Moyvannan Electricity Substation

Environmental Impact Assessment Report

Chapter 7: Water

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7.1 Introduction

7.1.1 Background and Objectives

This chapter provides a baseline assessment of the environmental setting of the project, as described at Chapter 3, in terms of hydrology and hydrogeology. The objectives of the assessment are to:

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

7.1.2 Description of the Project

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

- A 110kV 'loop-in/loop-out' electricity substation;
- Approximately 270m of 110kV underground electricity line between the electricity substation and the Athlone-Lanesborough overhead transmission line and the provision of 2 no. interface masts;
- Approximately 7.5km of underground electricity line between the electricity substation and the permitted Seven Hills Wind Farm grid connection infrastructure; and,
- All associated and ancillary site development, access, excavation, construction, landscaping and reinstatement works, including provision of site drainage infrastructure.

The entirety of the project is located within the administrative area of County Roscommon; while electrical equipment suppliers, construction material suppliers and candidate quarries which may supply aggregates are located nationwide. As there is no likelihood of the works associated with the supply of such materials, including their delivery, resulting in significant effects on the hydrological or hydrogeological environment, such activities have, therefore, been screened out from further assessment within this chapter.

7.1.3 Statement of Authority

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

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

This chapter was prepared by Michael Gill, Jenny Law and Conor McGettigan.

Michael Gill (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 22-years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms and renewable projects in Ireland. He has substantial experience in surface water drainage design and SUDs design, and surface water/groundwater interactions. For example, Michael was involved in the Environmental Impact Statement/Environmental Report (EIS/EIAR) for Seven Hills Wind Farm, Oweninny Wind Farm, Cloncreen Wind Farm, and Yellow River Wind Farm, and over 100 no. other wind farm related projects.

Jenny Law (BSc, MSc) is an environmental geoscientist holding a first honours degree in applied environmental geosciences from the University College Cork in 2022. Jenny has assisted in the preparation of the land, soils and geology and hydrology chapters for various EIARs, hydrological impact assessments, Water Framework Directive Assessment reports and Flood Risk Assessment reports for a variety of projects including wind farm developments, grid connections and strategic housing developments.

Conor McGettigan (BSc, MSc) is an Environmental Scientist with over 4 years' experience in the environmental sector in Ireland. Conor holds an M.Sc. in Applied Environmental Science (2020) and a B.Sc. in Geology (2016) from University College Dublin. Conor routinely prepares the hydrology and hydrogeology chapters of EIARs for wind farm developments. Conor has also prepared several flood risk assessments and Water Framework Directive compliance assessments for various renewable energy developments in Ireland.

7.1.4 Relevant Legislation

The 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 also complied with:

- Planning and Development Act 2000 (as amended);
- Planning and Development Regulations 2001 (as amended);
- S.I. No 296/2018: European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 which transposes the provisions of the EIA Directive as amended by the Directive 2014/52/EU into Irish Law;
- S.I. No. 477/2011: European Communities (Birds and Natural Habitats) Regulations, implementing EU Directives 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) and 79/409/EEC on the conservation of wild birds (the Birds Directive);
- S.I. No. 293/1988: Quality of Salmon Water Regulations;
- Water Framework Directive (2000/60/EC) (as amended by Decision No. 2455/2011/EC; Directive 2008/32/EC; Directive 2008/105/EC; Directive 2009/31/EC; Directive 2013/39/EU; Council Directive 2013/64/EU; and Commission Directive 2014/101/EU ('WFD');
- S.I. No. 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');
- S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009, as amended, and S.I. No. 722/2003 European Communities (Water Policy) Regulations, as amended, which implement EU Water Framework Directive (2000/60/EC) and provide for the implementation of 'daughter' Groundwater Directive (2006/118/EC).
- European Communities (Water Policy) Regulations 2003 (S.I. No. 722/2003);
- S.I. No: 122/2010: European Communities (Assessment and Management of Flood Risks) Regulations, resulting from EU Directive 2007/60/EC;
- S.I. No. 684/2007: Waste Water Discharge (Authorisation) Regulations, resulting from EU Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances (the Groundwater Directive);
- S.I. No. 9/2010: European Communities Environmental Objectives (Groundwater) Regulations 2010, as amended; and,
- S.I. No. 296/2009: European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009, as amended.

