southwest of T4;
  - An unnamed stream ~150m east/southeast of T6;
  - An unnamed stream ~280m northeast of T7; and,
  - An unnamed stream ~220m east/northeast of T8.
- An additional 4 no. crossings are located on the main access road from the N22 and cross tributaries of the Flesk River:
  - 1 unnamed stream in the townland of Coomacullen;
  - Coomacullen stream;
  - Cloonkeen stream; and,
  - An unnamed stream in the vicinity of Clonkeen substation.
- 1 no. existing crossing to be upgraded is located on the Inchamore stream, a tributary of the Bardinch River, within the Sullane River catchment.

All of these existing watercourse crossings are culverted.

In addition, there is 1 no. new proposed watercourse crossing located ~190m north of T11 over an unnamed tributary of the Roughty River.

The large setback distance from sensitive hydrological features means that adequate room is maintained for the proposed drainage mitigation measures (discussed below) to be properly installed and operate effectively. The proposed buffer zone will:

- Avoid physical damage (river/stream banks and river/stream beds) to watercourses and the associated release of sediment;
- Avoid excavations within close proximity to surface watercourses;
- Avoid the entry of suspended sediment from earthworks into watercourses; and,
- Avoid the entry of suspended sediment from the construction phase drainage system into watercourses, achieved in part by ending drain discharge outside the buffer zone and allowing percolation across the vegetation of the buffer zone.

Mitigation by Design

The Proposed Development design has been optimised to utilise the existing infrastructure (roads and hardstands) where practicable. This design prevents the unnecessary disturbance of peat and spoil, significantly reducing the potential for elevated concentrations of suspended solids in runoff.

Presented below are temporary and long-term drainage control measures that will be utilised during the construction phase of the Proposed Development. As stated above there is an existing drainage network in some areas of the Proposed Development site which comprises forestry drains and roadside drains and headwater streams. The measures outlined below will be used in conjunction with the existing drainage network to ensure the protection of all rivers and downstream watercourses.

- Source controls:
- Intercepter drains, vee-drains, diversion drains.
- Small working areas, covering temporary stockpiles, weathering off of side-cast peat/spoil, cessation of works in certain areas or other similar/equivalent or appropriate measures.
- In-Line controls:
- Interceptor drains, vee-drains, temporary sumps/attenuation lagoons, sediment traps, pumping systems, settlement ponds, temporary pumping chambers, or other similar/equivalent or appropriate systems.
- Treatment systems:
- Temporary sumps and attenuation ponds, temporary storage lagoons, sediment traps, and settlement ponds, and proprietary settlement systems such as “Siltbuster”, and/or other similar/equivalent or appropriate systems.

It should be noted for this site that an extensive network of forestry and roadside drains already exists, and these will be integrated and enhanced as required and used within the wind farm development drainage system. The integration of the existing forestry drainage network and the Proposed Development network is relatively simple. The key elements being the upgrading and improvements to water treatment elements, such as in line controls and treatment systems, including silt traps, settlement ponds and buffered outfalls.

The main elements of interaction with existing drains will be as follows:

- Apart from interceptor drains, which will convey clean runoff water to the downstream drainage system, there will be no direct discharge (without treatment for sediment reduction, and attenuation for flow management) of runoff from the Proposed Development drainage into the existing site drainage network. This will reduce the potential for any increased risk of downstream flooding or sediment transport/erosion;
- Temporary silt traps will be placed in the existing drains downstream of construction works, and these will be diverted into proposed interceptor drains, or culverted under/across the works area;
- During the operational phase of the wind farm runoff from individual turbine hardstanding areas will be not discharged directly into the existing drainage network but discharged locally at each turbine location through field drains, main drains, and existing settlement ponds;
- Buffered outfalls which will be numerous over the site will promote percolation of drainage waters across the bog surface and close to the point at which the additional runoff is generated, rather than direct discharge to the existing drains of the site;
- Drains running parallel to the existing roads requiring widening will be upgraded, widening will be targeted to the opposite side of the road. Velocity and silt control measures such as check dams, sandbags, oyster bags, straw bales, flow limiters, weirs, baffles, silt fences will be used during the upgrade construction works. Regular buffered outfalls will also be added to these drains to protect downstream surface waters; and,

- Existing culverts will be lengthened where necessary to facilitate access road widening.

Pre-commencement Temporary Drainage Works

Prior to the commencement of road upgrades (or new road/hardstand or turbine base installs) the following key temporary drainage measures will be installed:

- All existing dry forestry drains that intercept the proposed works area will be temporarily blocked down-gradient of the works using forestry check dams/silt traps;
- Clean water diversion drains will be installed upgradient of the works areas;
- Check dams/silt fence arrangements (silt traps) will be placed in all existing forestry drains that have surface water flows and also along existing forestry roadside drains; and,
- A double silt fence perimeter will be placed down-slope of works areas that are located inside the watercourse 50m buffer zone.

Silt Fences

Silt fences will be emplaced within drains down-gradient of all construction areas. Silt fences are effective at removing heavy settleable solids such as those present in the subsoils/sandstone tills that overlie the site. This will act to prevent entry to water courses of sand and gravel sized sediment, released from excavation of mineral sub-soils of glacial and glacio-fluvial origin, and entrained in surface water runoff. Inspection and maintenance of these of these structures during construction phase is critical to their functioning to stated purpose. They will remain in place throughout the entire construction phase.

Silt Bags

Silt bags will be used where small to medium volumes of water need to be pumped from excavations. As water is pumped through the bag, the majority of the sediment is retained by the geotextile fabric allowing filtered water to pass through. Silt bags will be used with natural vegetation filters or sedimats Sediment entrapment mats, consisting of coir or jute matting, will be placed at the silt bag location to provide further treatment of the water outfall from the silt bag. Sedimats will be secured to the ground surface using stakes/pegs. The sedimat will extend to the full width of the outfall to ensure all water passes through this additional treatment measure.

Settlement Ponds

The Proposed Development footprint will be divided into drainage catchments (based on topography, outfall locations, catchment size) and stormwater runoff rates based on the 10-year return period rainfall event will be calculated for each catchment. These flows will then be used to design settlement ponds for each drainage catchment. The settlement ponds will either be designed for 4.1hr or 24hr retention times used to settle out medium silt (0.01mm) and fine silt (0.004mm) respectively (EPA, 2006)[3]. Settlement pond at borrow pits will be designed to allow 24hr retention and settlement ponds along access roads and at turbine hardstands will have 4.1hr retention as there is additional in-line drainage controls proposed along access tracks and at hardstands.

Level Spreaders and Vegetation Filters

The purpose of level spreaders is to release treated drainage flow in a diffuse manner, and to prevent the concentration of flows at any one location thereby avoiding erosion. level spreaders are not intended to be a primary treatment component for development surface water runoff. They are not

[3] *Environmental Management Guidelines - Environmental Management in the Extractive Industry (Non-Scheduled Minerals) (EPA, 2006).*

sand alone but occur as part of a treatment train of systems that will reduce the velocity of runoff prior to be released at the level spreader. In the absence of level spreaders, the potential for ground erosion is significantly greater than not using them.

Vegetation filters are essentially end-of-line polishing filters that are located at the end of the treatment train. In fact, vegetation filters are ultimately a positive consequence of not discharging directly into watercourses which is one of the mitigation components of the drainage philosophy. This makes use of the natural vegetation of the site to provide a polishing filter for the wind farm drainage prior to reaching the downstream watercourses.

Again, vegetation filters are not intended to be a single or primary treatment component for treatment of works area runoff. They are not sand alone but are intended as part of a treatment train of water quality improvement/control systems (i.e. source controls→check dams→silt traps→settlement ponds→level spreaders →silt fences→vegetation filters).

Water Treatment Train

A final line of defence will be provided by a water treatment train such as a "Siltbuster". If the discharge water from construction areas fails to be of a high quality during regular inspections, then a filtration treatment system (such as a 'Siltbuster' or similar equivalent treatment train (sequence of water treatment processes) will be used to filter and treat all surface discharge water collected in the dirty water drainage system. This will apply for all of the construction phase.

Pre-emptive Site Drainage Management

The works programme for the entire construction stage of the development will also take account of weather forecasts, and predicted rainfall in particular. Large excavations and movements of soil/subsoil or vegetation stripping will be suspended or scaled back if heavy rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast.

