



GALETECH
ENERGY SERVICES



Islandmore Wind Farm

Environmental Impact Assessment
Report

Chapter 7: Water

Islandmore Wind Farm Limited

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7.1 INTRODUCTION

7.1.1 BACKGROUND AND OBJECTIVES

This chapter provides an assessment of the likely and significant effects of the project, as described at **Chapter 3**, 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 water and groundwater during the construction, operational and decommissioning phases;
- Identify mitigation measures to avoid, remediate or reduce likely or significant negative effects; and,
- Assess 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

In summary, the project comprises the following main components as described in **Chapter 3**:-

- 10 no. wind turbines, 3 no. with an overall height of 185m and 7 no. with an overall height of 150m;
- All associated and ancillary site development, excavation, construction, landscaping and reinstatement works, including provision of site drainage infrastructure and forestry felling;
- Works to the public road network along the turbine component haul route; and,
- 110kV electricity substation and installation of c. 7km of underground electricity line to facilitate connection of the wind farm to the existing Tonroe 110kV electricity substation at Ballaghaderreen, County Roscommon.

The project is located in north County Roscommon; c. 2km north of Ballaghaderreen, c. 13km east of Charlestown (Co. Mayo) and c. 6km southwest of Gorteen (Co. Sligo); and is located in close proximity to the county boundaries between counties Roscommon, Sligo and Mayo.

It is envisaged that turbine components will be transported from the Port of Galway through the counties of Galway, Mayo and Roscommon to the project site utilising, predominately, motorway and national roads. Accordingly, it is assessed that there is no likelihood of significant effects on population and human health arising from the transport of turbine components and, therefore, these works have been scoped out from further assessment.

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

7.1.3 STUDY AREA

The study area for assessing the likely zone of effects and cumulative impact assessment is the River Moy sub-catchment (Moy_SC_030) and the Lung River sub-

catchments (Lung_SC_010 and Lung_SC_020). The project site is located within the Moy_SC_30 and Lung_SC_20 catchments and drains to both the Lung River and the River Moy.

The underground electricity line is located in the Lung River catchment only.

The Moy_SC_030 sub-catchment has an area of 90km² and extends c. 30km downstream of the project site. Further downstream of this point, no likely indirect effects or cumulative effects are likely due to large catchment size and increasing flows in the River Moy.

The Lung_SC_010 and Lung_SC_020 have a combined area of 159km² and extend downstream as far Lough Gara, c. 6km downstream of the project site and underground electricity line.

Downstream of Lough Gara, no indirect effects or cumulative effects are likely due to the large storage and attenuation capacity of the Lough Gara waterbody.

The study area is shown at **Figure 7.1** below (Regional Hydrology Map).

7.1.4 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, BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 26-years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms and renewable projects in Ireland. He has substantial experience in surface water drainage design and SUDs design, and surface water/groundwater interactions. For example, Michael has worked on the EIS/EIARs for Glenard Wind Farm, Cloncreen Wind Farm, and Seven Hills Wind Farm, and over 100 other wind farm related projects across the country.

David Broderick (P. Geo, BSc, H. Dip Env Eng, MSc) is a Hydrogeologist with over 20-years' experience in both the public and private sectors. 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 completed numerous geology and water sections for input into Environmental Impact Assessment Reports/Environmental Impact Statements (EIAR/EIS) for a range of commercial developments. For example, David has worked on the EIS/EIAR for Oweninny Wind Farm, Cush Wind Farm, White Hill Wind Farm, Arderroo Wind Farm and Yellow River Wind Farm, and over 80 no. other wind farm related projects across the country.

7.1.5 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);*
- *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. 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. 99/2023: *European Communities Environmental Objectives (Drinking Water) Regulations 2023*.

7.1.6 RELEVANT GUIDANCE

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

- Circular Letter PL 1/2017: *Implementation of Directive 2014/52/EU on the effects of certain public and private projects on the environment (EIA Directive)*;
- *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*;
- OPW (2009) *The Planning System and Flood Risk Management*;
- 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 Services (Draft) *Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures*;

- Forest Service (2000) *Forestry and Water Quality Guidelines*. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford;
- COFORD (2004) *Forest Road Manual – Guidelines for the Design, Construction and Management of Forest Roads*;
- Inland Fisheries Ireland (2016) *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to 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 2006 *Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors*. CIRIA C532. London, 2006.
- Department of Housing, Planning & Local Government (2018) *Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment*; and,
- Roscommon County Development Plan 2022-2028 (including Strategic Flood Risk Assessment).

7.2 METHODOLOGY

7.2.1 DESK STUDY

A desk study of the project site and study area was completed in advance of undertaking the walkover surveys, field mapping and site investigations. This involved collecting all relevant geological, hydrological, hydrogeological and meteorological information for the project and surrounding 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);
- Geological Survey of Ireland Bedrock Geology 1:100,000 Scale Map Series, Sheet 11 (Geology of South Mayo);
- Geological Survey of Ireland Bedrock Geology 1:100,000 Scale Map Series, Sheet 12 (Geology of Longford- Roscommon);
- Geological Survey of Ireland (2004); Groundwater Body Initial Characterization Reports;
- OPW Past Flood Event Mapping (www.floodinfo.ie);
- CFRAM/OPW Flood Risk Assessment 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

An initial site walkover, constraints mapping and peat probing exercise were undertaken by HES on 6 September 2023.

Further ground surveys, surface water sampling and baseline monitoring was undertaken on 19 December 2024, 6 March 2025 and 9 April 2025.

A geotechnical and peat stability risk 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 (Volume II)**.

Separately, a Planning-Stage Spoil Management Plan has been prepared by FT (see **Annex 6.2 (Volume II)**) which details the treatment and management of material excavated during the construction phase of the project.

Site investigations (trial pitting and core drilling) were carried out by Irish Drilling Limited (IDL) between 1 and 28 March 2025 under the supervision of FT and HES. Please refer to **Annex 6.1** for IDL Factual Report, trial pit logs and drilling logs.

In summary, site investigations/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;
- A trial pit investigation (13 no.) to determine subsoil depth and lithology along with groundwater conditions (i.e. potential groundwater inflows);
- 205 no. peat probe locations along with slope angle measurements were carried out by FT as part of the geotechnical and peat stability assessment;
- Rotary core drilling at the 2 no. locations for assessment of bedrock lithology, groundwater conditions and feasibility for on-site borrow pit;
- Field hydrochemistry measurements (electrical conductivity, pH, dissolved oxygen and temperature) were taken to determine the origin and nature of surface water flows that drain the project site;
- Surface water sampling (2 no. rounds) was undertaken to determine the baseline water quality of the primary surface waters originating from the project site; and,
- Detailed topographical (LiDAR) surveys and hydrological modelling (i.e. flowpath, catchment and flow accumulation analysis) were carried out for the project site (refer to **Annex 7.1 (Volume II)**).

7.2.3 RECEPTOR SENSITIVITY/IMPORTANCE/IMPACT CRITERIA

Using the National Roads Authority (NRA 2008) guidance, an evaluation of the importance of the water environment within and downstream of the project site is 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** and the impact rating using **Table 7.5**.

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale.	River, wetland or surface water body ecosystem protected by EU legislation, e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid Waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.
Very High	Attribute has a high quality or value on a regional or national scale.	- River, wetland or surface water body ecosystem protected by national legislation – NHA status. - Regionally important potable water source supplying >2500 homes. - Quality Class A (Biotic Index Q4). - Flood plain protecting more than 50 residential or commercial properties from flooding. - Nationally important amenity site for wide range of leisure activities.
High	Attribute quality or value on a local scale.	- Salmon fishery Locally important potable water source supplying >1000 homes. - Quality Class B (Biotic Index Q3-4). - Flood plain protecting between 5 and 50 residential or commercial properties from flooding. - Locally important amenity site for wide range of leisure activities.
Medium	Attribute has a medium quality or value on a local scale.	- Coarse fishery. - Local potable water source supplying >50 homes Quality Class C (Biotic Index Q3, Q2-3). - Flood plain protecting between 1 and 5 residential or commercial properties from flooding.
Low	Attribute has a low quality or value on a local scale.	- Locally important amenity site for small range of leisure activities. - Local potable water source supplying <50 homes. - Quality Class D (Biotic Index Q2, Q1) Flood plain protecting 1 residential or commercial property from flooding. - Amenity site used by small numbers of local people.

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

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

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

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	- 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	- 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	- 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	- 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	- 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	- 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	- 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	Calculated risk of serious pollution incident <0.5% annually.

Table 7.4: Magnitude of Hydrogeology Impact (NRA, 2008)

Importance of Tribute	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 SCOPING AND 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. Matters and recommendations highlighted by the responses in relation to the water environment are referenced in **Table 7.6** below. The full responses from each of the below consultees are provided at **Annex 1.4**.

Consultee	Summary of Consultee Response (as referenced)	Issue(s) Addressed in Section(s)
OPW	"The Office of Public Works is not responsible for any channels within the study area, which falls under the remit of this office to maintain under the 1945 Arterial Drainage Act. There are no drainage district maintainable channels within the study area that fall	Sections 7.3.6, 7.3.16 & 7.4.4.8 and Annex 7.1 (Volume II) .

	under the remit of the local authority to maintain. Information on these locations can be found at https://www.floodinfo.ie/map/drainage_map/." "This office has no record of flooding or past flood events adjacent to the study area. It is recommended to carry out a review of historical flood risk using floodinfo.ie using link provided https://www.floodinfo.ie/map/floodmaps/. This office would recommend that no flooding should occur during or after construction of the proposed project." "Under Section 50 of the 1945 Arterial Drainage Act & SI No.122 of 2010, no person, including a body corporate, shall construct any new bridge or alter, reconstruct, or restore any existing bridge over any watercourse without the consent of the Commissioners or otherwise than in accordance with plans previously approved of by the Commissioners. Where the development intends to install or restore a culvert or bridge over a watercourse as part of this development, Section 50 approval will be required in advance from the Commissioners of Public Works."	
Uisce Éireann	- Uisce Éireann currently operates several water abstraction points in the locality, particular note are river intake points in operation approximately 7km to the east of the development, at the southern end of Lough Gara (WAB0000214/WAB0000208). Any finalised EIAR must assess the impact, if any, of this development on Uisce Éireann water sources and its water abstraction regime. Analysis should consider anywhere where a potential hydrological and hydrogeological pathway exists and include any all direct, indirect and cumulative effects on the abstraction points Potential impacts arising from run off and hydrocarbon during construction, operational and decommissioning phases, and should include mitigations against contaminants entering groundwater and surface waters via hydrological and hydrogeological pathways. - It is proposed that this wind farm be connected to the grid via the Ballaghaderreen substation, approximately 1.9km to the south of the development. An exact cabling route has not been presented in the scoping document, but given the relatively short distance, it seems unlikely to have any adverse interaction with Uisce Éireann underground infrastructure.	Section 7.3.14.2

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 this chapter. There are substantial desktop records detailing the characteristics of the site, the site was accessible thus allowing for a comprehensive assessment of site conditions, and the site investigations and baseline monitoring carried out were detailed and comprehensive.

7.3 DESCRIPTION OF THE EXISTING ENVIRONMENT

7.3.1 SITE LOCATION AND DESCRIPTION

The project site, which has an area of approximately 157ha, is located in north County Roscommon, c. 2km north of Ballaghaderreen, c. 13km east of Charlestown (Co. Mayo) and c. 6km southwest of Gorteen (Co. Sligo).

The project site is located in an upland peatland setting where the topography of the local area is generally undulating and sloping. The central portion of the wind farm site is centred on a hill (c. 180m OD elevation), which slopes away to c. 160m OD to the east and west, c. 140m OD to the south and c. 150m OD to the north.

Land cover within the project site is predominately a mixture of cutover bogs, intact bogs and small pockets of agricultural fields. All 10 no. wind turbines are located on peat bogs.

The GSI have the bogs mapped as cutover raised bogs but some of the bog areas, particularly the northern portion of the project site, have a more blanket bog appearance. The bog, on the southern portion of the project site, has a raised bog appearance.

There are also pockets of forestry and semi-natural areas on the northeast and southeast of the project site which are planted-on peat bogs. Pockets of grassland are located in the northwestern parts of the project site.

The project site is accessed via a network of public roads that pass through the project site with the central north-south trending public road being utilised as the main spinal access road of the project.

The underground electricity line (grid connection route) connects to the Tonroe 110kV substation which is situated c. 1.2km to the south of the wind farm site. The electricity line is approximately 7km in length and will generally be located within the carriageway of local public roads. The underground electricity line runs from the 110kV on-site substation which is located in grassland in the northwestern portion of the project site.

The haul route works between the Port of Galway and the junction of the N5 and R293, will be of a temporary nature (i.e. street furniture alteration and placement of hardcore at roundabouts and junctions) and will be contained within the carriageway of the roads.

From the junction of the R293 and L5501 to the wind farm site entrances, the public roads will be subject to permanent upgrade works including the widening of the existing carriageways together with the reprofiling of some carriageways to remove existing road crests.

Additionally, existing roadside drainage arrangements may be altered to accommodate the widening of carriageways. All existing roadside drains will be widened/maintained.

7.3.2 RAINFALL AND EVAPORATION

Long term rainfall and evaporation data was sourced from Met Éireann. The 30-year annual average rainfall (AAR; 1981-2010) recorded at Knock Airport, located approximately 14km west of the project site, is 1,353mm/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 annual average rainfall at the project site ranges from 1,325 to 1,356mm/year.

The highest annual average rainfall of 1,356mm/year is used in the project site water balance as a conservative measure. The 1991 to 2020 monthly values are shown in **Table 7.7** below

Met Éireann (AAR 1991-2020)												
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
141	114	105	85	88	90	95.7	100	97	131	145	151	1,356

Table 7.7: 1991–2020 Long-Term Annual Average Rainfall Data (mm)

The closest synoptic¹ weather station where the average potential evapotranspiration (PE) is recorded is at Claremorris, approximately 35km southwest of the project site. The long-term average PE for this station is 408mm/year. This value is used as a best estimate of the project site's PE. Actual Evaporation (AE) at the project site is estimated as 388mm/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:

$$\begin{aligned}
 \text{Effective rainfall (ER)} &= \text{AAR} - \text{AE} \\
 &= 1,356\text{mm/year} - 388\text{mm/year} \\
 \text{ER} &= 968\text{mm/year}
 \end{aligned}$$

Based on groundwater recharge coefficient estimates from the GSI (www.gsi.ie), coefficients range from 10–22.5% across the project site. This range relates to 'Cut Peat' (i.e. as described at **Chapter 6**).

Therefore, an average estimate of 15% recharge is taken for the project site. The relatively high drainage density in the area and dominant peat coverage, also suggest that surface drainage is the dominant flow regime at the project site.