7.1.5 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 (2005) *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*;
- DOE/NIEA (2015) *Wind Farms and Groundwater Impacts – A guide to EIA and Planning Considerations*;
- OPW (2009) *The Planning System and Flood Risk Management*;
- National Roads Authority (2008) *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*;
- *Wind Farm Development Guidelines for Planning Authorities* (2006);
- Inland Fisheries Ireland (2016): *Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Watercourses*;
- *Good Practice During Wind Farm Construction* (Scottish Natural Heritage, 2010);
- *PPG1 - General Guide to Prevention of Pollution (UK Guidance Note)*;
- *PPG5 – Works or Maintenance in or Near Watercourses (UK Guidance Note)*;

- CIRIA (Construction Industry Research and Information Association) 2006 *Guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006)*;
- CIRIA 2006 *Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors*. CIRIA C532. London, 2006.
- 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 the study area (see Section 7.2.7) was completed in Autumn 2023 to collect all relevant hydrological, hydrogeological and meteorological data. The desk study was completed in advance of, and to supplement, site walkover surveys, drainage mapping and site investigations. The desk study information has been reviewed, and updated where necessary, in August and September 2024.

The desk study involved consultation with and a review of the following sources:-

- Environmental Protection Agency database (www.epa.ie);
- Environmental Protection Agency's Hydrotool Database (www.catchments.ie);
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks & Wildlife Services Public Map Viewer (www.npws.ie);
- Water Framework Directive/EPA Catchments Map Viewer (www.catchments.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 12 (Geology of Longford-Roscommon);
- Geological Survey of Ireland (2004); Groundwater Body Initial Characterization Reports (www.gsi.ie);
- OPW Flood Databases (www.floodinfo.ie); and,
- Aerial Photography, 1:5000 and 6" base mapping (www.geohive.ie).

7.2.2 Baseline Monitoring and Site Investigations

Site walkover surveys, including drainage mapping and hydrological monitoring, were undertaken by Michael Gill, Conor McGettigan and Jenny Law of HES (refer to Section 7.1.3 for qualifications and experience). These surveys were completed during both wet and dry-weather periods.

In summary, the site investigations and baseline monitoring completed to inform the preparation of this chapter are as follows:

- Walkover surveys and hydrological mapping of the project site and the surrounding area were undertaken by HES whereby water flow directions and drainage patterns were recorded. These walkover surveys were completed on 22 February 2023, 18 January 2024 and 28 August 2024;
- A total of 2 no. surface water samples were undertaken to determine the baseline water quality of the primary surface waters in the vicinity of the project site;

- A total of 1 no. groundwater sample was obtained to determine the baseline groundwater quality in the areas of the project site;
- Apex Geophysics Ltd completed geophysical investigations at the electricity substation site in April 2023. The aim of these geophysical surveys was to provide information on the presence of any potential karst features, the thickness and type of soils and the depth to bedrock. The geophysical investigation report is provided at Annex 6.1;
- Ground Investigation Ireland (GII) completed intrusive site investigation at the electricity substation site between August and October 2023. The site investigation report is included at Annex 6.2. The site investigations comprised of:-
  - Excavation of 5 no. trial pits;
  - Drilling of 5 no. cable percussion boreholes with follow on rotary core borehole drilling (6 no.);
  - Completion of 1 no. soakaway test to determine the soil infiltration rate in accordance with BRE Digest 365;
  - The installation of 1 no. groundwater monitoring well at the electricity substation site; and,
- Seasonal groundwater level monitoring completed at the substation site in 2 no. wells (Well 1 and Well 2) between October 2023 and August 2024.

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 project site are quantified by applying the importance criteria set out at 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 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. • 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.

