



Cush Wind Farm Phase II

Environmental Impact Assessment Report

Chapter 7: Water

Cush Wind Limited

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7.1 INTRODUCTION

7.1.1 BACKGROUND AND OBJECTIVES

This chapter provides an assessment of any likely or significant effects of the project (including its secondary off-site elements which are described below) on water aspects (hydrology and hydrogeology) of the receiving environment.

The objectives of the assessment are to:

- Produce a baseline study of the existing water environment (surface and groundwater) in the area of the project;
- Identify likely positive and negative impacts of the project on surface and groundwater during the construction, operation and decommissioning phases;
- Identify mitigation measures to avoid, remediate or reduce any likely or significant negative effects; and,
- Assess any likely or significant cumulative effects of the project elements themselves as well as a result of other wind farms and other developments.

7.1.2 DESCRIPTION OF THE PROJECT

The project site is located in rural Co. Offaly, approximately 4km north of the town of Birr and c. 28km south-west of Tullamore, Co. Offaly.

The project assessed within this EIAR comprises a 3 no. wind turbine extension to the permitted Cush Wind Farm Phase I, together with all associated and ancillary infrastructure and works. This includes turbine foundations, crane hardstanding areas, access tracks, internal wind farm underground cabling, site drainage and rehabilitation works, peat/spoil management, a proposed electrical switch room building, and a c.5km underground electricity line required to facilitate connection of the project site to the national electricity network.

The final turbine model has not yet been selected; however, the proposed turbines will be selected within the turbine dimension range assessed in this EIAR, as set out in **Section 1.8.3, Chapter 1**.

For the purposes of this chapter, the assessment has been undertaken on the basis of the maximum assumed physical footprint within the turbine dimension range, as identified in **Table 1.6 of Chapter 1**.

The turbine component haul route and associated temporary and permanent accommodation works as described in **Chapter 3**, are located within Counties Galway, Roscommon, Westmeath and Offaly.

It is envisaged that turbine components will be transported from the Port of Galway to the project site via the N6, M6, N52 and N62, before accessing the project site from the permitted construction phase site entrance from the N62 national road.

However, as the route follows motorway and national roads through these counties, it is assessed that there is no likelihood of effects on water and, therefore, these areas have been screened out from further assessment.

A full description of the project is presented in **Chapter 3**.

7.1.3 STATEMENT OF AUTHORITY

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

Our core areas of expertise and experience include upland hydrology and wind farm drainage design. We routinely complete impact assessments for hydrology and hydrogeology for a large variety of project types, including wind farms and associated grid connections.

This chapter was prepared by Michael Gill and David Broderick.

Michael Gill (P. Geo., B.A.I., MSc, Dip. Geol., MIEI) is an Environmental Engineer with over 24 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms in Ireland. He has also managed EIAR assessments for infrastructure projects and private residential and commercial developments. In addition, he has substantial experience in wastewater engineering and site suitability assessments, contaminated land investigation and assessment, wetland hydrology /hydrogeology, water resource assessments, surface water drainage design and SUDs design, and surface water/groundwater interactions. For example, Michael has worked on the EIS/EIAR for Seven Hills WF, Cloncreen WF, and Derrinlough WF, and over 100 other wind farm-related projects.

David Broderick (P.Geo, BSc, H. Dip Env Eng, MSc.) is a Hydrogeologist with over 19 years' experience in both the public and private sectors. Having spent two years working in the Geological Survey of Ireland, working mainly on groundwater and source protection studies, David moved into the private sector. David has a strong background in groundwater resource assessment and hydrogeological/hydrological investigations in relation to developments such as quarries and wind farms. David has also completed numerous geology and water assessments for inclusion within EIARs for a range of commercial developments. David has worked on the EIS/EIAR for Drumlins Park WF, White Hill WF, Bracklyn WF, Pinewoods WF and Yellow River WF, and over 80 other wind farm related projects across the country.

7.1.4 RELEVANT LEGISLATION

This chapter has been 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.

Regard has also been taken of the requirements of the following legislation (where relevant):

- Planning and Development Act 2000 (as amended) (the '2000 Planning Act');
- 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 Directive 2014/52/EU into Irish Law;
- S.I. No. 94/1997: European Communities (Natural Habitats) Regulations,

resulting from EU Directives 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) and 79/409/EEC on the conservation of wild birds (the Birds Directive);

- S.I. No. 293/1988: Quality of Salmon Water Regulations, resulting from EU Directive 78/659/EEC on the Quality of Fresh Waters Needing Protection or Improvement in order to Support Fish Life;
- S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 and S.I. No. 722/2003 European Communities (Water Policy) Regulations which implement EU Water Framework Directive (2000/60/EC) and provide for implementation of 'daughter' Groundwater Directive (2006/118/EC). Since 2000 water management in the EU has been directed by the Water Framework Directive (WFD). The key objectives of the WFD are that all water bodies in member states achieve (or retain) at least 'good' status by 2015. Water bodies comprise both surface and groundwater bodies, and the achievement of 'Good' status for these depends also on the achievement of 'good' status by dependent ecosystems. Phases of characterisation, risk assessment, monitoring and the design of programmes of measures to achieve the objectives of the WFD have either been completed or are ongoing. In 2015 it will fully replace a number of existing water related directives, which are successively being repealed, while implementation of other Directives (such as the Habitats Directive 92/43/EEC) will form part of the achievement of implementation of the objectives of the WFD;
- S.I. No. 41/1999: Protection of Groundwater Regulations, resulting from EU Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances (the Groundwater Directive);
- S.I. No. 249/1989: Quality of Surface Water Intended for Abstraction (Drinking Water), resulting from EU Directive 75/440/EEC concerning the quality required of surface water intended for the abstraction of drinking water in the Member States (repealed by 2000/60/EC in 2007);
- S.I. No. 439/2000: Quality of Water intended for Human Consumption Regulations and S.I. No. 278/2007 European Communities (Drinking Water No. 2) Regulations, arising from EU Directive 98/83/EC on the quality of water intended for human consumption (the Drinking Water Directive) and WFD 2000/60/EC (the Water Framework Directive);
- S.I. No.106/2007: European Communities (Drinking Water) Regulations and S.I. No. 122/2014: European Union (Drinking Water) Regulations, arising from EU Directive 98/83/EC on the quality of water intended for human consumption (the Drinking Water Directive) and WFD 2000/60/EC (the Water Framework Directive);
- S.I. No. 684/2007 Waste Water Discharge (Authorisation) Regulations 2007;
- S.I. No. 99/2023: European Communities Environmental Objectives (Drinking Water) (Amendment) Regulations 2023;
- S.I. No. 9/2010: European Communities Environmental Objectives (Groundwater) Regulations 2010 as amended;
- S.I. No. 272/2009: European Communities Environmental Objectives (Surface Water) Regulations 2009 as amended; and,

- S.I. No. 77/2019: European Communities Environmental Objectives (Surface Water) (Amendment) Regulations 2019.

7.1.5 RELEVANT GUIDANCE

This chapter has been prepared in accordance with guidance contained in the following:

- *Guidance Document on Wind Energy Developments and EU Nature Legislation* (European Commission, 2020);
- *Guidance on the preparation of the EIA Report* (Directive 2011/92/EU as amended by 2014/52/EU);
- Environmental Protection Agency (2022) *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports*;
- Institute of Geologists Ireland (2013) *Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements*;
- National Roads Authority (2008) *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*;
- DOE/NIEA (2015) *Wind Farms and Groundwater Impacts – A guide to EIA and Planning Considerations*;
- Department of the Environment, Heritage, and Local Government (2006) *Wind Energy Development Guidelines for Planning Authorities 2006*;
- Department of the Housing, Planning, and Local Government (2019) *Draft Revised Wind Energy Development Guidelines*;
- Forestry Commission (2004) *Forests and Water Guidelines, Fourth Edition*. Publ. Forestry Commission, Edinburgh;
- Coillte (2009) *Forest Operations & Water Protection Guidelines*;
- Forest Service (2000) *Forestry and Water Quality Guidelines*. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford;
- COFORD (2004) *Forest Road Manual – Guidelines for the Design, Construction and Management of Forest Roads*;
- Inland Fisheries Ireland (2016) *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters*;
- *Good Practice During Wind Farm Construction* (Scottish Natural Heritage, 2010);
- PPG1 - *General Guide to Prevention of Pollution* (UK Guidance Note); PPG5 – *Works or Maintenance in or Near Watercourses* (UK Guidance Note);
- CIRIA (Construction Industry Research and Information Association) 2006 *Guidance on 'Control of Water Pollution from Linear Construction Projects'* (CIRIA Report No. C648, 2006);
- CIRIA 2001 *Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors*. CIRIA C532. London, 2001.
- Department of Housing, Planning & Local Government (2018) *Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental*

Impact Assessment; and,

- *Offaly County Development Plan 2021-2027.*

7.2 METHODOLOGY

7.2.1 DESK STUDY

A desk study of the project site and water study area (described in **Section 7.2.6** below) was completed in advance of undertaking the walkover survey, field mapping and site investigations. This involved collecting all relevant geological, hydrological, hydrogeological and meteorological information for the project site and water study area.

The desk study included consultation and review of the following data sources:

- Environmental Protection Agency database (www.epa.ie);
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks & Wildlife Services Public Map Viewer (www.npws.ie);
- Water Framework Directive/EPA Catchments Map Viewer (www.catchments.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 15 (Geology of Galway - Offaly). Geological Survey of Ireland (GSI, 1999);
- Geological Survey of Ireland (2004); Groundwater Body Initial Characterization Reports;
- OPW Past Flood Event Mapping (www.floodinfo.ie);
- OPW Flood Mapping (www.floodinfo.ie);
- Ordnance Survey Ireland (OSI) – 6 inch and 1:5000 scale basemaps; and,
- Aerial photography (www.bing.com/maps, www.geohive.ie, www.google.com/maps).

7.2.2 SITE INVESTIGATIONS

Site walkovers, hydrological mapping and site investigations (soil probing and trial pits) were undertaken by HES on 21 October 2022, 5 December 2022, 23 & 25 January and 26 March 2023.

Additional site walkovers, site investigations and baseline monitoring was carried out on 12 November 2025 and 23 January, 18 June & 13 August 2026.

A Peat Stability Assessment used to inform the assessment contained within this chapter was carried out by Fehily Timoney & Company (FT) and is enclosed at **Annex 6.1**. Separately, a Peat & Spoil Management Plan has been prepared (enclosed within the Planning-Stage CEMP at **Annex 3.4**) which details the treatment and management of material excavated during the construction phase of the project.

In summary, site investigations and assessments to address and inform the preparation of this water chapter include the following:

- Walkover surveys and hydrological mapping of the project site and the surrounding area were undertaken whereby water flow directions and

drainage patterns were recorded;

- Trial pit investigation carried out in December 2022 for the Cush Wind Farm Phase I planning application (7 no. trial pits were completed);
- 25 no. soil probe locations along with slope angle measurements were carried out by FT during March 2026 as part of the peat stability assessment;
- Field hydrochemistry measurements (electrical conductivity, pH, dissolved oxygen, temperature and turbidity) were taken to determine the origin and nature of surface water flows;
- Surface water sampling (2 no. rounds) was undertaken to determine the baseline water quality of the primary receiving surface waters;
- Stage 2 Site Specific Flood Risk Assessment (**Annex 7.1**); and,
- WFD Compliance Assessment Report (**Annex 7.3**).

7.2.3 RECEPTOR SENSITIVITY / IMPORTANCE / IMPACT CRITERIA

Using the National Roads Authority (NRA 2008) guidance, an estimation of the importance of the water environment at the project site and study area are quantified by applying the importance criteria set out in **Table 7.1** and **Table 7.2**; the impact magnitude is assessed using **Table 7.3** and **Table 7.4**, while the impact rating using **Table 7.5**

Importance	Criteria	Typical Example
Extremely High	<ul style="list-style-type: none"> • Attribute has a high quality or value on an international scale. 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Attribute has a high quality or value on a regional or national scale. 	<ul style="list-style-type: none"> • River, wetland or surface water body ecosystem protected by national legislation – NHA status. • Regionally important potable water source supplying >2500 homes. • Quality Class A (Biotic Index Q4). • Flood plain protecting more than 50 residential or commercial properties from flooding. • Nationally important amenity site for wide range of leisure activities.
High	<ul style="list-style-type: none"> • Attribute quality or value on a local scale. 	<ul style="list-style-type: none"> • 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. • Locally important amenity site for wide range of leisure activities.
Medium	<ul style="list-style-type: none"> • Attribute has a medium quality or value on a local scale. 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> Attribute has a low quality or value on a local scale. 	<ul style="list-style-type: none"> 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, residential or commercial property from flooding. Amenity site used by small numbers of local people.

Table 7.1: Estimation of Importance of Hydrology Criteria (NRA, 2008)

Importance	Criteria	Typical Example
Extremely High	<ul style="list-style-type: none"> Attribute has a high quality or value on an international scale. 	<ul style="list-style-type: none"> Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation, e.g. SAC or SPA status.
Very High	<ul style="list-style-type: none"> Attribute has a high quality or value on a regional or national scale. 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Attribute quality or value on a local scale. 	<ul style="list-style-type: none"> Regionally Important Aquifer Groundwater Provides large proportion of baseflow to local rivers. Locally important potable water source supplying >1000 homes. Outer source protection area for regionally important water source. Inner source protection area for locally important water source.
Medium	<ul style="list-style-type: none"> Attribute has a medium quality or value on a local scale. 	<ul style="list-style-type: none"> Locally Important Aquifer Potable water source supplying >50 homes. Outer source protection area for locally important water source.
Low	<ul style="list-style-type: none"> Attribute has a low quality or value on a local scale. 	<ul style="list-style-type: none"> Poor Bedrock Aquifer Potable water source supplying <50 homes.

Table 7.2: Estimation of Importance of Hydrogeology Criteria (NRA, 2008)

Magnitude	Criteria	Typical Examples
Large Adverse	Results in loss of attribute and /or quality and integrity of attribute	<ul style="list-style-type: none"> Loss or extensive change to a waterbody or water dependent. Habitat Increase in predicted peak flood level >100mm. Extensive loss of fishery Calculated risk of serious pollution incident >2% annually. Extensive reduction in amenity value
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	<ul style="list-style-type: none"> Increase in predicted peak flood level >50mm. Partial loss of fishery. Calculated risk of serious pollution incident >1% annually. Partial reduction in amenity value.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	<ul style="list-style-type: none"> Increase in predicted peak flood level >10mm. Minor loss of fishery. Calculated risk of serious pollution incident >0.5% annually. Slight reduction in amenity value.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	<ul style="list-style-type: none"> Negligible change in predicted peak flood level. Calculated risk of serious pollution incident <0.5% annually.

Table 7.3: Magnitude of Hydrology Impact (NRA, 2008)

Magnitude	Criteria	Typical Examples
Large Adverse	Results in loss of attribute and /or quality and integrity of attribute	<ul style="list-style-type: none"> Removal of large proportion of aquifer. Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems. Potential high risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >2% annually.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	<ul style="list-style-type: none"> Removal of moderate proportion of aquifer Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems. Potential medium risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >1% annually.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	<ul style="list-style-type: none"> Removal of small proportion of aquifer Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems. Potential low risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >0.5% annually.

Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	<ul style="list-style-type: none"> Calculated risk of serious pollution incident <0.5% annually.
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Table 7.4: Magnitude of Hydrogeology Impact (NRA, 2008)

Importance	Magnitude of Impact			
	Negligible	Small Adverse	Moderate Adverse	Large Adverse
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant/ Moderate	Profound/ Significant	Profound
High	Imperceptible	Moderate/Slight	Significant/ Moderate	Profound/ Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/Moderate

Table 7.5: Estimation of Impact Rating (NRA, 2008)

7.2.4 CONSULTATION

The scope of this assessment has also been informed by consultation with statutory consultees and other bodies with environmental responsibility.

This consultation process is outlined in **Chapter 1** of this EIAR. Issues, matters and recommendations highlighted by the responses in relation to the water environment are summarised in **Table 7.6** below. The full responses from each of the below consultees are provided in **Annex 1.7**.

Consultee	Key Extracts from Consultee Response	Issue(s) Addressed in Section(s)
Uisce Éireann	"Protection of drinking water source(s) from potentially adverse impacts is a priority for Uisce Éireann. It is Uisce Éireann's current policy to maintain safe and secure drinking water supplies and ensure that development will not give rise to any deterioration in water quality. Development proposals shall not impact public drinking water sources and/or abstraction point(s). It is also a requirement of the Water Framework Directive that waters used for the abstraction of drinking water are protected to avoid deterioration in quality. Where a development proposal has the potential to impact an Uisce Éireann Drinking Water Source(s), the applicant shall provide details of measures to be taken to ensure that there will be no negative impact to Uisce Éireann's Drinking Water Source(s) during the construction, operation and decommissioning phases of the development".	Sections: 7.3.15 7.3.16 and 7.3.19
Waterways Ireland	"Waterways Ireland is the navigation body responsible for the management of the inland waterways including the Lower Bann, Erne System, Shannon-Erne Waterway, Shannon	n/a

	Navigation, Royal Canal, Grand Canal and the Barrow Navigation. We do not have jurisdiction over this area".	
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Table 7.6: Summary of Water Related Scoping Responses

7.2.5 LIMITATIONS AND DIFFICULTIES ENCOUNTERED

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

There are substantial desktop records and previous site investigation data detailing the characteristics of the project site. The project site was accessible thus allowing for a comprehensive assessment of site conditions, and the baseline monitoring carried out were detailed and comprehensive.

7.2.6 WATER STUDY AREA

The water study area for potential hydrological effects (including cumulative effects) is the Rapemills River catchment which has an area of ~95km².

Downstream of the Rapemills River catchment (i.e. the River Shannon itself) no significant hydrological effects are likely due to the large upstream catchment area of the River Shannon (i.e. ~6,700km²) and the very high dilution effects afforded by such a large regional catchment and subsequent large surface water flows.