A recharge coefficient of 15% is used to calculate values for key hydrological properties. Therefore, annual groundwater recharge (15%) and runoff rates (85%) for the project site are estimated to be c. 145mm/year and c. 823mm/year respectively.

Table 7.8 presents return period rainfall depths for the project site. 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 (10-year, 50-year, 100-year). These extreme rainfall depths have been incorporated into the proposed wind farm drainage design.

On-site precipitation monitoring was not carried out for the baseline assessments as the Met Éireann 1991 to 2020 data provides long-term average rainfall depths for the project site location which were determined to be sufficient for this assessment. These data were used to carry out the baseline runoff assessments for the wettest months (refer to **Section** Error! Reference source not found. below). Also, the wind farm drainage design has been prepared on the basis of extreme weather event data and not short-term, contemporary data.

Duration	10-year Return Period (mm)	50-Year Return Period (mm)	100-Year Return Period (mm)
15-min	12.4	20.1	24.5
1-hour	19.9	31.1	37.4

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.

6-hour	36.8	54.9	64.8
12-hour	46.6	68.4	80.1
24-hour	59.1	85.1	99.1

Table 7.8: Return Period Rainfall Depths for Project Site

7.3.3 REGIONAL AND LOCAL HYDROLOGY

On a regional scale, the project site is mapped within 2 no. WFD Catchments. The northern portion of the project site, including 6 no. turbines (T1–T6), are located in the regional Moy and Killala Bay Catchment (HA: 34) and within the Moy_SC_030 sub catchment.

The southern section of the project site are mapped in the Upper Shannon Catchment (HA: 26B) and within Lung_SC_020 sub catchment.

The underground electricity line is located entirely in the Upper Shannon Catchment and within the Lung_SC_020 sub catchment. The electricity substation location sits on the surface water catchment divide between the two regional catchments, with the majority of the substation footprint draining south into the Upper Shannon Catchment. A regional hydrology map is shown at **Figure 7.1** below.

On a more local hydrology scale, the northern portion of the project site (within the Moy regional catchment) is located in the Owengarve River catchment (Owengarve (Sligo)_010 river sub basin). The Owengarve River flows in a north-westerly direction for approximately 25km before entering the River Moy.

The southern portion of the project site (within the regional Upper Shannon Catchment) lies within the Lung River catchment (Lung_050 river sub basin). This portion of the project site is drained by 3 no. tributaries of the Lung River that flow in a southerly direction for c. 2.5 to 3km towards the main channel of the Lung River which flows to the south of the project site.

From this point the Lung River flows northeasterly for approximately 4.5km, where it discharges to the Lough Gara middle lake. Lough Gara comprises 3 no. separate lake waterbodies (upper, middle and lower) that drain in a northerly direction into the Boyle River.

The underground electricity line is also located within the Lung_050 sub basin. A local hydrology map is shown below as **Figure 7.2**.

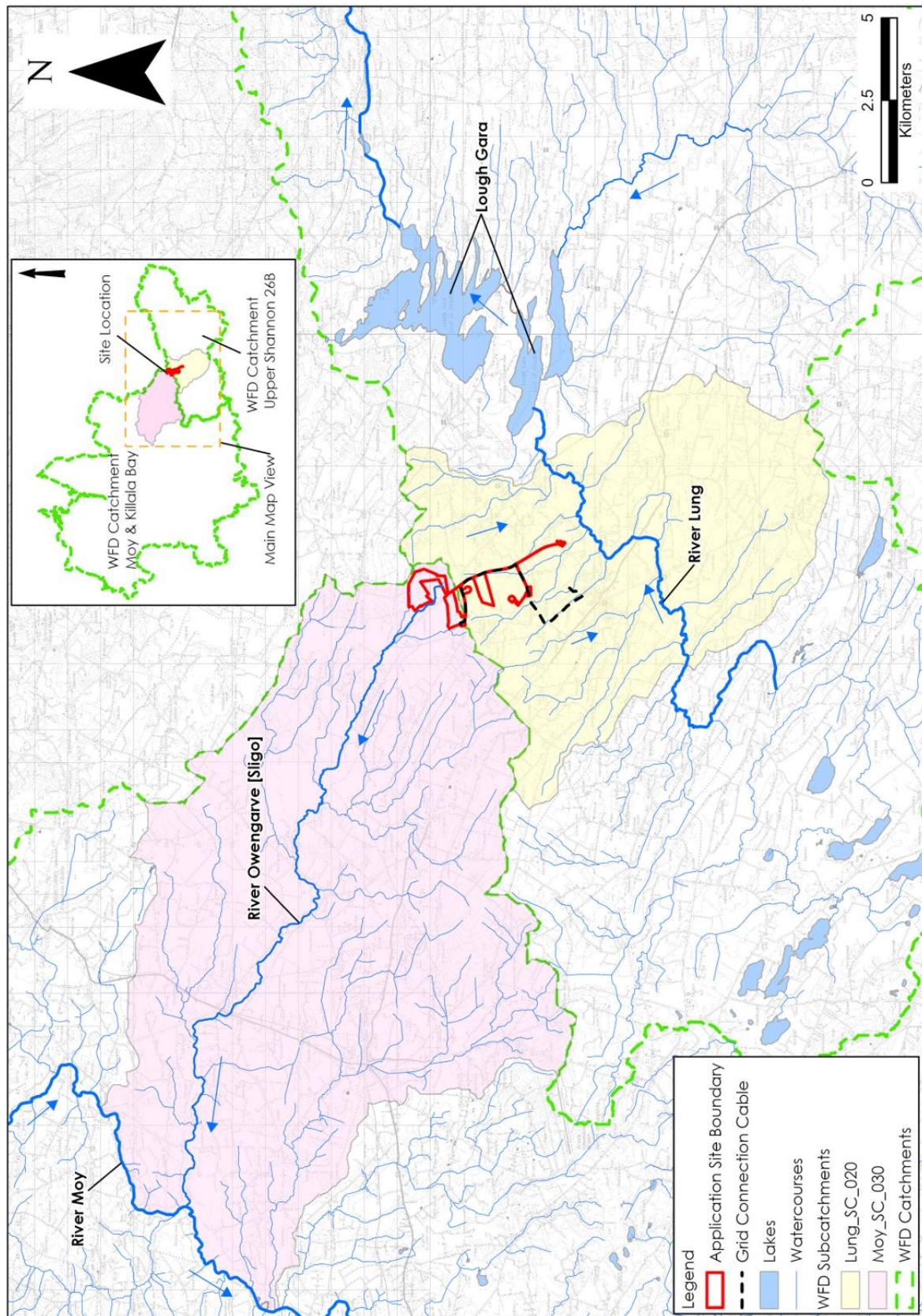


Figure 7.1: Regional Hydrology Mapping

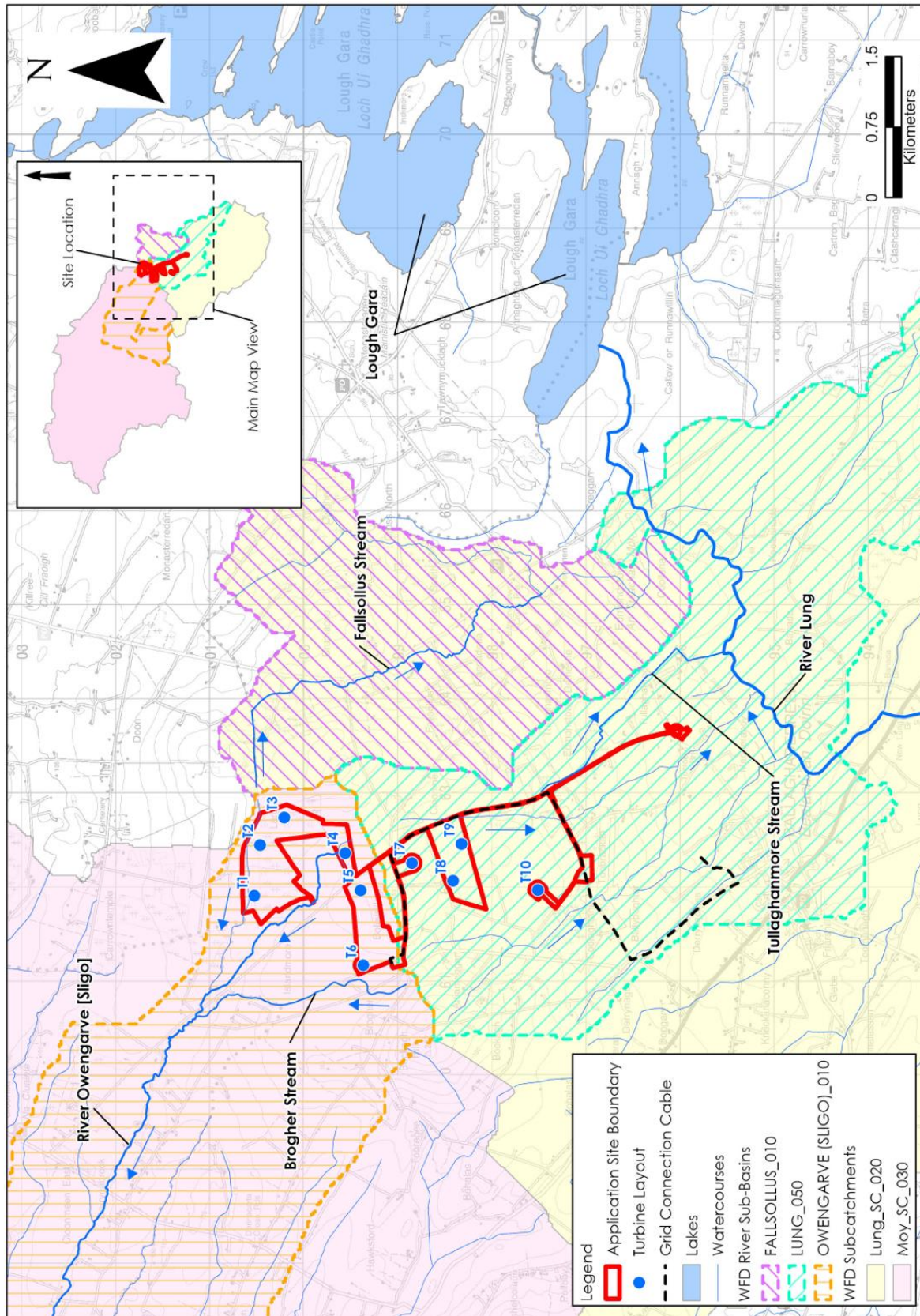


Figure 7.2: Local Hydrology Mapping

7.3.4 EXISTING DRAINAGE FEATURES

An existing drainage feature map for the project site is shown at **Figure 7.4**.

The northern portion of the project site (within the Moy and Killala Bay Catchment) is drained by 3 no. headwater streams of the Owengarve River. These streams merge c. 1km to the northwest of the project site.

The most westerly stream (EPA Name: Brogher Stream), which emerges from the Bockagh Hill area to the west of the project site, drains the area of turbine location T6, northern portion of the electricity substation location, along with a large portion of the intact bog located to the northwest of the project site.

The most easterly stream (unnamed by the EPA), which emerges 1km to the east of the project site, flows along the northern boundary of the project site close to the locations of turbines T1 and T2, which drain towards this watercourse via forestry drains and bog drains.

The central stream (EPA Name: Owengarve [Sligo]) emerges within the project site to the south of turbine location T4 and drains the area of turbine locations T3, T4, T5 and the borrow pit. There is a proposed watercourse crossing on the Owengarve [Sligo] Stream located along the proposed wind farm access road between turbine locations T3 and T4.

The southern portion of the project site (within the Lung River Catchment) is drained by 3 no. headwater streams which flow for c. 2.5-3km south towards the Lung River.

The majority of the southern portion of the project site (including turbine locations T7 to T9) is drained by the central stream (unnamed by the EPA) which emerges less than 0.5km to the east of turbine T7 prior to flowing southerly through the project site. On this stream, there are 2 no. existing watercourse crossings along public roads where road widening is proposed as part of the project. There is also a new crossing of this watercourse by the access track leading to turbine T9.

The western stream emerges approximately 0.2km west and downstream of the electricity substation location (unnamed by the EPA) where it continues to flow south and drains the area of turbine location T10 in the southwestern portion of the project site.

The eastern stream (EPA Name: Tullaghanmore Stream or Monstown Demesne) emerges close to the southeastern boundary of the project site and flows southerly adjacent to local road L5501 where road widening is proposed as part of the haul route works (there is no requirement to alter alignment of this watercourse).

The underground electricity line is located entirely within the Lung River Catchment. The underground electricity line intercepts EPA mapped watercourses at 6 no. locations. 5 no. of these locations are on existing public roads where a culvert or bridge is present; while the 6th location is an existing crossing/culvert located on a private access track near the Tonroe electricity substation.

Watercourse crossings along the underground electricity line are illustrated at **Figure 7.4**.

Bog drains associated with peat cutting are present across the project site, with the larger of these drains located in the central area of the project site, near turbine locations T8 and T9.

There are also networks of drains associated with forestry on the northeast and southeast of the project site.

Within the forested areas, numerous manmade drains are in place to drain the forestry plantations. The current internal forestry drainage pattern is influenced by the

topography, subsoils, layout of the forest plantation, and by the existing forest road network. The forest plantations are generally drained by a network of mound drains which typically run perpendicular to the topographic contours of the plantation and feed into collector drains, which discharge to interceptor drains down-gradient of the plantation.

Mound drains and ploughed ribbon drains are generally spaced approximately every 15m and 2m respectively. As illustrated at **Figure 7.3** below, interceptor drains are generally located up-gradient (cut-off drains) and down-gradient of forestry plantations. Interceptor drains are also located up-gradient of forestry access roads and watercourses. Culverts are generally located at stream crossings and at low points under forestry access roads which drain runoff onto down-gradient forest plantations.

A schematic of a typical standard forestry drainage network is illustrated at **Figure 7.3**. This schematic is representative of the drainage network in the forestry plantations at the project site.

The integration of the existing main drains with the project drainage network is a key component of the drainage design and is discussed further at **Section 7.3.16** and **Section 7.4.4.2** below.

