Pinewoods Wind Farm Substation and Grid Connection

Chapter 7: Water

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7.1 Introduction

7.1.1 Background and Objectives

This chapter provides an assessment of the likely effects of the proposed development (110kv substation, access track and associated works) 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 proposed development;
- Identify likely positive and negative significant effects of the proposed development on surface and groundwater during construction, operational and decommissioning phases of the development;
- Identify mitigation measures to avoid, reduce or offset significant negative effects;
- Assess significant residual effects; and
- Assess cumulative effects of the proposed development and other local developments.

7.1.2 Development Description

In summary, the proposed development comprises the following main components:-

- 1 no. 110kV 'loop in-loop out' air-insulated switchroom (AIS) substation including control buildings, transformers and all ancillary electrical equipment; and
- All associated site development, access and reinstatement works.

Due to the sloping nature of the proposed development site, and in order to minimise the volume of material to be excavated to provide the substation footing; the design of the proposed development has incorporated a split-level approach.

The entirety of the proposed development is located within the administrative area of County Laois; while the overall project (Pinewoods Wind Farm) is located partly within County Laois and County Kilkenny. Additionally, candidate quarries which may supply construction materials are also located within County Kilkenny and Carlow.

7.1.3 Statement of Authority

Hydro-Environmental Services (HES) are a specialist 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 (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 17 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 was involved in the preparation of Environmental Impact Statements (EIS) for the Oweninny Wind Farm, Cloncreen Wind Farm, Yellow River Wind Farm and over 100 no. other wind farm related projects.

David Broderick (BSc, H.Dip Env Eng, MSc) is a hydrogeologist with over 13 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 was involved in the preparation of Environmental Impact Statements (EIS) for the Oweninny Wind Farm, Cloncreen Wind Farm Yellow River Wind Farm and over 100 other wind farm related projects across Ireland.

7.1.4 Relevant Legislation

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

The requirements of the following legislation are complied with:-

- S.I. No. 349 of 1989: European Communities (Environmental Impact Assessment) Regulations, and subsequent Amendments (S.I. No. 84 of 1994, S.I. No. 101 of 1996, S.I. No. 351 of 1998, S.I. No. 93 of 1999, S.I. No. 450 of 2000 and S.I. No. 538 of 2001, S.I. 134 of 2013 and the Minerals Development Act 2017), the Planning and Development Act, and S.I. 600 of 2001 Planning and Development Regulations and subsequent Amendments. These instruments implement EU Directive 85/337/EEC and subsequent amendments, on the assessment of the effects of certain public and private projects on the environment;
- Directives 2011/92/EU and 2014/52/EU on the assessment of the effects of certain public and private projects on the environment, including Circular Letter PL 1/2017: Implementation of Directive 2014/52/EU on the effects of certain public and private projects on the environment (EIA Directive);
- Planning and Development Act, 2000, as amended;
- S.I. No 296 of 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. 293 of 1988: European Communities (Quality of Salmonid Waters) 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 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy) and S.I. No. 722 of 2003 European Communities (Water Policy) Regulations which implement EU Water Framework Directive

(2000/60/EC) establishing a framework for the Community action in the field of water policy and provide for implementation of 'daughter' Groundwater Directive (2006/118/EC) on the protection of groundwater against pollution and deterioration. Since 2000 water management in the EU has been directed by the Water Framework Directive (2000/60/EC) (as amended by Decision No. 2455/2011/EC; Directive 2008/32/EC; Directive 2008/105/EC; Directive 2009/31/EC; Directive 2013/39/EU; Council Directive 2013/64/EU; and Commission Directive 2014/101/EU ("WFD"). The WFD was given legal effect in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003);

- S.I. No. 684 of 2007: Waste Water Discharge (Authorisation) Regulations 2017, 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. 106 of 2007: European Communities (Drinking Water) Regulations 2007and S.I. No. 122 of 2014: European Communities (Drinking Water) Regulations 2014, arising from EU Directive 98/83/EC on the quality of water intended for human consumption (the "Drinking Water Directive") and EU Directive 2000/60/EC;
- S.I. No. 9 of 2010: European Communities Environmental Objectives (Groundwater) Regulations 2010 (as amended by S.I. No. 389/2011; S.I. No. 149/2012; S.I. No. 366/2016; the Radiological Protection (Miscellaneous Provisions) Act 2014; and S.I. No. 366/2016); and,
- S.I. No. 296 of 2009: The European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 (as amended by S.I. No. 355 of 2018).

7.1.5 Relevant Guidance

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

- 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;
- Department of Environment, Heritage and Local Government (2006): Wind Energy Development Guidelines for Planning Authorities;
- Inland Fisheries Ireland (2016): Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters;
- Scottish Natural Heritage (2010): Good Practice During Wind Farm Construction;
- 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, 2006).
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (DoHPLG, 2018);
- Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU), (European Union, 2017);

- 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; and,
- COFORD (2004): Forest Road Manual – Guidelines for the Design, Construction and Management of Forest Roads.

7.2 Methodology

7.2.1 Desk Study

A desk study of the proposed development site and surrounding area, including the site of the permitted Pinewoods Wind Farm, was completed in advance of undertaking the walkover survey, field mapping and site investigations. This involved collecting all relevant geological, hydrological, hydrogeological and meteorological information for the proposed development site and surrounding area. The desk study included consultation of the following data sources:-

- Environmental Protection Agency database (www.epa.ie); Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks & Wildlife Services Public Map Viewer (www.npws.ie);
- Water Framework Directive/EPA Catchments Map Viewer (www.catchments.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 18 (Geology of Tipperary). Geological Survey of Ireland (GSI, 1999);
- Geological Survey of Ireland (2004); Groundwater Body Initial Characterization Reports;
- Office of Public Works (OPW) Flood Hazard Mapping (www.floodinfo.ie);
- Environmental Protection Agency – "Hydrotool" Map Viewer (www.epa.ie);
- CFRAM Flood Risk Assessment (PFRA and CFRAM) maps (www.cfram.ie);
- Department of Environment, Community and Local Government on-line mapping viewer (www.myplan.ie);
- Ordnance Survey Ireland (OSI) – 6 inch and 1;5000 scale basemaps; and,
- Aerial photography (www.bing.com/maps, www.google.com/maps).

Concerns raised by local residents and consultees in previous submissions related to the Pinewoods Wind Farm as they relate to effects on water and the hydrological environment were also assessed in the preparation of this chapter.

7.2.2 Site Investigations

A walkover survey and baseline evaluation of the proposed development site was undertaken by HES on 20 March 2020. The proposed development site was previously visited by HES in February and March 2015 as part of the EIAR/EIS prepared in respect of the Pinewoods Wind Farm.

Specific site investigations, including trial pits and dynamic probes, at the proposed development site (described below) were undertaken by the Applicant on 21 January 2019.

In summary, site investigations to inform the preparation of this chapter comprise the following:-

- Walkover surveys and hydrological mapping of the proposed development site and the surrounding area were undertaken. Water flow directions and drainage patterns were also recorded;
- 7 no. trial pits and dynamic probes were undertaken at the substation location to investigate subsoil depth and lithology along with groundwater conditions (i.e. possible inflows);
- Field hydrochemistry measurements (electrical conductivity, pH, dissolved oxygen and temperature) were taken to determine the origin and nature of surface water flows; and,
- Surface water sampling (2 no. samples) was undertaken to determine the baseline water quality of the primary surface waters originating in the area of the proposed development site.

7.2.3 Receptor Sensitivity / Importance / Impact Criteria

Using the National Roads Authority (NRA 2008) guidance, an estimation of the importance of the water environment within and downstream of the proposed development area are quantified by applying the importance criteria set out in **Table 7.1** and **Table 7.2**; the impact magnitude is assessed using **Table 7.3** and **Table 7.4** 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	• Coarse fishery. • Local potable water source supplying

	scale.	>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 1residential 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. • Possible 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. • Possible 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. • Possible 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)

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

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

7.2.4 Consultation

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

This consultation process is outlined in **Chapter 1** of this EIAR. Issues, concerns and recommendations highlighted by the responses in relation to the water environment are summarised in **Table 7.6** below. The full responses from each of the below consultees are provided in **Annex 1.4.**

Consultee	Summary of Consultee Response	Response Addressed in

		Section
Geological Survey of Ireland	• General Groundwater Quality Protection • Flood Risk Management	7.3.5 7.3.8 7.5.1.3 7.5.1.4
Irish Water	• Generic response with respect protection of water supply infrastructure, surface waters and groundwater	7.3.13 7.5.1.1 7.5.1.3

Table 7.6: Summary of Scoping Responses

7.3 Description of the Existing Environment

7.3.1 Site Location and Description

The proposed development site, which has a total area of approximately 5.5a, is located ~8km to the southeast of Abbeyleix in Co. Laois. The site lies within the townland of Knockardagur, Co. Laois.

This area is part of the Castlecomer Plateau, a broad upland area which straddles the boundaries between counties Laois, Carlow and Kilkenny. It is an upland area with the site elevations ranging from 225 – 250m OD (meters above Ordnance Datum). Due to the sloping nature of the proposed development site and in order to minimise the volume of material to be excavated to provide the substation footing; the design of the proposed development has incorporated a split-level approach (see **Chapter 3** for full details).

