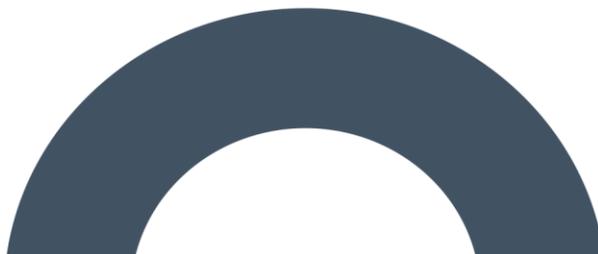


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Environmental Impact Assessment Report

Gannow Renewable Energy
Development,
Co. Galway

Chapter 9 Water



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9. WATER

9.1 Introduction

9.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by MKO Ireland (MKO) to carry out an assessment of the potential likely and significant effects of the Proposed Project on the hydrological (surface water) and hydrogeological (groundwater) aspects of the receiving environment.

The Proposed Project is described in full in Chapter 4: Description of the Proposed Project of this EIAR.

This chapter provides a baseline assessment of the environmental setting of the Site in terms of hydrology and hydrogeology and discusses the potential likely significant effects that the construction, operation and decommissioning of the Proposed Project will have. Where required, appropriate mitigation measures to avoid any identified significant effects to hydrology and hydrogeology are recommended and the residual effects of the Proposed Project post-mitigation are assessed.

For the purposes of this EIAR, the various project components are described and assessed using the following references: 'Proposed Project', 'Proposed Wind Farm', 'proposed turbines', 'Proposed Grid Connection', 'Site' and 'Proposed Wind Farm site'. Please see Section 1.1.1 of this EIAR for further details. A detailed description of the Proposed Project is provided in Chapter 4: Description of the Proposed Project of this EIAR.

9.1.2 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 and experience include upland/wetland hydrology, hydrogeology and windfarm drainage design. We routinely complete impact assessments for hydrology and hydrogeology for a large variety of project types.

This chapter of the EIAR was prepared by Michael Gill, Conor McGettigan and Nitesh Dalal.

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

Conor McGettigan (BSc, MSc) is an Environmental Scientist with 4 years' experience in environmental consultancy in Ireland. Conor holds an M.Sc. in Applied Environmental Science (2020) and a B.Sc. in Geology (2016) from University College Dublin. Conor has prepared the Land, Soils and Geology and Hydrology and Hydrogeology Chapters for numerous wind farm EIAR projects. Conor routinely competes WFD Assessments for a wide variety of projects including wind farms, quarries and proposed residential developments. Conor has worked on the EIARs for over 20 no. wind farms projects across the country.

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Nitesh Dalal (B.Tech, PG Dip., MSc) is an Environmental Scientist with over 7 years' experience in environmental consultancy and environmental management in India. Nitesh holds an M.Sc. in Environmental Science (2024) from University College Dublin. Nitesh also holds a PG Diploma in Health, Safety and Environment from Annamalai University, India (2021) and a B.Tech. in Environmental Engineering (2016) from Guru Gobind Singh Indraprastha University, India (2016). Since joining HES Nitesh has assisted in the preparation of the hydrology and hydrogeology chapter of environmental impact assessments for a wide range of development types including wind farm developments.

9.1.3 Scoping and Consultation

The scope for this chapter of the EIAR has also been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties. This consultation process and the List of Consultees is outlined in Section 2.7 of this EIAR. Matters raised by Consultees in their responses with respect to the water environment are summarised in Table 9-1 below.

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

Consultee	Description	Addressed in Section
GSI	The GSI recommend the use of their online databases and maps in the characterisation of the baseline environment. No specific comments were provided.	All available GSI databases were used in the preparation of this EIAR chapter. Refer to Section 9.2.1.
OPW	The OPW made observations in relation to the following: The requirement of Section 50 in relation to new culverts or bridges. In relation to the Proposed Grid Connection the OPW state that if it is proposed to pass the cables in its ducting through the opening of any bridge or culvert, it would be considered to be a bridge modification and Section 50 consent would be required. If the cables and ducting are buried in the road then there is no issue. The OPW recommends that a Flood risk Assessment is completed.	All items are addressed in the assessment of effects on the local water resources (Section 9.5.2.14). The new proposed watercourse crossings at the Proposed Wind Farm site are detailed and assessed in Section 9.5.2.9. Watercourse crossings along the Proposed Grid Connection are assessed in Section 9.5.2.10. A Flood Risk Assessment has been completed and is summarised in Section 9.3.6 (and is attached in full in Appendix 9-1).

9.1.4 Relevant Legislation

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

The requirements of the following legislation are also complied with:

- Planning and Development Acts, 2000 (as amended);

- Planning and Development Regulations, 2001 (as amended);
- S.I. No 296/2018: European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 which transposes the provisions of the EIA Directive as amended by the Directive 2014/52/EU into Irish Law;
- S.I. No. 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. 293/1988: Quality of Salmon Water Regulations;
- Water Framework Directive (2000/60/EC) (as amended by Decision No. 2455/2011/EC; Directive 2008/32/EC; Directive 2008/105/EC; Directive 2009/31/EC; Directive 2013/39/EU; Council Directive 2013/64/EU; and Commission Directive 2014/101/EU (“WFD”).
- S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009, as amended, and S.I. No. 722/2003 European Communities (Water Policy) Regulations, as amended, which implement EU Water Framework Directive (2000/60/EC) and provide for the implementation of ‘daughter’ Groundwater Directive (2006/118/EC).
- European Communities (Water Policy) Regulations 2003 (S.I. No. 722/2003);
- S.I. No: 122/2010: European Communities (Assessment and Management of Flood Risks) Regulations, resulting from EU Directive 2007/60/EC;
- S.I. No. 684/2007: Waste Water Discharge (Authorisation) Regulations, resulting from EU Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances (the Groundwater Directive);
- S.I. No. 9/2010: European Communities Environmental Objectives (Groundwater) Regulations 2010, as amended; and,
- S.I. No. 296/2009: European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009, as amended.

9.1.5 Relevant Guidance

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

- 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);
- Environmental Protection Agency (2022): Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2022);
- Institute of Geologists Ireland (2013) Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements;
- DoE/NIEA (2015): Wind farms and groundwater impacts - A guide to EIA and Planning considerations”;
- OPW (2009) The Planning System and Flood Risk Management;
- National Roads Authority (2008) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Wind Energy Development Guidelines for Planning Authorities, 2006 (the Guidelines (DoEHLG, 2006)) and the Draft Revised Wind Energy Development Guidelines (the Draft Guidelines (DoEHLG, 2019));
- 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);
- CIRIA (Construction Industry Research and Information Association) Guidance on ‘Control of Water Pollution from Linear Construction Projects’ (CIRIA Report No. C648, 2006);
- Wind Farms and Groundwater Impacts: A guide to EIA and Planning considerations (DoE/NIEA, April 2015);

- Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2001;
- Land Types for Afforestation (Forest Service, 2016b);
- Forest Protection Guidelines (Forest Service, 2002);
- Forest Operations and Water Protection Guidelines (Coillte, 2013);
- Forestry and Water Quality Guidelines (Forest Service, 2000b); and,
- Forests and Water, Achieving Objectives under Ireland's River Basin Management Plan 2018-2021 (DAFM, 2018).

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9.2 Methodology

9.2.1 Desk Study

A desk study of the Site and Water Study Area (refer to Section 9.2.6 below) was completed in the spring of 2024 to collect all relevant hydrological, hydrogeological and meteorological data. The desk study was completed to supplement site walkover surveys, drainage mapping and site investigations. The desk study information has been checked and updated, where necessary, in March and April 2025.

The desk study involved consultation with the following sources:

- Environmental Protection Agency Databases (www.epa.ie);
- Environmental Protection Agency's Hydrotool Database (www.catchments.ie);
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks & Wildlife Services Public Map Viewer (www.npws.ie);
- Water Framework Directive Map Viewer (www.catchments.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Geological Survey of Ireland (GSI, 1999);
- Geological Survey of Ireland - Groundwater Body Characterisation Reports;
- Groundwater Karst Viewer (GSI online mapping portal – www.gsi.ie);
- OPW Flood Mapping (www.floodmaps.ie);
- GSI Groundwater Flood Mapping (www.gsi.ie);
- GSI Groundwater Body Characterisation Reports;
- Department on Environment, Community and Lowe Government on-line mapping viewer (www.myplan.ie);
- Group and Public Water Scheme Zone of Contribution Reports; and,
- Aerial Photography, 1:5000 and 6 inch base mapping.

9.2.2 Baseline Monitoring and Site Investigations

A comprehensive geological, hydrological and hydrogeological dataset has been collected as part of this EIAR study.

Initial walkover surveys of the Site, including hydrological mapping, was undertaken by Michael Gill and Conor McGettigan of HES on 24th September 2024 (refer to Section 9.1.2 above for qualifications and experience). Subsequent walkover surveys, hydrological monitoring, surface water flow monitoring, field hydrochemistry, grab sampling, were undertaken by Conor McGettigan and Nitesh Dalal of HES on 2nd and 17th April 2025. The hydrological monitoring and surface water sampling was completed during both dry and wet periods in order to sample and record flow volumes during both high and low flows.

In summary, the site investigations to address the Water chapter of this EIAR are as follows:

- HES completed initial site walkover surveys and drainage mapping at the Site on 24th September 2024, whereby water flow directions and drainage patterns were recorded. These surveys included field hydrochemistry monitoring and stream flow monitoring of watercourses draining the Site;
- Subsequent walkover surveys and hydrological mapping were completed by HES on 2nd and 17th April 2025;
- Intrusive site investigations comprising of 12 no. trial pit excavations (between 7th and 10th October 2024) were completed by Irish Drilling Ltd (IDL) under the supervision of Fehilly Timoney and Company (FTC). During these excavations observations were made on groundwater inflows;
- A total of 498 no. peat probes have been completed at the Site (combined FTC, HES and MKO dataset) (463 no. peat probes at the Proposed Wind Farm site and 35 no. peat probes at targeted locations along the Proposed Grid Connection). These investigations were completed to determine the thickness and geomorphology of the peat at the Site, and also to understand the sub-peat geology;
- In addition to peat probing, FTC completed in-situ shear vane testing. Strength testing was carried out at selected locations (61 no.) across the Proposed Wind Farm site to provide representative coverage of indicative peat strengths;
- HES completed gouge cores at all key Proposed Wind Farm infrastructure locations;
- Groundwater sampling was completed at the 2 no. groundwater monitoring wells on 10th July 2024;
- A total of 8 no. surface water grab samples were undertaken across 2 no. monitoring rounds (2nd April and 17th April 2025) to determine the baseline water quality of the primary surface waters originating from the Site. The sampling on 2nd April 2025 occurred during a very dry period whilst rainfall preceded the sampling completed on 17th April 2025; and,
- Field hydrochemistry and surface water flow monitoring were also completed on 2nd and 17th April 2025.

In addition, Fluvio R&D Limited have completed a site-specific Flood Risk Assessment for the Proposed Wind Farm. This FRA is included as Appendix 9-1 and includes flood modelling of the main watercourses draining the Proposed Wind Farm site. The results of the FRA are summarised in Section 9.3.6.

9.2.3 Impact Assessment Methodology

Please refer to Chapter 1: Introduction of the EIAR for detail on the impact assessment methodology (EPA, 2022). In addition, the sensitivity of the water environment receptors was assessed on completion of the desk study and baseline study. Levels of sensitivity which are defined in Table 9-2 for hydrology and Table 9-3 for hydrogeology are used to assess the potential effect that the Proposed Project may have on them.

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

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

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

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

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

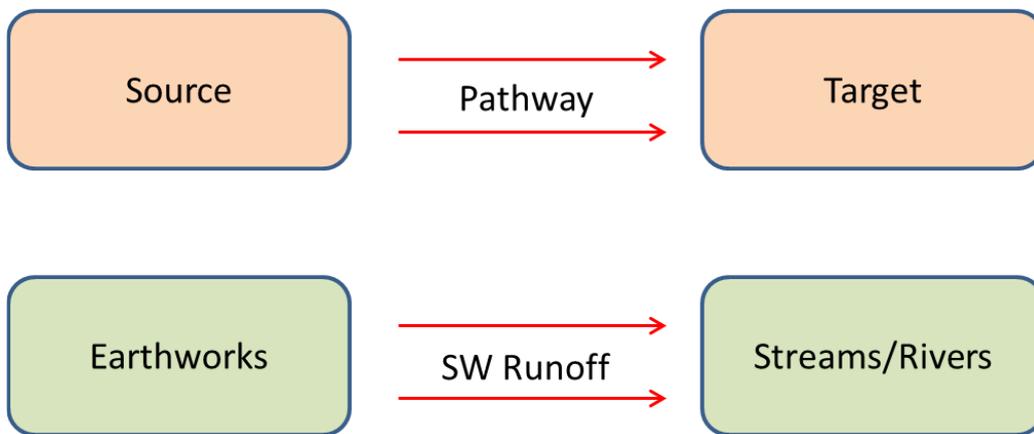
Importance	Criteria	Typical Example
Medium	Attribute has a medium quality or value on a local scale	Locally Important Aquifer. Potable water source supplying >50 homes. Outer source protection area for locally important water source.
Low	Attribute has a low quality or value on a local scale	Poor Bedrock Aquifer Potable water source supplying <50 homes.

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9.2.4

Overview of Impact Assessment Process

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



Where potential effects are identified, the classification of effects in the assessment follows the descriptors provided in the Glossary of Impacts contained in EPA, 2022.

The description process clearly and consistently identifies the key aspects of any potential impact, namely its source, character, magnitude, duration, likelihood and whether it is of a direct or indirect nature (i.e., using EPA, 2022 EIA terminology).

The assessment of effects is Step No. 6 of 7 in the EIA process. In order to provide an understanding of the stepwise impact assessment process applied below (Section 9.5), a summary guide is presented below, which defines the steps (Steps 6a to 6g) taken in each element of the impact assessment process. The guide also provides definitions and descriptions of the assessment process and shows how the source-pathway-target model and the EPA, 2022 impact descriptors are combined.

Using this defined approach, this impact assessment process is then applied to all construction, operation and decommissioning activities for the Proposed Project which have the potential to generate significant adverse impact on the hydrological and/or hydrogeological environment.

Table 9-4: Impact Assessment Process Steps

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

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9.2.5 Limitations and Difficulties Encountered

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

9.2.6 Study Area

The Water Study Area for the hydrological and hydrogeological impact assessment is defined by the regional surface water catchments and groundwater bodies within which the Proposed Project is located.

A regional hydrology map showing WFD surface water catchments and sub-catchments is included as Figure 9-1. The relevant surface water catchments within which the Proposed Project is located are detailed in Section 9.3.2.2. In addition, the bedrock aquifers and groundwater bodies which underlie the Site are detailed in Section 0.

9.3 Baseline/Receiving Environment

9.3.1 Proposed Project Description and Topography

9.3.1.1 Proposed Wind Farm site

The Proposed Wind Farm site is located within a rural, agricultural setting in eastern Galway, approximately 9.7km east of Athenry, Co. Galway and 13km north of Loughrea, Co. Galway. The village of Attymon, Co. Galway is located approximately 1km northwest of the nearest proposed turbine (T01) and the village of New Inn is located approximately 4.6km southeast of the nearest proposed turbine (T07). The Midland Great Western Railway Line between Galway City and Athlone town is located immediately to the north of the Proposed Wind Farm site. Attymon railway station which serves the townland of Attymon is located to the northwest of the Proposed Wind Farm. The Proposed Wind Farm site is located in the townlands of Derrynamanagh and Gannow in the east, Cappaghnanool, Cappanasruhaun and Killimor in the centre and Attimonmore South in the west. The Site has a total area of approximately 884ha.

The L3115 which serves Attymon railway station off the R348 is located immediately to the west of the Proposed Wind Farm. Several local roads branch off the L3115 and provide access to the western section of the Proposed Wind Farm site. The Proposed Wind Farm site is currently traversed by an agricultural track which extends northwards into the Proposed Wind Farm site. The eastern section of the Proposed Wind Farm site can be accessed via local roads which extend westwards from the L7176.

The proposed onsite 38kV substation is located in rough agricultural land and will be accessed via the Proposed Wind Farm site access roads.

Landuse with the Proposed Wind Farm site currently comprises of rough agricultural land, coniferous forestry with evidence of some turbary peat cutting in open peatland areas. The agricultural lands are located in the east and west of the Proposed Wind Farm site. Several natural watercourses also flow through the site including the Raford River in the east and the Killimor River in the west.

Topography at the Proposed Wind Farm site is relatively flat to gently undulating with gentle to moderate slopes. This topography is typical of a low-lying raised bog setting with local hills. Ground elevations within the Proposed Wind Farm site range from ~65mOD (metres above Ordnance Datum) to ~80mOD. The overall slope of the land is to the south/west. In places, the natural topography has been modified through previous peat extraction activities and associated drainage.

9.3.1.2 Proposed Grid Connection

The Proposed Grid Connection includes for 38kV underground cabling from the proposed onsite 38kV substation, in the townland of Attimonmore South, Co. Galway, to the existing Cashla 220kV substation in the townland of Barrettspark, Co. Galway. The Proposed Grid Connection measures approximately 21.8km in length and is located primarily within the curtilage of the public road corridor with three sections (approximately 0.2km, 0.6km and 1.5km) being located within private land. The Proposed Grid Connection is described in full in Chapter 4: Description of the Proposed Project, Section 4.3.2.

Topography along the Proposed Grid Connection is variable with the surrounding landscape comprising of undulating hills. Topography ranges from ~80mOD near Attymon to ~30mOD near the existing Cashla 220kV substation.

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9.3.2 Water Balance

9.3.2.1 Proposed Wind Farm

Long term Annual Average Rainfall (AAR) and evaporation data was sourced from Met Éireann. The 30-year AAR recorded at the Athenry (Attymon) rainfall station, located ~1.4km southwest of the Proposed Wind Farm site, are presented in Table 9-5. The long-term average annual rainfall at Athenry (Attymon) rainfall station is ~1,033mm/year.

Met Éireann also provide a grid of AAR for the entire country for the period of 1991 to 2020. Based on this more site-specific modelled rainfall values, the AAR at the Proposed Wind Farm site ranges from 1,205 to 1,217mm/year. The AAR for the Proposed Wind Farm site is taken to be 1,213mm/year (this is considered to be the most accurate estimate of AAR from the available sources).

Table 9-2 Local Average long-term Rainfall Data (mm)

Station		X-Coord		Y-Coord		Height (MAOD)		Opened		Closed		
Athenry (Attymon)		158500		228500		78		1951		1991		
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
91.9	64.6	63.4	60.9	67.1	72.2	82.5	99.5	106.5	105.8	104.6	114.2	1,033
Proposed Wind Farm site (X-Coord: 161,000, Y-Coord: 230,000)												
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
123	98	91	74	75	83	93	107	95	118	126	131	1,213

The closest synoptic¹ station where the average Potential Evapotranspiration (PE) is recorded is at Birr, located ~51km to the southeast of the Proposed Wind Farm site. The long-term average PE for this station is 444.9mm/yr. This value is used as the best estimate of the Proposed Wind Farm site PE. Actual Evaporation (AE) at the Proposed Wind Farm site is estimated as 422.7mm/yr (which is 0.95 × PE).

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

$$\text{Effective rainfall (ER)} = \text{Annual Average Rainfall (AAR)} - \text{Actual Evaporation (AE)}$$

$$= 1,211 \text{ mm /yr} - 422.7\text{mm/yr}$$

$$\text{ER} = 788.3 \text{ mm/yr}$$

Groundwater recharge and runoff coefficient estimates are available from the GSI (www.gsi.ie). Within the Proposed Wind Farm site groundwater recharge coefficients range from 4% to 85%. The vast majority of the Proposed Wind Farm site is mapped as having recharge coefficients of 4% due to the coverage of peat soils. The highest rates of groundwater recharge are mapped in the vicinity of the Raford River in the east of the Proposed Wind Farm site where groundwater recharge rates range from 25 to 85%.

Based on the observations made during site walkover surveys and site-specific geological data from peat probe investigations and trial pit excavations a recharge coefficient (15%) at the lower end of the scale

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.

was chosen. During the walkover surveys and drainage mapping a high density of surface water features were recorded in the area. Furthermore, the site investigations encountered peat soils/subsoils and low permeability glacial tills which will restrict groundwater recharge. Therefore, the hydrogeological regime at the Proposed Wind Farm site is characterised by low rates of groundwater recharge and high rates of surface water runoff. Based on this recharge coefficient (15%) the average annual groundwater recharge for the Proposed Wind Farm site is estimated to be 118.2mm/year (*i.e.* 15% of the effective rainfall (788.3 mm) and the annual runoff rate is estimated to be ~370mm/yr.

Met Éireann’s Translate Project (<https://www.met.ie/science/translate>) provides projections for a range of future climate change scenarios, as Ireland’s future climate will depend on global greenhouse gas emissions reductions. The severity of any future climate change will depend on the degree of future warming. In relation to precipitation chances, the models show that summer rainfall may decrease by approximately 9% and winter rainfall could increase by up to 24%. In a 1.5°C world, average winter and summer precipitation rates are projected to be 4.66mm/day and 2.94mm/day respectively in Co. Galway. In a 4°C world, the average winter and summer precipitation rates in Co. Galway are projected to be 5.23mm/day and 2.68mm/day respectively.

In addition to average rainfall data, extreme value rainfall depths are available from Met Éireann. Table 9-6 below presents return period rainfall depths for the area of the Proposed Wind Farm site. These data are taken from <https://www.met.ie/climate/services/rainfall-return-periods> and they provide rainfall depths for various storm durations and sample return periods (1-year, 5-year, 30-year and 100-year). These extreme rainfall depths will be the basis of the Proposed Wind Farm drainage hydraulic design as described further below.

Table 9-3 Return Period Rainfall depths (mm) for the Proposed Wind Farm site

Return Period (Years)				
Storm Duration	1	5	30	100
5 mins	3.6	5.5	8.7	11.6
15 mins	5.8	9.1	14.3	19.0
30 mins	7.6	11.6	17.90	23.5
1 hour	9.9	14.8	22.4	29.0
6 hours	19.6	28.0	40.1	50.2
12 hours	25.7	35.8	50.3	62.1
24 hours	33.5	45.7	62.9	76.8
2 days	42.5	56.3	75.2	89.9

9.3.2.2 Proposed Grid Connection

The AAR along the Proposed Grid Connection ranges from a minimum of 1,217mm/yr in the vicinity of the Proposed Wind Farm site to a maximum of 1,238mm/yr further west. The average AAR along the route is taken to be 1,228mm/yr.

Groundwater recharge estimates from the GSI along the Proposed Grid Connection underground cabling route range from 4 to 25% in the east to ~60% in the west. In the west, groundwater recharge and surface water runoff are estimated to be ~737mm/yr and ~491mm/yr respectively. In the east, groundwater recharge and surface water runoff are estimated to be ~184mm/yr and ~1,044mm/yr (based on a recharge coefficient of 15%).

9.3.3 Regional and Local Hydrology

9.3.3.1 Proposed Wind Farm

Regionally the Proposed Wind Farm site is located in the Galway Bay Southeast WFD surface water catchment within Hydrometric Area 29 of the Western River Basin District. The 3rd Cycle Galway Bay Southeast Catchment Report (EPA, 2024) states that this surface water catchment includes the area drained by all streams entering tidal water in Galway Bay between Black Head and Renmore Point, Galway, draining a total area of 1,270km². The largest urban centre in the catchment is the eastern part of Galway City. The other main urban centres in this catchment are Athenry, Loughrea, Gort, and Oranmore. This catchment is predominantly underlain by karstified limestone, including the northern part of the Burren in County Clare, and the groundwater and surface water systems in the area are closely interlinked in this catchment (EPA, 2024).

On a more local scale, the vast majority of the Proposed Wind Farm site is mapped within the Raford River sub-catchment (Raford_SC_010). A very small area in the west of the Proposed Wind Farm site is located in the Clarinbridge River sub-catchment (Clarinbridge_SC_010).

Within the Raford River sub-catchment, the Proposed Wind Farm site is mapped in 2 no. WFD river sub-basins: the Raford_020 WFD river sub-basin in the west and the Raford_030 WFD river sub-basin in the east. Within the Raford_020 WFD river sub-basin the Proposed Wind Farm site is dissected by the Raford River (EPA Code: 29_161). The Raford River flows to the west ~250m south of T7 and to the southeast ~90m south of T8. The Raford River then continued to the southeast before it veers to the west to the north of the R348. Within the Raford_030 WFD river sub-basin, the Proposed Wind Farm site is dissected by the Killimor River (referred to by the EPA as the Attimonbeg Stream, EPA Code: 29-368). The Killimor River flows to the south ~230m west of T3 and ~40m east of T2. The Killimor River continues to flow to the south and discharges into the Raford River near Kiltullagh (note that this section of the Raford River is also known as the Clogheravaun River on the Discovery Series basemaps). The Raford River then continues to flow to the southwest and discharges into the Kilcolgan (EPA Code: 29_263) River near Craughwell. The Kilcolgan River is also known locally as the Dunkellin River. The Kilcolgan River continues to the west, passing through Rahasane Turlough and discharges into Dunbulcaun Bay.

Within the Clarinbridge River sub-catchment, the Proposed Wind Farm site is located in the Clarinbridge_010 WFD river sub-basin. The Clarinbridge River flows to the south ~1km to the west of the Proposed Wind Farm site. This section of the Clarinbridge River is referred to as the Cloonkeen River in the OSI Discovery series maps. This river flows to the south-east of Athenry Town and continues to the southwest before discharging into Dunbulcaun Bay.

A regional hydrology map showing the WFD catchments and sub-catchments is included as Figure 9-1. A local hydrology map, which includes the WFD river sub-basins is presented as Figure 9-2.

Table 9-7 below summarised the hydrological setting of the Proposed Wind Farm infrastructure with respect to WFD catchments, sub-catchments and river sub-basins.

9.3.3.2 Proposed Grid Connection

On a regional scale, the Proposed Grid Connection is located in the Galway Bay Southeast WFD surface water catchment within Hydrometric Area 29 within the Western River Basin District.

On a more local scale, the Proposed Grid Connection is mapped within 3 no. WFD river sub-catchments. Within the Proposed Wind Farm site, ~100m of the Proposed Grid Connection underground cabling route from the onsite 38kV substation towards the L3115 local road is mapped in the Raford River sub-catchment (Raford_SC_010). The vast majority of the eastern section of the Proposed Grid Connection is mapped in the Clarinbridge River sub-catchment (Clarinbridge_SC_010)

whilst the western section is mapped in the Carrowmoneash River sub-catchment (Carrowmoneash [Oranmore]_SC_010).

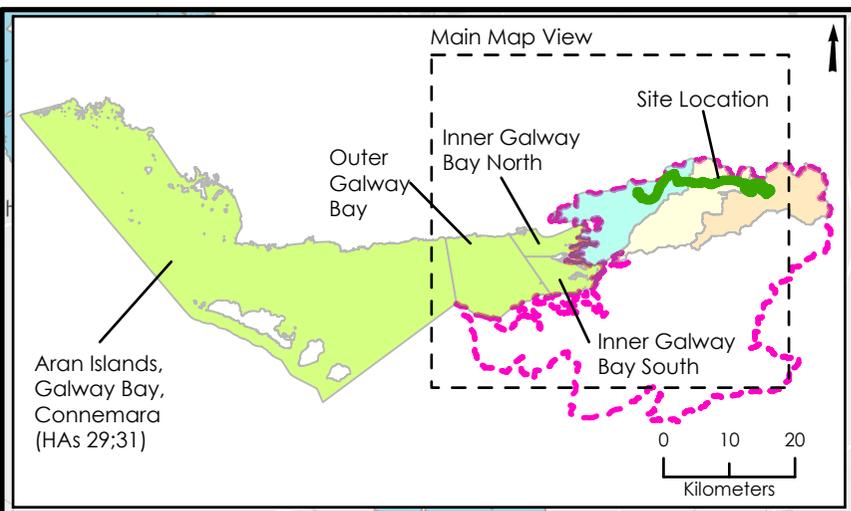
Within the Clarinbridge River sub-catchment, the Proposed Grid Connection is mapped within the Clarinbridge_010 and the Clarinbridge_020 WFD river sub-basins. Within the Clarinbridge_010 WFD river sub-basin, the Proposed Grid Connection (~6km in length) is mapped to cross 3 no. watercourses: the Clarinbridge River (EPA Code: 29C02), the Toorkeel Stream (EPA Code: 29T06) and the Glennagloghaun Stream (EPA Code: 29G17). Within the Clarinbridge_020 WFD river sub-basin, the Proposed Grid Connection (~3.9km in length) is mapped to cross 1 no. watercourse: the Shoodaun River (EPA Code: 29S03) at Graigabbey Bridge. All watercourse crossings are at existing bridge and culvert locations.