In comparison, the Rapemills River catchment (~95km²) only accounts for 1.4% of the River Shannon catchment upstream of the Rapemills/Shannon confluence. The potential for dilution/assimilation is very high.

In terms of hydrogeology, the project site is mapped to overlie several separate groundwater bodies as described underneath.

The wind farm site is mapped to overlie 3 no. groundwater bodies (GWBs), namely; Banagher GWB (IE_SH_G_040), Birr Gravels GWB (IE_SH_G_244) and Birr GWB (IE_SH_G_041).

The underground electricity line is also mapped to overlie the Birr Gravels GWB and Birr GWB as well as the Shinrone GWB (IE_SH_G_205).

7.3 DESCRIPTION OF THE EXISTING ENVIRONMENT

7.3.1 SITE LOCATION AND DESCRIPTION

The project site is located c. 4km north of Birr, Co. Offaly. The wind farm site planning application boundary includes an area of 87.12ha, while the underground electricity line is c. 5km in length.

The wind farm site setting is primarily cutaway raised bog with some grassland. The 3 no. proposed turbine locations (T9, T10 and T11) are located on a Bord na Mona (BnM) owned bog which is named 'Galros Bog'. Much of Galros Bog is now cutaway and most of the original raised bog surface has been removed. The bog surface is extensively drained by a north – south trending, parallel running open drain network.

Galros Bog is bordered on its western side by the N62 road between Cloghan and Birr. The bog is situated in a small topographical basin surrounded by esker ridges along the northern and western and south-western sides. Conifer plantation has been

developed on cutover bog adjacent to the south side of the bog. The West Galros Stream, a tributary of the Rapemills River, flows along the southwestern boundary of the bog.

Galros Bog topography is typically flat or very gently sloping with ground elevations ranging from approximately 56m OD on the northeast of the bog to approximately 47m OD on the southwest.

The underground electricity line will connect into the proposed Mullanafawnia 110kV substation (separate planning application) which is located c.3.8km to the southeast of the wind farm site. The proposed route is approximately 5km in length and extends from the proposed electrical switch room building ('switch room') located within agricultural lands to the southeast of the proposed wind farm site.

The underground electricity line will cross the N52 national road and the L7006 local road using horizontal directional drilling ('HDD'), thereby avoiding open trenching within the public road. The underground electricity line route runs adjacent to the Rapemills River channel for approximately 2.5km and will also cross beneath the Rapemills River at two locations using HDD. Accordingly, four HDD crossings are proposed in total. The topography along the proposed route is relatively flat with ground elevations ranging from approximately 51 to 65m OD.

The haul route works are predominately located within motorway and national roads. The majority of the works comprise the temporary removal of street furniture to accommodate the delivery of turbine components.

From the junction of the M6 and N52, the haul route follows the N52 to its junction with the N62. Along this section temporary hardcore will be laid on roundabout central islands and road signs, street furniture and street lighting temporarily removed at a number of locations.

A temporary reverse manoeuvre location will be required along the eastern side of the N52/N62 junction and will only be utilised by turbine component delivery vehicles travelling towards the project site. The physical (temporary) works proposed in order to accommodate this reverse manoeuvre were permitted as part of the Cush Wind Farm Phase I planning consent (ACP Reference: ABP-318816-24).

7.3.2 RAINFALL AND EVAPOTRANSPIRATION

Long term rainfall and evaporation data was sourced from Met Éireann. The 30-year (1981-2010) annual average rainfall recorded at the Birr rainfall station, located ~4km southwest of the project site, is 850mm/year.

Met Éireann also provide a grid of average annual rainfall for the entire country for the period of 1991 to 2020. Based on this more site-specific modelled rainfall values, the average annual rainfall at the project site is 895mm/year. Monthly 1991 to 2020 totals are presented in **Table 7.7** below.

The 1991 to 2020 data is considered to be the most accurate estimate of average annual rainfall from the available sources.

Met Éireann (1991 – 2020)												
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
85	66	64	59	59	72	73	78	67	90	91	91	895

Table 7.7: 1991 to 2020 Average Rainfall Data (mm)

The closest synoptic¹ weather station where the average potential evapotranspiration (PE) is recorded is also at Birr. The long-term average PE for this station is 445mm/yr. This value is used as a best estimate of the project site's PE.

Actual Evaporation (AE) at the project site is estimated as 423mm/year (calculated as $0.95 \times \text{PE}$).

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

$$\begin{aligned}\text{Effective rainfall (ER)} &= \text{AAR} - \text{AE} \\ &= 895\text{mm/year} - 423\text{mm/year} \\ \text{ER} &= 472\text{mm/year}\end{aligned}$$

Based on groundwater recharge coefficient estimates from the GSI (www.gsi.ie), an estimate of 18mm/year average annual recharge is given for basin peat in this area (recharge coefficient of c. 4%). This means that the hydrology of the wind farm site is characterised by very high surface water runoff rates and very low groundwater recharge rates.

Therefore, conservative annual recharge and runoff rates for the wind farm site are estimated to be 18mm/year and 454mm/year respectively.

Recharge coefficient estimates for the lands along the underground electricity line route are significantly higher (42% to 85%) due to the presence of moderate to high permeability subsoils such as limestone tills, eskers and gravels respectively.

In addition to average rainfall data, extreme value rainfall depths are available from Met Éireann. A summary of various return periods and duration rainfall depths for the project site are presented in **Table 7.8**.

This data is taken from <https://www.met.ie/climate/services/rainfall-return-periods> and provides rainfall depths for various storm durations and sample return periods. These extreme rainfall depths have been incorporated into the proposed wind farm drainage design.

Return Period (Years)				
Storm Duration	1	5	30	100
5 mins	3.8	6.6	13.9	17.1
15 mins	6.2	10.9	19.5	28.0
30 mins	7.8	12.3	22.9	32.0
1 hour	10	16.2	26.8	36.5
6 hours	18.6	27.2	40.4	51.5
12 hours	23.6	33.3	47.3	58.9
24 hours	30	40.6	55.5	67.3
2 days	37.1	48.6	63.9	75.8

Table 7.8: Return Period Rainfall Depths for Project Site

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.

7.3.3 LOCAL AND REGIONAL HYDROLOGY

On a regional scale, the project site is located within Hydrometric Area 25 (Lower Shannon Catchment) and locally situated inside the Shannon[lower]_SC_040 sub-catchment which is the Rapemills River catchment.

The Rapemills River (Rapemills_010) rises approximately 8km to the east of the wind farm site and then flows in westerly direction approximately 0.6km to the south of the wind farm site.

East of the wind farm site, the Rapemills River runs adjacent to the underground electricity line route for approximately for 2.5km.

The Rapemills River then flows into the River Shannon approximately 12km downstream of the project site.

The Rapemills River is considered to have 'High Importance' using (NRA 2008) criteria for the estimation of the importance of the water environment (refer to **Table 7.1** above).

A regional and local hydrology map is shown below as **Figure 7.1**.

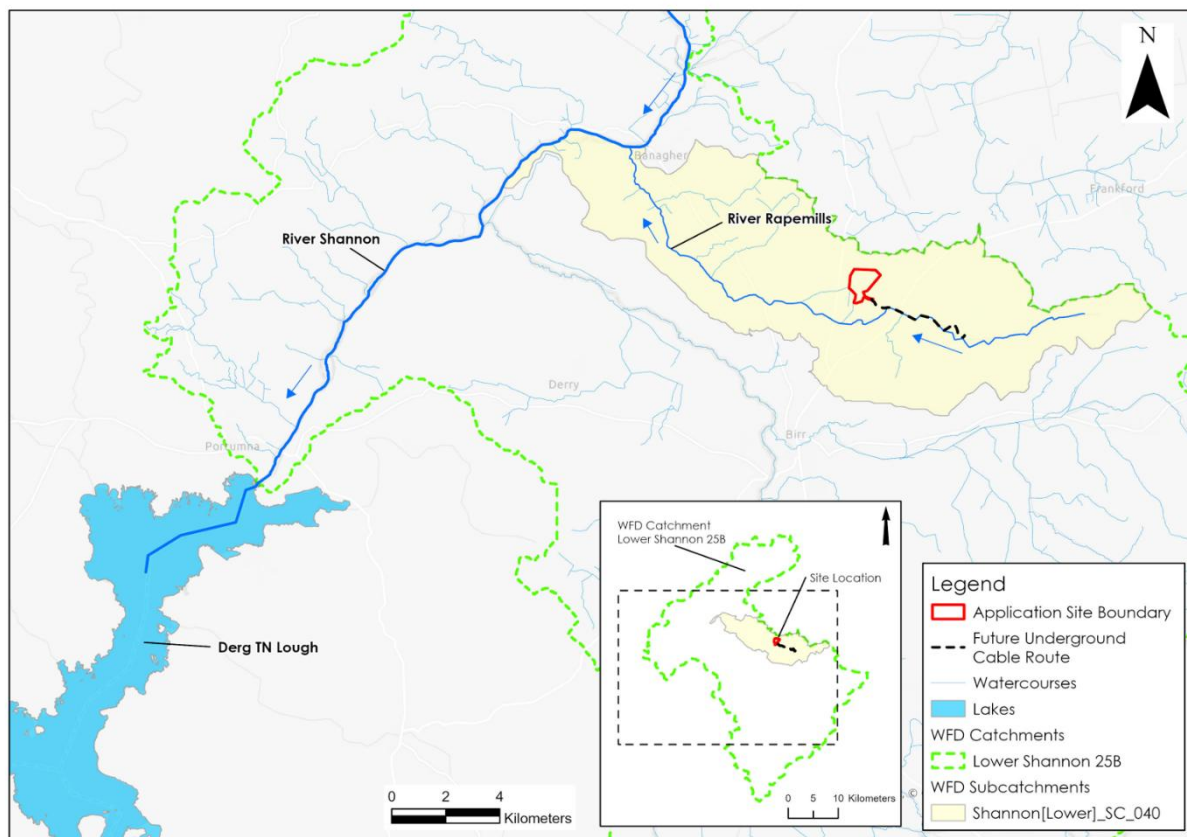


Figure 7.1: Regional and Local Hydrology Mapping

7.3.4 EXISTING DRAINAGE REGIME

The primary drainage feature at the project site is the Rapemills River which flows adjacent to the underground electricity line route and 0.6km from the wind farm site (proposed 3 no. wind turbines). Refer to **Figure 7.2** for an overall project site drainage map.

The Rapemills River channel is typically deep (2m) with steep banks and up to 5m in

width.

A tributary stream of the Rapemills River, referred to as the West Galros Stream by the EPA, emerges from forestry located to the southwest of the wind farm site. The West Galros Stream then crosses the N62 and merges with the Rapemills River approximately 1km downstream of the wind farm site.

The West Galros Stream has a modified channel appearance, up to 3m wide, ~1m deep with a high-water level that's close to ground level. The stream is also heavily vegetated. The majority of the wind farm site, including all of Galros Bog, initially drain to the West Galros Stream.

The southeastern portion of the wind farm site is drained by the Eglish 25 Stream (EPA Name) which flows southerly along the edge of a separate bog to the south of Galros Bog, prior to discharging into the Rapemills River approximately 0.6km to the south of the wind farm site. The grassland area on the southeast of the wind farm site, where the proposed switch room building is located, also drains to the Eglish 25 Stream.

The cutaway surface of Galros Bog is extensively drained by north – south orientated, parallel running open drain network. Drainage from the open drain network is then collected by an underground pipe network which discharges into 2 no. separate large settlement ponds located on the southwest of the bog for attenuation/treatment, prior to release into the adjacent West Galros Stream. All surface water drainage from the bog surface at the 3 no. proposed turbine locations, including the proposed spoil deposition areas, enter these settlement ponds via the drain network described above. Refer to **Figure 7.3** below for a Galros Bog drainage map (Mapping Source: BnM 2026).

The haul route works at the N62/N52 junction is intercepted by a small watercourse that drains westerly into a wetland area located immediately to the northwest of the road junction.

As stated above, the underground electricity line route runs adjacent to the Rapemills River for approximately for 2.5km. Along the proposed route minor field drains are crossed at most field boundaries where they drain into the Rapemills River.

The overall drainage regime at the project site is illustrated at **Figure 7.2**, while the BnM drainage network at Galros Bog is detailed on **Figure 7.3**

A draft bog rehabilitation plan for Galros Bog has been prepared by BnM (BnM 2026) as part of obligations to carry out peatland rehabilitation via an IPC Licence (refer to Annex 6.2 of the EIAR). Refer to Section 7.3.18 below for how the plan interacts with the wind farm drainage design.

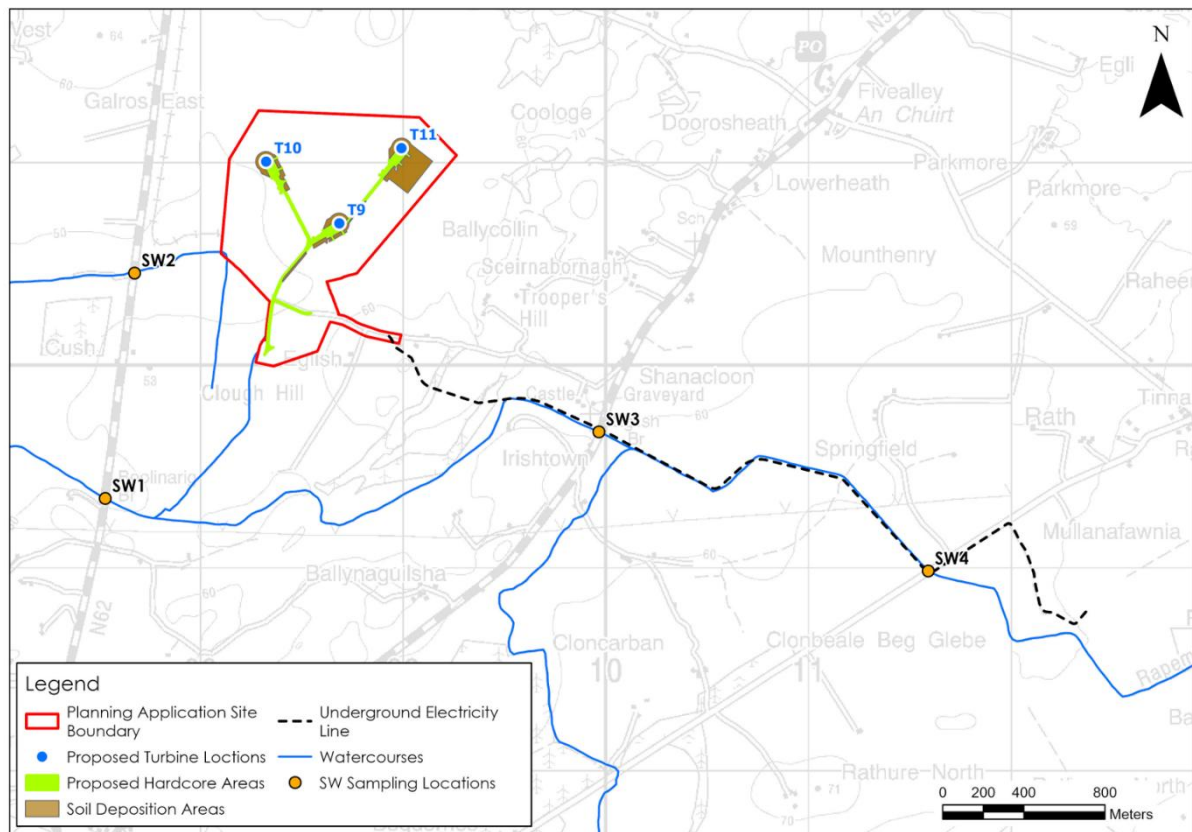


Figure 7.2: Overall Project Site Drainage



Figure 7.3: Galros Bog Drainage Map (Source: BnM 2026)

7.3.5 BASELINE RUNOFF

The following water balance assessment gives a preliminary indication of the highest monthly average volume of surface water runoff expected from the wind farm site only. The assessment does not include the underground electricity line route as it has no potential to affect surface water runoff regime due to its underground nature.

The calculations are carried out for the month with the highest average recorded rainfall versus evapotranspiration (December), for the current baseline site conditions, in terms of recharge/runoff ratios (**Table 7.9**). It represents, therefore, the average wettest monthly scenario in terms of volumes of surface water runoff from the wind farm site pre-development.

The rainfall depths presented in this section, which are long term averages, are not used in the design of the sustainable drainage system for the project. As outlined in **Section 7.3.18** below, a '1-in-100year return' period has been used for design purposes.

The surface water runoff co-efficient for the wind farm site is estimated to be 96% due to the dominant basin peat coverage which causes very low recharge potential (4%).

The highest long-term average monthly rainfall recorded over the period 1991 – 2020 occurred in December, at 91mm.

The average monthly evapotranspiration for the synoptic station at Birr over the same period in December was 0mm. The calculation is carried out for the wind farm site planning application area (c. 87.12ha).

The balance indicates that a conservative estimate of surface water runoff from the project during the highest rainfall month is 76,003m³/month, which equates to an average of 2,452m³/day, as outlined in **Table 7.10**.

Water Balance Component	Depth (m)
Average December Rainfall (R)	0.091
Average December Potential Evapotranspiration (PE)	0
Average December Actual Evapotranspiration (AE = PE x 0.95)	0
Effective Rainfall December (ER = R - AE)	0.091
Recharge (4% of ER)	0.0036
Runoff (96% of ER)	0.0874

Table 7.9: Water Balance and Baseline Runoff Estimates for Wettest Month (December)

Wind Farm Site (ha)	Baseline Runoff per month (m3)	Baseline Runoff per day (m3)
87.12	76,003	2,452

Table 7.10: Baseline Runoff for the Wind Farm Site (December)

7.3.6 PUBLISHED FLOOD MAPPING

The following is a summary of a Site-Specific Flood Risk Assessment ('FRA') (Stage 2) carried out for the project. Refer to **Annex 7.1** for the FRA report. The FRA at **Annex**

7.1 constitutes a Stage 2 site-specific FRA for Cush Wind Farm Phase II. It is informed by the Stage 3 hydraulic modelling completed for Cush Wind Farm Phase I in 2023 insofar as that modelling covers the overlapping wind farm site and the same receiving watercourses and flood mechanisms.