Land use at the proposed development site is agricultural grassland/pasture and ground conditions at were noted to be firm under foot. In the wider landscape, agricultural grassland/pasture remains the predominant landuse; however, locally, forestry is prevalent particularly to the south east including at the site of the permitted Pinewoods Wind Farm.

The proposed development site is bordered by a hedgerow to the west, by open grassland to the east and north and a public road to the south from where the proposed site entrance will provide access to the proposed development site.

7.3.2 Water Balance

Long term Annual Average Rainfall (AAR) and evaporation data was sourced from Met Éireann. The 30-year annual average rainfall (1981-2010) recorded at Abbeyleix, approximately 8 km northwest of the substation site, are presented in **Table 7.7** below.

Abbeyleix												
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
94	67	72	63	63	67	70	87	74	105	91	90	943

Table 7.7: Local Average Long-Term Rainfall Data (mm)

The closest synoptic station where the average potential evapotranspiration (PE) is recorded is at Kilkenny, approximately 26km south of the site. The long-term average PE for this station is 459mm/yr. This value is used as a best estimate of the proposed development site's PE. Actual Evaporation (AE) at the site is estimated as

436mm/year (which is 0.95 × PE).

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

Effective rainfall (ER) = AAR – AE

= 943 - 436

ER = 507mm/year

Based on groundwater recharge coefficient estimates from the GSI (www.gsi.ie), an estimate of 100-130mm/year average annual recharge cap is given for the local aquifers. This means that the hydrology of the study area is characterised by relatively high surface water runoff rates and low groundwater recharge rates. Based on a conservative recharge cap of 100mm/year, the annual runoff rate for the site is estimated to be 407mm/yr.

Table 7.8 presents return period rainfall depths for the area of the proposed development. The 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 (1-year, 50-year, 100-year). These extreme rainfall depths will provide the basis of the detailed drainage design for the proposed development.

Duration	10-year Return Period (mm)	50-Year Return Period (mm)	100-Year Return Period (mm)
15 min	11	15.3	17.5
1 hour	20	27.7	31.7
6 hour	43.2	59.9	68.6
12 hour	58.1	80.6	92.4
24 hour	78.3	108.6	124.4
48 hour	94.4	127.6	144.6

Table 7.8: Return Period Rainfall Depths for Proposed Development Site

7.3.3 Local and Regional Hydrology

Regionally, the proposed development site itself is located in the Nore River surface water catchment within Hydrometric Area 15 of the South Eastern River Basin District (SERBD). A regional hydrology map is shown as **Figure 7.1**.

In terms of local hydrology, the proposed development site is situated within the Owenbeg River catchment (also named the Owveg River). The Owenbeg River flows in a southerly direction approximately 2km west of the site. A local hydrology map is shown as **Figure 7.2.**

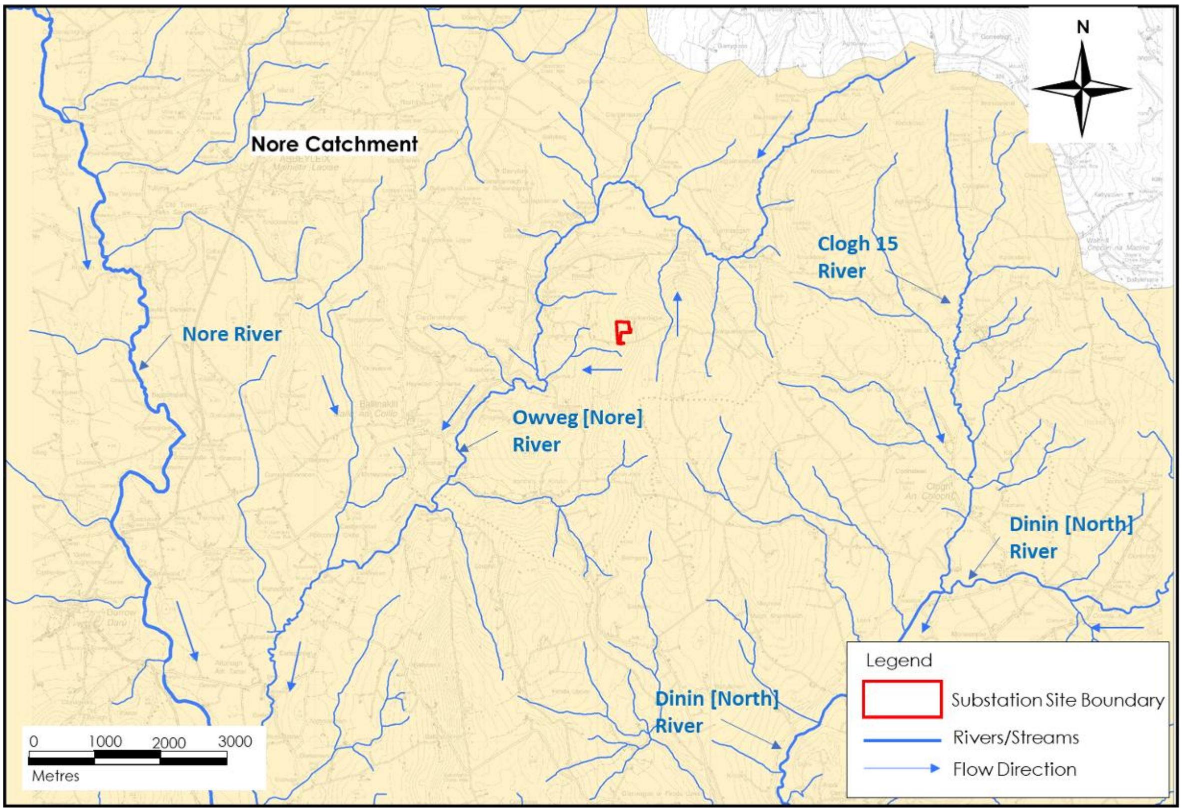


Figure 7.1: Regional Hydrology Mapping

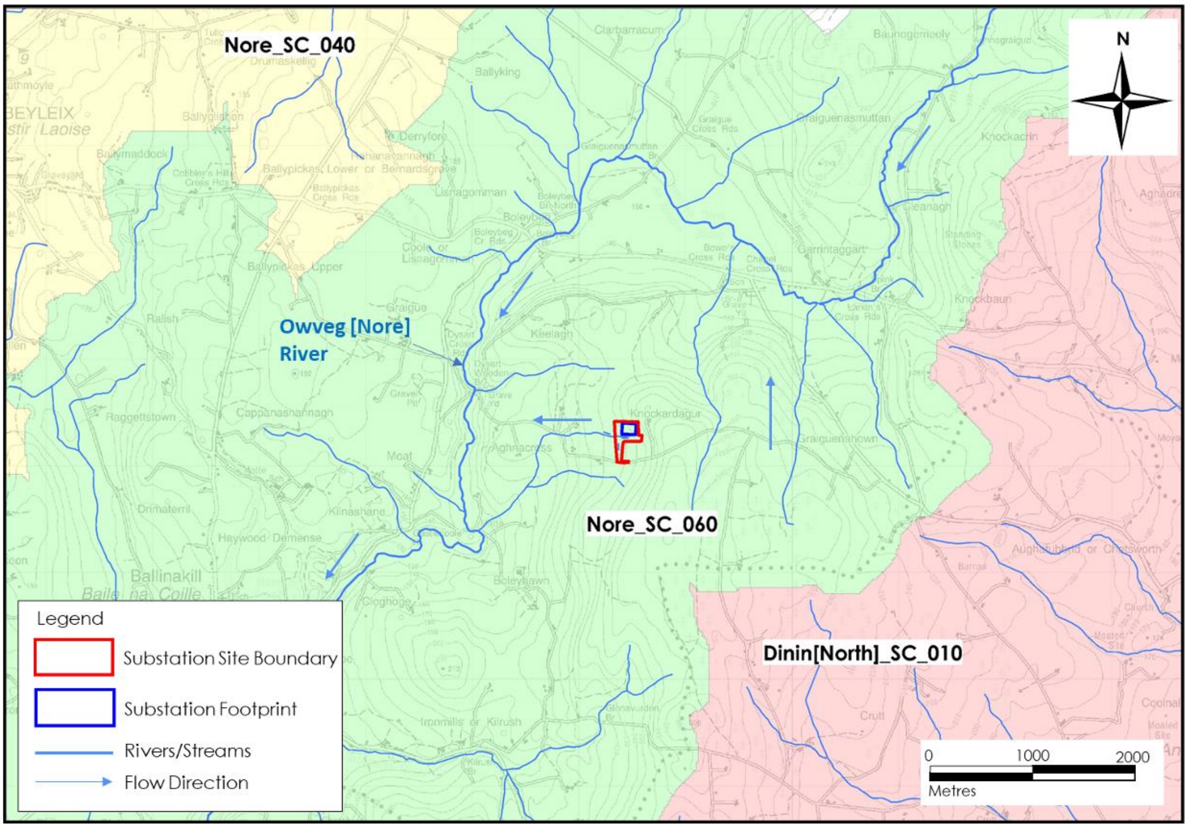


Figure 7.2: Local Hydrology Mapping

7.3.4 Site Drainage

There is 1 no. watercourse within the proposed development site. The watercourse (the Knockardagur) is a small 1st order stream which flows in a westerly direction within the hedgerow located immediately south of the footprint of the proposed 110kV electricity substation. The stream rises from a small spring which is located ~10m to the south of the substation footprint. Spring flow rates are <5L/s. The proposed development will not interfere with the spring outfall nor will there be a crossing required over the Knockardagur Stream. It is also noted that the Knockardagur Stream is predominately dry and is assessed as only likely to have flow rates following intense of prolonged rainfall.