The following forecasting systems are available and will be used on a daily basis at the site to direct proposed construction activities:

- General Forecasts: Available on a national, regional and county level from the Met Eireann website (www.met.ie/forecasts). These provide general information on weather patterns including rainfall, wind speed and direction but do not provide any quantitative rainfall estimates;
- MeteoAlarm: Alerts to the possible occurrence of severe weather for the next 2 days. Less useful than general forecasts as only available on a provincial scale;
- 3-hour Rainfall Maps: Forecast quantitative rainfall amounts for the next 3 hours but does not account for possible heavy localised events;
- Rainfall Radar Images: Images covering the entire country are freely available from the Met Eireann website (www.met.ie/latest/rainfall_radar.asp). The images are a composite of radar data from Shannon and Dublin airports and give a picture of current rainfall extent and intensity. Images show a quantitative measure of recent rainfall. A 3-hour record is given and is updated every 15 minutes. Radar images are not predictive; and,
- Consultancy Service: Met Eireann provide a 24-hour telephone consultancy service. The forecaster will provide interpretation of weather data and give the best available forecast for the area of interest.

Using the safe threshold rainfall values will allow work to be safely controlled (from a water quality perspective) in the event of forecasting of an impending high rainfall intensity event.

Works will be suspended if forecasting suggests either of the following is likely to occur:

- >10 mm/hr (i.e. high intensity local rainfall events);
- >25 mm in a 24-hour period (heavy frontal rainfall lasting most of the day); or,
- >half monthly average rainfall in any 7 days.

Prior to works being suspended the following control measures will be completed:

- All active excavations will be secured and sealed off;
- Temporary or emergency drainage will be installed to prevent back-up of surface runoff; and,
- No works will be completed during heavy rainfall and for up to 24 hours after heavy events to ensure drainage systems are not overloaded.

Timing of Site Construction Works

Construction of the site drainage system will only be carried out during periods of low rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses. Construction of the drainage system during this period will also ensure that attenuation features associated with the drainage system will be in place and operational for all subsequent construction works.

Monitoring

An inspection and maintenance plan for the on-site construction drainage system will be prepared in advance of commencement of any works. Regular inspections of all installed drainage systems will be undertaken, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water in parts of the systems where it is not intended. Inspections will also be undertaken after tree felling.

Any excess build-up of silt levels at dams, the settlement pond, or any other drainage features that may decrease the effectiveness of the drainage feature, will be removed. Checks will be carried out on a daily basis.

During the construction phase field testing and laboratory analysis of a range of parameters with relevant regulatory limits and EQSs will be undertaken for each primary watercourse, and specifically following heavy rainfall events (as per the CEMP is included in **Appendix 4-3** of this EIAR).

Allowance for Climate Change

Climate Change rainfall projections are typically for a mid-century (2050) timeline. The projected effects of climate change on rainfall are therefore modelled towards the end of the life cycle of the Proposed Development, as the turbines have a life span of ~30 years. It is likely that the long-term effects of climate change on rainfall patterns will not be observed during the lifetime of the proposed wind farm. As outlined in the above sections we have designed settlement ponds for a 1 in 10-year return flow. This approach is conservative given that the project will likely be built over a much shorter period (12-18 months), and therefore this in-built redundancy in the drainage design more than accounts for any potential short term climate change rainfall effects.

Post Mitigation Residual Effects: The potential for the release of suspended solids to watercourse receptors is a risk to water quality and the aquatic quality of the receptor. Proven and effective measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect will be negative, imperceptible, indirect, short term, likely effect on down gradient watercourse and water-dependant ecosystems.

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

9.5.2.3 Excavation Dewatering and Potential Effects on Surface Water Quality

Some minor groundwater/surface water seepages will likely occur in turbine base excavations, the borrow pit and construction compound excavations and in the internal cabling trenches. This will create additional volumes of water to be treated by the runoff management system. Inflows will likely require management and treatment to reduce suspended sediments. No contaminated land was noted at the Proposed Development site and therefore pollution issues are not anticipated.

However, due to the elevated nature of the Proposed Development site and the poor permeability of the bedrock aquifer, groundwater inflows will be minor. Furthermore, no groundwater inflows were recorded in the existing onsite borrow pit.

However, surface water runoff and shallow groundwater within the peat deposits may require some management and treatment in order to reduce suspended sediments. The main potential significant effects are as a result of turbidity and suspended solids on downstream surface watercourses.

No effects will occur within the Flesk and Sullane river catchments due to the lack of any significant excavations within the catchments to these watercourses. The works in these areas are limited to upgrades of the existing site access road.

Pathway: Overland flow and groundwater flow paths.

Receptor: Down-gradient rivers (Roughty River and associated tributaries) and associated dependent ecosystems.

Pre-Mitigation Potential Effect: Indirect, negative, significant, temporary, unlikely effect on surface watercourse and associated water-dependent ecosystems.

Proposed Mitigation Measures:

Management of surface water and groundwater seepages and subsequent treatment prior to discharge into the drainage network will be undertaken as follows:

- Appropriate interceptor drainage, to prevent upslope surface runoff from entering excavations will be put in place;
- If required, pumping of excavation inflows will prevent build-up of water in the excavation;
- The interceptor drainage will be discharged to the site constructed drainage system or onto natural vegetated surfaces and not directly to surface waters;
- The pumped water volumes will be discharged via volume and sediment attenuation ponds adjacent to excavation areas, or via specialist treatment systems such as a Siltbuster unit;
- There will be no direct discharge to surface watercourses, and therefore no risk of hydraulic loading or contamination will occur;
- Daily monitoring of excavations by a suitably qualified person will occur during the construction phase. If high levels of seepage inflow occur, excavation work will immediately be stopped and a geotechnical assessment undertaken; and,
- A mobile 'Siltbuster' or similar equivalent specialist treatment system will be available on-site for emergencies in order to treat sediment polluted waters from settlement ponds or excavations should they occur. Siltbusters are mobile silt traps that can remove fine particles from water using a proven technology and hydraulic design in a rugged unit. The mobile units are specifically designed for use on construction-sites. They will be used as final line of defence if needed.

Post Mitigation Residual Effects: The potential for the release of suspended solids to watercourse receptors is a risk to water quality and the aquatic quality of the receptor. Proven and effective measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect will be – Negative, imperceptible, indirect, short term, unlikely effect on the Roughty River and its associated tributaries and associated water-dependent ecosystems.

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

9.5.2.4 Potential Effect on Groundwater Levels During Excavation Works

Dewatering of the borrow pit (if required) and other deep excavations (i.e. turbine bases) have the potential to impact on local groundwater levels. However, groundwater level effects will not be significant due to the local hydrogeological regime, the elevation of the Proposed Development site along with the proposed borrow pit excavation method as outlined below.

No groundwater level effects will occur from the construction of the internal grid connection cabling trench due to the shallow nature of the excavation (i.e. ~1.2m), the excavation of the trench within the road carriageway and the unsaturated nature of the subsoil/bedrock to be excavated. Similarly, no effects will occur as a result of the proposed rad upgrades or road construction.

Pathway: Groundwater flow paths.

Receptor: Groundwater levels within the underlying Beara Sneem GWB.

Pre-Mitigation Potential Effect: Negative, indirect, temporary, imperceptible unlikely effects on local groundwater levels within the Proposed Development site.

Mitigation Measures / Impact Assessment:

The Proposed Development site is underlain by Locally Important aquifers and contains bedrock which is generally unproductive. The Proposed Development site is elevated and groundwater will flow downslope, discharging into nearby surface water streams and tributaries of the Roughty River.

The existing onsite borrow pit, which is proposed to be extended in order to facilitate the Proposed Development, was inspected during the site walkover surveys and no groundwater inflows were noted. The borrow pit is located in elevated terrain and no groundwater inflows occur. Similarly due to the location of the borrow pit, it is likely to receive only minimal surface water inflow and therefore no significant dewatering works will be required at the borrow pit location.

The proposed turbine bases are located in bedrock which is generally unproductive. No groundwater dewatering will be required due to the relatively shallow nature of the excavations and lack of observed groundwater inflows within the existing excavations such as the onsite borrow pit.

The topographical (i.e. the elevation of the turbines, borrow pit and other proposed infrastructures) and hydrogeological setting of the Proposed Development site means that no significant groundwater dewatering is expected to be required. Moreover, direct rainfall and surface water runoff will be the main inflows that will require water volume and water quality management. For the avoidance of doubt. we would generally define dewatering as a requirement to permanently drawdown the local groundwater table by means of over pumping, e.g. as would be required for the operation of a bedrock quarry in a valley floor.

Relevant environmental management guidelines from the EPA quarry 2006 guidance document – "Environmental Management in the Extractive Industry" in relation to groundwater issues will be implemented during the construction phase.

Post Mitigation Residual Effects: Due to significant elevation of the Proposed Development site and the local hydrogeological regime (poorly productive aquifer), along with the relatively shallow nature of the proposed works, the potential for water level drawdown effects at receptor locations is negligible. The residual effect is: Negative, imperceptible, indirect, short-term, unlikely effects on local groundwater levels within the Proposed Development site.