OPW's River Flood Extents Mapping, National Indicative Fluvial Mapping, Past Flood Event mapping (<https://www.floodinfo.ie/map/floodmaps/>) and historical mapping (i.e. 6" & 25" base maps) were consulted to identify if any areas of the project site are potentially at risk of flooding.

The project site is not located within an OPW Arterial Drainage Scheme area or Flood Relief Scheme Benefiting area

No past flood incidents within the project site were identified from OPW's Past Flood Event Mapping (refer to **Figure 7.4**).

The closest mapped past flood event to the project site is located at Fivealley (Flood ID 2904), 2.5km to the east of the wind farm site. According to OPW flood reports, low-lying lands floods on a recurring basis. The project site does not drain towards Fivealley.

The closest mapped downstream flooding event to the project is on the Lower Shannon approximately 12km downstream of the project site.

There is no text on local available historical 6" or 25" mapping for the project site that identify areas that are "prone to flooding".

OPW's CFRAM River Flood Extents Mapping is currently the most accurate available flood mapping for the country; however, this is currently not available for the Rapemills River catchment.

OPW NIFM, which is available for the Rapemills River, shows the estimated 100-year and 1000-year flood zones (refer to **Figure 7.5** below).

According to the NIFM, no part of the proposed wind farm site is located within a mapped fluvial flood zone. Therefore, the proposed wind farm site is mapped above the 1000-year flood level and therefore all proposed infrastructure is located in Flood Zone C (Low Risk).

NIFM flood zones are however mapped along the course of the Rapemills River to the east of the wind farm site which also encroach the proposed underground electricity line route. However, due to the underground nature of the electricity line, the proposed infrastructure will have no potential to increase flood risk (i.e. they will be no loss of floodplain storage or topographic alterations). The underground electricity line is 'water compatible' in terms of flood risk.

According to the Geological Survey Ireland (GSI) Winter 2015/2016 Surface Water Flood mapping, localised surface water flooding (ponding) was recorded on the northeast and southwest of Galros Bog within the wind farm site. Given the flat to undulating topography of the bog surface, localised flooding/ponding would be expected after heavy rainfall events. The mapped surface water flood zones/ponding areas do not significantly interact with the wind farm site infrastructure. The Winter 2015/2016 event was an unprecedented rainfall event.

Similarly, the Geological Survey Ireland (GSI) Maximum Historic Groundwater Flood mapping show some localised groundwater flooding on the south of Galros Bog/wind farm site. Given the low permeability nature of the shell marl and lacustrine clays underlying the peat, the flooding/ponding is likely to be surface water runoff rather than groundwater upwelling.

It is a key design feature of the wind farm design to ensure that all surface water runoff is treated (water quality control) and attenuated (water quantity control) prior to diffuse discharge at pre-existing Greenfield rates. As such, the mechanism by which downstream flooding, as a result of the project, is prevented and controlled is through avoidance by design.

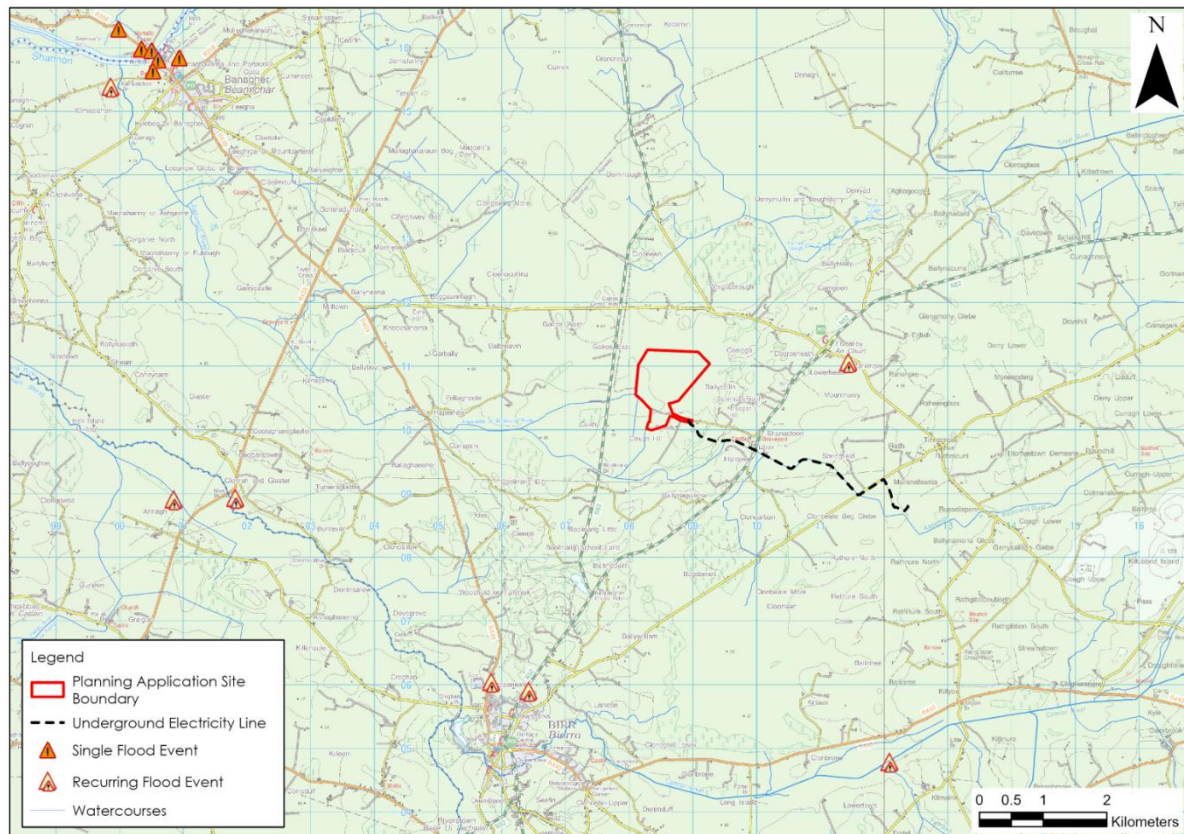


Figure 7.4: OPW Past Flood Event Mapping

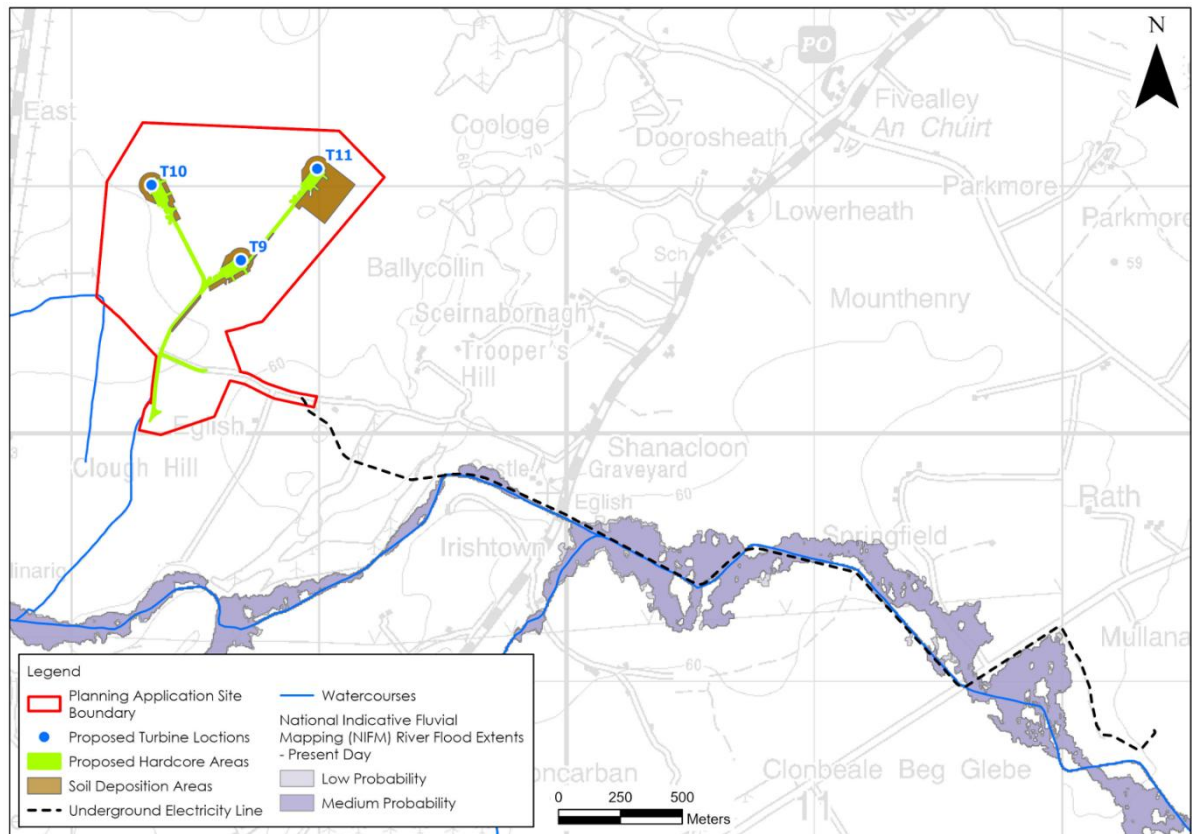


Figure 7.5: National Indicative Fluvial Mapping

7.3.7 PREVIOUS SITE-SPECIFIC FLOOD MODELLING

Previously, a stage 3 site specific flood risk assessment including flood modelling was completed by HES in December 2023 for the Cush Wind Farm Phase I². Refer to **Annex 7.1** for the current project FRA report which summarises the Stage 3 assessment.

The Stage 3 site specific flood risk assessment involved detailed site topographic surveys, use of Lidar data and flood flow modelling of the Rapemills River, West Galros Stream and floodplains.

The site specific modelled 100-year and 1000-year flood zones are shown on **Construction-stage flood** risk is nevertheless assessed in this chapter and in the FRA at **Annex 7.1**.

² Hydro Environmental Services (December 2023) Proposed Cush Wind Farm Stage 3 Flood Risk Assessment.

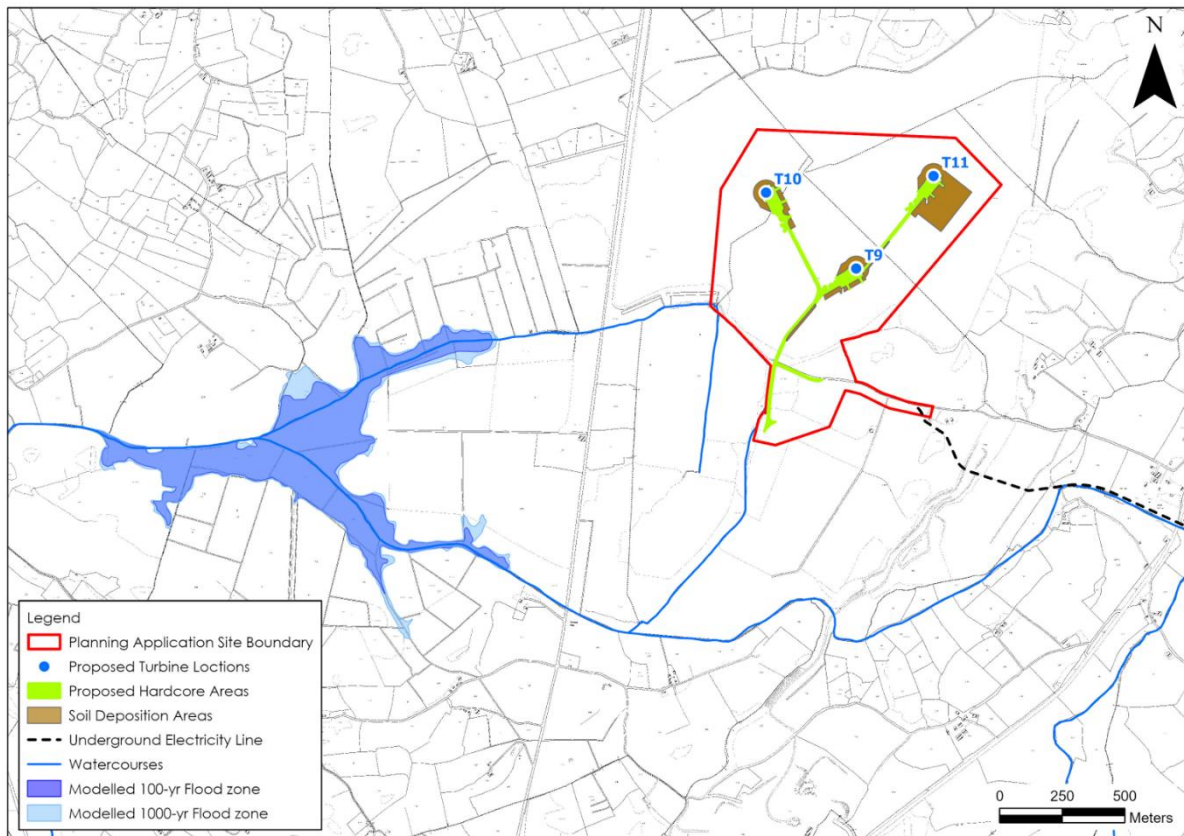


Figure 7.6 below. A 20% increase in flows is allowed for climate change.

No part of wind farm site is located inside the modelled 100-year and 1000-year flood zones which is consistent within the NIFM flood zone mapping.

Further detailed flood modelling relating to this project was not carried out for the stretch of the Rapemills River along the underground electricity line route as there is no proposed infrastructure above ground level required as part of this project.

Fluvial flood zones do not present as a constraint to the underground electricity line and accordingly additional hydraulic modelling of the completed underground electricity line is not required (i.e. the underground electricity line is 'water compatible' in terms of flood risk). Construction-stage flood risk is nevertheless assessed in this chapter and in the FRA at **Annex 7.1**.

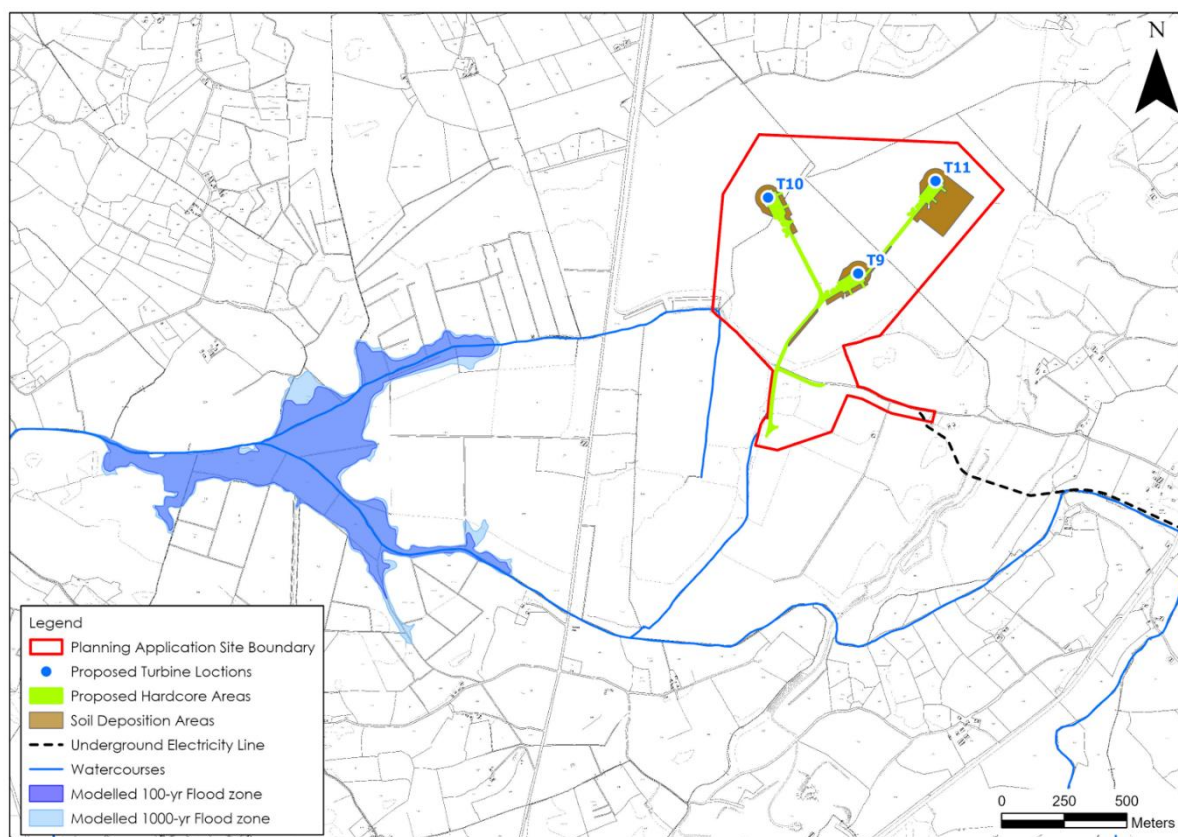


Figure 7.6: Site Specific Modelled Flood Zones (Source: HES 2023)

7.3.8 SURFACE WATER QUALITY/HYDROCHEMISTRY

Biological Q-rating³ data for EPA monitoring points on the Rapemills River are shown in **Table 7.11** below. Most recent data available is from 2023 (for one location only) and shows that the Q-rating for the Rapemills River is Q3-4 (Moderate Status).

