Planning and Environmental Consultants

Environmental Impact Assessment Report (EIAR)

Crumhach Wind Farm, Co. Sligo

Chapter 9 - Hydrology and Hydrogeology

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9. HYDROLOGY AND HYDROGEOLOGY

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 likely and significant effects of the proposed Crumhach Wind Farm on Hydrology and Hydrogeology aspects of the receiving environment.

The Proposed Project (Proposed Wind Farm, Proposed Grid Connection Route) is described in full in Chapter 4 of this EIAR.

Where 'the Site' is referred to, this relates to the primary study area for the Proposed Project EIAR, as delineated by the EIAR Site Boundary and includes the Proposed Wind Farm and Proposed Grid Connection Route.

Where the 'Proposed Wind Farm' is referred to, this relates to 17 no. Proposed Turbines and associated foundations and hard-standing areas, access tracks, temporary construction compounds, onsite 110kV substation, internal underground cabling, onsite LiDAR compounds, peat and spoil management areas, site drainage, biodiversity enhancement, borrow pits, turbine delivery route (TDR) accommodation works and all ancillary works and apparatus. The Proposed Wind Farm is described in detail in Chapter 4 of the EIAR.

The 'Proposed Turbines' refers to the 17 no. turbines associated with the Proposed Wind Farm as outlined above.

Where the 'Proposed Grid Connection Route' is referred to, this encompasses the 110kV underground cabling connecting the proposed onsite 110kV substation to the existing Srananagh 220kV substation, and all ancillary works and apparatus.

Where the 'Existing Wind Farm' is referred to, this relates to all components of the existing Dunneill Wind Farm and Kingsmountain Wind Farm developments which are located within the Site.

In addition, where the construction phase is detailed and assessed within the EIAR, this includes for the removal of the existing 23 no. turbines at the Existing Wind Farm and the construction of the 17 no. Proposed Turbines and associated infrastructure at the Site. The existing turbines will be removed prior to constructing the Proposed Wind Farm.

The objectives of the assessment are:

- Produce a baseline study of the existing water environment (hydrology, hydrogeology and natural resources) in the area of the Proposed Project;
- Identify likely significant effects of the Proposed Project on surface water and groundwater natural resources during the construction, operational and decommissioning phases of the Proposed Project;
- Identify mitigation measures to avoid, reduce or offset significant negative effects;
- Assess significant residual effects; and,
- Assess the cumulative effects of the Proposed Project itself as well as other local developments (as described in Chapter 2 of this EIAR).

The Water Study Area for assessing the potential zone of impact and cumulative effect assessment is the Easky_SC_010 and Dunmoran_SC_010 sub-catchments (which contain the Proposed Wind Farm and a short section of the Proposed Grid Connection Route) along with Owenmore(Sligo)_SC_030 and Owenmore(Sligo)_SC_040 sub-catchments which contain the Proposed Grid Connection Route only. The Water Study Area is shown on **Figure 9-1.**

9.1.2 Glossary of Terms and Acronyms

Glossary of Terms and Acronyms used in this chapter are shown in **Table 9-1.**

Table 9-1: Glossary of Terms and Acronyms

Term	Definition
Abstraction	The removal of water from a surface water body or groundwater source.
Aquifer	A geological formation capable of storing and transmitting groundwater.
Baseline Environment	The existing environmental conditions against which potential impacts are assessed.
Bedrock Aquifer	An aquifer contained within fractured or weathered bedrock.
Biotic (Q) Rating	EPA ecological classification system based on aquatic macroinvertebrates used to assess river water quality.
Bog Drainage Network	Artificial drains constructed to lower water levels within peatlands.
Buffer Zone	An undeveloped strip adjacent to a watercourse designed to protect water quality.
Catchment	The land area that drains rainfall to a common river, lake or estuary.
CFRAM	Catchment Flood Risk Assessment and Management.
COD (Chemical Oxygen Demand)	A measure of the oxygen required to chemically oxidise organic matter in water.
Construction Environmental Management Plan (CEMP)	A document outlining environmental protection measures to be implemented during construction.
Cutaway Bog	Peatland where commercial peat extraction has ceased and rehabilitation is underway.
Dewatering	Temporary removal of groundwater or surface water to facilitate excavation.
Directional Drilling (HDD)	Horizontal drilling technique used to install services beneath rivers or roads without open excavation.
DO	Dissolved Oxygen.
Drain	Manmade watercourse.

Drainage Management Plan	Design strategy for collecting, treating and controlling runoff from a development.
Ecological Status	Overall ecological condition of a waterbody as defined under the Water Framework Directive.
Electrical Conductivity (EC)	Indicator of the concentration of dissolved ions in water.
EPA	Environmental Protection Agency.
Environmental Impact Assessment Report (EIAR)	Report assessing the likely significant environmental effects of a proposed development.
Flood Risk Assessment (FRA)	Assessment of flood risk to and from a proposed development.
Flow Duration Curve	Graph showing the percentage of time specified flow rates are equalled or exceeded.
Geomorphology	Study of landforms and the processes that shape rivers and landscapes.
Geological Survey Ireland (GSI)	National geological agency responsible for geological and hydrogeological information.
Grab Sample	A single water sample collected at a specific location and time.
Groundwater	Water stored beneath the ground within soil and rock.
Groundwater Body (GWB)	A distinct volume of groundwater defined under the Water Framework Directive.
Groundwater Vulnerability	The ease with which contaminants can reach groundwater from the land surface.
Hydrochemistry	Chemical characteristics of groundwater or surface water.
Hydrogeology	Study of groundwater occurrence, movement and quality.
Hydrology	Study of the occurrence, movement and distribution of surface water.
Hydromorphology	Physical characteristics of rivers including channel form, flow and connectivity.
IFI	Inland Fisheries Ireland.
Impermeable Surface	Surface that does not readily permit infiltration, such as concrete or asphalt.
IPC Licence	Integrated Pollution Control Licence issued by the EPA.
Karst	Landscape developed in soluble rocks such as limestone, characterised by underground drainage, swallow holes and springs.

Lidar	Laser-based surveying technology used to produce detailed topographic models.
Mitigation Measure	Action taken to avoid, reduce or offset adverse environmental effects.
NHA	Natural Heritage Area.
NIFM	National Indicative Fluvial Mapping.
NPWS	National Parks and Wildlife Service.
NTU	Nephelometric Turbidity Units
OPW	Office of Public Works.
Peat Probing	Investigation used to determine peat depth and stratigraphy.
Permeability	Ability of soil or rock to transmit water.
pH	Measure of the acidity or alkalinity of water.
Public Water Supply (PWS)	Water supply serving the public, usually operated by Uisce Eireann.
Receiving Environment	Existing environment that may be affected by the proposed development.
Residual Effect	Environmental effect remaining after mitigation has been applied.
River Basin Management Plan (RBMP)	National plan for implementing the Water Framework Directive.
Runoff	Water flowing across the ground surface following rainfall.
SAC	Special Area of Conservation designated under the Habitats Directive.
Sediment	Soil or particulate matter transported by flowing water.
Settlement Pond	Pond designed to remove suspended solids by allowing particles to settle.
Siltbuster	Proprietary treatment system used to remove suspended solids from construction water.
SPA	Special Protection Area designated under the Birds Directive.
Surface Water	Rivers, streams, lakes, canals and other waters at the ground surface.
Surface Water Body (SWB)	A river, lake, transitional or coastal waterbody defined under the Water Framework Directive.
SuDS (Sustainable Drainage Systems)	Drainage techniques designed to mimic natural drainage and manage runoff sustainably.

Suspended Solids (TSS)	Fine particles suspended within water that contribute to turbidity.
Turbidity	Measure of water clarity caused by suspended particles.
Water Framework Directive (WFD)	European legislation requiring protection and improvement of the ecological and chemical status of water bodies.
Water Quality	Physical, chemical and biological characteristics of water.
Watercourse	Any natural or artificial channel conveying water.
Wetland	Area where water is the primary factor controlling soils and ecological communities.

9.1.3 Statement of Authority

Hydro-Environmental Services (HES) are a specialist geological, 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 include hydrology, hydrogeology, water resources, wetland hydrology, flood risk assessment, water quality assessment and wind farm drainage design.

This chapter of the EIAR was prepared by David Broderick, Michael Gill and Adam Keegan.

David Broderick (P. Geo., BSc, H. Dip Env Eng, MSc) is a Hydrogeologist with over 19 years' experience in both the public and private sectors. Having spent two years working in the Geological Survey of Ireland, mainly on groundwater and source protection studies, David moved into the private sector. David has a strong background in groundwater resource assessment, karst hydrology and hydrogeological/hydrological investigations in relation to developments such as quarries and wind farms. David has completed over 25 Source Protection Assessments for the GSI/NFGWSs, and Irish Water and for private developments across the country in a wide variety of hydrogeological settings. David has completed numerous geology and water sections for input into EIARs for a range of commercial developments. David has worked on the EIS/EIARs for Lyre Wind Farm, Glenard Wind Farm, Ballyouskill Wind Farm, and over 60 other wind farm related projects across the country. David worked on his first wind energy project in 2010, and he has continued to work on similar projects since then.

Michael Gill (P. Geo., B.A.I., MSc, Dip. Geol., MIEI) is a Civil/Environmental Engineer and Hydrogeologist with over 24 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms in Ireland. He has also managed EIAR assessments for infrastructure projects and private residential and commercial developments. Michael has completed over 30 Source Protection Assessments for the GSI/NFGWSs, and Irish Water and for private developments across the country in a wide variety of hydrogeological settings. In addition, he has substantial experience in wastewater engineering and site suitability assessments, contaminated land investigation and assessment, karst hydrology and hydrogeology, water resource assessments, surface water drainage design and SuDs design, and surface water/groundwater interactions. For example, Michael has worked on the EIS/EIARs for Lemanaghan Wind Farm, Seven Hills Wind Farm, Carrownagowan Wind Farm, and over 100 other wind farm related projects across the country. Michael worked on his first wind energy project in 2003, and he has continued to work on similar projects since then.

Adam Keegan (P.Geo., BSc, MSc) is a Hydrogeologist with 10 years of experience in the environmental sector in Ireland. Adam has been involved in Environmental Impact Assessment Reports (EIARs) for numerous projects including wind farms, grid connections, quarries and small housing developments. Adam holds an MSc in Hydrogeology and Water Resource Management. Adam has worked on several wind farm EIAR projects, including Croagh WF, Lyrenacarriga WF (SID), Cleanrath WF, Carrownagowan WF (SID), and Fossy WF.

9.1.4 Scoping and Consultation

The scope for this chapter of the EIAR has also been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties. This consultation process and the list of Consultees is outlined in Section 2.7 of this EIAR. Matters raised by Consultees in their responses with respect to the water environment are summarised in **Table 9-2** below.

Table 9-2: Summary of Water Environment Related Scoping Responses

Consultee	Matters Raised - Description	Addressed in Sections
HSE	*"The proposed development has the potential to have a significant impact on the quality of both surface and ground water. All drinking water sources, both surface and ground water, must be identified. Public and Group Water Scheme sources and supplies should be identified together with any private wells supplying potable water to houses in the vicinity of the proposed development. Measures to ensure that all sources and supplies are protected should be described. The applicant should consider the impact of the proposed development on nearby Lough Easky and associated water treatment plant. The lake provides a drinking water source for approximately 6,000 local residents. Any possible adverse impacts from the proposed development on the lake must be identified and carefully managed to ensure that water quality is not affected".* *"The National Environmental Health Service recommends that a walk-over survey of the site is undertaken in addition to a desktop analysis of Geological Survey of Ireland data in order to identify the location of private wells used for drinking water purposes. Any potential significant impacts to drinking water sources should be assessed. Details of bedrock, overburden, vulnerability, groundwater flows, aquifers and catchment areas should be considered when assessing potential impacts and any proposed mitigation measures".* *"Any impacts on surface water as a result of the construction of the underground cables should be identified and addressed in the EIAR".*	Sections 9.3.14 & 9.5.2.10
OPW	*"The Office of Public Works is not responsible for any channels within the study area, which falls under the remit of this office to maintain under the 1945*	Sections 9.3.6 & 9.5.2.8

Consultee	Matters Raised - Description	Addressed in Sections
	Arterial Drainage Act. The EIAR Site Boundary follows the path of the N59 National Primary Road and passes through the Dunmoran Drainage District. This is a maintainable channel that falls under the remit of the local authority to maintain". *"This office has no record of flooding or past flood events adjacent to the study area. It is recommended to carry out a review of historical flood risk using floodinfo.ie using link provided. This office would recommend that no flooding should occur during or after construction of the proposed project.* *"Under Section 50 of the 1945 Arterial Drainage Act & SI No.122 of 2010, no person, including a body corporate, shall construct any new bridge or alter, reconstruct, or restore any existing bridge over any watercourse without the consent of the Commissioners or otherwise than in accordance with plans previously approved of by the Commissioners".* *"Where the development intends to install or restore a culvert or bridge over a watercourse as part of this development, Section 50 approval will be required in advance from the Commissioners of Public Works".*	
Uisce Éireann	*"The proposed development is in the locality of Lough Esky, where Uisce Éireann operates an abstraction point that serves the Lough Esky regional water supply. It is noted that the proposed development is approximately 600 meters to the south of this facility. These proposals cannot give rise to any deterioration of Lough Esky water source. Care must be taken to avoid interaction with and any impact to, this body of water and its catchment, particularly at the South easterly extent of the proposed boundary, where there is potential risk of catchment interaction is greatest. Potential impacts on any water source(s) in proximity to your proposals and having hydrological connectivity with your development site at construction and operational phases should be assessed and mitigations proposed for any potential impacts".* *"Where the development proposal has the potential to impact an Uisce Éireann Drinking Water Source(s), the applicant shall provide details of measures to be taken to ensure that there will be no negative impact to Uisce Éireann's Drinking Water Source(s) during the construction and operational phases of the development. Hydrological / hydrogeological pathways between the applicant's site and receiving waters should be identified as part of the report".*	Sections 9.3.14 & 9.5.2.10

9.1.5 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:

- Planning and Development Act 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 and S.I. No. 722/2003 European Communities (Water Policy) Regulations which implement EU Water Framework Directive (2000/60/EC) and provide for implementation of 'daughter' Groundwater Directive (2006/118/EC). Since 2000 water management in the EU has been directed by the Water Framework Directive (WFD). The key objectives of the WFD are that all water bodies in member states achieve (or retain) at least 'good' status by 2015. Water bodies comprise both surface and groundwater bodies, and the achievement of 'good' status for these depends also on the achievement of 'good' status by dependent ecosystems. Phases of characterisation, risk assessment, monitoring and the design of programmes of measures to achieve the objectives of the WFD have either been completed or are ongoing. In 2015 it replaced a number of existing water related directives, which are successively being repealed, while implementation of other Directives (such as the Habitats Directive 92/43/EEC) will form part of the achievement of implementation of the objectives of the WFD;
- S.I. No. 41/1999: Protection of Groundwater 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. 294/1989: Quality of Surface Water Intended for Abstraction (Drinking Water), resulting from EU Directive 74/440/EEC concerning the quality required of surface water intended for the abstraction of drinking water in the Member States (repealed by 2000/60/EC in 2007);
- S.I. No. 477/2011: European Communities (Birds and Natural Habitats) Regulations, implementing 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: 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. 296/2009: European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009, as amended.
- S.I. No. S.I. No. 99/2023: European Communities Environmental Objectives (Drinking Water) (Amendment) Regulations 2023;
- S.I. No. 287/2022: European Communities Environmental Objectives (Groundwater) (Amendment) Regulations 2016;

- S.I. No. 9/2010: European Communities Environmental Objectives (Groundwater) Regulations 2010 as amended;
- S.I. No. 272/2009: European Communities Environmental Objectives (Surface Water) Regulations 2009 as amended; and,
- S.I. No. 77/2019: European Communities Environmental Objectives (Surface Water) (Amendment) Regulations 2019.

9.1.6 Relevant Guidance

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

- Environmental Protection Agency (2022): Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;
- European Commission (2017): Environmental Impact Assessment of Projects – Guidance on the Preparation of the Environmental Impact Assessment Report;
- Institute of Geologists Ireland (2013): Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements;
- National Roads Authority (2008): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Forestry Commission (2004): Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh;
- Coillte (2009): Forest Operations & Water Protection Guidelines;
- Forest Services (Draft) Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures;
- Forest Service (2000): Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford;
- COFORD (2004): Forest Road Manual – Guidelines for the Design, Construction and Management of Forest Roads;
- 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 Watercourses (UK Guidance Note);
- CIRIA (Construction Industry Research and Information Association) 2006: Guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006);
- CIRIA 2006: Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2006;
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (DoHPLG, 2018);
- DOE/NIEA (2015): Wind Farms and Groundwater Impacts – A guide to EIA and Planning Considerations;
- Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU), (European Union, 2017);
- 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);
- OPW (2009) The Planning System and Flood Risk Management;
- Wind Energy Development Guidelines for Planning Authorities, 2006 (the DoEHLG 2006 Guidelines) and the Draft Revised Wind Energy Development Guidelines (Draft DoHLGH 2019 Guidelines);
- 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); and,
- Forestry and Water Quality Guidelines (Forest Service, 2000b).

9.2 Methodology

9.2.1 Desk Study

A desk study of the Site and Water Study Area was completed prior to the undertaking of field mapping, walkover assessments and site investigations. The desk study involved collecting all relevant geological, hydrological, hydrogeological and meteorological data for the Site and Water Study area. This included consultation and review of the following:

- Environmental Protection Agency databases (www.epa.ie);
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks and Wildlife Services Public Map Viewer (www.npws.ie);
- Water Framework Directive "catchments.ie" Map Viewer (www.catchments.ie), including all relevant River Basin Management Plans (RBMPs);
- Bedrock Geology 1:100,000 Scale Map Series, Geological Survey of Ireland (GSI);
- Geological Survey of Ireland - Groundwater Body Characterisation Reports;
- OPW Flood Mapping Databases (www.floodinfo.ie);
- Aerial Photography, 1@5,000 and 6" base mapping; and,
- Myplan.ie: National Planning Applications Map Viewer (https://myplan.ie/national-planning-application-map-viewer).

9.2.2 Baseline Monitoring and Site Investigations

Geological/hydrological/hydrogeological baseline monitoring and site investigations of the Site were undertaken by David Broderick and Adam Keegan of HES (refer to Section 9.1.3 above for qualifications and experience) on 3rd and 4th of October and 13th November 2024, 22nd and 23rd May 2025, 3rd February, 4th March and 2nd April 2026.

The following geotechnical reports were prepared by Fehily and Timoney (FT) in support of the application:

- Geotechnical and Peat Stability Assessment (**Appendix 8-1**); and
- Peat and Spoil Management Plan (**Appendix 4-2**).

A total of no. 850 peat probes were carried out at the Site by FT, MKO and HES and between August 2024 and March 2026.

Geotechnical ground investigations (i.e. trial pitting) were undertaken in July 2025, under the supervision of FT. A total of 19 no. trial pits, supervised by FT, were carried out at the Site.

The baseline geological assessment of the Site was further supplemented by historical trial pit logs, borehole logs and geophysical surveys completed during the development of the Existing Wind Farm.

There are existing trial pit logs (11 no.) and shell and auger borehole logs (11 no.) for the Existing Wind Farm (Kingsmountain) when investigations were carried out in October 2001 and March 2002 respectively.

Site investigations at the Existing Wind Farm (Dunneill) were carried out between 24th September and 9th October 2008 which included trial pits (16 no.), dynamic probing (6 no.) and geophysical surveys.

In summary, site investigations by the project team to address the Hydrology and Hydrogeology Section of the EIAR included the following:

- Walkover surveys and geological mapping of the Site were undertaken to assess general ground conditions undertaken on the dates listed above;
- Detailed hydrological mapping of the Site was undertaken whereby water flow directions and drainage patterns were recorded;
- Use of Lidar topographic data to create detailed site drainage mapping;
- A total of 850 no. peat probes were undertaken by HES, MKO and FT to determine the thickness and geomorphology of peat overlying parts of the Site;
- Trial pitting (19 no.) by FT and gouge cores (10 no.) by HES to investigate soil, peat and mineral subsoil lithology as well as depth to bedrock;
- Field hydrochemistry measurements (electrical conductivity, pH, dissolved oxygen, turbidity and temperature) were carried out on 3rd February and 2nd April 2026 to determine the origin of surface water flows (2 no. rounds); and,
- Surface water sampling (2 no. rounds) for baseline and hydrological characterisation purposes was also carried out on 3rd February and 2nd April 2026.

9.2.3 Impact Assessment Methodology

The EPA document '*Guidelines on the information to be contained in Environmental Impact Assessment Reports*' (EPA, 2022), hereafter the EPA 2022 Guidelines, criteria for the assessment of likely significant effects require that likely effects are described with respect to their extent, magnitude, type (i.e., negative, positive or neutral) probability, duration, frequency, reversibility, and transfrontier nature (if applicable). The descriptors used in this environmental impact assessment are those set out in the EPA (2022) Glossary of effects as shown in Section 1.2 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 using NRA (2008) criteria. Levels of importance which are defined in **Table 9-3** and **Table 9-4** are used to assess the potential effect that the Proposed Project may have on them.

Table 9-3: 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.
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.

Importance	Criteria	Typical Example
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.

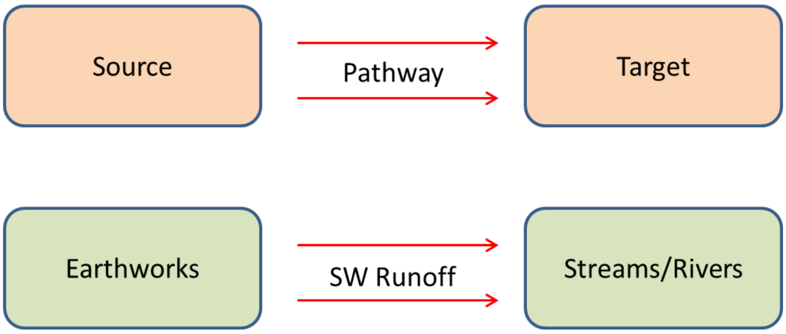
Table 9-4: Estimation of Importance of Hydrogeology Criteria (NRA, 2008)

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.
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.

Importance	Criteria	Typical Example
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 impacts on downstream environmental receptors (see below, bottom as an example) as a result of the Proposed Project.



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

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

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

In order to provide an understanding of the stepwise impact assessment process applied below (Section 9.5), we have firstly presented in **Table 9-5** below a summary guide that defines the steps (1 to 7) taken in each element of the impact assessment process. The guide also provides definitions and descriptions of the assessment process and shows how the source-pathway-target model and the EPA impact descriptors are combined.

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

Table 9-5: Stepwise Impact Assessment Process

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

9.2.5 Limitations and Difficulties Encountered

No material limitations or difficulties were encountered during the preparation of the Hydrology and Hydrogeology Chapter of this EIAR. The assessment was informed by historical and recent site investigations, seasonal monitoring, and other relevant baseline information. The extent of the available information is considered appropriate to characterise the existing hydrological and hydrogeological environment and to assess the likely significant effects of the Proposed Development for the purposes of this EIAR.

9.3 Receiving Environment

9.3.1 Site Description and Topography

The Proposed Wind Farm is situated on the northwestern slopes of the Ox Mountains, located approximately 4.5km south of the village of Dromore West and 3km southwest of the village of Templeboy in Co. Sligo, at their nearest points.

The Proposed Wind Farm is in an upland setting which is dominated by blanket bog and coniferous forestry. There are two wind farms within the Site (Existing Wind Farm), namely Dunneill Wind Farm which is located on the north of the Site and Kingsmountain Wind Farm which is located on the east of the Site. The Site has existing access tracks (Existing Wind Farm, forestry and bog tracks), with up to 8.2km to be upgraded and utilised by the Proposed Project. The total Existing Wind Farm footprint is 9ha and approximately 3.7ha is to be used as part of the Proposed Project.

The Proposed Wind Farm is accessed via the L6309 and L2702 Local Roads off the N59 National Road, travelling in an east-west direction north of the Site and the N17 National Road, which runs in a north-south direction to the southeast of the Site. The current entrance to the Existing Wind Farm is proposed as the main site entrance, utilising the existing access roads and infrastructure.