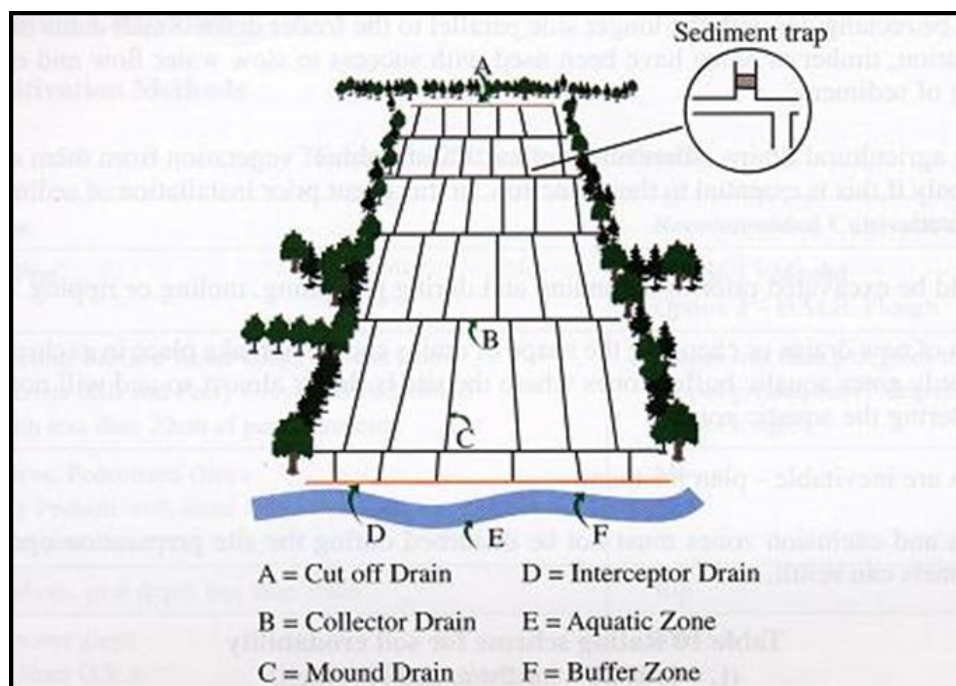


Figure 7.3: Schematic of Existing Forestry Drainage

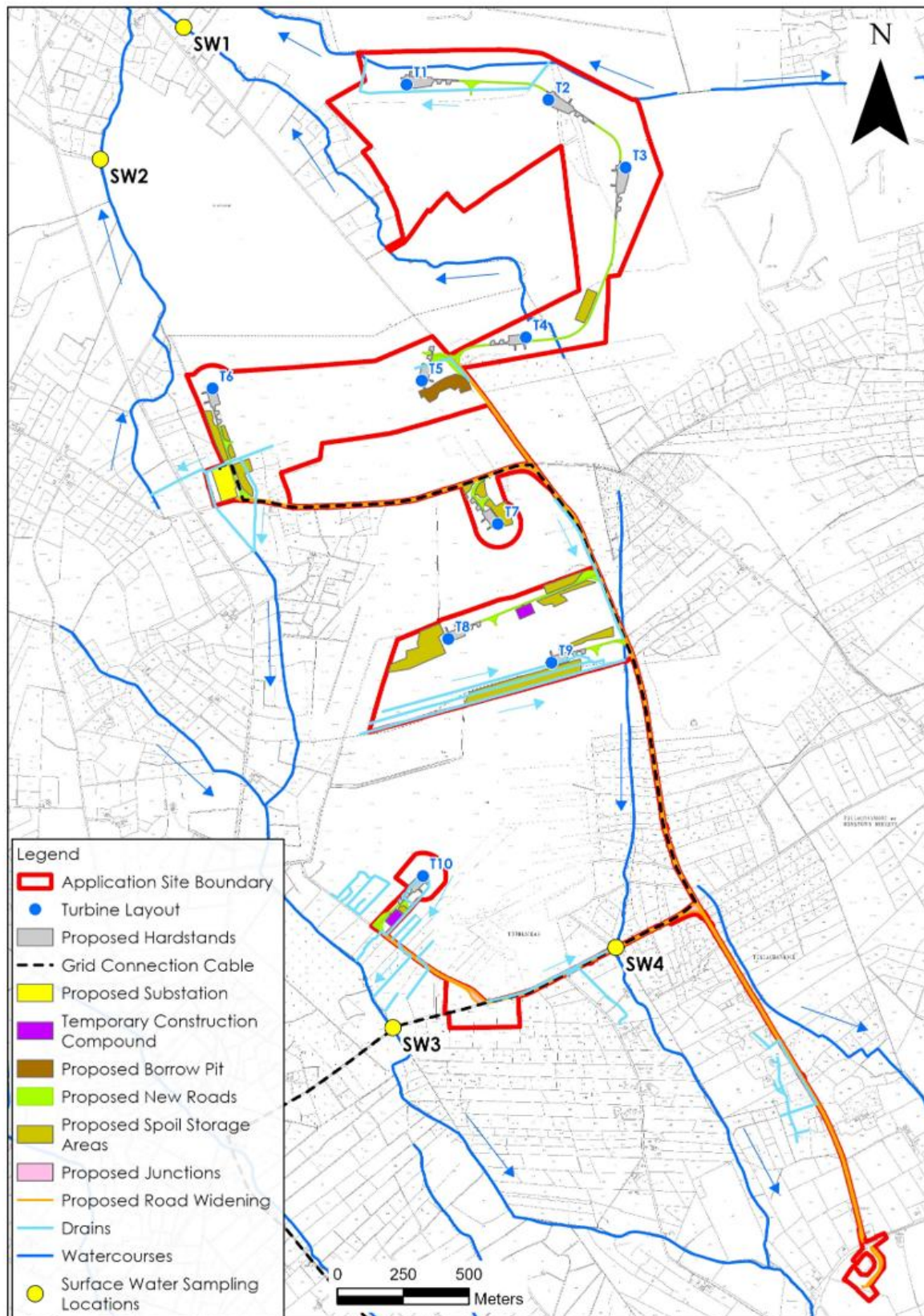


Figure 7.4: Project Site Drainage Map

7.3.5 PROJECT SITE WATER BALANCE

The following water balance assessment gives a preliminary indication of the highest

monthly average volume of surface water runoff expected from the project site pre-development.

The calculations are carried out for the month with the highest average recorded rainfall versus evapotranspiration, for the current baseline site conditions, in terms of subsoil type and thickness (**Table 7**). It represents, therefore, the average wettest monthly scenario in terms of volumes of surface water runoff from the project 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; and a '1-in-100-year return' period has been used for design purposes.

The surface water runoff co-efficient for the project site is estimated to be 85%, based on the coverage of peat at the project site. The highest long-term average monthly rainfall (site-specific modelled rainfall values – 1991 to 2020) is 151mm which occurred over the month of December.

The average monthly evapotranspiration for the synoptic station at Claremorris over the same period in December was 0mm. The calculation is carried out for the project site area (c. 157ha).

The balance indicates that a conservative estimate of surface water runoff for the project site during the highest rainfall month is 201,510m³/month, which equates to an average of 6,500m³/day, as outlined in **Table 7.10**.

Water Balance Component	Depth (m)
Average December Rainfall (R)	0.151
Average December Potential Evapotranspiration (PE)	0
Effective Rainfall December (ER = R - AE)	0.151
Recharge (15% of ER)	0.02265
Runoff (85% of ER)	0.12835

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

Project Site Area (ha)	Baseline Runoff per month (m ³)	Baseline Runoff per day (m ³)
157	201510	6500

Table 7.10: Baseline Runoff for Project Site

7.3.6 FLOOD RISK IDENTIFICATION

This section is a summary of a site-specific flood risk assessment (FRA) undertaken for the project site. The full FRA report is attached **Annex 7.2 (Volume II)**.

The OPW's River Flood Extents Mapping (CFRAM), 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 any areas of the project site which are potentially at risk of fluvial flooding.

No recurring flood incidents within the project site, along the underground electricity line or haul route work areas were identified from OPW's Past Flood Event Mapping (refer to **Figure 7.5**).

The closest mapped recurring flooding event to the project site is situated in a low-lying area c.1.5km west of the project site (Flood ID: 66). This mapped recurring flood event is not downstream of the project site.

There are no mapped single or recurring flooding events downstream of the project site within a 10km distance.

Identifiable map text on local available historical 6" or 25" mapping for the project site area do not identify any lands that are "liable to flood".

There is no OPW River Flood Extents (CFRAM) Mapping available for the watercourses draining the project site or underground electricity line and therefore the National Indicative Fluvial Mapping (**Figure 7.6**) was consulted which has mapped fluvial flood zones for watercourses in both the Owengarve River and Lung River catchments.

Based on the National Indicative Fluvial Mapping (NIFM), no 100-year or 1000-year flood zones encroach the project site, underground electricity line or haul route works areas.

There are fluvial flood zones within the Owengarve River catchment c. 1.2km northwest and downstream of the project site. Fluvial flood zones within the Lung River catchment are mapped 0.5km south and downstream of the project site.

All project infrastructure is therefore located above the mapped 1000-year flood level and therefore all infrastructure is located in Flood Zone C (Low Risk).

It is a key design feature of the project 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.

The GSI Historical Groundwater flood map and the modelled groundwater flood extents map (www.floodinfo.ie) do not show the occurrence of any groundwater flooding within the project site, route of the underground electricity line or haul route works areas.

Groundwater flooding is not assessed to be a likely risk at the project site due to elevated topography and poorly productive bedrock aquifers.

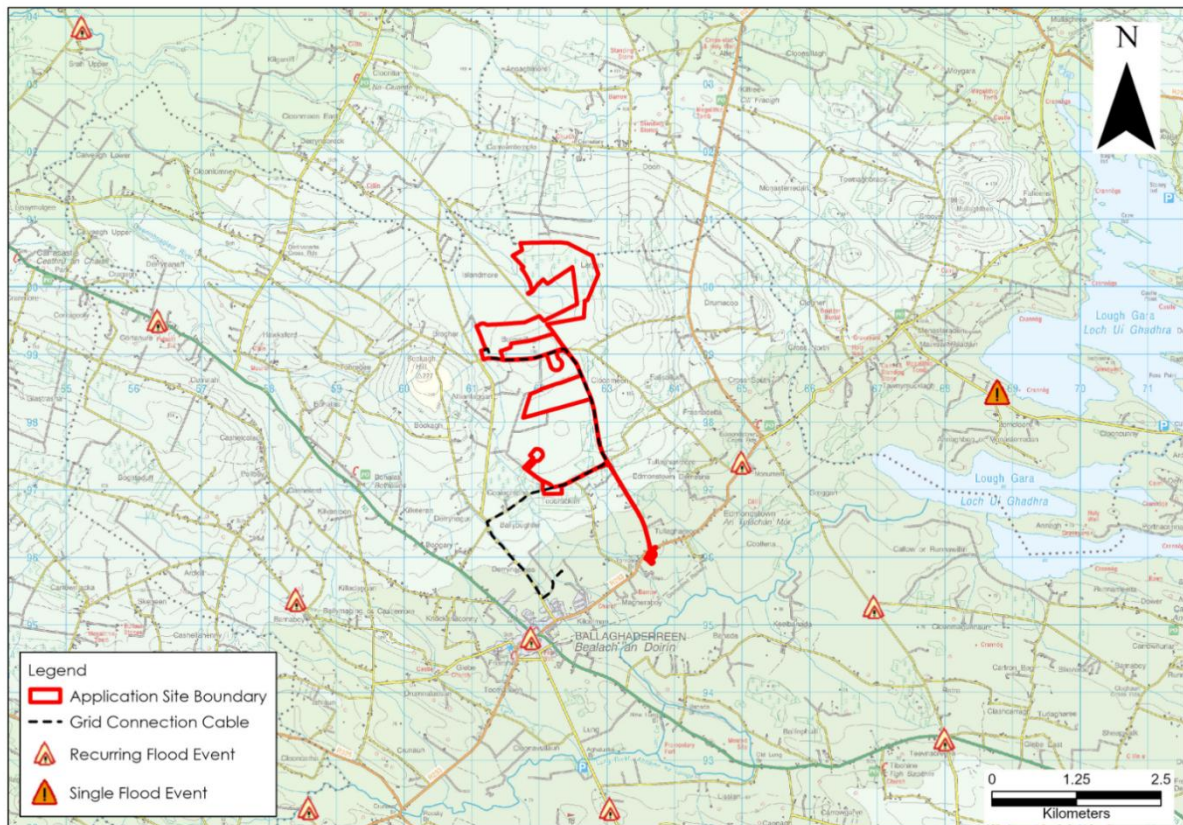


Figure 7.5: OPW Flood Hazard Mapping

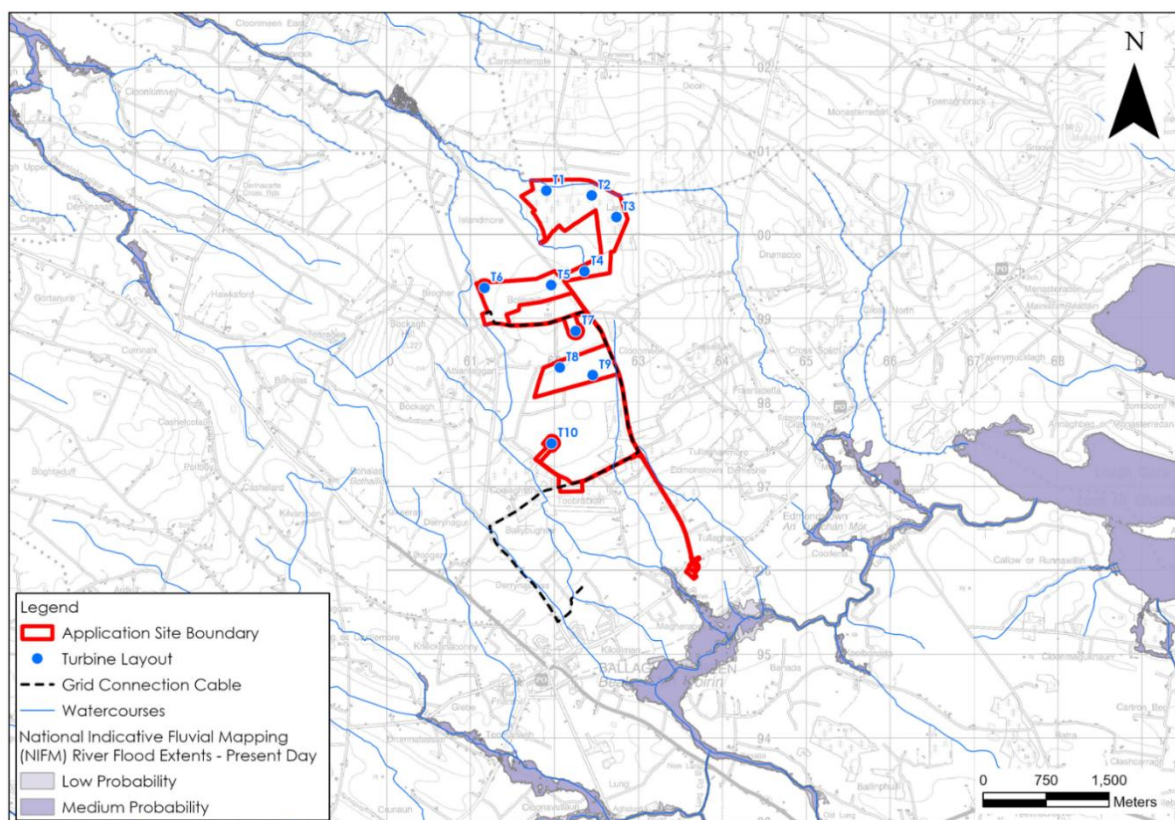


Figure 7.6: National Indicative Fluvial Mapping

7.3.7 SURFACE WATER QUALITY

Biological Q-rating² data for EPA monitoring points on downstream river waterbodies are listed at **Table 7.11** below.