In addition, a man-made/agricultural drain is located along the western boundary (downslope) of the proposed development site along an existing hedgerow. This drain, which is likely to only have flow during very wet periods, discharges to the Knockardagur to the southwest of the proposed 110kV substation. Furthermore, a second stream flows (<5L/s) along the hedgerow to the west (downslope) of the proposed access track which merges with the Knockardagur at the same location as the abovementioned drain. A site drainage map is shown as **Figure 7.3**.

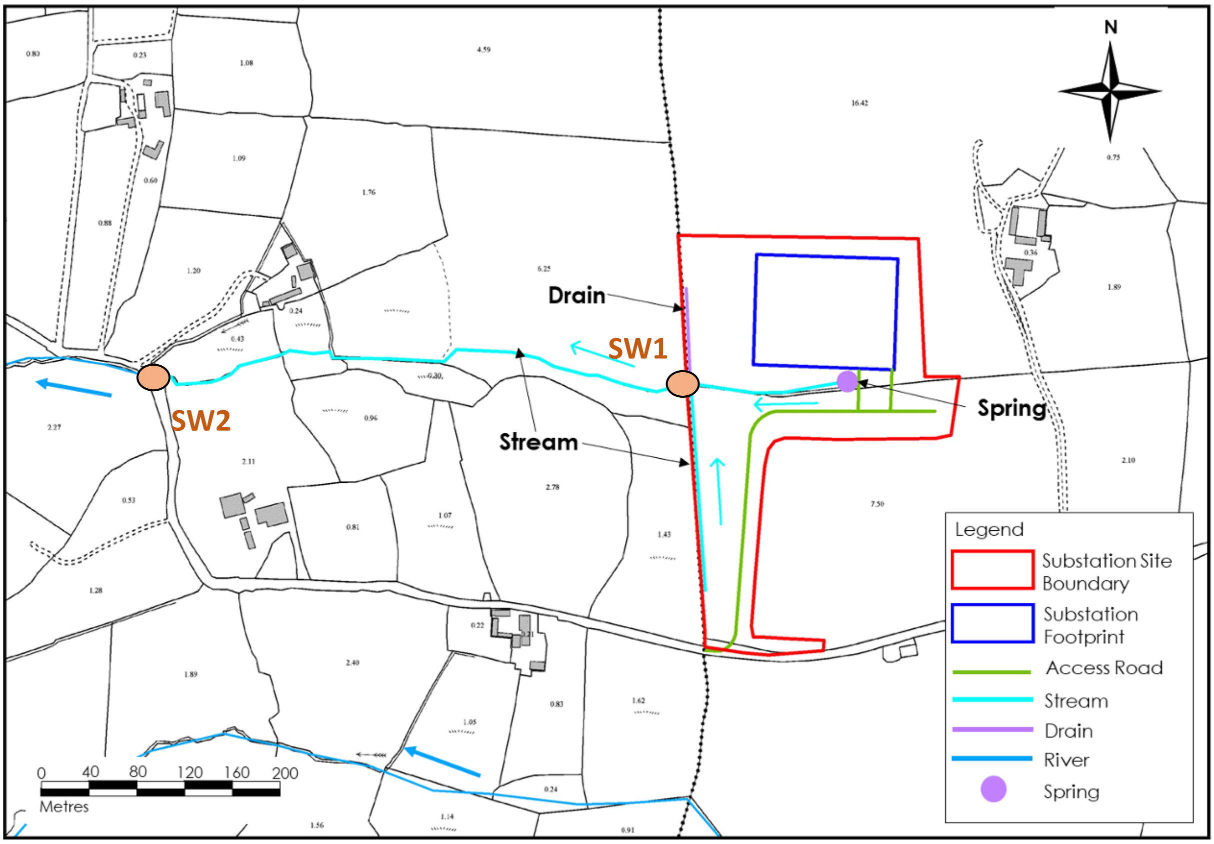


Figure 7.3: Site Drainage Map

7.3.5 Flood Risk Identification

To identify those areas as being at risk of flooding, the OPW's indicative river and coastal flood map (www.floodmaps.ie), CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie) and historical mapping (i.e. 6" and 25" base maps) were consulted.

No recurring flood incidents were identified from OPW's flood hazard mapping either within the proposed development site or in the surrounding area (**Figure 7.4**). Notably, no flooding incidences are mapped along the Owenbeg River immediately downstream of the proposed development site.

The PFRA mapping demonstrates the extents of the indicative 1 in 100-year flood zone which relates to fluvial (i.e. river) and pluvial (i.e. rainfall) flood events (**Figure 7.5**). The 1 in 100-year fluvial flood zone incorporates notable land area surrounding the Owenbeg River to the west and northwest of the proposed development site.

There is no 1 in 100-year fluvial flood zones mapped within the site or surrounding area, particularly in relation to the Knockardagur stream. Therefore, it is concluded that, based on the available flood mapping, the proposed development site is located in Flood Zone C (Low Risk).

There is no identifiable map text on local available historical 6" or 25" mapping for the study area that identify lands that are "prone to flooding".

There are no areas within the proposed development site or downstream of it mapped as "Benefiting Lands". Benefiting lands are defined as a dataset prepared by the OPW identifying land(s) that might benefit from the implementation of Arterial (Major) Drainage Schemes (under the Arterial Drainage Act 1945) and indicating areas of land subject to flooding or poor drainage.

A walkover of the proposed development site was undertaken on 20 March 2020 during which it was surveyed for any signs or anecdotal evidence of flooding. No such signs were noted. Local landowners were also consulted in relation to historical flooding on their lands and no flood events were identified.