Station Name/Code	River Waterbody	Q-Value Score	Year	Status
Br near Eglish Castle	Rapemills_010	4	1987	Good
Boolinarig Bridge	Rapemills_010	4	1987	Good
Br at Rapemills	Rapemills_010	3 - 4	2023	Moderate
Br SW of Taylors X Rds	Rapemills_020	4 - 5	1987	High

Table 7.11: Latest EPA Q-Rating

Field hydrochemistry measurements of unstable parameters, electrical conductivity ($\mu\text{S}/\text{cm}$), pH (pH units), temperature ($^{\circ}\text{C}$) and dissolved oxygen (DO-%) were taken at surface water sampling location (SW1–SW4) downstream of the project site on 18 June and 13 August 2026. These results are listed in **Table 7.12** below. Refer to **Figure 7.2** for sample locations.

Electrical conductivity (EC) values for the monitoring locations ranged between 597 and 660 $\mu\text{S}/\text{cm}$ which would be typical for a catchment dominated by limestone bedrock and calcareous glacial tills. The flow in the rivers has a high groundwater

³ The Q-Rating scheme method is used whereby a Quality-index is assigned to a river or stream based on macroinvertebrate data.

component.

The pH values, which ranged between 7.5 and 7.9, were generally near neutral, would be typical of catchments a mixture of peat and mineral soil coverage. The dissolved oxygen concentrations are generally within the normal range for a 'Good' status watercourses.

Surface water samples (2 no. rounds) were also taken on at the 4 no. sampling locations for laboratory analysis on those dates.

Results of the laboratory analysis are shown alongside relevant surface water quality regulations (EQS) in **Table 7.13** (18 June 2026) and **Table 7.14** (13 August 2026) below. Original laboratory reports are attached as **Annex 7.2**.

Location	EC (µS/cm)		pH		Dissolved Oxygen (%)	
	18/06/26	13/08/26	18/06/26	13/08/26	18/06/26	13/08/26
SW1	620	633	7.7	7.8	87	77.6
SW2	600	597	7.9	7.9	87.5	86.5
SW3	623	641	7.8	7.5	89.4	81.9
SW4	660	656	7.9	7.9	89.0	89

Table 7.12: Summary of Field Hydrochemistry Results

Parameter	EQS	Sample ID			
		SW1	SW2	SW3	SW4
Total Suspended Solids (mg/L)	25(+)	6	<5	<5	<5
Ammonia N (mg/L)	≤0.065 to ≤0.04(*)	0.07	<0.02	<0.02	<0.02
Nitrite NO ₂ (mg/L)	-	<0.05	<0.05	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	≤ 0.035 to ≤0.025(*)	<0.02	<0.02	<0.02	<0.02
Nitrate - NO ₃ (mg/L)	-	8.9	22.6	22.6	22.6
Nitrogen (mg/L)	-	2.3	5.3	5.4	6.2
Phosphorus (mg/L)	-	<0.10	<0.10	<0.10	<0.10
Chloride (mg/L)	-	22.5	24.2	24	22.1
BOD	≤ 1.3 to ≤ 1.5(*)	4	1	<2	2

(+) S.I. No. 293/1988: Quality of Salmon Water Regulations.

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

Table 7.13: Analytical Results of Surface Water Sampling (18/06/2026)

Parameter	EQS	Sample ID			
		SW1	SW2	SW3	SW4
Total Suspended Solids (mg/L)	25(+)	<5	<7	<7	<5
Ammonia N (mg/L)	≤0.065 to ≤0.04(*)	<0.02	0.03	<0.02	0.02
Nitrite NO ₂ (mg/L)	-	<0.05	<0.05	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	≤ 0.035 to ≤0.025(*)	<0.02	<0.02	<0.02	<0.02
Nitrate - NO ₃ (mg/L)	-	22.6	8.9	30.5	22.6
Nitrogen (mg/L)	-	5.4	2.1	9.8	9.9
Phosphorus (mg/L)	-	<0.10	<0.10	<0.10	<0.10
Chloride (mg/L)	-	25.1	25.2	23.9	22.2
BOD	≤ 1.3 to ≤ 1.5(*)	<2	2	<2	<2

(+) S.I. No. 293/1988: Quality of Salmon Water Regulations.

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

Table 7.14: Analytical Results of Surface Water Sampling (13/08/2026)

Total suspended solids were below the laboratory reporting limits in seven of the eight samples collected over both sampling rounds. A concentration of 6mg/L was recorded at SW1 on 18 June 2026. All eight results were below the 25mg/L comparison value presented in **Tables 7.13 and 7.14**.

In addition, ortho-phosphate, phosphorus and nitrite results are also below the laboratory detection limits in all samples (i.e. very low concentrations).

Ammonia N concentrations were also typically very low, with results being below or just slightly above the laboratory detection limit.

Nitrate results were more variable and typically ranged between approximately 9 and 30mg/L over both sampling rounds. Chloride concentrations are relatively consistent across all samples and within the range of 22 to 25mg/L.

All ortho-phosphate results are below the High status threshold with regard S.I. 272/2009 (as amended). With the exception of sample SW1 (18/06/2026), ammonia results were also below High status threshold.

BOD concentrations of 4mg/L at SW1 and 2mg/L at SW4 on 18 June 2026, and 2mg/L at SW2 on 13 August 2026, exceeded the relevant threshold values presented in Tables 7.13 and 7.14. The result of 1mg/L at SW2 on 18 June 2026 was below those thresholds. Results reported as <2mg/L cannot be assessed against the relevant thresholds because the laboratory reporting limit exceeds the threshold values.

7.3.9 HYDROGEOLOGY

Based on the GSI bedrock mapping (www.gsi.ie), Dinantian Pure Unbedded Limestones (Waulsortion Limestone) underlie most of the wind farm site (including all 3 no. turbine locations).

Dinantian Pure Bedded Limestones (Viséan Limestones) are mapped on the east of the wind farm site and along the underground electricity line route.

The Dinantian Pure Unbedded Limestone is classified by the GSI (www.gsi.ie) as a Locally Important Aquifer, having bedrock which is moderately productive only in local zones (LI). According to WFD groundwater body mapped, the Dinantian Pure Unbedded Limestone is 'poorly productive'. Bedrock permeability tends to decrease rapidly with depth. Most flow occurs in the upper ≤ 15 m, in the zone that comprises a weathered layer and a connected fracture zone below this. Groundwater flow paths are generally short, in the order of 30-300m long, with groundwater discharging to the streams and rivers that traverse the aquifer. Local groundwater flows are determined by the local topography. There is no regional flow system.

Dinantian Pure Bedded Limestones (Viséan Limestones) are classified by the GSI as a Regionally Important Karstified Aquifer with diffuse flow (Rkd). Groundwater flow paths in karstified aquifers can be up to several kilometers in length. According to WFD groundwater body mapped, the Dinantian Pure Bedded Limestones is 'karstic'.

The limestone bedrock in the area of the proposed project site is typically covered by a substantial thickness of peat, marl, lacustrine clay and glacial deposits (typical descending order from ground level to bedrock). Please refer to the Land, Soils and Geology Chapter (**Chapter 6**). There are no bedrock exposures at the project site.

The glacial deposits will likely provide the dominant potential pathway for groundwater movement at the project site especially where permeable tills or sands and gravels are present under peat, marl and lacustrine deposits. The peat, marl and lacustrine clay deposits have very low permeability and significantly limit groundwater recharge with the project site (i.e. high surface water runoff rates).

Due to the presence of the overlying peat (which results in minimal recharge) and the low permeability of the underlying marl and lacustrine deposits, groundwater movement through the underlying glacial deposits will be relatively slow unless higher permeability sands and gravels horizons are present. Recharge is likely to be limited to the perimeter of the development site where the peat is thin or absent (the presence of peat, marl and clays will significantly reduce recharge to underlying regional groundwater systems). Based on topography and regional surface water drainage regime, the groundwater flow direction is likely to be westerly towards the Shannon River. A low groundwater gradient is expected due to flat topography.

There is a shallow water table in the peat layer across the wind farm site which comprises mainly rainwater. This is perched and largely isolated from the underlying regional groundwater system (which occurs in underlying till and bedrock).

Sand and gravels are mapped to overlie the bedrock along the majority of the underground electricity line route (i.e. Birr Gravels GWB). These gravels deposits are classified by the GSI as a Locally Important Gravel Aquifer (Lg).

The Dinantian Pure Bedded Limestones are prone to karstification while, the Dinantian Pure Unbedded Limestones do not typically dispose themselves to significant karstification as they are generally massive and can contain mudstone, making them less prone to weathering.

The GSI do not map any karst features within the wind farm site or along the underground electricity line. However, a karst spring (Tobernarpoula Spring) is mapped 0.8km to the south of the wind farm site where the underlying geology is mapped as Dinantian Pure Unbedded Limestones. Tobernarpoula Spring discharges into the Rapemills River downstream of the project site.

Based on NRA (2008) criteria shown in the **Table 7.2** above, Locally Important aquifers have a Medium Importance. The regionally important aquifer at the eastern side end of the project site has a High Importance.

A local bedrock aquifer map is shown as **Figure 7.7** below.

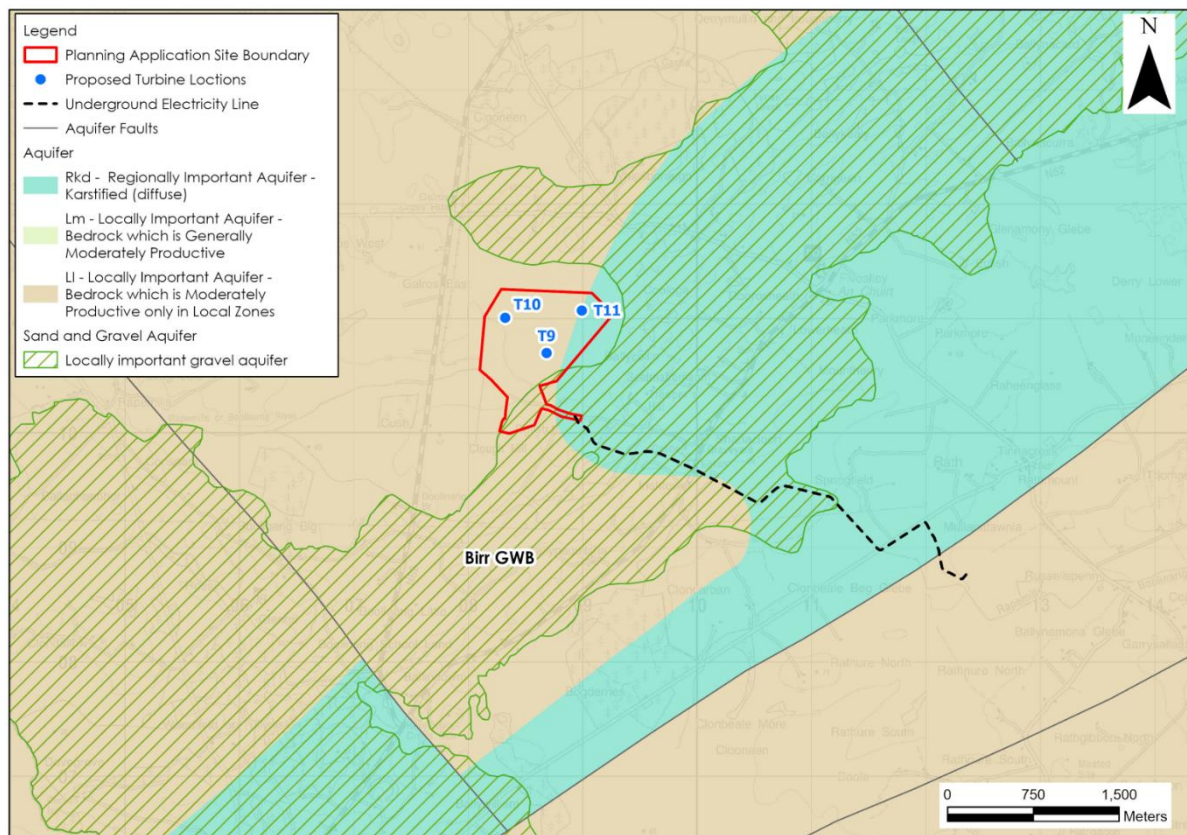


Figure 7.7: Bedrock and Sand/Gravel Aquifer Mapping

7.3.10 GROUNDWATER VULNERABILITY

The mapped groundwater vulnerability rating of the bedrock aquifer beneath the wind farm site is mainly Moderate. This is consistent with the presence of basin peat itself underlain by a substantial depth of marl and lacustrine clays and glacial deposits over the majority of the wind farm site.

Most of the wind farm site including all proposed turbines, are in an area mapped as moderate groundwater vulnerability.

A high vulnerability rating is mapped over the underground electricity line route where gravels or eskers are present. The remainder of the underground electricity line route is mapped as moderate vulnerability where peat and limestone tills are present.

Due to the low permeability nature of the basin peat which covers the majority of the project site, there is a very low potential for groundwater recharge, dispersion and

movement within the underlying bedrock aquifer; therefore, surface water bodies such as drains and streams/ivers are more vulnerable (to contamination from project wind farm activities) than groundwater at this general location.

7.3.11 GROUNDWATER HYDROCHEMISTRY

Based on data from the GSI publication on the local GWBs, groundwaters in this area are typically very hard with a calcium-bicarbonate signature. Hardness generally ranges from 380 – 450 mg/l as CaCO₃, with high electrical conductivities (650 – 800 µS/cm).

7.3.12 GROUNDWATER BODY WFD STATUS

The following sections (Sections 7.3.12 & 7.3.13) are a summary of the WFD Compliance Assessment undertaken for the project. The full WFD Assessment report is attached **Annex 7.3**.

Local Groundwater Body (GWB) status information is available from www.catchments.ie.

The wind farm site is mapped to overlie 3 no. groundwater bodies (GWBs), namely; Banagher GWB (IE_SH_G_040), Birr Gravels GWB (IE_SH_G_244) and Birr GWB (IE_SH_G_041).

The underground electricity line is also mapped to overlie 3 no. groundwater bodies (GWBs), namely; Birr Gravels GWB (IE_SH_G_244), Birr GWB (IE_SH_G_041) and the Shinrone GWB.

All GWBs in the area of the project site as assigned 'Good Status', which is defined based on the quantitative status and chemistry. No groundwater pressures are reported for these groundwater bodies.

7.3.13 RIVER WATERBODY WFD STATUS

Table 7.15 below summaries the WFD information for river waterbodies downstream of the project site within the Rapemills River catchment. Refer to **Annex 7.3** for a review of all river waterbodies further downstream in the River Shannon catchment.

The Rapemills River has been assigned an overall 'Moderate Status' (2019- 2024) along with a risk result of "At Risk" (3rd Cycle).

Refer to **Table 7.15** below for additional information such Risk Result and Pressure Category.

By applying the NRA (2008) criteria in **Table 7.1** above, local and downstream watercourses have a High Importance.

Regional Catchment	Water Body	Overall WFD Status (2019-2024)	Risk result (3 rd Cycle)	Pressures & Activities
Shannon	Rapemills_010	Moderate	At Risk	Agriculture
	Rapemills_020	Moderate	At Risk	Agriculture & Peat

Table 7.15 : WFD Status and Risk Result

7.3.14 DESIGNATED SITES & HABITATS

Within the Republic of Ireland, designated sites include Natural Heritage Areas (NHAs), proposed Natural Heritage Areas (pNHAs), candidate Special Areas of Conservation (cSAC), Special Areas of Conservation (SAC) and Special Protection Areas (SPAs).

Local designated sites in the area and downstream of the project are shown on **Figure 7.8** below. The project is not located within any designated conservation site.

Designated sites in close proximity to the project include Lough Coura pNHA (Site Code: 000909). Lough Coura is located approximately 0.9km to the north of the wind farm site. The project site does not drain into Lough Coura.

As stated previously, both the wind farm site and underground electricity line route drains to the Rapemills River, which passes the All Saints Bog and Esker SAC and pNHA (Site Code: 000566) and the All Saints Bog SPA (Site Code:004103)c.5.5km downstream of the project site.

However, there is no surface water connection between the project site and All Saints Bog and Esker SAC as All Saints Bog discharges into Rapemills River and not vice versa.

Groundwater flow in the area of the project site is likely to be westerly towards All Saints Bog and Esker SAC. However, groundwater flow below Saints Bog will be limited to the deeper glacial deposits which are separated from the overlying bog by very low permeability marl and lacustrine clay deposits which underlies the basin peat in this area.

The Rapemills River ultimately drains into the River Shannon and flows through the River Shannon Callows SAC (Site Code: 000216) and the Middle Shannon Callows SPA (Site Code:004096), which lie approximately 7.8km northwest of the project site.

These designated sites are considered to have Very High (NHA) to Extremely High (SAC) Importance according to NRA (2008) criteria (**Table 7.1**).

Local designated sites in the area, and downstream, of the project are shown at **Figure 7.8** below.