Proposed Turbines T8 to T17 are located within the Existing Wind Farm, while Proposed Turbines T1 to T7 as well as the proposed 110kV substation are located in coniferous forestry and peatlands on the west of the Site that were not previously developed for wind energy.

The topography of the Proposed Wind Farm is mountainous with a ground elevation of between 110 and 390m OD. The highest elevations are on the southeast of the Proposed Wind Farm where the ground slopes steeply up towards the summit of the Ox Mountains. The upper reaches of the Dunneill River (referred to as the Owenduff River within the Site) flows through the Proposed Wind Farm. Ground slopes in the central and western part of the Proposed Wind Farm are more moderate.

Land-cover on the Proposed Wind Farm primarily comprises peat bog, with coniferous forest to the north-west, east and south of the site. South of the Proposed Wind Farm comprises largely of transitional wood scrub, while land-use in the northern end of the site comprises largely of pastoral agriculture and low-density residential.

Current land-use along the Proposed Grid Connection Route and TDR accommodation works areas comprise public road corridor, pastures, low density residential, industry, commercial forestry and land principally used for agriculture with significant areas of natural vegetation.

The proposed Biodiversity Management and Enhancement Plan (BMEP) lands, situated centrally within the Proposed Wind Farm, are located on open bogland and also at areas proposed for peat and spoil management.

9.3.2 Water Balance

Long term Average Annual Rainfall (AAR) and evaporation data was sourced from Met Éireann. The 30-year annual average rainfall (1980 - 2010) recorded at Cloonacool (Lough Easky) rainfall station, located 3.7km southwest of the Site, are presented in **Table 9-6**. This is the most appropriate station to use with respect to distance (from the Proposed Wind Farm) and elevation.

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 Wind Farm ranges from 1,360 to 1,900mm/year. The higher value is used in the water balance present below.

Table 9-6: Local Average long-term Rainfall Data (mm)

Station		X-Coord		Y-Coord		Ht (MAOD)		Year Start		Year End		
Cloonacool		151500		263500		61		1981		2010		
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
161.3	122.7	133	99.5	102.6	104.1	113.5	133.4	131.9	169.8	168.4	161.9	1602

The closest synoptic[1] station where the average potential evapotranspiration (PE) is recorded is at Belmullet, approximately 75km west of the Site. The long-term average PE for this station is 510mm/year. This value is used as a best estimate of the Site PE. Actual Evaporation (AE) at the Site is estimated as 485mm/year (which is 0.95 × PE).

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

Effective rainfall (ER) = AAR – AE

= 1,900mm/year – 485mm/year

ER = 1,415mm/year

Based on groundwater recharge coefficient estimates from the GSI (www.gsi.ie), recharge is capped at 50 - 200mm/year due to the poorly productive nature of the underlying bedrock aquifer at the Proposed Wind Farm (refer to Section 9.3.8 which deals with Site hydrogeology). 100mm/year is taken as an average for the Proposed Wind Farm (recharge coefficient of ~7%).

This means that the hydrology of the Proposed Wind Farm is characterised by high surface water runoff rates (93%) and low groundwater recharge rates (7%). Therefore, conservative annual recharge and runoff rates for the Proposed Wind Farm are estimated to be 100mm/yr and 1,315mm/yr respectively.

A recharge coefficient is not applicable to the Proposed Grid Connection Route due to the cabling being placed within the carriageway of public roads (i.e. existing impermeable manmade surface).

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 Site is -4% under the medium-low emission scenario and -2% under the high emissions scenario.

In addition to average rainfall data, extreme value rainfall depths are available from Met Éireann. **Table 9-7** below presents return period rainfall depths for the area of the Proposed Wind Farm. These data are taken from https://www.met.ie/climate/services/rainfall-return-periods and they provide rainfall depths for various storm durations and sample return periods (1-year, 10-year, 30-year and 100-year). The 10-year rainfall depths are the basis of the Proposed Wind Farm drainage hydraulic design as described further below.

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

Table 9-7: Return Period Rainfall Depths (mm) for the Proposed Wind Farm

Return Period (Years)				
Storm Duration	1	10	30	100
5 mins	3.6	7.6	10.6	14.9
15 mins	5.8	12.5	17.4	24.5
30 mins	7.6	15.9	21.8	30.3
1 hour	9.9	20.1	27.2	37.4
6 hours	19.7	37.2	48.7	64.7
12 hours	25.7	47.1	61	80
24 hours	33.5	59.7	76.4	98.9
2 days	42.2	70.6	88	110.8

9.3.3 Regional and Local Hydrology

Regionally, the Site is located in the WFD Sligo Bay surface water catchment within Hydrometric Area No. 35 of the North Western River Basin District. A regional hydrology map is shown as **Figure 9-1** below.

On a more local scale the Proposed Wind Farm is located in 2 no. sub catchments; namely the Easky_SC_010 and the Dunmoran_SC_010. Within the Easky_SC_010 the Proposed Wind Farm drains to the Easky River (Easky_010) and the Buncrowey River (Buncrowey_010). The Buncrowey River is a tributary of the Easky River.

With the Dunmoran_SC_010, the Proposed Wind Farm drains to the Dunneill River (Dunneill_010), Doonbeakin River (Doonbeakin_010) and Lugdoon Stream (Lugdoon_010). Refer to **Table 9-8** below which summarises the Proposed Wind Farm infrastructure within each sub-basin.

All the above-mentioned river waterbodies drain into Sligo Bay to the north which is approximately 6km downstream of the Proposed Wind Farm at its closest point.

On leaving the proposed 110kV substation on the west of the Proposed Wind Farm, the Proposed Grid Connection Route passes through the Easky_SC_010 (1.6km), Dunmoran_SC_010 (26.1km), Owenmore[Sligo]_SC_040 (5.5km) and Owenmore[Sligo]_SC_030 (7.8km). Local drainage along the Proposed Grid Connection Route on a sub-basin scale is summarised in **Table 9-8** below.

The turbine delivery route (TDR) overrun area works located along local road L2702 and L6309 to the west and north of the Proposed Wind Farm, are located in the Easky_SC_010 and Dunmoran_SC_010 sub-catchments respectively. A TDR overrun area on the N59 near Ballysadare is located in the Owenmore(Sligo)_SC_040 sub-catchment.

The proposed Biodiversity Management and Enhancement Plan (BMEP) lands, situated centrally within the Proposed Wind Farm, are located within the Easky_SC_010 and Dunmoran_SC_010 where they drain to the Buncrowey River (Buncrowey_010) and Dunneill River (Dunneill_010) respectively.

The existing 23 no. turbines from the Existing Wind Farm are located in the Dunmoran_SC_010 and drain to the Dunneill River (Dunneill_010 and Doonbeakin_010 sub-basins). Refer to **Table 9-8** below for a summary of regional and local hydrology at the Proposed Project. A local hydrology map is shown as **Figure 9-2**.

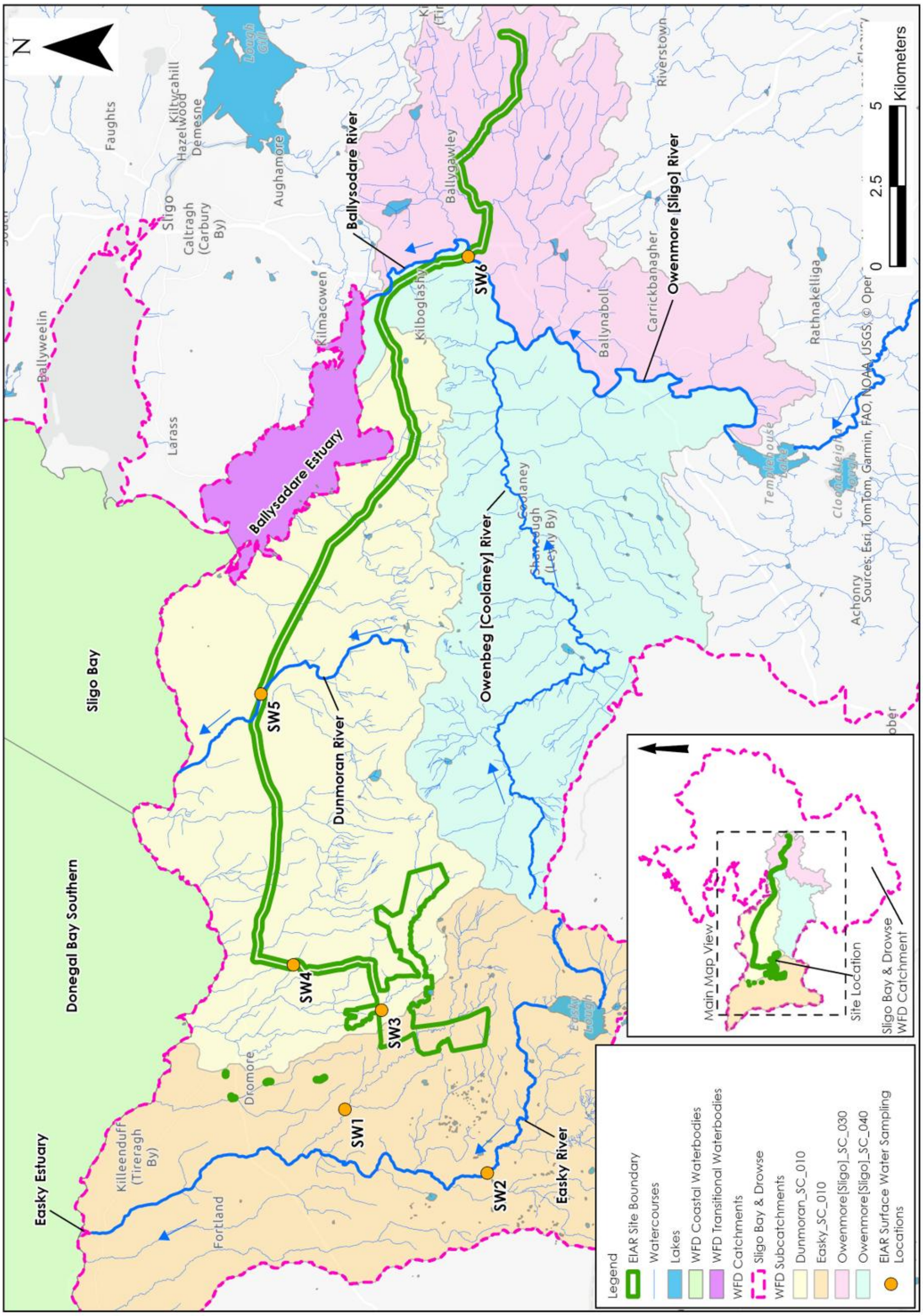


Figure 9-1: Regional Hydrology Map

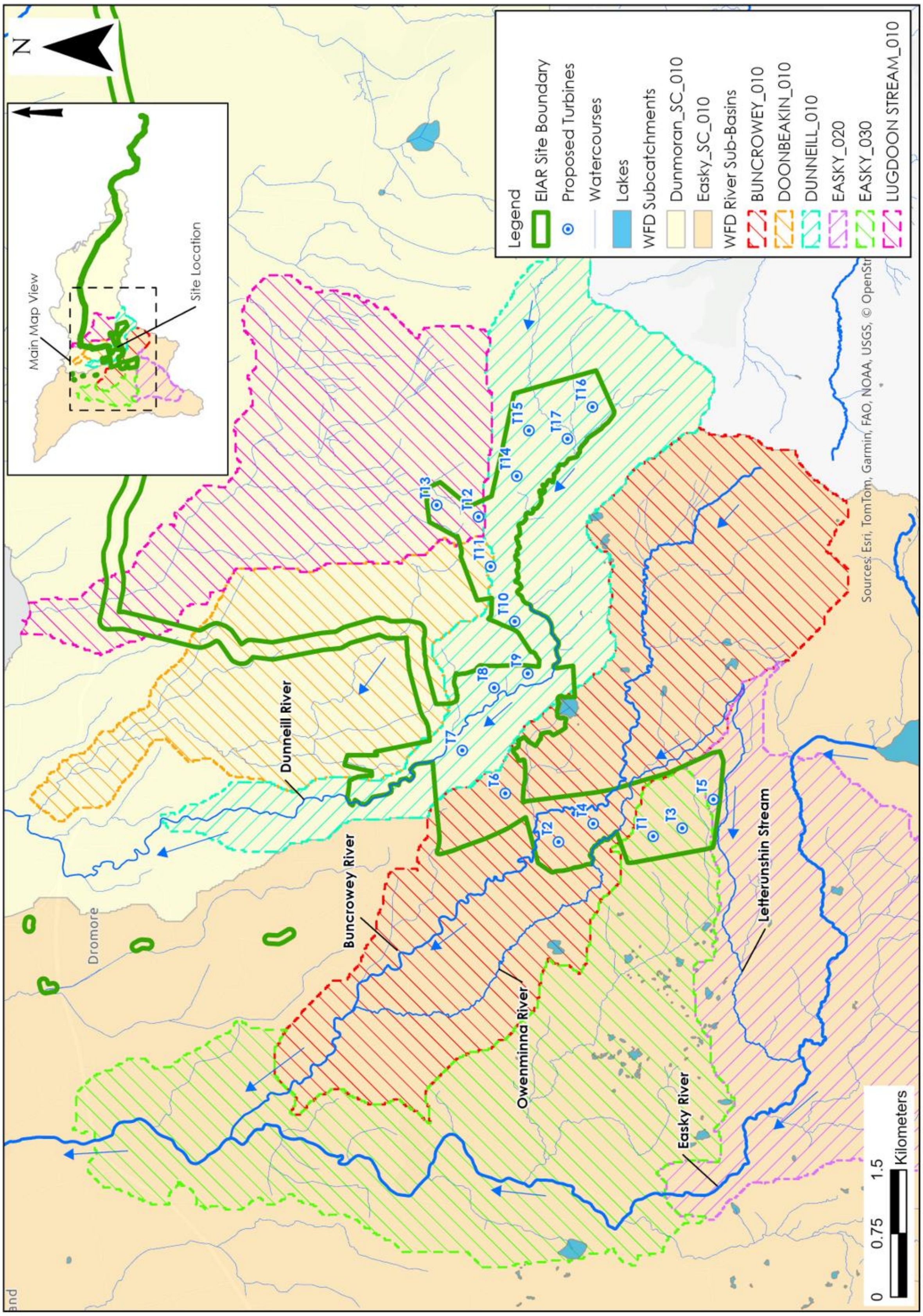


Figure 9-2: Local Hydrology Map

Table 9-8: Summary of Regional & Local Hydrology at the Proposed Project

WFD Sub-catchment	WFD Sub-basin	Proposed Project
	Proposed Wind Farm	
Easky_SC_010	Easky_020	1 no. Proposed Turbin e, 1 no. temporary construction compound and 1 no. TDR overrun area
	Easky_030	2 no. Proposed Turbines, 2 no. peat/spoil management areas and 1 no. Lidar compound
	Buncrowey_010	3 no. Proposed Turbines, 3 no. peat/spoil management areas, 110kV substation, and BMEP lands and 1 no. TDR overrun areas
	Carrownrush_010	2 no. TDR overrun areas
Dunmoran_SC_010	Dunneill_010	20 no. (of 23) Existing Wind Farm turbines for removal. 9 no. Proposed Turbines, 4 no. peat/spoil management areas, 3 no. borrow pits, 1 no. temporary construction compound, decommissioned turbine lay down areas, BMEP lands, 1 no. Lidar compound and 2 no. TDR overrun areas
	Doonbeakin_010	3 no. (of 23) Existing Wind Farm turbines for removal. Proposed 1 no. peat/spoil management areas
	Lugdoon Stream_010	2 no. Proposed Turbines & 2 no. peat/spoil management areas
Owenmore(Sligo)_SC_040	Ballysodare_010	1 no. TDR overrun area

Proposed Grid Connection Route		
Easky_SC_010	Buncrowey_010	1.6km (1 no. EPA WC)
Dunmoran_SC_010	Dunneill_010	0.76km (1 no. EPA WC)
	Doonbeakin_010	4km (4 no. EPA WC)
	Dunneill_020	0.2km (1 no. EPA WC)
	Lugdoon Stream_010	1.03km (1 no. EPA WC)
	Kilrusheighter_010	3.31km (3 no. EPA WC)
	Doonflin_010	1.3km (1 no. EPA WC)
	Dunmoran_010	4.2km (2 no. EPA WC)
	Barnabrack_010	11.3km (9 no. EPA WC)
Owenmore(Sligo)_SC_040	Ballysodare_010	4km (1 no. EPA WC)
	Owenmore(Sligo)_080	1.5km (1 no. EPA WC)
Owenmore(Sligo)_SC_030	Unshin_050	3.9km (7 no. EPA WC
	Unshin_040	3.9km (1 no. EPA WC)

9.3.4 Project Site Existing Drainage

9.3.4.1 Drainage Regime

Refer to **Figure 9-4** for a drainage map of the Proposed Wind Farm.

The portion of the Proposed Wind Farm within the Easky River sub-catchment (Easky_SC_010) is drained by several unnamed headwater streams of the Easky River itself along with the upper reaches of Buncrowey River (upper reaches are referred to as the Crowagh River and Owenminna River).

Easky River emerges from Easky Lough which is located 1.9km to the south of the Proposed Wind Farm. The Proposed Wind Farm is not located in the Easky Lough surface water catchment. Easky Lough is located 5km further up-stream in the Easky River catchment relative to the Proposed Wind Farm.

The southwestern portion of the Proposed Wind Farm is drained by headwater streams that drain directly into the Easky River which is located 4km to the west of the Site. There is 1 no. watercourse existing crossing along an existing bog track between Proposed Turbines T3 and T5 that will be upgraded as part of the Proposed Wind Farm.

The Buncrowey River, which is a tributary of the Easky River, forms from several headwater streams that flow through the western portion of Proposed Wind Farm after emerging from the slopes of the Ox Mountain to the south of the Proposed Wind Farm. The existing public road (L2702) on the west of the Proposed Wind Farm that will be upgraded by the Proposed Wind Farm crosses 3 no. headwater streams of the Buncrowey River. There is also 1 no. existing crossing of a Buncrowey headwater stream on the L6309 on the north of the Site which is also proposed for upgrade.

The central and eastern portion of the Proposed Wind Farm drain directly to the upper reaches of the Dunneill River (referred to as the Owenduff River on its upper reaches) which flows along the southeastern boundary of the Proposed Wind Farm prior to flowing through the central portion of the Proposed Wind Farm for approximately 3km. The Existing Wind Farm (including its 23 no. turbines) also drains directly to the Dunneill River.

3 no. EPA mapped headwater streams of the Dunneill River are crossed by the Existing Wind Farm access track infrastructure that will be upgraded for the Proposed Wind Farm.

The Dunneill River (Owenduff River) then flows northerly through the central and northern portion of the Proposed Wind Farm prior to flowing off-site at the Existing Wind Farm (Dunneill). Also, there is also 1 no. existing crossing of the Dunneill River on the L6309 public road on the north of the Site.

The northeastern portion of the Proposed Wind Farm is drained by headwater streams of the Doonbeakin River and Lugdoon Stream, with the former being a tributary of the Dunneill River.

Runoff from Existing Wind Farm hardstand and access roads is 'typically over the edge' with roadside drains present along some sections of access roads. On steeper sections of Existing Wind Farm access roads at Kingsmountain, ACO drains ('drainage grips') are present for control of surface water runoff. Refer to the drainage drawings (**Appendix 4-3**) for the locations of existing access road ACO drains and drain culverts.

Within the Proposed Wind Farm, there are numerous manmade drains that are in place predominately to drain the forestry plantations. The current internal forestry drainage pattern is influenced by the topography, peat subsoils, layout of the forest plantation and by the existing road network. The forest plantations are generally drained by a network of mound drains or plough ribbons 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. As illustrated in **Figure 9-3**, 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 9-3.**

In addition, the drainage map was created using Lidar ground surface elevation data. Lidar data allows detailed mapping on the topographic contours of the Proposed Wind Farm, thereby allowing identification of potential drainage pathways at the Proposed Wind Farm that are greater than 150m in length. The 150m drainage pathways are not watercourses but potential drainage pathways for surface water runoff (overland flow) after rainfall events. The 150m drainage pathways are shown on the drainage drawings (**Appendix 4-3**).

The integration of the existing main drains with the Proposed Wind Farm drainage is a key component of the wind farm drainage design which is discussed further in Section 9.4.2.2 below.

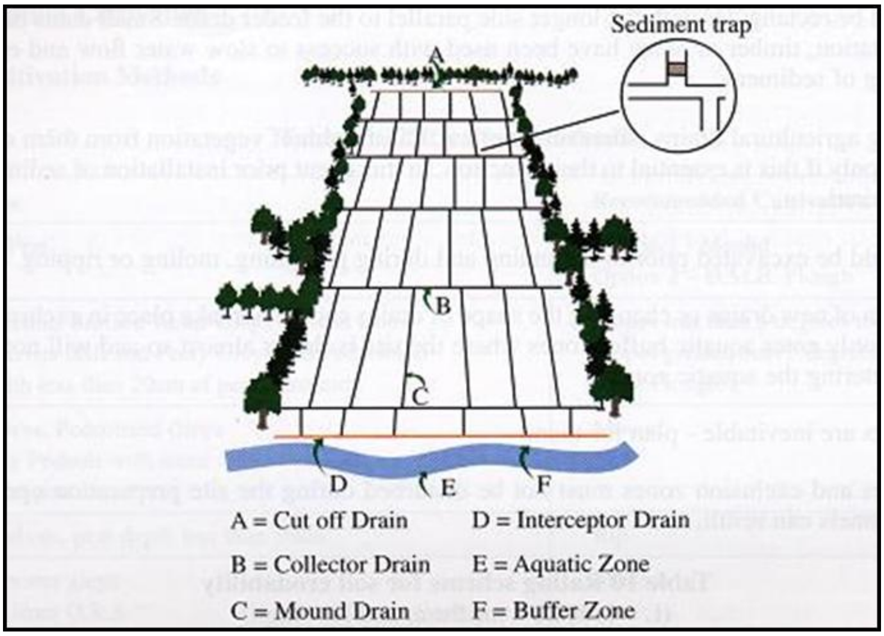


Figure 9-3: Typical Forestry Drainage

Along the Proposed Grid Connection Route underground cabling there are 15 no. bridge crossings and 19 no. culvert crossings (34 no. watercourse crossings in total), which includes natural stream/rivers and drains. 31 no. of these watercourses are EPA mapped watercourse crossing locations. Refer to **Table 9-8** above for the number of EPA mapped watercourse crossings within each sub-catchment/sub-basin).