The Q-Rating is a water quality rating system based on both the habitat and the invertebrate community assessment and is divided into status categories ranging from Q1 (Bad) to 4-5 (High).

Most recent data available (2022-2025) shows that the Q-ratings are 'Good' to 'High' downstream of the project site within the Owengarve River and River Moy catchment, whilst Q values are 'Moderate' to 'Good' downstream of the southern portion of the project site within the Lung River catchment and further downstream in the Boyle River.

Station Name	River Waterbody	Year	Q-Value Score	Status
Bridge at Derrynabrock	Owengarve (Sligo)_010	2024	Q4	Good
Ford N.W. of Srah Upper	Owengarve (Sligo)_010	2025	Q4-5	High
Bridge in Curry	Owengarve (Sligo)_020	2025	Q4-5	High
Dawros Br	Owengarve (Sligo)_030	2022	Q4-5	High
Bridge at Banada	Moy_050	2022	Q4-5	High
Br on Ballaghaderreen Bypass	Lung_050	2023	Q4	Good
Edmundstown bridge/bridge u/s L Gara	Lung_050	2020	Q4	Good
Cuppanagh Bridge	Boyle_010	2023	Q3-4	Moderate
Footbridge 1.8 km u/s Boyle	Boyle_020	2023	Q4	Good

Table 7.11: 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 locations (SW1–SW4) downstream of the project site and underground electricity line on 6 March (round 1) and again on 9 April 2025 (round 2) and the results are listed at **Table 7.12** below. Please refer to **Figure 7.4** for sample locations.

Electrical conductivity (EC) values for surface waters downstream of the project ranged between 106 and 145 $\mu\text{S}/\text{cm}$ which would be typical for a peatland catchment with non-calcareous bedrock geology.

pH values, which ranged between 7.0 and 7.3, were generally near neutral and would be typical of catchments with peat coverage. The dissolved oxygen concentrations are within the normal range for a 'Good' to 'High' status watercourses.

Surface water samples (2 no. rounds) were also taken at the 4 no. monitoring locations for laboratory analysis.

Results of the laboratory analysis are shown alongside relevant water quality

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

regulations values (EQS) at **Table 7.13** (Round No. 1) and **Table 7.14** (Round No. 2) below. Original laboratory reports are attached as **Annex 7.3**.

Location	EC ($\mu\text{S}/\text{cm}$)		pH		Dissolved Oxygen (%)	
	06/03/25	09/04/25	06/03/25	09/04/25	06/03/25	09/04/25
SW1	125	115	7.3	7.2	95	98
SW2	115	106	7.3	7.1	99	94
SW3	145	130	7.2	7.0	97	98
SW4	138	135	7.1	7.1	95	93

Table 7.12: Summary of Surface Water Chemistry Measurements

Parameter	EQS	Sample ID			
		SW1	SW2	SW3	SW4
Total Suspended Solids (mg/L)	25 ⁽⁺⁾	<5	<5	<5	<5
Ammonia N (mg/L)	≤ 0.065 to ≤ 0.04 (*)	<0.02	<0.02	0.04	<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)	-	<5	<5	<5	<5
Nitrogen (mg/L)	-	1.0	<1.0	1.1	1.2
Phosphorus (mg/L)	-	<0.10	<0.10	<0.10	<0.10
Chloride (mg/L)	-	19	19.6	20.2	28.2
BOD	≤ 1.3 to ≤ 1.5 (*)	1	<1	<1	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 (Round No. 1, 06/03/2025)

Parameter	EQS	Sample ID			
		SW1	SW2	SW3	SW4
Total Suspended Solids (mg/L)	25 ⁽⁺⁾	<5	<5	<5	<5
Ammonia N (mg/L)	≤ 0.065 to ≤ 0.04 (*)	0.03	0.04	<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)	-	<5	<5	<5	<5
Nitrogen (mg/L)	-	1.3	1.0	1.5	1.6
Phosphorus (mg/L)	-	<0.10	0.10	<0.10	<0.10
Chloride (mg/L)	-	17.3	18.5	17.5	36.7

(+) 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 (Round No. 2, 09/04/2025)

Total suspended solids were <5mg/L in all samples during both sampling rounds which

is below the S.I. No. 293/1988 Maximum Acceptable Concentration (MAC) of 25mg/L. Nitrite, nitrate, phosphorus and ortho-phosphate were at or below the laboratory detection limits.

Nitrogen levels were generally low in all samples. Levels of chloride are typical of surface waters in an inland setting.

Ammonia ranged between <0.02 to 0.04mg/L and in comparison to the Environmental Objectives Surface Water Regulations (S.I. 272/2009 as amended), all results for ammonia were below the 'High Status' threshold.

All results for ortho-phosphate were also below the 'High Status' threshold (≤ 0.025 mg/L). All results for BOD were also below the 'High Status' threshold except for SW4 in sample round no. 1.

7.3.8 HYDROGEOLOGY

The northern portion of the project site is mapped within the Kilkelly Charlestown Groundwater Body (IE_WE_G_0032). The southern portion of the project site, including the underground electricity line and haul route works are mapped in the Curlew Mountains GWB (IE_SH_G_073). Both GWBs are classified as 'poorly productive bedrock' according to WFD mapping. Poorly productive bedrock refers to rock units with low permeability and limited groundwater storage according to the GSI.

The 'Silurian Metasediments and Volcanics' and the 'Devonian Old Red Sandstones' that underlie the northern and central sections of the wind farm site respectively are classified by the GSI (www.gsi.ie) as a Poor Aquifer (bedrock which is generally unproductive except for local zones- PI). Proposed turbine locations T1 to T8, including the proposed borrow pit area, are mapped to be underlain by a Poor Aquifer.

The 'Basalts & other Volcanic rocks' that underly the southern portion of the wind farm site are classified as a Locally Important Aquifer (bedrock which is moderately productive only in local zones – LI). Proposed turbine locations T9 and T10 are mapped to be underlain by a Locally Important Aquifer. The underground electricity line is mapped to be underlain by both types of aquifers.

The aquifer types underlying the project site typically have no intergranular permeability; groundwater flow occurs in fractures and faults. Permeability is highest in the upper few metres but generally decreases rapidly with depth. In general, groundwater flow is concentrated in the upper 15m of the aquifer, although deeper inflows from along fault zones or connected fractures can be encountered.

Groundwater levels are about 1.5-15m below ground level (mbgl) and flow direction will generally follow topography (i.e. flow perpendicular to ground level contours). Close to the rivers and streams, water levels will be near ground level. Surface water features are considered to be in hydraulic continuity with the water table.

Groundwater flow distances will be very localised. Groundwater flow paths are generally short, typically 30-300m, with groundwater discharging to small springs, or to the streams and rivers that traverse the aquifer. Flow directions are expected to approximately follow the local surface water catchments. Groundwater is generally unconfined.

Owing to the poor productivity of the aquifers in these bodies it is unlikely that any major groundwater - surface water interactions occur. Baseflow to rivers and streams is assessed as likely to be relatively low.

Groundwater flow directions are expected to closely mimic topography (GSI, 2004). Therefore, groundwater flow directions at the project site are expected to be in a northerly and southerly direction which mirrors the surface water catchment divide topography.

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

Investigation drilling carried out at the borrow pit location (IDL Hole ID: RC-01) and near turbine location T9 (IDL Hole ID: RC-02) both encountered weathered SANDSTONE underlain by very strong SANDSTONE at depth.

The thickness of the shallow weathered sandstone was between 2.4m (RC-02) and 4.8m (RC-01). No fractures, faulting or cavities were encountered in the deeper strong SANDSTONE during the drilling that would suggest the potential for significant groundwater flows.

The glacial tills below the peat (determined to be a mixture of SILT, SAND and GRAVEL by trial pitting) have low to moderate permeability based on groundwater inflow observations.

Groundwater level monitoring was not carried out as part of the baseline assessment as groundwater levels in peatland environments are typically shallow all year round due to the poorly draining nature (i.e. low permeability) of the mineral subsoils and bedrock that underlies the peat, such as the geological setting at the project site. For the same reasoning, in-situ hydraulic conductivity testing was not deemed necessary.

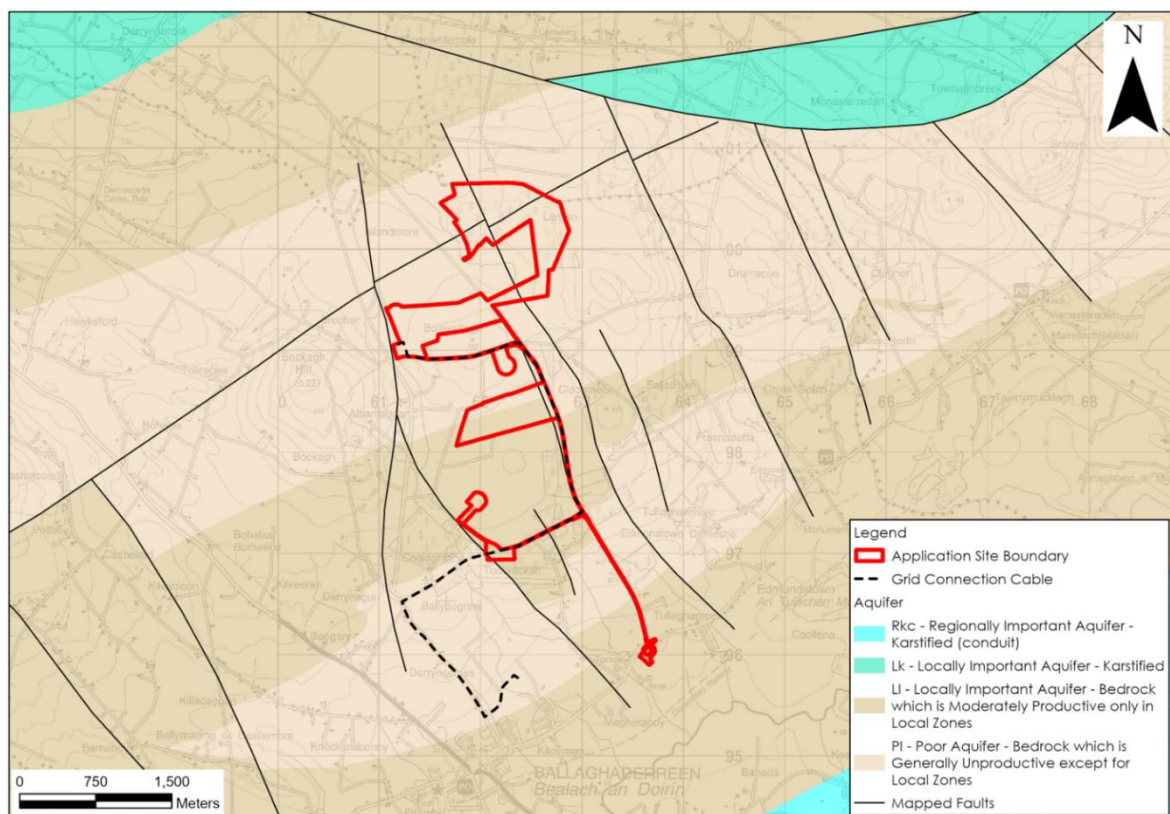


Figure 7.7: Bedrock Aquifer Mapping

7.3.9 GROUNDWATER VULNERABILITY

The mapped groundwater vulnerability rating of the aquifer beneath the project site ranges from 'High' to 'Extreme' (X), with the majority of the project site mapped as

'High'.

The central, more elevated portion of the project site, is mapped as Extreme (E) which suggests bedrock is at or close to the surface (<3m of overburden). This is consistent with the findings of borehole RC-01 at the borrow pit which encountered bedrock at a depth of 2mbgl.

The remainder of the project site, which is slightly lower lying in elevation, is mapped as having 'High' groundwater vulnerability rating which suggests overburden depths of 3 - 5m. This is consistent with the findings of borehole RC-02 (located north of turbine T8) which encountered bedrock at a depth of 5m below ground level (mbgl). Also, the trial pits typically encountered subsoils depths greater than 3m.

The vulnerability rating along the route of the underground electricity line is mainly 'Extreme' at the northern and central sections of the route, and 'Low' to 'Moderate' at the lower lying southern end of the route.

However, as set out above, due to the low permeability nature of the bedrock aquifers underlying the project site and underground electricity line, groundwater flowpaths are likely to be short (30m–300m), with recharge emerging close by at springs and surface streams.

This means there is a low likelihood of groundwater dispersion and movement within the aquifer; therefore, surface water bodies such as drains and streams/rivers are more vulnerable (to contamination from human activities) than groundwater at this general location

7.3.10 GROUNDWATER HYDROCHEMISTRY

Site-specific groundwater quality data is not available for the project site. Groundwater sampling would generally not be undertaken for this type of project at this type of location as groundwater quality impacts would not be anticipated given the lack of pollution sources, low likelihood of groundwater dispersion and movement within the aquifer as outlined in the preceding section.

In general, Devonian Old Red Sandstone and Silurian rocks groundwaters have moderate hardness, alkalinity and conductivity; although the hydrochemistry of the Silurian Metasediments can be quite variable and such groundwaters have a calcium-bicarbonate signature. The Old Red Sandstone, Silurian rocks and Ordovician Metasediments are siliceous.

Based on data from the GSI publication on the Kilkelly-Charlestown GWB, Silurian Metasediments generally have a CaMgHCO_3 signature. Alkalinity of 116mg/l (CaCO_3), Total Hardness at 126mg/l and Conductivity measurements of 325 $\mu\text{S}/\text{cm}$ have been recorded within this GWB.

7.3.11 GROUNDWATER BODY WFD STATUS

A WFD Compliance Assessment report has been prepared and is provided at **Annex 7.4**.

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

The Kilkelly Charlestown GWB (IE_WE_G_0032) and the Curlew Mountains GWB (IE_SH_G_073) are both assigned 'Good Status', which is defined based on the quantitative and qualitative status, and both are 'Not at Risk' of not maintaining 'Good' status. No groundwater pressures are reported for either GWB.

7.3.12 SURFACE WATER BODY WFD STATUS

River Water Body status information is also available from www.catchments.ie. River Water Body status information is available for the Owengarve River and Lung River in the area of the project site. Please refer to the WFD Compliance Assessment report for the status of all river waterbodies in the study area.

The Owengarve (Sligo)_010, in which the northern portion of the project site is located, is assigned an overall 'Good Status' in the latest WFD cycle (2019 – 2024).