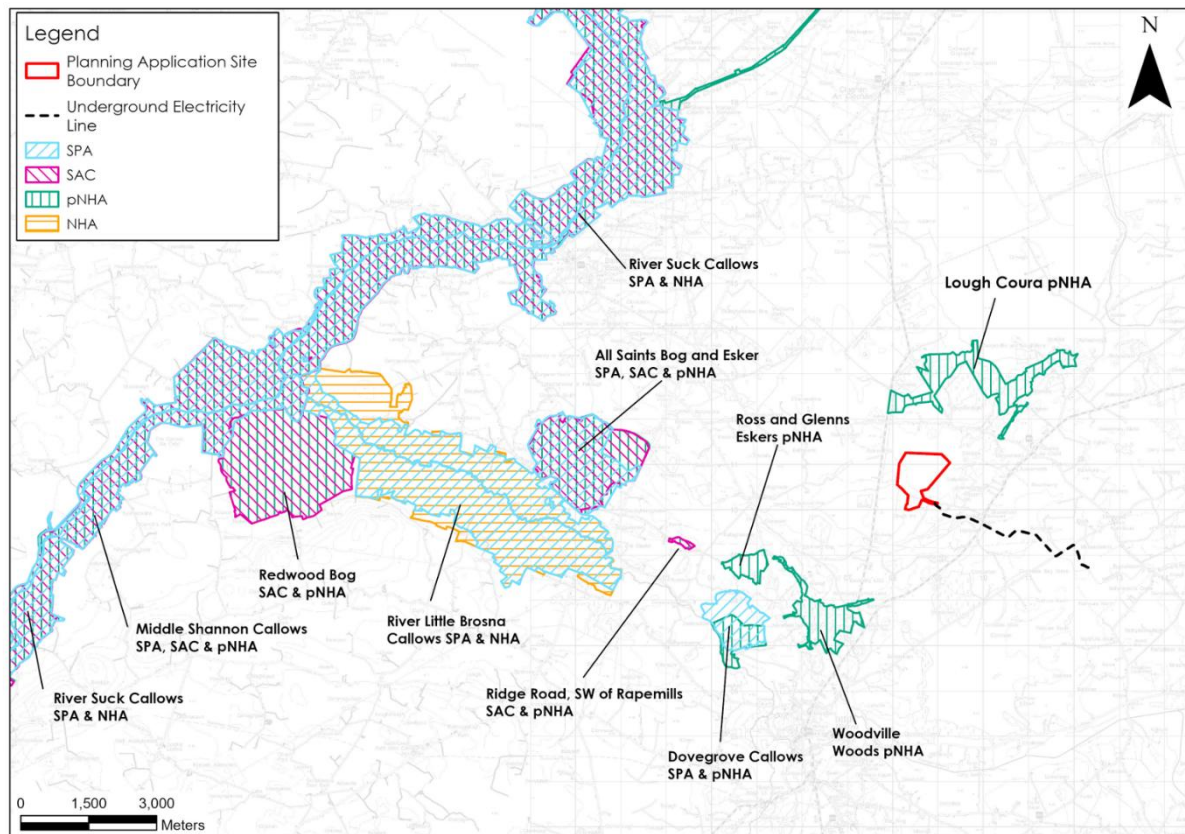


Figure 7.8: Designated Sites

7.3.15 GROUNDWATER SUPPLIES

Rath Group Water Scheme (GWS) groundwater source protection area is mapped at the eastern end of the underground electricity line route, with approximately 400m of the proposed route located within the source protection area. The section of the proposed route within the source protection area is on private lands (grassland). The proposed route is set back at least 300m from the source wells and springs. Refer to **Figure 7.9** to below for GSI source protection area mapping.

According to the source protection report⁴ (GSI/Offaly County Council, 2009), the source consists of 1 no. spring and 2 no. boreholes located 300m to the north of the Rapemills River. The origin of the groundwater is reported to be the underlying pure bedded limestones. The thickness of overburden at the source varies between 3 and 6.9m. Rath GWS is considered to have High Importance according to NRA (2008). criteria (**Table 7.2**).

Private well locations (accuracy of <50m only) were reviewed using GSI well database (www.gsi.ie). There are no GSI wells mapped with 1km of the wind farm site.

Wells along the underground electricity line route were not identified as no effects on groundwater are expected due to the shallow nature of the proposed works.

GSI mapped wells with accuracy greater than 50m were not assessed due to the poor information/accuracy regarding their location. To overcome the poor accuracy, it is conservatively assumed that every private dwelling in the area of the project site

⁴ Rath Group Water Scheme Groundwater Source Protection Zones (July, 2009)

(shown on **Figure 7.9**) has a well supply and this impact assessment approach is described further below.

Private dwellings (i.e. potential wells) along the underground electricity line route were not identified due to the very low risk posed to any potential well.

Please note wells may or may not exist at each property, but our conservative rationale here is that it is better to assume a well may exist at each downgradient property and assess the potential impacts from the project on such assumed wells, rather than make no assessment and find out later that groundwater wells do actually exist.

The private well assessment undertaken below in **Section 7.4.3.9** assumes the groundwater flow direction is reflective of the topography and overall surface drainage regime and is therefore likely to follow a general westerly pattern along the Rapemills River catchment.

Using this conceptual model of groundwater flow, dwellings that are potentially located down-gradient of the project site to the west are identified (if any) and an impact assessment for these actual and potential well locations is undertaken if required.

This assessment focused on the wind turbine locations as these are the locations where the deepest excavations will be undertaken. All excavations required for site entrances, access tracks, crane hardstandings, compounds, and the switch room building will be shallow and therefore there is no likelihood of significant effects on groundwater supplies.

Local private wells are considered to have Low Importance according to NRA (2008) criteria (**Table 7.2**).

7.3.16 SURFACE WATER (DRINKING) ABSTRACTIONS

There are no river waterbody drinking water protected areas (Article 7 Abstraction for Drinking Water) between the project and Lough Derg. Lough Derg TN (Public Water Supply) is a drinking water protected area.

Lough Derg is located approximately 30km downstream of the project site. Lough Derg TN Public Water Supply is considered to have a Very High Importance according to NRA (2008) criteria (**Table 7.1**).

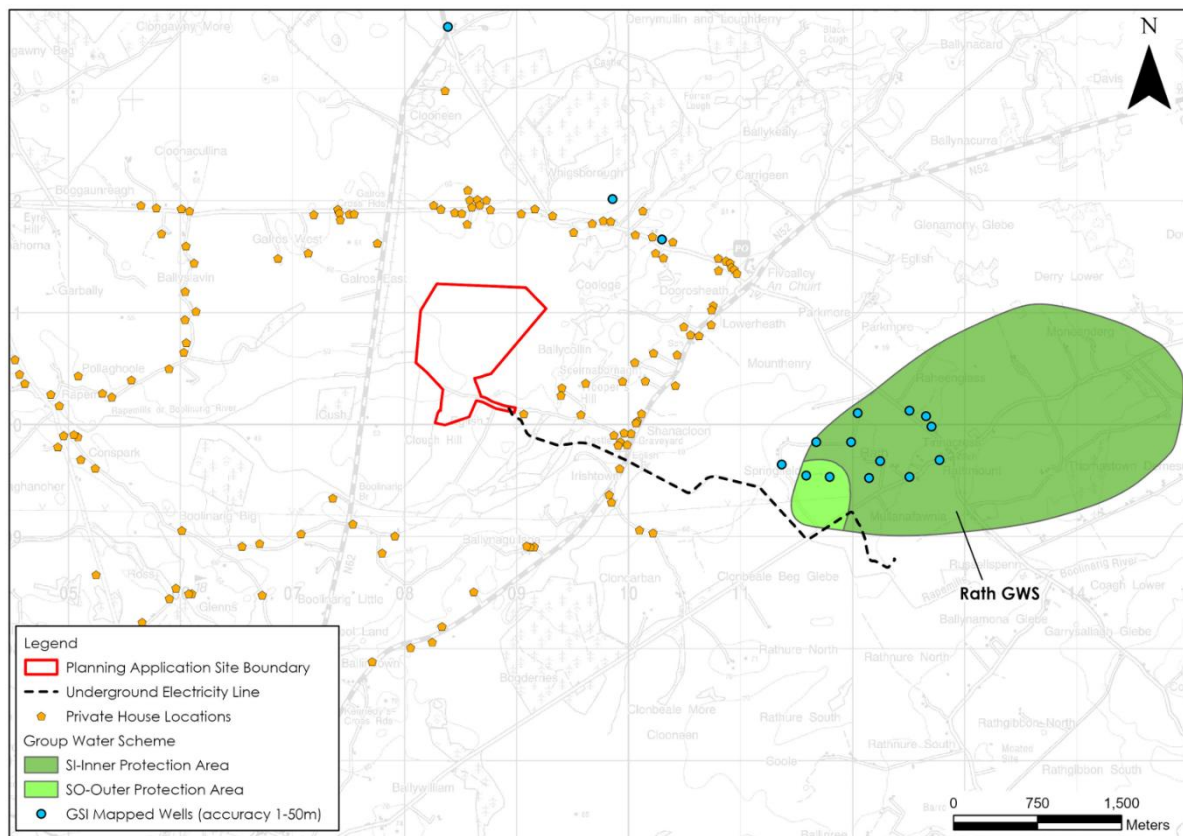


Figure 7.9: Groundwater Source Locations

7.3.17 DEVELOPMENT INTERACTION WITH THE WATERCOURSES AND EXISTING MANMADE DRAINAGE NETWORK

In relation to hydrological constraints, a 50m hydrological buffer has been applied to natural watercourses within the wind farm site. All wind farm infrastructure is located outside this buffer. Sections of the underground electricity line necessarily pass within 50m of the Rapemills River and cross beneath it at two locations using HDD; the specific controls set out in Section 7.5.1.1 apply to those works. Artificial bog and field drains are not treated as natural-watercourse constraints and will be maintained using appropriately sized culverts or cross-drains where crossed.

The general design approach for wind farm developments is to utilise and integrate the project with the existing land infrastructure where possible whether it be existing access tracks or the existing land 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 bog drains have no notable hydrological value and can be readily integrated into the proposed drainage scheme using the methods outlined below (see Section 7.5.1.1 below).

7.3.18 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 project. The first method involves 'keeping clean water clean' by avoiding disturbance to natural drainage features, minimising any works in or around artificial drainage features, and diverting clean surface water flow around excavations, construction areas and temporary storage areas.

The second method involves collecting any drainage waters from works areas within the project site which may carry silt or sediment, and nutrients, to route them towards stilling ponds prior to controlled diffuse release over vegetated surfaces. There will be no direct discharges to surface waters. During the construction phase all runoff from works areas (i.e. dirty water) will be attenuated and treated, through various attenuation methods, to a high quality prior to being released. Examples of attenuation methods include interceptor drains, collector drains, check dams, stilling/silt/sediment ponds, existing settlement ponds, and buffered outfalls.

As described in **Section 7.3.4** above, the Galros Bog portion of the project site drains to the West Galros Stream via 2 no. settlement ponds/lagoons. This area of the project site includes the 3 no. proposed turbine locations and the spoil deposition areas.

These existing settlement ponds will continue to provide water treatment for this area of the project site and the project will benefit from their presence during the various stages (i.e. construction, operation and decommissioning). However, the project is not reliant on these existing ponds for runoff treatment, and they will only compliment the proposed wind farm drainage.

A schematic of the site drainage management is shown as **Figure 7.10** below. A Planning-Stage Surface Water Management Plan (SWMP) has been prepared and is enclosed at **Annex 3.4**. The SWMP, prepared by GES on the basis of a drainage design by Jennings O'Donovan & Partners, incorporates drainage design features to ensure the appropriate management of surface waters at the project site.

A detailed SWMP, incorporating a further-developed drainage design, will be prepared, post consent, as part of the detailed design process prior to construction (as is the normal course) demonstrating the implementation of the drainage design and attenuation infrastructure.

The proposed drainage regime for the wind farm site has been developed having regard to the existing drainage characteristics of Galros Bog and the wider rehabilitation and environmental stabilisation objectives identified in the draft Galros Bog Rehabilitation Plan (2026), included at **Annex 6.2**. The drainage design seeks, insofar as practicable, to work with the existing hydrological regime rather than fundamentally alter it. Existing drainage pathways have therefore been retained and integrated into the proposed drainage arrangement where appropriate, while clean runoff will be kept separate from water arising within construction areas and potentially sediment-laden runoff will be collected, attenuated and treated prior to controlled discharge.

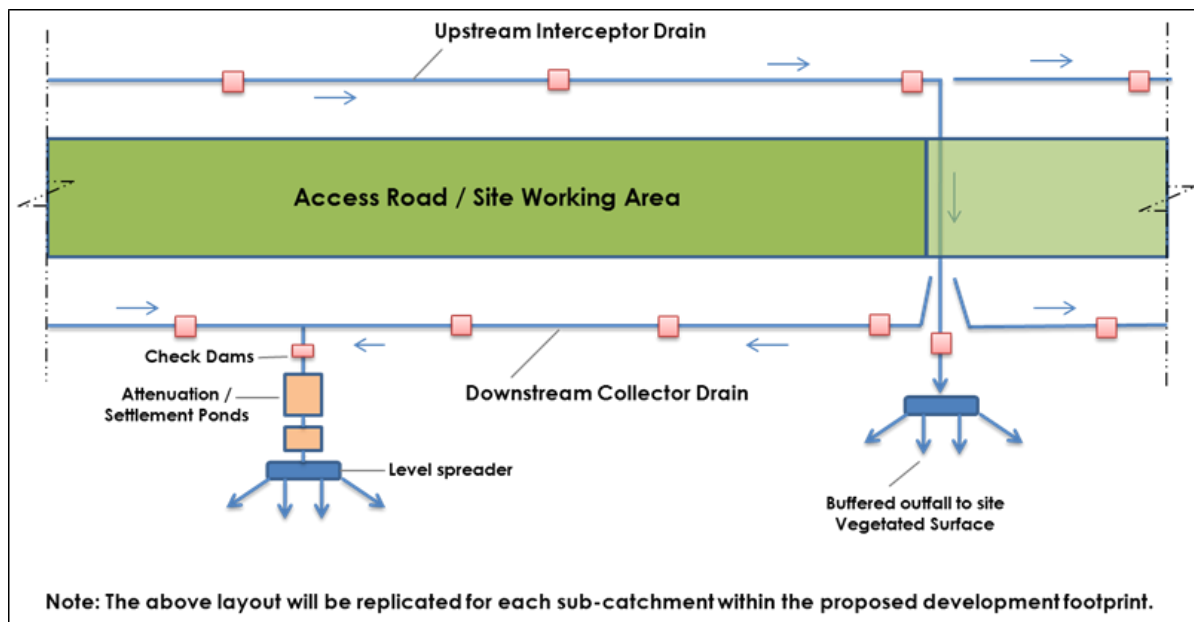


Figure 7.10: Schematic of Proposed Primary Site Drainage Management

7.3.19 RECEPTOR SENSITIVITY

Due to the nature of wind farm developments and underground electricity lines (grid connection), being near surface construction activities, impacts on groundwater are generally negligible and surface water is generally the main sensitive receptor assessed during impact assessments, especially in peatland environments.

The primary risks to groundwater at the project would be from cementitious materials, hydrocarbon spillage and leakages and potential piling works at turbine bases.

These potential likely and significant effects are assessed in **Section 7.4** below. Most of these are common potential impacts on all construction sites (such as road works and industrial sites). All potential contamination sources are to be carefully managed at the project site during the construction and operation phases of the project and mitigation measures are proposed below (**Section 7.5**) to deal with these potential impacts.

The bedrock aquifers are not likely to be sensitive to pollution due to moderate groundwater vulnerability at the wind farm site. This is because the majority of the wind farm site is covered in basin peat which in turn is underlain by marl, clays and glacial tills and these layers act as a protective cover to the underlying bedrock aquifer.

The underlying glacial deposits are not mapped as an aquifer, but they are likely to be used locally as a water supply and therefore they can also be classed as Sensitive to pollution.

The underground electricity line route passes over locally important sand and aquifers which lack the protective layers of peat, clays and glacial tills. These aquifers are sensitive to pollution as they are more vulnerable. The groundwater vulnerability along the underground electricity line is rated as high in areas.

However, at the proposed wind farm site in particular, any contaminants which may be accidentally released on-site are more likely to travel to nearby streams within surface runoff.

Surface waters such as the Rapemills River and West Galros Stream are classed as High Importance and are very sensitive to potential contamination. These watercourses also provide drainage pathways to downstream designated sites.

The designated sites that are hydraulically connected (surface water flow paths only) to the project include the River Shannon Calllows SAC and Middle Shannon Callows SPA, and therefore have Extremely High Importance. These designated sites can be considered very sensitive in terms of potential impacts.

Comprehensive surface water protection measures and controls are outlined below to ensure protection of all downstream receiving waters. Mitigation measures will ensure that surface runoff from the project site will be of a high quality and will not affect the quality of downstream surface water bodies. Any introduced drainage works at the site will mimic the existing hydrological regime thereby avoiding changes to flow volumes leaving the site.

The key design approach employed at the wind farm site has been the avoidance of sensitive aquatic areas by implementing a 50m buffer. It is evident that all proposed wind farm site infrastructure is located more than 50m from a natural watercourse. The underground electricity line route does encroach the 50m buffer along the Rapemills River which is unavoidable.

The hydrological buffer, where achieved, will create setback distances and ensure that the drainage mitigation/management measures (discussed below) can be installed up-gradient of primary drainage features within sub-catchments to facilitate appropriate, efficient and effective attenuation and treatment of surface water runoff.

Rath GWS is considered to have High Importance and sensitive in terms of potential effects from the underground electricity line works only.

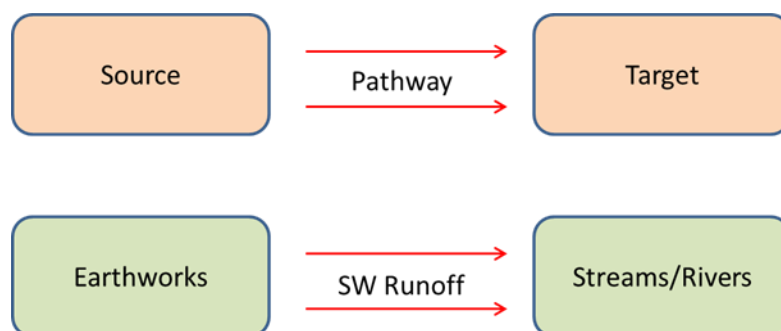
The public water supply abstraction from Lough Derg is not likely to be sensitive to effects due to the significant downstream distance (30km) and is therefore scoped out of further assessment.

7.4 DESCRIPTION OF LIKELY EFFECTS

The likely effects of the project are set out below, with mitigation measures that will be put in place to eliminate or reduce them provided in following sections.