Note that the Clarinbridge River may also be referred to as the Lavally River downstream of Athenry or the Graigabbey River upstream of Athenry.

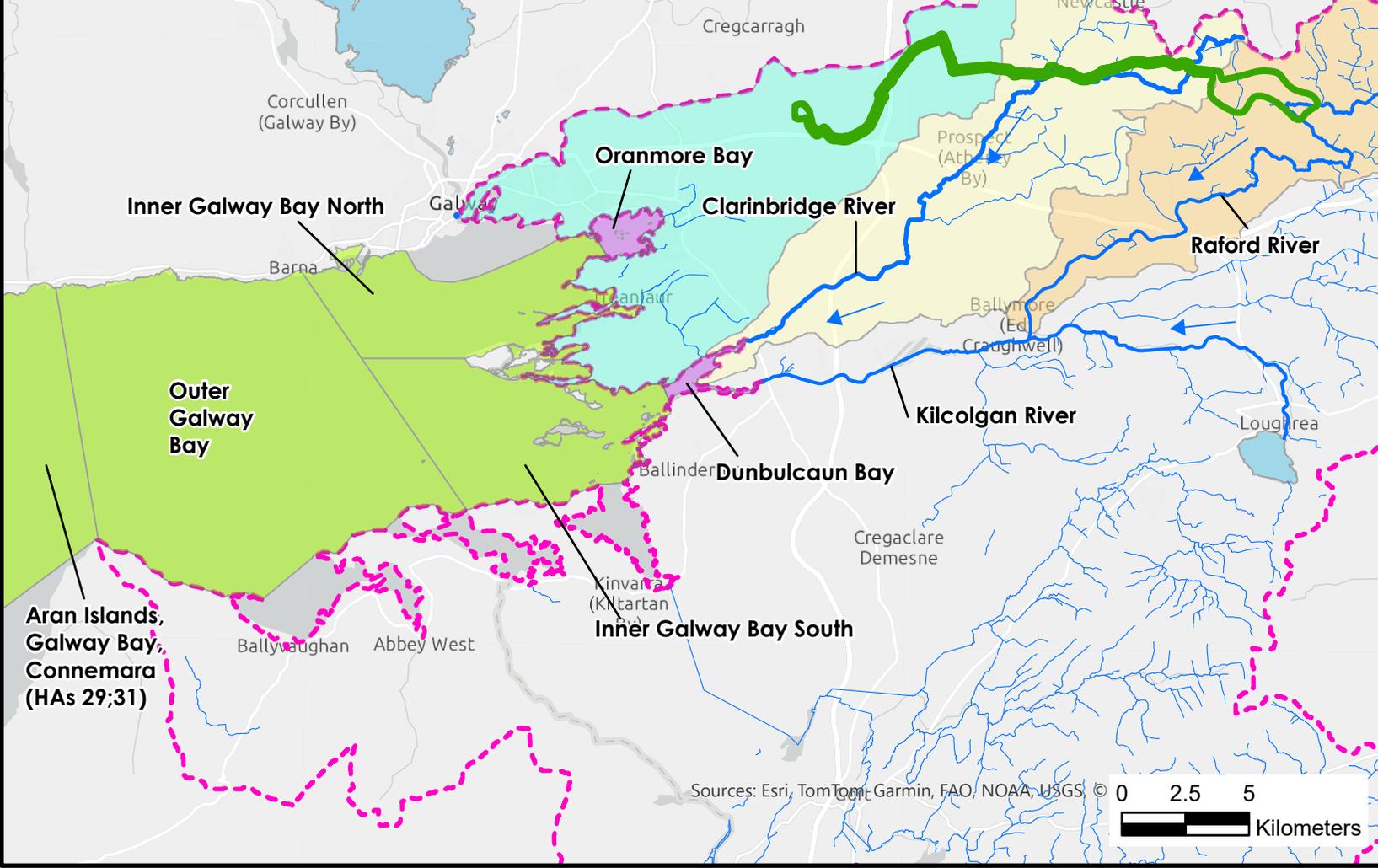
Further to the west, within the Carrowmoneash River sub-catchment, ~11.8km of the Proposed Grid Connection is mapped within Carrowmoneash (Oranmore)_010 WFD river sub-basin. This area is devoid of rivers and streams and there are no surface water features in the vicinity of the Proposed Grid Connection. The nearest mapped watercourse is the Innplot Stream located ~4.9km to the southwest.

Table 9-4: WFD Catchments, sub-catchments and river-basins and Proposed Project infrastructure

WFD Catchment	WFD Sub-Catchment	WFD River Sub-Basin	Proposed Project Infrastructure
Galway Bay Southeast	Raford_SC_010	Raford_020	T4, T5, T6, T7, T7, met mast, eastern construction compound, site access roads, felling areas, biodiversity enhancement areas and peat and spoil management areas
		Raford_030	T1, T2, T3, onsite 38kV substation, western construction compound, site access roads, biodiversity enhancement areas, peat and spoil management areas
	Clarinbridge_SC_010	Clarinbridge_010	Site access roads, Proposed Grid Connection (~5.8km including 3 no. crossings)
		Clarinbridge_020	Proposed Grid Connection (~3.7km including 1 no. watercourse crossing)
	Carrowmoneash [Oranmore]_SC_010	Carrowmoneash (Oranmore)_010	Proposed Grid Connection (~11.7km and no watercourse crossing)



- Legend
- EIAR Site Boundary
 - Watercourses
 - Lakes
 - WFD Catchments
 - Galway Bay South East
 - WFD Subcatchments
 - CARROWMONEASH[Oranmore]_SC_010
 - Clarinbridge_SC_010
 - Raford_SC_010
 - WFD Coastal Waterbodies
 - WFD Transitional Waterbodies



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Client: Gannow Ltd.

Job: Gannow Renewable Energy Development, Co. Galway

Title: Regional Hydrology Map

Figure No: 9-1

Drawing No: P1706-0-0925-A4-901-00A

Sheet Size: A4

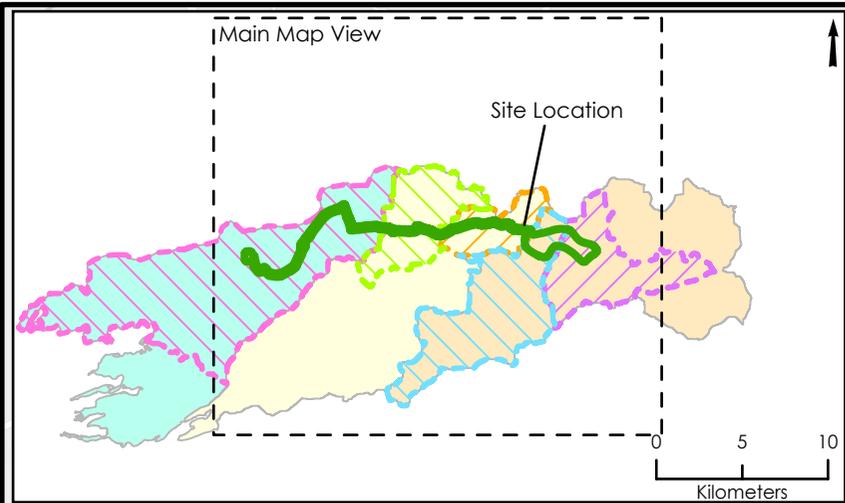
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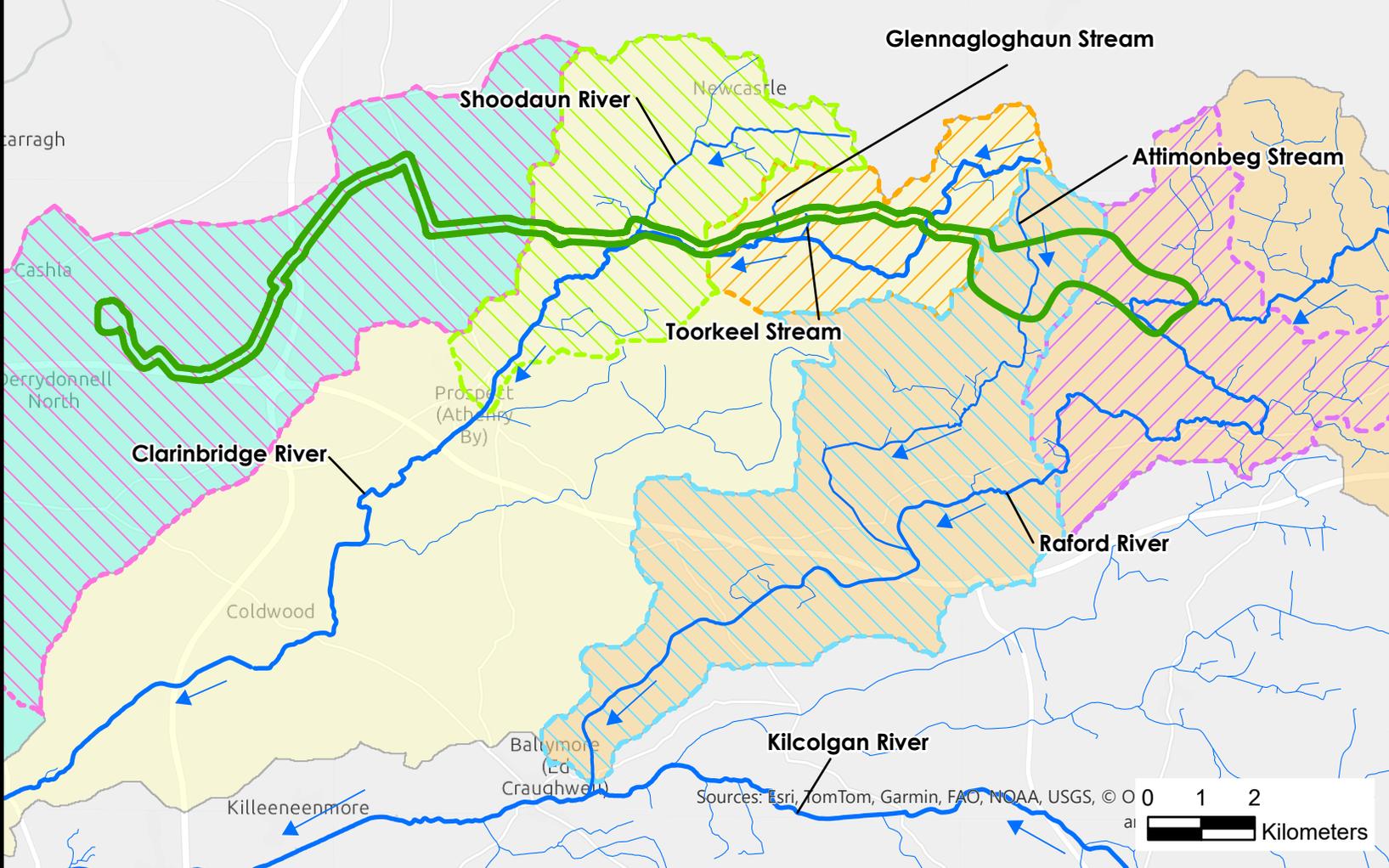
Drawn By: GA

Date: 19/09/2025

Checked By: MG



- Legend
- EIAR Site Boundary
 - Watercourses
 - Lakes
 - WFD Subcatchments
 - CARROWMONEASH[Oranmore]_SC_010
 - Clarinbridge_SC_010
 - Raford_SC_010
 - WFD River Sub-Basins
 - CARROWMONEASH (Oranmore)_010
 - CLARINBRIDGE_010
 - CLARINBRIDGE_020
 - RAFORD_020
 - RAFORD_030



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Job: Gannow Renewable Energy Development, Co. Galway

Title: Local Hydrology Map

Figure No: 9-2

Drawing No: P1706-0-0925-A4-902-00A

Sheet Size: A4

Project No: P1706-0

Scale: 1:150,000

Drawn By: GA

Date: 19/09/2025

Checked By: MG

Surface Water Flows

The closest OPW gauging station to the Proposed Wind Farm site is located on the Raford River at Rathgorgin (Station Code: 29001). This station is located ~4.6km downstream of the confluence between the Raford River and the Killimor River. The 95 percentile flow at this location is $0.102\text{m}^3/\text{s}$. This means that at this location on the Raford River the flow is equal to or greater than 102l/s 95% of the time.

The EPA's Hydrotool, available on www.catchments.ie, was also consulted in order to estimate baseline flow volumes in the local area. The Hydrotool dataset contains estimates of naturalised river flow duration percentiles. Several nodes were consulted in the vicinity and downstream of the Proposed Wind Farm site.

Figure 9-3 below presents the estimated flow duration curves for each of the consulted Hydrotool Nodes downstream of the Proposed Wind Farm site.

A 95 percentile flow relates to the flow which will be exceeded within the river 95% of the time. For example, the 95 percentile flow at Node 29_368 on the Killimor River downstream of T2 is estimated to be $0.013\text{m}^3/\text{s}$ (13l/s). This indicates that 95% of the time, the flow at this location is estimated to be at or above 13l/s . The flow volumes are larger in the Raford River in the west of the Proposed Wind Farm site. In the vicinity of T8, the 95 percentile flow is estimated to be 96l/s at Hydrotool Node 29_160. The flow volumes in these watercourses increase progressively downstream of the Proposed Wind Farm site, with the 95 percentile flow in the Raford River downstream of the Killimor River estimated to be 339l/s .

Due to the increasing flow volumes downstream of the Proposed Wind Farm and the Proposed Grid Connection the potential for effects associated with the Proposed Wind Farm decreases progressively downstream.

In terms of the Proposed Grid Connection, the greatest flow volumes occur on the Clarinbridge River. Smaller flows occur on the tributaries of this watercourse *i.e.* the Toorkeel and the Glennagloghaun stream over which the Proposed Grid Connection is proposed. The 95 percentile flow on the Clarinbridge River upstream of the Toorkeel Stream is $0.019\text{m}^3/\text{s}$ (Hydrotool Node: 29_422). The 95 percentile flow on the Clarinbridge River upstream of Atherny is $0.088\text{m}^3/\text{s}$ (Hydrotool Node: 23_359).

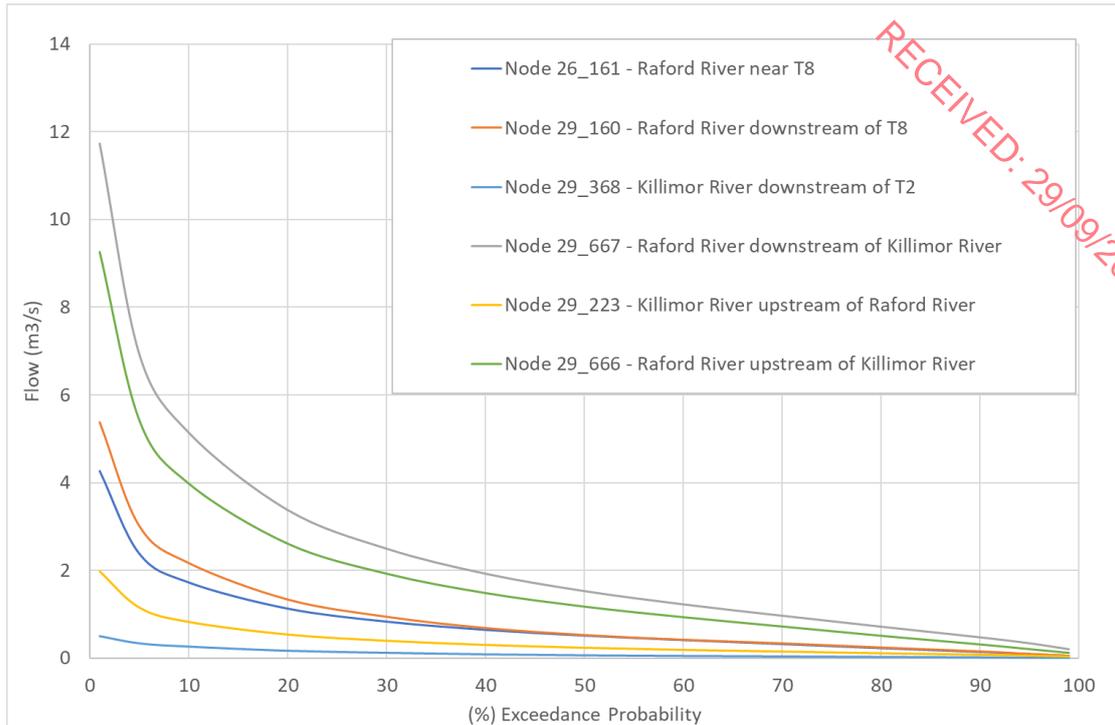


Figure 9-3: EPA Hydrotool Node Flow Duration Curves

9.3.5 Proposed Wind Farm site Drainage

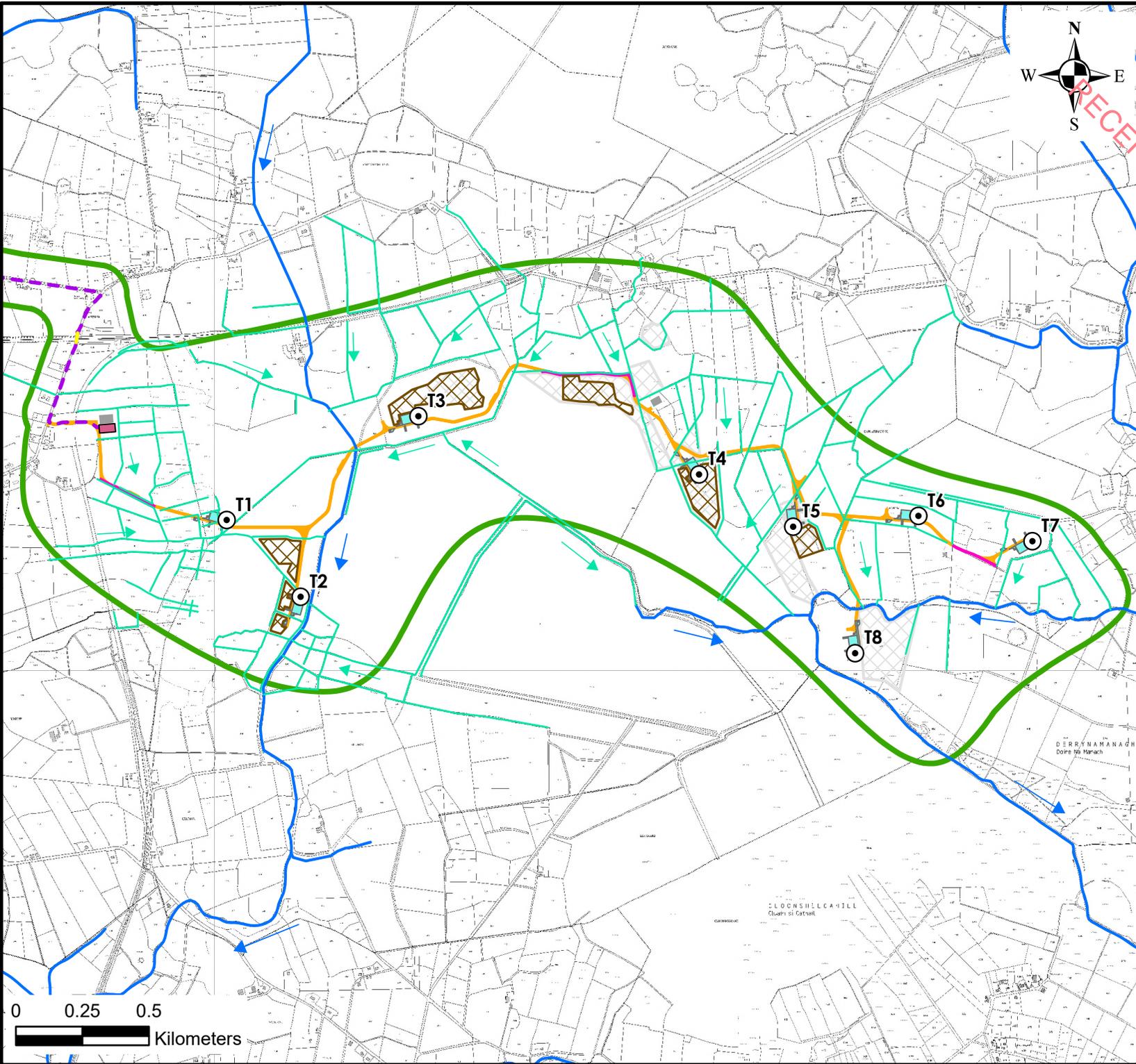
As stated above, the Proposed Wind Farm site is drained by the Raford River in the east and the Killimor River in the west.

An existing drainage map for the Proposed Wind Farm site is shown as Figure 9-4. The drainage map was created using OSI mapped watercourses, aerial photography, field mapping and Lidar data. Lidar data allows detailed mapping on the topographic contours of the site, thereby allowing identification of potential drainage pathways at the Proposed Wind Farm site that are greater than 150m in length. Based on this assessment the main drainage pathways at the Proposed Wind Farm site are shown and the connectivity (i.e., pathways and outlet points) of these drains with the downstream EPA mapped streams/ivers can be clearly illustrated.

The Killimor River was noted to flow along an existing access track within the Proposed Wind Farm site. This watercourse had a relatively deeply incised channel and a flow of ~5l/s during the site walkover surveys. The Killimor River received drainage from the surrounding peat bog which contained several deeply incised drains. Further to the west, the Raford River was noted to be meandering in the vicinity of T8 and had more significant flows.

In places the natural drainage is further facilitated by a network of manmade drains. The nature of these manmade drains depends on the local land use and comprise of agricultural field drains or forestry drains.

The forestry plantations within the Proposed Wind Farm site are generally drained by a network of mound drains which typically run perpendicular to the topographic contours of the Proposed Wind Farm site and feed into collector drains, which discharge to interceptor drains down-gradient of the plantation. Mound drains and ploughed ribbon drains are generally spaced approximately every 15m and 2m respectively. Interceptor drains are generally located up-gradient (cut-off drains) and down-gradient of forestry plantations. A schematic of a typical standard forestry drainage network and one which is representative of the site drainage network is shown as Figure 9-5. The forestry drains are the primary drainage routes towards the natural streams, but the flows in the higher elevated drains are generally very low or absent most of the time.



- Legend
- EIAR Site Boundary
 - Proposed Turbine Layout
 - Proposed Met Mast
 - Proposed Hardstands
 - Proposed New Roads
 - Proposed Upgrades to Existing Roads
 - Proposed Temporary Construction Compounds
 - Proposed Onsite 38kV Substation
 - Proposed Grid Connection
 - Proposed Grid Connection HDD Location
 - Proposed Enhancement and Replanting
 - Proposed Peat and Spoil Management Areas
 - Watercourses
 - Mapped Drains

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Job: Gannow Renewable Energy Development, Co. Galway

Title: Proposed Wind Farm Site Drainage Map

Figure No: 9-4

Drawing No: P1706-0-0925-A4-903-00A

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Scale: 1:20,000

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Checked By: MG

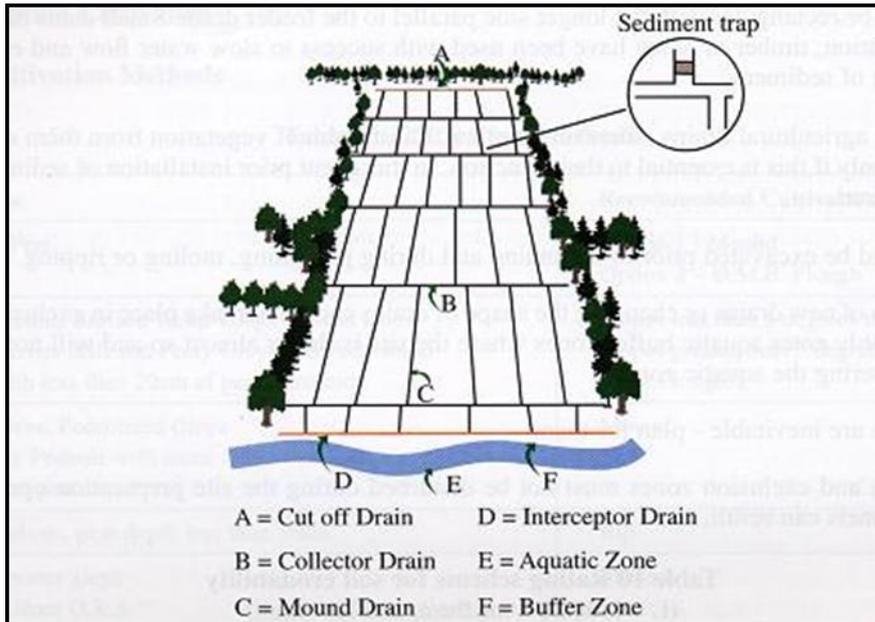


Figure 9-5: Schematic of Forestry Drainage

9.3.6 Flood Risk Assessment

9.3.6.1 HES Desk Study

9.3.6.1.1 Proposed Wind Farm

To identify those areas as being at risk of flooding, OPW’s River Flood Extents Map, the National Indicative Fluvial Mapping, Past Flood Event Mapping (www.floodinfo.ie) and historical mapping (i.e. 6” and 25” base maps) were consulted.

Identifiable map text on local available historical 6” or 25” mapping for the Proposed Wind Farm site identifies land which is ‘liable to flood’ along the Raford River. There is no text along the Killimor River within the Proposed Wind Farm site which indicated lands prone to flooding. However, there is text indicating flooding on this watercourse ~1.5km downstream of the Proposed Wind Farm site.

The OPW National Flood Hazard Maps have no records of any recurring or historic flood incidences within the Proposed Wind Farm site (www.floodinfo.ie). The closest mapped historic flood event is found ~2.3km south of the Proposed Wind Farm site at Turlough - Knockatogher, Galway (Flood ID: 976). This flood event is associated with a turlough and is recurring. Another recurring flood event is recorded ~2.34km to the south of the Proposed Wind Farm site at Killtullagh to Carnakelly (Flood ID: 1910) and is described in the local area engineers report as follows: “Stream overflows its banks every year after heavy rain. Road is liable to flood”.

The GSI’s Winter 2015/2016 surface water flood map shows areas of fluvial and pluvial flooding during the Winter 2015/2016 flood event, which was the largest recorded flood event in many areas. This flood map does not record any mapped flood areas within the majority of the Proposed Wind Farm site. A small area of surface water flooding is recorded in the east of the Proposed Wind Farm site along the Raford River.

CFRAM mapping has not been completed for the area of the Proposed Wind Farm site. NIFM fluvial flood maps record low (1,000-year flood event) and medium (100-year flood event) probability fluvial flood zones along the Raford River in the eastern portion of the Proposed Wind Farm site. T8 is mapped within these flood zones. NIFM fluvial flood zones are also mapped along the Killimor River

downstream of the western section of the Proposed Wind Farm site. These fluvial flood zones do not encroach upon the Proposed Wind Farm site.

The GSI Historical 2015/2016 groundwater flood map does not record any groundwater flooding within the area of the Proposed Wind Farm. The nearest area of historic groundwater flooding is mapped at ~1.6km in the south of the Proposed Wind Farm site and is associated with the location of a known turlough. In addition, the GSI predictive groundwater flood maps do not record any zones of groundwater flooding within the Proposed Wind Farm site.

The proposed onsite 38kV substation is mapped in Flood Zone C and is at low risk of flooding.

The main risk of flooding at the Proposed Wind Farm site is fluvial flooding adjacent to the Raford River.

9.3.6.1.2 Proposed Grid Connection

In addition to the Flood Risk Assessment completed for the Proposed Wind Farm site, the potential for flooding along the Proposed Grid Connection has also been assessed.