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

9.5.2.5 Potential Release of Hydrocarbons

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons can cause significant pollution risk to groundwater, surface water and associated aquatic ecosystems, and to terrestrial ecology. In addition, the accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk. Hydrocarbons have 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: Groundwater flowpaths and site drainage network.

Receptor: Surface water quality in down-gradient rivers (Roughty, Flesk, Sullane rivers and associated tributaries) and groundwater quality in the underlying aquifers.

Pre-Mitigation Potential Effect:

Negative, indirect, slight, short-term, unlikely effect on local groundwater quality.

Negative, significant, indirect, short term, unlikely effect on surface water quality in downgradient watercourses (Roughty, Flesk, Sullane rivers and associated tributaries).

Proposed Mitigation Measures:

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

- All plant will be inspected and certified to ensure they are leak free and in good working order prior to use on site;
- On-site re-fuelling of machinery will be carried out using a mobile double skinned fuel bowser.
    - The fuel bowser, a double axel custom-built refuelling trailer or truck will be re-filled off site and will be towed/driven around the site to where machinery is located.
    - The 4x4 jeep/fuel truck will also carry fuel absorbent material and pads in the event of any accidental spillages.
    - The fuel bowser will be parked on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site.
    - 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;
- A permit to fuel system will be put in place;

- Fuels stored on site will be minimised. Any storage areas will be bunded appropriately for the fuel storage volume for the period of the construction;
- The electrical control building will be bunded appropriately to the volume of oils likely to be stored and to prevent leakage of any associated chemicals and to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used will be regularly inspected for leaks and fitness for purpose;
- An emergency plan for the construction phase to deal with accidental spillages will be contained within the Construction Environmental Management Plan. Spill kits will be available to deal with accidental spillages.

Post Mitigation Residual Effect: 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 is considered to be - Negative, imperceptible, indirect, short-term, unlikely effect on groundwater and surface water quality.

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.

9.5.2.6 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 $\geq 6 \leq 9$ 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.

Peat ecosystems are dependent on low pH hydrochemistry. They are extremely sensitive to the introduction of high pH alkaline waters into the system. 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. Placed concrete in turbine bases and foundations can also have minor local effects on groundwater quality over time. However, due to the limited surface area of exposed concrete, the anoxic conditions below ground, and the high rate of dilution from the wider groundwater system relative to the small volumes of groundwater that would come in contact with the concrete, the potential for impacts are low.

Pathway: site drainage network.

Receptor: Peat water and groundwater hydrochemistry and downstream surface watercourses including the Roughty, Flesk, Sullane and their associated tributaries.

Pre-Mitigation Potential Effect:

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

Negative, imperceptible, indirect, short-term, unlikely effect on local groundwater quality.

Proposed Mitigation Measures:

- No batching of wet-cement products will occur on site. Ready-mixed supply of wet concrete products and emplacement of pre-cast elements, will take place;
- Where possible pre-cast elements for culverts and concrete works will be used;

- Where concrete is delivered on site, only the chute will be cleaned, using the smallest volume of water possible. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed. Chute cleaning water is to be isolated in temporary lined wash-out pits located near proposed site compounds. These temporary lined wash-out pits will be removed from the site at the end of the construction phase;
- The contractor will use weather forecasting to plan dry days for pouring concrete; and,
- The contractor will ensure pour site is free of standing water and plastic covers will be ready in case of a sudden rainfall event.

No mitigation is required for potential groundwater effects as these are imperceptible at the outset.

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 of 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 peat water hydrochemistry and groundwater hydrochemistry and the hydrochemistry of downstream surface watercourses including the Roughty, Flesk and Sullane rivers and their associated tributaries.

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

9.5.2.7 Groundwater and Surface Water Contamination from Wastewater Disposal

Release of effluent from on-site temporary wastewater treatment systems has the potential to impact on groundwater and surface water quality if site conditions are not suitable for an on-site percolation unit. Effects on surface water quality could affect fish stocks and aquatic habitats.

Pathway: Groundwater flowpaths and site drainage network.

Receptor: Down-gradient well supplies, groundwater quality and surface water quality in the Roughty, Rivers and associated tributaries.

Pre-Mitigation Potential Effect:

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

Negative, slight, indirect, short-term, unlikely effect on local groundwater quality.

Proposed Mitigation Measures:

- During the construction phase, a self-contained port-a-loo with an integrated waste holding tank will be used at each of the site construction compounds, maintained by the providing contractor, and removed from the site on completion of the construction works;
- Water supply for the site office and other sanitation will be brought to site and removed after use by a licensed contractor to be discharged at a suitable off-site treatment location; and,
- No water or wastewater will be sourced on the site, nor discharged to the site.

Post Mitigation Residual Effect: The potential for contamination resulting from wastewater disposal is a risk to surface and groundwater quality. This is a risk common to all construction sites containing welfare facilities. Proven and effective measures to mitigate the release of wastewater on site 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 surface water (Roughty River and associated tributaries) or groundwater quality.

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.

9.5.2.8 Morphological Changes to Surface Watercourses

Diversion, culverting, road crossing of surface watercourses can result in morphological changes, changes to drainage patterns and alteration of aquatic habitats. Construction of structures over watercourses has the potential to significantly interfere with water quality and flows during the construction phase.

Within the Proposed Development site, road upgrades are proposed over a total of 10 no. existing watercourse crossings. These crossing locations are listed in Section 9.5.2.2 above. Existing culverts have been operational within the Existing Kilgarvan Wind Farm and do not display any requirement for upgrade. All of the existing watercourse crossings are culverted and no instream works are proposed.

There is an existing pipe culvert crossing along the site access road, on a small tributary of the Flesk River near the existing Clonkeen 110kV substation / N22 access gate, which will require to be extended. In addition, there is 1 no. new proposed watercourse crossing located ~190m north of T11 which will be required to facilitate the Proposed Development.

In addition to the natural watercourses, there is a high density of manmade forestry drains within the Proposed Development site. However, these are not considered to be a significant constraint and can be rerouted around the proposed infrastructure and/or integrated into the proposed drainage design.

Pathways: site drainage network.

Receptors: Surface water flows, stream morphology and water quality in local watercourses.

Pre-Mitigation Potential Effect: Negative, moderate, direct, long-term, likely effect on surface water flows, local stream morphology and surface water quality.

Proposed Mitigation Measures:

The Proposed Development design has been optimised to utilise the existing infrastructure (roads and hardstands) where practicable. As mentioned, road upgrades are proposed over a total of 10 no. existing watercourse crossings within the Existing Kilgarvan Wind Farm site, and only 1 no. new crossing is proposed. This design prevents the unnecessary disturbance of the existing site drainage network and also largely eliminates the requirement for instream works across the Proposed Development site.

Mitigation measures are detailed below:

- The new proposed watercourse crossing between proposed T8 and T11 (upper Lettercannon tributary) will be a pipe culvert (non-fisheries channel in the extreme upper headwater);
- The proposed extension to the existing pipe culvert crossing along the site access road, on a small tributary of the Flesk River near the Clookeen sub-station / N22 access gate;

- Section 50 consent (Arterial Drainage Act, 1945) will be required for this new crossing. The Section 50 requirement will determine final pipe culvert dimensions, but will allow for a minimum 300mm embed of the pipe below the existing bed level, plus sufficient freeboard;
- IFI will be provided with a copy of the finalised pipe crossing dimensions and construction method statement. If the channel is not fully dried out during the construction period, a water management technique will be employed (dam and pump over or temporary piping) to dry out the construction reach. Any additional measures stipulated by IFI will be incorporated into the final design and construction method statement for the proposed crossing;
- Instream construction will be carried out in the period July to September inclusive. This is a conservative working window that will help ensure construction occurs during very low or no flow and will minimise the risk of entrainment of suspended sediment in surface water runoff to fisheries waters in the lower Lettercannon tributary and the Roughty River; and,
- During the near-stream construction work, double row silt fences will be placed immediately down-gradient of the construction area for the duration of the construction phase. There will be no batching or storage of cement allowed on-site. The bottom edge of geotextile silt fence material will be installed to a 200mm embed below ground level. Stakes will be placed at the ends, on any bends, and at 2m intervals along the silt fence. Stakes will be driven a minimum of 400mm to provide adequate support. The silt fence will have a tensioned wire backing - a minimum of 2 lines of wire run along the stakes. The top wire is used to clip the geotextile onto to hold it up and provide strength against trapped sediment. Silt fences will be checked and maintained weekly at minimum, and always before any forecasted heavy rain event.

Post Mitigation Residual Effects: The potential for the construction of watercourse crossing and associated near stream and in-stream works is a risk to water quality and the aquatic quality of the receptor. Proven and effective measures to protect water quality have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect will be - Negative, imperceptible, direct, long-term, unlikely effect on downstream water quality and aquatic habitats.