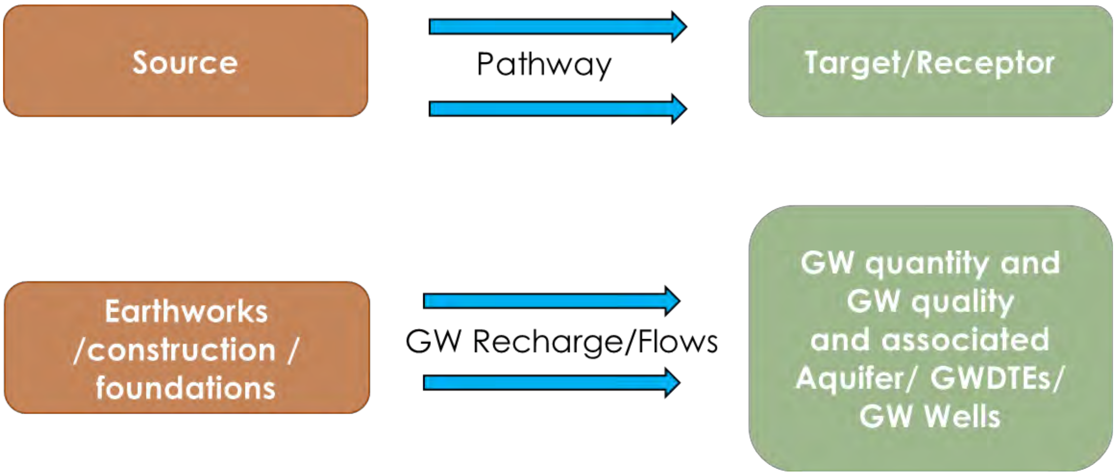
Table 7.4: Magnitude of Hydrogeology Impact (NRA, 2008)

	Magnitude of Impact			
Importance of Attribute	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 Overview of Impact Assessment Methodology

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



Where potential impacts are identified, the classification of impacts in the assessment follows the descriptors provided in the Glossary of Impacts contained in the Environmental Protection Agency (EPA) Environmental Protection Agency (May 2022) *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports*.

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

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

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

Step 6a	Identification and Description of Potential Impact Source This section presents and describes the activity that brings about the potential impact or the potential source of pollution. The significance of effects is briefly described.	
Step 6b	Pathway / Mechanism	The route by which a potential source of impact can transfer or migrate to an identified receptor. In terms of this type of development, surface water and groundwater flows are the primary pathways, or for example, excavation or soil erosion are physical mechanisms by which a potential impact is generated.
Step 6c	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 6d	Pre-Mitigation Effect	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impact before mitigation is put in place.
Step 6e	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 6f	Residual Effect	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impacts after mitigation is put in place.
Step 6g	Significance of Effects	Describes the likely significant post mitigation effects of the identified potential impact source on the receiving environment.

Table 7.6: Impact Assessment Process Steps

7.2.5 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 at Chapter 1 of this EIAR. Issues, concerns and recommendations highlighted by the responses in relation to the water environment are summarised at Table 7.7 below. The full responses from each of the below consultees are provided at Annex 1.5.

Consultee	Summary of Consultee Response	Issue(s) Addressed in Section(s)
Geological Survey of Ireland	• Please use the karst specific layers in the GSI database; • Identification of areas of High to Extreme groundwater vulnerability; and, • Use of Groundwater Flood Maps in the Flood Risk Assessment.	Sections 7.3.10, 7.3.9 and 7.3.6

National Federation of Group Water Schemes	• No GWSs in the local area.	Sections 7.3.14.1
OPW	• Where the grid connection crosses a river, the invert pipe crossing should be buried at least 1m below the existing bed level, the pipe should be embedded in concrete and suitably protected; and • Use of information on www.floodinfo.ie to inform the flood risk assessment.	Crossing will be completed by directional drilling Summary of FRA presented in Section 7.3.6.
Uisce Éireann	• Uisce Éireann provided a standard response in relation to potential effects on Uisce Éireann infrastructure and water supplies; and, • Uisce Éireann responded to a Pre-Connection Enquiry and confirmed that there is sufficient capacity for the proposed development and that an existing watermain fronts the proposed development site boundary.	Sections 7.3.14.1

Table 7.7: Summary of Scoping Responses

7.2.6 Limitations and Difficulties Encountered

No limitations or difficulties were encountered during the preparation this chapter.

7.2.7 Study Area

The study area for this assessment is defined by the regional surface water catchments and groundwater bodies within which the project is located.

A regional hydrology map showing WFD surface water catchments and sub-catchments is provided at Figure 7.1 (Annex 7.1). The relevant surface water catchments within which the project is located are detailed at Section 7.3.3. In addition, the bedrock aquifers and groundwater bodies which underlie the project are detailed at Section 7.3.8.