The OPWs Past Flood Events map does not record any historic or recurring flood events along the Proposed Grid Connection. The closest mapped historic flood event is found ~750m south of the Proposed Grid Connection at Clarinbridge, Carrowtober West (Flood ID: 1891).

NIFM fluvial flood zones are mapped along the Clarinbridge River, which runs parallel to the Proposed Grid Connection underground cabling route in the townland of Binn. These fluvial flood zones encroach upon the route along an existing local road. NIFM fluvial flood zones are also recorded where the Proposed Grid Connection is mapped to cross over a tributary of the Clarinbridge River in the townland of Graigabbey. An existing crossing exists at this location.

There are no historic or predictive groundwater flood zones located along the Proposed Grid Connection.

In summary, the vast majority of the Proposed Grid Connection is at low risk of flooding. However, there are areas which may be prone to flooding, principally at existing watercourse crossings. Due to the depth of the Proposed Grid Connection underground cabling, this will have no impact during the operational phase of the Proposed Project.

9.3.6.2 Summary Flood Risk Assessment (Fluvio R&D Ltd)

This section provides a summary of the Flood Risk Assessment (FRA) which has been undertaken by Fluvio R&D Ltd. for the Proposed Wind Farm site. The full FRA report is attached as Appendix 9-1. This Stage 3 FRA is completed in line with the guidelines provided in "The Planning System and Flood Risk Management" (OPW, 2009).

The Stage 3 FRA includes detailed hydrological modelling along the Killimor and Raford rivers in the vicinity of the Proposed Wind Farm site. Flood level modelling for the Killimor and Raford rivers was undertaken using HEC-RAS open channel flow software. The modelling was based on detailed river and tributary/drain cross sections and topographic maps (DTM) of the Site. HEC-RAS is a 2-dimensional flow model which can calculate channel water depth/level using parameters such as flood volumes, channel dimensions, slope and friction coefficients (Mannings n number). To investigate the potential for flooding within the Proposed Wind Farm site, modelling of design flood volumes (i.e., 10-year, 100-yr and 1000-yr) was undertaken for the rivers and the surrounding lands.

The site-specific modelling shows that in addition to T8 which is mapped in fluvial flood zones along the Raford River, T1 and T2 in the west of the Proposed Wind Farm site are also mapped in flood zones associated with fluvial flooding along the Killimor River and several local surface water drains.

Flow velocities, flood levels and flood extents were modelled for the 100-year and a 1,000-year fluvial flood events. The modelling was completed both for the existing conditions onsite and for the proposed design condition, which includes the Proposed Wind Farm infrastructure.

A comparison of water levels and flow velocities in the channels, between the existing and design river system imply that there would be no significant change in water levels and in flow velocities. This means that all normal river flows remain unaffected by the Proposed Wind Farm works. Comparison of the modelled water levels between the existing and the design river system for 100-year and 1,000-year plus climate change flood events, indicate a maximum water level increase of +0.06m for the 100-year flood event and a maximum increase of +0.15m for the 1,000-year flood event. Comparison of flow velocities also implies that there will be no increase in the potential for erosion, which was demonstrated by insignificant flow velocity increases between the existing and design scenarios. Therefore, comparison of the hydrographs for the existing and design conditions show that the impact of the Proposed Wind Farm on the storage capacity of the Proposed Wind Farm site is minor.

The Proposed Wind Farm has been designed, cognisant of the fluvial flood risk at the Proposed Wind Farm site. Hardstands for the proposed turbines located within or in close proximity to the modelled fluvial flood zones (T1, T2 and T8) have been designed with finished floor levels 0.5m above the flood levels for flood Zone B (1 in 1,000-year flood event) (refer to Table 9-8). This design will ensure that flooding at the Proposed Wind Farm site poses no risk to the proposed infrastructure and that access will be maintained during flooding events.

The proposed onsite 38kV substation is located outside of the modelled Flood Zones A and B.

The Proposed Wind Farm road network will be constructed at existing ground levels in order to avoid flood plain flow blockage of pre-construction flood flow paths.

Table 9-5: Proposed Wind Turbine Hardstands Finished Ground Levels

Infrastructure	1,000-year flood level (including 20% Climate Change factor) (mOD)	Finished Ground Level (mOD)
T1	71.00	71.50
T2	69.00	69.50
T8	70.14	70.64
Substation	76.20	76.70

9.3.7 Surface Water Quality

9.3.7.1 EPA Water Quality Monitoring

9.3.7.1.1 Proposed Wind Farm

Biological Q-rating² data for EPA monitoring points on the Raford and Kilcolgan rivers from 2024 are shown in Table 9-6 below. The Q-Rating is a water quality rating system based on both the habitat and the invertebrate community assessment and is divided into status categories ranging from 0-1 (Poor) to 4-5 (Good/High).

There are no EPA monitoring locations situated on the Killimor River in the vicinity or downstream of the Proposed Wind Farm site. The Raford River achieved a Q4 rating (Good status) at Raford Bridge (Station ID: RS29R010200) downstream of the eastern section of the Proposed Wind Farm site. The Raford River also achieved a Q4 rating upstream of its confluence with the Killimor River at a bridge east of Kiltullagh (Station ID: RS29R010300). Further downstream the Kilcolgan River achieved a Q-3-4 rating (moderate status) at the Old Road Bridge in Craughwell and upstream of Rahasane Turlough

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

(Station ID: RS29K010400). Downstream of Rahasane Turlough, the Kilcolgan River achieved a Q3 rating (Poor status) at Kilcolgan Bridge (Station ID: RS29K010600).

9.3.7.1.2 **Proposed Grid Connection**

The eastern section of the Proposed Grid Connection is drained by the Clarinbridge River. Biological Q-rating data for EPA monitoring points on the Clarinbridge River from 2024 are shown in Table 9-6 below.

In the vicinity of the Proposed Grid Connection, the Clarinbridge River achieved a Q4 rating at a bridge north of Ballyboggan (Station ID: RS29C020040). Downstream of the Proposed Grid Connection and in the vicinity of Athenry Town the Clarinbridge River achieved Q3-4 ratings. Further downstream, near Lavally, the Clarinbridge River achieved a Q3 rating (Station ID: RS29C020450).

As stated above, there are no watercourses in the vicinity of the Proposed Grid Connection in the Carrowmoneash (Oranmore)_010 sub-catchment.

A map of local EPA monitoring stations is attached as

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Figure 9-6 below.

Table 9-6: Latest EPA Water Quality Monitoring Q-Rating Values (2020)

Watercourse	Station ID	Easting	Northing	Year	EPA Q-Rating Status
Raford River	RS29R010200	160854	226103	2024	Q4 (Good)
Raford River	RS29R010300	157953	224945	2024	Q4 (Good)
Kilcolgan River	RS29K010400	151100	219931	2024	Q3-4 (Moderate)
Kilcolgan River	RS29K010600	144201	218414	2024	Q3 (Poor)
Clarinbridge_010	RS29C020040	154321	230121	2024	Q4 (Good)
Clarinbridge_020	RS29C020100	150378	227846	2024	Q3-4 (Moderate)
Clarinbridge_020	RS29C020200	150181	227256	2024	Q3-4 (Moderate)
Clarinbridge_050	RS29C020450	143908	222069	2024	Q3 (Poor)

9.3.7.2 HES Water Quality Monitoring

Field hydrochemistry measurements of unstable parameters, electrical conductivity ($\mu\text{S}/\text{cm}$), pH (pH units) and temperature ($^{\circ}\text{C}$) along with turbidity (NTU) were taken at 4 no. surface water sampling locations over 2 no. monitoring rounds completed on 2nd April and 17th April 2025. The sampling on the 2nd April was completed during a period of prolonged dry weather whilst the sampling on 17th April was preceded by heavy rainfall on the 16th April 2025. The results are listed in Table 9-10 below. The monitoring locations are shown in Figure 9-6.

The surface water samples indicate a neutral to basic type surface water, with pH ranging from 7.65 to 8.21. Dissolved oxygen ranges from 10.64 to 13.06mg/l, with electrical conductivity relatively high ranging from 481.5 to 647 $\mu\text{S}/\text{cm}$. Turbidity ranged from <0.01 to 4.73NTU).

Table 9-7: Field Parameters - Surface Water Chemistry Measurements (02/04/2025 to 17/04/2025)

Location ID	Temp °C	DO (mg/l)	EC (µS/cm)	pH	Turbidity (NTU)
SW1	9 - 11	11.61 - 12.2	613 - 626	8.16 - 8.21	1.26 - 2.09
SW2	7.3 - 9	10.64 - 11.12	481.5 - 493.1	7.89 - 7.95	3.43 - 4.73
SW3	7.8 - 10.4	12.73 - 13.06	601 - 623	7.76 - 7.93	0.77 - 1.09
SW4	8.3 - 9.9	11.27 - 11.28	627 - 647	7.65 - 7.67	<0.01 - 0.86

Surface water grab samples were also taken at these locations for laboratory analysis on 2 no. occasions (2nd April and 17th April). Results of the laboratory analysis are shown alongside relevant water quality regulations in Table 9-11 below. The laboratory reports are attached as Appendix 9-2.

Suspended solid concentrations were below the limit of detection (5mg/l) of the laboratory in 7 of the 8 no. samples. All suspended solid concentrations were well below the S.I 293/1988 threshold limit of 25 mg/l in all samples.

Ammonia concentrations found to be of 'High' status with regards to the threshold of ≤ 0.04 mg/l, as detailed in S.I. 272/2009, during both sampling rounds at SW1, SW3 and SW4. Ammonia concentration was of 'Good' status (≤ 0.065) at SW2 on 17th April. The ammonia concentration exceeded this 'Good' status threshold during the first monitoring round.

Biological Oxygen Demand (BOD) concentrations were of 'High' status threshold of ≤ 1.3 mg/l (S.I. 272/2009) in 6 of the 8 no. samples taken. Both samples obtained from SW2 exceeded the 'Good' status threshold concentration ≤ 1.5 mg/l.

Ortho-phosphate concentrations were below the limit of detection of the laboratory (0.02mg/l) in all samples. All samples achieved 'High' status with regard to ortho-phosphate concentrations (≤ 0.025 mg/l).

Nitrate concentrations were generally below the limit of detection of the laboratory and ranged from < 5 -5.8mg/l. Chloride concentrations ranged from 18.5 to 24.5mg/l.

Table 9-8: Summary Laboratory Surface Water Quality Data (02/04/2025 to 17/04/2025)

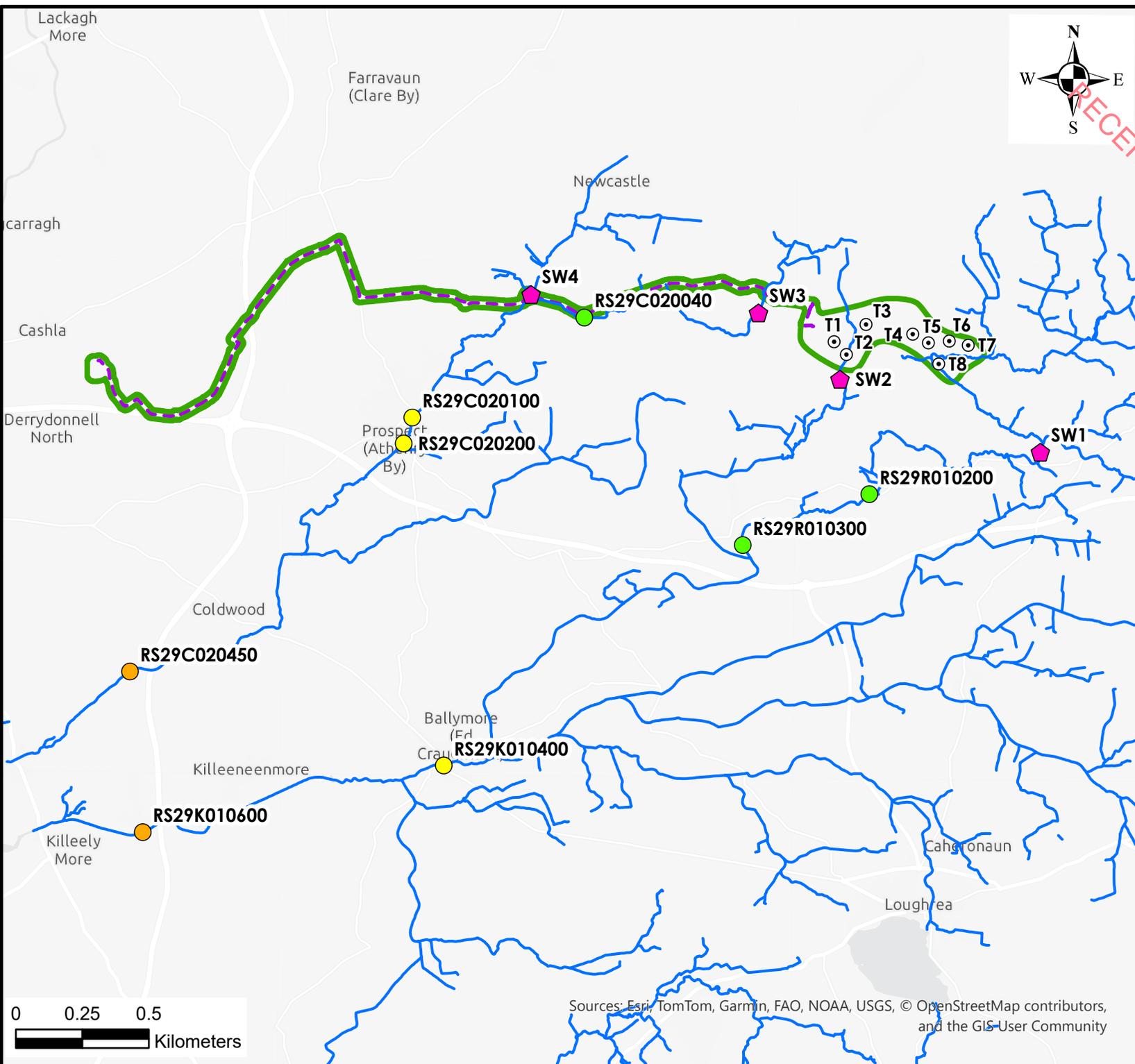
Location ID	Suspended Solids (mg/l)	BOD ₅ (mg/l)	Orthophosphate (mg/l)	Nitrate (mg/l NO ₃)	Ammonia (mg/l)	Chloride (mg/l)
EQS	$\leq 25^{(3)}$	≤ 1.3 to $\leq 1.5^{(4)}$	≤ 0.035 to $\leq 0.025^{(2)}$	-	≤ 0.065 to $\leq 0.04^{(2)}$	-
SW1	<5	<1 to 1	<0.02	<5.0	<0.02	23.8 - 24.5
SW2	<5 - 8	2	<0.02	<5.0	0.06 - 0.08	19.5 - 22.6
SW3	<5	<1 to 1	<0.02	<5.0	<0.02	18.7 - 20.7
SW4	<5	<1	<0.02	5.3 - 5.8	<0.02	18.5 - 20

(+) S.I. No. 293/1988: European Communities (Quality of Salmonid Waters) Regulations, 1988.

(*) S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009.

³ S.I. No. 293/1988: European Communities (Quality of Salmonid Waters) Regulations

⁴ S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy).



- Legend**
- EIA Site Boundary
 - Proposed Turbine Layout
 - Proposed Grid Connection underground cabling route
 - Watercourses
 - ◆ Surface Water Sample Locations
 - EPA Water Quality Monitoring Q-Rating Values
 - Q4 (Good)
 - Q3-4 (Moderate)
 - Q3 (Poor)

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Client: Gannow Ltd.

Job: Gannow Renewable Energy Development, Co. Galway

Title: EPA Monitoring Stations and HES SW Sampling Locations

Figure No: 9-6

Drawing No: P1706-0-0925-A4-906-00A

Sheet Size: A4

Project No: P1706-0

Scale: 1:120,000

Drawn By: GA

Date: 20/09/2025

Checked By: MG



Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS-User Community

9.3.8 Hydrogeology

9.3.8.1 Proposed Wind Farm

The Proposed Wind Farm site is mapped to be underlain by the Dinantian Upper Impure Limestones of the Lucan Formation (www.gsi.ie). The bedrock underlying the Proposed Wind Farm site is classified by the GSI as being a Locally Important Aquifer – Bedrock which is Moderately Productive only in Local Zones.

In terms of Groundwater Bodies (GWBs), the vast majority of the Proposed Wind Farm site is underlain by the Groundwater Dependant Terrestrial Ecosystem – Rahasane Turlough (SAC000322).

A very small area in the west of the Proposed Wind Farm site is underlain by the Loughrea GWB. The Loughrea GWB is characterised by poorly productive bedrock. According to the GSI's Characterisation Report for the Loughrea GWB (GSI, 2004), this GWB occupies the area between Loughrea and Attymon. The GWB is composed primarily of low transmissivity rocks. Most of the groundwater flux is likely to be in the uppermost part of the aquifer: comprising a broken and weathered zone typically less than 3m thick; a zone of interconnected fissuring typically less than 10m; and a zone of isolated fissuring typically less than 150m. Groundwater flow is expected to be concentrated in fractured and weathered zones and in the vicinity of fault zones and karstification is expected to be limited. Recharge occurs diffusely through the subsoils and rock outcrops. Recharge is limited by the low permeability bedrock and in places by low permeability till, thus most of the available recharge discharges rapidly to nearby streams. A small proportion of point recharge occurs via the limited number of swallow holes present. Groundwater flowpaths are short (300m) with groundwater discharging rapidly to nearby streams. The overall groundwater flow direction is to the west.

A bedrock geology aquifer map is attached as Figure 9-7.

9.3.8.1.1 Summary Proposed Wind Farm site Geology

A detailed description of the geology of the Proposed Wind Farm site is presented in Chapter 8: Land, Soils and Geology of this EIAR. A summary is presented here to inform the hydrogeological characterisation of the Proposed Wind Farm site.

Baseline geological data is available from the GSI through their online map viewer (www.gsi.ie). The bedrock across the Proposed Wind Farm site is mapped as the Lucan Formation. Subsoils are predominantly mapped as peat and till derived from limestones.

The site-specific data on the geology of the Proposed Wind Farm site is included in Section 8.3.3.2 of Chapter 8: Land, Soils and Geology of this EIAR. The site-specific data is summarised as follows:

- Peat is present in many areas of the Proposed Wind Farm site with the recorded peat depths ranging from 0 to 7.2m with an average of 1.1m;
- Where present, the peat is typically underlain by low permeability glacial till deposits or shelly marl and lacustrine clay;
- Where peat is not present, the subsoils comprise of glacial tills described as sandy or gravelly silt and clay;
- Therefore, the soils/subsoils at the Proposed Wind Farm site are of low permeability and will restrict groundwater recharge.
- No significant granular deposits were encountered during the site investigations which would indicate the presence of an overburden sand or gravel aquifer.

9.3.8.1.2 Proposed Wind Farm site Field Hydrogeological Data

A total of 12 no. trial pits were excavated at the Proposed Wind Farm site by IDL under the supervision of FTC in October 2024.

Based on these intrusive site investigations it has been determined that the local geology of the Proposed Wind Farm site is characterised by peat and low permeability glacial tills. No significant sand or gravel deposits were encountered in any of the trial pits.

Groundwater inflows were recorded in all 11 of the 12 no. trial pit excavations. Groundwater seepages were recorded in 7 no. trial pits (TP01, TP04, TP05, TP06, TP07, TP09 and TP11) at depth ranging from 0.2 to 1.6mbgl. More significant groundwater ingresses were recorded on the logs of 6 no. trial pits (TP01, TP02, TP03, TP05, TP08 and TP10). Some of these occurred in the same trial pit excavations but at greater depths than the seepages described above. The groundwater ingresses ranged from 1.0 to 3.0mbgl.

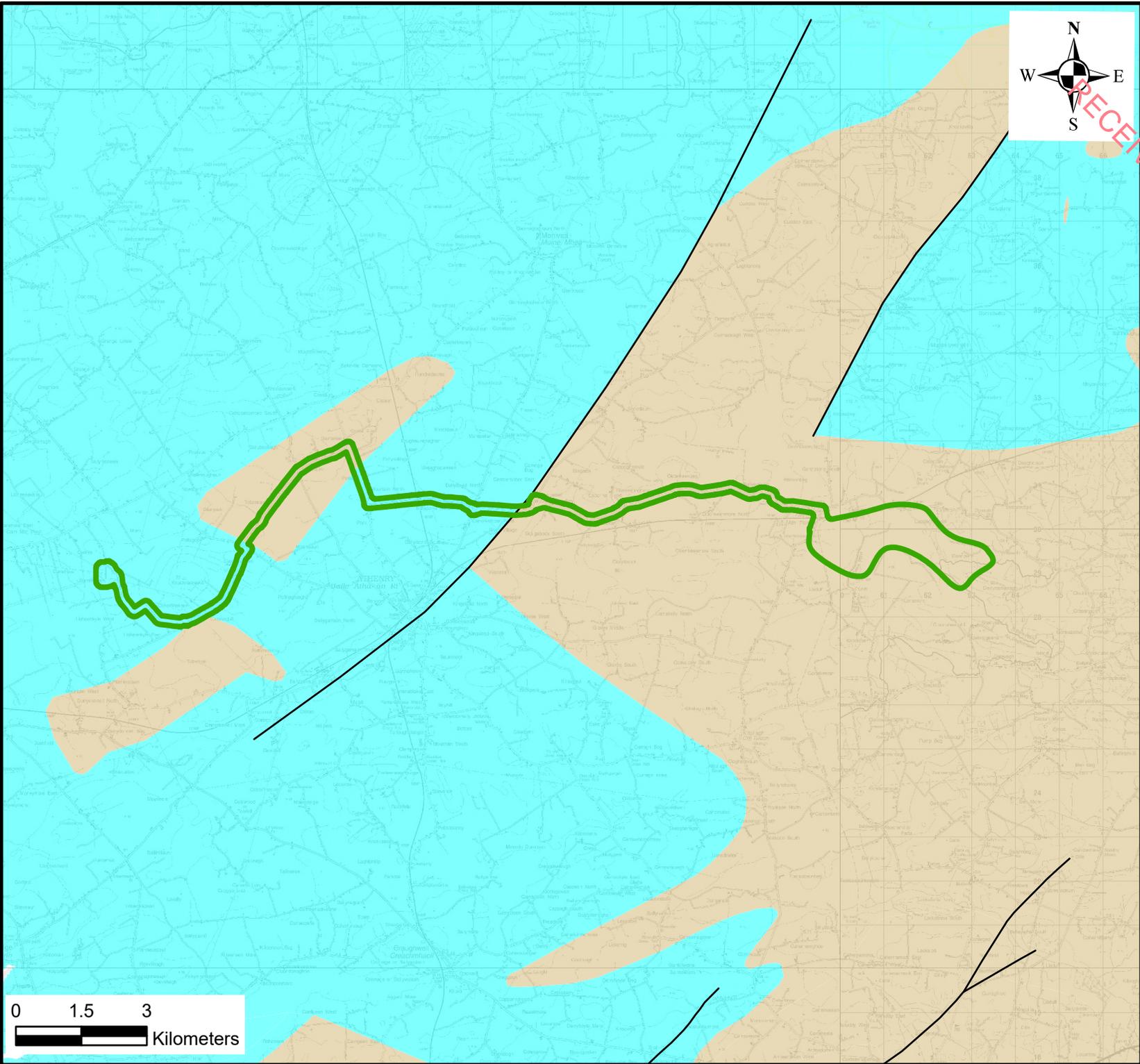
9.3.8.2 Proposed Grid Connection

The eastern section of the Proposed Grid Connection is mapped to be underlain by Locally Important Aquifer – Bedrock which is Moderately Productive only in Local Zones. ~9.6km of the Proposed Grid Connection is underlain by a Regionally Important Aquifer – Karstified (conduit).

In terms of GWBs, much of the eastern section (~7.4km) is underlain by the Loughrea GWB. A small section in the vicinity of the Proposed Wind Farm is also underlain by the GWDTE – Rahasane Turlough GWB.

Much of the western section of the Proposed Grid Connection is underlain by the Clarinbridge GWB. According to the GSI's Characterisation Report for the Clarinbridge GWB (GSI, 2004), this GWB is composed primarily of high transmissivity karstified limestone. A large number of karst features occur, including turloughs, caves, dolines, swallow holes and springs. Recharge occurs via point and diffuse mechanisms. Point recharge occurs via swallow holes and via discrete sinks located in the beds of the main rivers. In general, the degree of interconnection in karstic systems is high and they support regional scale flow systems. Surface water catchments are often bypassed by groundwater flowing beneath surface water channels and across surface water catchment divides. Most of the groundwater flow occurs in the upper epikarstic layer and in a zone of interconnected solutionally enlarge bedding planes and fissures, generally extending to a depth of 30m. Groundwater storage in karstified bedrock is low and the potential for contaminant attenuation in such aquifers is limited.

In addition, ~2.2km of the Proposed Grid Connection in the vicinity of the M6 is underlain by the GWDTE-Galway Bay Complex Fens (SAC000268).



Legend

- EIAR Site Boundary
- Mapped Faults
- Bedrock Aquifer
 - RkC - Regionally Important Aquifer - Karstified (conduit)
 - LI - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones



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Client: Gannow Ltd.

Job: Gannow Renewable Energy Development, Co. Galway

Title: Local Bedrock Aquifer Map

Figure No: 9-7

Drawing No: P1706-0-0925-A4-907-00A

Sheet Size: A4

Project No: P1706-0

Scale: 1:120,000

Drawn By: GA

Date: 19/09/2025

Checked By: MG

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Kilometers

9.3.9 Groundwater Vulnerability

9.3.9.1 Proposed Wind Farm site

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

The vulnerability rating of the majority of bedrock aquifer underlying the Proposed Wind Farm site is mapped by the GSI to range from Low to Extreme. The vast majority of the Proposed Wind Farm site is mapped in areas of Low to Moderate vulnerability. Both T5 and T8 are mapped in areas with High to Extreme vulnerability. The proposed onsite 38kV substation is mapped in an area of Moderate to Low groundwater vulnerability.

Site investigations at the Proposed Wind Farm site comprising of trial pits and peat probes have revealed the presence of low permeability peat and glacial till subsoils across the Proposed Wind Farm site. With regards to the areas mapped by the GSI as having high and extreme groundwater vulnerability:

- TP05 completed in the vicinity of T5 extended to a depth of 2.8mbgl and encountered 0.7m of peat overlying gravelly silt and clays.
- HES completed 2 no. gouge cores at T08 which encountered 2.25m peat over shelly marl and lacustrine clay to depths in excess of 3mbgl.
- Therefore, based on site specific data, a significant proportion of potential groundwater recharge at T05 and T08 will be rejected due to the low permeability of the local soils and subsoils.

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

Table 9-9: Groundwater Vulnerability and Subsoil Permeability and Thickness (Groundwater Protection Schemes Report 1999)

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

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

9.3.9.2 Proposed Grid Connection

Groundwater vulnerability along the Proposed Grid Connection ranges from Low to Extreme. ~10.64km of the Proposed Grid Connection is mapped in areas of Extreme groundwater vulnerability, with an additional ~7.6km mapped in areas of high vulnerability.

The areas of high and extreme vulnerability are located predominantly in the western section of the Proposed Grid Connection. Groundwater vulnerability is extremely high in karst areas due to the high degree of interconnection between surface and groundwaters in these areas. There are several mapped karst landforms along the western section of the Proposed Grid Connection. Groundwater will be most vulnerable to potential effects in areas of High and Extreme vulnerability which are located in the Regionally Important Karst Aquifer.

9.3.10 Karst Features

9.3.10.1 Proposed Wind Farm site

According to the GSI Groundwater Resources mapping (www.gsi.ie) the bedrock underlying the Proposed Wind Farm site is a Locally Important Aquifer that is Moderately Productive in Local Zones. The bedrock is not identified as being a karst aquifer.