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

9.5.2.9 Potential Effects on Local Groundwater Well Supplies

The biggest risk to groundwater wells will be due to groundwater contamination due to the accidental release of hydrocarbons and cement-based products as a result of construction activities within the Proposed Development site

No effects are groundwater levels / quantity will occur due to the elevated nature of the Proposed Development site. No significant dewatering works are proposed for any excavations.

There are no downgradient public or group scheme groundwater supplies that can be impacted by the Proposed Development.

We have also completed an assessment of private wells within 1km of the Proposed Development site boundary, following the assumption that all dwellings are likely to have a private groundwater well. A number of private dwelling houses were identified along the local roads in the lands surrounding the Proposed Development site. The closest dwelling is ~300m from the Proposed Development site boundary. Some of these dwellings are located down-gradient (i.e., downslope) of the proposed infrastructure. However, significant distances exist between these dwellings and proposed infrastructure

locations, with all dwellings located in excess of 850m from proposed turbines (closest dwelling is ~899m from the nearest proposed turbine location).

Due to the shallow nature of the proposed works (road upgrade and widening) along the main site access road, no effects on private groundwater well supplies will occur in the Cahersiveen or Ballinahassig West GWBs.

Pathway: Groundwater flowpaths.

Receptor: Down-gradient groundwater supplies (groundwater wells).

Pre-Mitigation Potential Effect: Negative, imperceptible, indirect, long term, unlikely effect on down gradient water supplies.

Impact Assessment:

There are no local groundwater well supplies in the vicinity of the Proposed Development site. All local dwellings are located significant distances from key Proposed Development infrastructure locations (i.e. borrow pit, turbines, construction compounds).

Regardless, if private wells are located downslope of the Proposed Development site or not (or if wells are installed in the future), the potential for effects is negligible for the following conclusive reasons:

- The Proposed Development site is underlain by an aquifer of relatively low permeability;
- Groundwater flowpaths are therefore typically very short (~300m maximum);
- Consequently, the majority of groundwater flows within the Proposed Development site emerge as springs/baseline along streams/rivers and leave the site as surface water flows and not groundwater flows;
- Therefore, the potential to effect local wells (whether they are downslope or not) is very low as groundwater flowpaths between the Proposed Development infrastructure and potential source typically do not exist due to the large setback distance (>850km);
- Nevertheless, mitigation is provided in the EIAR to deal with typical construction phase groundwater hazards such as oils and fuels; and,
- Therefore, based on our hydrogeological assessment of the Proposed Development site with regard to groundwater user risk and the proposed mitigation measures, we can robustly say the potential to effect local wells/water supply sources is negligible.

Post Mitigation Residual Effects: For the reasons outlined in the impact assessment above (separation distances, and prevailing geology, topography and groundwater flow directions), we consider the residual effects to be - negative, imperceptible, indirect, long term, unlikely effect in terms of quality or quantity on local groundwater abstractions.

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

9.5.2.10 Use of Siltbuster and Effect on Downstream Surface Water Quality

Siltbusters are regularly used to remove suspended sediments on construction sites by means of chemical dosing and sedimentation (i.e. use of coagulants and flocculants to accelerate the settlement process). The benefits of using enhanced settlement systems on downstream surface water quality are widely known and are a positive effect. However, potential overdosing with chemical agents means there is a perceived risk of chemical carryover in post treatment water which could result in negative effects on downstream water quality.

Wind farm construction water (i.e. surface water runoff or pumped groundwater) has sometimes very fine particles, particularly clays and peat, with slow settling velocities which do not settle out efficiently, even in a lamella clarifier at normal flow rates. In these cases, chemical dosing can be used to aggregate the particles (i.e. force them to combine and become heavier), increasing the particle settling rate and cleaning the water via gravity separation techniques. Agents commonly used include poly aluminium chloride (PAC), aluminium sulphate, ferric iron and ferrous iron. These agents are commonly used in drinking water treatment plants, so their use is widespread, and there is significant scientific knowledge around their use and control.

The benefits of using a Siltbuster system in emergency scenarios where all other water treatment systems have proven ineffective are considerable. An example of treatment capability of siltbuster systems from northwest Mayo is provided in **Figure 9-14**. This is a duration curve of downstream water quality data post siltbuster treatment. The system was setup so that any water not meeting discharge criteria was recycled back to the settlement ponds. The graph shows all data, and only 24 data points out of 1194 records were above 20 mg/L (i.e. recycling, and repeat treatment occurred at these times to ensure compliance at the discharge location).

Note that the Siltbuster system will not be used under normal conditions during the construction phase. The mitigation proposed to protect water quality is already outlined above in Section 9.5.2.1 to 9.5.2.8.

The use of Siltbuster is only proposed as an emergency back up in the event of failure of all other proposed water treatment mitigation measures, e.g. in the event of peat failure. The Siltbuster system is a proven and effective method of water quality treatment during these events. As stated in Section 8.3.8.7, the peat stability assessment showed that the Proposed Development site has an acceptable margin of safety, is suitable for the Proposed Development and is considered to be at low risk of peat failure. Therefore, it is extremely unlikely that the Siltbuster system will be utilised.

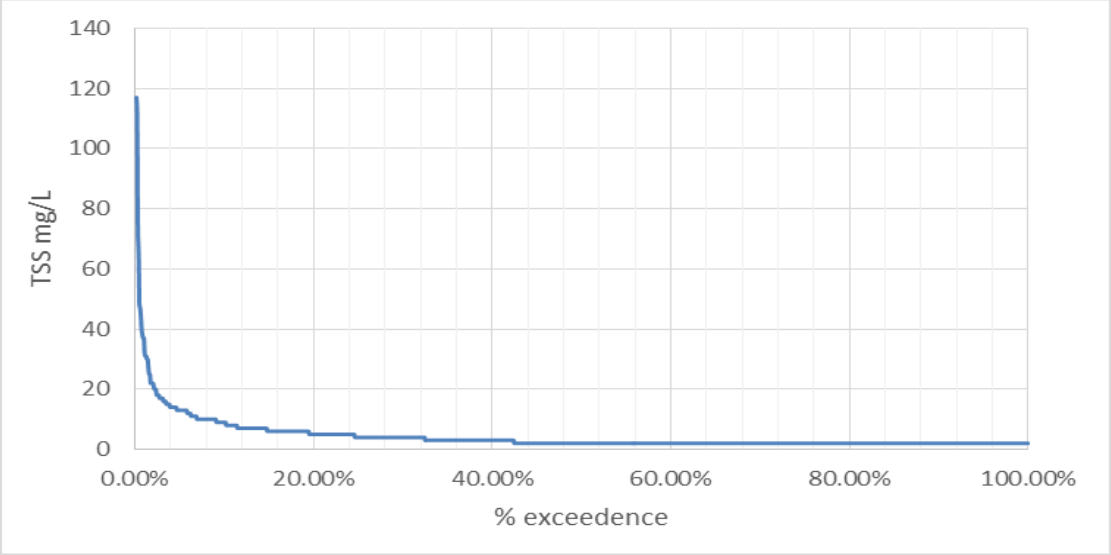


Figure 9-14: TSS treatment data using Siltbuster systems (with chemical dosing)

Pathways: Drainage and surface water discharge routes.

Receptors: Down-gradient rivers (in the Roughty River).and associated dependent ecosystems.

Pre-Mitigation Potential Effect: Negative, slight, indirect, temporary, unlikely effect on downgradient water quality.

Mitigation Measures:

Chemical dosing is intended to force smaller/lighter particles to join together and therefore be heavy enough to settle out. As such the added chemicals are bound in the flocc and do not get carried over into the treated discharge water. As such, the risk to water quality relates to operational issues, such as spill management and prevention of overdosing. Measures that will be employed to prevent spills and prevent overdosing and potential chemical carryover include:

- Use of bunded chemical storage areas;
- Loading and unloading of chemical containers by trained staff;
- Use of spill kits and emergency response procedures in the event of a spill;
- The siltbuster system comprises an electronic in-line dosing system which provides an accurate means of adding agents so overdosing does not occur;
- Continued monitoring and water analysis of pre and post treated water by means of an inhouse lab and dedicated staff, means the correct amount of chemical is added by the dosing system;
- Dosing rates of chemical to initiate settlement is small, being in the order of 2-10 mg/L and the vast majority of the chemical is removed in the deposited sediment;
- Final effluent not meeting the discharge criteria is recycled and retreated, which has a secondary positive effect of reducing carryover; and,
- Use of biodegradable chemical agents can be used at very sensitive sites (i.e. adjacent to SACs).

Post Mitigation Residual Effects: With the implementation of appropriate controls, including the dosing technology and the continual monitoring of pre and post treatment water, the appropriate volume of chemical agent can be added to ensure that chemical carryover concentrations are present only in tiny trace amounts which will not cause any effects to receiving waters or associated aquatic ecology. The residual effect is - Negative, imperceptible, indirect, temporary, unlikely effect on downstream water quality.