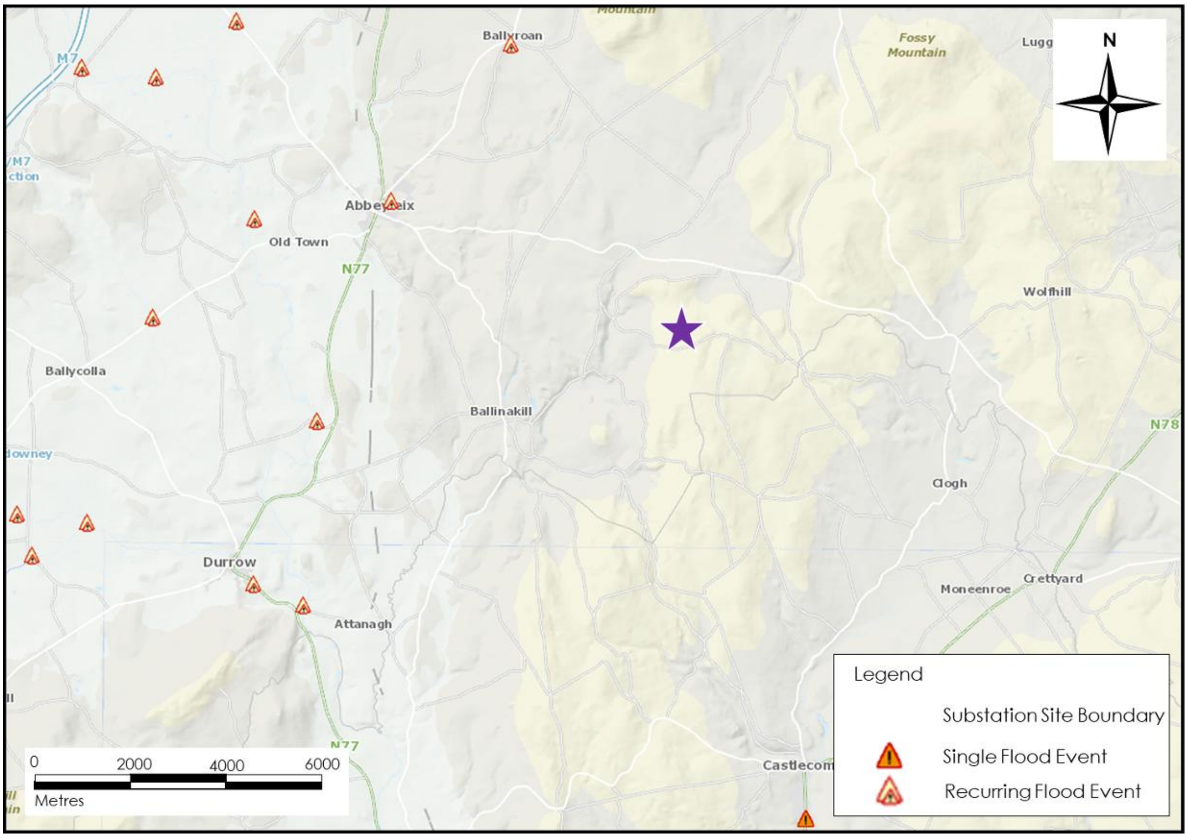


Figure 7.4: OPW Flood Hazard Mapping

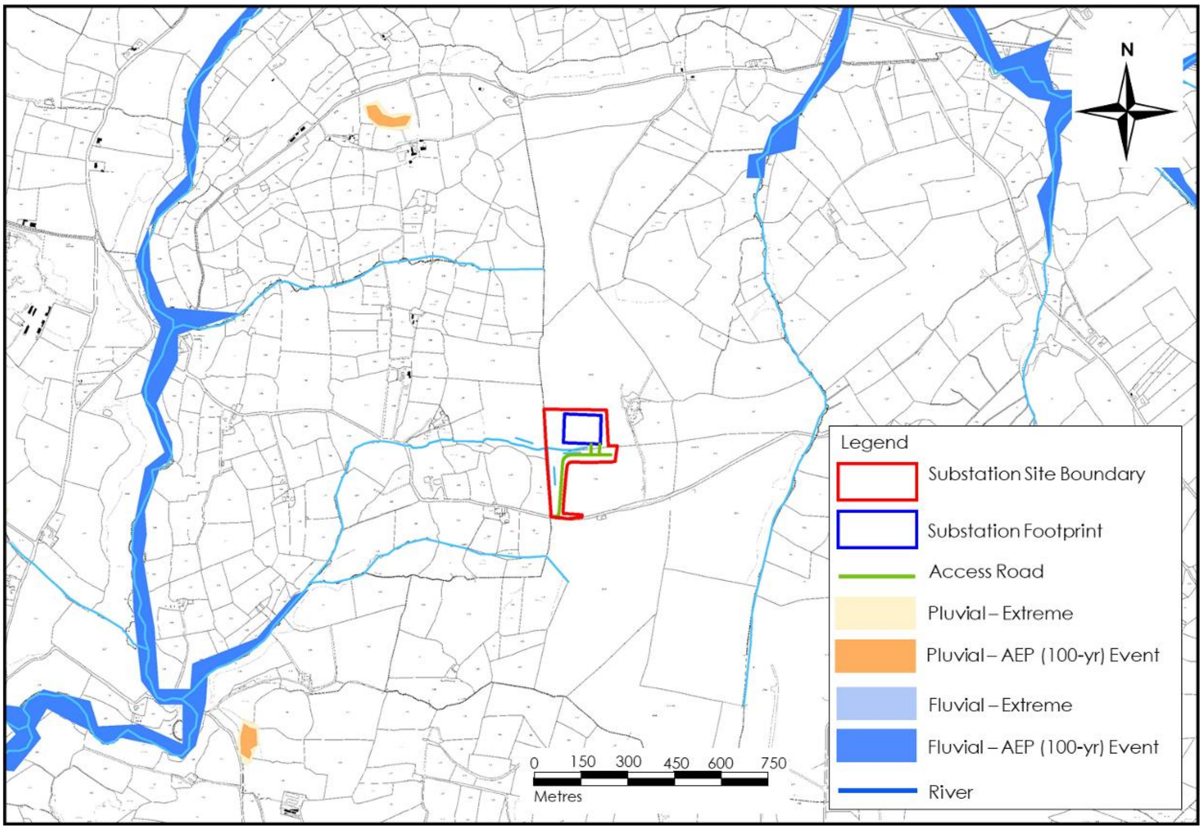


Figure 7.5: PFRA Flood Zone Mapping

7.3.6 Surface Water Hydrochemistry

Q-rating data for EPA monitoring points are available on the Owenbeg River in the area of the proposed development. The most recently available data indicates that the Owenbeg River has a Q4 rating (Good Status) both upstream and downstream of the proposed development site. There is no Q-rating data for the Knockardagur stream which provides the only hydrological connection between the proposed development site and the Owenbeg River.

Surface water samples were taken from 2 no. locations along the Knockardagur stream, both of which are downstream of the proposed development site. Sampling was undertaken on the 20th March 2020 during a relatively dry spell of weather. Field hydrochemistry measurements of unstable parameters, electrical conductivity (µS/cm), pH (pH units) and temperature (°C) were taken at each location and the results are listed in **Table 7.9** below. Refer to **Figure 7.3** above for sample locations.

Electrical conductivity (EC) values for surface waters at sampling locations SW1 and SW2 ranged between 139 and 147µS/cm which would be typical for the local mapped geology (*i.e.* sandstone; see **Chapter 6**).

The pH values, which ranged between 7.2 and 7.3 at each sampling location, were generally near neutral and would be typical of catchments with mineral soil coverage.

Location	EC (µS/cm)	pH	Temperature
SW1	147	7.3	8.3
SW2	139	7.3	8.4

Table 7.9: Summary of Surface Water Chemistry Measurements

The results of analyses carried out on the water samples are shown alongside relevant water quality regulations in **Table 7.10** below. In addition, Environmental Objectives Surface Water Regulations (S.I. 272 of 2009) are shown in **Table 7.11** below. Laboratory reports are provided at **Annex 7.1.**

Parameter	EC DIRECTIVES			Sample ID	
	2006/44/EC		EC DW Regs 2007	SW1	SW2
	Salmonid	Cyprinid			
Total Suspended Solids (mg/L)	≤ 25 (O)	≤ 25 (O)	-	<5	<5
Ammonia N (mg/L)	≤0.04	≤0.02	0.3	0.03	0.11
Nitrite NO_2 (mg/L)	≤ 0.01	≤ 0.03	0.5	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	-	-	-	<0.02	0.02
Nitrate - NO_3 (mg/L)	-	-	50	9	7.5
Nitrogen (mg/L)	-	-	-	2.1	1.8
Phosphorus (mg/L)	-	-	-	<0.1	<0.1
Chloride (mg/L)	-	-	250	11.4	10.2
BOD	≤ 3	≤ 6	-	<2	2

Table 7.10: Analytical Results of Surface Water Sampling

Parameter	Threshold Values (mg/L)
BOD	High status ≤ 1.3 (mean)
	Good status ≤ 1.5 mean
Ammonia-N	High status ≤ 0.04 (mean)
	Good status ≤0.065 (mean)
Ortho-phosphate	High status ≤0.025 (mean)
	Good status ≤0.035 (mean)

Table 7.11: Chemical Conditions Supporting Biological Elements*

** Environmental Objectives Surface Water Regulations (S.I. 272 of 2009)*

Total suspended solids was reported at <5mg/L in both samples which is below the Freshwater Fish Directive (2006/44/EC) MAC of 25mg/L.

Nitrite was below the laboratory detection limit of 0.05 mg/L in both samples. Nitrate ranged between 7.5 and 9mg/L and was slightly higher in the SW1 which are both substantially below the threshold level of 50mg/L.

Ortho-phosphate ranged between <0.02 to 0.02mg/L. In comparison to the Environmental Objectives Surface Water Regulations (S.I. 272 of 2009), all results for ortho-phosphate exceeded the "High Status" threshold.

In relation to Ammonia N, which ranged between 0.03 and 0.11mg/L, there was a notable increase in the downstream sample (SW2) which is likely to be reflective of agricultural activities in the local area. SW2 exceeded both the "Good Status" and "High Status" while SW1 was below the "High Status" threshold.

BOD ranged between <2 and 2mg/L, which exceeds both the "Good status" and "High status" threshold limits.

7.3.7 Hydrogeology

The Namurian sandstones, which underlie the subject site and parts of the permitted Pinewoods Wind Farm site, are classified by the Geological Survey of Ireland (GSI) (**www.gsi.ie**) as a Poor Aquifer, having bedrock which is generally unproductive except for local zones (Pl/Pu). Bedrock aquifer mapping is shown as **Figure 7.6** below.

The shales and sandstones that underlie the site generally have an absence of inter-granular permeability, and most groundwater flow is expected to be in the uppermost part of the aquifer comprising a broken and weathered zone typically less than 3m thick, a zone of interconnected fissuring 10m thick, and a zone of isolated poorly connected fissuring typically less than 150m (GSI, 2004).

Groundwater levels in this bedrock type, elsewhere, have been measured mainly 0-5m below ground level. However, the presence of a spring close to the south of the proposed substation footprint suggests that groundwater levels are close to the surface locally as a result of the low permeability nature of the bedrock.

During the trial pit investigation (refer to **Figure 6.2** of **Chapter 6**), no significant groundwater inflows were noted within the proposed development footprint area (location were deepest excavations will occur). However, an approximate static groundwater level of 2.3m was noted in trial pit TP7.

Groundwater flowpaths are likely to be short (30-300m), with groundwater discharging to nearby streams and small springs. Water strikes deeper than the estimated interconnected fissure zones suggest a component of deep groundwater flow, however shallow groundwater flow is considered to be dominant. Groundwater flow directions are anticipated to follow topography; and, therefore, groundwater directions within the site are expected to be towards the primary streams within the valleys of the site (GSI, 2004).