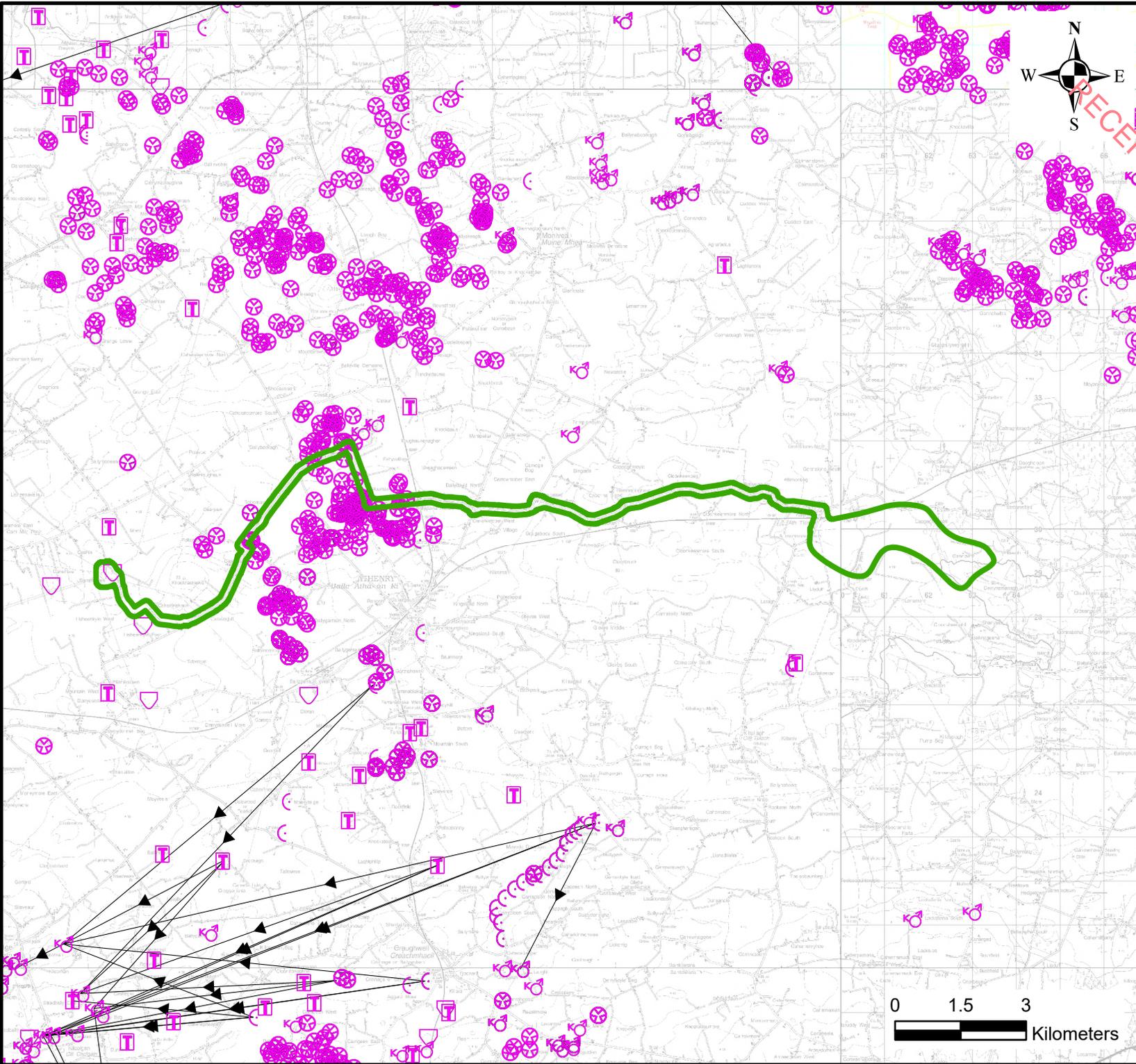
Furthermore, the GSI karst features database (www.gsi.ie) does not record the presence of any karst features within the Proposed Wind Farm site. The closest mapped karst features are a turlough and 2 no. swallow holes mapped ~2.5km southwest of T2.

No karst features were recorded during the walkover surveys of the Proposed Wind Farm site or during the intrusive site investigations.

9.3.10.2 Proposed Grid Connection

The GSI karst features database (www.gsi.ie) does not record the presence of any karst features in the eastern section of the Proposed Grid Connection which is underlain by the Lucan Formation. Numerous karst features are mapped in the western section of the Proposed Grid Connection which is underlain by the Burren Formation. The Burren Formation is described by the GSI as a Regionally Important Karst Aquifer.

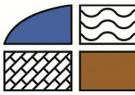
The GSI map a high density of enclosed depressions in the vicinity of the Proposed Grid Connection along the R347 and the adjacent sections of local roads to the east and west. Further, to the southwest several enclosed depressions are also mapped in the townland of Castlelambert. Finally, a cave is mapped near the existing Cashla 220kV substation in the townland of Barrettspark.



Legend

-  EIAR Site Boundary
- Karst Features**
 -  Cave
 -  Enclosed Depression
 -  Spring
 -  Swallow Hole
 -  Turlough
 -  Tracer Lines

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Title: GSI Karst Features Map

Figure No: 9-8

Drawing No: P1706-0-0925-A4-908-00A

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Project No: P1706-0

Scale: 1:120,000

Drawn By: GA

Date: 19/09/2025

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9.3.11 Groundwater Hydrochemistry

9.3.11.1 Proposed Wind Farm

The hydrogeological regime at the Proposed Wind Farm site is characterised by high rates of surface water runoff and low rates of groundwater recharge. There is no site-specific groundwater quality data available for the Proposed Wind Farm site. Groundwater sampling would generally not be undertaken for this type of development in terms of EIAR reporting, as groundwater quality effects are extremely unlikely. There are also no proposed discharges to ground associated with the Proposed Wind Farm.

Furthermore, there is no groundwater hydrochemistry data available from the GSI relating to the GWDTE-Rahasane Turlough (SAC000322) GWB.

The GSI's Characterisation Report for the Loughrea GWB (GSI, 2004) states the Dinantian Upper Impure Limestones are typically hard to very hard (total hardness ranging from 256-440mg/l and alkalinity ranging from 244-408mg/l CaCO₃). The groundwater has a calcium bicarbonate signature (CaHCO₃). The GSI state that there no data for electrical conductivity in this GWB but that it is expected to be similar to the national average for Dinantian Limestone of 690µS/cm.

9.3.11.2 Proposed Grid Connection

The Proposed Grid Connection is underlain by a total of 4 no. GWBs.

The available hydrochemical data for the Loughrea GWB is presented above. No hydrochemical data is available for the GWDTE – Rahasane Turlough or the GWDTE-Galway Bay Complex Fens GWBs.

The GSI's Characterisation Report for the Clarinbridge GWB (GSI, 2004) states that groundwaters in this area are typically hard to very hard. Hardness ranges from 300-372mg/l CaCO₃ at Clarinbridge to 197-400mg/l CaCO₃ at Athenry. Electrical conductivities range from 607-725 µS/cm at Clarinbridge and 494-743µS/cm at Athenry. The Clarinbridge GWB also has high alkalinity, with a calcium carbonate signature (276-348mg/l CaCO₃ for Clarinbridge and 154-376mg/l CaCO₃ for Athenry). Surface water derived from the Loughrea GWB have higher concentrations of dissolved iron (0.2-0.7 mg/l in the Lavally River).

9.3.12 Water Framework Directive Water Body Status & Objectives

The River Basin Management Plan was adopted in 2018 and has amalgamated all previous river basin districts into one national river basin management district. The Water Action Plan 2024 is Ireland's third River Basin Management Plan and it outlines the measures the Government and other sectors are taking to improve water quality in Ireland's groundwater, rivers, lakes, estuarine and coastal waters, and provides sustainable management of our water resources. The Water Action Plan 2024 enhances and builds upon the work of the first and second-cycle plans. The Water Action Plan objectives, which have been integrated into the design of the Proposed Project, include the following:

- Ensure full compliance with relevant EU legislation
- Prevent deterioration.
- Meet the water standards and objectives for designated protected areas.
- Protect high-status waters.
- Implement targeted actions and pilot schemes in focus sub-catchments aimed at (i) targeting water bodies close to meeting their objective and (ii) addressing more complex issues that will build knowledge for future cycles.

Our understanding of these objectives is that surface waters, regardless of whether they have ‘Poor’ or ‘High’ status, should be treated the same in terms of the level of protection and mitigation measures employed, i.e. there should be no negative change in status at all.

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.

9.3.12.1 Groundwater Body Status

Local Groundwater Body (GWB) status information is available from www.catchments.ie and the available information is summarised in Table 9-10.

The Loughrea, Clarinbridge, GWDTE – Rahasane Turlough and the GWDTE-Galway Bay Complex Fens GWBs all achieved ‘Good’ status in all 3 no. WFD cycles. The GWDTE – Rahasane Turlough GWB is deemed to be ‘at risk’ of failing to meet its WFD objectives. Agriculture and domestic wastewater have been identified as significant pressures on this GWB. The Loughrea, Clarinbridge and the GWDTE-Galway Bay Complex Fens GWBs have been deemed to be ‘not at risk’ of failing to meet their respective WFD objectives. No significant pressures have been identified to be impacting these GWBs.

Table 9-10: WFD Groundwater Body Status

Groundwater Body	Status 2010-2015	Status 2013-2018	Status 2016-2021	3 rd Cycle Risk Status	WFD Pressures
GWDTE-Rahasane Turlough	Good	Good	Good	At risk	Agriculture and Domestic wastewater
Loughrea	Good	Good	Good	Not at risk	None
Clarinbridge	Good	Good	Good	Not at risk	None
GWDTE-Galway Bay Complex Fens (SAC000268)	Good	Good	Good	Not at risk	None

9.3.12.2 Surface Water Body Status

A summary of the WFD status and risk result of Surface Water Bodies (SWBs) in the vicinity and downstream of the Proposed Project are shown in Table 9-14 below.

Within the Raford_SC_010 sub-catchment, the eastern section of the Proposed Wind Farm site is mapped within in Raford_020 WFD river sub-basin. The Raford_020 SWB achieved ‘Moderate’ status in all 3 no. WFD cycles. The western section of the Proposed Wind Farm site is mapped in the Raford_030 WFD river sub-basin. This SWB achieved ‘Good’ status in all 3 no. WFD cycles. Further downstream, the status of the Kilcolgan River ranges from ‘Poor’ (Kilcolgan_030 and _040 SWBs) to ‘Moderate’ (Kilcolgan_050 SWB).

With regards to risk status, the Raford_020, Kilcolgan_030 and Kilcolgan_040 SWBs have been deemed to be ‘at risk’ of failing to meet their respective WFD objectives. The Raford_020 SWB in the

vicinity of the Proposed Wind Farm site is under significant pressure from agriculture and domestic wastewater. The risk status of the Raforde_030 and Kilcolgan_050 SWBs is currently 'under review'.

Within the Clarinbridge_SC_010 sub-catchment, the Proposed Grid Connection is mapped in the Clarinbridge_010 and the Clarinbridge_020 WFD river sub-basins. The Clarinbridge_010 SWB achieved 'Good' status in the last 2 no. WFD Cycles (2013-2018, and 2016-2021). The Clarinbridge_020 SWB achieved 'Moderate' status. Further downstream, the status of the Clarinbridge River (Clarinbridge_030, _040 and _050 SWBs) is 'Poor'.

With regards to risk status, the Clarinbridge_010 SWB is deemed to be 'not at risk' whilst the risk status for the Clarinbridge_020 SWB is currently 'under review'. Urban wastewater has been listed as a pressure on the Clarinbridge_020 SWB. Further downstream, the Clarinbridge River (Clarinbridge_030, _040 and _050 SWBs) is 'at risk'. Urban wastewater is also listed as a significant pressure on the Clarinbridge_030 and _040 SWBs.

Within the Carrowmoneash [Oranmore]_SC_010 sub-catchment, the Proposed Grid Connection is mapped within the Carrowmoneash (Oranmore)_010 river sub-basin. Within this river sub-basin there are no SWBs in close proximity to the Proposed Grid Connection. The Carrowmoneash (Oranmore)_010 SWB achieved "Poor" status in the latest WFD cycle, having been "Unassigned" for both the 1st and 2nd WFD cycles. The risk status for this SWB is currently 'under review'. Domestic wastewater and urban run-off have been identified as significant pressures.

Table 9-11: Summary WFD Information for Surface Water Bodies

River Waterbody	Status 2010-2015	Status 2013-2018	Status 2016-2021	3 rd Cycle Risk Status	WFD Pressures
Raford_020	Moderate	Moderate	Moderate	At risk	Domestic Waste Water, and agriculture pressure
Raford_030	Good	Good	Good	Under review	None
Kilcolgan_030	Moderate	Bad	Poor	At risk	Agriculture, Hydromorphology, Industry, and Urban Wastewater Pressures
Kilcolgan_040	Moderate	Poor	Poor	At risk	Agriculture, Hydromorphology, Industry and Domestic Wastewater Pressures
Kilcolgan_050	Unassigned	Moderate	Moderate	Under Review	None
Clarinbridge_010	Moderate	Good	Good	Not at risk	None
Clarinbridge_020	Unassigned	Moderate	Moderate	Under Review	Urban waste water
Clarinbridge_030	Poor	Poor	Poor	At risk	Urban waste water
Clarinbridge_040	Poor	Poor	Poor	At risk	Urban waste water
Clarinbridge_050	Poor	Poor	Poor	At risk	Agriculture, Domestic Waste Water, Urban run-off
Carrowmonash (Oranmore)_010	Unassigned	Unassigned	Poor	Under Review	Domestic waste water, Urban waste water
Dunbulcaun Bay	Unassigned	High	Good	Not at risk	None
Inner Galway Bay South	Unassigned	Good	High	Not at risk	None

9.3.13 Designated Sites and Habitats

9.3.13.1 Proposed Wind Farm

Within the Republic of Ireland, 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). A map of local designated site for the area is attached as Figure 9-9 below.

The Proposed Wind Farm site is not located within any designated site. However, there are downstream hydrological connections to some designated sites as described below:

- The Raford River Bog NHA (Site Code 000321) is located ~0.4km to the east of the Proposed Wind Farm site. This NHA is hydrologically connected with the Proposed Wind Farm site via the Raford River. This NHA is comprised of a raised bog which includes both areas of high and cutover bog.
- The Rahasane Turlough SAC/pNHA (Site Code: 000322) and SPA (Site Code: 004089) is located ~14km to the southwest of the Proposed Wind Farm site. This SAC comprises of 2 no. basins which are connected at times of flood. Rahasane Turlough used to be the natural sink of the Dunkellin River but now an artificial channel takes some of the water further downstream. Water escapes the channel and flows into active swallow-ole systems. This SAC/pNHA and SPA is hydrologically connected to the Proposed Wind Farm site via the Killimor, Raford and Kilcolgan rivers.
- The Galway Bay Complex SAC/pNHA (Site Code: 000268) is located ~21km to the southwest of the Proposed Wind Farm site. This site comprises of the inner, shallow part of a large bay and is hydrologically connected to the Proposed Wind Farm site via the Killimor, Raford and Kilcolgan rivers.
- The Inner Galway Bay SPA (Site Code: 004031) is located ~21km to the southwest of the Proposed Wind Farm site. This SPA is hydrologically connected to the Proposed Wind Farm site via the Killimor, Raford and Kilcolgan rivers.

Other designated sites within 10km of the Proposed Wind Farm site include:

- The Lough Corrib SAC (Site Code: 000297), located ~3.5km to the northwest;
- The Lough Tee Bog NHA (Site Code: 000307), located over 3km to the north of the Proposed Wind Farm site;
- Monivea Bog pNHA (Site Code: 000311) and SAC (Site Code: 002352) located ~5.3km to the northwest;
- Tiaquin Bog pNHA (Site Code: 001709), located ~6.5km to the northwest; and,
- Callow Lough pNHA (Site Code: 001239), located ~9.7km to the northeast.

These sites are located upstream and upgradient of the Proposed Wind Farm site.

9.3.13.2 Proposed Grid Connection

The Proposed Grid Connection is not located within or adjacent to any designated site. However, there are downstream hydrological connections to several designated site as described below:

- The Galway Bay Complex SAC/pNHA (Site Code: 000268) is located ~4.5km to the southwest of the Proposed Grid Connection. The SAC/pNHA is hydrologically connected to the Proposed Grid Connection via the Clarinbridge River.
- The Inner Galway Bay SPA (Site Code: 004031) is located ~6.4km to the southwest of the Proposed Grid Connection. This SPA is hydrologically connected to the Proposed Grid Connection via the Clarinbridge River.
- Rahasane Turlough SAC (Site Code: 000322) is located ~9.7km south of the Proposed Grid Connection.

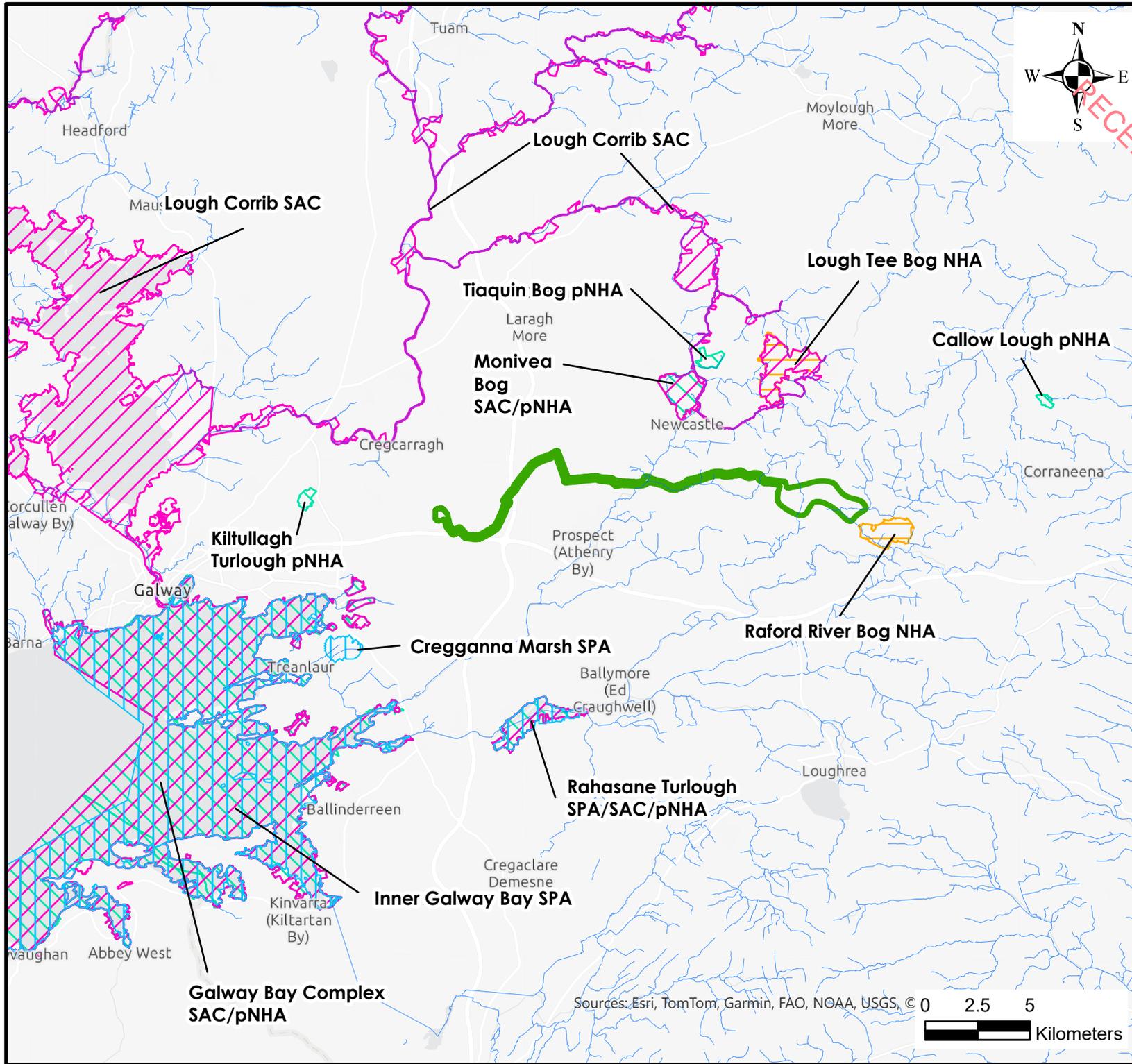
Other designated sites within 10km of the Proposed Grid Connection include:

- Cregganna Marsh SPA (Site Code: 004142) and NHA (Site Code: 000253) is located ~6.8km to the southwest of the Proposed Grid Connection. There are no direct hydrological connections. However, given the karstic nature of the local bedrock indirect hydrogeological connections may exist.
- Lough Corrib SAC (Site Code: 000297) is located ~3.7km to the northwest of the Proposed Grid Connection. There are no direct hydrological connections. However, given the karstic nature of the local bedrock indirect hydrogeological connections may exist.

- Kiltullagh Turlough pNHA (Site Code: 000287) is located ~6km west of the Proposed Grid Connection. There are no direct hydrological connections. However, given the karstic nature of the local bedrock indirect hydrogeological connections may exist.

Monivea Bog pNHA, Lough Tee Bog NHA, Killaclogher Bog NHA and Tiaquin Bog pNHA are all located to the north and upstream/upgradient of the Proposed Grid Connection to the west of Atymon.

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

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Client: Gannow Ltd.

Job: Gannow Renewable Energy Development, Co. Galway

Title: Designated Sites Map

Figure No: 9-9

Drawing No: P1706-0-0925-A4-909-00A

Sheet Size: A4

Project No: P1706-0

Scale: 1:250,000

Drawn By: GA

Date: 19/09/2025

Checked By: MG

Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © 0 2.5 5 Kilometers

9.3.14 Water Resources

9.3.14.1 Surface Water Resources

There are no surface water abstractions for drinking water located downstream of the Proposed Wind Farm site on the Raford, Killimor or Kilcolgan Rivers. Furthermore, there are no surface water abstractions for drinking water located downstream of the Proposed Grid Connection along the Clarinbridge River.

The Corrib Lower Drinking Water Protected Area (DWPA, relating to the abstraction at Luimnagh WTP) is located ~13km to the west of the Proposed Grid Connection underground terminus at the existing Cashla 200kV substation. There is a distinct lack of surface water features in the area of the Proposed Grid Connection that would provide a hydrological connection to this DWPA. The closest mapped watercourse to the Cashla 220kV substation is ~2.8km to the northwest. Further downstream this stream discharges into the Clare (Galway) River which in turn discharges into the Lough Corrib.

9.3.14.2 Groundwater Resources

The Raford River within the Proposed Wind Farm site is mapped in the Outer Source Protection Area of the Rhynn Killeeneen Group Water Scheme (GWS). 1 no. watercourse crossing within the Proposed Wind Farm site is mapped to cross this Outer Source Protection Area. Further details on this GWS are provided in Section 9.3.14.2.1 below.

A search of private well locations (accuracy of 1 – 50m only) was undertaken using the GSI well database (www.gsi.ie). No such wells were identified either within or adjacent to the Proposed Wind Farm site. There is 1 no. well mapped adjacent to the northwest at Attymon with a locational accuracy of 1km. This well (Well ID: 1423SEW008) has a ‘Excellent’ yield class and used for domestic and agricultural purposes.

It is accepted that the GSI database does not include all potential water wells. As such, and in order to be conservative, for the purposes of assessment, as completed in Section 9.5.2.11, we assume that there is a groundwater well source at each local house location as identified in Chapter 5: Population and Human Health of this EIAR: Population & Human Health.

An information request was submitted to Uisce Éireann for the location of all Uisce Éireann groundwater abstraction locations within 5km of the Proposed Wind Farm site. No groundwater abstractions were identified.

With respect to the Proposed Grid Connection, 4 no. watercourse crossings are proposed over the Clarinbridge River which forms part of the Outer Source Protection Area of the Brockagh Lisduff Group Water Scheme. Further details on this GWS are provided in Section 9.3.14.2.2 below.

A search of private well locations (accuracy of 1 – 50m only) was also completed using the GSI well database (www.gsi.ie) for wells along the Proposed Grid Connection. 3 no. wells were identified along the route.

- A well (GSI Well ID: IE_GSI_GW_Well_8540) has a locational accuracy of 50m and is assigned a ‘Good’ yield class. This well is mapped along the R347 and is stated as being for the Carnaun, Castle Ellen GWS. Note that the GSI’s database of Group and Public Water Supplies does not identify this GWS. Nevertheless, for the purposes of a conservative assessment it is assumed that a supply exists at this location.
- A well (GSI Well ID: IE_GSI_GW_Well_8656) is located along the Proposed Grid Connection in the townland of Castlelambert and is reported as having an excellent yield class and used for agriculture and domestic uses.

- A well (GSI Well ID: IE_GSI_GW_Well_8561) is located ~150m east of the Proposed Grid Connection in the townland of Castlambert. This well is associated with the Castlambert GWS. Note that the GSI's database of Group and Public Water Supplies does not identify this GWS. Nevertheless, for the purposes of a conservative assessment it is assumed that a supply exists at this location.
- A well (GSI Well ID: IE_GSI_GW_Well_8697) is located ~750m south of the Proposed Grid Connection in the townland of Lisheenkyle East. This well is associated with the Palmerstown PWS. Note that the GSI's database of Group and Public Water Supplies does not identify this GWS. Nevertheless, for the purposes of a conservative assessment it is assumed that a supply exists at this location.
- A well (GSI Well ID: IE_GSI_GW_Well_8677) is located ~1.1km to the northwest of the Proposed Grid Connection in the townland of Cashla. This well is associated with the Cashla, Athenry GWS. Note that the GSI's database of Group and Public Water Supplies does not identify this GWS. Nevertheless, for the purposes of a conservative assessment it is assumed that a supply exists at this location.
- A well (GSI Well ID: IE_GSI_GW_Well_8676) is located ~1.1km to the northwest of the Proposed Grid Connection in the townland of Cartymore. This well is associated with the Cartymore GWS. Note that the GSI's database of Group and Public Water Supplies does not identify this GWS. Nevertheless, for the purposes of a conservative assessment it is assumed that a supply exists at this location.

A map of local groundwater wells and Source Protection Areas is included as Figure 9-10 below.

9.3.14.2.1 **Ryhnn Killeeneen Group Water Scheme**

The GSI's Establishment of Groundwater zones of Contribution, Ryhnn Killeeneen Group Water Scheme, Co. Galway (GSI/Arup, 2018) was consulted in order to provide additional information in regard to this GWSs and its associated Source Protection Area.

The Ryhnn Killeeneen GWS is supplied by a borehole located in Ryhnn, ~6km southwest of Craughwell. The borehole abstracts groundwater that flows through conduits in a Regionally Important karstified limestone aquifer. The GWS abstracts 100m³/day and has ~184 no. connections.

With regards to the Source Protection Area, rainfall falling within the main zone of contribution infiltrates to ground until it reaches the bedrock aquifer where it easily enters the groundwater system and travels through the existing conduit and fracture network in the karstified limestone bedrock. The main zone of contribution has been delineated by a combination of hydrogeological mapping, geological boundaries and recharge and water balance calculations. The delineated area is larger than the calculated area to account for longer flowpaths which may be present in karstified bedrock. The Proposed Wind Farm is located ~13.3km to the northeast of this delineated main Source Protection Area.

The Source Protection Area is extended along the Dunkellin River which flows from east to west through the zone of contribution. A swallow hole is mapped along this river in the eastern section of the zone of contribution. The GSI also map several turloughs in the local area. Water entering the swallow hole may also enter the abstraction. No tracer tests have been completed to prove that this connection exists. The GSI include the Dunkellin River in the Source Protection Area as water from the river may be reaching the abstraction point via this swallow hole. Upgradient of the swallow hole a 20m buffer has been included on the river as water entering the river may reach the swallow hole and end up at the abstraction point.

The GSI (2018) recommended the completion of tracer tests at the swallow hole which would be useful to test the connection between the swallow hole and the abstraction borehole. If there was no connection, the 20m buffer along the Dunkellin River upgradient of the swallow hole could be removed from the Source Protection Area.