Significance of Effects: For the reasons outlined above, no significant effects on the surface water quality will not occur. In fact, we consider that the use of siltbuster systems has a significant positive effect in respect of protected surface water quality.

9.5.2.11 Potential Effects on Surface Water Drinking Supplies

The Flesk River (Flesk (Kerry)_040 SWB) in the vicinity of the Proposed Development site has been identified as a Drinking Water Protected Area (DWPA). The proposed works in the catchment of this SWB comprise of road upgrades and widening and include a total of 3 no. existing watercourse crossings. In addition, ~0.12ha of forestry will be felled in the catchment of this SWB.

Surface water connections from the Proposed Development site to the Flesk River and its tributaries including the Owgarriv River, could transfer poor quality surface water that may affect this DWPA.

Due to physical, hydrological and hydrogeological separation, all other surface water DWPAs have no potential to be affected by the Proposed Development.

Pathways: Surface water flowpaths.

Receptors: Down-gradient water quality in the Flesk (Kerry)_040 DWPA.

Pre-Mitigation Potential Effect: Negative, significant, indirect, short-term, likely effect on downstream DWPA.

Proposed Mitigation Measures:

- Mitigation measures for felling are detailed in Section 9.5.2.1.
- Mitigation measures for sediment control are detailed in Section 9.5.2.2.
- Mitigation measures for the control of hydrocarbons during construction works are detailed in Section 9.5.2.5.
- Mitigation measures for the control of cement-based products during construction works are detailed in Section 9.5.2.6.

Implementation of these mitigation measures will ensure the protection of water quality in receiving waters.

Furthermore, groundwater from below the Proposed Development site may also discharge as baseflow to the Flesk River and its tributaries. Groundwater quality and quantity will not be affected by the Proposed Development due to the minor nature of the proposed works within the catchment of the Flesk River.

Post-Mitigation Residual Effects: Construction activities at the Proposed Development site pose a threat to surface water DWPA linked with the Proposed Development. Proven and effective measures to mitigate the risk of surface and groundwater contamination have been proposed which will break the pathway between the potential source and the downstream receptor. These mitigation measures will ensure that surface water runoff from the Proposed Development site will be equivalent to baseline conditions and will therefore have no effect on downstream water quality. The residual effect will be Negative, imperceptible, indirect, short-term, unlikely effect on downstream water quality within the Flesk (Kerry)_040 DWPA.

Significance of Effects: For the reasons given above, no significant effects on any DWPA will occur.

9.5.2.12 Potential Effects on Hydrologically Connected Designated sites

The Proposed Development site is not located within any designated conservation site. However as stated above in Section 9.3.13, several designated sites are hydrologically linked with the Proposed Development site.

Within the Dunmanus-Bantry-Kenmare surface water catchment, the only designated sites with potential to be impacted by the Proposed Development will occur downstream of the site along the Roughty River. The Roughty River pNHA is located immediately downstream of the Proposed Development site and is hydrologically connected with the Proposed Development site via the Glanlee River, the Thureehouma Stream and several other unnamed tributaries of the Roughty River. The surface water connections from the Proposed Development site to the Roughty River could transfer poor quality surface water that may affect the conservation objectives of this designated site.

Within the Laune-Maine-Dingle Bay Catchment, the Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC/pNHA is hydrologically connected with the Proposed Development site via the tributaries of the Flesk River which drain the main access road. This SAC/pHNA is therefore susceptible to potential water quality effects which may arise during the construction phase of the Proposed Development.

Due to physical, hydrological and hydrogeological separation all other designated sites have no potential to be affected by the Proposed Development.

Pathway: Surface water flowpaths, and groundwater levels.

Receptor: Down-gradient water quality Roughty River pNHA, the Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC/pNHA.

Pre-Mitigation Potential Effect: Negative, significant, indirect, short term, likely effect on the Roughty River pNHA and the Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC/pNHA.

Proposed Mitigation Measures:

- Mitigation measures for felling are detailed in Section 9.5.2.1.
- Mitigation measures for sediment control are detailed in Section 9.5.2.2.
- Mitigation measures for the control of hydrocarbons during construction works are detailed in Section 9.5.2.5.
- Mitigation measures for the control of cement-based products during construction works are detailed in Section 9.5.2.6.

Implementation of these mitigation measures will ensure the protection of surface water quality in receiving waters.

Post Mitigation Residual Effects: Construction activities pose a threat to designated sites hydrologically linked with the Proposed Development site. Proven and effective measures to mitigate the risk of surface and groundwater contamination have been proposed which will break the pathway between the potential source and the downstream receptor. These mitigation measures will ensure that surface water runoff from the Proposed Development site will be equivalent to baseline conditions and will therefore have no impact on downstream surface water quality and/or the status or ecology of the protected species and habitats within the designated sites. The residual effect is considered to be Negative, imperceptible, indirect, short term, unlikely effect on the Roughty River pNHA, the Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC/pNHA.

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

9.5.2.13 Potential Effects on Surface 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 9.3.11 and Section 9.3.12 respectively. The Roughty River in the vicinity and downstream of the Proposed Development site achieved "High" status. To the north of the Proposed Development site, the status of the Flesk and Loo rivers range from "Good" to "High" status. Meanwhile, to the east the Sullane River is of "Good" status. Many of these SWBs have been deemed to be "not at risk" of failing to meet their respective WFD objectives, however, the Flesk (Kerry)_040 SWB and the Sullane_010 SWB downstream of the main access road have been deemed to be "at risk" and are under significant pressure from hydromorphological stresses within their respective catchments.

In terms of GWBs the Beara Sneem, Cahersiveen and Ballinhassig West GWBs all achieved "Good" status in the latest WFD cycle.

Changes in surface water of groundwater flow regimes and water quality has the potential to impact on the objectives and status of the associated GWB and SWBs.

A detailed WFD Compliance Assessment Report has been completed in combination with this EIAR Chapter and is included in **Appendix 9-3**.

Pathways: Groundwater flowpaths and surface water flowpaths within the Proposed Development site.

Receptors: WFD Groundwater Bodies and Surface Water Bodies.

Pre-mitigation Potential Effect:

Indirect, negative, moderate, short-term, unlikely effect on downstream SWBs.

Indirect, negative, slight, short-term, unlikely effect on the underlying Athboy GWB.

Proposed Mitigation Measures:

- Mitigation measures for felling are detailed in Section 9.5.2.1.
- Mitigation measures for sediment control are detailed in Section 9.5.2.2.
- Mitigation measures for the control of hydrocarbons during construction works are detailed in Section 9.5.2.5.
- Mitigation measures for the control of cement-based products during construction works are detailed in Section 9.5.2.6.

Implementation of these mitigation measures will ensure the protection of water quality in receiving waters.

In addition to the above, mitigation measures previously outlined for the protection of groundwater quality and groundwater quantity are detailed above and will ensure the protection of groundwater.

Post-Mitigation Residual Effects: Mitigation for the protection of surface and groundwater during the construction 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.

9.5.3 Operational Phase - Likely Significant Effects and Mitigation Measures

9.5.3.1 Progressive Replacement of Natural Surface with Lower Permeability Surfaces

Progressive replacement of the peat or vegetated surface with impermeable surfaces could potentially result in an increase in the proportion of surface water runoff reaching the surface water drainage network. This could potentially increase runoff from the site and increase flood risk downstream of the development. In reality, the access roads will have a higher permeability than the underlying peat. However, in the baseline scenario runoff rates are high as a result of the prevailing peat soils (96% runoff). In order to assess the potential change as a result of access road and hardstand footprints we have increased the runoff rate to the maximum, i.e., 100% (4% higher than normal). The assessed footprint comprises turbine bases and hardstandings, access roads and temporary construction compounds. During storm rainfall events, additional runoff coupled with the increased velocity of flow

could increase hydraulic loading, resulting in erosion of watercourses and impact on aquatic ecosystems.

Pathway: site drainage network.

Receptor: Surface waters and dependent ecosystems.

Pre-Mitigation Potential Effect: Negative, slight, direct, long-term, likely effect on all downstream surface water bodies.

Impact Assessment:

The emplacement of the proposed permanent hardstand development footprint (~22.4ha), as described in Chapter 4, (assuming emplacement of impermeable materials as a worst-case scenario) could result in an average total site increase in surface water runoff of ~13,053m^3/month (**Table 9-17**). This represents a potential increase of ~33% in the average monthly volume of runoff from the Proposed Development areas comparison to the baseline pre-development site runoff conditions. This is a very small increase in average runoff and results from the naturally high surface water runoff rates and the relatively small area of the Proposed Development site being developed. The proposed total permanent hardstand development footprint being ~22.8ha, representing 2.9% of the total Proposed Development site of ~775ha.