7.3 Description of the Existing Environment

7.3.1 Project Site Location and Description

The project site is located in rural County Roscommon. The electricity substation site is located c. 8 kilometres (km) northwest of Athlone town, c. 2.5km northwest of Kiltoom and c. 8km east of the permitted Seven Hills Wind Farm. The electricity substation will be located in the townland of Moyvannan. The underground electricity line will extend southwards from the electricity substation and will be located within private lands (in the vicinity of the substation) and along the local and regional road network as far the junction between the L7636 and the R363 in the village of Brideswell.

The electricity substation site can be accessed from the N61 national secondary road which is located c. 700m to the east. Several local roads extend to the west from this national road and facilitate access to the electricity substation site. Meanwhile, the R362 and the R363 provide access to the underground electricity line.

The project site, and surrounding topography, is typical of this region and comprise a generally flat landscape with occasional gentle undulations, with ground elevations at the electricity substation site ranging between 69 metres (m) and 80m above Ordnance Datum (mOD). Ground elevations along the underground electricity line generally range between 49m and 80mOD, with the greatest elevation location in the north. To the east of the project site, the terrain generally slopes towards the western shores of Lough Ree while, to the north, west and south, there are a number of turloughs, including Lough Funshinagh, which highlight the presence of localised depressions in the landscape.

The electricity substation site comprises of agricultural pastures with field boundaries delineated by stone walls. There are also one-off rural dwellings and agricultural holdings in the local area, the nearest dwelling being c. 300m to the southeast of the footprint of the electricity substation. Meanwhile, the underground electricity line is c. 7.5km in length and is located largely within the public road network with a small section located within private lands in the immediate vicinity of the electricity substation. Dwellings are located along the majority of the public roads along which the underground electricity line is proposed.

7.3.2 Water Balance

Long term rainfall and evaporation data was sourced from Met Éireann. The 30-year annual average rainfall volumes (AAR; 1981-2010) recorded at Lecarrow rainfall station, located c. 6.5km north of the electricity substation site are presented at Table 7.8 below. The long-term average annual rainfall at Lecarrow rainfall station is 977mm/yr.

However, the AAR at Lecarrow rainfall station is likely to underestimate the actual AAR at the project site due to the elevation difference (the highest elevation at the project site is c. 80mOD which is higher than Lecarrow rainfall station which stands at c. 47mOD).

Met Éireann also provide a grid of average annual rainfall for the entire country for the period from 1991 to 2020. Based on this more site-specific modelled rainfall values, the average annual rainfall at the electricity substation site is 1,015mm/yr. Meanwhile, the average annual rainfall along the underground electricity line ranges from 1,015 to 1,030mm/y with an average of 1,022mm/yr.

Station		X--Coordinate		Y-Coordinate		Elevation (mOD)		Opened		Closed	
Lecarrow		196,900		254,900		47		1952		-	
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
102	76	81	60	63	68	66	80	78	105	94	104

Table 7.8: Local Average Long-Term Rainfall Data (mm)

The closest synoptic[1] weather station where the average potential evapotranspiration (PE) is recorded is at Mullingar, c. 45km east of the electricity substation site. The long-term average PE for this station is c. 446mm/yr. This value is used as a best estimate of the project site's PE. Actual Evaporation (AE) at the project site is estimated as c. 424mm/year (calculated as 0.95 × PE).

The effective rainfall (ER) represents the water available for runoff and groundwater

[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.

recharge. The ER for the electricity substation site is calculated as follows:-

Effective rainfall (ER) = AAR – AE
= 1,015mm/year – 424mm/year
ER = 591mm/year

Groundwater recharge and runoff coefficient estimates are available from the GSI (www.gsi.ie). Within the vicinity of the electricity substation site, groundwater recharge coefficients range from 60% to 85%. The 60% recharge value is assigned in areas were till is overlain by well-drained soil. Meanwhile, the 85% recharge value is assigned by the GSI where they map areas of bedrock outcrop or subcrop. Based on the site investigation data (see Chapter 6) which encountered overburden thickness typically in excess of 5m at the electricity substation site, a recharge coefficient of 70% is assigned to the overall electricity substation site. Based on the above, annual recharge and runoff rates at the electricity substation site are estimated to be c. 414mm/yr and c. 177mm/yr respectively.