The Lung_050 river waterbody, in which the southern portion of the project site is located along with the underground electricity line, achieved 'Moderate Status' in the last WFD cycle.

The status of both river water bodies has not changed since the previous WFD cycle (2016–2021).

Both river waterbodies are 'At Risk' of not achieving or maintaining 'Good Status' with the pressure in the Owengarve (Sligo)_010 reported to be hydromorphology. No pressures are reported for the Lung_050 river waterbody.

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

European Code	River Waterbodies	Overall Status (2016 – 2021)	Overall Status (2019 – 2024)	Risk Result	Pressure Category
IE_WE_34O030050	Owengarve (Sligo)_010	Good	Good	At Risk	Hydromorphology
IE_SH_26L030400	Lung_050	Moderate	Moderate	At Risk	n/a

Table 7.15: WFD Status and Risk Result

7.3.13 DESIGNATED SITES AND 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 illustrated at **Figure 7.8** below. The project site is not located within or adjacent to any designated conservation site.

The project site is hydrologically connected to the River Moy SAC (Site Code: 002298). At its closest point, this designated site is located approximately 4.9km to the northwest and downstream of the project site and is hydrologically connected via the Owengarve River which drains the northern portion of the project site.

The Moy system is one of Ireland's premier salmon waters. The site is also important for the presence of four other species listed on Annex II of the E.U. Habitats Directive, namely Sea Lamprey, Brook Lamprey, Otter and Whiteclawed Crayfish.

Lough Gara SPA (Site Code: 004048) and pNHA (Site Code: 000587) are located approximately 6km downstream of the project site and are hydrologically connected via the Lung River which the drains the southern portion of the project site.

Tullaghanrock Bog SAC (Site Code: 002354) and Callow Bog SAC (Site Code: 000595) are located along the banks of the Lung River upstream of Lough Gara and are

located c. 1.6km and 2.7km downstream of the project site respectively. Hydrological connectively with the project site and will be limited to surface water flows in the Lung River (i.e. there is no groundwater flow connectivity with the project site and these designated bogs due to large separation distances and dominant surface water drainage regime).

There are also several pNHA designated sites located along the banks of the Owengarve River, approximately 5.5km downstream of the project site. These bogs include Gowlaun Bog pNHA, Tawnaghbeg Bog pNHA, Kilgariff Bog pNHA, and Derrynabrock Bog pNHA).

Hydrological connectively with the project site and these designated bogs will be limited to surface water flows in the Owengarve River (i.e. there is no groundwater flow connectivity with the project site and these designated bogs due to separation distances and the surface water flow regime).

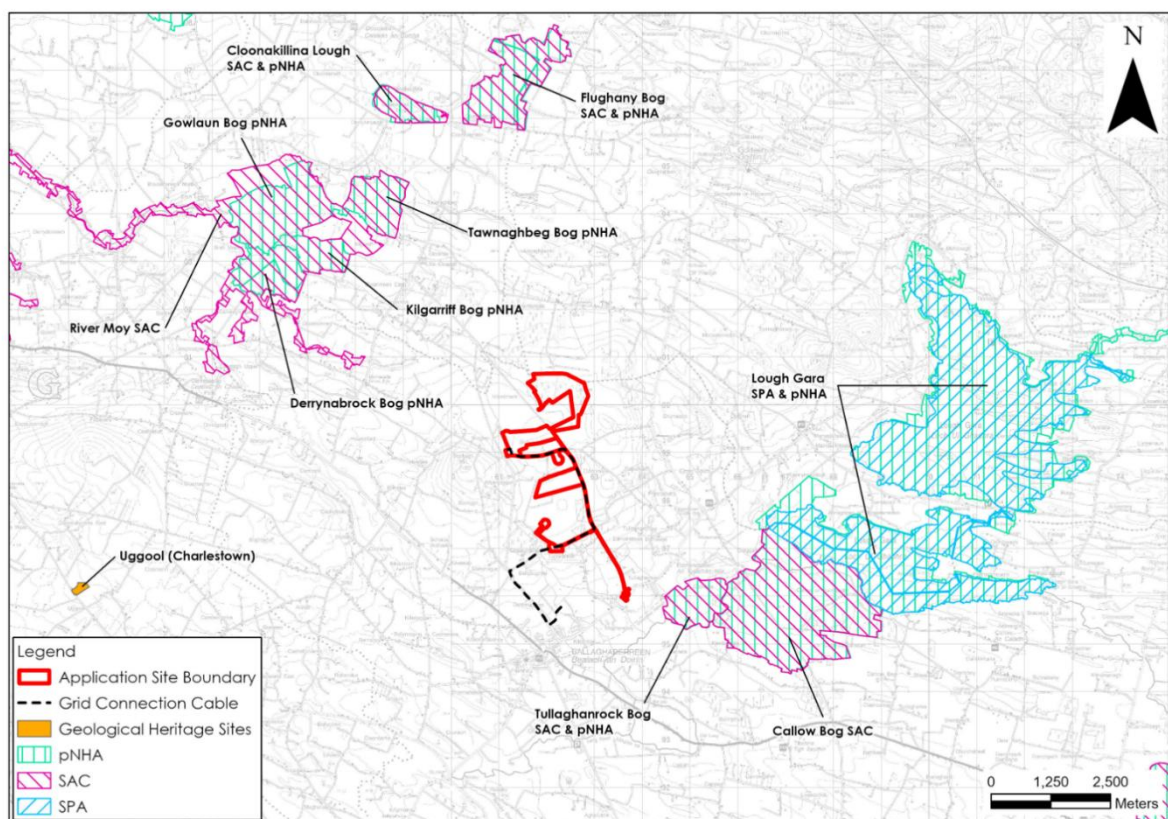


Figure 7.8: Designated Sites

7.3.14 WATER RESOURCES

7.3.14.1 Groundwater

According to the GSI online groundwater protection area mapping, there are no Public Water Supply or National Federation Group Water Scheme groundwater source protection areas (SPAs) in the vicinity of the project.

Private well locations (accuracy of <50m only) were reviewed using GSI well database (www.gsi.ie). There are no mapped wells in the immediate area of the project site. 2 no. boreholes and 1 no. infiltration gallery are the nearest wells mapped by the GSI, located c. 1km southeast of turbine T10 (i.e. the nearest turbine), in the

townland of Tullaghanrock. Each of the infrastructures were drilled on December 29, 1899 and have locational accuracies of 20m.

One of the boreholes (GSI Name: 1429SEW018) has failed, whilst the other has a poor yield class (GSI Name: 1429SEW031) which is consistent with the poorly productive nature of the bedrock aquifers underlying the project site. Please refer to **Figure 7.9** below for GSI mapped wells.

Due to the characteristics of the underground electricity line and its location being mainly within the carriageway of public roads, no assessment on potential wells located along the its line route (public road or private land sections) was carried out due to the lack of likely effects owing to construction methodologies and, in particular, the shallow depth of excavations.

As the GSI well database is not exhaustive in terms of the locations of all wells in the area (as the database relies on the submission of data by drillers and the public etc.) it is assumed that every private dwelling in the vicinity of the project site has a water supply well associated with it (this is unlikely to be the case but is a precautionary assessment). Private dwellings are also shown at **Figure 7.9** below.

However, all of these dwellings are remote (>500m) from areas of the project site where deep excavations are proposed (i.e. turbine locations and borrow pit); and given the local bedrock geology type, the poorly productive nature of the underlying aquifer and short groundwater flow paths; there will be very limited, if any; hydraulic connection between any potential wells and groundwater flow from the proposed site.

As stated in **Section 7.3.8** above, groundwater flow paths are typically between 30–300m in length and given the fact that all dwellings are more than 500m away from turbine locations and the proposed borrow pit, there is a very low risk of impact. The likely effect on private wells is further assessed in **Section 7.4.4.11** below.

7.3.14.2 Surface Water

As raised in the Uisce Éireann scoping response (refer to **Table 7.6** above), a public water supply surface water abstraction is located at the southern end of Lough Gara (WAB0000214/WAB0000208); and the associated North Roscommon Water Treatment Plant at Lough Gara provides water to 6,500-customers.

However, the abstraction is from the most southerly (upper) lake of the Lough Gara group which is not downstream of the project site. The abstraction point is shown on **Figure 7.9** below.

The southern portion of the project site drains to the Lung River which flows into the middle lake of the Lough Gara group which is downstream of the upper water supply abstraction lake. Therefore, the project has no hydrological connectivity with the Lough Gara public water supply abstraction.

Also, there are no river waterbodies downstream of the project that are drinking water protected areas.

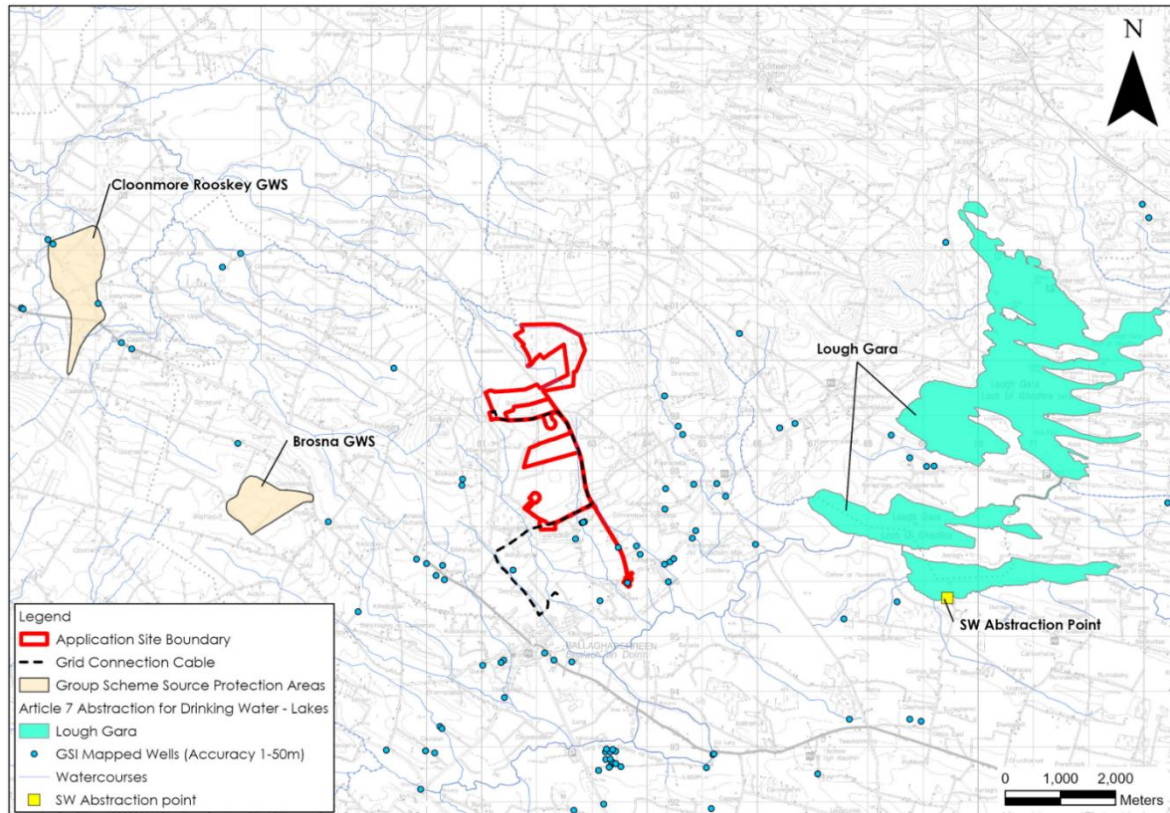


Figure 7.9: Drinking Water Supplies

7.3.15 RECEPTOR SENSITIVITY

Due to the nature of wind farms and associated underground electricity line developments, being near surface construction activities, effects on groundwater are generally negligible and surface water is generally the main sensitive receptor. The primary risk to groundwater arising from the project would be from cementitious materials, hydrocarbon spillage and leakages. These are common potential impacts on all construction sites (such as road works and industrial sites). All likely contamination sources are to be carefully managed at the site during the construction, operation and decommissioning phases and mitigation measures are proposed below to deal with these likely effects.

Based on criteria set out in **Section 7.2.3**, groundwater at the project site can be classed as Low to Medium Importance in terms sensitivity to pollution as the underlying bedrock is generally unproductive. Any contaminants which may be accidentally released are most likely to travel to nearby streams within surface water runoff.

Surface waters such as the Owengarve River, River Moy, Lung River and Lough Gara are classed as High to Very High Importance and are very sensitive to potential contamination.

As stated in **Section 7.1.3** above, the study area for assessing the likely zone of effects and cumulative effects assessment is the River Moy sub-catchment (Moy_SC_030) and the Lung River sub-catchments (Lung_SC_010 and Lung_SC_020). Further downstream of the Moy_SC_030, no indirect effects or cumulative effects are likely due to large catchment size and increasing flows in the River Moy.

Likewise, downstream of Lough Gara (i.e. Boyle River), no indirect effects or

cumulative effects are likely due to the large storage and attenuation capacity of the Lough Gara waterbodies.

Downstream designated sites such as the River Moy SAC and Lough Gara SPA/pNHA have Extremely High Importance. These designated sites can be considered very sensitive in terms of likely effects.

Designated bogs in the area of the project site such as Tullaghanrock Bog SAC, Callow Bog SAC, Gowlaun Bog pNHA, Tawnaghbeg Bog pNHA, Kilgarriff Bog pNHA and Derrynabrock Bog pNHA) can be scoped out for further assessment due to setback distances and the lack of groundwater connectivity with the project site. The project has is not likely to affect these groundwater dependant habitats or alter their surface water drainage regime.

The Owengarve River and Lung River, which drain the project site, flow close to these bogs, but the hydrological interaction is negligible and the pathway for likely significant effects does not exist.

The public water supply abstraction from Lough Gara (upper lake) is scoped out as the upper lake is not located downstream of the project as described at **Section 7.3.14.2** above.

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 has been the avoidance of sensitive aquatic areas, where possible, by implementing a 50m buffer.

From the hydrological constraints map (**Figure 7.10**), it is evident that; other than some small sections of turbine hardstands and associated access tracks at T1, T4 and T5, the watercourse crossings at turbines T4 and T9, along with sections of public road upgrades along the L5501; the majority of the wind farm infrastructure (including all turbine foundation locations, borrow pit and peat/spoil deposition areas) is located outside of areas that have been assessed to be hydrologically sensitive.

The hydrological buffer will 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.