Baseflow contribution to streams tends to be low, particularly in summer as the groundwater regime cannot sustain summer baseflows due to low storativity within the aquifer. In winter, low permeabilities will lead to a high water table and possible water logging of soils. Local groundwater flow directions will mimic topography, whereby flowpaths will be from topographic high points to lower elevated discharge areas at local streams (GSI, 2004). The groundwater direction in the area of the substation site is expected to the downslope to the west.

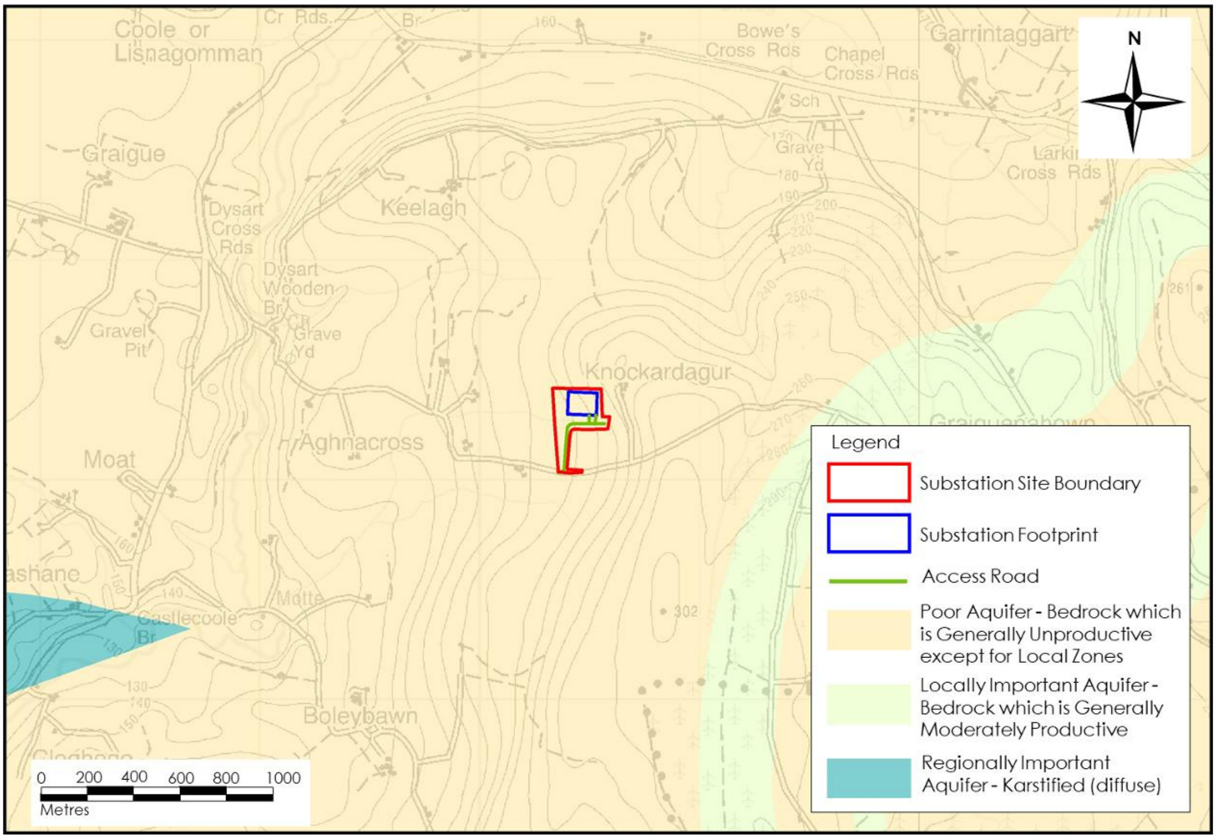


Figure 7.6: Bedrock Aquifer Mapping

7.3.8 Groundwater Vulnerability

The vulnerability rating of the aquifer at the proposed development site, as classified by the GSI, (west to east) ranges between Extreme (E) to Extreme (X) which is reflective of the varying depth of local subsoils. An Extreme (X) vulnerability rating is given where bedrock is at or close to the surface. An Extreme (E) vulnerability rating is given where subsoils are present with a maximum thickness of 3 metres.

Based on the site investigations completed at the proposed development site, which encountered bedrock at depths ranging from 1.3m to 6.6m (see **Chapter 6**), the actual mapped vulnerability mainly ranges from Extreme (X) to High (3-5m) with more localised Moderate vulnerability (5-10m).

However, due to the relatively low permeability of the shales and sandstones underlying the site, groundwater flowpaths are likely to be short (30–300m), with recharge emerging close by at seeps and surface streams. As a result, there is a low likelihood of groundwater dispersion and movement within the aquifer and, therefore, surface water bodies such as local drains and streams are more vulnerable than groundwater at this site.

7.3.9 Groundwater Hydrochemistry

There are no groundwater quality data for the proposed development site and groundwater sampling would generally not be undertaken for this type of development as groundwater quality effects would not be anticipated. However, the surface water sample taken immediately downstream of the site (SW1) is considered to be particularly representative of local groundwater conditions due to the proximity of the spring upslope.

Based on data from GSI publication *Calcareous/Non calcareous classification of bedrock in the Republic of Ireland* (WFD,2004), alkalinity for these non-calcareous bedrock type generally ranges from 14 – 400mg/L while electrical conductivity and hardness are reported to have mean values of 446µS/cm and 200mg/L respectively.

7.3.10 Groundwater Body Status

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

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

The Ballingarry GWB (IE_SE_G_009) underlies the proposed development site and is assigned 'Good Status', which is defined based on the quantitative status and chemical status of the GWB.

7.3.11 Surface Water Body Status

River/Surface Water Body status information is also available from **www.catchments.ie**. River/Surface Water Body status information is available for sub-catchments within the Owenbeg River in the area of the proposed development. The Owenbeg (Owveg(Nore)) is assigned "Good Status" both upstream and downstream of the site.

7.3.12 Designated Sites & Habitats

Due to the presence of the Knockardagur stream within the proposed development site, notwithstanding the fact that it is predominately dry and only on occasions will contain flow, a number of European and nationally designated sites are hydrologically connected to the subject site. Nationally designated sites include National Heritage Areas (NHAs) and proposed National Heritage Areas (pNHAs); while European sites designated for nature conservation include Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSAC) and Special Protection Areas (SPAs).

The proposed development site is not located within any designated conservation site. Designated sites in the wider vicinity of the proposed development site are show in **Figure 7.7**.

The proposed development site drains to the Owenbeg River, via the Knockardagur stream, which forms part of the River Barrow and River Nore SAC. The River Nore, downstream of the proposed development site, also comprises an SPA (designated due to the presence of Kingfisher) and a pNHA (River Nore and Abbeyleix Woods Complex).

The following key aquatic species and habitats of the River Barrow and River Nore SAC were identified as being at risk from a deterioration in water quality:-

- Water courses and vegetation;
- White-clawed Crayfish;
- Sea Lamprey;
- Brook Lamprey;
- River Lamprey;
- Twaite Shad;
- Salmon; and
- Nore Pearl Mussel.

The River Barrow and River Nore SAC is, therefore, considered to be very sensitive to the effects of water quality deterioration.

Designated sites that are not hydrologically connected to the development site but are located in the wider vicinity of the subject site include Lisbigney Bog SAC and pNHA (5.9km to the southwest of the site). These designated sites are not hydrologically connected to the proposed development site and, therefore, there is no likelihood of any interaction with these sites.