These calculations are based on a groundwater recharge rate of 25%. This recharge rate is based on estimates from the GSI (www.gsi.ie) and is likely to represent a worst-case scenario for the Proposed Development. Based on site observations runoff rates will likely be higher than 75% and therefore the new increase in runoff rates will be lower than that presented in **Table 9-17.**

Table 9-17: Baseline Site Runoff V Development Runoff

Site Baseline Runoff/wettest month (m^3)	Baseline Runoff/day (m^3)	Proposed Permanent Hardstanding Area (m^2)	Hardstanding Area 100% Runoff / wettest month(m^3)	Hardstanding Area 75% Runoff (m^3)	Net Increase/month (m^3)	Net Increase/day (m3)	% Increase from Baseline Conditions – no hardstand areas (m^3)	% Increase from Baseline Conditions across Site (m^3)
1,806,525	58,275	224,000	52,214	39,161	13,053	421	33%	0.7%

The additional volume is low (~0.7% of increase runoff across the entire Proposed Development site) due to the fact that the runoff potential from the Proposed Development site is naturally high. Also, the above calculation assumes that all hardstanding areas will be impermeable which will not be the case as access tracks will be constructed of permeable stone aggregate. Furthermore, this assessment assumes that all proposed permanent hardstand areas are currently natural surfaces. This is not the case as many of the roads which will be used for the Proposed Development are existing and are proposed for upgrade. Therefore, the existing baseline runoff volumes are likely to be higher than that discussed above and thereby the net increase in runoff as a consequence of the Proposed Development will be lower. The increase in runoff from the Proposed Development will, therefore, be negligible. This is even before mitigation measures will be put in place.

Proposed Mitigation:

The Proposed Development design has been optimised to utilise the existing infrastructure (roads and hardstands) where practicable. This design prevents the unnecessary creating of additional road and hardstand areas which would increase surface water runoff from the Proposed Development site.

As part of the Proposed Development drainage design, it is proposed that runoff from the proposed infrastructure will be collected locally in new proposed silt traps, settlement ponds and vegetated buffer areas prior to release into the existing site drainage network. The new proposed drainage measures will then create significant additional attenuation to what is already present. The operational phase drainage system will be installed and constructed in conjunction with the existing site drainage network and will include the following:

- Interceptor drains will be installed up-gradient of all proposed infrastructure to collect clean surface runoff, in order to minimise the amount of runoff reaching areas where suspended sediment could become entrained. It will then be directed to areas where it can be re-distributed into downstream field drains;
- Collector drains will be used to gather runoff from access roads and turbine hardstanding areas of the site likely to have entrained suspended sediment, and channel it to new local settlement ponds for sediment settling;
- On sections of access road transverse drains ('grips') will be constructed where appropriate in the surface layer of the road to divert any runoff off the road into swales/roadside drains;
- Check dams will be used along sections of access road drains to intercept silts at source. Check dams will be constructed from a 4/40mm non-friable crushed rock;
- Settlement ponds, emplaced downstream of access road sections and at turbine locations, will buffer volumes of runoff discharging from the drainage system during periods of high rainfall, by retaining water until the storm hydrograph has receded, thus reducing the hydraulic loading to existing drains;
- Settlement ponds will be designed in consideration of the greenfield runoff rate; and,
- All surface water runoff from the development will have to pass through the proposed settlement ponds prior to release into the existing site drainage network.

As described above the proposed integration of the wind farm drainage with the existing forestry drainage is a key component of the proposed drainage management within the development. By integration we mean maintaining surface water flowpaths where they already exist, avoid creation of new or altered surface water flowpaths, and maintaining the drainage regime (i.e. normal flow) within each forestry compartment. Critically, there will be no alternation of the catchment size contributing to each of the main downstream watercourses. All wind farm drainage water captured within individual site sub-catchments will be attenuated and released within the same sub-catchments that it was captured.

Post Mitigation Residual Effect: With the implementation of the Proposed Development drainage measures as outlined above, and based on the post-mitigation assessment of runoff, we consider that residual effects are - Negative, imperceptible, direct, long-term, moderate probability effect on all downstream surface water bodies.

Significance of Effects: For the reasons outlined above, no significant effects on downstream flood risk will occur.

9.5.3.2 Runoff Resulting in Contamination of Surface Waters

During the operational phase, the potential for silt-laden runoff is much reduced compared to the construction phase. In addition, all permanent drainage controls will be in place and the disturbance of ground and excavation works will be complete. Some minor maintenance works may be completed, such as maintenance of site entrances, internal roads and hardstand areas. These works would be of a very minor scale and would be very infrequent. Potential sources of sediment laden water would only arise from surface water runoff from small areas where new material is added during maintenance works.

These minor activities could, however, result in the release of suspended solids to surface water and could result in an increase in the suspended sediment load, resulting in increased turbidity which in

turn could affect the water quality and fish stocks of downstream water bodies. Potential effects could be significant if not mitigated.

During such maintenance works there is a small risk associated with the release of hydrocarbons from site vehicles, although it is not envisaged that any significant refuelling works will be undertaken on site during the operational phase.

Maintenance works will be contained within the Proposed Development site boundaries and no maintenance works are likely to be required along the main access road *i.e.* within the Flesk and Sullane River catchments.

Pathways: Drainage and surface water discharge routes.

Receptors: Down-gradient rivers (Roughty River and associated tributaries) and water dependent aquatic ecosystems.

Pre-Mitigation Potential Effect: Negative, slight, indirect, temporary, unlikely effect.

Proposed Mitigation Measures:

- Mitigation measures for sediment control are the same as those outlined in Section 9.5.2.12.
- Mitigation measures for the control of hydrocarbons during maintenance works are similar to those outlined in Section 9.5.2.53.

Post Mitigation Residual Effects: With the implementation of the Proposed Development drainage measures as outlined above, and based on the post-mitigation assessment of runoff, we consider that residual effects are - Negative, imperceptible, indirect, temporary, unlikely effect on downstream water quality in the Roughty River (and associated tributaries) and water-dependent aquatic ecosystems.

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

9.5.3.3 Effect of Proposed Blanket Bog Rehabilitation

The overall aim of the Blanket Bog Rehabilitation and Management Plan is to rehabilitate/restore an area of blanket bog (~5.5ha), which has previously been partly drained and planted with conifers, in order to mitigate for the loss of blanket bog and heath habitats as a result of the Proposed Development.

The current drainage system in the proposed rehabilitation area was designed to lower the local water table to facilitate forestry activities. This lowered peat water table does not support typical bog communities. Therefore, in order to achieve the aims of the rehabilitation plan, it will be necessary to alter the drainage regime which currently exists in the proposed restoration area.

The proposed works include the felling of coniferous forestry and drain blocking which will be completed during the construction phase of the Proposed Development. The drain blocking will help establish a more suitable hydrological/hydrogeological regime where the peat water table will be much closer to the surface than it is at present.

Peatland restoration is also associated with improvements in the quality of surface water runoff. Water quality improvements associated with rehabilitated peatlands are not limited to reduced suspended solid concentrations with international studies have shown a long-term reduction in pollutant concentrations, including nitrate and ammonia.

The rehabilitation plans will also improve water attenuation in the proposed restoration area, with the blocked drains slowing the rate at which water enters downgradient rivers.

Pathways: Water volume, peat water level rise, and site drainage.

Receptors: Local peat bog hydrology/hydrogeology and downstream surface water quality/quantity.

Mitigation Measures:

No specific mitigation measures are required in relation to the proposed alteration of the existing bog hydrogeology as the proposed measures will have a positive effect on the bog hydrogeology within the proposed rehabilitation area.

Any works undertaken as part of the rehabilitation plan will be implemented in accordance with the published guidance and best practice, as follows:

- Coillte (2008) Restoring Active Blanket bog in Ireland (LIFE Project Number LIFE02 NAT/IRL/8490). End of Project Report.
- Mackin et al. (2017) Best practice in raised bog restoration in Ireland. Irish Wildlife Manuals, No. 99. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Ireland.

Post Mitigation Residual Effects: Following the implementation of the Blanket Bog Rehabilitation and Management Plan, the rehabilitation area will likely be wetter, will retain more water, will recolonise with typical bog communities, and will eventually become a naturally functioning peatland area with much-reduced silt and nutrient output. As such, we consider the residual effects of the Blanket Bog Rehabilitation and Management Plan to be moderate, positive, direct, long-term effect on local peat bog hydrology/hydrogeology and downstream surface water quality.

Significance of Effects: For the reasons outlined above we consider that the Blanket Bog Rehabilitation and Management Plan will have a significant positive effect on local hydrogeology within the restoration area.