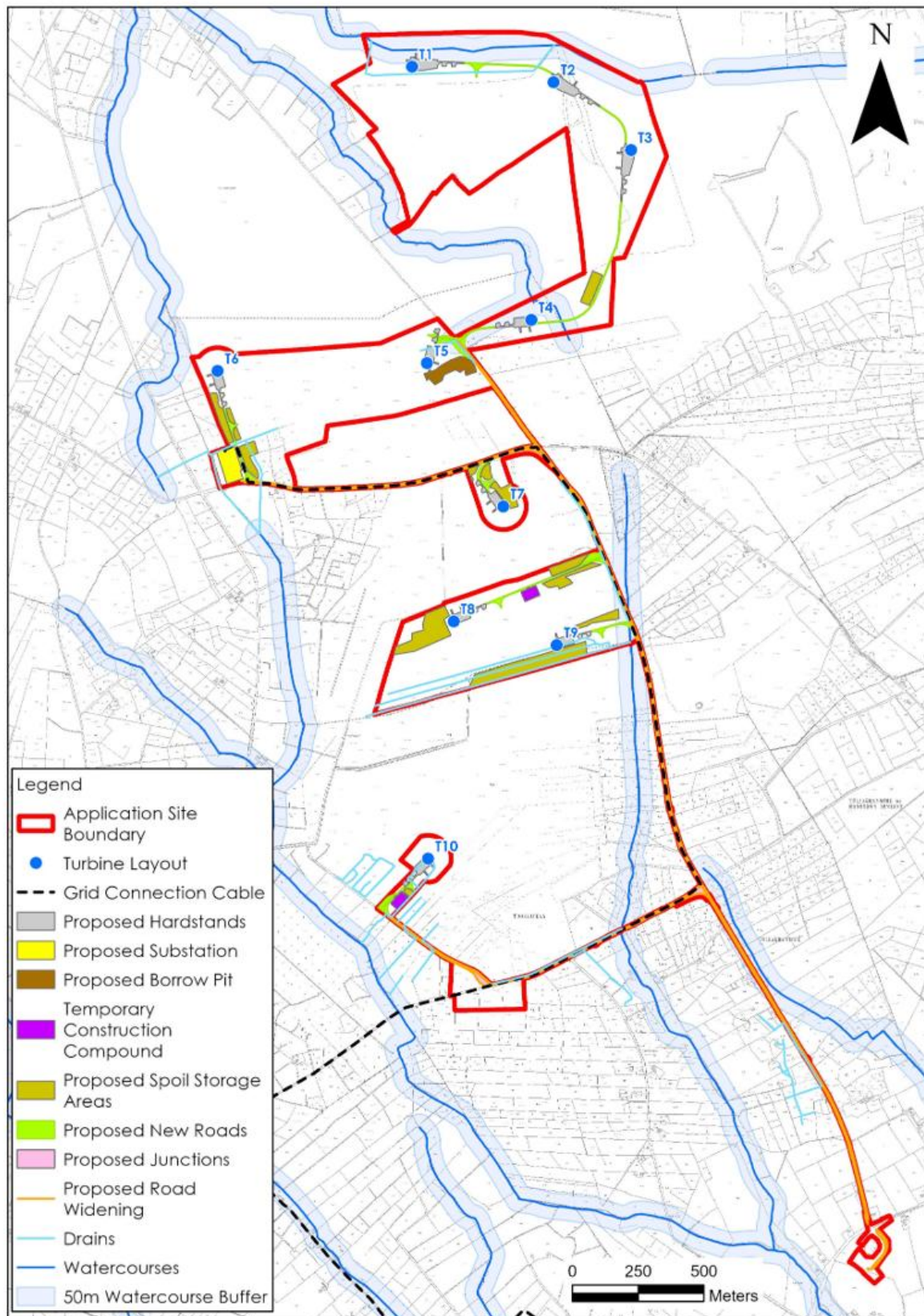


Figure 7.10: Hydrological Constraints Mapping

7.3.16 INTERACTION WITH THE MANMADE DRAINAGE NETWORK

In relation to hydrological constraints, as described above, a self-imposed buffer zone

of 50m has been put in place for on-site streams where feasible. Manmade drainage ditches at the site are not considered a hydrological constraint.

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 may affect downstream watercourses in terms of suspended solid input in runoff (unless managed appropriately).

The existing land/forestry/bog drains have no notable hydrological value and can be readily integrated into the project's drainage scheme using the methods outlined below (see **Section 7.5.2.2**).

7.3.17 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, settlement ponds, and buffered outfalls.

A schematic of the site drainage management is shown at **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.

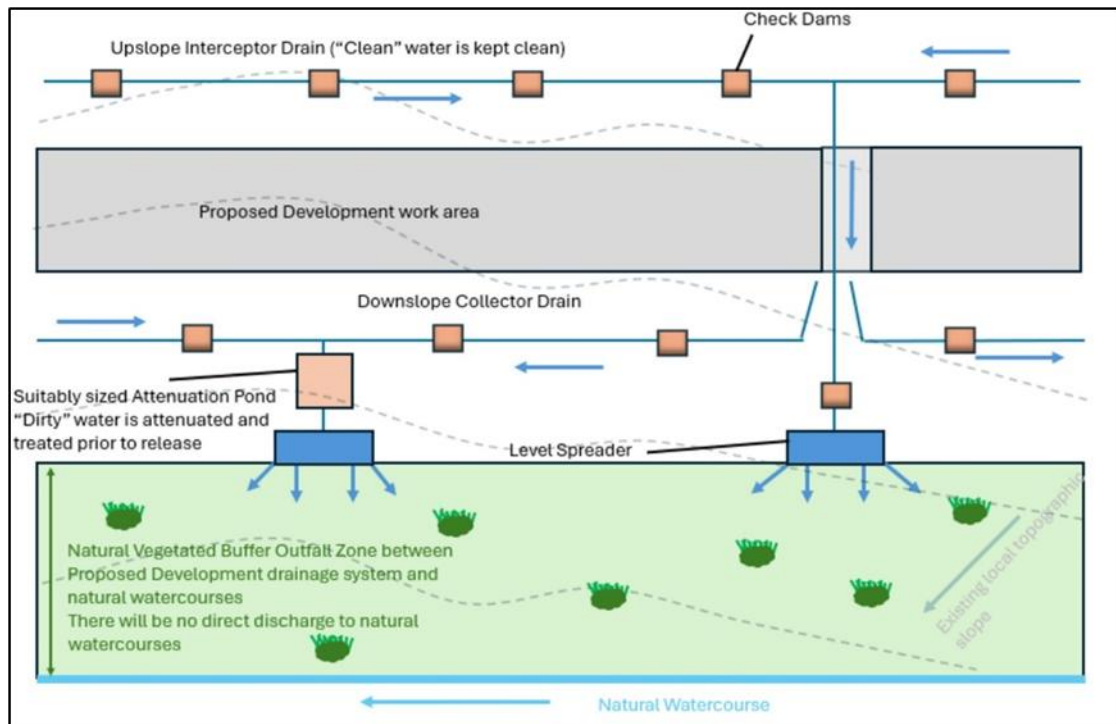


Figure 7.10: Schematic of Proposed Primary Site Drainage Management

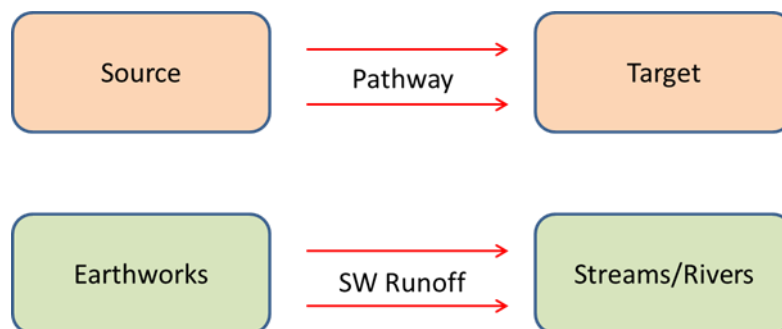
7.4 DESCRIPTION OF LIKELY EFFECTS

7.4.1 INTRODUCTION

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

7.4.2 OVERVIEW OF IMPACT ASSESSMENT PROCESS

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



Where likely effects are identified, the classification of effects 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 assessment process applied below (**Sections 7.4.4, 7.4.5 and 7.4.6**), 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 project construction and operation activities which have the potential to generate a source of likely negative effect 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.

7.4.3 DO NOTHING SCENARIO

In the 'do nothing' scenario, there would be no alteration to the hydrological and hydrogeological environment. The hydrological regime, including runoff rates, would remain unchanged and current land use practices would continue. Existing land drainage arrangements would continue to function in their current manner.

7.4.4 CONSTRUCTION PHASE

7.4.4.1 Tree Clear Felling and Surface Water Quality Effects

A total of 6.5 hectares of forestry will be permanently felled to accommodate the construction and operation of the project.

The tree felling activities will be the subject of a Felling Licence application to the Forest Service, in accordance with the *Forestry Act 2014 and the Forestry Regulations*

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

Likely effects during tree felling activities occur mainly from:-

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

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

Attribute	Description
Receptor	Down-gradient streams, rivers and lakes (Owengarve River, River Moy, Lung River and Lough Gara) and dependant ecosystems
Pathway/Mechanism	Drainage and surface water discharge routes
Pre-Mitigation Effect	Indirect, negative, moderate, temporary, likely effect

Table 7.16: Tree Clear Felling and Surface Water Quality Effects

7.4.4.2 Earthworks (Removal of Vegetation Cover, Excavations 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**. The likely 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 (grid connection) including cable trench and haul route works resulting in entrainment of sediment from the excavations during construction; and,
- Erosion of sediment from emplaced site drainage channels.

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

A description of the likely pre-mitigation effect is shown in **Table 7.17** below. The likely magnitude of effect is Small Adverse to Moderate Averse (NRA, 2008).

Attribute	Description
Receptor	Down-gradient streams, rivers (Owengarve River, River Moy, Lung River and Lough Gara) and dependant ecosystems
Pathway/Mechanism	Drainage and surface water discharge routes

Pre-Mitigation Effect	Indirect, negative, moderate/significant, short term, likely effect
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Table 7.17: Earthworks and Stock Piling

7.4.4.3 Groundwater Level Drawdown Effects During Earthworks

Dewatering of deep excavations (such as turbine foundations and the borrow pit) may affect local groundwater levels briefly. However, groundwater level effects are assessed to be minimal (if any) due to the existing local hydrogeological regime as further discussed below. No dewatering is assessed as likely to be required for the piled turbine foundation design.

The deepest excavation works will be centred around the turbine foundations and borrow pit. Turbine foundation depths are expected to have a maximum depth of c. 5m and the borrow pit to have a maximum depth of c. 10m below ground level.

No groundwater level effects are anticipated from the construction of the underground electricity line (grid connection) due to the shallow nature of the excavations (i.e. c. 1-2m) which will largely be contained within the carriageway of public roads. Similarly, the completion of horizontal directional drilling (HDD) activities are not assessed as likely to affect groundwater levels.

The borrow pit is located in poorly productive bedrock (i.e. sandstone) which is generally unproductive in terms of groundwater flow. This was confirmed by the investigation drilling carried out at the proposed borrow pit location (refer to drilling log for RC-01 in **Annex 6.1**) which encountered very strong SANDSTONE at depth.

No fractures, faulting or cavities were encountered during the drilling that would suggest the likelihood of significant groundwater flows. The 10 no. turbine foundations are also located in similarly unproductive bedrock.

In addition, the topographical and hydrogeological setting (i.e. elevated location) of the borrow pit and turbine locations means no significant groundwater dewatering is assessed as likely to be required during the working of the borrow pit or turbine base construction.

Moreover, direct rainfall and surface water runoff will be the main inflows that will require water volume and water quality management. Any inflows from the upper weathered bedrock will essentially be surface water (i.e. rainfall) and not seepages from the low to moderate permeability mineral subsoils.

For the avoidance of doubt, we define dewatering as a requirement to permanently drawdown the local groundwater table by means of over pumping, e.g. as would be required for the operation of a bedrock quarry in a valley floor. Considerate is assessed that this example is very different in scale and operation from the operation of a temporary shallow borrow pit in an elevated location, for the following reasons:-

- Firstly, the borrow pit and turbines are located on elevated local hills where the ground elevations are >140m OD;
- These elevations are above the elevations of the local valleys and streams;
- The borrow pit will have a depth of 10mbgl and the turbine bases 5mbgl. In the context of the topographical/elevated setting, this depth range is relatively shallow;
- The local bedrock units form aquifers that are known to be generally unproductive. This means that groundwater flows will be relatively minor;

- The flow paths (i.e. the distance from the point of recharge to the point of discharge) in this type of geology is short (30-300m), localised, and will also be relatively shallow;
- No regional groundwater flow regime, i.e. large volumes of groundwater flow, will be encountered at these elevations;
- Therefore, shallow groundwater inflows will largely be fed by recent rainfall, and possibly by limited groundwater seepage from mineral subsoils and localised bedrock weathering;
- The sloping nature of the project site along with the coverage of peat means groundwater recharge is going to be very low;
- As such, the shallow groundwater flow system will be small in comparison to the expected surface water flows from the bog surface;
- As a result, there will be a preference for high surface water runoff as opposed to groundwater recharge and flow; and,
- Hence, it is assessed that the management of surface water will form the largest proportion of water to be managed and treated.

The likely magnitude of effect is Small Adverse (NRA, 2008).

Due to the prevailing geology/hydrogeology at the project site, the local and temporary nature of the excavation works, no mitigation is required with regard to likely groundwater level drawdown effects.

A description of the likely final effect is shown in **Table 7.18** below.

Attribute	Description
Receptor	Groundwater levels/flow paths
Pathway/Mechanism	Groundwater flowpaths
Final Effect	Direct, slight, temporary/brief, likely effect. No permanent effects

Table 7.18: Groundwater Level Drawdown Effects

7.4.4.4 Excavation Dewatering/Pumping and Surface Water Quality Effects

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 man-made pollution issues are not assessed as likely to occur.

A description of the likely pre-mitigation effect is shown in **Table 7.19** below. The likely magnitude of effect is Small Adverse to Moderate Averse (NRA, 2008).

Attribute	Description
Receptor	Down-gradient streams, rivers (Owengarve River, River Moy, Lung River and Lough Gara) and dependant ecosystems
Pathway/Mechanism	Overland flow and site drainage network
Pre-Mitigation Effect	Indirect, negative, moderate/significant, short term, likely effect on surface water quality

Table 7.19: Excavation Dewatering and Surface Water Quality Effects

7.4.4.5 Release of Hydrocarbons During Construction and Storage

The 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 compounds and the electricity substation. 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 at locations 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.

The likely magnitude of effect is Negligible to Small Adverse (NRA, 2008).

A description of the likely pre-mitigation effect is shown in **Table 7.20** below.