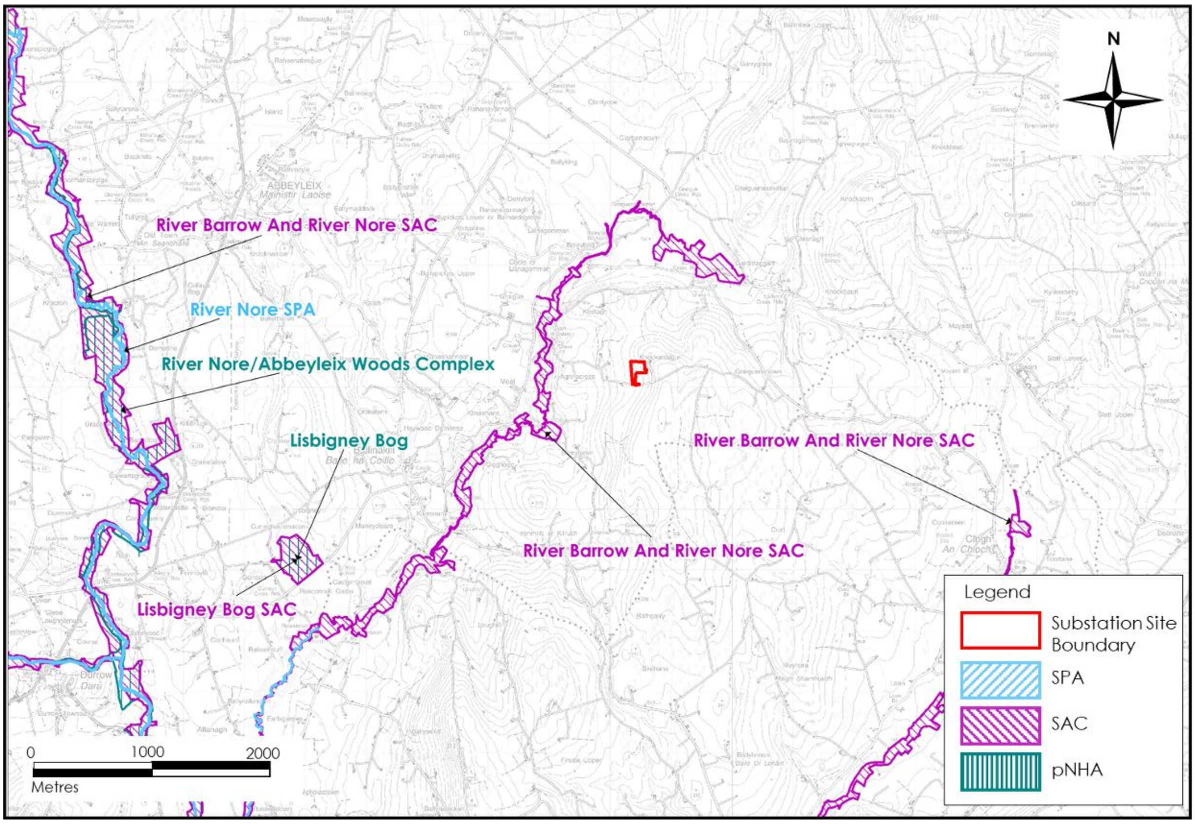


Figure 7.7: Designated Sites

7.3.13 Water Resources

There are no mapped groundwater source protection areas for public water supplies in the immediate vicinity of the proposed development.

There are a number of group water scheme (GWS) boreholes in the wider area including Ironmills GWS, Graiguenahoun GWS, Garrintaggert No. 2 and No. 3 GWS and Moyadd No. 1 GWS. Each of the GWS boreholes listed above are, at least, 2km from the proposed development and the proposed development site is not located inside the groundwater zone of contributions (ZOC) of these sources.

A search of private well locations (wells with a mapped accuracy of 1–50m were only considered) in the GSI well database (www.gsi.ie) was also undertaken. No private wells with a mapped accuracy of 1–50m are present within 1km of the proposed development site.

As the GSI well database is not exhaustive, in terms of all well locations being identified, it has been assumed that every private dwelling within 500m of the proposed development site has a well supply and this impact assessment approach is described further below. This is an extremely conservative approach[1] as it is unlikely that every private dwelling will have its own supply well.

The private well assessment undertaken below also assumes that groundwater flow patterns and direction in the aquifer underlying the site mimics the topography of the site, whereby flowpaths will be from topographic high points to lower elevated discharge areas at streams and rivers. Using this conceptual model of groundwater flow, dwellings which are possibly located down-gradient of the proposed development site are identified and an impact assessment for these potential well locations is undertaken in the impact assessment section below.

The locations of private dwellings within 500m of the proposed development site are illustrated at **Figure 7.8**. **Figure 7.8** also illustrates, based on topography/slope that there are no private dwellings located directly down-gradient of the proposed substation footprint excavation area. Impacts on the groundwater levels of local wells from the site entrance and access road construction are not likely due to the shallow nature of the required excavations. Measures are provided at **Section 7.4** below with regard groundwater quality protection for the overall site.

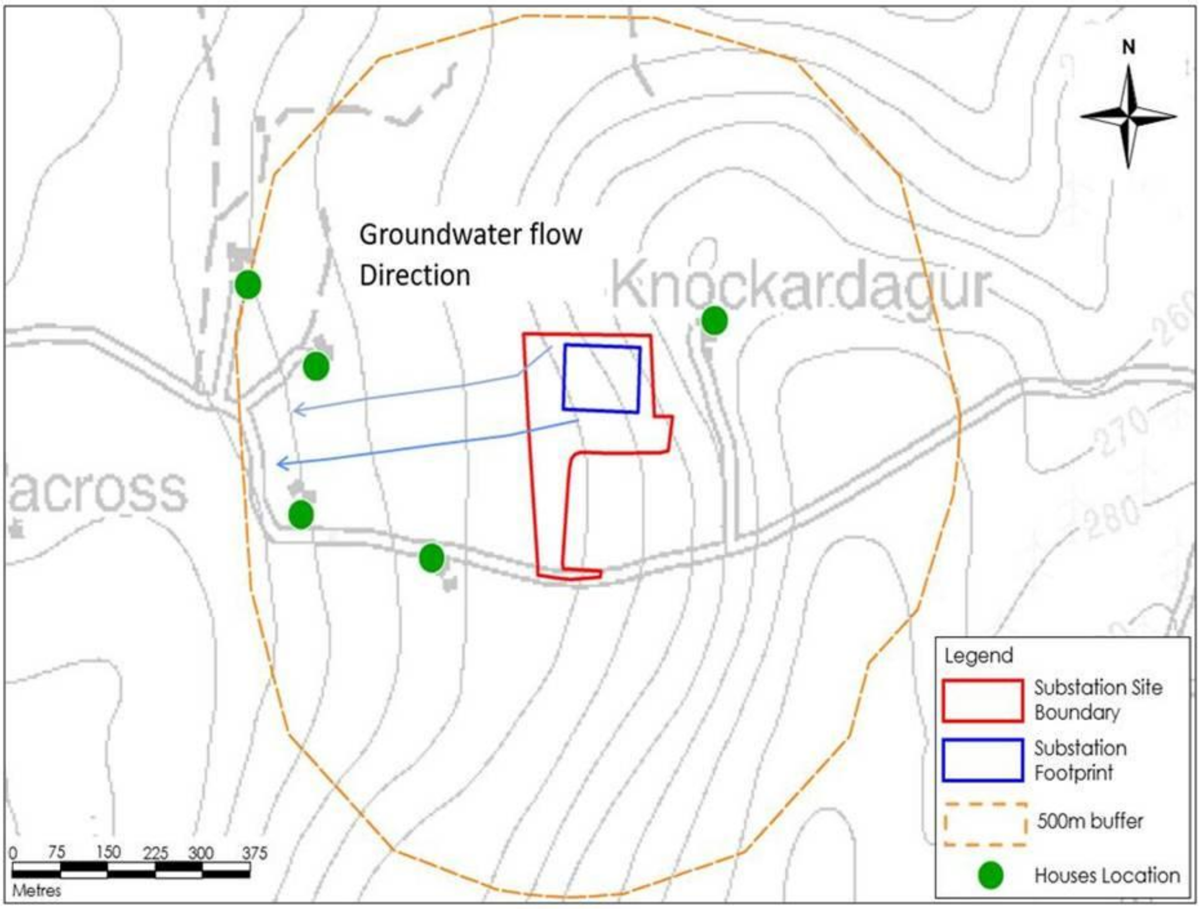


Figure 7.8: Private Dwelling Locations

[1] Please note that while wells may or may not exist at each property, the precautionary approach employed assumes that a well exists at each downgradient property and an assessment is therefore completed for each downstream dwelling.

7.3.14 Receptor Sensitivity

Due to the nature of the proposed development, being near surface construction activity, effects on groundwater are generally negligible. The primary risk to groundwater at the proposed development site would be from cementitious materials, hydrocarbon spillage and leakages. These are common possible effects on all construction sites (such as road works and industrial sites). All contamination sources are to be carefully managed at the site during the construction and operational phases of the development and mitigation measures are proposed below to avoid and manage any likelihood of effects.

Based on criteria set out at **Table 7.1** above, the Poor Aquifers (i.e. Namurian sandstones) at the site can be classed as Not Sensitive to pollution.

The majority of the proposed development site is also covered in poorly draining soil which acts as a protective cover to the underlying aquifer. Any contaminants which may be accidently released on-site are more likely to affect local surface water features, via runoff, than infiltrate groundwaters.

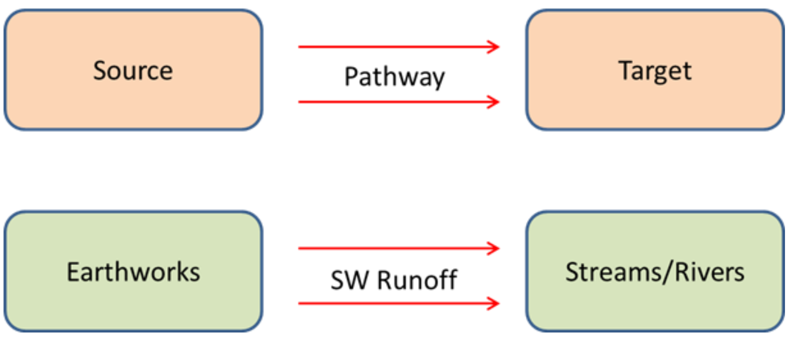
Surface water is evaluated to be the main sensitive receptor particularly given the presence of the Knockardagur stream within the proposed development site and the hydrological connectivity between the proposed development site and the Owenbeg (Owveg) River which forms part of the River Barrow and River Nore SAC. The SAC is considered to be very sensitive to adverse effects on water quality.