9.5.3.4 Assessment of WFD Effects

There is no direct discharge from the Proposed Development to downstream receiving waters. Mitigation for the protection of surface water during the operational phase of the Proposed Development will ensure the qualitative status of the receiving SWBs will not be altered by the Proposed Development.

Similarly, there is no direct discharge to groundwaters associated with the Proposed Development. Mitigation for the protection of groundwater during the operational phase of the Proposed Development will ensure that the qualitative status of the receiving GWB will not be altered by the Proposed Development.

A full assessment of the potential effects of the operational phase of the Proposed Development on the status of the receiving waterbodies is included in WFD Compliance Assessment Report attached as **Appendix 9-3**.

9.5.4 Decommissioning Phase - Likely Significant Effects and Mitigation Measures

The Proposed Development is expected to have a lifespan of ~35 years. Upon decommissioning, the wind turbines and meteorological masts will be dismantled and all above ground components would be removed off-site for recycling.

The potential effects associated with decommissioning of the Proposed Development will be similar to those associated with construction but of a reduced magnitude, due to the reduced scale of the

proposed decommissioning works in comparison to construction phase works. Turbine and mast foundations will remain and will be covered with earth and allowed to revegetate. Site roads will continue to be used by landowners and will therefore not be removed. The underground cables will be cut and tied, and the ducting will be left in place. Excavation and removal of this infrastructure would result in considerable disturbance to the local environment in terms of disturbance to underlying soils and an increased sedimentation (if turbine foundations and hardstands are being reinstated there is a risk of silt-laden run-off entering receiving waters) and an increased possibility of contamination of local groundwater.

A decommissioning plan will be agreed with Kerry County Council prior to decommissioning of the Proposed Development. A Decommissioning Plan is included as **Appendix 4-5**.

However, as noted in the Scottish Natural Heritage report (SNH) Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms (SNH, 2013) reinstatement proposals for a wind farm are made approximately 30 years in advance, so within the lifespan of the wind farm, technological advances and preferred approaches to reinstatement are likely to change. According to the SNH guidance, it is, therefore:

"best practice not to limit options too far in advance of actual decommissioning but to maintain informed flexibility until close to the end-of-life of the wind farm".

Some of the impacts will be avoided by leaving elements of the Proposed Development in place where appropriate. The existing onsite 110kV Coomagearlahy substation and 110kV electrical cabling will be retained as a permanent part of the national grid. The turbine bases will be rehabilitated by covering with local topsoil/peat in order to regenerate vegetation which will reduce runoff and sedimentation effects. Mitigation measures to avoid contamination by accidental fuel leakage and compaction of soil by on-site plant will be implemented as per the construction phase mitigation measures.

No significant effects on the hydrological and hydrogeological environment will occur during the decommissioning stage of the Proposed Development.

9.5.5 Risk of Major Accidents and Disasters

The main risk of Major Accidents and Disasters at peatland sites is related to peat stability. A peat stability risk assessment (**Appendix 8-1**) has been completed for the Proposed Development site and it concludes that with the implementation of the proposed mitigation measures that the risk of a peat failure at the Proposed Development site is negligible/none.

Flooding can also result in downstream Major Accidents and Disasters. However, due to the small scale of the Proposed Development footprint and with the implementation of the proposed mitigation measures, the increased flood risk associated with the Proposed Development is negligible/none (refer to Section 9.5.3.1).

9.5.6 Assessment of Health Effects

Potential health effects arise mainly through the potential for surface and groundwater contamination which may have negative effects on public and private water supplies. There are no mapped public or group water scheme groundwater protection zones in the area of the Proposed Development site. Notwithstanding this, the Proposed Development design and mitigation measures ensures that the potential for effects on the water environment will not be significant.

The Flesk_040 SWB is listed as a DWPA. Mitigation measures have been proposed for the protection of surface water quality and quantity during all phases of the Proposed Development.

Flooding of property can cause inundation with contaminated flood water. Flood waters can carry waterborne disease and contamination/effluent. Exposure to such flood waters can cause temporary health issues.

Flooding of property can cause inundation with contaminated flood water. Flood waters can carry waterborne disease and contamination/effluent. Exposure to such flood waters can cause temporary health issues. A detailed Flood Risk Assessment has also shown that the risk of the Proposed Development contributing to downstream flooding is also very low, as the long-term plan for the site is to retain and slow down drainage water within the existing site. On-site drainage control measures will ensure no downstream increase in flood risk.

9.5.7 Cumulative Effects

This section presents an assessment of the potential cumulative effects associated with the Proposed Development and other developments (existing and/or proposed) on the hydrological and hydrogeological environment.

The main likelihood of cumulative effects is assessed to be hydrological (surface water quality) rather than hydrogeological (groundwater). Due to the hydrogeological setting of the Proposed Development site (i.e. low permeability peat overlying a locally important bedrock aquifer) and the near surface nature of construction activities, cumulative effects with regard groundwater quality or quantity arising from the Proposed Development are assessed as not likely.

The primary potential for cumulative effects will occur during the construction phase of the Proposed Development as this is when earthworks and excavations will be undertaken at the Proposed Development site. The potential for cumulative effects during the operational phase of the Proposed Development will be significantly reduced as there will be no exposed excavations, there will be no sources of sediment to reach watercourses, there will be no use of cementitious materials and fuels/oil will be kept to a minimum at the site. During the decommissioning phase, the potential cumulative effects are similar to the construction phase, but to a lesser degree with less ground disturbance.

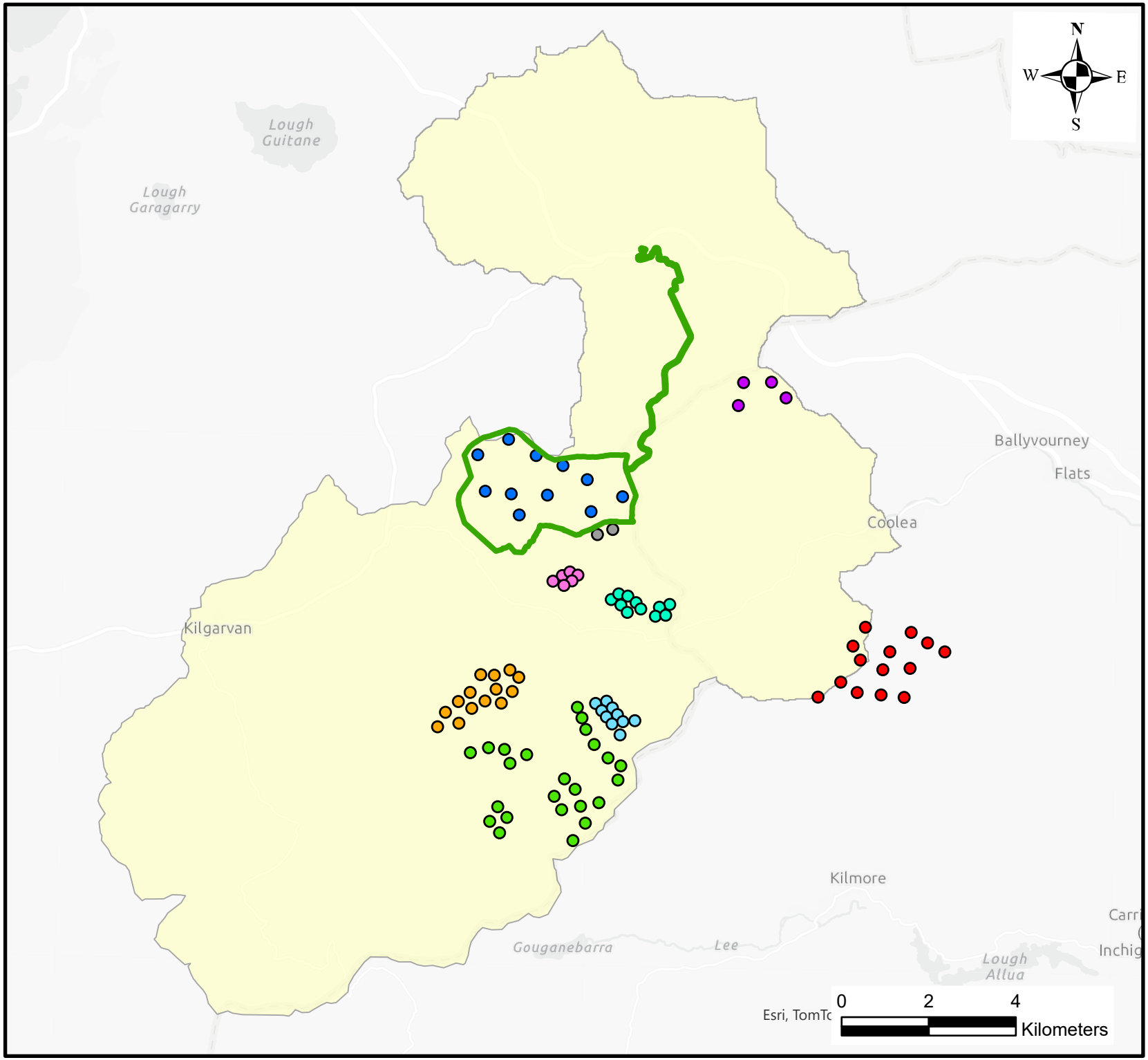
A cumulative hydrological and hydrogeological study area has been delineated as shown below in **Figure 9-15**.