Attribute	Description
Receptor	Groundwater, surface water (Owengarve River, River Moy, Lung River and Lough Gara) and ecosystems
Pathway/Mechanism	Groundwater flowpaths and site drainage network
Pre-Mitigation Effect	Indirect, negative, imperceptible, short term, unlikely effect on local groundwater quality. Given the nature of the groundwater environment, discussed at Section 7.3.8 above, negative effects on groundwater quality are assessed to be unlikely. Indirect, negative, moderate, short term, unlikely effect on surface water quality

Table 7.20: Release of Hydrocarbons

7.4.4.6 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.

The likely magnitude of effect is Moderate Adverse (NRA, 2008).

A description of the likely pre-mitigation effect is shown in **Table 7.21** below.

Attribute	Description
Receptor	Groundwater quality, surface water quality (Owengarve River, River Moy, Lung River and Lough Gara) and ecosystems
Pathway/Mechanism	Groundwater flowpaths and site drainage network
Pre-Mitigation Effect	Indirect, negative, significant, temporary, unlikely effect on surface water quality. Indirect, negative, slight, temporary, unlikely effect on local groundwater.

Table 7.21: Contamination from Wastewater

7.4.4.7 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.

The likely magnitude of effect is Moderate Adverse (NRA, 2008).

A description of the likely pre-mitigation effect is shown in **Table 7.22** below.

Attribute	Description
Receptor	Surface water hydrochemistry (Owengarve River, River Moy, Lung River and Lough Gara) and ecosystems
Pathway/Mechanism	Site drainage network
Pre-Mitigation Effect	Indirect, negative, significant, short term, unlikely effect on surface water

Table 7.22: Release of Cement-Based Products

7.4.4.8 Morphological Changes to Surface Water Courses & Drainage Patterns at the Project Site

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

Only 2 no. new crossings of watercourses by access tracks will be required at the project site. The watercourses to be crossed are 1st order streams.

The underground electricity line intercepts EPA mapped watercourses at 6 no. locations. 5 no. of these locations are on existing public roads where a culvert or bridge is already present. The 6th location is an existing crossing/culvert located on a private access track near the Tonroe electricity substation.

No instream works are required at watercourse crossing locations along the underground electricity (grid connection) line as directional drilling will be employed to navigate watercourse crossings and to avoid trenching/excavations within either the channel of watercourses or bridging structures over watercourses.

The likely magnitude of effect is Negligible (NRA, 2008).

A description of the likely pre-mitigation effect is shown in **Table 7.23** below.

Attribute	Description
Receptor	Surface water flows, stream morphology and water quality
Pathway/Mechanism	Site drainage network.
Pre-Mitigation Effect	Negative, direct, imperceptible, short term, likely effect

Table 7.23: Watercourse Morphological Effects**7.4.4.9 Hydrological Effects on Designated Sites**

The project is hydrologically connected to the River Moy SAC. At its closest point, this designated site is located approximately 5.5km downstream of the project site and is downstream (hydrologically connected) via the Owengarve River.

Lough Gara SPA/pNHA is located approximately 6km downstream of the project site and are hydrologically connected via the Lung River which the drains the southern portion of the project site.

Surface water effects are unlikely to be significant due to dilution/assimilation capacity effects over such distances (both the River Moy SAC and Lough Gara SPA being >5km downstream from the project site). Notwithstanding this, surface water management and mitigation is proposed to protect local surface water and thereby avoiding significant negative downstream surface water quality effects.

The likely magnitude of effect is Negligible (NRA, 2008).

A description of the likely pre-mitigation effect is shown in **Table 7.24** below.

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 7.24: Effects on Designated Sites**7.4.4.10 Effects on Waterbody WFD Status**

WFD status and Risk Results for downstream river waterbodies and the underlying GWBs are presented in **Sections 7.3.12 & 7.3.10** above.

Due to the poorly productive nature of the underlying bedrock aquifer, there is no 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. Owengarve (Sligo)_010 and Lung_050 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.

The likely magnitude of effect is Small Averse (NRA, 2008) to local river water bodies only.

A description of the likely pre-mitigation effect is shown in **Table 7.25** below.

Attribute	Description
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Receptor	Down-gradient groundwater and surface water bodies WFD 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 7.25: WFD Status Effects

7.4.4.11 Effects on Local Private Domestic Wells

In the area of the project site, private dwelling houses (potential well locations) are mainly located along the surrounding public roads.

The most substantial risk to potential down-gradient wells will be from deeper excavations such as the turbine foundations and borrow pit.

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.

The closest distance between a proposed turbine or borrow pit location and local dwelling houses (potential well) is >500m. In order to be conservative, and following the worst-case assumption, it is assumed that all dwellings in the surrounding lands have a private groundwater well.

However, due to the relatively shallow nature of the deepest excavations (5-10mbgl), the topography, hydrogeological regime and the >500m setback distance from potential wells, negative effects on private wells are unlikely.

The project is not likely to significantly impact any potential down-gradient private wells for the following reasons:-

- The large set back distances between proposed turbine and borrow pit locations and downstream potential well locations (>500m);
- The short groundwater flowpath distances (30–300m);
- The project will involve relatively shallow excavations (3m-10mbgl) which are typically located on elevated ground which thereby lessens the true depth of the excavation;
- The moderate-low permeability of the glacial deposits below the peat which will limit the distance of any likely groundwater level drawdown effects;
- The low permeability and low recharge characteristics of the underlying bedrock aquifers that underlies the project 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 hydrogeology, topography and groundwater flow directions), it has been assessed the project is not likely to significantly affect local groundwater wells and therefore no specific mitigation is required.

The likely magnitude of effect is Negligible (NRA, 2008).

A description of the likely final effect is shown in **Table 7.26** below.

Attribute	Description
Receptor	Local private wells
Pathway/Mechanism	Groundwater flowpaths
Final Effect	No negative direct or indirect effects on private wells are likely

Table 7.26: Effects on Local Domestic Wells

7.4.4.12 Water Quality Effects from Haul Route Upgrade Works

From the junction of the N5 and R293 to the wind farm site entrances, the public roads will be subject to permanent and temporary upgrade works including the widening of the existing carriageways together with the reprofiling of some carriageways to remove existing road crests.

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

The likely magnitude of effect is Small Adverse (NRA, 2008).

A description of the likely pre-mitigation effect is shown in **Table 7.27** below.

Attribute	Description
Receptor	Down-gradient streams, rivers (Lung River and Lough Gara) and dependant ecosystems
Pathway/Mechanism	Drainage and surface water discharge routes
Pre-Mitigation Effect	Indirect, negative, moderate, short term, likely effect

Table 7.27: Effects from Haul Route Upgrade Works

7.4.5 OPERATION PHASE

7.4.5.1 Increased Runoff Rates due to Hardstand Placement

The progressive replacement of the vegetated surface with impermeable surfaces could result in an increase in the proportion of surface water runoff reaching the surface water drainage network. The permanent development footprint comprises crane hardstandings, access tracks and electrical substation amongst others. 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 impacts on downstream aquatic ecosystems.

The emplacement of the project footprint, as described in **Chapter 3**, (assuming emplacement of impermeable materials) could result in an average total site increase in surface water runoff of 1,948m³/month, for the month of highest average recorded rainfall.

This equates to an average increase of 63m³/day (**Table 7.28**). This represents only a 0.97% increase in the average daily/monthly volume of runoff from the project 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 project site.

Specifically, the project permanent infrastructure footprint is approximately 8.6ha, representing c. 5.5% of the total landholding area of 157ha.

The additional runoff volume is low due to the fact that the runoff potential from the project site is already relatively high (85% runoff coefficient) due to the prevailing baseline hydrogeological conditions at the project site.

Also, it should be noted that this calculation assumes that all hardstanding areas will be impermeable, which is a highly conservative approach given that access tracks, crane hardstandings and the electricity substation compound will be constructed of aggregates which will facilitate the permeation/recharge of rainfall. A water balance assessment is provided in **Table 7.28** below.

Baseline Runoff/month (m ³)	Baseline Runoff/day (m ³)	Permanent Footprint Area (m ²)	Footprint Area 100% Runoff (m ³)	Footprint Area 85% Runoff (m ³)	Net Increase/month (m ³)	Net Increase/day (m ³)	% Increase from Baseline Conditions (m ³)
201,510	6,500	86,000	12,986	11,038	1,948	63	0.97

Table 7.28: Baseline Runoff for the Project Site (Pre and Post-Development)

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 and dependant ecosystems.
Pathway/Mechanism	Site drainage network.
Pre-Mitigation Effect	Direct, negative, imperceptible, long term, likely effect

Table 7.29: Increased Runoff Rates due to Hardstand Placement

7.4.5.2 Hydrocarbon Spillages and 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 operational phase.

Oil used in transformers (at the substation and within each turbine [if required]) and storage of oils at the substation 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 dependant ecosystems.
Pathway/Mechanism	Site drainage network.
Pre-Mitigation Effect	Direct, negative, imperceptible, long-term, unlikely effect

Table 7.30: Hydrocarbons Spillages and Leakages

7.4.5.3 Groundwater and Surface Water Contamination from Wastewater Disposal

It is proposed that all wastewater effluent, associated with welfare facilities at the

electricity substation (see **Chapter 3**), will be stored on-site in a sealed tank, and will be removed by tanker on a regular basis by a licensed waste management company to a licensed wastewater facility for treatment and disposal. There will be no discharges of wastewater on-site.

7.4.6 DECOMMISSIONING PHASE

Decommissioning phase effects are likely to be very similar to construction phase impacts but the overall likelihood of 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 site are likely to be retained for forestry uses.

7.4.7 'WORST-CASE' SCENARIO

The 'worst-case' for hydrological and hydrogeological effects are assessed to comprise the contamination of surface water features during the construction, operational 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.

7.4.8 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 site (i.e. low permeability soils, silts and clays overlying an unproductive bedrock aquifer) and the generally near surface nature of construction activities, cumulative effects with regard groundwater quality or quantity arising from the project are assessed as being unlikely to occur.

In terms of cumulative hydrological effects arising only from elements of the project (wind farm infrastructure, electricity substation, underground electricity line, haul route works and forestry), 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, substation, 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 general adherence to the 50m hydrological buffer 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.

A hydrological cumulative impact assessment of the project has been undertaken with regards cumulative effects with other projects and plans, including wind energy developments, located in the River Moy (Moy_SC_030) and Lung River (Lung_SC_010 and Lung_SC_020) catchments. Owing to distance and the increased assimilative capacity generated by increased water volumes, it is assessed that significant cumulative effects are not likely to arise beyond these sub-catchments.

In terms of the likely effects of wind farm developments on downstream surface water bodies, the greatest risk of cumulative effects is during the construction phase and particularly during earthworks and excavations.

A number of developments, identified at **Chapter 1**, also have the potential to result in cumulative hydrological effects; however, the mitigation measures outlined below will ensure that the project will not result in any likely significant effects and it is assessed that there is no likelihood of interaction with other developments or for cumulative effects to occur.

Within the Moy_SC_030 sub-catchment, there is only 1 no. existing turbine (Grady Joinery Wind Turbine). There are no other proposed or permitted wind farms in the Moy_SC_030 sub-catchment. Therefore, no hydrological cumulative effects are expected with other wind energy developments within the Moy_SC_030 sub-catchment.

In the Lung River catchment, there are 2 no. existing wind farms (Largan Hill Wind Farm and Roosky Wind Farm). As both these wind farms are constructed and operational, there is no risk of construction phase overlap with the project and therefore no significant cumulative effects will occur. The water balance assessment, undertaken at **Section** Error! Reference source not found. above, demonstrates that even in the absence of mitigation, the likelihood of increased runoff effects from the project site during the operational 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 operational phase with regard flood risk and hydromorphology will be neutral.

The N5 Ballaghaderreen to Scramoge Road Upgrade Scheme was assessed for likely hydrological cumulative effects. The N5 Upgrade Scheme is not located in the project cumulative study area (refer to above) and therefore cumulative effects with the project are not likely.

The North Connacht 110 kV Project, which is a 110 kV underground electricity circuit running approximately 53km from Ballina (County Mayo) to Ballaghaderreen, is partially located within the cumulative study area. Approximately 17km of the electricity line is within the cumulative study area (i.e. Moy_SC_030 and Lung_SC_020 sub-catchments), where the proposed route is predominately along public roads. Due to the expected 110 kV project, construction programme (i.e. the electricity line trench will be excavated in stages) and the transient nature of the works over several kilometres, the construction methodologies to be implemented, the surface water control measures to be put in place and the general remoteness from the project site, significant cumulative effects are not assessed as likely.

On the basis of the above, it is assessed that the likely cumulative magnitude of effect is Negligible (NRA, 2008) with a final likely significance of imperceptible. No significant cumulative effects are likely.

7.4.9 ASSESSMENT OF HEALTH EFFECTS

The potential for adverse health effects arise largely through the potential for surface and groundwater contamination which can have negative effects on drinking water supplies. The project site is not located upstream of any public water supply abstractions.

For the reasons outlined in Section **7.4.4.11** above (separation distances, and prevailing hydrogeology, topography and groundwater flow directions), it has been

assessed the project is not likely to affect local groundwater supplies. Notwithstanding this, the project design and mitigation measures will ensure that the potential for effects on the water environment will not be significant.

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

A site-specific Flood Risk Assessment (**Annex 7.2**) has been carried out for the project, summarised in **Section 7.3.6**. The lack of project infrastructure encroachment into flood zones, combined with the assessment of changes in permeable surfaces (**Section Error! Reference source not found.**) demonstrates that the risk of the project contributing to downstream flooding is imperceptible. On-site (construction, operation and decommissioning phase) drainage control measures will ensure no downstream increase in local flood risk.

7.5 MITIGATION MEASURES AND MONITORING

7.5.1 INTRODUCTION

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 had 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:-

- Clean water drains will be installed upslope of the works area to intercept clean surface water to prevent it becoming contaminated by silt/sediment from construction activities;
- All surface water runoff from construction works areas will be directed to specially constructed downslope dirty-water swales surrounding all areas of ground proposed to be disturbed (including areas for the temporary storage of material);
- The swales will direct runoff into settlement ponds/silt traps where silt/sediment will be allowed to settle; and,
- Following treatment and the settlement of silt/sediment, clean water will be discharged indirectly to the local drainage network via buffered outfalls thus ensuring that no scouring occurs.

The suite of surface water drainage infrastructure will include *inter alia* upslope interception (clean water) drains, downslope collector (dirty water) swales, sediments, 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; and,
- 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.

7.5.2 CONSTRUCTION PHASE

7.5.2.1 Clear Felling and Surface Water Quality Effects

Best practice methods and mitigation measures related to the protection of water have been derived from:-

- Department of Agricultural, Food and the Marine (2019) *Standards for Felling and Reforestation*;
- Forestry Commission (2004) *Forests and Water Guidelines, Fourth Edition*. Publ. Forestry Commission, Edinburgh;
- Coillte (2009) *Forest Operations and Water Protection Guidelines*;
- Forest Services (Draft) *Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures*;
- Coillte (2009) *Methodology for Clear Felling Harvesting Operations*; and,
- Forest Service (2000) *Forestry and Water Quality Guidelines*. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.