Brockagh Lisduff Group Water Scheme

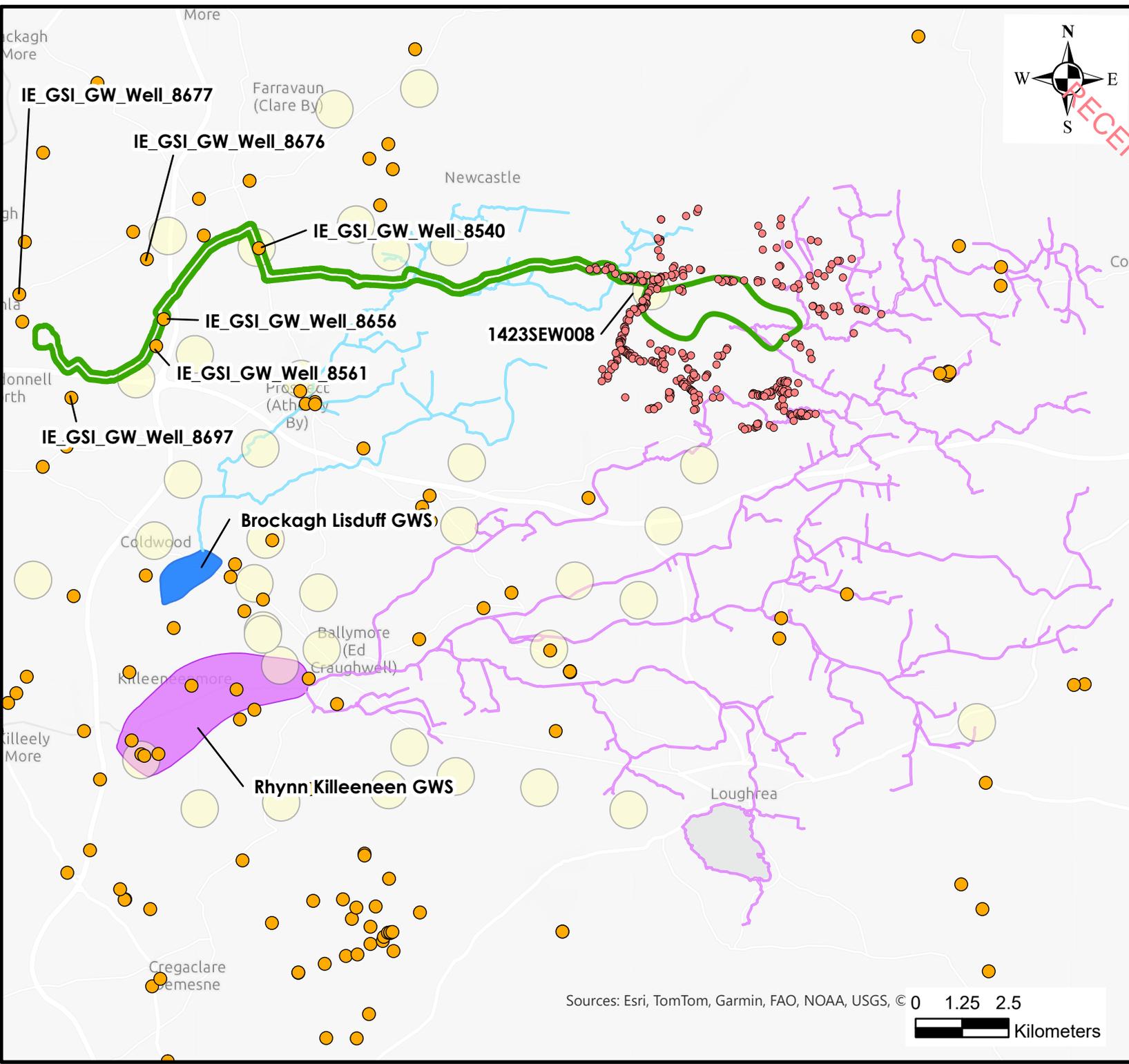
The GSI's Establishment of Groundwater zones of Contribution, Brockagh Lisduff Group Water Scheme, Co. Galway (GSI/Arup, 2018) was consulted in order to provide additional information in regard to this GWSs and its associated Source Protection Area.

The Brockagh Lisduff GWS is supplied by a borehole located in Caherbulligin, ~5km northwest of Craughwell. The borehole abstracts groundwater that flows through conduits in a Regionally Important karstified limestone aquifer. The GWS abstracts 108m³/day and serves ~25 no. farms.

With regards to the Source Protection Area, rainfall falling within the main zone of contribution infiltrates to ground until it reaches the bedrock aquifer where it easily enters the groundwater system and travels through the existing conduit and fracture network in the karstified limestone bedrock. The main zone of contribution has been delineated by a combination of hydrogeological mapping, geological boundaries and recharge and water balance calculations. The delineated area is larger than the calculated area to account for longer flowpaths which may be present in karstified bedrock. The Proposed Grid Connection is located ~11.3km to the northeast of this delineated main Source Protection Area.

The Source Protection Area includes a section of the Clarinbridge/Lavally River, where a swallow hole is also present. According to GSI records no tracer tests have been completed on this swallow hole and the discharge point is unknown. Therefore, flow into the swallow hole may be reaching the abstraction point. Consequently, the Source Protection Area includes a 20m buffer around the river upgradient of the swallow hole as water entering the river may enter the swallow hole and subsequently the abstraction point.

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- Legend
- EIAR Site Boundary
 - Local Dwellings
 - GSI Mapped Wells
 - accuracy to 50m
 - accuracy to 1km
 - Group Water Scheme
 - Brockagh Lisduff
 - ZOC Brockagh Lavalley River And Tributaries
 - Rhynn Killeeneen
 - ZOC Rhynn Killeeneen

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Client: Gannow Ltd.

Job: Gannow Renewable Energy Development, Co. Galway

Title: Map of Groundwater Wells and Water Supplies

Figure No: 9-10

Drawing No: P1706-0-0925-A4-910-00A

Sheet Size: A4

Project No: P1706-0

Scale: 1:140,000

Drawn By: GA

Date: 19/09/2025

Checked By: MG

Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © 0 1.25 2.5
 Kilometers

9.3.15 Receptor Sensitivity

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

Due to the nature of wind farm developments (and associated grid connections), 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 risks to groundwater at the Site would be from cementitious materials, hydrocarbon spillage and leakages, and potential piling works. Some of these (cementitious materials, hydrocarbon spillage and leakages, suspended sediment entrainment) 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 potential effects.

The following groundwater receptors are identified for impact assessment:

- The Locally Important Bedrock Aquifer underlying the Proposed Wind Farm site. This aquifer can be considered as being of Medium Importance (refer to Table 9-);
- The Locally Important and the Regionally Important Aquifer – karstified (conduit) aquifers along the Proposed Grid Connection. The Locally Important Bedrock Aquifer is of Medium Importance whilst the Regionally Important Aquifers are of Very High Importance;
- The WFD status of the GWBs underlying the Proposed Wind Farm site (i.e. Loughrea and the GWDTE – Rahasane Turlough GWBs) and the Proposed Grid Connection (Loughrea, GWDTE – Rahasane Turlough, Clarinbridge, Galway Bay Complex Fens GWBs);
- The Rhyhn Killeeneen GWS downgradient of the Proposed Wind Farm site;
- The Brockagh Lisduff GWS downgradient of the Proposed Grid Connection;
- Local private groundwater abstractions in the lands surrounding the Proposed Wind Farm site; and,
- Local groundwater abstractions, including the abstractions for the Carnaun, Castle Ellen GWS, the Castlambert GWS, the Palmerstown PWS, the Cashla, Athenry GWS and the Cartymore GWS, along the Proposed Grid Connection.

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

The quantification of flow volumes presented in Section 9.3.4 indicates that the watercourses in the immediate vicinity of the Proposed Wind Farm site will be most susceptible to potential effects. Further downstream, the watercourses will be less susceptible to potential effects due to increasing flow volumes which provide a greater dilution effect. A quantitative analysis of flow volumes has shown that due to dilution no effects associated with the Proposed Wind Farm will occur downstream of EPA HydroTool Node 29_174 on the Kilcolgan River upstream of Craughwell.

The following surface water receptors are identified for impact assessment:

- The Raford, Killimor and Kilcolgan Rivers. The Raford River can be considered to be of Very High Important whilst the Kilcolgan River is of Medium to High Importance (refer to Table 9-2) based on their assigned Q-ratings (Q4);

- All watercourses along the Proposed Grid Connection including the Clarinbridge River which is considered to be of Medium to Very High Importance based on its Q-ratings; and,
- The WFD status of all SWBs downstream of the Proposed Project.

The Corrib Lower DWPA is also included for the purposes of a conservative assessment. This surface water abstraction is located ~13km to the west of the Proposed Grid Connection underground terminus at Cashla substation.

In terms of designated sites, only those designated sites which are hydrologically/hydrogeologically linked with the Site will be included in the impact assessment. These include:

- The Raforde River Bog NHA which is located downstream of the Proposed Wind Farm;
- The Rahasane Turlough SAC/pNHA and SPA which is located downstream of the Proposed Wind Farm site via the Raforde and Kilcolgan rivers;
- The Galway Bay Complex SAC/pNHA which is located downstream of the Proposed Grid Connection along the Clarinbridge River;
- The Inner Galway Bay SPA which is located downstream of the Proposed Grid Connection along the Clarinbridge River;
- The Cregganna Marsh SPA and NHA, the Lough Corrib SAC and the Kiltullagh Turlough pNHA are included in the impact assessment due to the potential hydrogeological connection, via the karst bedrock, with the Proposed Grid Connection.

All other designated sites are screened out of the impact assessment due to the lack of hydrological/hydrogeological connection to the Proposed Project or the significant distance between the Site and these designated sites.

9.4

Characteristics of the Proposed Project

The Proposed Project is defined in full in Chapter 4: Description of the Proposed Project.

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

- Establishment of the 2 no. temporary construction compounds within the Proposed Wind Farm site, and the emplacement of the construction compounds. Note that the eastern temporary construction compound includes the proposed met mast location. Runoff from these construction areas have the potential to effect surface water quality.
- Construction of the new proposed internal site access roads (6.1km) and the 0.5km of new access road along the Proposed Grid Connection. These activities have the potential to impact on surface water quality.
- Construction of the crane hardstand areas and turbine assemblage areas will utilise ground bearing foundations. This will involve the importation of material from local appropriately authorised quarries. Construction of these areas has the potential to impact on surface water quality.
- Construction of the onsite substation will be completed with a ground bearing foundation. Wastewater effluent will be collected in an underground concrete holding tank and periodically emptied by a licenced contractor for the operational phase of the Proposed Project. Construction of the onsite substation and associated parking area has the potential to effect surface water quality.
- Construction of the foundations for the 8 no. proposed turbines. Volumes of peat and spoil generated by construction is estimated to be 89,750m³ and 37,700m³ respectively.

- The movement of large volumes of peat and spoil have the potential to effect surface water quality.
- Based on the site-investigation data it is likely that piled foundations will be required at the majority of the turbine foundations. Gravity foundations may be constructed at T4, T5 and T6 subject to confirmatory ground investigations prior to construction to confirm the depth to bedrock. The use of piled foundations has the potential to affect local groundwater quality.
 - Construction of the proposed turbine foundations will require large volumes of concrete which will be sourced from local concrete batching plants / quarries. Concrete could affect surface water and groundwater quality.
 - Cabling between turbine locations and the onsite substation will involve the excavation of a shallow trench (approximately 1.2m deep), placement of ducting and backfilling with aggregate, lean-mix concrete, and excavated material, as appropriate (depending on the location of the cable trench). These works have the potential to impact on surface water quality.
 - Construction of the Proposed Grid Connection underground electrical cabling between the proposed onsite 38kV substation and the Cashla 220kV substation will involve the excavation of a trench, placement of ducting and backfilling with lean-mix concrete and compacted engineered fill. These works have the potential to impact on surface water quality.
 - Settlement ponds where constructed will be volume neutral, i.e. all material excavated will be used to form side bunds and landscaping around the ponds. There will be no excess material from settlement pond construction. The material will also be reinstated during decommissioning.
 - Grey water will be supplied by rainwater harvesting and water tankered to site where required. A groundwater well may also be installed adjacent to the substation, and it will be drilled and installed in accordance with the Institute of Geologists Ireland, Guide for Drilling Wells for Private Water Supplies (IGI, 2007). Alternatively, bottled water will also be used for potable supply.
 - Storage of excavated peat and spoil within the proposed peat and spoil management areas within the Proposed Wind Farm site has the potential to impact surface water quality.
 - Tree felling and replanting of forestry at alternative replacement lands. It is estimated that ~7.5ha of coniferous forestry will be felled to accommodate infrastructure. While this work will be done with Forestry Service licences and approvals, the works could result in soil/subsoils erosion. All forestry replanting will occur outside of the hydrological catchments within which the Site is located.
 - The Proposed Biodiversity Management and Enhancement works, which are proposed over a total of 22.99ha, include (i) the enhancement and management of ~7.8ha of wet grassland for Marsh Fritillary, (ii) the felling of ~4.5ha of coniferous forestry and the management of this land for Marsh Fritillary, (iii) the planting of ~1.9ha of native woodland, (iv) drain blocking and peat storage across 5.3ha of cutover bog, and (v) drain blocking and habitat management for Marsh Fritillary (3.5ha). These works have the potential to impact downstream surface water quality, whilst the proposed drain blocking will also have potential to affect the local peat hydrological regime.

9.4.1 Proposed Drainage Management

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 existing 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 new proposed silt traps and settlement ponds (or stilling

ponds) prior to controlled diffuse release into the existing drainage network. There will be no discharge of untreated or unattenuated water to the existing hydrological features (forestry and agricultural drains or natural watercourses).

During the construction phase, all runoff from works areas (i.e. dirty water) will be slowed down and treated to a high quality prior to being released. A schematic of the proposed site drainage management is shown as Figure 9-11 below. A detailed drainage plan showing the layout of the proposed drainage design elements is shown in Appendix 4-3 of the EIAR.

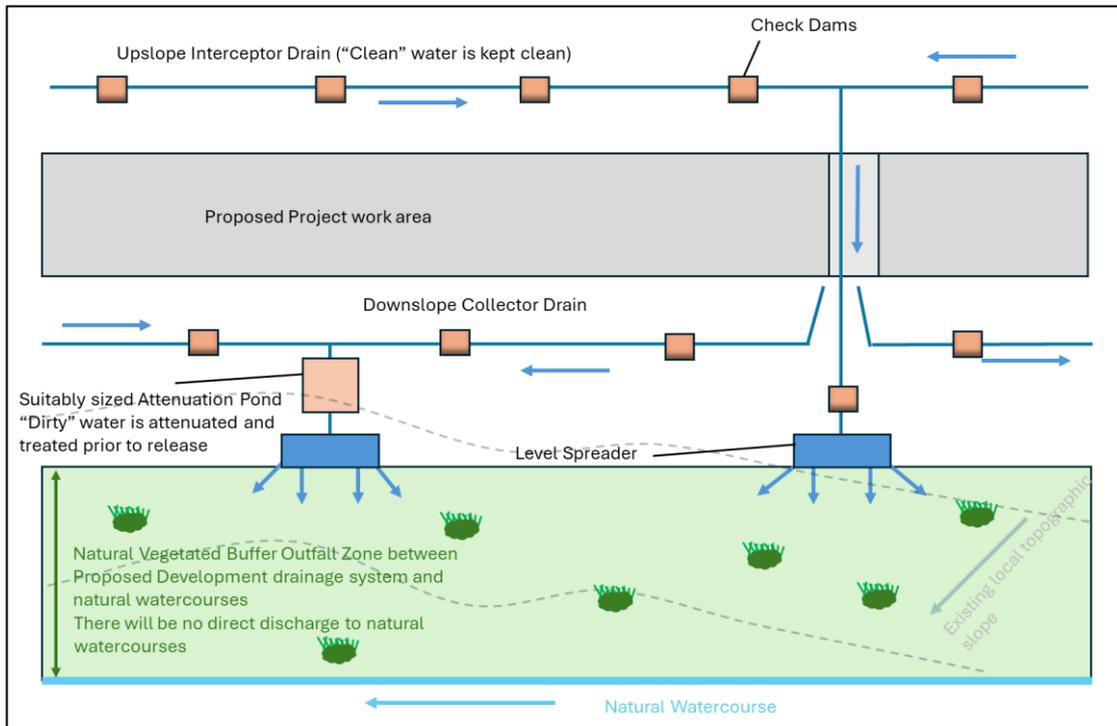


Figure 9-11: Schematic of Proposed Wind farm site Drainage Management

9.4.2

Proposed Project Interaction with the Existing Drainage Network

In relation to hydrological constraints, where appropriate a self-imposed buffer zone of 50m has been put in place for on-site streams and rivers (Note that some infrastructure is proposed within the delineated 50m hydrological buffer zone and additional mitigation measures are prescribed in Section 9.5.2.3 for these works). 10m buffers were applied to manmade forestry, peat and agricultural drains where possible. However, these manmade drains are not considered a significant hydrological constraint.

The general design approach to wind farm layouts is to utilise and integrate with the existing drainage infrastructure where possible whether it be existing access roads or the existing forestry / peat / agricultural 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 forestry and agricultural drains have no major ecological or hydrological value and can be readily integrated into the Proposed Wind Farm drainage scheme.

In order to integrate the Proposed Wind Farm drainage with the existing forestry drainage (as per the drainage plans included in Appendix 4-3) the following design approach has been implemented:

- Lidar data was used to map in detail the existing farm and forestry drainage at the site and how the proposed infrastructure interacts with these existing manmade and natural drainage patterns;
- Lidar data and available aerial photography was used to digitise existing farm and forestry drainage and field drains within the Proposed Wind Farm site;
- The Proposed Wind Farm footprint was divided up into drainage catchments (based on topography, outfall locations, catchment size) and we have calculated stormwater runoff rates for each catchment based on the 10-year return period rainfall event. These flows are used to design settlement ponds for each drainage catchment;
- Cut-off (interceptors drains) are included to locally re-route existing farm and forestry drains where required;
- The proposed construction phase settlement ponds are designed for 11hr and 24hr retention times used to settle out medium silt (0.006mm) and fine silt (0.004mm) respectively (EPA, 2006)⁵; and,
- The proposed locations of temporary drainage measures that will be installed prior to construction of the Proposed Wind Farm commencing are identified on the drainage drawings.

9.5 Likely Significant Effects and Associated Mitigation Measures

9.5.1 Do -Nothing Scenario

If the Proposed Project was not developed, the Proposed Wind Farm site will continue to function as it does at present, with no changes made to the current land-use of commercial forestry, agricultural land and peat bogs. Landuse along the Proposed Grid Connection would remain unchanged from its present condition. In terms of hydrology, the existing surface water drainage regime would continue to function and may be extended in places.

The impact of this is considered neutral in the context of the EIAR. If the Proposed Project were not to proceed, the opportunity to capture an even greater part of County Galway's valuable renewable energy resource would be lost, as would the opportunity to further contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. The opportunity to generate local employment and investment and to diversify the local economy would also be lost.

Furthermore, the opportunity to create the new proposed areas of native woodland and enhanced habitats for Marsh Fritillary within the Proposed Wind Farm site would be lost. Please see Appendix 6-4 Biodiversity Management and Enhancement Plan for details.

In the Do Nothing Scenario, there may be a slight decrease in average annual rainfall at the Proposed Wind Farm site as a result of climate change. This is discussed in Section 9.3.2 above and any change in annual rainfall will result in changes in local recharge and runoff volumes.

⁵ Environmental Protection Agency (2006): *Environmental Management in the Extractive Industry (Non-Schedule Minerals)*;

9.5.2 Construction Phase - Likely Significant Effects and Mitigation Measures

The likely significant effects of the construction phase of the Proposed Project and mitigation measures that will be put in place to eliminate or reduce them are shown in this section. It should be noted that the main potential effects on the soils and geology environment will occur during the construction phase. The assessment considers the Proposed Project as a whole i.e. both the Proposed Wind Farm and the Proposed Grid Connection. Where this is required to be assessed separately, this is noted in the text.'

9.5.2.1 Potential Effects from Tree Felling

A total of 7.5ha of coniferous forestry will have to be permanently felled within and around the footprint of the proposed infrastructure. Felling of trees along hedgerows will also be completed at the Proposed Wind Farm site as part of the construction of the Proposed Wind Farm. It is also proposed to fell 0.1ha of native woodland.

Felling of coniferous plantations required as part of the Proposed Wind Farm will be the subject of a Felling Licence application to the Forest Service, in accordance with the Forestry Act 2014 and the Forestry Regulations 2017 (SI 191/2017) and as per the Forest Service's policy on granting felling licenses for wind farm developments.

Potential effects during tree felling occurs mainly from:

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

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

Pathways: Drainage and surface water discharge routes.

Receptors: Surface waters (Killimor, Raford and Kilcolgan rivers) and associated water-dependant ecosystems downstream of the Proposed Wind Farm site.

Pre-Mitigation Potential Effect: Indirect, negative, significant, temporary, likely effect on surface watercourse and associated water-dependent ecosystems. Therefore, in the absence of mitigation measures, there will be the potential for significant effects on downstream surface waters and associated water-dependent ecosystems.

Proposed Mitigation Measures:

Tree 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)
- Forestry and the Landscape Guidelines (Forest Service, 2000c)
- Forests and Water, Achieving Objectives under Ireland’s River Basin Management Plan 2018-2021 (DAFM, 2018)
- Coillte Planting Guideline SOP
- Code of Best Forest Practice (Forest Service, 2000)

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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 9-12.

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

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

Table 9-12: 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

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

Mitigation by Design:

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

- Machine combinations (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. Where possible, 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;

- Brash mats will be placed on the racks to support the vehicles on soft ground, reducing mineral soil disturbance and erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal should take place when they become heavily used and worn. Provision should be made for brash mats along all off-road routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion occurring, extraction will be suspended during periods of high rainfall;
- Silt fences will be installed at the outfalls of existing drains downstream of felling areas. No direct discharge of such drains to watercourses will occur. Sediment traps and silt fences will be installed in advance of any felling works and will provide surface water settlement for runoff from work areas and will prevent sediment from entering downstream watercourses. Accumulated sediment will be carefully disposed of at pre-selected spoil repository areas. Where possible, all new silt traps will be constructed on even ground and not on sloping ground;
- In areas particularly sensitive to erosion it will be necessary to install double or triple sediment traps and increase buffer zone width. These measures will be reviewed onsite during construction;
- Double silt fencing will also be put down slope of felling areas which are located in close proximity to streams and/or relevant watercourses;
- Drains and silt traps will be maintained throughout all felling works, ensuring that they are clear of sediment build-up and are not severely eroded;
- Timber will be stacked in dry areas, and outside watercourse buffer zones. Check dams and silt traps will be emplaced on the down gradient side of timber storage/processing sites;
- Works will be carried out during periods of no, or low rainfall, in order to minimise entrainment of exposed sediment in surface water runoff;
- All refuelling will be completed outside of the designated 50m hydrological buffer zones. Mobile bowser, drip kits, qualified personnel will be used where refuelling is required; and,
- Branches, logs or debris will not be allowed to build up in aquatic zones. All such material will be removed when harvesting operations have been completed, but care will be taken to avoid removing natural debris deflectors.

Silt Traps:

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

Pre-emptive Site Drainage Management :

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

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

- General Forecasts: Available on a national, regional and county level from the Met Éireann website (www.met.ie/forecasts). These provide general information on weather patterns including rainfall, wind speed and direction but do not provide any quantitative rainfall estimates;
- MeteoAlarm: Alerts to the possible occurrence of severe weather for the next 2 days. Less useful than general forecasts as only available on a provincial scale;

- 3-hour Rainfall Maps: Forecast quantitative rainfall amounts for the next 3 hours but does not account for possible heavy localised events;
- Rainfall Radar Images: Images covering the entire country are freely available from the Met Éireann website (www.met.ie/latest/rainfall_radar.asp). The images are a composite of radar data from Shannon and Dublin airports and give a picture of current rainfall extent and intensity. Images show a quantitative measure of recent rainfall. A 3-hour record is given and is updated every 15 minutes. Radar images are not predictive; and,
- Consultancy Service: Met Éireann provide a 24-hour telephone consultancy service. The forecaster will provide an interpretation of weather data and give the best available forecast for the area of interest.

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

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

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

Timing of Proposed Project Felling Works:

Felling will only be carried out during periods of no or low rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses.

Drain Inspection and Maintenance:

The following items 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. During pre-felling inspections the main drainage ditches will be identified. Ideally 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 within 10m of 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 the Site, if impeded by silt or debris, will be unblocked; and,
- All accumulated silt will be removed from drains and culverts, and silt traps, and this removed material will be deposited away from watercourses to ensure that it will not be carried back into the trap or stream during subsequent rainfall.

Surface Water Quality Monitoring:

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

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

- Avoid man-made ditches and drains, or watercourses that do not have year round flows, i.e. avoid ephemeral ditches, drains or watercourses;
- Select sampling points upstream and downstream of the forestry activities;
- It is advantageous if the upstream location is outside/above the forest in order to evaluate the impact of land-uses other than forestry;
- Downstream locations will be selected: one immediately below the forestry activity, the second at exit from the forest, and the third some distance from the second (this allows demonstration of no impact through dilution effect or contamination by other land-uses where impact increases at third downstream location relative to second downstream location); and,
- The above sampling strategy will be undertaken for all on-site sub-catchments streams where tree felling is proposed.

Also, daily surface water monitoring forms (for visual inspections and field chemistry measurements) will be utilised at every works site near any watercourse. These will be taken daily and kept on site for record and inspection.

Post Mitigation Residual Effect: Proven forestry best practice measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect will be a negative, imperceptible, indirect, temporary, likely effect on downstream watercourses and associated water-dependent ecosystems.

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

9.5.2.2 Potential Effects from Earthworks Resulting in Suspended Solids Entrainment in Surface Waters

Construction phase activities including access road construction, turbine foundation/hardstanding construction, temporary construction compound construction, met mast construction, substation construction, storage of peat and spoil in the designated peat and spoil management areas and the underground cabling works will require varying degrees of earthworks resulting in excavation of soils and subsoils. In addition, the biodiversity enhancement works will have the potential to release suspended solids to surface waters. Potential sources of sediment-laden water include:

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

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

Pathways: Drainage and surface water discharge routes.

Receptors: Surface waters (Killimor, Raford and Kilcolgan rivers) and associated water-dependant ecosystems downstream of the Proposed Wind Farm site.

All watercourses (Clarinbridge River and its tributaries) and associated water-dependent ecosystems downstream of the Proposed Grid Connection.

Pre-Mitigation Potential Effect: Negative, significant, indirect, temporary, likely effect on downstream watercourses and water-dependent ecosystems. In the absence of mitigation measures, there will be the potential for significant effects on downstream surface waters and associated water-dependent ecosystems.

Proposed Mitigation Measures:

Mitigation by Avoidance

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

The majority of the key Proposed Project areas are located significantly away from the delineated 50m watercourse buffer zones with the exception of T2, its associated hardstand and access roads, the upgrading of an existing watercourse crossing, new watercourse crossings, upgrades to existing site access tracks and new site access tracks. Additional control measures, which are outlined further in Section 9.5.2.3, will be undertaken at these locations.

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

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

Mitigation by Design:

Proposed Wind Farm site:

- Source controls:
 - Interceptor drains, vee-drains, diversion drains, flume pipes, erosion and velocity control measures such as use of sandbags, oyster bags filled with gravel, filter fabrics, and other similar/equivalent or appropriate systems.
 - Small working areas, covering stockpiles, weathering off stockpiles, cessation of works in certain areas.
- In-Line controls:
 - Interceptor drains, vee-drains, oversized swales, erosion and velocity control measures such as check dams, sandbags, oyster bags, flow limiters, weirs, baffles, silt bags, silt fences, sedimats, filter fabrics, and collection sumps, temporary sumps, sediment traps, pumping systems, settlement ponds, temporary pumping chambers, or other similar/equivalent or appropriate systems.
- Treatment systems:
 - Temporary sumps and ponds, temporary storage lagoons, sediment traps, and settlement ponds, and proprietary settlement systems such as Siltbuster, and/or other similar/equivalent or appropriate systems.

It should be noted that for the Proposed Wind Farm site, an extensive network of forestry, peat and agricultural drains already exist, and these will be integrated and enhanced as required and used within the Proposed Wind Farm drainage system. The integration of the existing forestry drainage network

and the Proposed Wind Farm network is relatively simple. The key elements being the upgrading and improvements to existing water treatment elements, such as in line controls and treatment systems, including silt traps, settlement ponds and buffered outfalls.