With the majority of the Proposed Development site being located in the catchment of the Roughty River, we have completed a quantitative analysis in order to delineate our hydrological cumulative assessment area within this catchment. Our assessment is based on flow volumes obtained from EPA HydroTool Nodes in the vicinity and downstream of the Proposed Development Site. Meanwhile, due to the nature of the works in the Sullane and Flesk River catchments (i.e. road upgrades and minor felling), the cumulative area in these catchments is defined by the extent of the WFD river sub-basin within which the Proposed Development is located.

- Within the Roughty River Catchment our assessment concludes that due to dilution no hydrological cumulative effects will occur beyond EPA Hydrotool Node 21_6201 on the Roughty River.
- Within the Sullane River Catchment, no cumulative hydrological effects will occur downstream of the Sullane_010 River sub-basin.
- Within the Flesk River Catchment, no cumulative hydrological effects will occur downstream of the Flesk_040 River sub-basin.

There will be no potential for cumulative effects beyond this cumulative study area due to increases in flow volumes (as the catchment area increases) and increasing distance from the Proposed Development.

The cumulative hydrological and hydrogeological study area has a total area of ~29,089ha (12,016ha in the Roughty River Catchment, 3,240ha in the Sullane River Catchment and 5,207ha in the Lower Shannon Catchment).



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Legend

- EIAR Site Boundary
- Kilgarvan WF Proposed Turbine Layout
- Hydrological Cumulative Assessment Area

Other Wind Farms

- Gortyrahilly
- Grousemount
- Grousemount/Barnastooka
- Inchamore
- Midas (Coolknoohil/Everwind)
- Midas (Foilgreana/Coolknoohil)
- Midas (Inchee/ Coolknoohil)
- Sillahertane/Coomagearlaghy II Wind Farm

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Client: Ørsted

Job: Proposed Repowering of the Existing Kilgarvan Wind Farm

Title: Cumulative Hydrological/ Hydrogeological Study Are

Figure No: 9-15

Drawing No: P1585-0-0424-A4-915-00A

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Scale: 1:120,000	Drawn By: GA
Date: 10/04/2024	Checked By: MG

9.5.7.1 Cumulative Effects with Commercial Forestry

The Proposed Development site is situated in the catchment of the Roughty River which comprises largely of mountainous terrain and upland peat bogs. According to Corine land cover mapping (www.epa.ie) (2018) there is a total of ~3,132ha of coniferous forestry within the cumulative study area. This represents ~11% of the total cumulative study area.

The most common water quality problems arising from forestry relate to the release of sediment and nutrients to the aquatic environment, and impacts from acidification. Forestry may also give rise to modified stream flow regimes caused by associated land drainage.

Due to the close proximity of these forested areas to the Proposed Development site and given that they drain to the same watercourses as the Proposed Development, the potential cumulative effects on downstream water quality and quantity need to be assessed.

However the mitigation measures detailed in Section 9.5.2, 9.5.3 and 9.5.4 for the construction, operation and decommissioning phases of the Proposed Development will ensure the protection of downstream surface water quality.

For these reasons we consider that there will not be a significant cumulative effect associated with commercial forestry activities.

9.5.7.2 Cumulative Effects with Agriculture

The Proposed Development site is situated in the Roughty River catchment which comprises largely of mountainous terrain and upland peat bogs. According to Corine land cover mapping (www.epa.ie) (2018) there is a total of ~770ha of agricultural land within the cumulative study area. This represents ~8% of the total cumulative study area.

Agriculture is the largest pressure on water quality in Ireland. Agricultural practices such as the movement of soil and the addition of fertilizers and pesticides can lead to nutrient losses and the entrainment of suspended solids in local surface watercourses. This can have a negative effect on local and downstream surface water quality.

In an unmitigated scenario the Proposed Development would have the potential to interact with these agricultural activities and contribute to a deterioration of downstream surface water quality through the emissions of elevated concentrations of suspended solids and ammonia.

However the mitigation measures detailed in Section 9.5.2, 9.5.3 and 9.5.4 for the construction, operation and decommissioning phases of the Proposed Development will ensure the protection of downstream surface water quality.

For these reasons we consider that there will not be a significant cumulative effect associated with agricultural activities.

9.5.7.3 Cumulative Effects with One Off Housing Developments

A detailed cumulative assessment has been carried out for all planning applications (granted and awaiting decisions) within the cumulative assessment area described above.

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 Proposed Development site and the temporal period of likely works, no cumulative effects will occur as a result of the Proposed Development (construction, operation and decommissioning phases).

9.5.7.4 Cumulative Effects with the Removal of the Existing Kilgarvan Turbines

In order to facilitate the construction of the Proposed Development, the existing 28 no. turbines at the Existing Kilgarvan Wind Farm will be removed from the site. This will occur during the construction phase of the Proposed Development as detailed in Chapter 4. Other ancillary infrastructure that will not be utilised for the Proposed Development will be left to naturally regenerate. Where existing electrical onsite cabling is direct buried within peat, this will be left in-situ, cut, and tied, in order to minimise peat disturbance. No excavations will be completed. Where cables have been ducted, the cable will be snipped at both ends and pulled from the ducts. The site roads will be reused to facilitate the Proposed Development.

These decommissioning activities will overlap with the construction phase activities of the Proposed Development and may therefore result in cumulative hydrological and hydrogeological effects. These effects will be associated with increased activity on-site, increasing the potential for accidental spills/leaks. The volumes of peat and soil which will be disturbed within the Proposed Development site will also be increased due to the decommissioning activities. This will increase the risk of suspended solids entrainment in surface water runoff.

However, the proposed decommissioning activities will be completed in accordance with best practice procedures as per the decommissioning plan. This will ensure that the decommissioning activities do not in any way have a negative effect on downstream surface water quality and quantity. Similarly, the mitigation and best practice measures proposed in this EIAR chapter will ensure that the construction phase of the Proposed Development does not have the potential to result in significant effects on the hydrological/hydrogeological environment.

Based on the above, no cumulative effects will occur as a result of the Proposed Development and the removal plans for the existing Kilgarvan Wind Farm turbines.

9.5.7.5 Cumulative Effects with Other Wind Farms

In addition to the existing Kilgarvan Wind Farm which is located within the Proposed Development site and will be removed as part of the Proposed Development, a total of 5 no. additional permitted or proposed wind farms have been identified within the cumulative study area (refer to **Table 9-21**). Within these wind farm there are a total of 77 no. turbines situated within the cumulative study area.

Most of the other wind farms identified within the cumulative study area have already been constructed and are currently in the operational phase of development and are generating electricity. Given that the construction phase of the Proposed Development cannot overlap with the construction phase of these operational wind farms, the potential for cumulative hydrological effects to occur is significantly reduced.

Meanwhile, the Inchamore Wind Farm is currently in the planning process, with 5 no. turbines proposed in the Sullane_010 river sub-basin. The potential for cumulative effects with the Proposed Development is limited given the scale of the works being proposed within the Sullane_010 sub-basin (road upgrades and minor felling).

The EIARs for the above wind farm developments detail potential hydrological and hydrogeological issues relating to the operation and decommissioning phases of these developments and propose a suite of best practice mitigation measures designed to ensure that the developments do not in any way have a negative effect on downstream surface water quality and quantity. Similarly, the mitigation and best practice measures proposed in this EIAR chapter will ensure that the Proposed Development does not have the potential to result in significant effects on the hydrological/hydrogeological environment.

Therefore, with the implementation of the proposed mitigation measures (both for the Proposed Development and for the other wind farms listed in **Table 9-21**) there will be no cumulative effects associated with the construction, operational or decommissioning phases of the Proposed Development and other wind farms within the cumulative study area.

Table 9-18: List of Other Wind Farm Developments Assessed for Hydrological Cumulative Effects

Catchment	Wind Energy Developments (Status)	Total Turbine No.	Turbine No. in Catchment
Roughty River	Midas (Operational)	24	23
	Barnastooka (Operational)	14	14
	Sillahertane (Operational)	10	10
	Grousemount (Operational)	24	24
Sullane River	Inchamore	5	5
Totals		77	76

9.5.8 Post Consent Monitoring

Construction phase Surface Water Monitoring will occur and is detailed in Chapter 7, Section 7.5.7.4.

No post-consent monitoring is required from a hydrological perspective.