Mitigation by Avoidance

There is a requirement in the *Forest Service Code of Practice* and in the *FSC Certification Standard* for the installation of buffer zones adjacent to aquatic zones at planting stage. Minimum buffer zone widths recommended in the Forest Service (2000) guidance document *Forestry and Water Quality Guidelines* are detailed at **Table 7.31**.

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

Table 7.31: Minimum Buffer Zone Widths (Forest Service, 2000)

A total of 6.5ha of forestry will be permanently felled to accommodate the construction and operation of the project.

During the construction phase, a self-imposed conservative buffer zone of 50m will be maintained for all streams. These buffer zones are illustrated at **Figure 7.10**. Only approximately 0.8ha of the total 6.5ha proposed for felling is located inside a 50m watercourse buffer zone.

The large distance between the majority of the felling areas and sensitive aquatic zones means that any poor quality runoff arising from felling areas can be adequately managed and attenuated prior to reaching the aquatic buffer zone and primary drainage routes. Where tree felling is required in the vicinity of streams, the additional mitigation measures outlined below will be employed.

Mitigation by Design

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

- Machine combinations (i.e. handheld or mechanical) will be chosen which are most suitable for ground conditions and which will minimise soils disturbance;
- Checking and maintenance of tracks and culverts will be ongoing through any felling operation. No tracking of vehicles through watercourses will occur. Where possible, existing drains will not be disturbed during felling works;
- Ditches which drain from the areas to be felled towards existing surface watercourses will be blocked, and temporary silt traps will be constructed. No direct discharge of such ditches to watercourses will occur. Drains and sediment traps will be installed during ground preparation. Collector drains will be excavated at an acute angle to the contour (c. 0.3%-3% gradient), to minimise flow velocities. Main drains to take the discharge from collector drains will include water drops and rock armour, as required, where there are steep gradients and avoid being placed at right angles to the contour;
- Sediment traps will be sited in drains downstream of felling areas. Machine access will be maintained to enable the accumulated sediment to be excavated. Sediment will be carefully disposed of in the spoil deposition areas. All new silt traps will be constructed on even ground and not on sloping ground;
- In areas particularly sensitive to erosion or where felling inside the 50m buffer is required, it will be necessary to install double or triple sediment traps;
- All drainage channels will taper out before entering the 50m buffer zone. This ensures that discharged water gently fans out over the buffer zone before entering the aquatic zone, with sediment filtered out from the flow by ground

vegetation within the zone. On erodible soils, silt traps will be installed at the end of the drainage channels;

- Drains and silt traps will be maintained throughout all felling works, ensuring that they are clear of sediment build-up and are not severely eroded. Correct drain alignment, spacing and depth will ensure that erosion and sediment build-up are minimised and controlled;
- Brush mats will be used to support vehicles on soft ground, reducing topsoil and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brush mat renewal will take place before they become heavily used and worn. Provision will be made for brush mats along all off-road (track) routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion occurring, extraction will be suspended during periods of high rainfall;
- Timber will be stacked in dry areas, and outside the 50m watercourse buffer. Straw bales and check dams will be emplaced on the down gradient side of timber storage/processing sites;
- Works will be carried out during periods of no, or low, rainfall in order to minimise entrainment of exposed sediment in surface water run-off;
- Checking and maintenance of tracks and culverts will be ongoing through the felling operation;
- Refuelling or maintenance of machinery will not occur within 100m of a watercourse. Mobile bowser, drip kits and qualified personnel will be used where refuelling is required;
- A permit to refuel system will be adopted;
- Branches, logs or debris will not be allowed to build up in the 50m buffer. All such material will be removed when harvesting operations have been completed, but care will be taken to avoid removing natural debris deflectors;
- Trees will be cut manually from along streams and using machinery to extract whole trees; and,
- Travel will only be permitted perpendicular to and away from surface water features.

Silt Traps

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

Drain Inspection and Maintenance

The following items will be carried out during pre-felling inspections and regularly thereafter:-

- Communication with tree felling operatives in advance to determine whether any areas have been reported where there is unusual waterlogging or bogging of machines;
- Inspection of all areas reported as having unusual ground conditions;

- Inspection of main drainage ditches and outfalls. During pre-felling inspections, the main drainage ditches will be identified. Where possible, the pre-felling inspection will be carried out during rainfall;
- Following tree felling, all main drains will be inspected to ensure that they are functioning;
- Extraction tracks within 10m of drains will be broken up and diversion channels created to ensure that water in the tracks spreads out over the adjoining ground;
- Culverts on drains exiting the site, if impeded by silt or debris, will be unblocked; and,
- All accumulated silt will be removed from drains, culverts and silt traps, and this removed material will be deposited away from watercourses to ensure that it will not be carried back into the trap or stream during subsequent rainfall.

Surface Water Quality Monitoring

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

Details of the proposed surface water quality monitoring programme are outlined in the Water Quality Monitoring Plan (refer to **Annex 3.4**).

The surface water sampling locations used in this EIAR for the project site (i.e. SW1–SW4) will also be used as sampling locations during felling activities.

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

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

The key mitigation measure during the construction phase is the avoidance of sensitive aquatic areas by using a 50m buffer.

From the hydrological constraints map (**Figure 7.10**), it is evident that; other than some small sections of crane hardstandings and associated access tracks at T1 and T4, the watercourse crossings at turbines T4 and T9, and some sections of haul route upgrade works; the majority of the wind farm infrastructure (including all turbine foundation locations, borrow pit and peat/spoil deposition areas) is located outside of areas that have been assessed to be hydrologically sensitive.

As set out above and at **Chapter 3**, specific 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 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; and,
 - Small working areas, covering stockpiles, weathering off stockpiles, cessation of works in certain areas or other similar/equivalent or appropriate measures.
- In-Line controls 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.

It should be noted for this site that an extensive network of land, bog and forestry drains already exists and these will be integrated and enhanced as required and used within the wind farm drainage system. The integration of existing land drainage networks and wind farm networks 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.

Pre-commencement Temporary Drainage Works

Prior to the commencement of haul route upgrades, access tracks, crane hardstandings and turbine foundations, the following key temporary drainage measures will be installed:-

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

Water Treatment Train

While the proposed drainage plan is assessed as providing a sufficient level of protection to avoid any deterioration in downstream water quality; a temporary final line of defence can be provided by a water treatment train (i.e. sequence of water treatment processes), 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) 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 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.

Management of Runoff from Peat/Spoil Deposition Areas

It is proposed that excavated peat/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 dedicated peat/spoil deposition areas and in the 1 no. spent borrow pit.

Proposed peat/spoil deposition areas and the borrow pit are located outside the 50m stream buffer zone (refer to **Figure 7.10**).

During the initial placement of peat/spoil in the deposition areas, silt fences, straw bales and biodegradable matting will be used to control surface water runoff. Drainage from overburden deposition areas will ultimately be routed to an oversized swale and a number of silt/settlement ponds with appropriate storage and settlement capacity, designed for a '1-in-100 year 6-hour return' period, before being discharged.

Spoil deposition areas will be sealed with a digger bucket and allowed to vegetate naturally. 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 water:-

- 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; and,
- A double silt fence perimeter will be placed down-slope of works areas that are located inside the watercourse 50m buffer zones such as at watercourse crossing locations.

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

Directional Drilling

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 10 metre vegetative buffer zone will be maintained (if present) between disturbed areas and the watercourse bank. There will be no storage of material/equipment, excavated material (see below) 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 100m 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;
- Two 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 further frac-out is high, a new drilling alignment will be sought at the crossing location.

Pre-emptive Site Drainage Management

The works programme for the initial construction stage of the project will also take account of weather forecasts, and predicted rainfall in particular. Large excavations and movements of peat/subsoil or vegetation stripping will be suspended or scaled back if 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.

The use of 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 precise siting and composition of the surface water management measures. The respective plans, which will form part of a detailed 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.

7.5.2.3 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 cabling and 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;
- All pumped water volumes will be discharged to the surface water management system 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 required.

7.5.2.4 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 compounds. 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 or for storage within the spoil deposition areas; 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.

7.5.2.5 Groundwater and Surface Water Contamination from Wastewater Disposal

Measures to avoid contamination of ground and surface waters by wastewaters will comprise:-

- Self-contained port-a-loos (chemical toilets) with an integrated waste holding tank will be installed at the site compound, maintained by the providing contractor, and removed from site on completion of the construction works;
- Water supply for the site office and other sanitation will be brought to site and removed after use to be discharged at a suitable off-site treatment location; and,
- No water will be sourced on the site, nor will any wastewater be discharged to the site.

7.5.2.6 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, emplacement of pre-cast products will be utilised;
- All watercourse 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 compounds, 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 sites will be kept free of standing water and plastic covers will be ready in case of sudden rainfall event.

7.5.2.7 Morphological Changes to Surface Water Courses & Drainage Patterns

The following mitigation measures are proposed:-

- The 2 no. proposed new stream crossings will be clear span bridges (bottomless culverts) and the stream beds will remain undisturbed. No in-stream excavation works at the crossing locations are proposed and therefore there will be no impact on the stream at the proposed crossing

location;

- Wind farm electrical cabling or the underground electricity line cabling will be installed either above or below an existing culvert and will not directly interfere with the culvert;
- At the time of construction, all guidance/best practice requirements of the Office of Public Works (OPW) or Inland Fisheries Ireland will be incorporated into the design/construction of the proposed watercourse/culvert crossings;
- As a further precaution, in-stream construction work (if/where required) will only be carried out during the period permitted by Inland Fisheries Ireland for in-stream works according to *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (2016)* (i.e., July to September inclusive). This time period coincides with the period of lowest expected rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses (any deviation from this will be done in discussion with the IFI);
- During the near stream construction works (i.e. within the 50m buffer zone), double row silt fences will be emplaced immediately down-gradient of the construction area for the duration of the construction phase;
- The 2 no. new watercourse crossings at the wind farm site will require a Section 50 license application to the OPW in accordance with the Arterial Drainage Act 1945. The river/stream crossings will be designed in accordance with OPW guidelines/requirements on applying for a Section 50 consent; and,
- No instream works are proposed at the underground electricity line watercourse crossings, with all crossings being carried out via HDD.

7.5.2.8 Hydrological Effects 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, etc.), 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 7.6.1.2** below, an “imperceptible, short-term effect” on local streams and rivers would, if an incident occurs, would be very localised and of a short duration. Therefore, significant indirect hydrological or water quality effects on the downstream Lough Gara SPA/pNHA and River Moy SAC are not likely.

7.5.2.9 Effects on WFD Status

Mitigation measures relating to the protection of surface water drainage regimes and surface water quality at the project site have been detailed in **Section 7.5.2.1** (clear felling), **Section 7.5.2.2** (suspended solids), **Section 7.5.2.4** (hydrocarbons), **Section 7.5.2.6** (cement-based products) and **Section 7.5.2.7** (hydromorphological changes).

Similarly, mitigation measures for the protection of groundwater quantity and quality have been detailed in **Section 7.4.4.3** (groundwater levels), **Section 7.5.2.4** (hydrocarbons) and **Section Error! Reference source not found.7.5.2.6** (cement-based products).

The implementation of these mitigation measures will ensure the protection of

downstream SWBs and underlying GWBs.

7.5.2.10 Water Quality Effects from Turbine Delivery Route Works

The proposed mitigation measures for protection of surface water quality will also be used at the haul route works areas.

In particular, this includes the application of the temporary pre-construction drainage measures (see **Section 7.5.2.2** above) for surface water quality protection.

7.5.3 OPERATION PHASE

7.5.3.1 Progressive Replacement of Natural Surface with Lower Permeability Surfaces

The operational 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/track side drains will be used to collect runoff from access tracks, crane hardstanding areas and substation 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 does not require mitigation measures.

7.5.3.2 Hydrocarbons Spillages/Leakages

Mitigation measures relating to oils and fuels are as follows:-

- All storage containers will be labelled appropriately, including hazardous markings;
- Fuels stored on site will be minimised. Any storage areas will be bunded appropriately for the fuel storage volume for the time period of the construction;

- The substation transformer and oil storage tanks will be located in a concrete bund, impervious to rainwater ingress, capable of holding 110% of the stored oil volume;
- Bunds will be to standard specified in CIRIA Report 163 'Construction of bunds for oil storage tanks' and CIRIA Report C535 'Above-ground proprietary prefabricated oil storage tank systems';
- Barrels and banded containers will be stored upright and internally where appropriate and always on drip trays or sump pallets;
- Appropriate spill kits will be available at all storage locations;
- 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;
- All fuel/chemical storage facilities will be subject to weekly inspection; and,
- An emergency plan for the operational phase to deal with accidental spillages will be contained within Environmental Management Plan. Spill kits will be available to deal with accidental spillages.

7.5.4 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 banded.

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 landowners. It is considered that this approach will result in lesser effects than would their removal.

7.6 RESIDUAL EFFECT

7.6.1 CONSTRUCTION PHASE

7.6.1.1 Clear Felling and Surface Water Quality Effects

Proven forestry best practice measures to mitigate the likelihood of releases of sediment have been proposed above and will break the pathway between the likely sources and the receptor. The residual effect will be negative, imperceptible, indirect, temporary, and likely effect on downstream water quality and aquatic habitats.

7.6.1.2 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 as likely.

7.6.1.3 Groundwater Levels Drawdown Effects During Excavation works

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

7.6.1.4 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 are anticipated.

7.6.1.5 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 are assessed as likely.

7.6.1.6 Groundwater and Surface Water Contamination from Wastewater Disposal

No significant residual effects are assessed as likely to occur.

7.6.1.7 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 are assessed as likely to occur.

7.6.1.8 Morphological Changes to Surface Water Courses & Drainage Patterns

Significant effects due to morphological changes, occurring as a result of watercourse crossings or drain diversions, are assessed to not result in any likely significant residual effects. Residual effects are assessed to be negative, direct, imperceptible, short term and likely.

7.6.1.9 Hydrological Effects on Designated Sites

No significant residual effects are assessed as likely to occur.

Due to the knowledge of the ground conditions (subsoil and bedrock competency) 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.

7.6.1.10 Effects on Local Private Wells

No residual effects on local private wells will occur.

7.6.1.11 Effects on WFD Status

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

7.6.1.12 Water Quality Effects from Haul Route Works

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 as likely.

7.6.2 OPERATION PHASE

7.6.2.1 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; with no significant negative effects assessed as likely.

7.6.2.2 Hydrocarbons Spillages Leakages during the Operational Phase

Residual effects, following the implementation of mitigation measures, are assessed to be negative, indirect, imperceptible, long 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 likelihood of 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 wind farm, thereby largely 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 (project) 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 etc).

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 of 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 project.