7.4 Description of Likely Effects

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

7.4.1 Overview of Impact Assessment Process

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



Where likely effects are identified, the classification of effects in the assessment follows the descriptors provided in the glossary of impacts contained in the following guidance documents produced by the Environmental Protection Agency (EPA):-

- Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2017);
- Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (EPA, 2003); and,

- Guidelines on the Information to be contained in Environmental Impact Statements (EPA, 2002).

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

In order to provide an understanding of the stepwise impact assessment process applied below (**Sections 7.4.3 and 7.4.4**), we have firstly presented below a summary guide that defines the steps (1 to 7) taken in each element of the impact assessment process (see **Table 7.12**). The guide also provides definitions and descriptions of the assessment process and shows how the source-pathway-target model and the EPA impact descriptors are combined.

Using this defined approach, this impact assessment process is then applied to all construction and operation activities, associated with the proposed development, which have the potential to generate significant adverse effects on the hydrological and/or hydrogeological (including water quality) environments.

Step 1	Identification and Description of Impact Source This section presents and describes the activity that brings about the likely impact or the source of pollution. The significance of effects is briefly described.	
Step 2	Pathway/ Mechanism:	The route by which a 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 be impacted upon, e.g. human health, plant / animal species, aquatic habitats, soils/geology, water resources, water sources. The 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 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 impacts after mitigation is put in place.
Step 7	Significance of Effects:	Describes the likely significant post mitigation effects of the identified impact source on the receiving environment.

Table 7.12: Impact Assessment Approach

7.4.2 Do Nothing Scenario

In the do nothing scenario, there would be no alteration to the hydrological 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.

7.4.3 Construction Phase

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

Construction phase activities including access track and substation construction will require earthworks resulting in removal of vegetation cover and excavation of soil and mineral subsoil where present.

These activities could 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 (receiving waters).

Attribute	Description
Receptor	Down-gradient streams, rivers and dependant ecosystems
Pathway/Mechanism	Drainage and surface water discharge routes
Pre-Mitigation Effect	Indirect, negative, significant, temporary, likely effect

Table 7.13: Earthworks

7.4.3.2 Excavation Dewatering and Likely Effects on Surface Water Quality

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

Attribute	Description
Receptor	Down-gradient surface water bodies
Pathway/Mechanism	Overland flow and site drainage network
Pre-Mitigation Effect	Indirect, negative, moderate, temporary, unlikely effect on surface water quality

Table 7.14: Excavation Dewatering

7.4.3.3 Release of Hydrocarbons during Construction and Storage

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

Attribute	Description
Receptor	Groundwater and surface water
Pathway/Mechanism	Groundwater flowpaths and site drainage network
Pre-Mitigation Effect	Indirect, negative, slight, short term, unlikely effect on local groundwater quality. Given the nature of the groundwater environment, discussed at **Sections 7.3.7**, **7.3.8**, **7.3.9** and **7.3.10** above, adverse effects on groundwater quality are assessed to be unlikely. Indirect, negative, significant, short term, likely effect to surface water quality

Table 7.15: Release of Hydrocarbons

7.4.3.4 Groundwater and Surface Water Contamination from Wastewater

Release of effluent from site welfare treatment systems may impact on groundwater and surface waters.

Attribute	Description
Receptor	Groundwater quality and surface water quality
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 7.16: Contamination from Wastewater

7.4.3.5 Release of Cement-Based Products

Concrete and other cement-based products are highly alkaline and corrosive and can have significant adverse effects on water quality. They generate very fine, highly alkaline silt (pH 11.5) that can physically damage fish by burning their skin and blocking their gills. A pH range of ≥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 batching of wet concrete on site and washing out of transport and placement machinery are the activities most likely to generate a risk of cement based pollution.

Attribute	Description
Receptor	Surface water hydrochemistry and ecosystems
Pathway/Mechanism	Site drainage network
Pre-Mitigation Effect	Indirect, negative, moderate, brief, likely effect on surface water

Table 7.17: Release of Cement-Based Products

7.4.3.6 Hydrological Effects on Designated Sites

The proposed development site drains to the Owenbeg (Owveg) River which forms part of the River Barrow and River Nore SAC. The River Nore downstream of the site is also a designated pNHA (i.e. River Nore and Abbeyleix Woods Complex). Effects include a deterioration in water quality which could result in significant effects on the habitats and species of the designated sites in the absence of mitigation.

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

Table 7.18: Release of Cement-Based Products

7.4.4 Operational Phase

The increase in hardstanding area and roofing could result in increased runoff and erosion in the nearby stream. Pre-mitigation effects on surface water flows from site runoff are likely to result in a probable, indirect, negative, long term, reversible, slight effect.

The primary risk to surface water and groundwater quality during the operational phase will be from hydrocarbon/chemical spillage. Pre-mitigation effects are likely to result in a near certain, indirect, negative, short term, reversible, imperceptible effect.

It is proposed that all wastewater effluent, associated with welfare facilities in the Eirgrid building and IPP building (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.

7.4.5 Decommissioning Phase

As set out at **Chapter 3** (**Sections 3.2** and **3.8**), the proposed development will form part of the national electricity network and decommissioning of the substation is not proposed. Therefore, decommissioning phase effects will not occur.

7.4.6 'Worst-Case' Scenario

The 'worst-case' for hydrological effects is assessed to comprise the contamination of surface water features in the vicinity of the proposed development site during the construction and operational phases, which, in turn, could adversely affect the ecology and quality of the downstream surface water bodies. Furthermore, it is assessed that localised groundwater contamination from spillages or hydrocarbons and other pollutants could occur; however, based on the nature of the existing groundwater environment, any effects are not likely to be significant.

Based on the likelihood of adverse effects on the hydrological environment resulting from the construction and operation of the proposed development, it is assessed that a comprehensive suite of best practice construction methodologies and dedicated mitigation measures will be required to be implemented to prevent this 'worst-case' scenario from arising. Moreover, in addition to the prevention of the worst-case scenario, these construction methodologies and mitigation measures will ensure the avoidance of any likely significant effects on the hydrological environment.

7.4.7 Cumulative Effects

The main likelihood for cumulative effects is assessed to be hydrological (surface water quality) rather than hydrogeological (groundwater). Due to the hydrogeological setting of the site (i.e. clay overlying a poor bedrock aquifer) and the near surface nature of construction activities, cumulative effects with regard groundwater quality or quantity arising from the proposed development are not assessed as likely.

With regards surface water quality cumulative effects, is it evaluated that the only development which is likely to act in-combination with the proposed development is the Pinewoods Wind Farm. The construction, operation and decommissioning of the Pinewoods Wind Farm, which was previously subject to Environmental Impact Assessment (EIA) and Appropriate Assessment (AA), provides for an extensive suite of detailed surface water protection measures (detailed at **Annex 3.4, Volume II**) to ensure that all surface water runoff from the that development area will be treated to an extremely high standard prior to discharge.

The mitigation measures proposed in respect of the subject proposed development, detailed at **Section 7.5** below, will also ensure that all water discharged from the proposed development site has been subject to substantial treatment to remove all presence of silt, sediment and other pollutants. Therefore, and in consideration of the relatively small footprint of the proposed development and the localised nature of the works, there is no likelihood for the proposed development to act in combination with other existing, permitted or proposed developments, including the permitted Pinewoods Wind Farm, to contribute to or result in significant hydrological/water quality effects.

7.5 Mitigation & Monitoring Measures

The overarching objective of the proposed mitigation measures is to ensure that all surface water runoff is comprehensively attenuated such that no silt or sediment laden waters or deleterious material is discharged into the local drainage system. A Surface Water Management Plan (SWMP), incorporating the surface water drainage design has been prepared, see **Annex 3.5** (**Volume II**), 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 has been designed to mimic same and is sufficient to accommodate a 1-in-100 year rainfall event.

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

- All surface water runoff will be directed to specially constructed swales surrounding all areas of ground proposed to be disturbed (including areas for the temporary storage of material);
- The swales will direct runoff into settlement ponds and, subsequently, lagoon-type sediment ponds where silt/sediment will be allowed to settle; and
- Following the settlement of silt/sediment, clean water will be discharged 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* infiltration interception drains, swales, sedimats, flow attenuation and filtration check dams, settlement ponds, lagoon-type sediment ponds and buffered outfalls. A detailed description of each of these individual elements, their specific purpose and effectiveness and their technical implementation is provided at **Annex 3.5**.

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 provide lagoon-type sediment traps which adhere to the design principles outlined by Altmuller and Dettmer (2006). It is not proposed to adopt, in full, the recommendations of Altmuller and Dettmer but to adapt the overall principles as applicable to the proposed development site. These lagoon-type ponds will absorb the fine particles, which may not settle in the primary settlement ponds;
- 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 within the limits prescribed in the Freshwater Pearl Mussel and Salmonid Regulations.

It should be noted that the measures set out below refer to the overall mitigation framework within which the SWMP has been prepared; while further measures are also proposed.