All 34 no. watercourse crossings (both drains and natural) are existing culverts and bridges where works are required to accommodate the underground Proposed Grid Connection Route cable. No in-stream works are proposed at any of the Proposed Grid Connection Route crossing locations. Refer to the TLI Construction Methodology for the Proposed Grid Connection Route (**Appendix 4-7).**

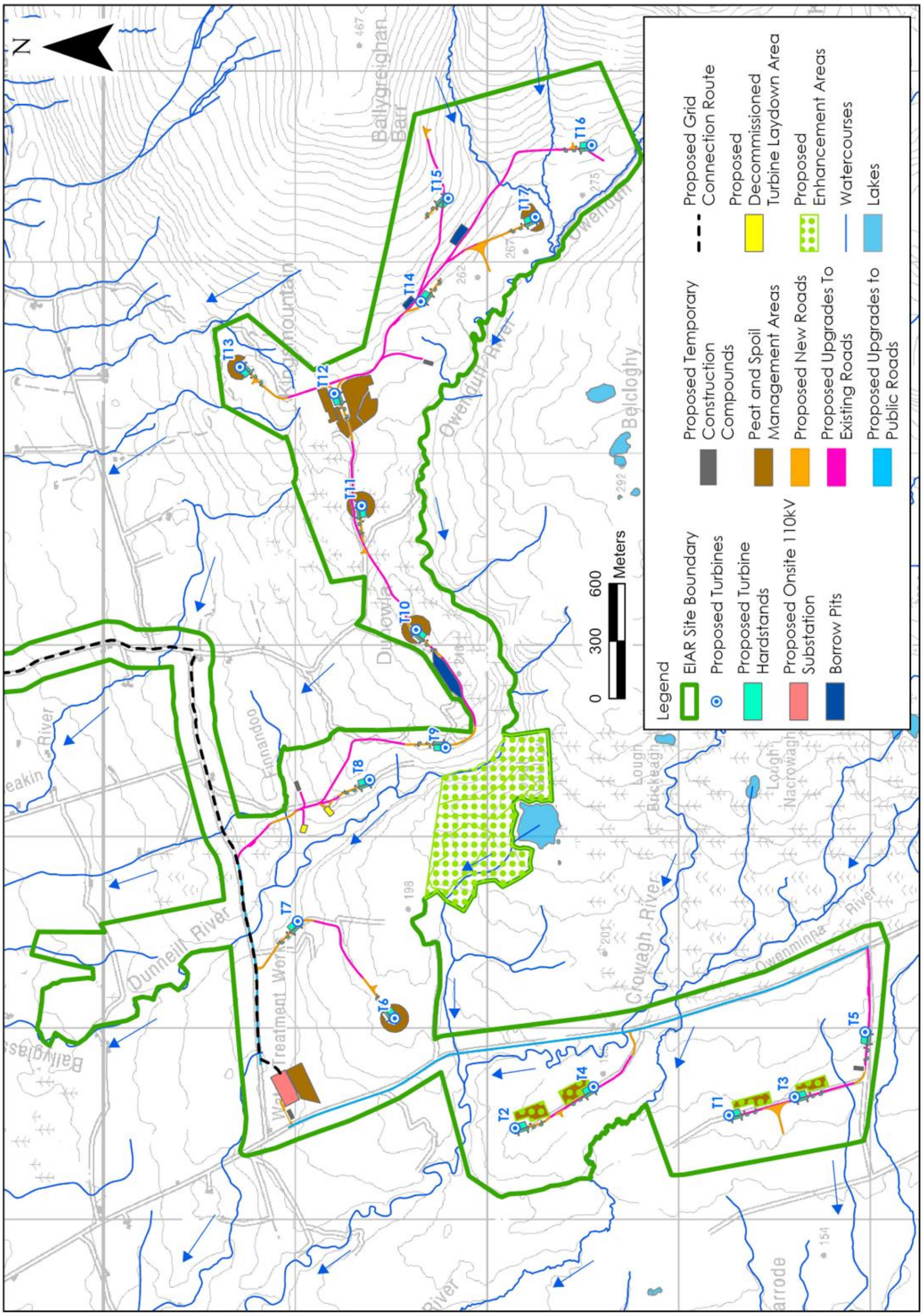


Figure 9-4: Site Drainage Map

9.3.5 Baseline Assessment of Site Runoff

This section undertakes a long-term water balance assessment and surface water runoff assessment for the baseline conditions at the Proposed Wind Farm only (~743ha in area). Due to the nature of the Proposed Grid Connection Route being along the public road network, this is not included in the assessment.

The rainfall depths used in this water balance, which are long term averages, are not used in the design of the sustainable drainage system for the Proposed Wind Farm. The Proposed Wind Farm drainage design is based on the 10-year return period rainfall event as described further in Sections 9.4.2 and 9.5.2.2 below.

The water balance calculations are carried out for the month (December) with the highest average recorded rainfall minus evapotranspiration, for the current baseline site conditions (**Table 9-9**).

The water balance represents the long-term average wettest monthly scenario in terms of volumes of surface water runoff from the Proposed Wind Farm prior to development.

The surface water runoff co-efficient for the Site is estimated to be 93% based on the predominant peat coverage, poorly draining mineral soils and low permeability bedrock (refer to Section 9.3.2 above). The Existing Wind Farm footprint (9ha) only accounts for 1.2% of the Proposed Wind Farm and therefore will have negligible effect on the water balance.

The highest long-term average monthly rainfall (site-specific modelled rainfall values – 1991 to 2020) is 212mm over December. The average monthly evapotranspiration for the synoptic station at Belmullet over the same period in December was 8.5mm.

The water balance presented in **Table 9-10** indicates that a conservative estimate of surface water runoff for the Site during the highest rainfall month is 1,409,101m^3/month or 45,455m^3/day.

Table 9-9: Water Balance and Baseline Runoff Estimates for Wettest Month (December)

Water Balance Component	Depth (m)
Average Highest Monthly Rainfall (R)	0.212
Average Potential Evapotranspiration (PE)	0.0085
Average Actual Evapotranspiration (AE = PE x 0.95)	0.0081
Effective Rainfall (ER = R - AE)	0.204
Recharge (7% of ER)	0.0143
Runoff (93% of ER)	0.189

Table 9-10: Baseline Runoff for the Proposed Wind Farm

Wate Balance Area	Approx. Area (ha)	Baseline Runoff per Wettest month (m^3)	Baseline Runoff per day (m^3) in wettest month
Proposed Wind Farm	743	1,409,101	45,455

9.3.6 Flood Risk Assessment

This section is a summary of a site-specific flood risk assessment (FRA) undertaken for the Site. The full FRA report is attached **Appendix 9-1**.

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

No recurring flood incidents within the Proposed Wind Farm were identified from OPW's Past Flood Event Mapping (Refer to **Figure 9-5).**

The closest mapped downstream recurring flood event (flood ID: 4446) is along the Easky River at Bellafarney Gleneasky townland, approximately 4.1km to the northwest of the Proposed Wind Farm, where "*flooding occurs in the flood plain here and lands badly affected*". The flooding is caused by increased river water levels rising over the winter period. The are no past flood events mapped along the Dunneill River catchment in which all the Existing Wind Farm is located and most of the Proposed Wind Farm.

There are several recurring flood events mapped along the N59 which overlaps with the Proposed Grid Connection Route, but due to the temporary nature of the constructions works and the fact that the electrical cable will be placed underground, flood events will not pose a risk to the Proposed Grid Connection Route.

The GSI's Winter 2015/2016 Surface Water Flood Map shows surface water flood extents for this particular 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 fluvial flood zones along watercourses within the Site.

The nearest GSI Winter 2015/2016 Surface Water Flood Map flood zones are located close to lake waterbodies to the south of the Proposed Wind Farm including Lough Nafullow and Belcloghy Lough which are the larger of the lakes in close proximity to the Proposed Wind Farm. Lough Nafullow is 0.49km from the closest Proposed Wind Farm infrastructure (Proposed Turbine T9), while Belcloghy Lough is 1km from the closest Proposed Wind Farm infrastructure (Proposed Turbine T17).

No CFRAM Flood Extent fluvial mapping has been completed for any of the surface water catchments in which the Proposed Wind Farm is located as CFRAM mapping does not cover small catchments such as the Easky River and Dunneill River catchments.

National Indicative Fluvial Mapping (NIFM) for the Present Day Scenario is available for catchments greater then $5km^2$ and therefore covers the Easky River and Dunneill River catchments at the Proposed Wind Farm.

The NIFM mapping shows localised fluvial flood zones close to the channels of the Dunneill River and Crowagh River (upper Easky River) where they flow through the Proposed Wind Farm (refer to **Figure 9-6** below). However, mapped flood zones are very localised to the river channel and do not encroach any Proposed Wind Farm infrastructure. Therefore, all Proposed Wind Farm infrastructure is located in Flood Zone C (Low risk).

Both CFRAM Flood Extent mapping and NIFM flood zone mapping is available for catchments along the Proposed Grid Connection Route. Fluvial flood zones are mapped at the larger watercourses, but this potential flooding has no consequence for the Proposed Project due to the underground nature of the Proposed Grid Connection at flood zones mapped areas.

Furthermore, the Proposed Wind Farm is not located within any GSI mapped historic or modelled groundwater flood zones. Also, based on the CFRAM rainfall (pluvial) flood mapping, surface water ponding/flooding is not a notable issue at the Proposed Wind Farm. This would be expected given the elevated and sloping nature of the topography.

As noted in the OPW scoping submission, the Site (i.e. Proposed Grid Connection Route only) passes through the Dunmoran Drainage District. This is a maintainable channel that falls under the remit of the local authority to maintain. The Proposed Grid Connection Route works will be confined within the carriageway of the N59 and therefore will have no potential to alter drainage.

It is a key design of the Proposed Wind Farm to ensure all surface water runoff is treated (water quality control) and attenuated (water quantity control) prior to diffuse discharge at pre-existing greenfield runoff rates. As such the mechanism by which downstream flooding is prevented and controlled is through avoidance by design. These proposed drainage attenuation measures are outlined in the impact assessment section below.

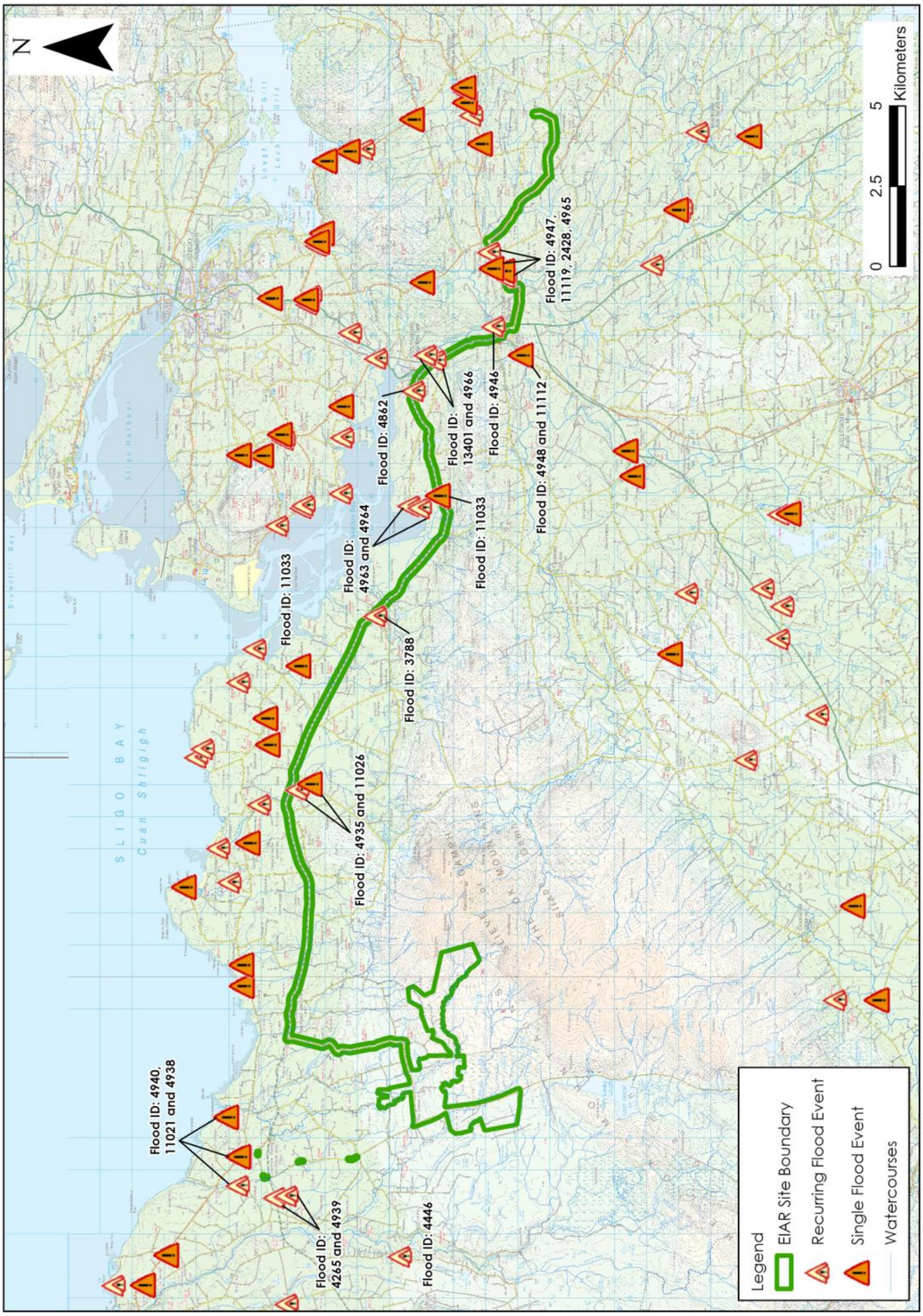


Figure 9-5: OPW Past Flood Event Mapping

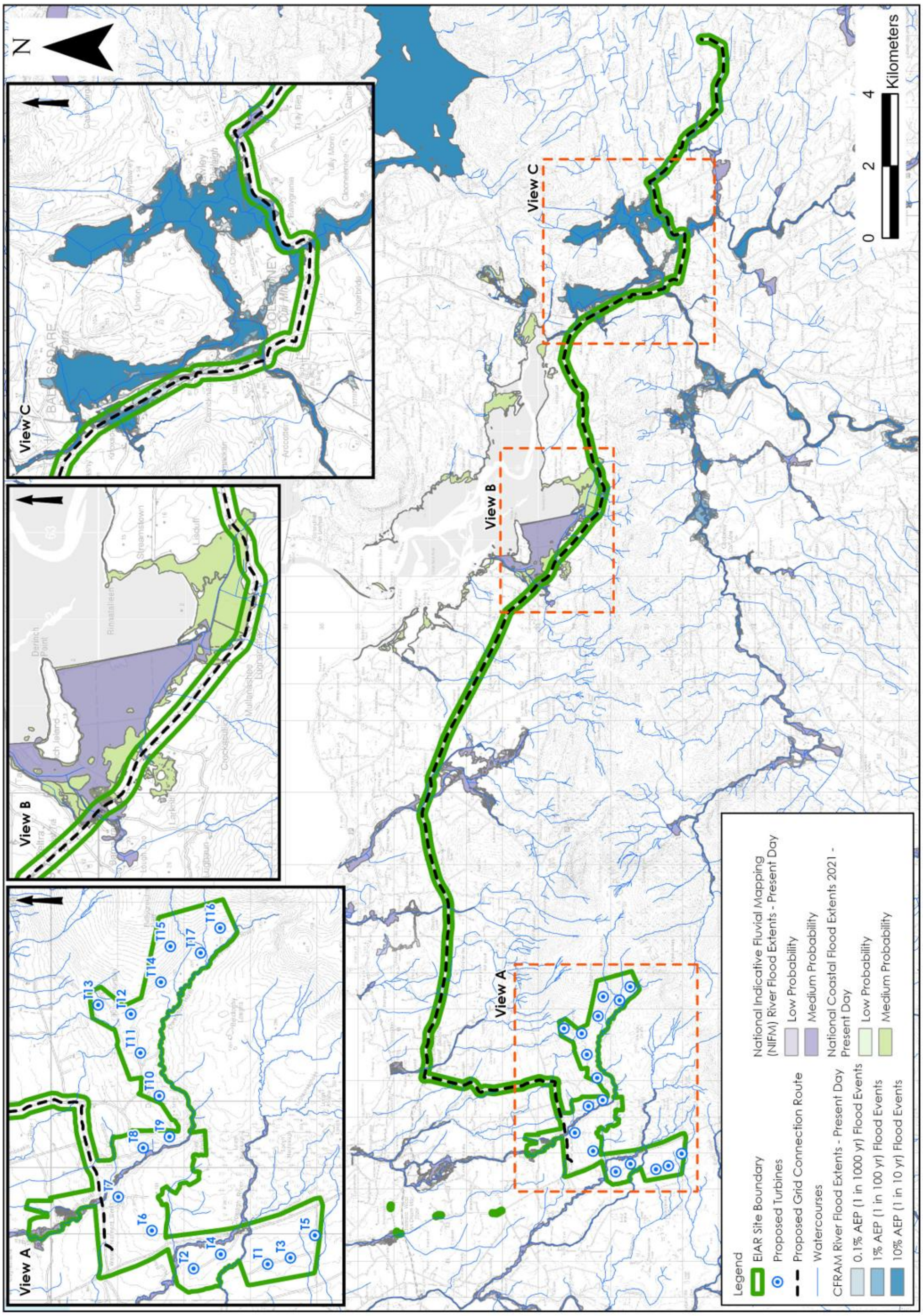


Figure 9-6: CFRAM and NIFM Mapping

9.3.7 Surface Water Quality

9.3.7.1 EPA Q-Rating

EPA biological Q-rating[2] is a water quality rating system based on both the habitat and the invertebrate community assessment and is divided into status categories ranging from 0-1 (Poor) to 4-5 (Good/High).

Q-rating data is available for the Easky River, Buncrowey River, Doonbeakin River and Dunneill River downstream of the Proposed Wind Farm. Latest data (2024) show that all monitoring points on the Easky River downstream of the Proposed Wind Farm achieved High Status (Q4-5). Refer to **Table 9-11** below for the most recent Q-rating data.

Most of the monitoring points on the Dunneill River also achieved High Status (Q4-5 with 1 no. monitoring point achieving a lesser Good Status (Q4). The 1 no. monitoring point on the Buncrowey River achieved Good Status (Q4).

Recent Q-rating data is sparser for watercourses further along the Proposed Grid Connection Route. The Doonbeakin_010 and Dunmoran_010 achieved Good Status while the Ballysodare_010 and Unshin_050 achieved High Status (Q4-5). The lowest Q-rating data for watercourses along the Proposed Grid Connection Route was for the Owenmore River (Owenmore_080) which achieved Moderate Status (Q3-4).

Table 9-11: Most Recent EPA Q-Rating Data

Watercourse	EPA Station ID	Easting	Northing	Year	EPA Q-Rating Status
Easky_010	Trasgarve d/s Lough Easky	144488	325088	2024	4-5 (High)
Easky_020	Bridge u/s Gowlan River	139322	326598	2024	4-5 (High)
Easky_030	Bridge at Camcuill	139957	333314	2024	4-5 (High)
Easky_040	Easky Bridge	137553	337792	2024	4-5 (High)
Buncrowey_010	Br u/s confluence with Easky R.	140555	331019	2024	4 (Good)
Dunneil_010	Br E Water Treatment Works	144487	329263	2024	4-5 (High)
Dunneil_010	Bridge 2 km u/s Dromore West	143755	332520	2024	4-5 (High)
Dunneil_020	80m u/s Br in Dromore West	143085	333674	2024	4-5 (High)
Dunneill_020	Donaghintraine Bridge	143847	334344	2024	4 (Good)
Doonbeakin_010	Ford u/s Dunneill River	143886	333943	2024	4 (Good)

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

Watercourse	EPA Station ID	Easting	Northing	Year	EPA Q-Rating Status
Dunmoran_010	Bridge N.W. of Langford House	155123	330589	2024	4 (Good)
Ballysodare_010	Ballysodare Bridge	166817	329068	2024	4-5 (High)
Owenmore_080	Collooney Bridge	167963	326544	2024	3-4 (Moderate)
Unshin_050	Bridge u/s Ballysodare River	168591	326908	2024	4-5 (High)

9.3.7.2 Field Hydrochemistry

Surface water sampling and field hydrochemistry (measurements of electrical conductivity (µS/cm), pH (pH units), turbidity (NTU) and dissolved oxygen (%)) were taken at 6 no. locations (SW1 – SW6) within surface watercourses downstream of the Site on 3rd February and 2nd April 2026 (refer to **Figure 9-1** for locations). Field hydrochemistry results are presented in **Table 9-12** below.

Electrical conductivity values for the local streams ranged between 44µS/cm and 532µS/cm with the lower values being characteristic of surface water catchments dominated by peat and non-calcareous bedrock (i.e. schist) and the higher values reflective of limestone bedrock dominated surface water catchments with mineral subsoils. pH values which were all slightly basic and ranged from 7.1 to 8.2 which is also a typical range for the above geological settings.

Dissolved oxygen saturation ranged between 93 and 98%. The dissolved oxygen levels would be normal for a Good to High Status and exceed the required dissolved lower limit of 80% (Surface Water Regulations S.I. No. 272/2009 as amended).

Table 9-12: Field Hydrochemistry Data

Location	EC (µS/cm)		pH [H^+]		Dissolved Oxygen %		Turbidity (NTU)	
	03/02/2026	02/04/2026	03/02/2026	02/04/2026	03/02/2026	02/04/2026	03/02/2026	02/04/2026
SW1	178	182	8.0	8.0	95.6	99	0.38	0.15
SW2	77.9	83	8.1	8.0	94.8	94	0.01	0.21
SW3	44.4	54	8.0	8.2	94.7	96	0.03	0.05
SW4	327	332	8.2	8.1	95.9	98	0.01	0.05
SW5	236	232	8.0	8.0	95.3	94	0.38	0.21
SW6	532	528	7.3	7.1	93	95	0.56	0.21

9.3.7.3 Laboratory Analysis

Surface water grab sampling was also conducted at monitoring locations SW1 – SW6 on the dates referred to above.

Results of analysis are show in **Table 9-13** and **Table 9-14** below alongside relevant Environmental Quality Standards (EQS) values for surface water. Laboratory reports are presented in **Appendix 9-2.**

Total suspended solids were 5mg/L or less in all samples which is below the European Communities (Quality of Salmonid Waters) Regulation value (S.I. No. 293 of 1988) of 25mg/L.

Results for ammonia N, nitrate, nitrite, nitrogen, phosphorus and orthophosphate were at or below the detection limit of the laboratory (i.e. very low levels).

All results for ammonia and orthophosphate achieved High Status with respect the European Communities Environmental Objectives (Surface Waters) Regulations (S.I. 272 of 2009 as amended). BOD levels were variable but generally exceeded the Good Status threshold.

Table 9-13: Analytical Results of HES Surface Water Samples (3rd February 2026)

Parameter	EQS	Sample ID					
		SW1	SW2	SW3	SW4	SW5	SW6
Total Suspended Solids (mg/L)	25(+)	<5	<5	<5	<5	5	<5
Ammonia N (mg/L)	Good Status: ≤0.065 High Status ≤ 0.04(*)	0.03	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrite NO_2 (mg/L)	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	Good Status ≤ 0.035 to High Status: ≤0.025(*)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrate - NO_3 (mg/L)	-	<5	<5	<5	5.3	<5	<5
Phosphorus (mg/L)	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrogen (mg/L)		1	1	1.2	1.3	<1.0	2.1
Chloride (mg/L)	-	10.6	10.5	8.8	19	12	20.3
BOD	Good Status: ≤ 1.5 High Status: ≤ 1.3(*)	4	2	1	<2	5	<2

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

Table 9-14: Analytical Results of HES Surface Water Samples (2nd April 2026)

Parameter	EQS	Sample ID					
		SW1	SW2	SW3	SW4	SW5	SW6
Total Suspended Solids (mg/L)	25(+)	<5	<5	<5	5	5	<5
Ammonia N (mg/L)	Good Status: ≤0.065 High Status ≤ 0.04(*)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrite NO_2 (mg/L)	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	Good Status ≤ 0.035 to High Status: ≤0.025(*)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrate - NO_3 (mg/L)	-	<5	<5	<5	<5	<5	<5
Phosphorus (mg/L)	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrogen (mg/L)		<1	<1	<1	1	1.8	1.9
Chloride (mg/L)	-	15.3	11.6	15.4	15.3	16.4	16.4
BOD	Good Status: ≤ 1.5 High Status: ≤ 1.3(*)	4	429	2	<5	<5	<5

(+) 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).

9.3.8 Hydrogeology

9.3.8.1 General Characteristics

The Proposed Wind Farm is largely located within the Collooney Groundwater Body (GWB) (IE_WE_G_0048) which has a mapped surface area of 231.8km^2. A small portion on the far west of the Proposed Wind Farm extends into the Easky East Groundwater Body (IE_WE_G_0050), which has a mapped surface area of 94.3km^2.

The Collooney GWB is classified as 'poorly productive bedrock' while the Easky East GWB is classified as 'karstic'. Refer to **Figure 9-7** below for GSI aquifer mapping.

The bedrock type of the Collooney GWB at the Proposed Wind Farm is predominantly Precambrian Quartzites, Gneisses & Schists along with Dinantian Upper Impure Limestones and Dinantian Shales and Limestones. The Precambrian Quartzites, Gneisses & Schists are classified by the GSI as a Poor Aquifer (PI). The Dinantian Limestones are both classified as Locally Important Aquifers (Lm & LI). The majority of the Proposed Wind Farm is located within the Collooney GWB except for 1 no. Proposed Turbine (T1) on the west of the Site.