7.4.1 OVERVIEW OF IMPACT ASSESSMENT PROCESS

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



Where likely impacts are identified, the classification of impacts in the assessment

follows the descriptors provided in the glossary of Impacts contained in the following guidance documents produced by the Environmental Protection Agency (EPA):

- *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports* (EPA, 2022);

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

In order to provide an understanding of the stepwise impact assessment process applied below (**Section 7.4 - 7.6**), we have firstly presented below a summary guide that defines the steps (1 to 7) taken in each element of the impact assessment process. The guide also provides definitions and descriptions of the assessment process and shows how the source-pathway-target model and the EPA impact descriptors are combined.

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

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

7.4.2 'DO NOTHING' SCENARIO

In the 'do-nothing' scenario, Cush Wind Farm Phase II would not proceed, while the permitted Cush Wind Farm Phase I would be constructed. The hydrological regime would remain influenced by existing land drainage and any changes arising from implementation of the draft Galros Bog Rehabilitation Plan (**Annex 6.2**). That plan provides for peatland rehabilitation and environmental stabilisation independently

of Phase II. No additional hydrological or hydrogeological effects attributable to Phase II would arise.

7.4.3 CONSTRUCTION PHASE

7.4.3.1 *Earthworks (Removal of Vegetation Cover, Excavations, Piling and Stock Piling) Resulting in Suspended Solids Entrainment in Surface Water*

Construction phase activities that will require earthworks resulting in removal of vegetation cover and excavation of peat, soil and mineral subsoil (where present) are detailed in **Chapter 3**. Potential sources of sediment laden water include:

- Drainage and seepage water resulting from infrastructure excavations;
- Stockpiled excavated material providing a point source of exposed sediment;
- Construction of the underground electricity line trenching and haul route works resulting in entrainment of sediment from the excavations during construction;
- Erosion of sediment from emplaced site drainage channels; and,
- Permanent spoil storage areas.

These activities can result in the release of suspended solids to surface watercourses and could result in an increase in the suspended sediment load, resulting in increased turbidity which, in turn, could affect the water quality and ecosystems of downstream river waterbodies.

In accordance with NRA (2008) classification, the receiving river waterbodies (Rapemills River and West Galros Stream) have High Importance due to the latest EPA Biological Q3-4 rating and WFD Moderate status.

A description of the likely pre-mitigation effect is shown in **Table 7.16** below. The potential likely magnitude of effect is Small Adverse (NRA, 2008).

Attribute	Description
Receptor	Down-gradient streams and rivers (Rapemills River, West Galros Stream) and dependent ecosystems
Pathway/Mechanism	Drainage and surface water discharge routes
Pre-Mitigation Effect	Indirect, negative, moderate, short term, likely effect on surface water quality

Table 7.16: Earthworks and Surface Water Quality Effects

7.4.3.2 *Groundwater Level Drawdown Effects During Excavation Works*

No borrow pits are proposed as part of the project, so no associated active dewatering works are required.

Smaller scale temporary dewatering may occur at some excavations (i.e. turbine bases), and these have the potential to temporarily affect local groundwater levels. However, temporary reductions in groundwater levels by temporary dewatering will be very localised and of small magnitude due to the nature and permeability of the local peat, lacustrine and subsoil/glacial till geology, which comprises very low permeability lacustrine along with moderate permeability glacial deposits.

The installation of gravity foundation turbine bases in the underlying glacial deposits in particular is likely to require some temporary dewatering arrangements, as

excavations are likely to be >5m in depth (refer to **Table 8.1** of the FT Peat Stability Assessment Report for indicative turbine foundation design).

However, due to the dominance of moderate to low permeability glacial fill subsoils and lacustrine deposits below the bogs, the impacts on groundwater levels will be localized to the excavation and only for a temporary basis during the construction work. Water level impacts are unlikely to be significant beyond 50m from any excavation.

Piling (if required at turbine locations), avoids the requirement for deep, open excavations and therefore active dewatering is typically not needed. There will be some minor displacement of groundwater volumes during drilling and pile column emplacement, but volumes will be very small (<10m³).

No groundwater level effects are anticipated from the construction of the underground electricity line route due to the shallow nature of the excavations (i.e. ~1-2m). Similarly, the completion of horizontal directional drilling (HDD) activities is assessed as not likely to affect groundwater levels.

A description of the likely final effect is shown in **Table 7.17** below. The likely magnitude of effect is Negligible. No mitigation is required with regard temporary, negligible, localised groundwater levels effects.

Attribute	Description
Receptor	Groundwater levels / flow paths /local aquifers
Pathway/Mechanism	Groundwater flowpaths
Final Effect	Direct, negative, imperceptible, temporary, likely effect on groundwater levels.

Table 7.17: Groundwater Level Effects from Excavations

7.4.3.3 Excavation Dewatering and Likely Effects on Surface Water Quality

Some minor surface water/shallow groundwater seepages and direct rainfall input will likely occur in excavations which will create additional volumes of water to be treated by the runoff/surface water management system. Inflows will require management and treatment to reduce suspended sediments. No contaminated land was noted at the project site and therefore pollution issues are not assessed as likely to occur.

A description of the likely pre-mitigation effect is shown in **Table 7.18** below. The likely magnitude of effect is Small Adverse (NRA, 2008).

Attribute	Description
Receptor	Down-gradient surface water bodies (Rapemills River, West Galros Stream)
Pathway/Mechanism	Overland flow and site drainage network
Pre-Mitigation Effect	Indirect, negative, moderate, short term, likely effect on surface water quality

Table 7.18: Excavation Dewatering Discharges

7.4.3.4 Potential Release of Hydrocarbons during Construction and Storage

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.

Hydrocarbons will be present at the project site where they will be stored at the temporary construction compound and the switch room. Construction plant and machinery will be refuelled at the construction compound; however, fuels/oils will also be transported around the project site for refuelling and maintenance purposes.

Hydrocarbon storage will not be carried out along the route of the underground electricity line as the works are transient; however, refuelling of plant and machinery will occur as necessary along the route with appropriate controls being implemented.

A description of the likely pre-mitigation effect is shown in **Table 7.19** below. The likely magnitude of effect is Small Adverse for groundwater and Moderate Adverse for surface water (NRA, 2008).

Attribute	Description
Receptor	Groundwater (Banagher GWB, Birr gravels GWB Shinrone GWB and Birr GWB) and surface water (Rapemills River, West Galros Stream)
Pathway/Mechanism	Groundwater flowpaths and site drainage network
Pre-Mitigation Effect	Indirect, negative, slight, short term, unlikely effect on local groundwater quality. Given the nature of the groundwater environment, discussed at Sections 7.3.9 and 7.3.19 above, negative effects on groundwater quality are assessed to be unlikely. Indirect, negative, moderate, short term, unlikely effect to surface water quality

Table 7.19: Release of Hydrocarbons

7.4.3.5 Groundwater and Surface Water Contamination from Wastewater Disposal

The release of effluent from site welfare wastewater treatment systems is likely to affect groundwater and surface water quality. The temporary construction compounds will accommodate chemical toilets/portaloos. The toilets will comprise sealed units to ensure that no discharges escape into the local environment and will be supplied and maintained by a licensed supplier. There is no requirement for the storage of wastewater along the underground electricity line. Therefore, environmental effects are not likely. No further mitigation is required.

7.4.3.6 Release of Cement-Based Products

Concrete and other cement-based products are highly alkaline and corrosive and can have significant negative impacts on water quality. They generate very fine, highly alkaline silt (pH 11.5) that can physically damage fish by burning their skin and blocking their gills. A pH range of ≥ 6 to ≤ 9 is set in S.I. No. 293 of 1988 Quality of Salmonid Water Regulations, with artificial variations not in excess of ± 0.5 of a pH unit. 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.

Freshwater ecosystems are dependent on stable near neutral pH hydrochemistry. They are extremely sensitive to the introduction of high pH alkaline waters into the system. The washing out of transport and placement machinery are the activities most

likely to generate a risk of cement-based pollution.

A description of the likely pre-mitigation effect is shown in **Table 7.20** below. The likely magnitude of effect is Small Adverse for groundwater and Moderate Adverse for surface water (NRA, 2008).

Attribute	Description
Receptor	Groundwater (Banagher GWB, Birr gravels GWB, Shinrone GWB and Birr GWB) and surface water (Rapemills River, West Galros Stream)
Pathway/Mechanism	Site drainage network
Pre-Mitigation Effect	Indirect, negative, slight, short term, unlikely effect on local groundwater quality. Given the nature of the groundwater environment, discussed at Sections 7.3.9 and 7.3.19 above, negative effects on groundwater quality are assessed to be unlikely. Indirect, negative, moderate, short term, unlikely effect to surface water quality

Table 7.20: Release of Cement-Based Products

7.4.3.7 Hydromorphological Changes to Surface Water Courses & Drainage Patterns

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

No access-track crossings of natural or EPA-designated watercourses are proposed within the wind farm site. Where access tracks cross artificial bog drainage ditches, appropriately sized culverts or cross-drains will be installed to maintain the existing drainage pathways. The underground electricity line will cross beneath the Rapemills River at two locations using HDD, thereby avoiding open trenching or works within the riverbed or channel. Subject to implementation of the HDD and inadvertent-return controls set out in **Section 7.5.1.1**, no likely significant hydromorphological effect will arise.

A description of the likely final effect is shown in **Table 7.21** below. No effects are likely as mitigation by design will prevent any effects.

Attribute	Description
Receptor	Surface water flows, stream morphology and water quality in the Rapemills River and West Galros Stream
Pathway/Mechanism	Crossing structures and morphological alterations.
Final Effect	No likely morphological effects

Table 7.21: River Waterbody Hydromorphological Effects

7.4.3.8 Hydrological Effects on Designated Sites

The project site drains to the northwest via the Rapemills River, which passes the All Saints Bog and Esker SAC and pNHA (Site Code: 000566) and the All Saints Bog SPA (Site Code:004103) 5.5km downstream from the project site.

However, there is no surface water connection between the project site and All Saints Bog and Esker SAC as All Saints Bog discharges into Rapemills River and not vice versa.

Groundwater flow in the area of the project site is likely to be westerly towards All

Saints Bog and Esker SAC. However, groundwater flow below Saints Bog and Esker SAC will be limited to the deeper glacial deposits which are separated from the bog by very low permeability marl and lacustrine clay deposits which underlies the basin peat in this area.

The Rapemills River and Little Brosna River ultimately drain into the River Shannon which flows through the River Shannon Calllows SAC (Site Code: 000216) and the Middle Shannon Callows SPA (Site Code:004096).

Downstream, surface water quality effects are unlikely to be significant at the location of the SACs due to dilution/assimilation capacity effects over such distances, particularly in the River Shannon itself.

Notwithstanding this, surface water management and mitigation is proposed to protect local surface water and avoid significant negative downstream surface water quality effects.

A description of the likely pre-mitigation effect is shown in **Table 7.22** below. The likely magnitude of effect is Negligible (NRA, 2008).

Attribute	Description
Receptor	Down-gradient water quality and designated sites
Pathway/Mechanism	Surface water flow-paths
Pre-Mitigation Effect	Indirect, negative, imperceptible, short term, unlikely effect

Table 7.22: Effects on Downstream Designated Sites

7.4.3.9 Effects on Local Private Wells

In the area of the project site, private dwelling houses (potential well locations) are mainly located along the surrounding public roads to the west of the project site. Westerly is also the expected groundwater flow direction.

The most substantial risk to potential down-gradient wells will be from deeper excavations such as the turbine foundations. The closest potential downstream dwellings (i.e. potential wells) to the west of the project site are just over 2km from the closest turbine (T10).

The construction of the underground electricity (grid connection) line is not likely to affect local wells due to the shallow nature of the works along the route.

However, due to the relatively shallow nature of the turbine foundation excavations (>5mbgl), the topography, hydrogeological regime and the >2km setback distance from potential wells, negative effects on private wells are unlikely.

With high confidence, the project is not likely to affect any potential down-gradient private wells for the following reasons:

- The large set back distances between proposed turbines and downstream potential well locations (>2km);
- The short groundwater flowpath distances (30–300m) in the underlying 'poorly productive' aquifer below the project site;
- The moderate groundwater vulnerability rating at the wind farm site;
- The moderate to low permeability of the glacial deposits below the peat and lacustrine layers which will limit the distance of any likely groundwater level

drawdown effects;

- The poorly productive and low recharge characteristics of the bedrock aquifer that underlie the wind farm site;
- Groundwater flow patterns are expected towards the local watercourses that drain the project site; and,
- The shallow excavation depths required for the underground electricity (grid connection) line.

For the reasons outlined above (separation distances, and prevailing geology, hydrogeology, topography and groundwater flow directions), it has been assessed the project is not likely to affect local groundwater wells and therefore no specific mitigation is required other than general best practice pollution prevention measures (refer to **Section 7.5** below).

A description of the likely final effect is shown in **Table 7.23** below. The likely magnitude of effect is Negligible (NRA, 2008).

Attribute	Description
Receptor	Down-gradient groundwater quality and private well drinking water sources
Pathway/Mechanism	Groundwater and surface water flowpaths
Final Effect	No effects on local private wells are likely

Table 7.23: Private Drinking Water Supplies

7.4.3.10 Effects on the WFD Status and Objectives

WFD status and Risk Results for downstream river waterbodies and the underlying GWBs are presented in **Sections 7.3.12** and **7.3.13** above.

Due to the poorly productive nature of the underlying bedrock aquifer underlying the wind farm site and the moderate groundwater vulnerability rating at the wind farm site, there is low likelihood of negatively affecting the WFD status of the GWBs, even in the absence of mitigation.

Without mitigation, construction works are likely to adversely impact on surface water quality which may negatively impact on the WFD status of these downstream surface waterbodies. River waterbodies in which the project are directly located are most of risk of negative effects to WFD status (i.e. Rapemills_010 and Rapemills_020 river waterbodies).

Our understanding of the objectives of the WFD 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. This is reflected in the strict mitigation measures proposed in relation to maintaining a high quality of surface water from the project which will ensure that the status of surface waterbodies in the vicinity of the project will be at least maintained regardless of their existing status.

A description of the likely pre-mitigation effect is shown in **Table 7.24** below. The likely magnitude of effect is Small Adverse (NRA, 2008) to WFD status.

Attribute	Description
Receptor	Down-gradient groundwater and surface water bodies status
Pathway/Mechanism	Groundwater and Surface water flowpaths
Pre-Mitigation Effect	Indirect, negative, moderate, short term, unlikely effect on WFD river waterbody status No likelihood of affecting WFD status of groundwater bodies

Table 7.24: WFD Status Effects

A full WFD Compliance Assessment Report is provided at **Annex 7.3**.

7.4.3.11 *Effects on the Rath Group Water Scheme Source*

Rath Group Water Scheme (GWS) groundwater source protection area is mapped at the eastern end of the underground electricity line route, with approximately 400m of the proposed route located within the source protection area. The section of the proposed route within the source protection area is on private lands (grassland). The proposed route is set back at least 300m from the source wells and springs.

According to the GSI, the origin of the groundwater feeding the source is reported to be the underlying pure bedded limestones. The thickness of overburden above bedrock at the source is reported to be between 3 and 6.9m which is deeper than the invert of the underground electricity trench (1.2m).

Therefore, the construction of the underground electricity line within the source protection area is not likely to affect groundwater flows to the source due to the shallow nature of the trench works (i.e. 1.2m). The trench excavation works will have no potential to affect groundwater flow paths feeding the source wells and springs which come from the deeper, underlying bedrock.

Spills and leaks of fuels hydrocarbons, as well as potential leaching of cement, do however present a small risk to the source during the underground electricity line works. However, due to the small volumes that will be present at any time, effects are not likely to be significant.

A description of the likely pre-mitigation effect is shown in **Table 7.25** below. The likely magnitude of effect on the Rath GWS source is Negligible to Small Adverse.

Attribute	Description
Receptor	Rath GWS groundwater source
Pathway/Mechanism	Groundwater flowpaths
Pre-Mitigation Effect	Indirect, negative, slight, temporary, unlikely effect on GWS water quality

Table 7.25: Effects on Rath GWS Groundwater Source

7.4.3.12 *Risk of Flooding during the Underground Electricity Line Construction*

NIFM fluvial flood zones are mapped along the course of the Rapemills River to the east of the wind farm site which encroach the proposed underground electricity line route.

Despite the high-risk flood zone mapping along the underground electricity line route, the likelihood of an extreme flood event (i.e. >10-year return period) happening during the construction phase of the underground electricity line is very low. Also, the underground nature of the works, means that there will be no permanent or fixed

project infrastructure at ground level that would be at risk of flooding itself or increasing flood risk downstream.

However, there is a flood risk to temporary works such as excavations, temporary stockpiles and also to people and plant.

A description of the likely pre-mitigation effect is shown in **Table 7.26** below. The likely magnitude of effect is Small to Moderate Adverse (NRA, 2008) to local river water bodies only.

Attribute	Description
Receptor	Underground electricity line route works and flood risk
Pathway/Mechanism	Surface water flows
Pre-Mitigation Effect	Direct, negative, moderate, temporary, unlikely effect

Table 7.26: Underground Electricity Line Flood Risk

7.4.4 OPERATION PHASE

Activities during the operation phase of the project will be significantly reduced compared to the construction phase, with extremely limited sources for likely significant negative hydrological and hydrogeological effects.

7.4.4.1 Groundwater and Surface Water Contamination from Wastewater Disposal

The switch room building will include welfare facilities and will be served by a sealed foul-water holding tank. Wastewater will be retained within the sealed tank and periodically removed from the project site by an appropriately authorised waste collector for treatment or disposal at an appropriately authorised facility. There will be no discharge of foul wastewater to ground, surface water or the site drainage network. Accordingly, there will be no likely effects on surface water or groundwater.

The likely magnitude of effect is Negligible (NRA, 2008). A description of the likely pre-mitigation effect is shown in **Table 7.27** below.