Groundwater recharge estimates from the GSI along the underground electricity line predominantly range between 60% and 85%. Therefore, assuming an AAR of 1,022mm/yr and a recharge coefficient of 70% along the majority of the underground connection line, groundwater recharge and runoff will be 419mm/yr and 179mm/y respectively. A small section to the north of Brideswell is estimated to have lower recharge coefficients where the GSI map the presence of peat. The groundwater recharge and surface water runoff in this area will be c. 419mm/yr and c. 179mm/yr respectively.

Table 7.9 presents return period rainfall depths for the electricity substation 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 project drainage design.

Duration	10-year Return Period (mm)	50-Year Return Period (mm)	100-Year Return Period (mm)
15 min	11.4	17.7	21.2
1 hour	17.9	26.2	30.7
6 hour	32.1	43.8	49.8
12 hour	40.2	53.3	60
24 hour	50.3	65	72.3

Table 7.9: Return Period Rainfall Depths for Project Site

7.3.3 Regional and Local Hydrology

On a regional scale, the project site is located within 2 no. surface water catchments. The electricity substation site and the northern section of the underground electricity line are mapped within the Upper Shannon (Lough Ree) regional surface water catchment within Hydrometric Area 26E. Meanwhile, the southern section of the underground electricity line is mapped in the Upper Shannon (Mid Shannon) regional surface water catchment within Hydrometric Area 26G. Both of these regional surface water catchments are situated in the Shannon Irish River Basin District.

The Upper Shannon (Lough Ree) Catchment covers an area of 581km² and is characterised by a flat landscape underlain by impure limestones to the east and purer, karstified limestones under and to the west of Lough Ree (EPA, 2024). Within this regional surface water catchment, the project site is located in the Shannon Upper sub-catchment (Shannon[Upper]_SC_090) with all surface waters draining towards Lough Ree. Lough Ree is located c. 2.5km east of the electricity substation site.

More locally, this area of the project site is mapped within 2 no. WFD river sub-basins. The electricity substation site and c. 1.6km of the underground electricity line are mapped in the Shannon (Upper)_110 WFD river sub-basin. Meanwhile, c. 1.8km of the underground electricity line is mapped in the Ballybay_010 WFD river sub-basin. There is a distinct lack of mapped surface water features in both of these river sub-basins.

Meanwhile, the Upper Shannon Catchment includes an area of 383km² and is comprised of the catchment area from Athlone to Shannonbridge. The catchment is characterised by flat topography and expanses of poorly drained boggy and flood prone areas (EPA, 2024). Within this regional surface water catchment the project site is located in the Shannon[Upper]_SC_100 sub-catchment and 2 no. WFD river sub-basins. This area of the project site is drained by the Cross (Roscommon) River with c. 1.4km of the underground electricity line mapped in the Cross (Roscommon)_010 WFD river sub-basin and c. 2.7km mapped in the Cross (Roscommon)_020 WFD river sub-basin. There is 1 no. mapped watercourse crossing over the Cross (Roscommon) River in the townland of Derryglad. This is an existing crossing along a public road. The Cross (Roscommon) River is mapped as flowing to the southeast and discharges into the River Shannon downstream of Athlone.

A regional hydrology map is illustrated at Figure 7.1 (Annex 7.1).

7.3.4 Surface Water Flows

Due to the lack of surface water features locally, there are no OPW gauging stations located in the vicinity of the electricity substation site. The closest gauging station downstream of the underground electricity line along the Cross (Roscommon) River is located at Summer Hill (Station Number: 26221). The upstream catchment area of the Cross (Roscommon) River at this location is estimated to be 103km² and the 95%ile flow is recorded as 0.664m³/s.

The EPA's Hydrotool, available on www.catchments.ie, was consulted in order to estimate the baseline flow volumes along the Cross (Roscommon) River (note that no Hydrotool nodes are available in the area of the electricity substation site). The Hydrotool dataset contains estimates of naturalised river flow duration percentiles.