Groundwater flow is expected to be concentrated in fractured and weathered zones and in the vicinity of fault zones. Generally, water levels are 0-10 m below ground level. Flow paths are likely to be up to 300m, with groundwater discharging rapidly to nearby streams and small springs. There are observed deep water strikes, indicating that there is a component of deep groundwater flow, however shallow groundwater flow is dominant. Groundwater flow directions are expected to follow topography (GSI, 2004).

Diffuse recharge occurs in this GWB via rainfall percolating through the subsoil and rock outcrops. Due to the low permeability of much of the subsoil (blanket peat), a high proportion of the available recharge will discharge into the streams. In addition, the steep slopes in the mountainous areas promote surface runoff. The stream density is high, indicating the high proportion of surface runoff (GSI, 2004).

The bedrock unit type of the Easky East GWB is Dinantian Pure Bedded Limestones which underlies the far western portion of the Proposed Wind Farm. This bedrock unit is classified as Regionally Important Aquifer – Karstified (RK). Only a very small portion of the Proposed Wind Farm is located within the mapped Easky East GWB and is limited to 1 no. Proposed Turbine location (T1).

The Dinantian Pure Bedded Limestones are generally devoid of intergranular permeability. Groundwater flows through fissures, faults, joints and bedding planes. In pure bedded limestones these openings are enlarged by karstification which significantly enhances the permeability of the rock. Two sub-types of karst aquifers are recognised, termed Rkc and Rkd. The data are not adequate to determine which sub-type it belongs to.

As flow pathways are often determined by discrete conduits, actual flow directions will not necessarily be perpendicular to the assumed water table contours. Flow velocities can be rapid and variable, both spatially and temporally. Rapid groundwater flow velocities indicate that a large proportion of groundwater flow takes place in enlarged conduit systems. Flow path lengths can be up to a several kilometres in length. Overall groundwater flow will be towards the rivers and lakes, but the highly karstified nature of the bedrock means that locally, groundwater flow directions can be highly variable (GSI, 2004).

Both point recharge and diffuse recharge occur in this GWB. Diffuse recharge occurs over the GWB via rainfall percolating through the permeable subsoil and rock outcrops in areas of blanket peat and low permeability till [such as the Proposed Wind Farm], a high proportion of the available recharge will discharge to the streams. The main discharges are to the small springs, streams, rivers and lakes. The stream density is relatively high, particularly for an area dominated by pure limestones (GSI, 2004).

According to the GSI karst database there are no karst features mapped with 5km of the Proposed Wind Farm.

The Proposed Grid Connection Route is also located within the Collooney GWB (discussed above) along with the Beltra-Sligo GWS (IE_WE_G_0043), Carrowmore West (IE_WE_G_0040) and Ballygawley GWB (IE_WE_G_0039) which are all classified as karstic.

The eastern end of the Proposed Grid Connection Route is located in the Lavagh-Ballintougher GWB (IE_WE_G_0038) which is classified as 'poorly productive bedrock'.

9.3.8.2 Summary of Site Investigations

Regional baseline geological data is available from the GSI through their online map viewer (www.gsi.ie). The bedrock across the Proposed Wind Farm is variable and is mapped by the GSI as mainly SCHIST and PSAMMITIC at the eastern and southern portions, including the Existing Wind Farm (Kingsmountain).

LIMESTONE and SHALES are mapped below the northern and western portions of the Proposed Wind Farm, including the Existing Wind Farm (Dunneill). Subsoils are predominantly mapped as blanket peat with some metamorphic tills and alluvium mapped along river valleys. No karst features were observed at The Proposed Wind Farm.

The Proposed Project investigations and geotechnical assessments were extensive and consisted of 850 no. peat depth probes and 19 no. trial pits and extensive ground truthing.

In addition, there are historical trial pit logs (27 no.), shell and auger borehole logs (11 no.), dynamic probing (6 no.) and geophysical surveys (electrical resistivity) available for Existing Wind Farm.

The baseline geological setting of the Proposed Project has been thoroughly examined is fully understood.

Site investigations are summarised as follows:

- Peat depths recorded across the Proposed Wind Farm ranged from 0 to 7.2m with an average depth of 1.15m;
- Approximately 55% of recorded peat depth were less than 1m, 76% less and 2m and 90% less than 3m;
- The average peat depths recorded at the Proposed Turbines varied from 0.2 to 3m with an average of 1.3m;
- With respect to the new proposed access roads, peat depths are typically less than 2m (average 1.8m) and therefore proposed road construction will be a combination of floating and founded (i.e. excavate and replace methods);
- At the 3 no. proposed borrow pit locations, peat depths are shallow (<0.5m);
- Mineral subsoils (glacial tills) typically consisted of brown silty SAND and GRAVEL with cobbles and boulders and/or brown slightly gravelly sandy SILT with cobbles and boulders;
- Bedrock was encountered at 4 no. of the IDL trial pit locations which are all located along the Existing Wind Farm (Kingsmountain) access roads. Depth to bedrock ranged from 0m to 3.2m;
- Historical borehole logs for the Existing Wind Farm (Kingsmountain) encountered strong SCHIST bedrock at depths ranging from 2.3 to 6.6mbgl with an average of 4.9m; and,
- Historical trial pit logs for the Existing Wind Farm (Dunneill) encountered SHALE bedrock at depths ranging from 2.2 to 3.6mbgl with an average of 3.1m.

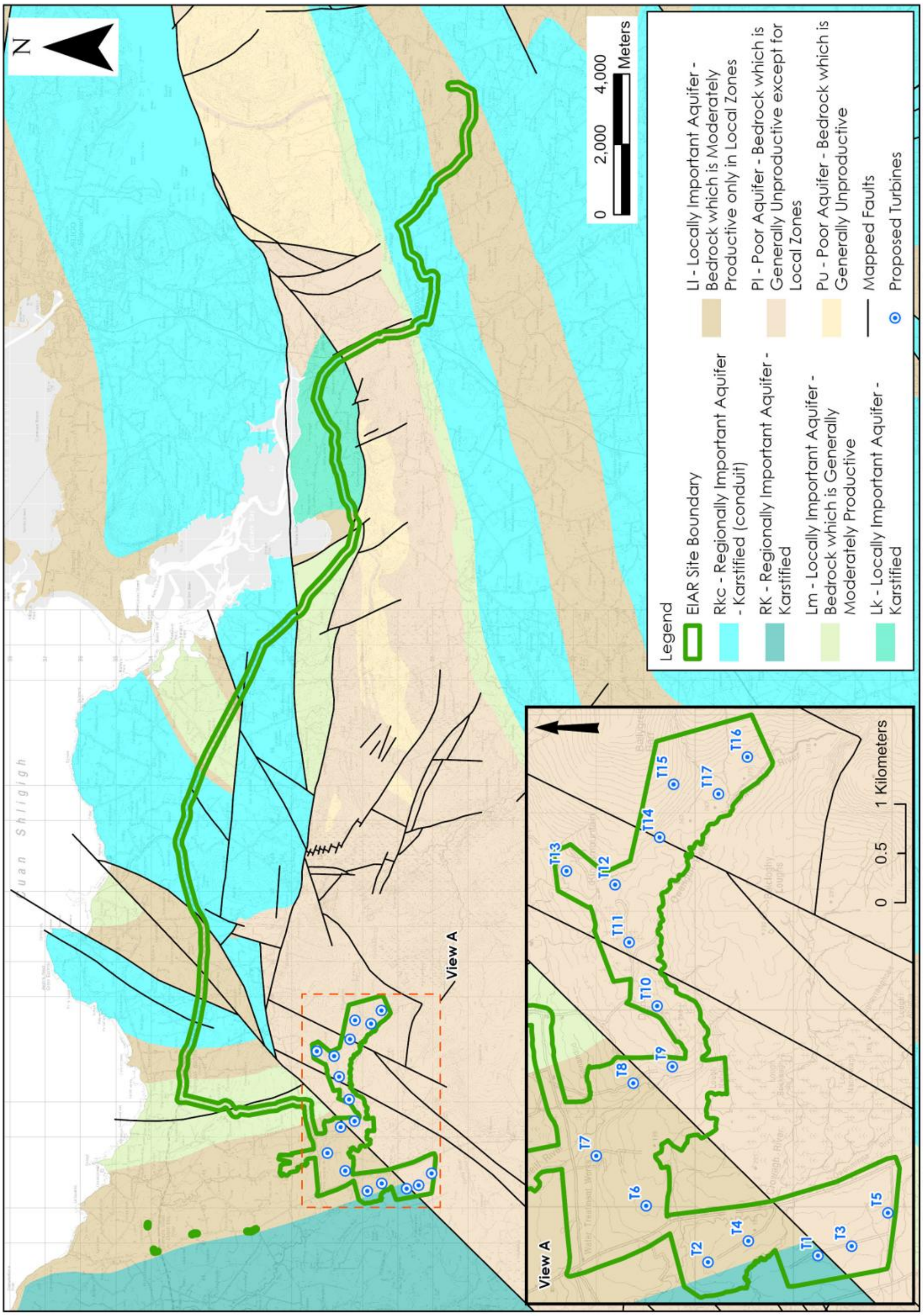


Figure 9-7: Bedrock Aquifer Mapping

9.3.9 Groundwater Vulnerability

The GSI groundwater vulnerability rating is a term used to represent the natural geological 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 concept of groundwater vulnerability was mainly devised for assessing the risk of practices such as manure spreading and wastewater discharge as these are potential pollutants to groundwater. The concept of groundwater vulnerability in wind farms is not as applicable as there are no discharges of potential pollutants to groundwater. The vulnerability rating does, however, give information on depth to bedrock which is useful in wind farm design (i.e. earthworks). The higher the groundwater vulnerability ratings reflect how close bedrock is to the ground surface which is favourable on a Proposed Wind Farm due to shallow depths to competent bedrock strata for founding purposes.

The GSI mapped groundwater vulnerability rating at the Proposed Wind Farm is predominately "Extreme" (0 to 3m of overburden) with a small portion on the northwest mapped "High" (3 - 5m of overburden). The vulnerability rating at these locations is generally consistent with the site investigation findings (refer to Section 9.3.8.2 above for the investigation summary).

9.3.10 Water Framework Directive Water Body Status and Objectives

The EU Water Framework Directive (2000/60/EC), as amended by Directives 2008/105/EC, 2013/39/EU and 2014/101/EU ("WFD"), was established to ensure the protection of the water environment. The Directive was transposed in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003).

The WFD's Water Action Plan 2024 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 WFD is not compromised.

The WFD is implemented through the River Basin Management Plans (RBMP) which comprises a six-yearly cycle of planning, action and review. RBMPs include identifying river basin districts, water bodies, protected areas and any pressures or risks, monitoring and setting environmental objectives. In Ireland the first RBMP covered the period from 2010 to 2015 with the second cycle plan covering the period from 2018 to 2021.

The River Basin Management Plan (2022 - 2027)/Water Action Plan 2024 objectives, which have been integrated into the design of the Proposed Project, include:

- Ensure full compliance with relevant EU legislation;
- Prevent deterioration;
- Meet the water standards and objectives for designated protected areas;
- Protect high status waters; and,
- Implement targeted actions and pilot schemes in focused sub-catchments aimed at (1) targeting water bodies close to meeting their objectives and (2) addressing more complex issues that will build knowledge for the third cycle.

Our understanding of these objectives is that water bodies, 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 as a result of a Proposed Project).

Strict mitigation measures (refer to Section 9.5.2 and 9.5.3) in relation to maintaining a high quality of surface water runoff from the development and groundwater protection will ensure that the status of both surface water and groundwater bodies in the vicinity of the Site will be at least maintained (see below for WFD water body status and objectives) regardless of their existing status.

Please refer to the WFD Compliance Assessment report for the Proposed Project (included as **Appendix 9-3**).

9.3.11 Groundwater Body Status

Local Groundwater Body (GWB) status information is available online (www.catchments.ie). Refer to **Table 9-15** below for groundwater bodies at the Site.

The Collooney GWB (IE_WE_G_0048) underlies the majority of the Proposed Wind Farm and it is assigned 'Good Status', which is defined based on the quantitative status and chemical status of the GWB. The assigned risk status (WFD 3rd Cycle) is Not at Risk. There are no significant pressures acting on this GWB.

The Easky East GWB (IE_WE_G_0050) underlies a small portion on the west of the Proposed Wind Farm and it is also assigned 'Good Status' and 'Not at Risk'. There are also no significant pressures acting on this GWB.

The Proposed Grid Connection Route is located within the Collooney GWB, Beltra-Sligo GWS, Carrowmore West, Ballygawley GWB and Lavagh-Ballintougher which are all assigned Good Status" and Not at Risk.

Table 9-15: Groundwater Body WFD Status and Risk

European Code	Groundwater Body	Overall Status (2019 – 2024)	Risk Status (3rd Cycle)	Pressure Category
Proposed Project				
IE_WE_G_0050	Easky East	Good	Not At Risk	n/a
IE_WE_G_0048	Collooney	Good	Not At Risk	n/a
Proposed Grid Connection Route				
IE_WE_G_0043	Beltra-Sligo	Good	Not At Risk	n/a
IE_WE_G_0040	Carrowmore West	Good	Not At Risk	n/a
IE_WE_G_0039	Ballygawley	Good	Not At Risk	n/a
IE_WE_G_0038	Lavagh-Ballintougher	Good	Not At Risk	n/a

9.3.12 River Water Body Status

Local River Waterbody status and WFD risk classification are available from (www.catchments.ie) and are summarised in **Table 9-16** below.

Table 9-16 below gives summary details of the river waterbodies located directly within the Site. Please refer to the WFD Compliance Assessment report (attached as **Appendix 9-3**) for details and status of all river waterbodies in the Site Water Study Area.

River waterbody status at the Proposed Wind Farm mainly vary from 'Good' to 'High'. Along the Proposed Grid Connection Route status varies from 'Poor' to 'High'. The Pressure Category for waterbodies At Risk is summarised in **Table 9-16** below.

Table 9-16: River Waterbody Status and Risk

European Code	Sub basin	Overall Status (2019 – 2024)	Risk Status (3rd Cycle)	Pressure Category
Proposed Wind Farm and Proposed Grid Connection Route				
IE_WE_35E010020	Easky_020	High	Not at Risk	n/a
IE_WE_35E010100	Easky_030	High	Not at Risk	n/a
IE_WE_35B090500	Buncrowey_010	Moderate	At Risk	Forestry
IE_WE_35D060100	Dunneill_010	Good	At Risk	Hydromorphology
IE_WE_35D090400	Doonbeakin_010	Good	Not at Risk	n/a
IE_WE_35L010400	Lugdoon Stream_010	Good	At Risk	Agriculture
Proposed Grid Connection Route Only				
IE_WE_35K35091	Kilrusheighter_010	Good	Under Review	n/a
IE_WE_35D100600	Doonflin_010	Moderate	At Risk	Agriculture
IE_WE_35D161400	Dunmoran_010	Good	Not at Risk	Agriculture
E_WE_35B300790	Barnabrack_010	Good	Under Review	n/a
IE_WE_35B050100	Ballysodare_010	Poor	At Risk	Anthropogenic Pressures
IE_WE_35O060900	Owenmore_080	Moderate	At Risk	Urban Wastewater
IE_WE_35U010500	Unshin_040	High	Not at Risk	n/a
IE_WE_35U010600	Unshin_050	High	Not at Risk	n/a

9.3.13 Designated Sites and Habitats

Designated sites include Natural Heritage Areas (NHAs), proposed Natural Heritage Areas (pNHAs), Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSAC) and Special Protection Areas (SPAs). Refer to **Figure 9-8** for designated sites local to the Proposed Project.

The Proposed Wind Farm is located adjacent to the Ox Mountain Bogs SAC and pNHA where it exists to the south and to the west of the Site boundary. An area of the Ox Mountain Bog SAC is also located within the Site, adjacent to the Existing Wind Farm (Dunneill Wind Farm), however, no new infrastructure is proposed in this area of the Proposed Wind Farm.

On the eastern portion of the Proposed Wind Farm the upper reaches of the Dunneill River (Owenduff River) form a hydrological 'no flow' boundary between the Proposed Wind Farm (and Existing Wind Farm) and the SAC to the south. Even though the Proposed Wind Farm (and Existing Wind Farm) infrastructure is located upslope of the SAC topographically, there is no potential for surface water or groundwater flows into the SAC due to the presence of the hydrological 'no flow' boundary offered by the Owenduff River channel. Surface water and groundwater flow from the Proposed Wind Farm preferentially discharge into the Owenduff River and is prevented from flowing into the SAC bog. This is illustrated for Proposed Turbine T17 (Cross-section CC') in **Appendix 9-4** (topographic cross-sections between the Proposed Wind Farm and the Ox Mountain Bogs SAC).

Additionally, the western portion of the Proposed Wind Farm (i.e. Proposed Turbines T1 to T6) is located up slope and potentially up-gradient of the SAC with regard surface water runoff and groundwater flow. The ground elevation at these Proposed Turbine locations is approximately 13m to 18m higher than the boundary of the SAC which is downslope to the west.

The Proposed Wind Farm infrastructure such as Proposed Turbines, hardstands and access tracks is setback in excess of 225m from the SAC boundary downslope to the west. Set back distances range between 225m (T4) to 523m (T3). Refer to **Appendix 9-4** for topographic cross-sections between the Proposed Wind Farm and the Ox Mountain Bogs SAC on the west of the Site.

Like the hydrological scenario on the east of the Proposed Wind Farm described above, there is a headwater stream of the Buncrowey River forming a hydrological boundary between Proposed Turbine T4 and the downslope SAC. This is illustrated for Proposed Turbine T4 (Cross-section AA') in **Appendix 9-4.** Therefore, on the west of the Proposed Wind Farm there are only 4 no. Proposed Turbines upslope (T1, T2, T3 and T6) and potentially up-gradient of the SAC in terms of surface water and groundwater flowpaths.

Designated sites further downstream of the Proposed Project include Dunneill River pNHA (Site Code: 001664) which is located approximately 4.5km downstream of the Site.

In addition, Easky River pNHA (Site Code: 001665) is located approximately 8.5km downstream of the Site.

Designated sites downstream of the Proposed Grid Connection Route only include Unshin River SAC and Ballysadarre SAC. The Proposed Grid Connection Route intercepts the Unshin River SAC at 2 no. locations along the underground cable route, which includes 1 no. existing bridge crossing on the Owenmore River and 1 no. existing bridge crossing on the Unshin River.

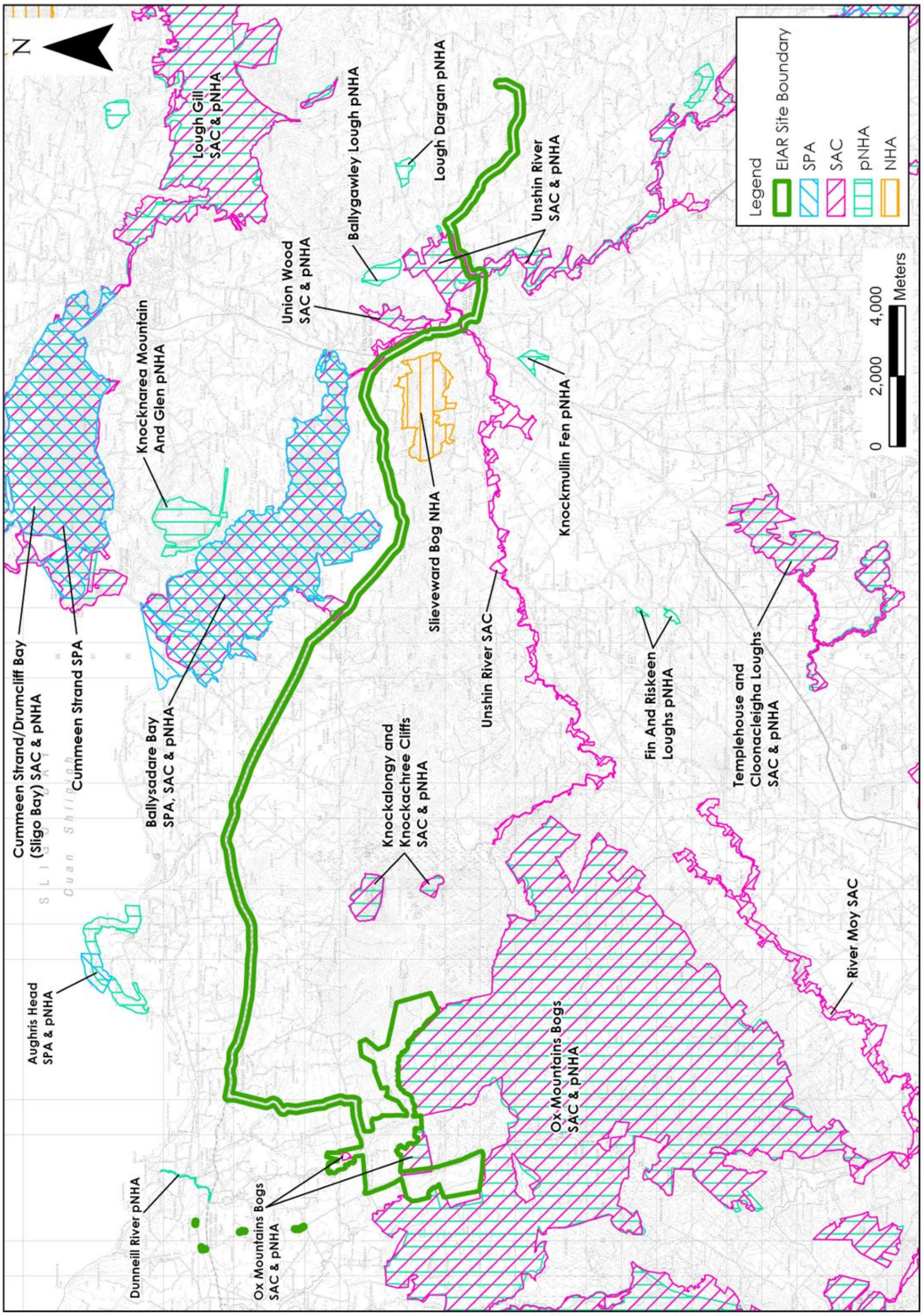


Figure 9-8: Local Designated Sites

9.3.14 Water Resources

9.3.14.1 Public/Group Water Schemes

Public water supply surface water abstractions in this area include Easky Lough which is located 1.9km to the south of the Site.

Neither the Proposed Wind Farm nor Proposed Grid Connection Route are located within the Easky Lough surface water catchment.

The Easky Lough water treatment plant is located immediately to the north of the Proposed Wind Farm 110kV substation location. The underground water mains from Easky Lough runs along the L6309 and L2702 local roads which is also the route of the Proposed Grid Connection Route underground cable. Please refer to Chapter 15 of the EIAR (Material Assets) for further information on infrastructure assets.

There are no mapped groundwater source protection zones that overlap with the Site.

9.3.14.2 Private Domestic Wells

A search of private well locations (accuracy of 1 – 50m only) was undertaken using the GSI well database (www.gsi.ie). Several wells have been mapped by the GSI in the surrounding lands at the Proposed Wind Farm, however they have poor locational accuracies (>50m).

Due to the nature of the Proposed Grid Connection Route underground cable being mainly within the carriageway of public roads outside the Proposed Wind Farm and the shallow nature of the works, no assessment on potential wells located along the cable route (public road or private land sections) was carried out due to the lack of potential effects.

As the GSI well database is not exhaustive in terms of the locations of all wells in the area (as the database relies on the submission of data by drillers and the public etc) it is assumed that every private dwelling down hydraulic gradient of the Proposed Wind Farm has a water supply well associated with it (this is unlikely to be the case but is considered as a precautionary assessment).

The majority of these dwellings are remote from the Proposed Wind Farm infrastructure (>760m) where the deepest excavations are required (i.e. Proposed Turbines and borrow pits) and given the bedrock geology type within the Proposed Wind Farm and the unproductive nature of the underlying aquifer there will be very limited hydraulic connection between any potential wells and groundwater flow from the Proposed Wind Farm.

The groundwater flow direction in the aquifer underlying the Proposed Wind Farm will mimic the local topography whereby flow paths will be from topographic high points to lower elevated discharge areas at streams and rivers. Therefore, the general groundwater flow direction at the Proposed Wind Farm is expected to be westerly and northerly.