Attribute	Description
Receptor	Surface waters, groundwater and dependent ecosystems.
Pathway/Mechanism	Site drainage network.
Final Effect	No likely indirect or direct negative effects

Table 7.27: Contamination from Wastewater

7.4.4.2 Increased Runoff due to Progressive Replacement of Natural Surface with Lower Permeability Surfaces

The progressive replacement of natural surface with impermeable surfaces could result in an increase in the proportion of surface water runoff reaching the surface water drainage network. The permanent project footprint comprises turbine hardstands, access tracks and switch room building. During rainfall events, additional runoff coupled with increased velocity of flow could increase hydraulic loading to local drains and streams, resulting in erosion of watercourses and impact on downstream aquatic ecosystems. The underground electricity line by its nature has

no potential to affect surface water runoff rates.

The permanent physical footprint of the wind farm site infrastructure is approximately 2.33ha.

The spoil storage areas have not been included in this assessment as there is no hardstand placement. The spoil storage areas will essentially involve placement of peat on an already existing peat surface and therefore there will be no significant change in ground conditions affecting runoff.

It is calculated (**Table 7.28**), that the emplacement of the proposed wind farm footprint, as described in **Chapter 3**, (assuming emplacement of impermeable materials) would result in an average total site increase in surface water runoff of 85m³/month, for the month of highest average recorded rainfall (December). This equates to an average increase of 2.7m³/day.

This represents a 0.11% increase in the average daily/monthly volume of runoff from the wind farm site in comparison to the baseline pre-development site runoff conditions. This is a very small increase in average runoff and results from a relatively small area of the overall wind farm site being developed. Specifically, the proposed permanent development hardstand area is approximately 2.33ha, representing ca. 2.7% of the wind farm planning application site area of c. 87ha.

The additional runoff volume is low due to the fact that the runoff potential from the wind farm site is naturally very high (96% runoff coefficient) due to the prevailing baseline hydrogeological conditions at the project site (i.e. peat surfaces, lacustrine clays etc). Also, this calculation assumes that all hardstanding areas will be impermeable which is a precautionary assumption given that access tracks and crane hardstands will be constructed of aggregates which will facilitate the permeation/recharge of rainfall. A water balance assessment is provided below.

Baseline Runoff/month (m ³)	Baseline Runoff/day (m ³)	Permanent Footprint Area (m ²)	Footprint Area 100% Runoff (m ³)	Footprint Area 96% Runoff (m ³)	Net Increase/month (m ³)	Net Increase/day (m ³)	% Increase from Baseline Conditions
76,003	2,452	23,300	2,120	2,035	85	2.7	0.11

Table 7.28: Baseline Runoff for the Project Site

The likely magnitude of effect is Negligible (NRA, 2008). A description of the likely pre-mitigation effect is shown in **Table 7.29** below.

Attribute	Description
Receptor	Surface waters (Rapemills River, West Galros Stream) and dependent ecosystems.
Pathway/Mechanism	Site drainage network.
Pre-Mitigation Effect	Direct, negative, imperceptible, long term, likely effect on existing drainage / runoff volumes

Table 7.29: Increased Surface Water Runoff Rate Effects

7.4.4.3 Hydrocarbons Spillages/Leakages

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

Oil used in transformers (at the switch room and within each turbine) and storage of oils at the switch room could leak during the operation phase and result in effects on water quality.

The likely magnitude of effect is Negligible (NRA, 2008). A description of the likely pre-mitigation effect is shown in **Table 7.30** below.

Attribute	Description
Receptor	Surface waters, groundwater and dependent ecosystems.
Pathway/Mechanism	Site drainage network.
Pre-Mitigation Effect	Direct, negative, imperceptible, long-term, unlikely effect.

Table 7.30: Hydrocarbons Spillages Leakages during the Operation Phase

7.4.5 DECOMMISSIONING PHASE

Decommissioning phase effects are likely to be very similar to construction phase impacts but the overall likelihood for significant negative effects will be much lower due to reduced groundworks and excavations taking place. Some of the effects will be reduced or avoided by retaining some elements of the project where appropriate; for example, access tracks within the project site are likely to be retained for agricultural uses.

7.4.6 PRECAUTIONARY ASSESSMENT SCENARIO

The 'worst-case' for hydrological and hydrogeological effects are assessed to comprise the contamination of surface water features during the construction, operation and decommissioning phases, which in turn could affect the ecology and quality of the downstream surface water bodies. Also, it is assessed that localised groundwater contamination from spillages or hydrocarbons and other pollutants could occur. However, best practice construction methodologies and dedicated mitigation measures will be put in place to prevent this 'worst-case' scenario from arising.

7.4.7 HYDROLOGICAL CUMULATIVE EFFECTS

The main likelihood of cumulative effects is assessed to be hydrological (surface water quality) rather than hydrogeological (groundwater). Due to the hydrogeological setting of the project site (i.e. low permeability peat, silts and clays overlying a poor productive aquifer) and the near surface nature of construction activities, cumulative impacts with regard groundwater quality or quantity arising from the proposed project are assessed as being unlikely to occur.

In terms of cumulative hydrological effects arising only from elements of the project (wind farm infrastructure, switch room building, underground electricity line and haul route works), no likely significant effects are expected for the reasons described below.

With regards to the project itself, significant cumulative effects amongst the constituent components (i.e. wind farm, switch room, electricity line, etc.) are not

assessed as likely to be significant due to the construction methodologies, construction programme (i.e. the underground electricity line trench will be excavated in stages) and the transient nature of the underground electricity line works extending over several kilometres.

Moreover, the surface water control measures to be put in place and the adherence to the 50m hydrological buffer at the project site will further reduce the likelihood of cumulative effects arising. Additional drainage control measures are outlined below, where works or infrastructure is located inside a 50m buffer zone along the underground electricity line.

A hydrological cumulative impact assessment of the project has been undertaken below with regards cumulative effects with other projects and plans, including wind energy developments, located in the Rapemills River catchment (the proposed project is situated entirely within the Rapemills River catchment). Cumulative effects downstream of the Rapemills River catchment are unlikely for the reasons outlined below.

Downstream of the Rapemills River catchment (i.e. the River Shannon itself) no cumulative hydrological effects are likely due to large upstream catchment area of the River Shannon (i.e. ~6,700km²) and the very high dilution effects afforded by such a large regional catchment and subsequent large surface water flows. In comparison, the Rapemills River catchment (~95km²) only accounts for 1.4% of the River Shannon catchment upstream of the Rapemills/Shannon confluence. The potential for dilution is very high.

All proposed turbine locations (3 no.) at the project site are located within the Rapemills River catchment. Also, there are two other wind farms locally that have turbines operating in the Rapemills River catchment. These are Derrinlough Wind Farm and Meenwaun Wind Farm, both of which are constructed and operational. Also located within the Rapemills River catchment are the permitted 8 no. turbines from Cush Wind Farm Phase I.

Both the Derrinlough Wind Farm and Meenwaun Wind Farm are both operational and therefore construction phase effects cannot overlap with the project if permitted. The project is anticipated to be constructed concurrently with Cush Wind Farm Phase I, with both developments forming part of the same overall construction programme, however significant cumulative effects during construction are not likely.

The assessment also takes account of the Section 146B alteration request for Cush Wind Farm Phase I. The Phase I water assessment was based on the turbine dimension range permutation, which provides the basis for the maximum physical footprint relevant to this assessment. The proposed turbine dimension alterations do not increase that assessed footprint and therefore do not alter the conclusions regarding cumulative hydrological or hydrogeological effects.

Derrinlough Wind Farm has 21 no. turbines but only 6 no. are located in the Rapemills River catchment. All four of the Meenwaun Wind Farm turbines are located in the Rapemills River catchment.

Therefore, in terms of operation phase effects, the total number of wind turbines that could potentially be operating in the Rapemills River catchment is 21 no. (3 no. from the project site, 8 no. from Cush Wind Farm Phase I, 6 no. from Derrinlough Wind Farm and 4 no. from Meenwaun Wind Farm).

The total area of the Rapemills catchment is c. 95km² which equates to 1 no. turbine

per 4.5km² which is considered not significant in terms of likely cumulative hydrological effects on the Rapemills River during the operation phase.

The water balance assessment, undertaken at **Section 7.4.4.2** above, demonstrates that even in the absence of mitigation, the likelihood of increased runoff from the proposed project site during the operation phase is imperceptible. Therefore, the implementation of the proposed drainage control, which will release stormwater from the project site at Greenfield rates, will ensure cumulative effects during the operation phase with regard flood risk and hydromorphology will be neutral.

The proposed Mullanafawnia 110kV substation, which is proposed by a separate developer and subject to a separate planning application, has also been considered in the cumulative assessment. Having regard to the localised nature of the works and the surface water management and pollution prevention measures inherent in that project for the project, no likely significant cumulative hydrological or hydrogeological effects are anticipated.

In relation to non-wind farm, smaller commercial and private development in the Rapemills catchment, the majority of the local developments relate to the provision and/or alteration of one-off housing and agricultural developments.

These developments are typically small scale and localised in nature and impacts on water quality or flows (surface water or groundwater) are not expected. Therefore, hydrological cumulative impacts with respect to the project will not occur.

7.5 MITIGATION & MONITORING MEASURES

The overarching objective of the proposed mitigation measures is to ensure that all surface water runoff is comprehensively treated and attenuated such that no silt or sediment laden waters or deleterious material is discharged into the local drainage system. A Planning-Stage SWMP, incorporating the surface water drainage design has been prepared, see **Annex 3.4**, and incorporates the principles of Sustainable Drainage Systems (SuDS) through an arrangement of surface water drainage infrastructure. The SWMP has regard to Greenfield runoff rates and is designed to mimic same and is sufficient to accommodate a 1-in-100 year rainfall event.

While the SuDS is an amalgamation of a suite of drainage infrastructure; the overall philosophy is straightforward. In summary:

- All surface water runoff will be directed to specially constructed swales surrounding all areas of ground proposed to be disturbed (including the area for the temporary storage of material);
- The swales will direct runoff into settlement ponds/silt traps where silt/sediment will be allowed to settle;
- Following treatment, clean water will be discharged indirectly to the local drainage network via buffered outfalls thus ensuring that no scouring occurs; and,
- Drainage from the BnM lands (Galros Bog) also have the added benefit of large existing attenuation ponds at the bog outfalls.

The suite of proposed surface water drainage infrastructure will include interception drains, collector drains swales, sedimats, flow attenuation and filtration check dams, settlement ponds/silt traps, and buffered outfalls.

The design criteria implemented as part of the SuDS are as follows:

- To minimise alterations to the ambient site hydrology and hydrogeology;
- To provide settlement and treatment controls as close to the site footprint as possible and to replicate, where possible, the existing hydrological environment of the site;
- To minimise sediment loads resulting from the development run-off during the construction phase;
- To preserve greenfield runoff rates and volumes;
- To strictly control all surface water runoff such that no silt or other pollutants shall enter watercourses and that no artificially elevated levels of downstream siltation or no plumes of silt arise when substratum is disturbed;
- To provide settlement ponds to encourage sedimentation and storm water runoff settlement;
- To reduce stormwater runoff velocities throughout the site to prevent scouring and encourage settlement of sediment locally;
- To manage erosion and allow for the effective revegetation of bare surfaces;
- To manage and control water within the site and allow for the discharge of runoff from the site below the MAC of the relevant surface water regulation value; and,
- The high sensitivity of downstream receptors along with WFD status.

7.5.1 CONSTRUCTION PHASE

7.5.1.1 *Earthworks (Removal of Vegetation Cover, Excavations and Stock Piling) Resulting in Suspended Solids Entrainment in Surface Water*

Mitigation by Avoidance

The key mitigation measure during the construction phase is the avoidance of sensitive aquatic areas by using a 50m buffer. From the constraints map (**Annex 7.4**) it is evident that only the underground electricity line is within a 50m buffer zone.

As described above and at **Chapter 3**, specific mitigation measures, incorporated into the design of the project and through implementation of best practice methodologies (discussed below) will be employed where work inside buffer zones is proposed.

The generally large setback distance from sensitive hydrological features at the project site ensures that sufficient space is provided for the installation of drainage mitigation measures (discussed below) and to ensure their effective operation. The proposed buffer zone will ensure:

- Avoidance of physical damage to watercourses, and associated release of sediment;
- Avoidance of excavations within close proximity to surface water courses;
- Avoidance of the entry of suspended sediment from earthworks into watercourses; and,
- Avoidance of the entry of suspended sediment from the construction phase drainage system into watercourses, achieved in part by ending drain

discharge outside the buffer zone and allowing percolation across the vegetation of the buffer zone.

Mitigation by Prevention

The following section details the measures which will be put in place during the construction phase to ensure that surface water features are protected from the release of silt or sediment and to ensure that all surface water runoff is fully treated and attenuated to avoid the discharge of dirty water.

- Source controls to limit the likelihood for 'dirty water' to occur:
 - Interceptor drains, vee-drains, diversion drains, flume pipes, erosion and velocity control measures such as use of sand bags, oyster bags filled with clean washed gravel, filter fabrics, and other similar/equivalent or appropriate systems;
 - Small working areas, covering stockpiles, weathering off stockpiles, cessation of works in certain areas or other similar/equivalent or appropriate measures.
- In-Line controls to ensure appropriate management of silt laden water:
 - Interceptor drains, vee-drains, oversized swales, erosion and velocity control measures such as check dams, sand bags, oyster bags, straw bales, flow limiters, weirs, baffles, silt bags, silt fences, sedimats, filter fabrics, and collection sumps, temporary sumps/attenuation lagoons, sediment traps, pumping systems, settlement ponds, temporary pumping chambers, or other similar/equivalent or appropriate systems.
- Treatment systems to fully attenuate silt laden waters prior to discharge:
 - Temporary sumps and attenuation ponds, temporary storage lagoons, sediment traps, and settlement ponds, and proprietary settlement systems such as Siltbuster, and/or other similar/equivalent or appropriate systems; and
 - The existing settlement ponds lagoons on the BnM lands.

It should be noted for this site that an extensive network of bog drains already exists, and these will be integrated and enhanced as required and used within the wind farm drainage system. The wind farm drainage will coexist with the BnM bog rehabilitation plan. The integration of the existing land drainage network and the proposed wind farm network is common practice in wind energy developments and will also result in benefits to surrounding lands.

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 wind farm drainage into the existing site drainage network. This will reduce the likelihood of 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 is taking place, and these will be diverted into proposed interceptor drains, or culverted under/across the works area; and

- Buffered outfalls, which will be numerous over the site, will promote percolation of drainage waters across vegetation and close to the point at which the additional runoff is generated, rather than direct discharge to the existing drains of the site.

Water Treatment Train

While the silt/sediment ponds and lagoons are assessed as providing a sufficient level of protection to avoid any deterioration in downstream water quality; a final line of defence can be provided by a water treatment train such as a 'Siltbuster', if required. If the discharge water from construction areas fails to be of a high quality, then a filtration treatment system (such as a 'Siltbuster' or similar equivalent treatment train [sequence of water treatment processes]) will be used to filter and treat all surface discharge water collected in the dirty water drainage system. This water treatment train will apply for the entirety of the construction phase.

Silt Fences

Silt fences will be emplaced within drains down-gradient of all construction areas. Silt fences are effective at removing heavy settleable solids. This will act to prevent entry to watercourses of sand and gravel sized sediment, released from excavation of mineral sub-soils of glacial and glacio-fluvial origin, and entrained in surface water runoff. Inspection and maintenance of these structures during construction phase is critical to their functioning to stated purpose. They will remain in place throughout the entire construction phase. Double silt fences will be emplaced within drains down-gradient of all construction areas inside the hydrological buffer zones to provide an additional layer of protection in these areas.

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, most 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) 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.

Existing BnM/Galros Bog Settlement Ponds/lagoons

The project infrastructure on the BnM lands (i.e. turbines T9 – T11 and spoil deposition areas) have the added benefit of the existing settlement ponds/lagoon providing additional attenuation and any future measures introduced as part of the rehabilitation plan.

Management of Runoff from Soil Deposition Areas

It is proposed that excavated overburden/spoil will be utilised for reinstatement of excavated areas etc. and for landscaping purposes. Excess material, or material which is unsuitable for this purpose, will be stored, permanently, at 1 no. dedicated spoil deposition area located southeast of proposed turbine T11 as well as smaller deposition areas at each of the 3 no. turbine locations.

All proposed spoil deposition areas are located outside the 50m stream buffer zone

(refer to **Annex 7.4**).

During the initial placement of spoil in the deposition areas, silt fences, straw bales and biodegradable matting will be used to control surface water runoff. Double silt fencing will be placed along the edge of each bog drain that intercepts the deposition areas.

Drainage from overburden deposition areas will ultimately be into to the existing bog drain network where it is proposed that check dams will be installed every 20m or so to create a series of settlement ponds, before being discharged.

The spoil deposition area drainage on the BnM lands have the added benefit of the existing settlement ponds/lagoons.

Spoil deposition areas will be sealed with a digger bucket and vegetated as soon possible to reduce sediment entrainment in runoff. Once re-vegetated and stabilised, spoil deposition areas will no longer be a likely source of silt laden runoff. Surface water protection infrastructure will be left in place until the areas have stabilised.

Underground Electricity Line Installation Works

Mitigation measures which are outlined below will be implemented to ensure that silt laden or contaminated surface water runoff from the trenching work does not discharge directly to the Rapemills River:

- All existing dry drains that intercept the works area will be temporarily blocked down-gradient of the works using temporary check dams/silt traps (e.g. straw bales);
- Clean water diversion drains will be installed upgradient of the works areas, as required;
- Check dams/silt fence arrangements (silt traps or straw bales) will be placed in all existing drains that have surface water flows and also along existing roadside drains;
- A double silt fence perimeter will be placed down-slope of works areas that are located inside the watercourse 50m buffer zones;
- At drain crossing locations, where open trenching is required, damming and over pumping method will be used to manage flows in the drain.

Specific mitigation measures relating to the directional drilling at the crossing location are detailed below.