7.5.1 Construction Phase

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

The management of surface water runoff and subsequent treatment prior to release off-site will be undertaken during construction work as follows:-

- Prior to the commencement of construction activities, silt fencing will be placed along the western boundary of the proposed development site and up-gradient of the Knockardagur stream. It is important to note that no construction activities will commence until all necessary preliminary water quality protection measures have been implemented to the satisfaction of the Ecological Clerk of Works (ECoW) and Environmental Manager (EM);
- All necessary preventative measures, set out in this chapter and the Surface Water Management Plan (see **Annex 3.5**) will be implemented to ensure no entrained sediment, or deleterious matter, will enter the Knockardagur stream or other watercourse/existing drain;
- Disturbed Sediment Entrainment Mats - SEDIMATS (see http://www.hy-tex.co.uk/ht_bio_sed.html) will also be used in the Knockardagur stream. These

will be installed according to the manufacturer's instructions at suitable locations on the stream;

- The silt fences will be embedded into the local soils to ensure all site water is captured and directed to the surface water drainage system;
- As construction works progress through the site towards the substation footprint, water protection measures will be implemented.;
- Discharge to ground will be via a buffered outfall arrangement e.g. silt bag which will filter any remaining sediment from the pumped water;
- No pumped construction water will be discharged directly into local streams and all surface water runoff will be fully treated prior to discharge;
- Installation of upslope interceptor drainage to keep clean surface water runoff away from works areas;
- Daily monitoring of the excavation/earthworks, the water treatment and pumping system and the discharge area will be completed by the EM throughout the construction phase;
- If high levels of silt or other contamination is noted in the water treatment systems, all construction works will be immediately stopped. No works will recommence until the issue is resolved, to the satisfaction of the EM, and the cause of the elevated source is fully remedied;
- Earth works will be scheduled to take place during periods of low rainfall to reduce run-off and possible siltation of watercourses; and
- The Construction Industry Research and Information Association (CIRIA) provide guidance on the control and management of water pollution from construction sites ('Control of Water Pollution from Construction Sites, guidance for consultants and contractors', CIRIA, 2001). The guidance contained within this document will be strictly implemented and enforced on-site which will ensure that surface water arising during the course of construction activities will contain minimum sediment.

Pre-emptive Site Drainage Management

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

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

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

quantitative measure of recent rainfall. A 3 hour record is given and is updated every 15 minutes. Radar images are not predictive; and,
- Consultancy Service: Met Eireann provide a 24 hour telephone consultancy service. The forecaster will provide interpretation of weather data and give the best available forecast for the area of interest.

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 should 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.

7.5.1.2 Excavation Dewatering and Effects on Surface Water Quality

The management of excavation dewatering (pumping) 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 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 will be directed to the surface water drainage system for treatment prior to discharge;
- There will be no direct discharge to surface watercourses, and therefore no risk of hydraulic loading or contamination will occur;
- Daily monitoring of site excavations by the EM will occur during the construction phase. If high levels of seepage inflow occur, excavation work at this location will cease immediately and a geotechnical assessment undertaken; and,
- A mobile 'Siltbuster' or similar equivalent specialist treatment system will be available on-site for emergencies. Siltbusters are mobile silt traps that can remove fine particles from water using a proven technology and hydraulic design in a rugged unit. The mobile units are specifically designed for use on construction-sites. They will be used as final line of defence if needed.

7.5.1.3 Release of Hydrocarbons during Construction and Storage

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

- The volume of fuels or oils stored on site will be minimised. All fuel and oil will be stored in an appropriately bunded area within the temporary construction compound at the Pinewoods Wind Farm site and will be transported to the proposed development site as required. 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 re-fuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer, 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. 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 spillage;
- All waste tar material arising from road cuttings (as may be required in the construction of the site entrance) will be removed off-site and taken to a licensed waste facility. Due to the possibility of contamination of soils and subsoils, it is not proposed to utilise this material for any reinstatement works; and
- An outline emergency plan for the construction phase to deal with accidental spillages is contained within the preliminary CEMP (**Annex 3.4**). This emergency plan will be further developed prior to the commencement of development, and will be agreed with the Planning Authority as part of the detailed CEMP.

7.5.1.4 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 Pinewoods Wind Farm temporary construction 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.

7.5.1.5 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 take utilised;

- 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 within the Pinewoods Wind Farm temporary construction compound with waters being tankered off site and disposed of at an approved licensed facility. There will be no discharge of cement contaminated waters to the construction drainage system or to any drain or watercourse;
- Weather forecasting will be used to ensure that prolonged or intense rainfall is not predicted during concrete pouring activities; and,
- The pour site will be kept free of standing water and plastic covers will be ready in case of sudden rainfall event.

7.5.1.6 Hydrological Effects on Designated Sites

The proposed mitigation measures for protection of surface water quality, discussed above and further detailed at **Annex 3.5**, will ensure that the quality of runoff from proposed development areas will be very high and that no deleterious material is discharged to watercourses.

As stated in **Section 7.4.3.1** above, in the absence of mitigation, there could be an "imperceptible, temporary, low probability effect" on local streams and rivers which, if occurring, would be extremely localised and of a very short duration (i.e. hours). Given the wide ranging and comprehensive set of mitigation measures outlined above and further detailed in the SWMP, it is concluded that there is no likelihood of significant hydrological or water quality effects on any downstream designated site including the River Barrow and River Nore SAC, River Nore SPA and River Nore & Abbeyleix Woods Complex pNHA.

7.5.2 Operational Phase

7.5.2.1 Progressive Replacement of Natural Surface with Lower Permeability Surfaces

Stormwater Runoff

Stormwater control measures are as follows:-

- During the operational phase, stormwater from the proposed development site will be discharged to ground via soakaways following attenuation;
- Stormwater discharge from the proposed development site will be limited to greenfield runoff rates, therefore there will be no increase in storm water runoff rates entering the local environment;
- Runoff from the transformer and car park areas will be also be passed through an oil interceptor to prevent any discharge of hydrocarbons; and,
- It is likely that minor volumes of groundwater seepage will arise from the cut slopes. This water will be directed into the surface water management system for appropriate treatment prior to discharge.

Hydrocarbons and Chemicals

Proposed mitigation measures for storage of fuel and chemicals are outlined as follows:-

- All storage containers will be labelled appropriately, including hazardous markings;

- All holding tanks will be constructed of material appropriate for fuel/chemical storage and will be bunded to at least 110% of the maximum tank volume or 25% of the total capacity of all the tanks within the bund, whichever is greatest;
- All bulk tanks will be located within an impervious bund;
- 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 bunded 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;
- All fuel/chemical storage facilities will be subject to weekly inspection; and,
- Leaking or empty drums will be removed from the site immediately and disposed of via a registered waste disposal contractor.

7.5.3 Decommissioning Phase

As set out at **Chapter 3** (**Sections 3.2** and **3.8**), the proposed development will form part of the national electricity network and decommissioning of the substation is not proposed. Therefore, no decommissioning phase mitigation measures are required.

7.6 Residual Effects

7.6.1 Construction Phase

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

Following the implementation of appropriate mitigation measures, as outlined above, the residual effect is assessed to be a negative, indirect, imperceptible, short term, likely effect. Significant adverse effects on water quality are not assessed as likely.

7.6.1.2 Excavation Dewatering and Likely Effects on Surface Water Quality

Residual effects, following the implementation of mitigation measures, are assessed to be indirect, imperceptible, short term and are not assessed as likely to be significant.

7.6.1.3 Likely 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.

7.6.1.4 Groundwater and Surface Water Contamination from Wastewater Disposal

No significant residual effects are assessed as likely to occur.

7.6.1.5 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.

7.6.1.6 Likely Hydrological Effects on Designated Sites

No significant residual effects are assessed as likely to occur.

7.6.2 Operational Phase

7.6.2.1 Replacement of Natural Surface with Lower Permeability Surfaces

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

7.6.3 Decommissioning Phase

As set out at **Chapter 3** (**Sections 3.2** and **3.8**), the proposed development will form part of the national electricity network and decommissioning of the substation is not proposed. Therefore, residual decommissioning phase effects will not occur.

7.7 Monitoring

Ongoing monitoring of the surface water drainage system will be the responsibility of the EM. Prior to the commencement of development, a detailed Water Quality Inspection & Monitoring Plan (WQIMP) will be agreed with the Planning Authority. The monitoring programme will comprise field testing and laboratory analysis of a range of agreed parameters. Surface water monitoring will be undertaken along the Knockardagur stream and will include sampling locations SW1 and SW2.

The civil works contractor, who will be responsible for the construction of the site drainage system, and EM will undertake regular inspections of the drainage system to ensure that all measures are functioning effectively. 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 at any drainage features that may decrease the effectiveness of the drainage feature will be removed and disposed of at a licensed waste management facility.

7.8 Summary

During each phase of the proposed development (construction and operation), a number of activities will take place on the site of the proposed development which will have the potential to adversely affect the hydrological regime or water quality at the site or its vicinity. These likely 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 for effect.

Surface water drainage measures, pollution control and other preventative measures have been incorporated into the project design to minimise any likely adverse effects on water quality and downstream designated sites.

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 site runoff into local watercourses.

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

Overall, the proposed development presents no likelihood for significant effects on surface or groundwater quality following the implementation of the proposed mitigation measures. Additionally, this assessment has determined that there is no likelihood for significant cumulative effects to arise as a result of the construction, operation or decommissioning of the proposed development.