As stated in Section 9.3.8.1 above, groundwater flow paths are typically between 30 – 300m in length and given the fact that all dwellings are a minimum of 728m away from the Proposed Turbines and the proposed borrow pits, there is a very low risk of impact. The potential effect on private wells is further evaluated in Section 9.5.2.10 below.

9.3.14.3 WFD Drinking Water Protected Areas

There are no river waterbodies downstream of the Site which are identified as Drinking Water Protected Areas (DWPAs).

Easky Lough is listed as a DWPA in Article 7- Abstraction for Drinking Water. There is no Proposed Project infrastructure located in the Easky Lough surface water catchment.

9.3.15 Receptor Sensitivity

Due to the nature of Proposed Project, being near surface construction activities, impacts on groundwater are generally negligible and surface water is generally the main sensitive receptor assessed during impact assessments.

The primary risk to groundwater at the Site will be from cementitious materials, hydrocarbon spillage and leakages. These are common potential impacts on all construction sites (such as road works and industrial sites). All potential contamination sources are to be carefully managed at the Site during the construction, operational and decommissioning phases of the Proposed Project and mitigation measures are proposed below to deal with these common potential effects.

Groundwater at the Site can be considered medium importance. However, the majority of the Proposed Wind Farm is covered in peat and silty/clayey subsoils which acts as a protective cover to the underlying aquifer, which is mainly poorly productive.

Any contaminants which may be accidently released on-site will travel to nearby streams within surface runoff. The low permeability of the bedrock means that any contaminants that may reach the bedrock would not disperse and would remain localised to the source or would be removed as runoff during wet periods.

Surface waters such as the downstream Easky River, Dunneill River etc can be considered to have very high importance. The primary potential contaminant is suspended solids and associated nutrients. The Easky River also has populations of freshwater pearl mussels.

There are no river waterbodies downstream of the Site which are identified as Drinking Water Protected Areas (DWPAs). Easky Lough is listed as a DWPA in Article 7- Abstraction for Drinking Water. There is no Proposed Project infrastructure located in the Easky Lough surface water catchment. All surface water drinking water supplies are therefore scoped out for further assessment.

The designated sites that are hydraulically connected (surface water flow paths only) to the Proposed Project include Dunneill River pNHA, Easky River pNHA, Unshin River SAC and Ballysadarre SAC.

Ox Mountain Bogs SAC/pNHA is located potentially down-gradient of the Proposed Wind Farm at its western boundary with regard both surface water runoff and groundwater flows. The Proposed Wind Farm infrastructure (Proposed Turbines, hardstands and access tracks) is set back more than 225m from this SAC boundary as shown on **Figure 9-9** below (hydrological constraints map).

Nonetheless, comprehensive surface water mitigation and controls are outlined below to ensure protection of all downstream receiving waters. Mitigation measures will ensure that surface runoff from the developed areas of the Site will be of a high quality and will therefore not impact on the quality of downstream surface water bodies and/or designated sites. Any introduced drainage works at the Site will mimic the existing hydrological regime thereby avoiding changes to flow volumes leaving the Site. Refer to Section 9.4.2 below.

A hydrological constraints map for the Proposed Wind Farm is shown as **Figure 9-9**. A self-imposed 50m buffer from streams and lakes was applied during the constraints mapping and will be maintained during the construction phase. Apart from the total 9 no. existing water crossing locations (Existing Wind Farm access tracks, public roads (for upgrade) and existing bog tracks) and TDR overrun areas, the Proposed Wind Farm infrastructure is located outside the delineated buffer zones within the Proposed Wind Farm.

Due to downstream Freshwater Pearl Mussel populations in the Easky River, a 100m buffer will be maintained for a tributary stream of the Easky River which flows to the south of Proposed Turbine T5.

The large setback distance from sensitive hydrological features means they will not be impacted on by excavations/drains etc. It also allows adequate room for the proposed drainage mitigation measures (discussed below) to be properly installed up-gradient of primary drainage features within sub-catchments. This will ensure attenuation of surface runoff to be more effective.

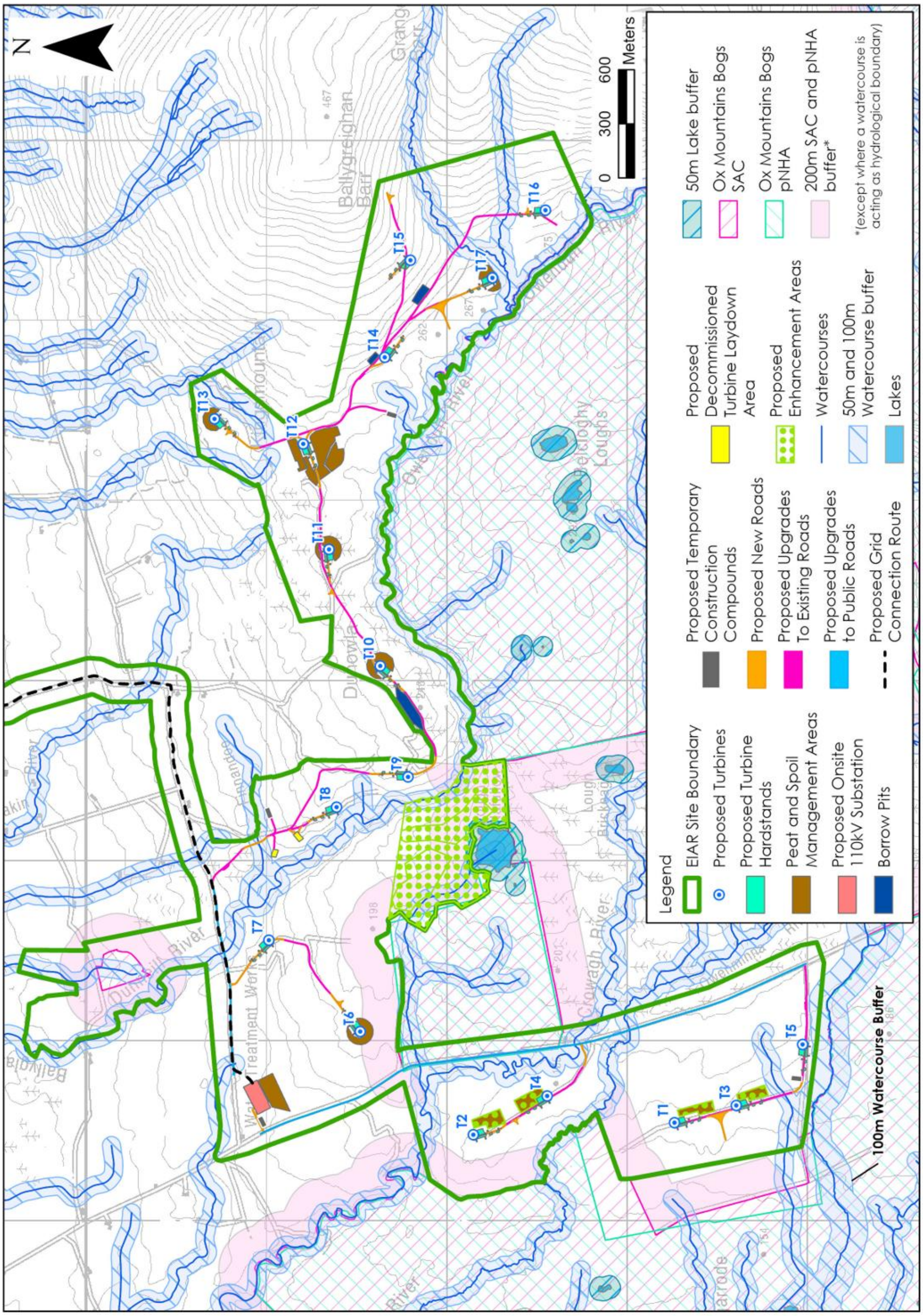


Figure 9-9: Hydrological Constraints Map

9.4 Characteristics of the Proposed Project

9.4.1 Proposed Project Summary

Please refer to Section 4.1 of the EIAR for a description of the Proposed Project (i.e. Proposed Wind Farm and Proposed Grid Connection Route).

It should also be noted that the assessment of the development footprint of the Proposed Project, within this EIAR, is based on the maximum potential footprint for all of the infrastructural elements.

The main characteristics of the Proposed Wind Farm that could impact on hydrology and hydrogeology are:

- Removal of the existing 23 no. turbines at the Existing Wind Farm developments;
- Establishment of 4 no. temporary construction compounds, which will involve minor regrading of soil/subsoil and the emplacement of hardstands. Welfare facilities will be provided at the primary temporary construction compound. Wastewater effluent will be collected in a wastewater holding tank and periodically emptied by a licenced contractor;
- Construction of new site access tracks will predominantly use the excavate and replace technique. This will involve the use of aggregate from 3 no. proposed on-site borrow pits;
- Construction of 14 no. Proposed Turbine new crane hardstand areas and upgrade of 3 no. Existing Wind Farm hardstand areas along with turbine assemblage areas will utilise ground bearing foundations;
- 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 proposed settlement pond locations (refer to **Appendix 4-3** drainage plan drawings) have been assessed for peat instability risks;
- Grey water will be supplied by rainwater harvesting at the substation and water tankered to site where required. Bottled water will be used for potable supply;
- Construction of 17 no. Proposed Turbine foundations, which are expected to be a combination of gravity base and piled foundation design;
- Cabling between Proposed Turbine locations and the on-site 110kV substation will involve the excavation of a shallow trench (approximately 1.2m deep), placement of ducting and backfilling;
- Replacement of 1 no. existing watercourse crossing culvert along the existing access track between Proposed Turbines T3 and T5. The other 8 no. existing watercourse crossing structures will not require replacement but may require minor upgrade works such as widening;
- Tree felling (total 29.3ha) for the purposes of Proposed Wind Farm construction;
- Establishment of 5 no. dedicated peat and spoil management areas as well as utilising the 3 no. exhausted borrow pits for permanent peat placement;
- Upgrade of 8.2km of existing road and construction of 5.1km of new access tracks using both excavate/replace and floating road methods;
- Construction of the on-site 110kV substation and control building with a subsoil bearing foundation. Welfare facilities will be provided at the substation along with a temporary construction compound;
- Turbine delivery route accommodation works along the L63071, L2702, L6309 and N59; and,
- Enhancement of 36ha of peatland habitats.

The main characteristics of the Proposed Grid Connection Route that could impact on hydrology and hydrogeology are:

- Approximately 41.6km of an underground cabling route between the proposed 110kV substation at the Proposed Wind Farm and the existing Sranangh 220kV substation involving the excavation of a double 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);
- 34 no. existing watercourse culvert/bridge crossings along the public road section of the cable route (31 no. of these are EPA mapped watercourses);
- At 19 no. of these crossing locations the cable will be placed either underneath or above the culvert by open trench method;
- At 15 no. of these crossing locations (i.e. mainly bridges) the cable will be placed by means of Horizontal Directional Drilling (HDD); and,
- No in-stream are proposed at any existing crossing location.

9.4.2 Proposed Drainage Management

9.4.2.1 Drainage Design Philosophy

Runoff control and drainage management are key elements in terms of mitigation against impacts on surface water bodies. Two distinct methods will be employed to manage drainage water within the Site. The first method involves 'keeping clean water clean' by avoiding disturbance to natural drainage features, minimising any works in or around artificial drainage features, and diverting clean surface water flow around excavations, 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 stilling ponds prior to controlled diffuse release over vegetated surfaces. There will be no direct discharges to surface waters.

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. A schematic of the proposed site drainage management is shown below as **Figure 9-10.**

A detailed drainage plan showing the layout of the proposed drainage design elements during construction and operation is shown in **Appendix 4-3** of the EIAR.

This drainage approach has successfully been employed at numerous wind farm developments across the county including the nearby Cahermurphy Wind Farm, Glenmore Wind Farm and Slievecallan Wind Farm.

A detailed drainage plan showing the layout of the proposed construction and operational drainage design elements as shown in **Figure 9-10** and in **Appendix 4-3**.

9.4.2.2 Drainage Design Approach

The general design approach to wind farm layouts is to utilise and integrate with the existing forestry or bog 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 of a 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 drains have no major ecological or hydrological value and can be readily integrated.

The drainage plan is a key component of the Proposed Project and the following is a summary of the approach used in the drainage design:

- Use of available high-resolution 1m DSM Lidar data to map in more detail the existing forestry and bog drainage (that has potential to interact with proposed infrastructure) at the Proposed Wind Farm and how the proposed infrastructure interacts with this existing drainage. Using these Lidar data potential runoff pathways are mapped that are >150m[3] in length. The outcome of this mapping is shown on the drainage plan drawings;
- Lidar data and available aerial photography is used to digitise existing forestry drainage and field drains within the development area;
- The Proposed Wind Farm footprint is divided up into drainage catchments (based on topography, outfall locations, catchment size) and then stormwater runoff rates are calculated based on the 10-year return period These flows are used to design settlement ponds for each drainage catchment;
- Settlement pond(s) are then designed for each development footprint catchment, and identified a location for each pond;
- Cut-off (interceptors drains) are re-routed to account for existing forestry and farm land drains;
- The 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)[4]; and,
- Drainage plans also show the proposed locations of temporary drainage measures that will be installed prior to the Proposed Wind Farm construction commencing.

In relation to hydrological constraints, a self-imposed buffer zone of 50m to 100m has been put in place for on-site streams and rivers. Manmade forestry drains at the Proposed Wind Farm are not considered a hydrological constraint and therefore no buffering of forestry drains has been undertaken.

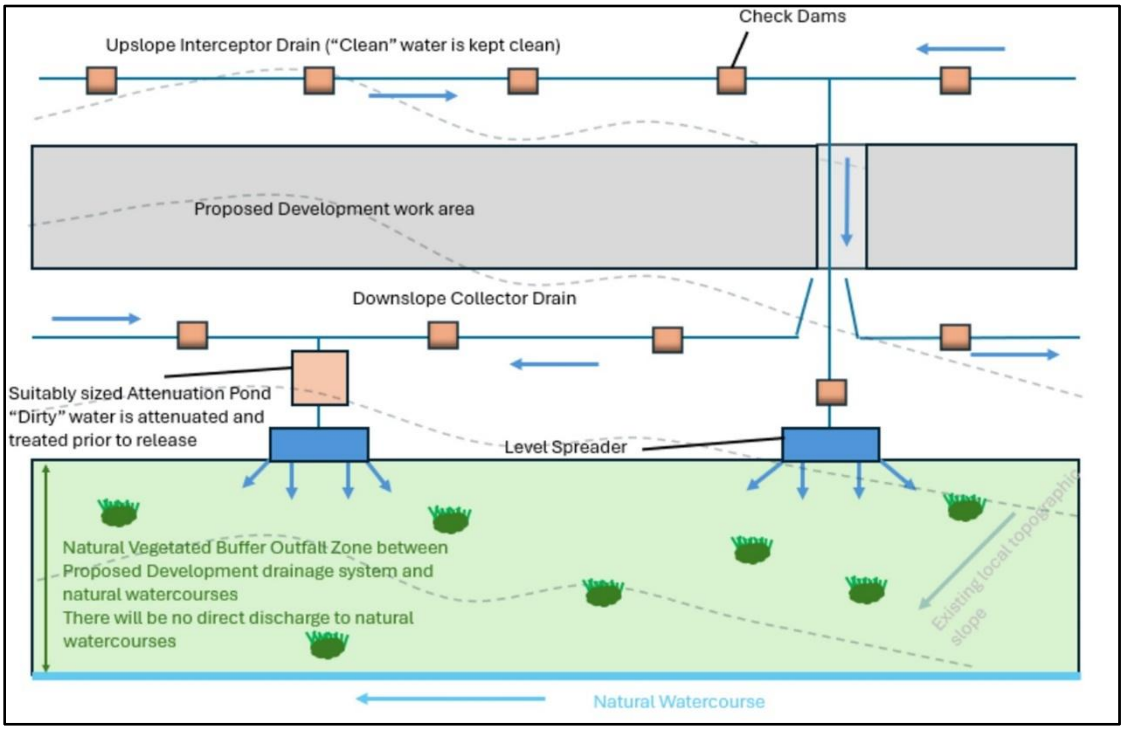


Figure 9-10: Schematic of the Proposed Drainage Management

3 We tested several pathway lengths (25m to 250m) and 150m produced the optimal results.
4 Environmental Management Guidelines - Environmental Management in the Extractive Industry (Non-Scheduled Minerals) (EPA, 2006).

9.5 Likely Significant Effects and Mitigation Measures

The potential effects of the Proposed Project and mitigation measures that will be put in place to eliminate or reduce them are set out below.

9.5.1 'Do-Nothing' Scenario

An alternative land use option to repowering the Existing Wind Farm as part of the Proposed Project would be to leave the Existing Wind Farm as it is, with no changes made to the existing operating 23 no. wind turbines within the Existing Wind Farm. In doing so, environmental effects in terms of emissions are likely to be neutral for the short term, however 13 no. of the existing turbines (existing Dunneil Wind Farm) are due to be decommissioned in accordance with their planning permissions in 2039. Once the 13 no. turbines are decommissioned, there will be a negative effect on greenhouse gas emissions. The 10 no. turbines which were commissioned in 2003 will be left in situ (existing Kingsmountain Wind Farm). However, these machines are aging and are not as efficient as the newer machines. Although these turbines do not have a decommissioning date, they will eventually break down and have to be decommissioned. The opportunity to continue capturing the available renewable energy resource with the Existing Wind Farms would be lost.

An alternative land use option to developing a renewable energy project in the greenfield sections of the Proposed Wind Farm (i.e areas of the Proposed Wind Farm located outside the footprint of the Existing Wind Farm) would be to leave the area as it is with no changes made to the current land use practices of commercial forestry, turf cutting, and public road corridor.

In implementing the 'Do-Nothing' alternative, however, the opportunity to capture a significant part of Co. Sligo's renewable energy resource would be missed, as would the opportunity to contribute to meeting Government and EU 2030 targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. In addition, the opportunity to meet the obligations as laid out in the Climate Action and Low Carbon Development Act 2021 will be lost. The opportunity to generate local employment, development contributions, and rates would also be forgone. Furthermore, the opportunity to implement the measures outlined in the Biodiversity Management and Enhancement Plan (BMEP) as outlined in Appendix 6-4 would also be lost.

9.5.2 Construction Phase – Likely Significant Effects and Mitigation Measures

9.5.2.1 Potential Effects from Clear Felling

Felling works only relate to the Proposed Wind Farm element and not the Proposed Grid Connection Route. Only the Proposed Wind Farm is assessed herein.

Tree felling will be required within and around Proposed Wind Farm infrastructure footprint to allow for the construction of Proposed Turbine bases, access tracks, underground cabling, 110kV substation and the other ancillary infrastructure. 29.3ha of conifer plantation will be felled to accommodate the Proposed Wind Farm construction and operation.

It should be noted that forestry within the Proposed Wind Farm was originally planted as a commercial crop and will be felled in the future should the Proposed Project proceed or not.

The tree felling activities required as part of the Proposed Project 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 licences for wind farm developments.

Potential impacts during tree felling occur mainly from:

- Exposure of soil and subsoils due to vehicle tracking or forwarding extraction methods resulting in a source of suspended sediment which can become entrained in surface water runoff and enter surface 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 could be significant if not mitigated.

Pathways: Drainage and surface water discharge routes.

Receptors: Surface waters (Easky River, Dunneill River, Buncrowey River, Doonbeakin River and Lugdoon Stream), associated dependent ecosystems and designated sites.

Pre-Mitigation Effect: Indirect, negative, slight, temporary, likely effect on surface water quality and associated water-dependent ecosystems. Therefore, in the absence of mitigation measures, there will be no potential for significant effects on downstream surface waters 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);
- Forest Protection Guidelines (Forest Service, 2002);
- Forest Operations and Water Protection Guidelines (Coillte, 2013);
- Forestry and Water Quality Guidelines (Forest Service, 2000b);
- 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); and,
- 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 9-17**.

Table 9-17: Minimum Buffer Zone Widths (Forest Service, 2000)

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%)	10 m	15 m
Steep	(15 – 30%)	15 m	20 m
Very steep	(>30%)	20 m	25 m

During the Proposed Project design phase a self-imposed buffer zone of 50 metres was maintained for all natural watercourses where Proposed Wind Farm infrastructure such as Proposed Turbines, borrow pits, peat and spoil management areas and temporary construction compounds were kept outside of buffer zones.

Due to downstream Freshwater Pearl Mussel populations in the Easky River, a 100m buffer will be maintained for a tributary stream of the Easky River which flows to the south of Proposed Turbine T5. These buffer zones are shown on **Figure 9-9** and **Appendix 4-3**.

With the exception of minor encroachment of proposed felling areas inside the 50m buffer zone at Proposed Turbines T8 (0.31ha), T13 (0.195ha) and T17 (0.67ha), the majority of the proposed felling areas (27.92ha of the total 29.3ha proposed) are located outside of imposed buffer zones.

Additional mitigation (detailed below) will be carried out where tree felling is required inside the buffer zones.

The large distance between most of the proposed felling areas (which are outside the 50m and 100m buffer zone) and sensitive aquatic zones means that potential poor-quality runoff from felling areas, will be adequately managed and attenuated prior to even reaching the aquatic buffer zone and primary drainage routes.

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 (i.e., handheld or mechanical) will be chosen which are most suitable for ground conditions and which will minimise soils disturbance;
- All machinery will be operated by suitably qualified personnel;
- Checking and maintenance of roads and culverts will be on-going through any felling operation. No tracking of vehicle through watercourses will occur, as vehicles will use road infrastructure and existing watercourse crossing points. Existing drains will not be disturbed during felling works;
- 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;
- Ditches which drain from the proposed area to be felled towards existing surface watercourses will be blocked, and temporary silt traps will be constructed. No direct discharge of such ditches to watercourses will occur. Drains and sediment traps will be installed during ground preparation. Collector drains will be excavated at an acute angle to the contour (approximately 0.3%-3% gradient), to minimise flow velocities. Main drains to take the discharge from collector drains will include water drops and rock armour, as required, where there are steep gradients, and will avoid being placed at right angles to the contour;
- Sediment traps will be sited in drains downstream of felling areas. Machine access will be maintained to enable the accumulated sediment to be excavated. Sediment will be

carefully disposed of in the peat disposal areas. Where possible, all new silt traps will be constructed on even ground and not on sloping ground;
- All drainage channels will taper out before entering the 50m and 100m buffer zone. This ensures that discharged water gently fans out over the buffer zone before entering the aquatic zone, with sediment filtered out from the flow by ground vegetation within the zone. On erodible soils, silt traps will be installed at the end of the drainage channels, to the outside of the buffer zone;
- 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. Correct drain alignment, spacing and depth will ensure that erosion and sediment build-up are minimized and controlled;
- Brash mats will be used to support vehicles on soft ground, reducing peat and mineral soils 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;
- Timber will be stacked in dry areas, and outside a local 50m and 100m watercourse buffer. 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 run-off;
- Refuelling or maintenance of machinery will not occur within 100m of a watercourse. Fuel truck, drip kits, qualified personnel will be used where refuelling is required;
- A permit to refuel system will be adopted;
- 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;
- Crossing of streams will not be permitted;
- Trees will be cut manually from along streams and using machinery to extract whole tree; and,
- Travel only perpendicular to and away from stream.

Silt Traps:

Silt traps will be strategically placed down-gradient 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.

Drain Inspection and Maintenance:

The following items will be carried out during pre-felling inspections 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. Main drainage ditches will be identified during pre-felling inspections. The pre-felling inspection will be carried out during rainfall;
- Following tree felling all main drains will be inspected to ensure that they are functioning;
- Extraction tracks near drains will be broken up and diversion channels created to ensure that water in the tracks spreads out over the adjoining ground;
- Culverts on drains exiting in 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;
- Where possible, 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 (for visual inspections and field chemistry measurements) will also be utilised at every works site near any watercourse. These will be taken daily and kept on-site for record and inspection.

Residual Effect: 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 mitigation measures will ensure that surface water runoff from the Proposed Wind Farm will be equivalent to baseline conditions and will therefore have no potential impact on the status, ecology or hydromorphology of downstream waters. The residual effect of the Proposed Wind Farm will be negative, imperceptible, indirect, temporary, likely effect on downstream water quality and aquatic habitats.