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

- Apart from interceptor drains, which will convey clean runoff water to the downstream drainage system, there will be no direct discharge (without treatment for sediment reduction, and attenuation for flow management) of runoff from the Proposed Wind Farm site 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 settlement ponds and buffered outfalls onto vegetated surfaces;
- Buffered outfalls which will be numerous over the Proposed Wind Farm 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 Proposed Wind Farm 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, sandbags, oyster bags, 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.

Proposed Grid Connection:

The majority of the Proposed Grid Connection is >50m from any nearby watercourse, sections within 50m of the Proposed Grid Connection are confined to existing watercourse crossings at bridges and culverts. It is proposed to limit any works in any areas located within 50m of any watercourse/waterbody including the stockpiling of excavated soils and subsoils.

There is a total of 10 no. watercourse crossings (4 no. crossings over EPA mapped watercourses and additional crossings (6 no.) over watercourses which are not included in the EPA database) along the Proposed Grid Connection. All the crossings are existing bridges and culverts along the public road.

No in-stream works are required at any of these crossings, however due to the proximity of the streams to the construction work at the crossing locations, there is a potential for surface water quality impacts during trench excavation work. Mitigation measures are outlined below.

A constraint/buffer zone will be maintained for all crossing locations where possible, whereby all watercourses will be fenced off. In addition, measures which are outlined below will be implemented to ensure that silt laden or contaminated surface water runoff from the excavation work does not discharge directly to the watercourse.

Pre-commencement Temporary Drainage Works

Prior to the commencement of construction works (new road/hardstand, turbine foundation installs or upgrade of existing roads) the following key temporary drainage measures will be installed:

- All existing land and forestry drains that intercept the proposed works area will be temporarily blocked down-gradient of the works using forestry check dams/silt traps;
- Clean water interceptor drains will be installed upgradient of the works areas;

- Check dams/silt fence arrangements (silt traps) will be placed in all existing that have surface water flows; and,
- A double silt fence perimeter will be placed down-slope of works areas that are located inside the watercourse 50m buffer zone.

Silt Fences:

Silt fences will be emplaced within drains down-gradient of all construction areas. Silt fences are effective at removing heavy settleable solids such as those present in the subsoils/sandstone tills that overlie the site. This will act to prevent entry to water courses of sand and gravel sized sediment, released from excavation of mineral sub-soils of glacial and glacio-fluvial origin, and entrained in surface water runoff. Inspection and maintenance of these of these structures during construction phase is critical to their functioning to stated purpose. They will remain in place throughout the entire construction phase. Double silt fences will be placed within drains down-gradient of all construction areas inside the 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 footprint has been divided into drainage catchments (based on topography, outfall locations, catchment size) and stormwater runoff rates based on the 10-year return period rainfall event were calculated for each catchment. These flows were then used to design settlement ponds for each drainage catchment. The settlement ponds are designed for 11hr or 24hr retention times used to settle out medium silt (0.006mm) and fine silt (0.004mm) respectively (EPA, 2006)⁵.

The supporting design calculations for all settlement ponds are included on Drawing D501 included in Appendix 4-4.

Level Spreaders and Vegetation Filters:

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

Water Treatment Train:

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

Pre-emptive Site Drainage Management

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

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

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

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

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

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

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

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

Management of Runoff from the Peat and Spoil Management Areas:

It is proposed that excavated peat and spoil will be placed in the designated peat and spoil management areas within the Proposed Wind Farm site. Peat excavated from T01, T02, T03 and T08 (72,490m³) will be transported to the adjacent peat storage areas, used to create pressure berms on both sides of the floating roads or used for landscaping around the hardstands. Peat and spoil excavated from T04 to T08 (43,900m³) will be transported to the peat/spoil storage areas at T04 and T05 or used as landscaping around the hardstands where no peat is present (T04 to T07). Shallow Peat/Topsoil removed from T04 to T08 will be temporarily stockpiled locally and used to cover the peat/spoil storage areas at T04 and T05, as well as any landscaping areas. Spoil excavated from the substation platform (2,500m³) will either be landscaped around the platform or transported to the spoil storage areas at T04 and T05. A small volume of spoil (~350m³ per turbine base) will be used as ballast backfill.

The spoil management areas are located outside the 50m hydrological buffer zone.

Proposed surface water quality protection measures regarding the peat and spoil management areas are as follows:

- Where applicable the vegetative topsoil layer of the peat and spoil management areas will be rolled back to facilitate placement of excavated spoil up to a maximum height of 1.2 to 1.5 metres, following which the vegetative-top soils layer will be reinstated;
- Where reinstatement is not possible, peat and spoil management areas will be sealed with a digger bucket and seeded as soon possible to reduce sediment entrainment in runoff;
- An interceptor drain will be installed upslope of the identified peat and spoil management areas to divert any surface water away from these areas where necessary;
- Silt fences and double silt-fences will be emplaced down-gradient of the designated peat and spoil management areas and will remain in place throughout the entire construction phase, or until reseeded has been established to a sufficient level;
- Once the peat and spoil management area has been seeded and vegetation is established the risk to downstream surface water is significantly reduced.

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 Environmental Quality Standards (EQSs) will be undertaken for each primary watercourse, and specifically following heavy rainfall events (as per the CEMP included in Appendix 4-5 of this EIAR).

Allowance for Climate Change

Climate change rainfall projections are typically for a mid-century (2050) timeline. The projected effects of climate change on rainfall are therefore modelled towards the end of the life cycle of the Proposed Wind Farm, as the proposed turbines have a life span of 35 years. It is likely that the long-term effects of climate change on rainfall patterns will not be observed during the lifetime of the Proposed Wind Farm. As outlined in the above sections we have designed settlement ponds for a 1 in 10-year return flow. This approach is conservative given that the Proposed Project will likely be built over a much shorter period (18-24 months), and therefore this in-built redundancy in the drainage design more than accounts for any potential short term climate change rainfall effects.

However, the settlement ponds are designed for 1 in 10 years flows with built in redundancy (+20%) to account for climate change effects on rainfall.

Post Mitigation Residual Effects: Proven and effective measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect will be a negative, imperceptible, indirect, short term, likely effect on water quality, and water-dependant ecosystems downstream of the Proposed Wind Farm site and Proposed Grid Connection.

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

9.5.2.3 **Potential Effect Associated with Works Within the Hydrological Buffer Zones within the Proposed Wind Farm Site**

Whilst the majority of the proposed work areas within the Proposed Wind Farm site are located outside of the delineated 50m natural watercourse buffer, the following work areas encroach upon the delineated buffer zones:

- A total of 2 no. proposed watercourse crossings – refer to Section 9.5.2.9;
- T2 and its associated hardstand;
- New proposed access roads;
- Proposed enhancement lands for Marsh Fritillary; and,
- ~998m of linear planting.

Due to the close proximity of these works to natural watercourses, these works could result in the release of suspended solids to surface waters 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.

Pathways: Drainage and surface water discharge routes.

Receptors: Surface waters (Killimor, Raford and Kilcolgan rivers) and associated water-dependant ecosystems downstream of the Proposed Wind Farm site.

Pre-Mitigation Potential Effect: Negative, significant, indirect, temporary, likely effect downstream watercourses and water-dependent ecosystems. In the absence of mitigation measures, there will be the

potential for significant effects on downstream surface waters and associated water-dependent ecosystems.

Proposed Mitigation Measures:

Mitigation by Avoidance:

The Proposed Wind Farm layout has been designed to limit the amount of works within the delineated hydrological buffer zones associated with natural watercourses. Several consultations between HES, MKO and the project design team completed in the spring and summer of 2024 resulted in several design iterations which had the overall aim of reducing the volume of works within the buffer zones.

It is worth noting that whilst T2 is located within the 50m buffer zone. An existing access track separates the proposed turbine location from the EPA mapped watercourse, which provides a natural barrier to prevent any runoff from the works are entering the watercourse at this location.

Mitigation by Design:

All mitigation measures detailed in Section 9.5.2.2 above will be implemented at these work locations.

The following additional mitigation measures will also be implemented:

- Double or triple silt fences will be placed downgradient of all work locations within the hydrological buffer zones; and,
- All works will be completed during the dry weather periods and works will be postponed in the event of rainfall.

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 will be a negative, imperceptible, indirect, short term, likely impact on down gradient watercourse and water-dependant ecosystems.

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

9.5.2.4 **Potential Effects on Surface Water Quality from Excavation Dewatering**

Some groundwater/surface water seepages will likely occur in turbine foundation excavations, substation compound excavations and sections of the internal cabling trenches, and this will create additional volumes of water to be treated by the runoff management system. Groundwater inflows will likely be small however larger volumes of water may occur where excavations encounter granular subsoils. Inflows will require management and treatment to reduce suspended sediments. No contaminated land was noted at the Proposed Wind Farm site and therefore pollution issues arising from such sources will not occur.

With respect to the Proposed Grid Connection, some minor groundwater/surface water seepages will also occur in shallow trench excavations, and this will create additional volumes of water to be treated by the drainage management system. Inflows will require management and treatment to reduce suspended solids. No contaminated land was noted along the Proposed Grid Connection therefore pollution issues are not anticipated in this respect.

Pathway: Overland flow and site drainage network.

Receptor: Surface waters (Killimor, Raford and Kilcolgan rivers) and associated water-dependant ecosystems downstream of the Proposed Wind Farm site.

All watercourses in the vicinity and downstream of the Proposed Grid Connection including the Clarinbridge River and its associated tributaries.

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

Proposed Mitigation Measures:

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

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

Post Mitigation Residual 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 will be a negative, imperceptible, indirect, short term, unlikely effect on local surface watercourses and associated water-dependent ecosystems.

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 on Groundwater Levels During Excavation Works

Dewatering of deep excavations (i.e. turbine foundations) have the potential to impact on local groundwater levels and flows. However, temporary reductions in groundwater levels by short duration and transient dewatering works will be very localised and of small magnitude due to the nature and permeability of the local subsoil and bedrock geology. Groundwater level effects will not be significant due the local hydrogeological regime. Any effects will be temporary and will be contained within the lower areas of the Proposed Wind Farm site.

No groundwater level impacts are predicted from the construction of the Proposed Grid Connection, access roads, substation compound or met mast due to the shallow nature of these excavation (i.e. 0 - ~1.2m).

Pathway: Groundwater flowpaths.

Receptor: Groundwater levels within the underlying GWDTE – Rahasane Turlough GWB.

Pre-Mitigation Potential Effect:

Negative, indirect, temporary, imperceptible unlikely effects on local groundwater levels within the bedrock aquifer at the Proposed Wind Farm site. In the absence of mitigation measures, there will be no potential for significant effects on groundwater levels.

Mitigation Measures / Impact Assessment:

The Proposed Wind Farm site is underlain by a Locally Important Bedrock Aquifer which is unproductive in terms of groundwater flow. This bedrock aquifer is overlain by glacial tills, lacustrine clays and peat which are also of low permeability. No significant occurrence of granular sand and gravels was encountered during the site investigations.

The hydrogeological setting of the Proposed Wind Farm site means that no significant groundwater dewatering will be required during the construction phase. Moreover, direct rainfall and surface water runoff will be the main inflows that will require management. For the avoidance of doubt, dewatering is defined as a requirement to temporarily 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 to the excavations proposed at the Site, for the reasons detailed in the following bullet points:

- The excavations will be relatively shallow;
- The local bedrock is known to be unproductive. This means that groundwater flows will be relatively minor;
- 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;
- No regional groundwater flow regime, i.e. large volumes of groundwater flow, will be encountered at these elevations;
- Therefore, shallow groundwater inflows will largely be fed by recent rainfall, and possibly by limited groundwater seepage;
- Site investigations show that there are no deposits of potentially water bearing granular subsoils in the local area – the subsoils are dominated by glacial tills, and lacustrine clays of relatively low permeability;
- This means that the hydrogeological regime of the area comprises of high surface water runoff as opposed to groundwater recharge and flow; and,
- Hence, we consider that the management of surface water will form the largest proportion of water to be managed and treated at the proposed excavation locations.

Post Mitigation Residual Effect: Due to large topographic elevation and hydrogeology of the Proposed Wind Farm site the potential for water level drawdown impacts at receptor locations is considered negligible. The residual effect will be a negative, imperceptible, direct, short term, unlikely effect on groundwater levels.

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

9.5.2.6 Potential Effects from Hydrocarbons

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.

The potential release of hydrocarbons can occur during the works within the Proposed Wind Farm site and during works along the Proposed Grid Connection.

Pathway: Groundwater flowpaths and Site drainage network.

Receptors:

Surface waters (Killimor, Raford and Kilcolgan rivers), associated water-dependant ecosystems downstream of the Proposed Wind Farm site and underlying groundwater quality.

All watercourses in the vicinity of the Proposed Grid Connection including the Clarinbridge River and its associated tributaries and underlying groundwater quality.

Pre-Mitigation Potential Effect:

Negative, indirect, slight, short-term, unlikely effect on local groundwater quality below the Site. In the absence of mitigation measures, there will be no potential for significant effects on local groundwater quality.

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

Proposed Mitigation Measures:

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

- Wherever possible, vehicles will be refuelled off-site, particularly for regular road-going vehicles.
- All plant will be inspected and certified to ensure that they are leak free and in good working order prior to use at the Site.
- On-site refuelling of machinery will be carried out at designated refuelling areas at various locations throughout the Site.
- Heavy plant and machinery will be refuelled on-site by a fuel truck, with spill kits kept onboard, that will come to the Site as required on a scheduled and organised basis.
- Other refuelling will be carried out using mobile double skinned fuel bowser. The fuel bowser will be parked on a level area in the construction compound when not in use
- Only designated trained operatives will be authorised to refuel plant on-site;
- Refuelling or maintenance of machinery will not occur within the delineated hydrological buffer zones;
- Fuels stored on the Proposed Wind Farm site will be minimised;
- Any diesel or fuel oils stored at the temporary construction compound will be banded. The bund capacity will be sufficient to contain 110% of the storage tank's maximum capacity; and,

- An emergency plan for the construction phase to deal with accidental spillages will be contained within the Construction and Environmental Management Plan (Appendix 4-5). Spill kits will be available to deal with accidental spillages.

In relation to the Proposed Grid Connection, whilst no oils are around the cables, a lubricant will be used during cable pulling. The lubricant to be used is Techlube PHD which is a pourable, non-flammable, non-toxic and substantially biodegradable water-based product that does not pose a threat to the environment (Techlube PHD Technical Information Datasheet: <https://www.socomore.com/en/waterbased-lubricant-techlube-phd-20l-p-bk1.html>).

Post Mitigation Residual Effect: 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, imperceptible, indirect, short term, unlikely impact to local groundwater quality and a negative, imperceptible, indirect, short term, unlikely impact to surface water quality.

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

9.5.2.7 Potential Effects from the Use of Cement-Based Products

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

Batching of wet concrete at the Proposed Wind Farm and Proposed Grid Connection and washing out of transport and placement machinery are the activities most likely to generate a risk of cement-based pollution. Placed concrete in foundations (turbine, met mast and substation foundations) and the use of lean mix concrete along the Proposed Grid Connection can also have minor local effects on groundwater quality over time. However, due to the contained shuttering that concrete pours are put in, and the limited surface area of exposed concrete, the anoxic conditions below ground, and the higher rate of wider groundwater recharge and flow relative to the small volumes of shallow groundwater that would come in contact with the cured concrete, the potential for impacts are low.

Pathway: Site drainage network.

Receptors:

Surface waters (Killimor, Raford and Kilcolgan rivers), associated water-dependant ecosystems downstream of the Proposed Wind Farm site and underlying groundwater quality.

All watercourses in the vicinity of the Proposed Grid Connection including the Clarinbridge River and its associated tributaries and underlying groundwater quality.

Pre-Mitigation Potential Effect: Indirect, negative, moderate, short term, likely effect to surface watercourses and water-dependent ecosystems and local groundwater quality. In the absence of mitigation measures, there will be no potential for significant effects on local groundwater quality or downstream surface waters.

Proposed Mitigation Measures:

- No batching of wet-concrete 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 water will be undertaken at lined concrete washout ponds;
- 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 sudden rainfall event; and,
- At proposed turbine foundations, sand blinding, DPM, and lean-mix blinding are used to vertically contain the concrete. While the concrete is contained laterally by temporary/permanent shuttering. The concrete cures within 72hrs.

Post Mitigation Residual Effect: Proven and effective measures to mitigate the risk of releases of cement-based products or cement truck wash water have been proposed above and will break the pathway between the potential source and each receptor. The residual effect will be a negative, imperceptible, indirect, short term, unlikely effect on surface and groundwater quality.

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

9.5.2.8 Potential Effects from Wastewater

Release of effluent from on-site temporary wastewater treatment systems has the potential to impact on groundwater and surface water quality if site conditions are not suitable for an on-site percolation unit. Welfare facilities will be located at the proposed temporary construction compounds at the Proposed Wind Farm site. Impacts on surface water quality could affect fish stocks and aquatic habitats.

Mobile welfare facilities with self-contained toilet units will be used during the construction of the Proposed Grid Connection.

Pathway: Groundwater flowpaths and site drainage network.

Receptors: Surface waters (Killimor, Raford and Kilcolgan rivers), associated water-dependant ecosystems downstream of the Proposed Wind Farm site and underlying groundwater quality.

All watercourses in the vicinity of the Proposed Grid Connection including the Clarinbridge River and its associated tributaries and underlying groundwater quality.

Pre-mitigation Effect: Negative, significant, indirect, temporary, unlikely effect to surface water quality. Negative, slight, indirect, temporary, unlikely effect on local groundwater quality. 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:

- During the construction phase, a self-contained port-a-loo with an integrated waste holding tank will be used at each of the site construction compounds (and along the Proposed Grid Connection as required), maintained by the providing contractor, and removed from site on completion of the construction works;

- Water supply for the site office and other sanitation will be brought to Site and removed after use from the Site to be discharged at a suitable off-site treatment location; and,
- No water or wastewater will be sourced on the Site, nor discharged to the Site.

Post Mitigation Residual Effects: Proven and effective measures to mitigate the release of wastewater on Site have been proposed above and will break the pathway between the potential source and each receptor. The residual effect will be a negative, imperceptible, indirect, temporary, unlikely effect on surface water or groundwater quality.

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

9.5.2.9 Potential Effects from Morphological Changes to Surface Watercourses/Drains within the Proposed Wind Farm site

Within the Proposed Wind Farm site, there are a total of 2 no. watercourse crossing locations over natural watercourses (rivers and streams). The crossing locations are outlined below:

- A new crossing is proposed over the Killimor River between T2 and T3; and,
- A new crossing is proposed over the Raford River to the north of T8.

In addition to the natural watercourses, there are manmade agricultural, peat and forestry drains within the Proposed Wind Farm site. However, these are not considered to be a significant constraint and can be rerouted around the Proposed Wind Farm infrastructure and/or integrated into the proposed drainage design. Several of these drains are deeply incised and will be culverted where road crossings are proposed.

Pathway: Site drainage network.

Receptors: Surface waters (Killimor, Raford and Kilcolgan rivers), associated water-dependant ecosystems downstream of the Proposed Wind Farm site.

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

Proposed Mitigation Measures:

Mitigation measures for the new watercourse crossings are detailed below:

- The proposed new stream crossings at the Proposed Wind Farm site will be clear span watercourse crossings or bottomless box culverts. The construction methodology for these crossings have been designed to eliminate the requirement for instream work, and the existing banks will remain undisturbed. No in-stream excavation works are proposed at these locations and therefore there will be no direct impact on the stream at the proposed crossing locations. Abutments will be constructed from precast units combined with in-situ foundations;
- All guidance / mitigation measures required by the OPW and/or the Inland Fisheries Ireland (IFI)⁶ is incorporated into the design of the proposed crossings;
- All drainage measures will be installed in advance of the works;
- Plant and equipment will not be permitted to track across the watercourse;

⁶ Inland Fisheries Ireland (2016): Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters

- Once the foundations have been completed at both sides of the watercourse, the pre-cast concrete box culvert will be installed using a crane and there will be no contact with the watercourse;
- Where the box culvert is installed in sections, the joint will be sealed to prevent granular material entering the watercourse;
- As a further precaution, near stream construction work, will only be carried out during the period permitted by IFI for in-stream works according to the IFI (2016) guidance document “Guidelines on protection of fisheries during construction works in and adjacent to waters”, i.e., July 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);
- Where works are necessary inside the 50m buffer double row silt fences will be emplaced immediately down-gradient of the construction area for the duration of the construction phase; and,
- All new river/stream crossings will be designed in accordance with OPW guidelines/requirements on applying for a Section 50 consent.

The watercourse crossings 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 field drain crossings, the culverts will be suitably sized 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 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.

Additional mitigation measures for the sections of access roads which are mapped within the flood zones are detailed in Section 9.5.3.5.

Post Mitigation Residual Effect: Proven and effective measures to protect water quality have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect will be a negative, imperceptible, direct, long-term, unlikely effect on downstream water quality and aquatic habitats.

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

9.5.2.10 Potential Effects from Morphological Changes to Surface Watercourses along the Proposed Grid Connection

The Proposed Grid Connection includes a total of 4 no. crossings over EPA mapped watercourses and an additional 6 no. unmapped watercourses. These crossings comprise of existing bridge/culvert crossings.

Horizontal Directional Drilling is proposed at 3 no. crossings under EPA mapped watercourses. This is assessed separately in Section 9.5.2.21.

The remaining watercourse crossing methods are as follows:

➤ **Crossing Using Standard Trefoil Formation Over – Option A**

Watercourses will not be directly impacted upon since no instream works or bridge/culvert alterations are proposed. Where adequate cover exists above a bridge/culvert, the standard ESB approved trefoil arrangement will be used where the cable ducts pass over a culvert without any contact with the existing culvert or water course. The cable trench will pass over the culvert in a standard trench.

➤ **Flatbed Formation Under– Option B**

Where cable ducts are to be installed under an existing watercourse or service crossing where sufficient cover cannot be achieved by installing the ducts in a trefoil arrangement, the ducts will be laid in a much shallower trench, the depth of which will be determined by the location of the top of the obstacle or the depth of excavatable material under it. The ducts will be laid in this trench in a flatbed formation under the existing watercourse/service and will be encased in 6mm thick steel galvanized plate with a 35N concrete surround as per ESB Networks specification.

➤ **Flatbed Formation over– Option C**

Where cable ducts are to be installed over a watercourse or service crossing where sufficient cover cannot be achieved by installing the ducts in a trefoil arrangement, the ducts will be laid in a much shallower trench the depth of which will be determined by the location of the top of the obstacle or the depth of excavatable material over it. The ducts will be laid in this trench in a flatbed formation over the existing culvert and will be encased in 6mm thick steel galvanized plate with a 35N concrete surround as per ESB Networks specification.

Where a bridge/culvert or service has insufficient cover depth to fully accommodate the required trench, the ducts can be laid in a flatbed formation partially within the existing road surface. Where this option is to be employed, the ducts will also be encased in steel with a concrete surround as per ESB Networks specifications. In order to achieve cover over these ducts and restore the carriageway of the road, it may be necessary to raise the pavement level locally to fully cover the ducts. The increased road level will be achieved by overlaying the existing pavement with a new wearing course as required. Any addition of a new pavement will be tied back into the existing road pavement at grade. After the crossing over the culvert has been achieved, the ducts will resume to the trefoil arrangement within a standard trench.

➤ **Horizontal Directional Drilling – Option D** (assessed separately in Section 9.5.2.21).

Pathways: Runoff and surface water flowpaths.

Receptors: All watercourses in the vicinity of the Proposed Grid Connection including the Shoodaun and Clarinbridge rivers and associated tributaries.

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

Mitigation Measures:

The vast majority of the underground electrical cabling connection route is >50m from any nearby watercourse, sections within 50m of the route are confined to existing watercourse crossings at bridges. It is proposed to limit any works in any areas located within 50m of any watercourse/waterbody including the stockpiling of excavated soils and subsoils.

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

The following mitigation measures are proposed for the grid connection crossing works:

- No stockpiling of construction materials will take place along the grid route;
- No refuelling of machinery or overnight parking of machinery is permitted in this area;
- No concrete truck chute cleaning is permitted in this area;
- 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 works; and,
- Silt fencing will be erected on ground sloping towards watercourses at the stream crossings if required.

Please note that mitigation measures for HDD are detailed in Section 9.5.2.21.

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 will be a negative, imperceptible, direct, long term, likely effect on surface water flows and surface water quality.

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

9.5.2.11 Potential Effects Associated with Piled Foundations

Due to the depth of peat, piled foundations may be required at several proposed turbine locations. The requirement for piling will be determined during post-consent ground investigations. Based on the available site investigation data piling works are not envisaged at proposed turbines T4, T5 or T6, however, taking a precautionary approach an assessment of piling at all proposed turbines has been included below.

For the piled turbine foundations, a typical piling type and configuration could be up to 16 no. 900mm rotary bored piles.

The following potential scenarios arise in respect of proposed piling works:

- Creation of preferential pathways, through a low permeability subsurface layer (an aquitard such as lacustrine clay), to allow downward flow into the underlying aquifer;
- Creation of preferential pathways, through a low permeability subsurface layer (an aquitard such as lacustrine clay), to allow upward migration alkaline groundwater to the acidic bog surface, thus potentially altering local hydrochemistry and therefore vegetation at the bog surface; and,
- Creation of a blockage to regional groundwater flow within the underlying aquifer due to placement of pile clusters.

These pathways are analogous to pathways described for piling works associated with contaminated land sites, as detailed in Environment Agency (2001).

Pathway: Groundwater flowpaths (upward and/or downward pathways, and regional groundwater flows).

Receptor: Groundwater quality in the underlying GWDTE Rahasane Turlough GWB and groundwater hydrochemistry at the surface of the within the peat bog and the wider Proposed Wind Farm site.

Pre-Mitigation Potential Effect: Negative, moderate, direct, short term, likely effect on groundwater quality/hydrochemistry. In the absence of mitigation measures, there will be no potential for significant effects on local groundwater quality.

Proposed Mitigation Measures:

The proposed mitigation measures designed for the protection of downstream surface water quality and groundwater quality within the peat bog will be implemented at all construction work areas.

- Mitigation measures for sediment control are detailed in Section 9.5.2.2.
- Mitigation measures for the control of hydrocarbons during construction works are detailed in Section 9.5.2.6.
- Mitigation measures for the control of cement-based products during construction works are detailed in Section 9.5.2.7.

Proposed mitigation measures relative to piling works will comprise:

- Strict QA/QC procedures for piling works will be followed;
- Piles will be kept vertical during piling works;
- Good workmanship will be employed during all piling works; and
- Where required use bentonite seal to prevent upward/downward movement of surface water/groundwater.

Impact Assessment:

The ground conditions at the Proposed Wind Farm site can be typically categorised into the following deposits (based on data presented in Chapter 8: Land, Soils and Geology):

- **Peat** – Peat thicknesses from ranged from 0.1 to 7.2.
- **Shell Marl** – The peat is typically underlain by Shell Marl.
- **Lacustrine Clay** – Light grey to brown, soft to stiff slightly gravelly organic Silt/Clay with some cobbles. The thickness of the layer is variable.
- **Glacial Till** – Typically described as soft to stiff greenish grey to blueish grey slightly sandy slightly gravelly Silt/Clay. The thickness of the layer is variable across the proposed site.
- **Groundwater** - was recorded in 11 no. trial pits and varied between 0.2 and 3.0mbgl.

Proposed piles will penetrate through peat deposits and lacustrine clay deposits where they occur, and then into underlying glacial tills. Where present the clay layer is likely to act as an aquitard/low permeability layer, through which only very small amounts of water can flow.

Peat water is perched above the regional groundwater table. Peat water occurs in the bog basins, while regional groundwater flow will occur in the underlying bedrock aquifer. Glacial tills that occur between the base of the peat/lacustrine clays may be permeable in local zones, but in general will have a moderate to low permeability. Therefore, the two main groundwater systems are the upper acidic peat water, and the lower regional bedrock groundwater water. As the underlying bedrock is mainly limestone, the groundwater occurring within this aquifer will be alkaline.

For the piles the clay and also the glacial tills are likely to 'self-seal' around the piles, meaning that a long-term pathway between the upper peat/bog water and the lower bedrock aquifer will not be sustained.