Horizontal Directional Drilling (HDD)

The following mitigation will be carried out during directional drilling works:

- Firstly, the crossing works area will be clearly marked out with fencing or flagging tape to avoid unnecessary disturbance of vegetation;
- A minimum 10m vegetated buffer will be maintained between the HDD working areas, including launch and receiving pits, and the riverbank. Plant entry into this buffer will be avoided. Where limited access within the buffer is demonstrably unavoidable, ground-protection mats will be used and the duration and extent of access will be minimised. There will be no storage of material/equipment, excavated material or overnight parking of machinery inside the 10m buffer zone;
- Double silt fencing will be placed upslope of the buffer zone on each side of the watercourse.

- Mats will be used underneath the excavator, inside the 10 metre vegetative buffer zone, to prevent soil erosion/rutting and potential surface water quality impacts from localised surface water runoff;
- Temporary storage of excavated material will be undertaken outside of the 10m buffer on flat ground or within a local hollow area. A containment berm will be placed downslope of the excavated material which in turn will be surrounded by secondary silt fence protection to prevent saturated soil from flowing back into the watercourse;
- Operation of machinery and use of equipment within the 10m buffer will be kept to a minimum to avoid any unnecessary disturbance;
- There will be no refuelling allowed within 50m of the watercourse crossing;
- All plant will be checked for purpose of use prior to mobilisation at the watercourse crossing; and,
- Works shall not take place during periods of heavy rainfall and will be scaled back or suspended if heavy rain is forecasted.

Mitigation Measures relating to the use of a mixture of a natural, inert and fully biodegradable drilling fluid such as Clear Bore™ and water for directional drilling include:

- The area around the Clear Bore™ batching, pumping and recycling plants will be bunded using terram and sandbags in order to contain any spillages;
- One or more lines of silt fences will be placed between the works area and adjacent rivers and streams on both banks;
- Accidental spillage of fluids will be cleaned up immediately and transported off site for disposal at a licensed facility; and,
- Adequately sized skips will be used for temporary storage of drilling arisings during directional drilling works. This will ensure containment of drilling arisings and drilling flush.

A Fracture Blow-out (Frac-out) Prevention and Contingency Plan will be prepared by the drilling contractor prior to construction and will include the following measures:

- The drilling fluid/bentonite will be non-toxic and naturally biodegradable (i.e., Clear Bore Drilling Fluid or similar will be used);
- The area around the drilling fluid batching, pumping and recycling plants will be bunded using terram and/or sandbags to contain any potential spillage;
- A double row 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 a further inadvertent return remains high, the drilling methodology and alignment will be reviewed within the assessed works corridor before drilling recommences.

Pre-emptive Site Drainage Management

The works programme for the initial construction stage of the development will also take account of weather forecasts, and predicted rainfall in particular. Large excavations and movements of soil/subsoil or vegetation stripping will be suspended or scaled back if prolonged or intense 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;
- Meteo Alarm: 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 an impending high rainfall intensity event.

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

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

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

- Secure all open excavations;

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

Timing of Site Construction Works

The construction of the site drainage system will be carried out, at the respective locations, prior to other activities being commenced. The construction of the drainage system will only be carried out during periods of, where possible, no rainfall, therefore avoiding runoff. This will avoid 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 functional for all subsequent construction works.

Monitoring

Prior to the commencement of development, a detailed Site Drainage Plan and SWMP will be prepared to detail the siting and composition of the surface water management measures. The respective plans, which will form part of a detailed Construction Environmental Management Plan (CEMP), will be prepared prior to the commencement of development.

The CEMP will also include a detailed Water Quality Monitoring Plan for the monitoring of surface waters in the vicinity of the construction site by a designated Environmental Manager. The monitoring programme will comprise field testing and laboratory analysis of a range of agreed parameters. The civil works contractor, who will be responsible for the construction of the site drainage system, and Environmental Manager will undertake regular inspections of the drainage system to ensure that all measures are functioning effectively. The surface water sampling locations used in this EIAR (i.e. SW1 – SW4) will be used during construction activities. 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.

Any excess build-up of silt levels that may decrease the effectiveness of the drainage feature, will be removed and disposed of in an appropriate manner.

7.5.1.2 Excavation Dewatering and Effects on Surface Water Quality

The management of excavation dewatering (pumping), particularly in relation to any accumulation of water in foundations or underground electricity line trenches, 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;
- The interceptor drainage will be discharged to the site constructed drainage system or onto natural vegetated surfaces and not directly to surface waters to ensure that Greenfield runoff rates are mimicked;
- If required, pumping of excavation inflows will prevent build-up of water in the excavation;

- The pumped water volumes will be discharged via volume and silt/sediment ponds and settlement lagoons 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 wind farm excavations by the Environmental Manager will occur during the construction phase. If high levels of seepage inflow occur, excavation work at this location will cease immediately and a geotechnical assessment undertaken; and,
- A mobile 'Siltbuster' or similar equivalent specialist treatment system will be available on-site for emergencies. 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.

7.5.1.3 Release of Hydrocarbons during Construction and Storage

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

- The volume of fuels or oils stored on site will be minimised. All fuel and oil will be stored in an appropriately bunded area within the temporary construction compound. Only an appropriate volume of fuel will be stored at any given time. The bunded area will be roofed to avoid the ingress of rainfall and will be fitted with a storm drainage system and an appropriate oil interceptor;
- All bunded areas will have 110% capacity of the volume to be stored;
- On site refuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled at the temporary compound and will be towed around the site by a 4x4 jeep to where plant and machinery is located. No refuelling will be permitted at works locations within the 50m hydrological buffer. The 4x4 jeep will also be fully stocked with fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations to avoid any accidental leakages;
- All plant and machinery used during construction will be regularly inspected for leaks and fitness for purpose;
- Spill kits will be readily available to deal with and accidental spillages;
- All waste tar material arising from road cuttings (from trenching or other works in public roads) will be removed off-site and taken to a licensed waste facility. Due to the potential for contamination of soils and subsoils, it is not proposed to utilise this material for any reinstatement works; and
- An outline emergency plan for the construction phase to deal with accidental spillages is contained within the Planning-Stage CEMP (Annex 3.4). This emergency plan will be further developed prior to the commencement of development, and will be agreed with the Planning Authority as part of the

detailed CEMP.

7.5.1.4 Release of Cement-Based Products

The following mitigation measures are proposed to ensure that the release of cement-based products is avoided:

- No batching of wet-cement products will occur on site. Ready-mixed concrete will be brought to site as required and, where possible, pre-cast products will be utilised;
- All drain crossings will utilise pre-cast products and the use of wet-cement products within the hydrological buffer will be avoided;
- Where concrete is delivered on site, only the chute will be cleaned, using the smallest volume of water practicable. Chute cleaning will be undertaken at lined cement washout ponds with waters being stored in the temporary construction compound, removed off site and disposed of at an approved licensed facility. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed;
- Weather forecasting will be used to ensure that prolonged or intense rainfall is not predicted during concrete pouring activities; and,
- The concrete pour site will be kept free of standing water and plastic covers will be ready in case of sudden rainfall event.

7.5.1.5 Hydrological Impacts on Designated Sites

The proposed mitigation measures for protection of surface water quality, which will include buffer zones and robust drainage control measures (i.e. interceptor drains, swales, silt/settlement ponds, settlement lagoons), will ensure that the quality of runoff from development areas will be very high. Accordingly, no further mitigation measures are assessed as being required.

As stated in **Section 7.6.1.1** below, an “imperceptible, temporary effect” on local streams and rivers would, if it occurs, be extremely localised and of a very short duration (i.e. hours). Therefore, considering the imperceptible effects on local surface water quality along increased dilution capacity of downstream river waterbodies, significant indirect hydrological or water quality effects on the downstream designated sites will not occur.

7.5.1.6 Effects on the WFD Status

No additional targeted measures are required or proposed in respect of the WFD assessment. The strict implementation of the measures set out in the preceding sections will ensure that the status of both surface water and groundwater bodies in the vicinity of the site will be maintained.

With regard to treatment standards, the drainage system has been designed to achieve compliance with surface water Environmental Quality Standards (EQS) in the downstream receiving waters. Details of monitoring proposals, to ensure this compliance, is described in the Planning-Stage SWMP (**Annex 3.4**).

The application of the drainage management as outlined will ensure compliance with EU Surface Water Regulations and WFD requirements while also maintaining the baseline hydrology of the site.

As such, the project is compliant with the requirements of the Water Framework Directive (2000/60/EC) and the Groundwater Directive (2006/118/EC).

7.5.1.7 Effects on Rath GWS Source

The below mitigation only applies to the underground electricity line.

No refuelling or handling of fuels/oil/lubricants/chemicals will be permitted within 100m of the mapped source protection area boundary.

In addition, to prevent potential leaching of cement from the electricity cable trenching, a geotextile liner will be placed around the founding layer (lean mix concrete) where concrete is to be poured.

Also, there will be clear signage in place inside the source protection area to remind construction workers that the area is inside a drinking water protection area and that there are restrictions around the use of fuels/oil/lubricants/chemicals.

7.5.1.8 Risk of Flooding during the Underground Electricity Line Construction

The first point of mitigation is ongoing monitoring of weather forecasts and weather warnings. The project Environmental Manager (EM) or the site Ecological Clerk of Works (ECoW) will be responsible for monitoring weather forecasts during the construction phase.

When the forecast indicates rainfall exceeding any of the works-suspension thresholds set out above, or where a Met Éireann Status Yellow or higher rainfall warning is issued, the planned responses detailed below will be implemented.

A potential high intensity rainfall event would likely 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.

A managed retreat from the fluvial flood zone will be implemented in the event of a forecasted 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.
- Existing sediment control measures will be removed, as these may be washed away and deposited elsewhere by the floodwaters.
- All plant, machinery and equipment will be removed from the flood zones.
- Works will be postponed in the event of flood or high flows in the river.

Exposed soils/peat (exposed temporary stockpiles) will be covered with plastic sheeting 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).

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 project site will be inspected and corrective measures implemented to ensure safe working conditions e.g. dewatering of standing water in

open excavations, etc.

7.5.2 OPERATION PHASE

7.5.2.1 GROUNDWATER AND SURFACE WATER CONTAMINATION FROM WASTEWATER DISPOSAL

The sealed foul-water holding tank will be inspected and emptied as required by an appropriately authorised waste collector. No foul wastewater will be discharged to ground, surface water or the site drainage network.

7.5.2.2 Progressive Replacement of Natural Surface with Lower Permeability Surfaces

The operation phase drainage system of the project is described below:

- Interceptor drains will be installed up-gradient of all 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/road side drains will be used to collect runoff from access tracks, turbine hardstanding areas and switch room compound areas which may contain entrained suspended sediment, and channel it to settlement ponds for sediment settling;
- Transverse drains ('grips') will be constructed, where appropriate, in the surface layer of access tracks to divert any runoff into swales/track side drains;
- Check dams will be used along sections of access tracks drains to intercept silts at source. Check dams will be constructed from a 40mm non-friable crushed rock or similar;
- Swales and check dams will buffer volumes of runoff discharging from the drainage system during periods of high rainfall, by retaining water until the storm hydrograph has receded, thus reducing the hydraulic loading to watercourses; and,
- Settlement ponds will be designed in accordance the greenfield runoff rate requirements; and,
- Imported rock for construction purposes and road surfacing will be strong, well-graded limestone which will be resistant to erosion and have a low likelihood to generate fines in hardstand runoff.

The operation of the underground electricity line will not result in any likely hydrological or water quality effects and therefore do not require mitigation measures.

7.5.2.3 Hydrocarbons Spillages/Leakages

Mitigation measures relating to oils and fuels are as follows:

- Fuels stored on site will be minimised. Any storage areas will be bunded appropriately for the fuel storage volume during the construction phase;
- Any oil storage tanks will be located in a concrete bund, impervious to rainwater ingress, capable of holding 110% of the stored oil volume;
- Turbine transformers will be located within the turbines, and any leaks will be fully contained within the turbine thus eliminating any pathway for leakages to affect land and soil;
- Maintenance vehicles will be regularly inspected for leaks and fitness for purpose; and

- An emergency plan for the operation phase to deal with accidental spillages will be contained within Environmental Management Plan. Spill kits will be available to deal with accidental spillages.

7.5.3 DECOMMISSIONING PHASE

As in the construction phase, temporary surface runoff control measures will again be put in place during decommissioning works. The drainage system will remain operational during the decommissioning phase and will serve to treat any sediment laden surface water run-off due to a renewed disturbance of soils. Following decommissioning, re-vegetation will be implemented as soon as practicable and monitored to ensure vegetation is established.

Likely effects would be similar to the construction phase but to a lesser degree. There would be increased trafficking and an increased risk of disturbance to underlying soils at the project site. Any such effects would be less than during the construction phase as the drainage system would be fully mature and would provide additional filtration of runoff. Any diesel or fuel oils stored on site would be bunded.

Following decommissioning, turbine foundations, hardstanding areas and access tracks will be rehabilitated in accordance with the methods outlined at Chapter 3. The access tracks may be left in place, subject to agreement with the Planning Authority and the landowner. It is considered that this approach will result in lesser effects than their removal.

7.6 RESIDUAL EFFECTS

7.6.1 CONSTRUCTION PHASE

7.6.1.1 *Earthworks (Removal of Vegetation Cover, Excavations and Stock Piling) Resulting in Suspended Solids Entrainment in Surface Water*

Following the implementation of appropriate mitigation measures, as outlined above, the residual effect is assessed to be a negative, indirect, imperceptible, short term, likely effect and no significant effects on water quality are assessed to occur.

7.6.1.2 *Groundwater Level Effects*

Significant effects on groundwater levels/flows will not occur as a result of the project. It is concluded, therefore, that likely significant effects will not arise.

7.6.1.3 *Excavation Dewatering and Likely Impacts on Surface Water Quality*

Residual effects, following the implementation of mitigation measures, are assessed to be indirect, imperceptible, short term and no likely significant effects on surface water quality will occur.

7.6.1.4 *Release of Hydrocarbons during Construction and Storage*

Following the implementation of appropriate mitigation measures, as outlined above, the residual effect is assessed to be indirect, negative, imperceptible, short term and unlikely.

No significant effects on surface water or groundwater quality will occur.

7.6.1.5 *Groundwater and Surface Water Contamination from Wastewater Disposal*

No significant residual effects will occur.

7.6.1.6 Release of Cement-Based Products

Residual effects, following the implementation of mitigation measures, are assessed to be negative, indirect, imperceptible, short term and unlikely.

No significant effects on surface water quality will occur.

7.6.1.7 Morphological Changes to Surface Water Courses & Drainage Patterns

There will be no morphological changes to watercourses or drainage patterns.

7.6.1.8 Hydrological Effects on Designated Sites

No significant residual effects are assessed as likely to occur.

Due to the knowledge of the ground conditions (subsoil types) groundwater levels, gradients and flow directions as well as the mitigation measures provided to ensure the protection of water quality and water quantity (recharge), no residual effects on designated sites will occur.

7.6.1.9 Effects on local Groundwater Well Supplies

Due to the setback distance from potential downstream wells, the shallow nature of the earthworks, the low groundwater recharge and poorly productive aquifer characteristics of the project site, along with the slow and diffuse nature of groundwater flow, no effects on local wells will occur.

7.6.1.10 Effects on WFD Status

No effects on WFD status of surface water or groundwater bodies will occur.

7.6.1.11 Effects of the Rath GWS Sources

Due to the shallow nature of the underground electricity line works, the knowledge of the ground conditions (subsoil types) and deep groundwater flow paths feeding the source, as well as the mitigation measures provided to ensure the protection of water quality, no residual effects on Rath GWS will occur.

7.6.1.12 Risk of Flooding during the Underground Electricity Line Construction

A managed retreat from the fluvial flood zone will be implemented in the event of a forecasted high intensity rainfall event and/or weather warning related to rainfall and therefore the residual effect of fluvial flooding is negligible.

7.6.2 OPERATION PHASE

7.6.2.1 GROUNDWATER AND SURFACE WATER CONTAMINATION FROM WASTEWATER DISPOSAL

No significant residual effects on groundwater or surface water quality will occur.

7.6.2.2 Progressive Replacement of Natural Surface with Lower Permeability Surfaces

Following the implementation of appropriate mitigation measures, as outlined above, the residual effect is assessed to be direct, neutral, long term and likely; however, significant effects are not likely.

7.6.2.3 Hydrocarbons Spillages Leakages during the Operation Phase

Residual effects, following the implementation of mitigation measures, are assessed to be negative, indirect, imperceptible, short term and unlikely.

7.6.3 DECOMMISSIONING PHASE

No likely significant residual effects on the hydrological environment or on water quality are envisaged during the decommissioning stage of the project.

7.7 SUMMARY

During each phase of the project (construction, operation and decommissioning) a number of activities will take place which will have the potential to significantly affect the hydrological regime or water quality at the site or its vicinity. These significant potential effects generally arise from sediment input from runoff and other pollutants such as hydrocarbons and cement-based compounds, with the former having the most potential for impact.

Surface water drainage measures, pollution control and other preventative measures have been incorporated into the project design to minimise any likely adverse impacts on water quality and downstream designated sites. A self-imposed 50m stream buffer was used to inform the layout of the project site, thereby avoiding sensitive hydrological features.

The management of surface water is the principal means of significantly reducing sediment runoff arising from construction activities and to control runoff rates. The key surface water control measure is that there will be no direct discharge of wind farm runoff into local watercourses. This will be achieved by avoidance methods (i.e. stream buffers) and design methods (i.e. surface water treatment measures – settlement pond and tertiary lagoons).

Preventative measures also include fuel and concrete management and a waste management plan which will be incorporated into the detailed CEMP to be prepared prior to the commencement of development.

Overall, the project presents no likelihood for significant effects on surface or groundwater quality following the implementation of the proposed mitigation measures; while the project can be constructed, operated and decommissioned without affecting the WFD status of any waterbody or adversely affecting the achievement of WFD status. Additionally, this assessment has determined that there is no likelihood for significant cumulative effects to arise due to the construction, operation or decommissioning of the proposed development.

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