Significance of Effects: With the application of the mitigation outlined above, no significant effects on the surface water quality will occur.

9.5.2.2 Potential Effects from Earthworks (Removal of Vegetation Cover, Excavations and Stock Piling) Resulting in Suspended Solids Entrainment in Surface Waters

There will be earthworks required for both the Proposed Wind Farm and Proposed Grid Connection Route (Proposed Project) and therefore both are assessed herein.

Proposed Project construction phase activities that will require earthworks resulting in the removal of vegetation cover and excavation of peat and mineral subsoil (where present) are detailed in Chapter 4: Description of the Proposed Project. Potential sources of sediment laden water include:

- Drainage and seepage water resulting from infrastructure excavation;
- Stockpiled excavated material providing a point source of exposed sediment;
- Construction of the underground cable trench resulting in the entrainment of sediment from the excavations during construction; and,
- Erosion of sediment from emplaced site drainage channels and borrow pits.

These activities can result in the release of suspended solids to surface watercourses 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 impacts could be significant if not mitigated.

Pathways: Drainage and surface water discharge routes.

Receptors: Down-gradient streams and rivers (Easky River, Dunneill River, Buncrowey River, Doonbeakin River, Lugdoon Stream, Kilrusheighter Stream, Doonflin Stream, Dunmoran River, Barnabrack Stream, Ballysodare River, Owenmore River and Unshin River) associated dependent ecosystems and designated sites.

Pre-Mitigation Effect: Indirect, negative, significant, short-term, likely effect on surface water quality. In the absence of mitigation measures, there will be the potential for significant effects on downstream surface waters and associated water-dependent ecosystems.

Mitigation by Avoidance:

The key mitigation measure during the construction phase of the Proposed Wind Farm is the avoidance of sensitive aquatic areas where possible. From **Fiugre 9-9** it can be seen that all of the key areas of the Proposed Wind Farm infrastructure are located significantly further from the 50m and 100m delineated buffer zones with the exception of 9 no. existing watercourse crossing locations that are proposed for upgrade and TDR overrun areas.

No works are proposed inside the 100m buffer imposed for a tributary stream of the Easky River which flows to the south of Proposed Turbine T5.

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 operated effectively. The proposed buffer zone will:

- Avoid physical damage to watercourses, and associated release of sediment;
- Avoid excavations within close proximity to surface water courses;
- 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:

- Source controls:
    - Interceptor drains, vee-drains, diversion drains, flume pipes, erosion and velocity control measures such as use of sand bags, oyster bags filled with gravel, filter fabrics, and
    - Small working areas, covering stockpiles, weathering off stockpiles, cessation of works in certain areas or other similar/equivalent or appropriate measures.
- In-Line controls:
    - Interceptor drains, vee-drains, oversized swales, erosion and velocity control measures such as check dams, sand bags, oyster bags, straw bales, flow limiters, weirs, baffles, silt bags, silt fences, sedimats, filter fabrics, and

collection sumps, 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.

Please see **Appendix 4-3** for detailed drainage design drawings and mitigation measures. It should be noted that a network of bog, forestry, wind farm and roadside drains already exist at the Proposed Wind Farm, and these will be integrated and enhanced as required and used within the Proposed Project drainage system. The integration of the existing drainage network and the Proposed Project 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, stilling 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 Project drainage into the existing site drainage network. This will reduce the potential for any increased risk of downstream flooding or sediment transport/erosion;
- Silt traps will be placed in the existing drains upstream of any streams where construction works / tree felling is taking place, and these will be diverted into proposed interceptor drains, or culverted under/across the works area;
- Runoff from individual turbine hardstanding areas will be not discharged into the existing drain network but discharged locally at each turbine location through stilling ponds and buffered outfalls onto vegetated surfaces;
- Buffered outfalls which will be numerous over the site will promote percolation of drainage waters across vegetation and close to the point at which the additional runoff is generated, rather than direct discharge to the existing drains of the site; and,
- 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, sand bags, 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.

Pre-commencement Temporary Drainage Works

Prior to the commencement of new tracks/hardstands (or track upgrades) the following key temporary drainage measures will be installed:

- All existing dry drains that intercept the proposed works area will be temporarily blocked down-gradient of the works using temporary 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 drains that have surface water flows and also along existing roadside drains; and,
- A double silt fence perimeter will be placed down-slope of works areas that are located inside the 50m watercourse such as at watercourse crossings.

Refer to the drainage plan (**Appendix 4-3**) for the location of these temporary measures.

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.

Silt Fences:

Silt fences will be emplaced within drains down-gradient of all construction areas. Silt fences are effective at removing heavy settleable solids. 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 structures during construction phase will be carried out on a weekly basis. They will remain in place throughout the entire construction phase. Double silt fences will be placed within drains down-gradient of all construction areas inside the 50m hydrological buffer zones.

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 Wind Farm infrastructure footprint has been divided into drainage catchments (based on topography, outfall locations, and catchment size) and stormwater runoff rates based on the 10-year return period rainfall event were calculated for various catchment areas in order to size the settlement ponds as shown in **Table 9-18** below.

The location and dimensions of proposed settlement ponds are shown on the Proposed Wind Farm drainage plan drawings (**Appendix 4-3**).

All proposed settlement pond locations have been thoroughly assessed from a geotechnical and peat stability perspective (refer to **Appendix 8-1** for the Geotechnical and Peat Stability Assessment Report).

Table 9-18: Settlement Pond Design

Pond Size W [m] x L [m] x D [m]			Track/Hardstand Catchment Size (m^2)		
Return Period	10 yrs	Storm Duration	500	1000	2000
6hr retention for coarse silt		6 hrs	3.4 x 10.6 x 1 m	4.8 x 15.0 x 1 m	6.9 x 21.0 x 1 m
11hr retention for medium silt		12 hrs	3.8 x 12.0 x 1 m	5.5 x 16.5 x 1 m	7.5 x 24.2 x 1 m
24hr retention for fine silt		24 hrs	4.2 x 13.8 x 1 m	6.2 x 18.6 x 1 m	8.6 x 27.0 x 1 m

Level Spreaders and Vegetation Filters:

Level spreaders and vegetation filters will be implemented at the settlement ponds. 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 stand-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 Proposed 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 stand 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).

Pre-emptive Site Drainage Management

The works programme for the entire construction stage of the Proposed Project will also take account of weather forecasts and predicted rainfall in particular. Large excavations and movements of peat/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 provides 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 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:

- Secure all open excavations;
- Provide temporary or emergency drainage to prevent back-up of surface runoff; and,
- Avoid working during heavy rainfall and for up to 24 hours after heavy events to ensure drainage systems are not overloaded.

Management of Runoff from Peat and Spoil Repository Areas:
It is proposed that excavated spoil and peat will be used for landscaping where required. The excess material will then be placed in dedicated peat and spoil management areas as well as placement of peat/spoil in the 3 no. proposed borrow pits once the rock is fully extracted.

All proposed peat and spoil storage areas including borrow pits have been thoroughly assessed from a geotechnical and peat stability perspective (refer to **Appendix 8-1** for the Geotechnical and Peat Stability Assessment Report).

All proposed peat and spoil management areas, including the 3 no. borrow pits are located outside of 50m and 100m watercourse buffer zones (refer to **Figure 9-9**).

During the initial construction of repository/deposition areas, silt fences, straw bales and biodegradable geogrids will be used to control surface water runoff from works areas.

Where applicable, the vegetative top-soil layer of the peat and spoil management areas will be rolled back to facilitate placement of excavated spoil, following which the vegetative-top soils layer will be reinstated. Where reinstatement is not possible, spoil and peat management areas will be sealed with a digger bucket and seeded as soon possible to reduce sediment entrainment in runoff.

Drainage from peat and spoil storage areas will ultimately be routed to an oversized swale and a number of stilling ponds pond with appropriate storage and settlement designed for a 1 in 10-year return period before being discharged to the on-site drains.

Peat/subsoil reinstatement areas will be sealed with a digger bucket and vegetated as soon possible to reduce sediment entrainment in runoff. Once re-vegetated and stabilised peat/subsoil reinstatement areas will no longer be a potential source of silt laden runoff.

Therefore, at each stage of the peat and spoil management area development the above mitigation measures will be deployed to ensure protection of downstream water quality.

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 SWMP is included in **Appendix 4-4** of this EIAR).

Residual Effect: 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 mitigation measures will ensure that surface water runoff from the Site will be equivalent to baseline conditions and will therefore have no potential impact on the status, ecology or hydromorphology of downstream waters. The residual effects of the Proposed Project will be negative, imperceptible, indirect, short-term, likely effect on down-gradient rivers, water quality, and dependent ecosystems.

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

9.5.2.3 Potential Effects on Groundwater Levels during Excavation Works (Proposed Wind Farm)

Groundwater levels effects are only likely at the Proposed Wind Farm and not the Proposed Grid Connection Route due to the shallow nature of the underground cabling works (i.e. 0 -~1.2m) within the carriageway of public roads.

Potential dewatering of the 3 no. borrow pits and other deep excavations (i.e. turbine bases) have the potential to impact on local groundwater levels in the mineral soil and bedrock. However, temporary reductions in groundwater levels by temporary dewatering will be very localised due to the small nature of the inflows from the mineral subsoils (as already determined by trial pitting) and the competent and low permeability of the underlying Quartzites, Gneisses & Schists bedrock, Dinantian Upper Impure Limestones and Dinantian Shales and Limestones.

Pathway: Groundwater flow paths.

Receptor: Groundwater levels, local aquifer and Collooney GWB.

Pre-Mitigation Effect: Negative, slight, direct, temporary, likely effects on local groundwater levels. In the absence of mitigation measures, there will be no potential for significant effects on groundwater levels.

Impact Assessment/Proposed Mitigation Measures by Design:

The proposed 3 no. borrow pits are located in competent Quartzites, Gneisses & Schists bedrock which is generally unproductive in terms of groundwater flow (Poor Aquifer classification)

Also, the topographical and hydrogeological setting of the proposed borrow pits and Proposed Turbines means no significant groundwater dewatering is anticipated to be required during the operation of the borrow pits or turbine base construction.

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 dewatering is defined 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. It is considered that this example is very different in scale and operation from the proposed operation of a temporary shallow borrow pit on elevated ground. The basis for this consideration is as follows:

- Firstly, the 3 no. proposed borrow pit areas are located on elevated ground where the ground elevation is >240mOD and therefore are rock outcrops (which are visible to the eye);
- These elevations are above the elevations of the local valleys and streams;

- The proposed borrow pits will be between approximately 13 – 19mbgl which is notable. However, in the context of the topographical/elevated setting of the proposed borrow pits, this depth range is relatively shallow;
- The local bedrock is 'poorly productive' and typically has low intrinsic permeability due to the competency of the rock. This means that groundwater flows will be limited to seepages at worst;
- The flow paths (i.e. the distance from the point of recharge to the point of discharge) in this type of geology is short, localised, and will also be relatively shallow;
- Regional groundwater flow regime, i.e. large volumes of groundwater flow, will not be encountered at these elevations;
- Therefore, shallow groundwater inflows will largely be fed by recent rainfall, and possibly by limited groundwater seepage form localised shallow bedrock;
- The sloping nature of the ground/ridges on the hills where the borrow pits are proposed along with the coverage of soil means groundwater recharge will be very low;
- As such the shallow groundwater flow system will be small in comparison to the expected surface water flows from the bog surface;
- This means that there will be a preference for high surface water runoff as opposed to groundwater recharge and flow; and,
- Hence, the management of surface water will form the largest proportion of water to be managed and treated.

Similarly, no significant groundwater dewatering is anticipated to be required during the construction of the Proposed Turbine bases.

Residual Effects: Due to the local topography and competent, low permeability bedrock along with the prevailing hydrogeology of the Proposed Wind Farm the potential for groundwater level drawdown impacts is considered negligible. The residual effect will be negative, slight, direct, temporary, likely effects on local groundwater levels.

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

9.5.2.4 Potential Effects on Surface Water Quality from Excavation Dewatering

Pumping water from excavations might be required for both the Proposed Wind Farm and Proposed Grid Connection (Proposed Project) and therefore both are assessed herein.

Some minor groundwater/surface water seepages will likely occur in Proposed Turbine foundation excavations, borrow pits and cabling trenches, and this will create small additional volumes of water to be treated by the runoff management system. Cable trenching might require removal of water prior to backfilling.

Inflows will likely require management and treatment to reduce suspended sediments. No contaminated land was noted at the Site and therefore baseline contamination does not occur.

Pathway: Overland flow and site drainage network.

Receptor: Down-gradient surface water bodies, Down-gradient streams and rivers (Easky River, Dunneill River, Buncrowey River, Doonbeakin River, Lugdoon Stream, Kilrusheighter Stream, Doonflin Stream, Dunmoran River, Barnabrack Stream, Ballysodare River, Owenmore River and Unshin River) associated dependent ecosystems and designated sites.

Pre-Mitigation Effect: Indirect, negative, moderate, temporary, likely impact to surface water quality. In the absence of mitigation measures, there will be no potential for significant effects on downstream surface waters and associated water-dependent ecosystems.

Proposed Mitigation Measures:

Management of excavation inflows and subsequent treatment prior to discharge into the drainage network will be undertaken as follows:

- Appropriate interceptor drainage (as shown in **Appendix 4-3**), 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 silt bags or silt buster;
- 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;
- At the turbine locations and borrow pits adequately sized settlement ponds will be constructed to treat pumped water prior to discharge into a local manmade drain; and,
- A mobile 'Siltbuster' or similar equivalent specialist treatment system can be made available at turbine locations 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 Effect: 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 of the Proposed Project will be negative, imperceptible, indirect, short-term, likely effect on local surface water quality.

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

9.5.2.5 Potential Effects from Hydrocarbons

Hydrocarbons will be required for both the Proposed Wind Farm and Proposed Grid Connection Route (Proposed Project) and therefore both are assessed herein.

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

Pathway: Groundwater flowpaths and site drainage network.

Receptor: Groundwater (Easky East GWB, Collooney GWB, Beltra-Sligo GWB, Carrowmore West GWB, Ballygawley GWB and Lavagh-Ballintougher GWB).

Down-gradient streams and rivers (Easky River, Dunneill River, Buncrowey River, Doonbeakin River, Lugdoon Stream, Kilrusheighter Stream, Doonflin Stream, Dunmoran River, Barnabrack Stream, Ballysodare River, Owenmore River and Unshin River), associated dependent ecosystems and designated sites.

Pre-Mitigation Potential Effect:

Indirect, negative, slight, short term, unlikely effect to local groundwater quality.

Indirect, negative, significant, short term, unlikely effect to surface water quality.

Proposed Mitigation Measures:

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

- On site re-fuelling of machinery will be carried out using a fuel truck at a dedicated refuelling area located at the temporary construction compounds. The fuel truck will also carry fuel absorbent material and pads in the event of any accidental spillages;
- Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations;
- On-site 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. Fuel storage areas if required will be bunded appropriately for the fuel storage volume for the time period of the construction and fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose; and,
- An emergency plan for the construction phase to deal with accidental spillages will be included within the Construction and Environmental Management Plan (**Appendix 4-5**). Spill kits will be available to deal with and accidental spillage in and outside the re-fuelling area.

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 mitigation measures will ensure that surface water runoff from the site will be equivalent to baseline conditions and will therefore have no potential impact on the status or ecology of downstream waters. The residual effect of the Proposed Project will be negative, imperceptible, indirect, short-term, unlikely impact to local surface water and groundwater quality.

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

9.5.2.6 Potential Effects from Wastewater

Wastewater management will be required for both the Proposed Wind Farm and Proposed Grid Connection Route (Proposed Project) and therefore both are assessed herein.

Release of effluent from domestic wastewater treatment systems has the potential to impact on groundwater and surface waters if site conditions are not suitable for an on-site percolation unit.

Pathway: Groundwater flowpaths and site drainage network.

Receptor: Groundwater (Easky East GWB, Collooney GWB, Beltra-Sligo GWB, Carrowmore West GWB, Ballygawley GWB and Lavagh-Ballintougher GWB).

Down-gradient streams and rivers (Easky River, Dunneill River, Buncrowey River, Doonbeakin River, Lugdoon Stream, Kilrusheighter Stream, Doonflin Stream, Dunmoran River, Barnabrack Stream, Ballysodare River, Owenmore River and Unshin River), associated dependent ecosystems and designated sites.

Pre Mitigation Effect:

Indirect, negative, significant, temporary, unlikely effect to surface water quality.

Indirect, negative, slight, temporary, unlikely effect to local groundwater.

In the absence of mitigation measures, there will be the potential for significant effects on downstream surface water quality and no potential for significant effects on local groundwater quality.

Proposed Mitigation Measures:

- It is proposed to manage wastewater from the staff welfare facilities in the control buildings by means of a sealed storage tank, with all wastewater being tankered off site by permitted waste collector to wastewater treatment plants. It is not proposed to treat wastewater on-site.
- During the construction phase there will be 4 no. temporary construction compounds each of which will contain a self-contained port-a-loo with an integrated waste holding tank will be used at each of the site compounds, maintained by the providing contractor, and removed from site on completion of the construction works.

Residual Effect: Proven and effective measures to mitigate the release of wastewater from the Site have been proposed above and will break the pathway between the potential source and each receptor. No residual effects of the Proposed Project.

Significance of Effects: No significant effects on surface water or groundwater quality will occur.

9.5.2.7 Potential Effects from Cement-Based Products

Cement will be required for both the Proposed Wind Farm and Proposed Grid Connection Route (Proposed Project) and therefore both are assessed herein.

Concrete and other cement-based products are highly alkaline and corrosive and can have significant negative impacts on water quality. They generate very fine, highly alkaline silt (pH 11.5) that can physically damage fish by burning their skin and blocking their gills. A pH range of $\geq 6 \leq 9$ is set in S.I. No. 293 of 1988 Quality of Salmonid Water Regulations, with artificial variations not in excess of $\pm$ 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 the aquatic environment. Peat ecosystems are dependent on low pH hydrochemistry. They are extremely sensitive to 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.

Pathway: Site drainage network.

Receptors: Surface water, peat water hydrochemistry and underlying local groundwater quality.

Receptors: Groundwater (Easky East GWB, Collooney GWB, Beltra-Sligo GWB, Carrowmore West GWB, Ballygawley GWB and Lavagh-Ballintougher GWB).

Down-gradient streams and rivers (Easky River, Dunneill River, Buncrowey River, Doonbeakin River, Lugdoon Stream, Kilrusheighter Stream, Doonflin Stream, Dunmoran River, Barnabrack Stream, Ballysodare River, Owenmore River and Unshin River), associated dependent ecosystems and designated sites.

Pre-Mitigation Effect: Indirect, negative, moderate, short term, likely effect to surface waters.

Proposed Mitigation Measures:

- No batching of wet-cement products will occur on-site. Ready-mixed supply of wet concrete products and where possible, 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 practicable. 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 will be undertaken at lined cement washout ponds located outside 50m and 100m watercourse buffer zones);
- Weather forecasting will be used to plan dry days for pouring concrete; and,
- The pour site will be kept free of standing water and plastic covers will be ready in case of a sudden rainfall event.

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 mitigation measures will ensure that surface water runoff from the Site will be equivalent to baseline conditions and will therefore have no potential impact on the status or ecology of downstream waters. The residual effect will be negative, imperceptible, indirect, short-term, unlikely effect to surface water quality and local groundwater quality.

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

9.5.2.8 Potential Effects due to Watercourse Crossing Works (Proposed Wind Farm)

Upgrades of existing watercourse crossings will only be required at the Proposed Wind Farm and not along the Proposed Grid Connection Route. Only the Proposed Wind Farm is assessed herein.

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

There are 2 no. new proposed watercourse crossings (1 no. proposed and 1 no. to be upgraded) at the Proposed Wind Farm.

Replacement of 1 no. existing watercourse crossing will be required along an existing track between Proposed Turbines T3 and T5. The other 8 no. existing watercourse crossings may require minor upgrade works but not replacement of structures.

Pathway: Site drainage network.

Receptor: Surface water flows (Easky River, Dunneill River and Buncrowey River), associated dependent ecosystems and designated sites.

Pre-Mitigation Potential Effect: Negative, direct, imperceptible, long-term, likely effect on surface water flows and drainage patterns. In the absence of mitigation measures, there would be no potential for significant effects.

Proposed Mitigation Measures:

- The 1 no. replacement culvert will be bottomless or clear span structure and the existing banks will remain undisturbed. No in-stream excavation works are proposed and therefore there will be no direct impact on the stream at the proposed crossing location;
- Where the proposed internal cable route follows an existing road or road proposed for upgrade, the cable will pass over or below the culvert within the access road;
- All guidance / mitigation measures proposed by the OPW or the Inland Fisheries Ireland[5] is incorporated into the design of the proposed crossings;
- As a further precaution, near stream construction work, will only be carried out during the period permitted by Inland Fisheries Ireland for in-stream works according to the Eastern Regional Fisheries Board (2004) guidance document "Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites", i.e., May to September inclusive. This time period coincides with the period of lowest expected 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 (any deviation from this will be done in discussion with the IFI);
- During the near stream construction work double row silt fences will be emplaced immediately down-gradient of the construction area for the duration of the construction phase. There will be no batching or storage of cement allowed in the vicinity of the crossing construction areas;
- The upgraded watercourse crossing will require a Section 50 application (Arterial Drainage Act, 1945). The river/stream crossings will be designed in accordance with OPW guidelines/requirements on applying for a Section 50 consent; and,
- The crossing structure will be designed to accommodate a 100-year design flood with allowance for 300mm freeboard.

The watercourse crossing will be constructed to the specifications of the OPW bridge design guidelines 'Construction, Replacement or Alteration of Bridges and Culverts - A Guide to Applying for Consent under Section 50 of the Arterial Drainage Act, 1945', and in consultation with Inland Fisheries Ireland. Abutments will be constructed from precast units combined with in-situ foundations, placed within an acceptable backfill material.

Confirmatory inspections of the proposed new watercourse crossing location will be carried out by the Project Civil/Structural Engineer and the Project Hydrologist prior to the construction of the crossing.

In relation to the new proposed culverts and proposed culvert upgrades at forestry drain crossings, the culverts will be suitably sized (approx 900mm) for the expected peak flows in the relevant drain. All culverts will be installed with a minimum internal gradient of 1% (1 in 100). Smaller culverts will have a smooth internal surface. Larger culverts may have corrugated surfaces which will trap silt and contribute to the stream ecosystem. Depending on the management of water on the downstream side of the culvert, large stone may be used to interrupt the flow of water. This will help dissipate its energy and help prevent problems of erosion. Smaller water crossings will simply consist of an appropriately

[5] *Inland Fisheries Ireland (2016): Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters*

sized pipe buried in the sub-base of the road at the necessary invert level to ensure ponding or pooling does not occur above or below the culvert and water can continue to flow as necessary.

Residual Effect: With the application of the best practice mitigation outlined above, the residual effect will be negative, imperceptible, direct, long-term, unlikely impact on stream flows, stream morphology and surface water quality.

Significance of Effects: For the reasons outlined above, no significant effects on stream morphology or stream water quality will occur at crossing locations.

9.5.2.9 Potential Effects on Hydrologically Connected Designated Sites

Designated sites are located downstream to both the Proposed Wind Farm and Proposed Grid Connection Route. Therefore, both are assessed herein.

The Proposed Wind Farm is located adjacent to the Ox Mountain Bogs SAC and pNHA where it exists to the south and to the west of the Site boundary. An area of the Ox Mountain Bog SAC is also located within the Site, adjacent to the Existing Wind Farm (Dunneill Wind Farm), however, no new infrastructure is proposed in this area of the Proposed Wind Farm.

Designated sites further downstream of the Proposed Wind Farm and Proposed Grid Connection Route include Dunneill River pNHA which is located approximately 4.5km downstream of the Site.

In addition, Easky River pNHA (Site Code: 001665) is located approximately 8.5km downstream of the Proposed Wind Farm and Proposed Grid Connection Route.

Designated sites downstream of the Proposed Grid Connection Route only include Unshin River SAC and Ballysadare SAC.