Research indicates that provided the aquitard layer is of a reasonable thickness and the piles have a cross section without re-entrant angles, the likelihood of creating preferential flow paths for downward migration of leachate (i.e. peat water) is very low. This hypothesis is consistent with the results obtained by Hayman et al (1993) and Boutwell et al (2000).

For bored piles, as the temporary steel casing is removed, a steel reinforcement cage is added to the pile column and then concrete is added to the toe of the pile using a tremie pipe. Vermiculite is used to create a plug between the concrete and the displaced water, therefore the concrete seals the entire pile column and pushes the vermiculite plug to the surface as concrete is added. The temporary steel casing is removed carefully as the concreting works are being completed. This concreting process is similar to that used when grouting a water supply production well (IGI (2007), and EPA (2013)). This means that a long-term pathway between the upper peat/bog water and the lower bedrock aquifer will not be sustained.

Scenario 1: Creating a Pathway for Downward Flow

To ensure downward flow of peat water and/or pollutants from the piling works does not occur, a bentonite seal will be used in a starter pit for each pile, and the mitigation measures outlined above will be implemented. The concrete added to the bored pile will seal the pile annulus. As a result, the potential for either piling work option to create pathways for downward flow of peat water or pollutants that could affect groundwater quality in the underlying aquifer is imperceptible.

Scenario 2: Creating a Pathway for Upward Flow

No upwelling of groundwater to the peat surface water recorded in any of the site investigation locations recorded across the proposed site.

Notwithstanding this, to ensure upward flow of underlying groundwater via potential pathways created by piling works does not occur, a bentonite seal will be used in a starter pit for each pile, and the mitigation measures outlined above will be implemented. The concrete added to the bored pile will seal the pile annulus. As a result, the potential for piling works to create pathways for upward flow of alkaline groundwater to the bog surface is imperceptible.

Scenario 3: Blocking Regional Groundwater Flow

The scale of the Site is important, and it means that the Proposed Project footprint occurs over ~0.9% (7.6ha) of the Site.

If a piling array of 16 no. 900mm piles is applied at each proposed turbine base, this combined area of piling footprint amounts to 265m², or 10.180m² per turbine base. Each proposed turbine base is >490m apart. The area of the piles is distributed over a very large area, and that area only amounts to a very small percentage of the Site. Also, none of the proposed piles would penetrate into the underlying bedrock aquifer, as they will find sufficient resistance, either in the over lying glacial tills/mineral subsoils or upon reaching the top of bedrock. At such wide separation distance, the ability of clusters of piles, the potential to alter or affect regional groundwater flow is imperceptible.

Post-Mitigation Residual Effects: The proposed piling works potentially pose a threat to groundwater quality in the underlying regional groundwater system and also could potentially create a pathway for upward migration of alkaline groundwater to the peat surface. These potential effects will not arise at the Site due to a combination of the prevailing ground conditions, groundwater conditions, and proposed mitigation measures that will ensure the potential pathways for interaction of shallow (acidic peat water) and deeper (alkaline) groundwater are prevented from occurring. In additional, due to the

small footprint of proposed pile clusters, and the significant spacing between proposed turbine bases where pile clusters are proposed, the potential for such pile clusters to block regional groundwater flow is imperceptible at that scale. The proposed piled foundations therefore have no potential to change the WFD status or impact the WFD objectives of the underlying GWDTE Rahasane Turlough GWB. The residual effect will be a negative, imperceptible, indirect, short term, unlikely effect on groundwater flow, and ground quality/peat water hydrochemistry.

Significance of Effects: For the reasons given above, no significant effects on regional groundwater and the GWDTE Rahasane Turlough GWB will occur, and no significant effects on peat water hydrochemistry will occur from proposed piling works.

9.5.2.12 Potential Effects from the Use of Siltbuster

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 provide a positive effect. However, potential overdosing with chemical agents means there is a perceived risk of chemical carryover in post treatment water which could result in negative effects on downstream water quality.

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

The benefits of using a Siltbuster system in emergency scenarios where all other water treatment systems have proven ineffective are considerable. An example of treatment capability of siltbuster systems from northwest Mayo is provided in Figure 9-12. This is a duration curve of downstream water quality data post siltbuster treatment. The system was setup so that any water not meeting discharge criteria was recycled back to the settlement ponds. The graph shows all data, and only 24 data points out of 1194 records were above 20 mg/L (i.e. recycling, and repeat treatment occurred at these times to ensure compliance at the discharge location).

Note that the Siltbuster system will not be used under normal conditions during the construction phase. The mitigation proposed to protect water quality is already outlined above in Section 9.5.2.2 and Section 9.5.2.4.

The use of Siltbuster is only proposed as an emergency back up in the event of failure of all other proposed water treatment mitigation measures, e.g. in the event of landslide failure. The Siltbuster system is a proven and effective method of water quality treatment during these events. Given the relatively flat topography of the Proposed Wind Farm site, the risk of a landslide is considered to be low. Therefore, it is extremely unlikely that the Siltbuster system will be utilised.

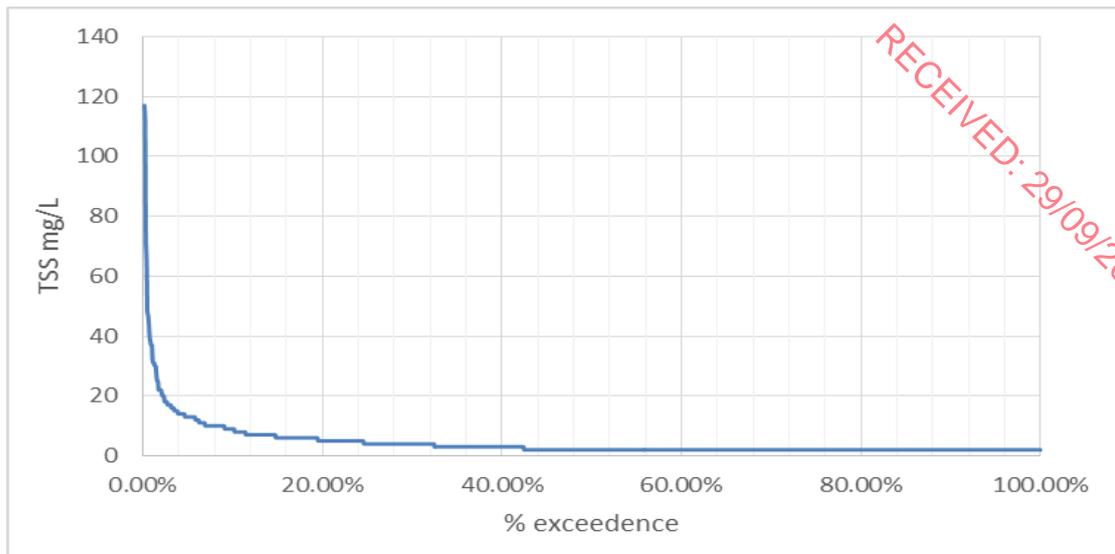


Figure 9-12: TSS treatment data using Siltbuster systems (with chemical dosing)

Pathways: Drainage and surface water discharge routes.

Receptors: Surface waters (Killimor, Raford and Kilcolgan rivers) and associated water-dependant ecosystems downstream of the Proposed Wind Farm site.

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

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, means the correct amount of chemical is added by the dosing system;
- Dosing rates of chemical to initiate settlement is small, being in the order of 2-10 mg/L and the vast majority of the chemical is removed in the deposited sediment;
- Final effluent not meeting the discharge criteria is recycled and retreated, which has a secondary positive effect of reducing carryover; and,
- Use of biodegradable chemical agents can be used at very sensitive sites (i.e. adjacent to SACs).

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

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

9.5.2.13 Potential Effects on Surface Water Quality Due to Fluvial Flooding During Construction

Some areas of the Proposed Wind Farm site, including the proposed location of T08 and its associated hardstand and site access tracks are located in fluvial flood zones along the Rafor River. T1 and T2 in the west of the Proposed Wind Farm site are also mapped in flood zones associated with fluvial flooding along the Killimor River and several local surface water drains.

Should a flood event coincide with the construction phase of the Proposed Project when major excavations and earthworks are being undertaken within the floodplains, there is the potential for surface water quality effects.

However, during such a flood event, surface water quality in the general area would be significantly compromised due to natural river erosion due to the large flow volumes. During flooding, floodwaters are generally highly turbid with a large suspended solid concentration due to the sheer volume and flow of water.

The likelihood of a 1 in 100-year fluvial flood event happening during the 18-24 months construction programme is very low (there is only 1% chance of a flood event of this magnitude happening in any given year). Therefore, there is 2% chance of a 1 in 100-year fluvial flood event occurring during the construction programme (assuming a 2-year construction phase).

With regard to the Proposed Grid Connection underground cabling route, some areas are located in mapped fluvial flood zones at existing watercourse crossings. No instream works are proposed at any of the existing bridge or culvert crossings. Therefore, there will be no potential for the displacement of floodwaters associated with the Proposed Grid Connection

Pathways: Drainage and surface water discharge routes.

Receptors: Surface waters (Killimor, Rafor and Kilcolgan rivers) and associated water-dependant ecosystems downstream of the Proposed Wind Farm site.

Pre-Mitigation Potential Effect: Negative, significant, indirect, short-term, likely effect on the downstream surface water quality. In the absence of mitigation measures, there will be the potential for significant effects on downstream surface water quality.

Mitigation Measures:

Despite the low likelihood of a fluvial flood event occurring during the construction of the Proposed Wind Farm, weather/rainfall events of those magnitudes likely to generate significant rainfall which would in turn cause fluvial flooding would be forecastable.

An emergency response system has been developed for the construction phase of the Proposed Project to respond to high rainfall events which may result in fluvial flooding.

A potential high intensity rainfall event would likely to be identified 3-5 days in advance, with more accurate forecasts of severity within 24-48 hours of occurrence. Preparations for a flood event would begin from the initial indications that there may be a high rainfall event. This would allow time for the preparation and the implementation of additional emergency mitigation measures.

As above, the first point of mitigation is ongoing monitoring of weather forecasts and weather warning. The Project EM (Environmental Manager) or the site ECoW will be responsible for monitoring weather forecasts during the construction phase. There will be a 24-hour advance meteorological forecasting (Met Eireann download) linked to a trigger-response system. When a pre-determined rainfall trigger levels is exceeded (e.g., sustained rainfall (any foreseen rainfall event longer than 4 hour duration)

and/or any yellow or greater rainfall warning (>25mm/hour) issued by Met Eireann), planned responses will be undertaken.

- Cessation of all construction works until the storm event, including the storm runoff has passed. All construction works will cease during storm events such as yellow warning rainfall events. Following heavy rainfall events, and before construction works recommence, the Proposed Wind Farm site will be inspected and corrective measures implemented to ensure safe working conditions e.g. dewatering of standing water in open excavations, etc.
- Exposed soils/peat (exposed temporary stockpiles) will be sealed with the bucket of an excavator during all relatively heavy rainfall events and during periods where works have temporarily ceased before completion at a particular area (e.g., overnight and weekends).

With regards to the fluvial flood zones at the Proposed Wind Farm site, a managed retreat from the fluvial flood zones will be implemented in the event of a high intensity rainfall event and/or weather warning related to rainfall. This will include the following:

- Any areas where soil/subsoil is exposed at the surface will be compacted firmly with a digger bucket of a suitably sized excavator.
- Open trenches will be backfilled and compacted.
- All oils, fuels and waste material will be removed from the flood zones.
- Existing sediment control measures will be removed, as these may be washed away and deposited elsewhere by the floodwaters.
- Site access tracks will be scraps and any excess soft material will be removed from the flood zones.
- All plant, machinery and equipment will be removed from the flood zones.

With regards to the flood zones along the Proposed Grid Connection, works may have to be postponed following heavy rainfall events which could cause flooding at watercourse crossings.

Post Mitigation Residual Effect: With the implementation of the prescribed mitigation measures the residual effect is a negative, slight, direct, short-term, unlikely effect on downstream surface water quality in watercourses and associated water dependent ecosystems downstream of the Proposed Wind Farm site including the Raforde River.

Significance of Effects: For the reasons outlined above and with the application of mitigation measures no significant effects will occur.

9.5.2.14 Potential Effects on Local Private Groundwater Well Supplies

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

No long term, permanent effects on groundwater levels / quantity will occur due to the lack of any proposed significant dewatering works, other than local temporary works at turbine/substation foundations are required for any excavations.

There are several public and group schemes that can be impacted by the Proposed Project. These are assessed separately in Section 9.5.2.18.

With regard to private wells, there are 75 no. inhabitable dwellings within 1km of the proposed turbine locations. No dwelling is located within 500m of any proposed turbine. The closest involved inhabitable dwelling is located approximately 542m from T03 (this is an involved landowner).

Due to the shallow nature of the proposed work along the Proposed Grid Connection underground cabling route, no effects on private groundwater well supplies will occur.

Pathway: Groundwater flowpaths.

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

Pre-Mitigation Effect: Negative, imperceptible, indirect, long-term, unlikely effect on down gradient private water supplies. In the absence of mitigation measures, there will be no potential for significant effects on local private groundwater well supplies.

Mitigation Measures / Impact Assessment:

There is no potential for effects on local private groundwater well supplies for the following reasons:

- The groundwater flow in the mineral soil deposits (glacial tills) beneath the peat/soil at the Proposed Wind Farm site is expected to discharge into the local surface watercourses i.e. the existing site drainage network which discharges to the Killimor and Raford rivers;
- The bedrock aquifer is classified as a Locally Important Aquifer and groundwater flowpaths will be short (<300m);
 - No dwellings are located within 500m of any proposed turbine location;
- Groundwater flow will be towards low watercourses and there are no dwellings located between the proposed turbine locations and the Killimor or Raford rivers;
- No significant excavation dewatering will be required and there will be no potential for effects to local groundwater levels;
- Furthermore, tried and tested, best practice mitigation measures for the protection of local groundwater quality have been proposed above with respect to suspended solids, hydrocarbons, cement-based products and wastewater.

Post Mitigation Residual Effects: With the implementation of the prescribed mitigation measures the residual effect will be a negative, imperceptible, indirect, long-term, unlikely effect in terms of quality or quantity on local private groundwater abstractions.

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

9.5.2.15 Potential Effects on Surface Water Drinking Supplies

There are no surface water Drinking Water Protected Areas (DWPA) downstream of the Proposed Wind Farm site.

The Lough Corrib DWPA (relating to the abstraction at Luimnagh WTP) is located ~13km to the west of the Proposed Grid Connection. There are no surface water connections from the Proposed Grid Connection to this DWPA. The DWPA is located in the Corrib regional surface water catchment whilst the Proposed Grid Connection is located in the Galway Bay South East surface water catchment. However, the bedrock geology in the local area is karstic and groundwater flowpaths in karst aquifers can cross surface water catchment boundaries. Therefore, an indirect hydrogeological connection may exist between the Proposed Grid Connection and the Lough Corrib DWPA.

Pathways: Surface water flowpaths, and groundwater flowpaths.

Receptors: Down-gradient water quality in the Lough Corrib DWPA.

Pre-Mitigation Potential Effect: Negative, imperceptible, indirect, short term, unlikely effect on downstream DWPA. In the absence of mitigation measures, there will be no potential for significant effects on the Lough Corrib DWPA.

Mitigation Measures / Impact Assessment:

There is very limited potential for effects on the Lough Corrib DWPA for the following reasons:

- The lack of any hydrological (surface water) connection between the Proposed Grid Connection and the DWPA;
- The only potential connectivity is via groundwater flowpaths in the underlying karst aquifers which can cross surface water catchment boundaries;
- The minor, transient and small-scale of the works along the Proposed Grid Connection significantly limit the potential for effects;
- Furthermore, tried and tested, best practice mitigation measures have been prescribed above for the protection of groundwater quality with respect to suspended solids, hydrocarbons, wastewater and cement-based products.

Post-Mitigation Residual Effects: For the reasons detailed above and with the implementation of the prescribed mitigation measures there will be no potential for residual effects on the Lough Corrib DWPA.

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

9.5.2.16 Potential Effects Due to Turbine Delivery Route Works

No effects on the water environment along the turbine delivery route will occur as no earthworks are required.

9.5.2.17 Potential Effects on Karst Features

There are no karst features in the area of the Proposed Wind Farm site and no karst features were recorded during the walkover surveys or site investigations.

However, some karst features are mapped by the GSI along the Proposed Grid Connection. In total ~9.76km of the Proposed Grid Connection underground cabling route is underlain by a Regionally Important Aquifer – karstified (conduit). As detailed in Section 9.3.10 there are several mapped karst features in the vicinity of the western section of the Proposed Grid Connection.

Any potential alteration in local groundwater quality or surface water quality has the potential to impact the Karstic Bedrock Aquifer underlying ~9.76km of the Proposed Grid Connection.

Pathway: Groundwater recharge and surface water drainage.

Receptor: Local karst features and the Regionally Important Karst Aquifer.

Pre-Mitigation Potential Effect: Indirect, negative, slight, unlikely effect on karst features and karst aquifer. In the absence of mitigation measures, there will be no potential for significant effects on karst features of the local karst aquifer.

Mitigation Measures / Impact Assessment:

The potential for effects on the underling karst aquifer is limited for the following reasons:

- The works along the Proposed Grid Connection are minor and transient in nature.

- Site drainage will be put in place in order to prevent any poor quality drainage water reaching the local karst features (Section 9.5.2.2 and Section 9.5.2.10)
- Mitigation measures relating to hydrocarbons (Section 9.5.2.6), cementitious materials (Section 9.5.2.7) and wastewater (Section 9.5.2.8) will provide adequate protection to groundwater and surface water quality and will ensure that groundwater quality will not be impacted.

Post Mitigation Residual Effect: For the reasons detailed above and with the implementation of the prescribed mitigation measures, the residual effect will be an indirect, negative, imperceptible, short-term, unlikely effect.

Significance of Effects: No significant effects on karst features will occur.

9.5.2.18 Potential Effects on Group Water Schemes

As detailed in Section 9.3.14.2, the outer Source Protection Area associated with the Rhyhn Killeeneen GWS includes the Raford River within the Proposed Wind Farm. The outer Source Protection Area associated with the Brockagh Lisduff GWS includes the Clarinbridge River along the Proposed Grid Connection. Furthermore, the GSI map several wells associated with GWS in the vicinity of the Proposed Grid Connection. These include the Carnaun, Castle Ellen GWS, the Castlambert GWS, the Palmerstown PWS, the Cashla, Atherry GWS and the Cartymore GWS.

Any potential effects on local water quality or quantity could potentially affect these water supplies.

Pathway: Site drainage network, surface water flowpaths and groundwater flowpaths.

Receptors: Rhyhn Killeeneen GWS, Brockagh Lisduff GWS, Carnaun, Castle Ellen GWS, the Castlambert GWS, the Palmerstown PWS, the Cashla, Atherry GWS and the Cartymore GWS.

Pre-Mitigation Effect: Indirect, negative, moderate, short-term, likely effect on local and downgradient GWS. In the absence of mitigation measures, there will be no potential for significant effects on local and downgradient GWS.

Impact Assessment & Proposed Mitigation Measures:

The design team were at all times aware that group water supplies and their associated Source Protection Areas existed in the vicinity of the Site, and as such all proposed mitigation and drainage design proposals were designed towards providing a “best in class” drainage management proposal for the Proposed Project considering the sensitive nature of the hydrogeological and hydrological environment.

Rhyhn Killeeneen GWS

No significant effects will occur on the Rhyhn Killeeneen GWS for the following reasons:

- The Proposed Wind Farm site is distant from the Rhyhn Killeeneen GWS source. The borehole associated with this supply is located ~18km to the southwest of the Proposed Wind Farm site.
- The Proposed Wind Farm site is also distant from the main Source Protection Area which is located ~13.3km to the southwest;
- The Raford/Dunkellin River is included in the Source Protection Area associated with this supply due to the presence of a swallow hole which may provide a linkage between the river and the abstraction boreholes. However, this connection has not been confirmed;

- The Source Protection Area includes a 20m buffer around the Raford/Dunkellin River within the Proposed Wind Farm site. However, a 50m hydrological buffer was applied to the Raford River as part of the hydrological constraints study for the Proposed Project;
- The length of the hydrological flowpath from the Proposed Wind Farm site along the Raford River to the inner Source Protection Area and the swallow hole (which potentially provides a connection to the GWS abstraction borehole) along the Dunkellin River is ~26km;
- The proposed works areas in the catchment of the Raford/Kilcolgan rivers are infinitely small in comparison to the catchment of these watercourses. For example, the catchment of the Kilcolgan River upstream of Craughwell is in excess of 100km²;
- The only works which directly overlap with the delineated Source Protection Area is the proposed crossing over the Raford River to the north of T08. No instream works are proposed at this location and the crossing will be completed using a clear span bridge crossing. Specific mitigation measures regarding the proposed watercourse crossing works are prescribed in Section 9.5.2.9.
- The proposed drainage regime will ensure that there will be no change to surface water runoff rates of groundwater recharge rates at the Proposed Wind Farm site;
- The mitigation measures described above in Section 9.5.2.1 (tree felling), Section 9.5.2.2 (suspended solids), Section 9.5.2.6 (hydrocarbons), Section 9.5.2.7 (cement-based products), Section 9.5.2.8 (wastewater) and Section 9.5.2.9 (morphological changes) will ensure the protection of water quality during the construction phase;
- Mitigation measures are also proposed for the protection of water quality in the event of a fluvial flood event at the Proposed Wind Farm site (Section 9.5.2.13);
- The proposed drainage design will ensure that all construction phase water is attenuated and treated prior to discharge at greenfield runoff rates.

Brockagh Lisduff GWS

No significant effects will occur on the Brockagh Lisduff GWS for the following reasons:

- The Proposed Grid Connection is distant from the Brockagh Lisduff GWS source. The Proposed Grid Connection is located ~9km from the inner Source Protection Area;
- The Clarinbridge River is included in the outer Source Protection Area associated with this supply. The length of the hydrological flowpath from the Proposed Grid Connection along the Clarinbridge River to the main Source Protection Area is ~11.3km;
- The proposed works areas in the catchment of the Clarinbridge River are infinitely small in comparison to the catchment of this river;
- All works are relatively minor and localised and cover very small areas (linear trench of ~1.1km length and of 1.2m depth);
- All works are temporary and transient in nature;
- All works will occur within an existing roadway; and,
- Mitigation measures for the protection of surface and groundwater water quality will be implemented during the Construction Phase along the Proposed Grid Connection.
- The only works which directly overlap with the delineated Source Protection Area are 4 no. watercourse crossings. Existing bridge/culvert crossings exist at these locations and no instream works are proposed. Specific mitigation measures regarding the proposed watercourse crossing works are prescribed in Section 9.5.2.10.

Carnaun, Castle Ellen GWS, the Castlelambert GWS, the Palmerstown PWS, the Cashla, Athenry GWS and the Cartymore GWS

No significant effects will occur on these GWSs for the following reasons:

- All works are relatively minor and localised and cover very small areas (linear trench of ~1.1km length and of 1.2m depth);
- All works are temporary and transient in nature;
- All works will occur within an existing roadway; and,
- Mitigation measures for the protection of surface and groundwater water quality will be implemented during the Construction Phase along the Proposed Grid Connection.

Post Mitigation Residual Effect: With the implementation of the prescribed mitigation measures the residual effect will be a negative, imperceptible, indirect, short term, unlikely effect on local group water supplies.

Significance of Effects: For the reasons outlined above, no significant effects will occur on local group water supplies.

9.5.2.19 Potential Effects on Hydrologically/Hydrogeologically Connected Designated Sites

The Raford River Bog NHA, the Rahasane Turlough SAC/pNHA and SPA are hydrologically connected with the Proposed Wind Farm site via the Raford and Kilcolgan rivers. The surface water connections from the Proposed Wind Farm site could transfer poor quality surface water that may affect the conservation objectives of these designated sites.

The Galway Bay Complex SAC/pNHA and Inner Galway Bay SPA are hydrologically connected to the Proposed Grid Connection via the Clarinbridge River. The surface water connections could transfer poor quality surface water that may affect the conservation objectives of these designated sites. However, given the small scale and transient nature of the works and the large volumes of water in Galway Bay the potential for effects would be very limited.

Furthermore, the Cregganna Marsh SPA and NHA, the Lough Corrib SAC and the Kiltullagh Turlough pNHA are included for the purposes of a conservative impact assessment due to the potential hydrogeological connection, via the karst bedrock, along the Proposed Grid Connection. However, the potential for effects is limited given the small scale and transient nature of the works.

All other downstream designated sites have been screened out of the assessment due to their distance from the Proposed Project and the lack of any hydrological/hydrogeological connectivity.

Pathway: Surface water flowpaths.

Receptor: Down-gradient water quality with the Raford River Bog NHA, Rahasane Turlough SAC/pNHA and SPA, Galway Bay Complex SAC/pNHA, Inner Galway Bay SPA, Cregganna Marsh SPA and NHA, Lough Corrib SAC and the Kiltullagh Turlough pNHA.

Pre-Mitigation Potential Effect: Indirect, negative, significant, short term, likely effect on the Raford River Bog NHA and the Rahasane Turlough SAC/pNHA and SPA downstream of the Proposed Wind Farm site. In the absence of mitigation measures, there will be the potential for significant effects on the Raford river Bog NHA and the Rahasane Turlough SAC/pNHA and SPA.

Indirect, negative, imperceptible, short-term, unlikely effect on the Galway Bay Complex SAC/pNHA and Inner Galway Bay SPA downstream of the Proposed Grid Connection. In the absence of mitigation measures, there will be no potential for significant effects on the Galway Bay Complex SAC/pNHA and the Inner Galway Bay SPA.

Indirect, negative, imperceptible, short-term, unlikely effect on the Cregganna Marsh SPA and NHA, Lough Corrib SAC and the Kiltullagh Turlough pNHA potentially downgradient of the Proposed Grid

Connection. In the absence of mitigation measures, there will be no potential for significant effects on the Cregganna Marsh SPA/NHA, Lough Corrib SAC and the Kiltullagh Turlough pNHA.

Mitigation Measures / Impact Assessment:

Raford River Bog NHA

There will be no significant effects on the Raford River Bog NHA for the following reasons:

- No works associated with the Proposed Project are proposed within this NHA;
- Strict, tried and tested-best practice mitigation measures have been prescribed in this EIAR for the protection of surface and groundwater quality at the Proposed Wind Farm site;
- A 50m buffer has been applied to the Raford River and the only works which directly overlap with the delineated 50 hydrological buffer zone is the proposed crossing over the Raford River to the north of T08. No instream works are proposed at this location and the crossing will be completed using a clear span bridge crossing. Specific mitigation measures regarding the proposed watercourse crossing works are prescribed in Section 9.5.2.9.
- The proposed drainage regime will ensure that there will be no change to surface water runoff rates of groundwater recharge rates at the Proposed Wind Farm site;
- The mitigation measures described above in Section 9.5.2.1 (tree felling), Section 9.5.2.2 (suspended solids), Section 9.5.2.6 (hydrocarbons), Section 9.5.2.7 (cement-based products), Section 9.5.2.8 (wastewater) and Section 9.5.2.9 (morphological changes) will ensure the protection of water quality during the construction phase;
- Mitigation measures are also proposed for the protection of water quality in the event of a fluvial flood event at the Proposed Wind Farm site (Section 9.5.2.13);
- The proposed drainage design will ensure that all construction phase water is attenuated and treated prior to discharge at greenfield runoff rates.

Rahasane Turlough SAC/pNHA and SPA

There will be no significant effects on the Rahasane Turlough SAC/pNHA and SPA for the following reasons:

- The length of the hydrological flowpath (~20km) between the Proposed Wind Farm site and the SAC;
- The potential for effects on this SAC is limited given the increasing volumes of water and associated dilution effect in downstream watercourses (Killimor, Raford and Kilcolgan rivers); and,
- Nevertheless, mitigation measures for the protection of surface and groundwater water quality will be implemented during the construction phase of the Proposed Project to ensure that there is no deterioration in local or downstream water quality.