Figure 7.2 below presents the modelled flow duration curves for the Cross (Roscommon) River downstream of the underground electricity line. A 95%ile flow equates to the flow which will be exceeded within the river 95% of the time. For example, at Node 26_506 immediately downstream of the crossing over the Cross (Roscommon) River, the 95%ile flow is modelled to be 0.165m³/s. Downstream of the confluence of the Cross (Roscommon) River and the EPA mapped Mihanboy River, the 95%ile flow at Node 26_1461 is modelled to be 0.275m³/s. The flow volumes increase progressively downstream due to the increasing catchment area of the Cross (Roscommon) River.

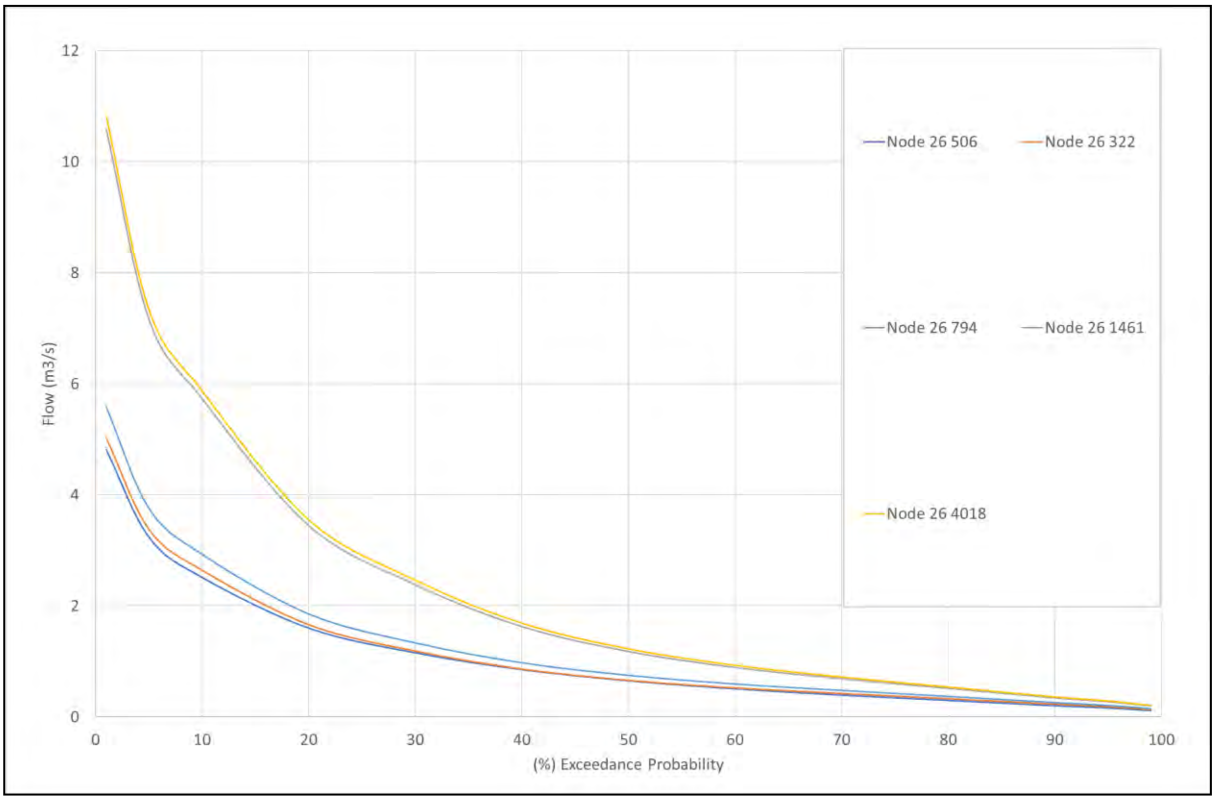


Figure 7.2: River Flow Exceedance Curves

7.3.5 Electricity Substation Site Drainage

There is a distinct lack of local drainage features (field drains, ditches, streams etc.) within the vicinity of the electricity substation site.

The closest EPA mapped watercourse is situated c. 1.8km to the southeast of the electricity substation site. This small stream, referred to by the EPA as the Moyvannan Stream, originates to the east of the N61 and flows to the east, discharging into Lough Ree.