Please also refer to Appropriate Assessment Screening Report and Natura Impact Statement (NIS) that are submitted alongside the EIAR.

Pathway: Surface water and groundwater flowpaths.

Receptor: Designated sites.

Pre-Mitigation Effect: Indirect, negative, slight, short-term, unlikely effect on designated sites. In the absence of mitigation measures, there is no potential for significant effects.

Impact Assessment & Proposed Mitigation Measures:

On the eastern portion of the Proposed Wind Farm the upper reaches of the Dunneill River (Owenduff River) form a hydrological boundary between the Proposed Wind Farm and the SAC to the south. Even though the Proposed Wind Farm infrastructure is located upslope of the SAC topographically, there is no potential for surface water or groundwater flows into the SAC bog due to the presence of the hydrological 'no flow' boundary offered by the Owenduff River (refer to **Appendix 9-4** for topographical cross-sections illustrating this). Therefore, there is no potential for the Proposed Wind Farm to effect Ox Mountain Bogs SAC/pNHA where it exists to the south on the eastern portion of the Site. Please note that the Existing Wind Farm (Kingsmountain) also exists upslope of the SAC on the eastern portion of the Proposed Wind Farm; and its presence has had no reported effects on the SAC.

On the west of the Proposed Wind Farm there are only 4 no. Proposed Turbines upslope (T1, T2, T3 and T6) and potentially up-gradient of the SAC in terms of surface water and groundwater flowpaths.

The Proposed Wind Farm infrastructure such as Proposed Turbines, hardstands and access tracks is setback in excess of 200m from the SAC boundary at these turbine locations. Set back distances range between 200m (T6) to 523m (T3). Refer to **Appendix 9-4** for topographic cross-sections between the Proposed Wind Farm and the Ox Mountain Bogs SAC on the west of the Site. The ground elevation at these Proposed Turbine locations is approximately 13m to 18m higher than the boundary of the SAC which is downslope to the west.

Therefore, as the base of any Proposed Turbine gravity base excavation (maximum 3m in depth) will be at a higher elevation than the SAC (>10m elevation difference), there will be no potential for temporary water level drawdown effects in the SAC bog due to excavation works/temporary dewatering etc. In the scenario that the Proposed Turbines will have a piled foundation, there will be no potential for effects on the SAC bog as no excavation dewatering will be required.

Mitigation measures for surface water and groundwater quality protection (outlined below) will ensure any runoff or groundwater drainage from the Proposed Wind Farm down towards the Ox Mountain Bogs SAC will be of high quality and therefore potential effects will not occur.

Designated sites downstream of the Site with regard surface water flows only include Dunneill River pNHA, Easky River pNHA, Unshin River SAC and Ballysadare SAC

Drainage mitigation measures for surface water quality protection during the construction phase are summarised again below: (Please refer to Sections 9.5.2.1, 9.5.2.2 & 9.5.2.4 above for the full description of these measures and how they will be applied).

- The proposed mitigation measures will include 50m to 100m buffer zones for avoidance of sensitive hydrological features (streams and rivers);
- Pre-construction drainage control measures (Section 9.5.2.2);
- Robust drainage control measures (i.e. interceptor drains, swales, settlement ponds and treatment trains such as Siltbuster) will ensure that the quality of runoff from Proposed Project areas will be very high; and,
- Best practice measures with regard use of oils, fuels (Section 9.5.2.5) and cement-based compounds (Section 9.5.2.7).

Post Mitigation Residual Effect: As stated in Section 9.5.2.2); above, there could potentially be a residual "imperceptible, short term, likely effect" on local streams and rivers but this would be very localised and over a very short time period (i.e. hours). Therefore, significant direct, or indirect impacts on the downstream designated sites will not occur.

No effects on local designated sites from the Proposed Project.

Significance of Effects: No significant impacts on local designated sites will occur.

9.5.2.10 Potential Effects on Local Groundwater Well Supplies from Excavations

There will be excavations required for both the Proposed Wind Farm and Proposed Grid Connection Route (Proposed Project) and therefore both are assessed herein.

In the area of the Proposed Wind Farm, private dwelling houses (potential well locations) are mainly located along public roads to the north of the Proposed Wind Farm.

The biggest risk to potential down-gradient wells will be from where deeper excavations are required such as the turbine bases and borrow pits.

Construction of the Proposed Grid Connection Route will not have the potential to effect local wells due to the shallow nature of the works along the cable route.

The closest distance between a proposed turbine or borrow pit location and a downstream dwelling house (potential well) is >760m. In order to be conservative and following the precautionary assumption, we have assumed that all dwellings in the surrounding lands have a private groundwater well.

However, due to the relatively shallow nature of the deepest excavations (13 - 17m), the hydrogeological regime and the >760m setback distance from potential wells, significant effects on private wells is unlikely.

Pathway: Groundwater flowpaths.

Receptor: Private Groundwater Supplies.

Pre-Mitigation Effect: Negative, imperceptible, indirect, short-term, unlikely effect on local wells. In the absence of mitigation measures, there will be no significant effects on local groundwater well supplies.

The Proposed Project will not give rise to significant effect on any potential down-gradient private wells for the following project design and geological reasons:

- The large set back distances between turbine and borrow pit locations and downstream potential well locations due to project design (>760m);
- The short groundwater flowpath distances (30 – 300m);
- The Proposed Project design will involve relatively shallow temporary excavations (13m - 17mbgl) which are typically located on elevated ground where thereby lessens the true depth of the excavation;
- The moderate to low permeability of the glacial deposits in which the turbine gravity base foundations will be constructed;
- The low permeability and low recharge characteristics of the underlying poorly productive aquifers at the Proposed Wind Farm;
- Localised groundwater flow patterns in the glacial deposits which is towards local rivers and streams that flow through the Proposed Wind Farm;
- Groundwater flow patterns are expected towards the internal watercourses that drain the Proposed Wind Farm; and,
- The shallow excavation depths required for Proposed Grid Connection cable.

Proposed Mitigation Measures: None required

Final Effects: For the reasons outlined in the impact assessment above (separation distances, and prevailing hydrogeology, topography and groundwater flow directions), it has been assessed the Proposed Project has no potential to impact on local groundwater wells.

Significance of Effects: For the reasons outlined above, no impacts on groundwater well supplies will occur.

9.5.2.11 Potential Effects from Turbine Delivery Route Works

Minor earthworks are required for the TDR. These include for temporary accommodation and overrun works (10 no. locations) along the proposed route. These TDR works are described in Section 4.4 of the EIAR.

Pathway: Surface water flowpaths.

Receptor: Down-gradient surface water quality.

Pre-Mitigation Potential Effect: Indirect, negative, imperceptible, short term, likely effect on surface water quality. In the absence of mitigation measures, there will be no potential for significant effects on surface water quality due to the minor nature of the works.

Proposed Mitigation Measures:

- All works are minor and localised and cover very small areas;
- These works are distributed over a wide area;
- All works are typically temporary in nature or with very minor permanent adjustments;
- All areas will be reinstated shortly after the works and reseeded; and,
- Application of the Pre-Construction Drainage Measures (see Section 9.5.2.2) for surface water quality protection.

Post Mitigation Residual Effect: 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 of the Proposed Project Turbine Delivery Route works will be no negative effect.

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

9.5.2.12 Potential Effects on WFD status

Refer to **Appendix 9-3** for the WFD Compliance Assessment Report.

Both the Proposed Wind Farm and Proposed Grid Connection Route have the potential to effect WFD status. Therefore, both are assessed herein.

WFD status and Risk Results for downstream river waterbodies and the underlying GWBs are presented in Section 9.3.11 and Section 9.3.12 above.

Due to the hydrogeological regime at the Proposed Wind Farm (poorly productive bedrock, low recharge regime and short groundwater flowpath distances), the potential to negatively affect the WFD status of the Easky East GWB, Collooney GWB is very low, even in the absence of mitigation.

There is no potential to affect the WFD status of GWBs along the Proposed Grid Connection Route due to the shallow nature of the works within the carriageway of public roads. Effects can be scoped out.

Without mitigation the proposed construction works do have the potential to adversely impact on surface water quality which may negatively impact on the WFD status of these downstream surface waterbodies.

The objectives of the WFD are 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. This is reflected in the strict mitigation measures in relation to maintaining a high quality of surface water from the Proposed Project will ensure that the status of surface waterbodies in the vicinity of the Proposed Project will be at least maintained regardless of their existing status.

Pathways: Drainage and surface water discharge routes.

Receptors: WFD status of underlying GWBs (Easky East GWB, Collooney GWB). Down-gradient streams and rivers (Easky River, Dunneill River, Buncrowey River, Doonbeakin River, Lugdoon

Stream, Kilrusheighter Stream, Doonflin Stream, Dunmoran River, Barnabrack Stream, Ballysodare River, Owenmore River and Unshin River), associated dependent ecosystems and designated sites.

Pre-Mitigation Effect: Indirect, negative, slight, temporary, unlikely effect on river waterbody status. No effects on GWB WFD status will occur. In the absence of mitigation measures, there will be no potential for significant effects on downstream SWBs of the underlying GWBs.

Proposed Mitigation Measures:

Comprehensive surface water mitigation and drainage controls are outlined in Section 9.5.2.1 (Felling of Coniferous Plantations), Section 9.5.2.2 (Earthworks), Section 9.5.2.4 (Excavation Dewatering), Section 9.5.2.5 (Hydrocarbons), Section 9.5.2.7 (Cement-based Products) and Section 9.5.2.8 (Morphological Changes to Watercourses). These will ensure the protection of surface water quality and flows in all downstream receiving watercourses.

Post Mitigation Residual Effect:

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

There will be no change in GWB or SWB status in the underlying GWB or downstream SWBs resulting from the Proposed Project. 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 WFD status will occur.

Significance of Effects: For the reasons outlined above, and with the implementation of the proposed mitigation, no significant effects on waterbody WFD status will occur.

9.5.2.13 Potential Effects from the Use of Siltbuster (Proposed Project)

Both the Proposed Wind Farm and Proposed Grid Connection Route may incorporate the use of a siltbuster. Therefore, both are assessed herein.

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.

Proposed Project 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 about 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 a site in northwest Mayo is provided in **Figure 9-11** below.

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).

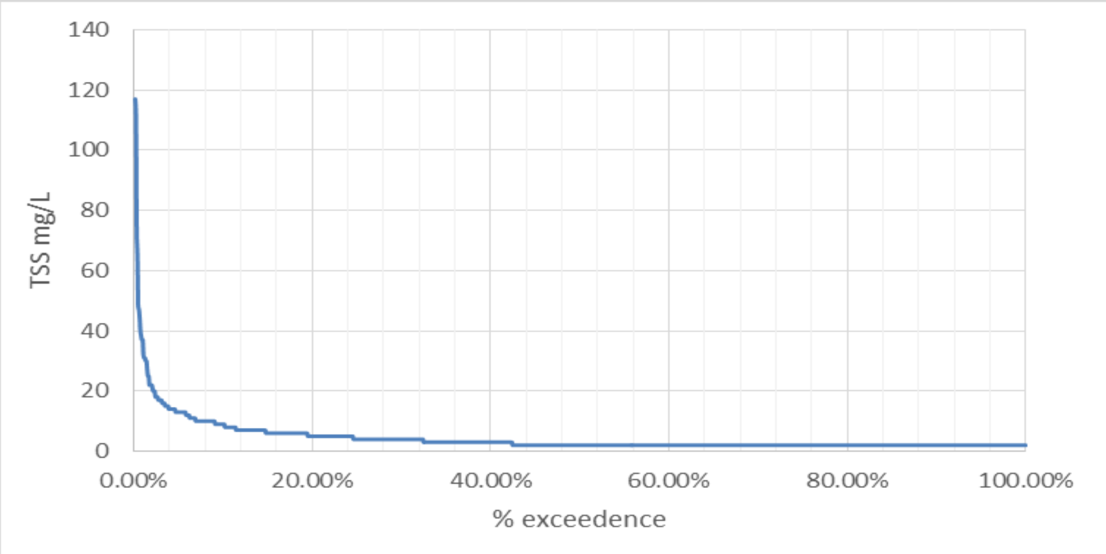


Figure 9-11 : TSS treatment data using Siltbuster systems (with chemical dosing)

Pathways: Drainage and surface water discharge routes.

Receptors: Down-gradient streams and rivers (Easky River, Dunneill River, Buncrowey River, Doonbeakin River, Lugdoon Stream, Kilrusheighter Stream, Doonflin Stream, Dunmoran River, Barnabrack Stream, Ballysodare River, Owenmore River and Unshin River), associated dependent ecosystems and designated sites.

Pre-Mitigation Effects: Negative, slight, indirect, temporary, likely effect on surface water quality. In the absence of mitigation measures, there is no potential for significant effects.

Mitigation Measures:

Measures employed to prevent overdosing and potential chemical carryover:

- The siltbuster system comprises an electronic in-line dosing system which provides an accurate means of adding reagents, so overdosing cannot occur;
- Continued monitoring and water analysis of pre and post treated water by means of an inhouse lab and dedicated staff will be carried out, which 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 will be used at very sensitive sites (i.e. upstream of SACs).

Residual Effects: With the implementation of the dosing technology and the continual monitoring of pre and post treatment water, the appropriate volume of chemical agent will 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 will be 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 occur. In fact, we consider that the use of siltbuster systems has a significant positive effect in respect of surface water quality.

9.5.2.14 Potential Effects from Earthworks Works and Watercourse Crossings (Proposed Grid Connection Route)

The Proposed Grid Connection Route comprises approximately 41.6km of underground cabling route and 34 no. existing watercourse crossings along public roads. 31 no. of the watercourses are EPA mapped watercourses with the rest being small unmapped watercourses and drains.

Horizontal Directional Drilling (HDD) will be used to negotiate 15 no. bridge structures and open trenching will be used to place the cable above or below the culvert at the 19 no. other crossing locations.

No instream works are proposed at any of the Proposed Grid Connection Route cable crossing locations.

Pathway: Surface water flowpaths/groundwater paths.

Receptor:

Pre-Mitigation Potential Effect: Negative, slight, indirect, temporary, likely effect to surface water quality. In the absence of mitigation measures, there will be no potential for significant effects on downstream surface waters.

Proposed Mitigation Measures:

Pre-commencement Temporary Drainage Works:

Prior to the commencement of the cable trenching or crossing works the following key temporary drainage measures will be installed:

- All existing roadside drains (where present) that intercept the proposed works area will be temporarily blocked down-gradient of the works using check dams/silt traps;
- Culverts, manholes and other drainage inlets (where present) will also be temporarily blocked; and,
- A double silt fence perimeter will be placed along the road verge on the down-slope side of works areas that are located inside a watercourse 50m buffer zone.

The following mitigation measures will be implemented for the underground cabling watercourse crossing works:

- No stock-piling of construction materials will take place along the Proposed Grid Connection Route;
- No refuelling of machinery or overnight parking of machinery is permitted within 100m of a watercourse crossing;
- No concrete truck chute cleaning is permitted along the Proposed Grid Connection Route;
- Works will not take place at periods of high rainfall, and will be scaled back or suspended if heavy rain is forecast;
- Local road drainage, culverts and manholes will be temporarily blocked during the works;
- Machinery deliveries will be arranged using existing structures along the public road;

- All machinery operations will take place away from the stream and ditch banks, apart from where crossings occur. Although no instream works are proposed or will occur;
- Any excess construction material will be immediately removed from the area and sent to a licenced waste facility;
- Spill kits will be available in each item of plant required to complete the stream crossing; and,
- Silt fencing will be erected on ground sloping towards watercourses at the stream crossings if required.

Fracture Blow-out (Frac-out) Prevention and Contingency Plan for HDD:

- The drilling fluid/bentonite will be non-toxic and naturally biodegradable (i.e. Clear Bore Drilling Fluid or similar will be used);
- The area around the drilling fluid batching, pumping and recycling plants will be bunded using terram and/or sandbags to contain any potential spillage;
- Double lines of silt fencing will be placed between the works area and the adjacent river;
- Spills of drilling fluid will be cleaned up immediately and transported off-site for disposal at a licensed facility;
- Adequately sized skips will be used where temporary storage of arisings are required;
- The drilling process / pressure will be constantly monitored to detect any possible leaks or breakouts into the surrounding geology or local watercourse;
- This will be gauged by observation and by monitoring the pumping rates and pressures. If any signs of breakout occur, then drilling will be immediately stopped;
- Any frac-out material will be contained and removed off-site;
- The drilling location will be reviewed, before re-commencing with a higher viscosity drilling fluid mix; and,
- If the risk of further frac-out is high, a new drilling alignment will be sought at the crossing location.

Post Mitigation Residual Effect: 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 of the Proposed Grid Connection Route will be negative, imperceptible, direct, temporary, likely effect on surface water quality.

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

9.5.2.15 Potential Effects on Wetland Hydrology (Proposed Wind Farm)

Only the Proposed Wind Farm infrastructure is located in areas of bog and therefore only the Proposed Wind Farm is assessed in this section.

Construction phase activities such as excavations, temporary dewatering, drainage installation and peat/spoil storage have the potential to affect local wetland hydrology.

Proposed Wind Farm infrastructure is located on blanket bog that has been drained and planted over with coniferous forestry and therefore the baseline peatland hydrology is already heavily modified.

Due to the already drained nature of the peat, no significant additional effects on wetland hydrology will occur.

Pathways: Surface Water and Groundwater flowpaths.

Receptors: Intact bog wetland hydrology.

Pre-Mitigation Potential Effects: Negative, imperceptible to slight (the potential effect varies spatially), direct/ indirect, temporary to long-term, likely effect on intact bog wetland hydrology. In the absence of mitigation measures, there will be no potential for significant effects.

Impact Assessment/Proposed Mitigation Measures:

As assessed in Section 9.5.2.3 above (groundwater level effects), no significant effects or long-term effects on (deep regional) groundwater levels will occur due to the relatively shallow depth of the gravity foundations (3 – 3.5m deep) and the low permeability nature of the cutover peat and glacial till overburden to be excavated. Significant groundwater inflows into turbine excavations will not occur for these reasons.

Any effects on groundwater levels will only be for a temporary basis during the construction work. Groundwater level effects are unlikely to be perceptible beyond 10m from the turbine base excavation. Once construction is completed and the works area reinstated, the local groundwater levels and peat waters levels (shallow water table) will return to baseline conditions.

The use of up to 8.2km of existing access tracks for the Proposed Wind Farm will also reduce the requirement for new track excavations, thereby help maintain the baseline hydrology of the Site.

Post Mitigation Residual Effect: Due to the prevailing hydrogeology/wetland hydrology at the Proposed Wind Farm as well as the local and temporary nature of the proposed excavation works as well as the proposed mitigation measures, residual effects across the Proposed Wind Farm on wetland hydrology will be negative, imperceptible, direct/indirect and temporary to short term.

Significance of Effects: For the reasons outlined above, effects on wetland hydrology will be imperceptible.

9.5.2.16 Potential Effects of the Biodiversity Management and Enhancement Plan

The BMEP (Appendix 6-4) sets out the measures to be implemented to ensure that the Proposed Project will result in a net gain in biodiversity. Specifically, proposed peatland restoration, peatland safeguarding and restoration of peat and spoil management areas.

This Plan has set out measures to be implemented during establishment and management phases to ensure that the measures are successful, as well as regularly monitoring by an ecologist to ensure the success of the measures outlined in the BMEP.

Some of these proposals will disturb local peat, soil and subsoil deposits and increase the likelihood of erosion of peat and subsoils. However, due to the largely non-invasive nature of the works the potential for effects on the water environment are limited.

Pathway: Drainage and surface water flows

Receptor: Surface water (Easky River and Dunneill River)

Pre-Mitigation Effect: Negative, direct, slight, temporary, likely effect on water quality due to disturbance associated with proposed restoration works. In the absence of mitigation measures, there will be no potential for significant effects on downstream surface waters.

Proposed Mitigation Measures:

All proposed habitat management and enhancement works will be in accordance with the best practice Forest Service regulation, policies and strategic guidance documents as well as Coillte, DAFM and

NatureScot guidance documents to ensure minimal potential negative effects on the local peat, soil and subsoil environment.

Given the nature of the restoration measures the following mitigation measures are proposed:

- Before any works are completed silt fences will be installed to limit the movement of entrained sediment in surface water runoff;
- Proposed off-road routes will be walked in advance of any machinery;
- All machinery operators will be experienced;
- The proposed areas will be walked before a machine goes off-road;
- Bog mats will be used where the excavator is required to travel over wet ground;
- A low ground pressure excavator with wide tracks (1.9m or greater) will be used to reduce compaction of the peat and subsoils.

Residual Effect: With the implementation of mitigation measures outlined above the residual effect will be a negative, temporary, direct, imperceptible, likely effect on downstream surface water quality.

Significance of Effects: For the reasons outlined above, and with the implementation of the listed mitigation measures, no significant effects on Easky River and Dunneill River will occur.

9.5.2.17 Effects on Downstream Freshwater Pearl Mussel Populations (Proposed Project)

The Proposed Project is located within the Easky River catchment where there are freshwater pearl mussel populations present.

Furthermore, Triturus carried out freshwater pearl mussel habitat appraisals in May 2024 along a 10km section of the Easky River to the west of the Proposed Wind Farm which were found to contain suitable freshwater pearl mussel habitat. Further details of the above is discussed in Chapter 6 of this EIAR.

Pathway: Site drainage network.

Receptor: Freshwater Pearl Mussel.

Pre-Mitigation Potential Effect: Indirect, negative, slight, temporary, likely effect.

Impact Assessment & Proposed Mitigation Measures:

As discussed above, only the western section of the Proposed Wind Farm is located within the Easky River catchment and only 1 no. Proposed Turbine (T5) is located upstream of where freshwater pearl mussel populations potentially exist. This is positive in terms of potential negative effects on freshwater pearl mussel populations.

The Proposed Project design team were at all times aware that freshwater pearl mussel populations existed in the downstream watercourses, and as such all proposed mitigation and drainage design proposals were designed towards providing a “best in class” drainage management proposal for the development considering the significant catchment sensitivities. A 100m buffer will also be maintained for a tributary stream of the Easky River which flows to the south of Proposed Turbine T5.

During the layout optimisation process, all surface waters at the site were classified as very sensitive/high importance. Very sensitive surface waters are receptors of high environmental importance such as designated sites (i.e. NHA or SAC) or a public drinking water supply source. The surface waters at the Proposed Project were applied the highest possible sensitivity rating.

As stated previously in the chapter, a comprehensive surface water management plan and drainage plan is proposed (refer to **Appendix 4-4**) and this will ensure that surface water runoff from the developed areas of the Site will be of a high quality and will therefore not impact on the quality of downstream rivers.

Detailed drainage management design and pollution prevention measures proposed during the construction phase are presented above in this chapter. These proposals are best in class and in line with current best practice approaches for surface water quality protection on wind farm and forestry sites.

As described in Section 9.5.2.2 above, while settlement ponds form an important element of the drainage proposals for the site, they are not stand alone but occur as part of a treatment train of systems that will be applied in series to ensure protection of downstream watercourses. The treatment of site runoff occurs before and also continues after the settlement ponds, with the “after” treatment also utilising natural elements of the site such as the existing vegetated ground. Therefore, the final “polished” discharge effluent quality will not be achieved until the discharge passes through the last element of the treatment series train which is the vegetated ground upslope of the local watercourse (i.e. compliance point).

A final line of defence can be provided by a water treatment train such as a “Siltbuster” if required. If the discharge water from construction areas fails to be of a high quality 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.

Daily inspections will be undertaken to assess the effectiveness of the water treatment trains and this will include a visual assessment of water quality and also portable probes for field hydrochemistry monitoring (turbidity, pH, electrical conductivity etc) will be used by the Ecological Clerk of Works (ECoW) to make on the spot checks.

Post Mitigation Residual Effect: With the implementation of mitigation measures outlined above the residual effect will be a negative, temporary, direct, imperceptible, likely effect on downstream freshwater pearl mussel populations.

Significance of Effects: No significant effects on the freshwater pearl mussel populations will occur.

9.5.2.18 Existing Wind Farm Turbine Removal

The existing 23 no. turbines and meteorological mast onsite will be removed from site in accordance with SSE Renewables (Ireland) Ltd. standards, whereby all elements of the turbines will be recycled and reused, and no components will be sent to landfill.