Galway Bay Complex SAC/pNHA and Inner Galway Bay SPA

There will be no significant effects on the Galway Bay Complex SAC/pNHA and Inner Galway Bay SPA for the following reasons:

- The length of the hydrological flowpath (~19km) between the Proposed Grid Connection and the SAC/pNHA and SPA
- All works are relatively minor and localised and cover very small areas (linear trench of ~1.1km length and of 1.2m depth);
- All works are temporary and transient in nature; and,
- Mitigation measures for the protection of surface and groundwater water quality will be implemented during the Construction Phase along the Proposed Grid Connection.

Cregganna Marsh SPA and NHA, Lough Corrib SAC and the Kiltullagh Turlough pNHA

There will be no significant effects on the Cregganna Marsh SPA and NHA, Lough Corrib SAC and the Kiltullagh Turlough pNHA for the following reasons:

- The lack of any direct hydrological connection;
- The only potential for effects is via groundwater flowpaths in the underlying karst aquifer;
 - However, these designated sites are distant, and in excess of 3km, from the Proposed Grid Connection
- All works are relatively minor and localised and cover very small areas (linear trench of ~1.1km length and of 1.2m depth);
- All works are temporary and transient in nature; and,
- Mitigation measures for the protection of surface and groundwater water quality will be implemented during the Construction Phase along the Proposed Grid Connection.

Post Mitigation Residual Effect: With the implementation of the prescribed mitigation measures the residual effect will be a negative, imperceptible, indirect, short term, unlikely effect on downstream designated sites.

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

9.5.2.20 Potential Effects on WFD Status and Objectives

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

The WFD status for GWBs and SWBs underlying and downstream of the Proposed Project are defined in Section 9.3.12.1 and Section 9.3.12.2 respectively.

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

Pathway: Surface water flowpaths.

Receptor: WFD status of downstream surface water bodies and underlying GWBs.

Pre-Mitigation Potential Effect: Indirect, negative, imperceptible, short term, likely effect on surface water and groundwater bodies. In the absence of mitigation measures, there will be no potential for significant effects on the WFD status of SWBs or GWBs.

Proposed Mitigation Measures:

Mitigation measures relating to the protection of surface water drainage regimes and surface water quality within the Proposed Wind Farm site have been detailed in Section 9.5.2.1 (tree felling), Section 9.5.2.2 (suspended solids), Section 9.5.2.6 (hydrocarbons), Section 9.5.2.7 (cement-based products), Section 9.5.2.8 (wastewater) and Section 9.5.2.9 (morphological changes). Mitigation measures have also been proposed along the Proposed Grid Connection in Section 9.5.2.10.

Similarly, mitigation measures for the protection of groundwater quantity and quality have been detailed in Section 9.5.2.5 (groundwater levels), Section 9.5.2.6 (hydrocarbons), Section 9.5.2.7 (cement-based products), Section 9.5.2.8 (wastewater) and Section 9.5.2.11 (piling).

We summarise that there will be no significant effects on GWB or SWB WFD status for the following reasons:

- The small footprint of the Proposed Wind Farm infrastructure in relation to the scale of the underlying GWBs (GWDTE Rahasane Turlough has a total area of ~33,700ha whilst the Loughrea GWB has a total area of 3,200ha);
- The Proposed Project does not involve any alteration of drainage patterns, therefore, the quantitative status of the receiving surface and groundwaters will remain unaltered;
- There will be no direct discharge from the Proposed Project site to receiving waters; and,
- Mitigation measures for the protection of surface and groundwater water quality will be implemented during the construction phase of the Proposed Project to ensure that there is no deterioration in local or downstream water quality. These mitigation measures will ensure the qualitative status the receiving waterbodies remains unaltered by the Proposed Project.

Post Mitigation Residual Effects: 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, no significant effects on WFD Groundwater Bodies and Surface Water Bodies status, risk or future objectives will occur as a result of the Proposed Project.

9.5.2.21 **Potential Effects During Horizontal Directional Drilling along the Proposed Grid Connection**

Surface water quality effects on local watercourses may occur during drilling and groundworks associated with potential horizontal directional drilling (HDD) at the 3 no. watercourse crossings (WC02 – EPA mapped Clarinbridge River, WC06 – EPA mapped Torkeel Stream, and WC09 – EPA mapped Shoodaun River) along the Proposed Grid Connection.

It is proposed that HDD will be undertaken to prevent direct impacts on the watercourse. However, there is a risk of indirect impacts from sediment laden runoff during the launch pit and reception pit excavation works. There is also the unlikely risk of fracture blow out and contamination of the watercourse with drilling fluid.

Pathways: Runoff and surface water flowpaths.

Receptors: All watercourses in the vicinity of the Proposed Grid Connection including the Clarinbridge and Shoodaun rivers and the Toorkeel Stream.

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

Proposed Mitigation Measures:

- 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);
- The crossing works area will be clearly marked out with fencing or flagging tape to avoid unnecessary disturbance;
- There will be no storage of material / equipment or overnight parking of machinery inside the hydrological buffer zone;
- Before any ground works are undertaken, double silt fencing will be placed upslope of the watercourse channels;
- Additional silt fencing or straw bales (pinned down firmly with stakes) will be placed across any natural surface depressions / channels that slope towards the watercourse;
- Silt fencing will be embedded into the local soils to ensure all site water is captured and filtered;
- The area around the bentonite batching, pumping and recycling plant will be bunded using terram (as it will clog) and sandbags in order to contain any spillages;
- Drilling fluid returns will be contained within a sealed tank / sump to prevent migration from the works area;
- Spills of drilling fluid will be cleaned up immediately and contained in an adequately sized skip before been taken off-site;
- If rainfall events occur during the works, there will be a requirement to collect and treat small volumes of surface water from areas of disturbed ground (i.e. soil and subsoil exposures created during site preparation works);
- This will be completed using a shallow swale and sump down slope of the disturbed ground; and water will be pumped to a proposed settlement pond area at least 50m from the watercourse;
- The discharge of water onto vegetated ground will be via a silt bag which will filter any remaining sediment from the pumped water. The entire percolation area will be enclosed by a perimeter of double silt fencing;
- Any sediment laden water from the works area will not be discharged directly to a watercourse or drain;
- Works shall not take place during periods of heavy rainfall and will be scaled back or suspended if heavy rain is forecasted;
- Daily monitoring of the compound works area, the water treatment and pumping system and the percolation area will be completed by a suitably qualified person during the construction phase. All necessary preventative measures will be implemented to ensure no entrained sediment, or deleterious matter is discharged to the watercourse;
- If high levels of silt or other contamination is noted in the pumped water or the treatment systems, all construction works will be stopped. No works will recommence until the issue is resolved and the cause of the elevated source is remedied;
- On completion of the works, the ground surface disturbed during the site preparation works and at the entry and exit pits will be carefully reinstated and re-seeded at the soonest opportunity to prevent soil erosion;
- The silt fencing upslope of the river will be left in place and maintained until the disturbed ground has re-vegetated;
- There will be no batching of cement along the Proposed Grid Connection;
- There will be no refuelling allowed within 100m of the watercourse crossing; and,

- All plant will be checked for purpose of use prior to mobilisation at the watercourse crossing.

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

- The drilling fluid 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;
- One or more 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: Due to the avoidance of instream works, the works being mainly carried out in the corridor of a public road along with the proposed mitigation measures the residual effect will be a negative, imperceptible, indirect, temporary, likely effect on surface water in the downstream watercourses.

Significance of Effects: For the reasons outlined above, 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 Surfaces with Lower Permeability Surfaces

Progressive replacement of the vegetated surface with impermeable surfaces could potentially result in an increase in the proportion of surface water runoff reaching the surface water drainage network. This could potentially increase runoff from the Site and increase flood risk downstream of the Proposed Project. For the purposes of assessment, it is conservatively assumed that the Proposed Wind Farm access roads and hardstands (including the proposed onsite 38kV substation) are impermeable. The assessed Proposed Project footprint (7.6ha) comprises turbine and met mast foundations and hard standings, access roads, onsite 38kV substation, and temporary construction compounds. During storm rainfall events, additional runoff coupled with increased velocity of flow could increase hydraulic loading, resulting in erosion of watercourses and impact on aquatic ecosystems.

There will be no potential increase in runoff along the Proposed Grid Connection. The works are predominantly 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. Only a very small section (0.5km) of access road will be constructed along the Proposed Grid Connection and this will drain over the edge and will not change the existing runoff and recharge rates in this area as all water currently recharges to ground.

Pathway: Site drainage network.

Receptor: Surface waters (Killimor, Raford and Kilcolgan rivers) and associated water-dependant ecosystems downstream of the Proposed Wind Farm site.

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

Effect Assessment:

The emplacement of the Proposed Project footprint, as described in Chapter 4: Description of the Proposed Project of the EIAR, (assuming emplacement of impermeable materials under a precautionary scenario) could result in an average total site increase in surface water runoff of approximately 362m³/month. This increase is small given the scale of the Proposed Project footprint in comparison to the overall site area. Furthermore, baseline runoff rates are very high due to the presence of low permeability peat soils across much of the Site. Therefore, the replacement of natural surfaces with impermeable surfaces at the Proposed Project footprint will not result in any significant increase in runoff. The runoff during the operational phase, in the absence of drainage controls, represents only a 0.3% increase in runoff in comparison to the baseline runoff rates across the Proposed Wind Farm site.

Table 9-13: Baseline Site Runoff vs Operational Phase Runoff

Site Baseline Runoff/month (m ³)	Baseline Runoff/day (m ³)	Permanent Hardstanding Area (m ²)	Hardstanding Area 100% Runoff (m ³)	Hardstanding Area 96% Runoff (m ³)	Net Increase/month (m ³)	Net Increase/day (m ³)	% Increase from Baseline Conditions (m ³)
1,111,718	35,861	76,000	9,956	9,557	398	12.8	0.035%

The additional volume is low due to the fact that the runoff potential across the majority of the Site is naturally high. Also, the calculation assumes that all hardstanding areas will be impermeable which will not be the case as access tracks will be constructed of permeable stone aggregate. Furthermore, the assessment does not consider the existing roads and hardstand areas present across the Site. The increase in runoff from the Proposed Project will, therefore, be negligible. This is even before mitigation measures will be put in place.

Proposed Mitigation by Design:

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 submitted with this planning application (Appendix 4-3):

- Interceptor drains will be installed up-gradient of all proposed infrastructure to collect clean surface runoff, in order to minimise the amount of runoff reaching areas where suspended sediment could become entrained. It will then be directed to areas where it can be re-distributed over the ground by means of a level spreader;

- Swales/roadside 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/roadside drains;
- Check dams will be used along sections of access road drains to intercept silts at source. Check dams will be constructed from a 4/40mm non-friable crushed rock;
- Settlement ponds, emplaced downstream of 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 have been designed in consideration of the greenfield runoff rate.

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

Post Mitigation Residual Effect: Proven and effective measures to attenuate runoff and mitigate the risk of flooding will be employed. The residual effect will be a neutral, indirect, long term, likely effect on down gradient streams/rivers.

Significance of Effects: No significant effects on downstream flood risk will occur during the operational phase of the Proposed Project.

9.5.3.2 Potential Effects from Runoff Resulting in Contamination of Surface Waters

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

These minor activities could, however, result in the release of suspended solids to surface water and could result in an increase in the suspended sediment load, resulting in increased turbidity which in turn could affect the water quality of downstream water bodies. Potential effects could be significant if not mitigated.

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

Maintenance works will be contained within the Proposed Wind Farm site and no routine maintenance works will be required along the Proposed Grid Connection.

Pathways: Drainage and surface water discharge routes.

Receptors: Down-gradient rivers (Killimor, Raford and Kilcolgan rivers) and associated water dependent ecosystems downstream of the Proposed Wind Farm site.

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

Proposed Mitigation Measures:

Mitigation measures for sediment control are the same as those detailed above for the construction phase.

With regards to hydrocarbons:

- Onsite re-fuelling of normal operational vehicles will not be carried out during the operational phase of the Proposed Project. 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.

Post-Mitigation 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, short term, unlikely effect on surface water quality and groundwater quality.

Significance of Effects: For the reasons outlined above, no significant effects on surface water or groundwater quality are anticipated during the operational phase of the Proposed Project.

9.5.3.3 Potential Effects on Surface Water and Groundwater 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.

9.5.3.4 Potential Effects on Group Water Supplies

During the operational phase, there will be no potential for effects on the Rhynn Killeeneen GWS downstream of the Proposed Wind Farm site.

There will be no direct discharge from the Proposed Project to downstream receiving waters during the operational phase. All Proposed Wind Farm site drainage measures will be in place. 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 Rhynn Killeeneen will not be altered by the Proposed Project.

There is no potential for effects on the GWS in the vicinity and downstream of the Proposed Grid Connection.

9.5.3.5 Potential Effects Associated with Flooding at the Proposed Wind Farm site and on Downstream Flood Risk

A detailed Stage 3 flood risk assessment (Appendix 9-1) has been completed for the Proposed Project. This FRA determined that the proposed turbine location T8, its associated hardstand and access road are located with the fluvial flood zones associated with flooding along the Raforde River. Furthermore, T1 and T2 are located in modelled flood zones associated with the Killimor River.

All other key infrastructure, including the proposed onsite 38kV substation, are proposed outside of the modelled fluvial flood zones.

The presence of infrastructure in fluvial flood zones has the potential to increase downstream flood risk due to storage reduction and alteration of surface water drainage patterns.

Pathways: Drainage and surface water discharge routes.

Receptors: Proposed Wind Farm infrastructure and upstream and downstream receptors (i.e. people and property).

Pre-Mitigation Potential Effect: Negative, moderate, direct, long-term, likely effect on Proposed Wind Farm infrastructure. In the absence of mitigation measures, there will be no potential for significant effects on Proposed Wind Farm infrastructure.

Negative, imperceptible, indirect, long term, likely effect on downstream receptors (i.e. property and people). In the absence of mitigation measures, there will be no potential for significant effects on downstream receptors.

Proposed Mitigation Measures:

The Proposed Wind Farm has been designed, cognisant of the fluvial flood risk at the Proposed Wind Farm site. Hardstands for the proposed turbines located within or in close proximity to the modelled fluvial flood zones (T1, T2 and T8) have been designed with finished floor levels 0.5m above the flood levels for flood Zone B (1 in 1,000-year flood event) (refer to Table 9-5 above). This design of a high level flood terrace, e.g. turbine hardstands with a 0.50m freeboard for floor levels with ramps to wind farm road network that is to be placed at existing ground levels, will ensure that flooding at the Proposed Wind Farm site poses no risk to the proposed infrastructure and that access will be maintained during flooding events. The proposed road network will be constructed at existing ground levels in order to avoid flood plain flow blockage of pre-construction flood flow paths. Access and

egress to the Proposed Wind Farm site during the operational phase will be from the west, via the L3115. This location is outside of the modelled flood zones.

Furthermore, all works at watercourse crossings will be constructed in compliance with OPW Section 50 guidance.

Whilst the proposed onsite 38kV substation is located outside of flood zones A and B, a final floor level will be set at 0.5m above the existing ground level.

The Stage 3 FRA demonstrates that the Proposed Wind Farm will not result in any significant change to water levels or flow velocities in the Raford or Killimor rivers. The FRA is included as Appendix 9-1. The FRA states that any potential increase in flood water levels as a result of the Proposed Project will be minimal, with some localised water level increases of 0.06m and 0.15m for the 100-year and 1,000-year flood events (plus climate change) respectively. Modelling also revealed that there will be no perceptible change in the river velocity as a result of the proposed infrastructure (no potential for increased erosion). Calculations of the pre and post development peak run-off flow rates have an increase in flow to the river of $0.85\text{m}^3/\text{s}$ for the critical rainfall event, and this relatively low flow will have an imperceptible effect on flood levels. Therefore, on the basis of the calculations and modelling presented in the FRA, it can be concluded that the Proposed Wind Farm will not increase flood risk within the Proposed Wind Farm site or elsewhere.

Precautionary rock armouring should also be provided around new culverts and bridges within the Proposed Wind Farm site.

Post-Mitigation Residual Effects: With the implementation of the Proposed Wind Farm drainage system and the use of the flood compensation areas the residual effect is considered to be a Negative, imperceptible, indirect, brief, likely effect on flood risk and downstream receptors (i.e. property and people).

Significance of Effects: For the reasons outlined above, no significant effects with regard flood risk.

9.5.4

Decommissioning Phase - Likely Significant Effects and Mitigation Measures

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

The potential effects associated with decommissioning of the Proposed 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 foundations and hard standing areas. This will be done by covering with topsoil to encourage vegetation growth and reduce run-off and sedimentation.

The Proposed Wind Farm roadways will be kept and maintained following decommissioning of the Proposed Wind Farm, as these will be utilised for forestry and other agricultural operations.

The electrical cabling connecting the proposed turbines to the onsite 38kV 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 cranes as used in their construction. They will then be transported off-site along their original delivery route. The disassembly and removal of the proposed turbines will not have an impact on the hydrological/hydrogeological environment at the Proposed Wind Farm site.

Other impacts such as possible soil compaction and 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 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 38kV substation and electrical cabling will be retained as a permanent part of the national grid. 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.

A Decommissioning Plan has been prepared (Appendix 4-6) the detail of which will be agreed with the local authority prior to any decommissioning. The Decommissioning Plan will be updated prior to the end of the operational period in line with decommissioning methodologies that may exist at the time and will agree with the competent authority at that time. The potential for effects during the decommissioning phase of the Proposed Project has been fully assessed in the EIAR.

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

9.5.5 Risk of Major Accidents and Disaster

The main risk of Major Accidents and Disasters (MADs) at peatland sites is related to peat stability. A Peat Stability Risk Assessment (PSRA) has been completed for the Proposed Wind Farm (Appendix 8-1) and concludes that the risk of a stability issue is low provided that appropriate mitigation measures and best practices are followed.

Flooding can also result in downstream MADs. With the implementation of the Proposed Wind Farm drainage system, the increased flood risk associated with the Proposed Project is negligible/none.

Please see Chapter 16: Major Accidents and Natural Disasters for further information on MADs at the Site.

9.5.6 Assessment of Health Effects

Potential health effects arise mainly through the potential for surface and groundwater contamination which may have negative effects on public and private water supplies. There are mapped public and group water scheme groundwater protection zones in the area of the Proposed Wind Farm site and several downgradient private groundwater well supplies. However, the Proposed Project design and mitigation measures ensure that the potential for effects on the hydrogeological 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 detailed Site-Specific Flood Risk Assessment (SSFRA) has been carried out. This Flood Risk Assessment, 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 insignificant. On-site (construction and operation phase) drainage control measures will ensure no downstream increase in local flood risk.

9.5.7 Assessment of Potential Cumulative Effects

This section presents an assessment of the potential cumulative effects associated with the Proposed Project and other developments (existing and/or proposed), plans and land uses as described in section 2.9 of Chapter 2: Background to the Proposed Project on the hydrological and hydrogeological environment.

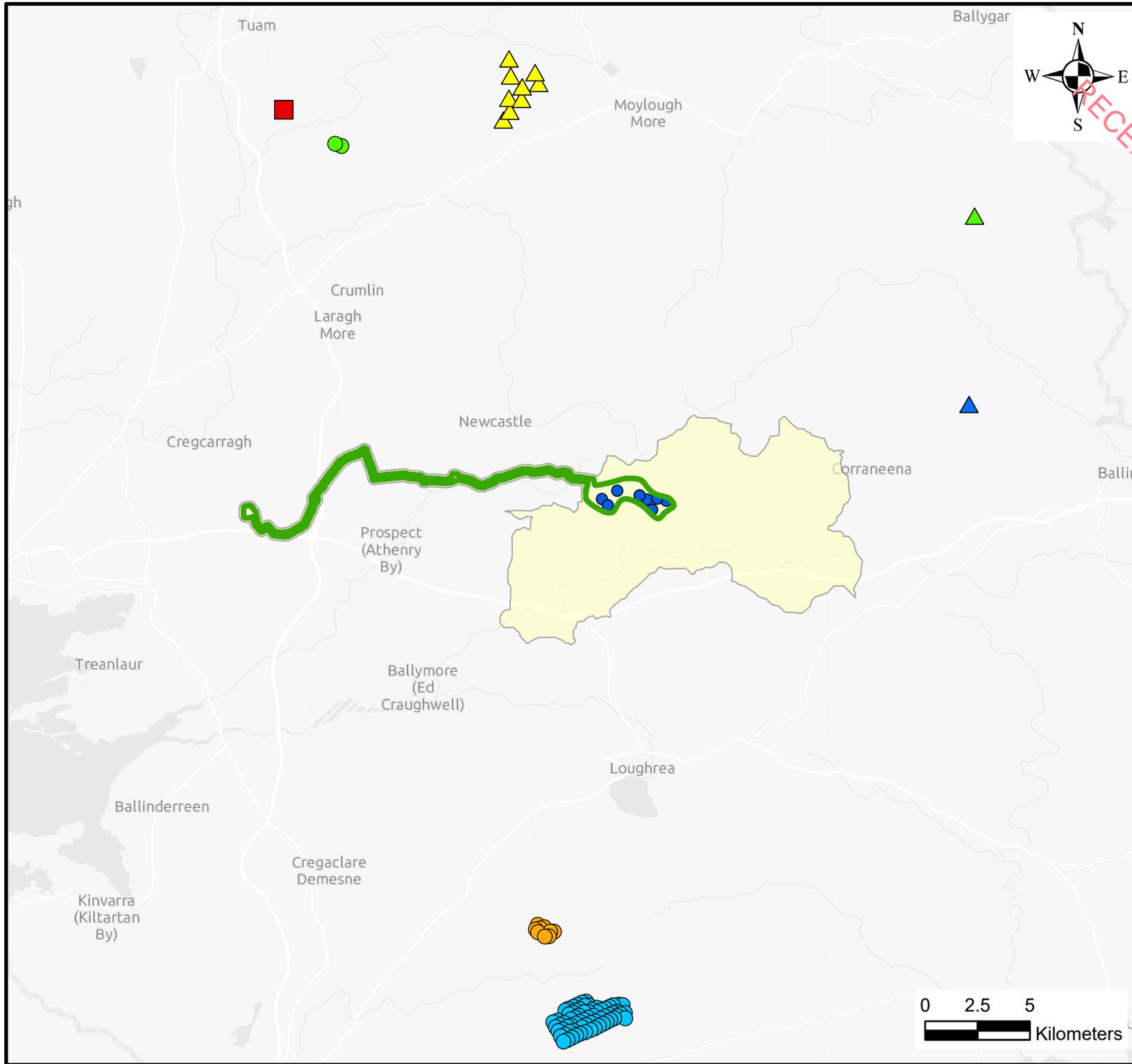
The main likelihood of cumulative effects is assessed to be associated with the surface water environment. Due to the nature of the underlying bedrock (i.e. Locally Important Aquifer), the soils and subsoils of low permeability, and the near surface nature of construction activities, cumulative effects with regard groundwater quality or quantity in the bedrock arising from the Proposed Project are assessed as not likely.

The primary potential for cumulative effects will occur during the construction phase of the Proposed Project as this is when earthworks and excavations will be undertaken at the Site. 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 lesser degree with less ground disturbance.

A cumulative hydrological and hydrogeological study area has been delineated as shown below in Figure 9-13.

The hydrological cumulative study area is delineated as follows:

- A quantitative assessment based on flow volumes obtained from the EPA HydroTool Nodes downstream of the Proposed Wind Farm site. This assessment concludes that due to dilution no hydrological cumulative effects will occur beyond EPA Hydrotool Node 29_174 on the Kilcolgan River immediately upstream of Craughwell. At this location the Kilcolgan River has a total upstream catchment area of 10,800ha. There will be no potential for cumulative effects beyond this cumulative study area due to increases in flow volumes (as the catchment area increases) and increasing distance from the Proposed Wind Farm site.
- A further assessment has been completed within a 200m zone of the Proposed Grid Connection. Due to the shallow nature of the underground cabling connection trench, a 200m buffer zones is an appropriate scale when considering potential cumulative effects on the water environment.



- Legend
- EIAR Site Boundary
 - Proposed Turbine Layout
 - Hydrological Cumulative Study Area
- Wind Farm Developments
- Existing Cloonlusk Wind Farm
 - Existing Derrybrien Wind Farm
 - Existing Sonnagh Old Wind Farm
 - Permitted Cloonascragh Wind Turbine
 - Proposed Cooloo Wind Farm
 - Proposed Derryfadda Wind Farm
 - Proposed Killuremore Wind Farm

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Title: Hydrological Cumulative Study Area

Figure No: 9-13

Drawing No: P1706-0-0925-A4-913-00A

Sheet Size: A4

Project No: P1706-0

Scale: 1:250,000

Drawn By: GA

Date: 22/09/2025

Checked By: MG

9.5.7.1 Potential Cumulative Effects with Turbary Peat Cutting

Private peat cutting on turbary plots will likely continue at the Proposed Wind Farm site. The construction phase of the Proposed Project may 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 infinitely small, significantly limiting the potential for cumulative effects to arise with the Proposed Project. Nevertheless, the mitigation measures detailed in Section 9.5.2, 9.5.3 and 9.5.4 for the construction, operation and decommissioning phases of the Proposed 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.

9.5.7.2 Cumulative Effects with Agriculture

The delineated cumulative study area is a largely agricultural area.

Agriculture is the largest pressure on water quality in Ireland. Agricultural practices such as the movement of soil and the addition of fertilizers and pesticides can lead to nutrient losses and the entrainment of suspended solids in local surface watercourses. This can have a negative impact 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 9.5.2, 9.5.3 and 9.5.4 for the construction, operation 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 agricultural activities.

9.5.7.3 Cumulative Effects with Commercial Forestry

The Proposed Wind Farm site and the wider hydrological cumulative study area includes some forested areas.

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 felling may also give rise to modified stream flow regimes caused by associated land drainage.

Given the occurrence of several forestry blocks within the Proposed Wind Farm site and in the surrounding lands, and given that they drain to the Killimor, Raford and Kilcolgan rivers, the potential cumulative effects on downstream water quality and quantity need to be assessed.

However, the mitigation measures detailed in Section 9.5.2, 9.5.3 and 9.5.4 for the construction, operation and decommissioning phases of the Proposed Project will ensure the protection of downstream surface water quality. Furthermore, it is unlikely that the construction phase of the Proposed Project, which will last 18-24 months, would overlap with felling operations (forestry rotations typically last 30-50 years).

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

9.5.7.4 Cumulative Effects with Other Wind Farm Developments

A total of 96 no. existing, permitted and proposed wind turbines have been identified within 25km of the Proposed Wind Farm site. These include the existing Cloonlusk Wind Farm which contains 2 no. operational wind turbines and is located ~21km from proposed turbines. The existing, not operational Derrybrien Wind Farm (70 no. turbines) is also located ~23km from proposed turbines. The existing Sonnagh Old Wind Farm contains 9 no. operational wind turbines and is mapped ~20km from proposed turbines. The proposed Cooloo Wind Farm is located ~18km from proposed turbines.

However, none of these wind farms are located within the delineated hydrological cumulative study area associated with the Proposed Wind Farm. Furthermore, in order to be ultra conservative an assessment was completed to identify any wind farm underlain by the Rahasane Turlough GWB. Similarly, no existing or proposed wind farm are located in this study area.

Therefore, there is no potential for cumulative effects with other wind farm developments.

9.5.7.5 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 for the Proposed Wind Farm site and the Proposed Grid Connection described above.

The planning applications identified within the study area for largely for new dwellings or renovations of existing dwellings, associated wastewater treatment systems as well as for the erection of farm buildings. The planning applications have been reviewed based on their type, scale and proximity to the Proposed Wind Farm site. Based on the scale of the works, their proximity to the Proposed Wind Farm 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).

A desk study of planning applications within 200m of the Proposed Grid Connection was undertaken. The majority of these applications relate to the construction or renovation/extension of domestic dwellings, which will not generate potential cumulative effects due to their scale. However, in the vicinity of Cashla 220kV substation there are applications for the construction of a battery energy storage system and a synchronous condenser. A Soils, Geology, Hydrology and Hydrogeology Environmental Report was submitted along with the application for this BESS. This report detailed mitigation measures for the protection of the hydrological and hydrogeological environment through all phases of the development.

The works along the Proposed Grid Connection are minor and transient, similar to roadworks being completed across the country and have no potential for significant cumulative effects on the hydrological or hydrogeological environment.

9.5.8 Post Consent Monitoring

No monitoring is required.