On the dismantling of existing turbines and meteorological mast, it is not intended to remove the concrete foundation from the ground and therefore no significant earthworks will be required.

It is considered that its removal will be the least preferred options in terms of having potential effects on the environment. Therefore, the turbine foundations not incorporated into the Proposed Project will be backfilled and covered with soil material.

Hardstands not being used for the re-used for the construction and operation of Proposed Wind Farm will be covered with soil material and regraded to match existing ground contours and profile. The area will then be seeded out or allowed to vegetate naturally.

There are sections of the existing track network which will not be upgraded to facilitate the Proposed Project. These will remain in use by local landowners to access livestock or will be left to naturally regenerate.

Pathway: Surface water flowpaths/groundwater paths.

Receptor: Surface waters (Dunneill River only) associated dependent ecosystems and designated sites.

Pre-Mitigation Effect: Negative, imperceptible, indirect, temporary, unlikely effect to surface water quality. In the absence of mitigation measures, there will be no potential for significant effects on downstream surface waters.

Proposed Mitigation Measures:

Pre-commencement Temporary Drainage Works:

Prior to the commencement of the removal works the following key temporary drainage measures will be installed:

- All existing roadside drains (where present) that intercept the proposed works area will be temporarily blocked down-gradient of the works using check dams/silt traps;
- Culverts, grips and other drainage inlets (where present) will also be temporarily blocked; and,
- A double silt fence perimeter will be placed along the road verge on the down-slope side of works areas that are located inside a watercourse 50m buffer zone.

Once the turbine base and hardstand are backfilled and covered with soil material, vegetation will be established to prevent risk to downstream surface water quality due to runoff.

Residual Effect: With the implementation of mitigation measures outlined above there will be no residual effects.

Significance of Effects: No significant effects on surface water quality will occur.

9.5.3 Operational Phase – Likely Significant Effects and Mitigation Measures

9.5.3.1 Potential Effects from the Replacement of Natural Surface with Low Permeability Surfaces (Proposed Wind Farm)

Hardstand emplacement will only be required at the Proposed Wind Farm. Only the Proposed Wind Farm is assessed herein. There will be no potential increase in runoff along the Proposed Grid Connection Route. The works are located in the carriageway of the existing road corridor and no change in surface water runoff rates will result as the trench and road surface will be reinstated.

The potential for increased surface water runoff is the primary potential impact during the operational phase of the Proposed Project.

Progressive replacement of the vegetated surface with impermeable surfaces will decrease the permeability of the ground within the Proposed Wind Farm footprint (i.e., turbine bases, hardstandings, 110kV substation and to a lesser extent the new access roads).

It should be noted that approximately 8.2km of the Proposed Wind Farm tracks already exist and are proposed for upgrade. The permeability along the internal underground cabling route through the Proposed Wind Farm will not be significantly altered, as the fill material will not be compacted.

The total permanent development footprint of the Proposed Wind Farm is 27.6ha. Approximately 3.7ha of the total permanent footprint comprises Existing Wind Farm infrastructure. The below water balance assessment (**Table 9-19** below) uses 27.6ha and is therefore conservative.

The emplacement of the Proposed Wind Farm footprint, as described in Chapter 4: Description of the Proposed Project of the EIAR, (assuming emplacement of impermeable materials as a worst-case scenario) could result in an average total site increase in surface water runoff of approximately 3,940m^3/month or 127m^3/day (**Table 9-19** below). This represents a potential increase of approximately 0.28% in the average daily/monthly volume of runoff from the Proposed Wind Farm area in comparison to the baseline pre-development site runoff conditions.

This is a very small increase in average runoff and results from a relatively small area of the overall Proposed Wind Farm being developed. Specifically, the permanent Proposed Wind Farm footprint is approximately 27.6ha, representing only 3.7% of the total Proposed Wind Farm area of 743ha.

The additional volume is low due to the fact that the runoff potential from the Proposed Wind Farm is naturally high (93%). Also, this calculation assumes that all hardstanding areas will be impermeable which considered to be a worst-case scenario. The increase in runoff from most of the development catchment will therefore be imperceptible and this is before mitigation measures will be put in place. This water balance assessment demonstrates that even in the absence of mitigation, the potential to alter the water balance of the Site or downstream hydrology/morphology is imperceptible.

Table 9-19: Baseline Site Runoff V Development Runoff

Baseline Runoff/month (m^3)	Baseline Runoff/day (m^3)	Permanent Footprint Area (m^2)	Footprint Area 100% Runoff (m3) (m^3)	Footprint Area 93% Runoff (m^3)	Net Increase/month (m^3)	Net Increase/day (m^3)	% Increase from Baseline Conditions (m^3)
1,409,101	45,455	276,000	56,283	52,343	3,940	127	0.28

Pathway: Site drainage network.

Receptor: Surface waters (Easky River, Dunneill River, Buncrowey River, Doonbeakin River, Lugdoon Stream)

Pre-Mitigation Potential Effect: Negative, imperceptible, indirect, long-term, likely effect on all downstream surface water bodies. In the absence of mitigation measures, there will be no potential for significant effects on downstream surface waters.

Proposed Mitigation by Design:

The proposed drainage philosophy outlined in Section 9.4.2.1 states that runoff control and drainage management are key elements in terms of mitigation against impacts on surface water bodies. Two distinct methods will be employed to manage drainage water within the Proposed Project. The first being 'keeping clean water clean' and the second involving the collection of any drainage waters from work area and to route them towards stilling ponds prior to controlled diffuse release over vegetated surfaces. The second method relates to proposed design measures that will prevent road surface and other hardstand areas acting as preferential flowpaths. All development site runoff will be collected, attenuated, treated and then released in a diffuse and regular manner that does not significantly change the natural drainage regime/hydrology of the site.

The operational phase drainage system of the Proposed Project will be installed and constructed in conjunction with the road and hardstanding construction work as described below and as shown on the drainage drawings (**Appendix 4-3**) submitted with this planning application:

- Interceptor drains will be maintained 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 will be re-distributed over the ground by means of a level spreader;
- Swales/road side drains will be used to collect runoff from access roads and turbine hardstanding areas of the site, likely to have entrained suspended sediment, and channel it to settlement ponds for sediment settling;
- On steep sections of access road transverse drains ('grips') will be constructed in the surface layer of the road to divert any runoff off the road into swales/road side 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 road swale 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 watercourses; and,
- Settlement ponds will be designed in consideration of the greenfield runoff rate.

These measures will ensure all surface water runoff from upgraded roads and new road surfaces (including hardstands and turbine base areas) will be captured and treated prior to discharge/release. Settlement ponds, check dams and buffered outfalls will prevent roads acting as preferential flowpaths by providing attenuation and water quality treatment.

Post Mitigation Residual Effect: Proven and effective measures to attenuate runoff will be employed. Indirect, neutral, long term, likely effect on surface waters.

Significance of Effects: No significant effects on surface water quantity will occur during the operational phase of the Proposed Project.

9.5.3.2 Potential Water Quality Effects from Runoff

Operational phase, site runoff will occur at the Proposed Wind Farm only and not the Proposed Grid Connection Route which will be fully underground. Only the Proposed Wind Farm is assessed herein.

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 are likely to be completed, such as maintenance of site entrances, internal roads and hardstand areas. These works will be of a very minor scale and will be very infrequent. Potential sources of sediment laden water will 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 against.

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

Pathways: Drainage and surface water discharge routes.

Receptors: Down-gradient rivers Easky River, Dunneill River, Buncrowey River, Doonbeakin River, Lugdoon Stream), associated dependent ecosystems and designated sites.

Pre-Mitigation Effect: Negative, slight, indirect, long term, likely effect on surface water quality.

Proposed Mitigation Measures:

The mitigation measures outlined in Sections 9.5.2.2 and 9.5.3.1 will ensure all surface water runoff from upgraded roads and new road surfaces (including hardstand and turbine base areas) will be captured and treated prior to discharge/release. Settlement ponds, checks dams and buffered outfalls will prevent roads acting as preferential flowpaths by providing attenuation and water quality treatment (refer to **Appendix 4-3**).

Post Mitigation Residual Effects: With the implementation of the proposed drainage measures as outlined above, and based on the post-mitigation assessment of runoff, residual effects will be negative, imperceptible, indirect, long term, unlikely effect on downstream water quality.

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

9.5.3.3 Potential Effects from Hydrocarbons

During maintenance works there is a small risk associated with 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.

Furthermore, transformers within each of the turbines will hold oil. Any leakage of oil could impact local surface and groundwater quality. Oil will also be stored within the substation.

Note that the risk posed by the visitor and staff car parks is very limited due to small numbers of cars envisaged at any one time and the unlikely scenario of oil/fuel leaks from parked cars.

Pathway: Site drainage network.

Receptor: Down-gradient rivers Easky River, Dunneill River, Buncrowey River, Doonbeakin River, Lugdoon Stream), associated dependent ecosystems and designated sites.

Pre-Mitigation Potential Effect:

Indirect, negative, slight, long term, unlikely effect on surface water quality.

Proposed Mitigation Measures (by Design):

- Onsite re-fuelling of normal operational vehicles will not be carried out during the operational phase of the development. These vehicles will be refuelled offsite;
- Fuels stored on-site will be minimised and any hydrocarbons stored on-site will be bunded. The bund capacity will be sufficient to contain 110% of the storage tank's maximum capacity;
- The substation 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;
- Oil in the turbine transformers will be fully bunded within the enclosed turbine and as such, there is no potential pathway to the water environment i.e. the pathway has been blocked;
- Any plant used during the operational phase will be regularly inspected for leaks and fitness for purpose; and,
- Spill kits will be available to deal with accidental spillages.

Residual Effects: Proven and effective measures to mitigate the risk of releases of hydrocarbons have been proposed above and will break the pathway between the potential source and each receptor. The residual effect will be a negative, indirect, imperceptible, long term, unlikely effect on surface water quality.

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

9.5.3.4 Potential Effects on WFD Status

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

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

A full assessment of the potential effects of the operational phase of the Proposed Project 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 potential impacts associated with decommissioning of the Proposed Project 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. A description of the decommissioning works is contained in Chapter 4: Description of the Proposed Project of this EIAR.

During decommissioning, it will be possible to reverse or at least reduce some of the potential effects caused during construction, and to a lesser extent operation, by rehabilitating constructed areas such as turbine bases and hard standing areas. This will be done by covering with peatland vegetation/scraw or poorly humified peat to encourage vegetation growth and reduce run-off and sedimentation.

The Site access tracks will be kept and maintained following decommissioning of the turbine infrastructure, as these will be utilised by ongoing forestry works and by local farmers.

The electrical cabling connecting the site infrastructure to the on-site substation will be removed, while the ducting itself will remain in-situ rather than excavating and removing it, as this is considered to have less of a potential environmental impact, in terms of soil exposure, and thus on the possibility of the generation of suspended sediment which could enter nearby watercourses.

The Proposed Turbines will be removed by disassembling them in a reverse order to their erection. This will be completed using the same model cranes as used in their construction. They will then be transported off-site. The disassembly and removal of the Proposed Turbines will not have an impact on the hydrological/hydrogeological environment at the Site.

Other impacts such as contamination by fuel leaks will remain but will be of reduced magnitude than the construction phase because of the smaller scale of the works and reduced volumes on-site.

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 Proposed 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 Project in place where appropriate. The onsite 110kV substation and Proposed Grid Connection Route cabling will be retained by EirGrid as a permanent part of the national grid. The hardstands for Proposed Turbines 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 are envisaged during the decommissioning stage of the Proposed Project.

9.5.5 Risk of Major Accidents and Disasters (Proposed Project)

The main risk of Major Accidents and Disasters (MADs) at peatland sites is related to peat stability. A geotechnical and peat stability assessment (**Appendix 8-1**) has been completed for the Proposed Wind Farm and it concludes that the Proposed Wind Farm has an acceptable margin of safety, and there is a negligible/none risk of peat instability/failure at the Proposed Wind Farm.

Flooding can also result in downstream MADs. However, due to the small scale of the Proposed Wind Farm footprint with regard the overall Site area (3.7%), the naturally high runoff rates, the avoidance of fluvial flood zones (see Section 9.3.6) and with the implementation of the proposed drainage measures, the increased flood risk associated with the Proposed Project is imperceptible.

Please refer to **Appendix 9-1** for the site-specific flood risk assessment report.

9.5.6 Assessment of Potential Health Effects (Proposed Project)

Potential health effects arise mainly through the potential for surface and groundwater contamination which can have negative effects on public and private water supplies. Notwithstanding this, the Proposed Project design and mitigation measures ensures that the potential for effects on the water environment will not be significant.

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 site-specific Flood Risk Assessment (**Appendix 9-1**) has been caried out for the Proposed Project, summarised in Section 9.3.6 The lack of Proposed Wind Farm infrastructure encroachment into flood zones, combined with the assessment of changes in permeable surfaces (Section 9.5.3.1) demonstrates that the risk of the Proposed Project contributing to downstream flooding is imperceptible. On-site (construction, operation and decommissioning phase) drainage control measures will ensure no downstream increase in local flood risk.

9.5.7 Cumulative Effects

9.5.7.1 Introduction

This section presents an assessment of the potential hydrological cumulative effects associated with the Proposed Project itself as well with 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 local hydrogeological setting (i.e. poorly productive bedrock and localised groundwater flowpaths) and the near-surface nature of construction activities, cumulative effects with regard to groundwater quality or quantity arising from the Proposed Project are assessed as not likely.

The potential for cumulative effects will typically be much higher during the construction phase of the Proposed Project as this is when earthworks and excavations will be undertaken at the Site. Similarly, when assessing other developments for cumulative effects (i.e. proposed wind farms in the same catchment where the construction phase could overlap with the construction phase of the Proposed Project), the construction phase will be the worst case period for potential effects.

The potential for cumulative effects during the operational phase of the Proposed Project 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 much lesser degree with less ground disturbance.

The cumulative Water Study Area for the Proposed Wind Farm is the Easky River, Dunneill River and Lugdoon Stream catchments.

The cumulative Water Study Area for the Proposed Grid Connection Route is Easky River, Dunneill River, Buncrowey River, Doonbeakin River, Lugdoon Stream, Kilrusheighter Stream, Doonflin Stream, Dunmoran River, Barnabrack Stream, Ballysodare River, Owenmore River and Unshin River.

The fact that the Proposed Project is spread across these several catchments is very positive from a hydrological cumulative impact scenario as works are not concentrated in one catchment. This is a significant mitigating factor against significant cumulative effects occurring.

9.5.7.2 Cumulative Effects of the Proposed Project

The potential for cumulative effects with regard elements of the Proposed Project itself (i.e. Proposed Wind Farm, Proposed Grid Connection Route, Existing Turbine Removal, TDR Works and BMEP) is significantly diminished because the Proposed Project is spread across several catchments and not concentrated in one catchment.

The Proposed Grid Connection Route and Proposed Wind Farm exist together only in 5 no. catchments (namely, Easky, Buncrowey, Dunnill, Doonbeakin and Lugdoon). Only approximately 10km of the total proposed 41.6km of Proposed Grid Connection underground cabling is situated within these shared catchments. The other 31km of Proposed Grid Connection Route underground cabling has no potential to contribute to cumulative with regard the Proposed Project.

Also, the fact that the Proposed Grid Connection Route is along public roads, the lack of in-stream works, the intermittent and transient nature of the trenching excavations (only approximately 100m of trenching carried out per day), the Proposed Grid Connection Route is not expected to contribute to hydrological cumulative effects within the catchments it is located.

The proposed TDR accommodation works near the Proposed Wind Farm are located in the Balllymooney River catchment (i.e. Carrownrush_010 sub-basin). There is no other Proposed Project infrastructure located in the Balllymooney River catchment other than the TDR works and therefore no Proposed Project cumulative effects can occur.

The Existing Turbine Removal works will occur in advance of the Proposed Wind Farm construction. The Existing Turbines are located in the Dunneill River where 9 no. of the Proposed Wind Farm turbines are located. The construction works will therefore not overlap, meaning no cumulative effects within the Dunneill River catchment are likely.

Finally, the BMEP works, which are located in the Easky River and Dunneill River catchments, require largely non-invasive ground works and therefore are not likely to contribute to cumulative effects.

No significant cumulative effects on the hydrological and hydrogeological environment are envisaged during the construction phase of the Proposed Project.

9.5.7.3 Cumulative Effects with Other Wind Farm Developments

A list of other wind farm developments in the Proposed Wind Farm Water Study Area is shown in **Table 9-20** below.

Other than the Existing Wind Farm (i.e. Dunneill and Kingsmountain) there are no other existing, permitted or proposed wind farm developments in the Dunneill River catchment. The proposed removal of the existing turbines is cumulatively assessed in Section 9.5.7.2 above.

There are 5 no. existing wind farm developments in the Easky River catchments as shown in **Table 9-20** below. Because these wind farms are existing and operational there is no potential for construction phase overlaps with the Proposed Project.

There is only one permitted wind farm (Firlough WF) in the Easky catchment, but only 1 no. of its 13 no. proposed turbines is located in the Easky River catchments and cumulative effects are not likely even if construction phase overlaps with the Proposed Project.

Therefore, it can be concluded with high confidence (based on the information available to date) that the Proposed Project is not likely to contribute to cumulative effects with regard other wind farm developments in the Water Study Area.

Table 9-20: List of Other Wind Farm Developments Assessed for Hydrological Cumulative Effects

Catchment	Development (Status)	Total Turbine No.	Turbine No. Catchment (Water Study Area
Easky River	Black Lough WF (Existing)	4	2
	Carrrowleagh 1 WF (Existing)	13	11
	Cloonkeelaun Single Wind Turbine (Existing)	1	1
	Cloonkeelaun Wind Farm (Carrowleagh WF Extension) Existing	3	3
	Cloonkeelaun 2 Wind Turbine (Existing)	2	2
	Firlough WF (Permitted)	13	1
Totals for Easky Catchment			**20**
Dunneill River	Dunneill WF (Existing)	13	13
	Kingsmountain WF (Existing)	10	10
Totals for Dunneill Catchment			**23**

9.5.7.4 Cumulative Effects with Agriculture

According to Corine land cover mapping (www.epa.ie) (2018) the Water Study Area catchments are largely agricultural catchment.

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 Project 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 for the construction, operation and decommissioning phases of the Proposed Project 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.

9.5.7.5 Cumulative Effects with Commercial Forestry

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 works can also give rise to modified stream flow regimes caused by associated land drainage.

However, the mitigation measures detailed for the construction, operation and decommissioning phases of the Proposed Project will ensure the protection of downstream surface water quality.

With regard to non-wind farm related forestry activities at the Site and the potential for cumulative impacts, it is proposed that all scheduled tree felling or replanting will not take place the same time as the Proposed Project construction phase in order to prevent hydrological cumulative impacts. No scheduled tree felling will occur in the same local catchment where the Proposed Project construction is taking place.

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

9.5.7.6 Cumulative Effects with Turbary Peat Cutting Activities

Private peat cutting on turbary plots will likely continue in the vicinity of the Site and in the wider cumulative area. The construction phase of the Proposed Project is likely to interact with these turbary activities and result in a deterioration of downstream surface water quality through the emissions of elevated concentrations of suspended solids and ammonia.

However, the areas of private peat cutting will be small, significantly limiting the potential for cumulative effects to arise with the Proposed Project. Nevertheless, the mitigation measures detailed for the construction, operational, and decommissioning phases of the Proposed Project will ensure the protection of downstream surface water quality.

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

9.5.7.7 Cumulative Effects with Other Developments

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

There are applications for new dwellings or renovations of existing dwellings, as well as for the erection of farm buildings (refer to **Appendix 2-3** for the list of developments assessed). Based on the scale of the works, their proximity to the Site and the temporal period of likely works, no cumulative effects will occur as a result of the Proposed Project (construction, operation and decommissioning phases).

9.6 EIA Classification Summary

Please see **Table 9-21** below for a summary of all identified impacts for the Proposed Project relating to hydrology and hydrogeology.

Table 9-21: Assessment Classification Summary

Topic	Pre-Mitigation Effect	Mitigation Section Reference	Residual Effect	Significance
Construction Phase				
Potential Effects from Clear Felling	Indirect, negative, slight, temporary	Section 9.5.2.1	negative, imperceptible, indirect, temporary	Not Significant
Potential Effects from Earthworks (Removal of Vegetation Cover, Excavations and Stock Piling) Resulting in Suspended Solids Entrainment in Surface Waters	Indirect, negative, significant, short-term	Section 9.5.2.2	negative, imperceptible, indirect, short-term	Not Significant
Potential Effects on Groundwater Levels during Excavation Works (Proposed Wind Farm)	Direct, negative, slight, temporary	Section 9.5.2.3	negative, slight, direct, temporary	Not Significant
Potential Effects on Surface Water Quality from Excavation Dewatering	Indirect, negative, moderate, temporary	Section 9.5.2.4	negative, imperceptible, indirect, temporary	Not Significant
Potential Effects from Hydrocarbons	Indirect, negative, slight, short term, unlikely effect to local groundwater quality.	Section 9.5.2.5	negative, imperceptible, indirect, short-term, unlikely impact to local surface water	Not Significant

	Indirect, negative, moderate, short term, unlikely effect to surface water quality.		and groundwater quality.	
Potential Effects from Wastewater	Indirect, negative, significant, temporary, unlikely effect to surface water quality. Indirect, negative, slight, temporary, unlikely effect to local groundwater.	Section 9.5.2.6	No residual effect	Not Significant
Potential Effects from Cement-Based Products	Short-Term, Moderate, Negative	Section 9.5.2.7	negative, imperceptible, indirect, short-term	Not Significant
Potential Effects due to Watercourse Crossing Works (Proposed Wind Farm)	Negative, direct, slight, long-term	Section 9.5.2.8	negative, imperceptible, direct, long-term	Not Significant
Potential Effects on Designated Sites	Indirect, negative, slight, short-term	Section 9.5.2.9	No residual effect	Not Significant
Potential Effects on Local Groundwater Well Supplies from Excavations	Short-Term, imperceptible, Negative	Section 9.5.2.10	No residual effect	Not Significant
Potential Effects from Turbine Delivery Route Works	Indirect, negative, imperceptible, short term	Section 9.5.2.11	No residual effect	Not Significant
Potential Effects on WFD status	Temporary, Slight, Negative	Section 9.5.2.12	No residual effect	Not Significant
Potential Effects from the Use of Siltbuster	Negative, slight, indirect, temporary	Section 9.5.2.13	negative, imperceptible, indirect, temporary	Not Significant
Potential Effects from Earthworks Works and Watercourse Crossings (Proposed Grid Connection Route)	Negative, slight, indirect, temporary	Section 9.5.2.14	negative, imperceptible, direct, temporary	Not Significant

Potential Effects on Wetland Hydrology (Proposed Wind Farm)	Negative, imperceptible to slight (the potential effect varies spatially), direct/ indirect, temporary to long-term	Section 9.5.2.15	negative, imperceptible, direct/indirect and temporary to short term	Not Significant
Potential Effects of the Biodiversity Management and Enhancement Plan	Negative, direct, slight, temporary	Section 9.5.2.16	negative, temporary, direct, imperceptible	Not Significant
Effects on Downstream Freshwater Pearl Mussel Populations	Indirect, negative, slight, temporary	Section 9.5.2.17	negative, temporary, direct, imperceptible	Not Significant
Existing Wind Farm Turbine Removal	Negative, slight, indirect, temporary	Section 9.5.2.18	No residual effect	Not Significant
Operational Phase				
Potential Effects from the Replacement of Natural Surface with Low Permeability Surfaces (Proposed Wind Farm)	Negative, imperceptible, indirect, long-term	Section 9.5.3.1	Indirect, neutral, long term	Not Significant
Potential Water Quality Effects from Runoff	Negative, slight, indirect, long-term	Section 9.5.3.2	negative, imperceptible, indirect, long term	Not Significant
Potential Effects of Hydrocarbons	Negative, slight, indirect long term	Section 9.5.3.3	Negative, imperceptible, indirect, long-term term	Not Significant
Potential Effects on WFD Status	No effect	Section 9.5.3.4	No effect	N/A
Decommissioning Phase				
Water	Not Significant	Section 9.5.4	Not Significant	Not Significant