The nearest hydrological feature to the electricity substation site is a cluster of unnamed lakes located c. 300m to the south. These features are mapped by the GSI and were observed during site walkover surveys. There was no visible surface water inlet or outlet to these features which were noted to be seasonal. These lakes are interpreted as being turloughs, i.e. topographic depressions in karst landscapes that are intermittently inundated on an annual basis mainly from groundwater and drain without overland stream flow.

The existing drainage regime at the electricity substation site is shown as Figure 7.3 (Annex 7.1).

7.3.6 Flood Risk Identification

A Flood Risk Assessment of the project site has been completed, the findings of which are presented in full at Annex 7.2 and are summarised below.

To identify those areas assessed as being at risk of flooding, the OPW's Past Flood Events Maps, the National Indicative Fluvial Mapping, National Catchment-based Flood Risk Assessment and Management (CFRAM) River Flood Extents, historical mapping (i.e. 6" and 25" base maps) and the GSI Groundwater Flood Maps were consulted. These flood maps are available to view at www.floodinfo.ie.

The OPW Past Flood Events Maps have no records of recurring or historic flood instances within the electricity substation site or along the underground electricity line. Similarly, identifiable text on local available historical 6" or 25" mapping does not identify any lands that are "liable to flood".

The closest mapped recurring flood event is situated c. 1.8km northwest of the electricity substation site at Lough Cup, Ardmullan. The lake level rises and was liable to flood the nearby road; although, according to the OPW Flood Hazard Mapping area engineer notes (2004), the level of the road has now been raised (Flood ID: 163). This mapped flood event is not downstream of the electricity substation site. Furthermore, there are no mapped recurring flood events downstream of the electricity substation site or immediately downstream of the underground electricity line.

The GSI's Winter 2015/2016 Surface Water Flood Map shows surface water flood extents for this winter flood event. This flood event is recognised as being the largest flood event on record in many areas. The flood map for this event does not record any flooding in the area of the electricity substation site. The nearest mapped flood zones are along the Moyvannan Stream, c. 2km to the southeast of the electricity substation site. With regards to the underground electricity line, the closest mapped flooding was recorded c. 100m to the east in the townland of Derryglad.

No CFRAM mapping has been completed for the area of the project. The closest mapped CFRAM fluvial flood zones for the Present Day Scenario are mapped along the Moyvannan Stream, c. 2km to the southeast of the electricity substation site. No CFRAM mapping has been completed along the Cross (Roscommon) River in the vicinity of the underground electricity line.

The National Indicative Fluvial Flood Map for the Present Day Scenario does not map any flood zones in the vicinity of the electricity substation site. Meanwhile, medium probability (1-in-100 year) flood zones are mapped along the Cross (Roscommon) River at, and in the vicinity of, the crossing of the river by the underground electricity line. This modelled flood zone is located at an existing crossing over this watercourse and the electricity line will result in no displacement of floodwaters.

With regards to groundwater flooding, the GSI Maximum Historic Groundwater Flood Map records historic groundwater flooding to the south and southeast of the electricity substation site. These historic groundwater flood zones are associated with turloughs but do not encroach upon the footprint of the project. Based on the GSIs Groundwater Flooding Probability Maps, the low probability groundwater flood zone does not differ significantly from the flood zone recorded in the Maximum Historic Groundwater Flood Map. Meanwhile, despite there being several areas of groundwater flooding in the lands surrounding the underground electricity line, no historic or modelled groundwater flood zones encroach the route.

Based on the above, the risk of flooding at the project site is low due to the well-drained nature of the soils and subsoils and the low density of surface water features in the local area.

7.3.7 Surface Water Quality

7.3.7.1 EPA Water Quality Monitoring

Biological Q-rating data for EPA monitoring points in the local catchments downstream of the project site are shown at Table 7.10 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).

There are no EPA monitoring stations available in the vicinity of the electrical substation site due to the lack of surface water drainage networks. The closest downstream EPA monitoring station is located on the River Shannon downstream of Lough Ree. In 2023, the River Shannon achieved a Q4 rating at Burgess Park in Athlone (Station Code: RS26S021720).

With regards to the underground electricity line, EPA monitoring has been completed on the Cross (Roscommon) River. The most recent monitoring (2023) was completed at a bridge at Burnbrook (Station Code: RS26C100200) downstream of the underground electricity line. The Cross (Roscommon) River was assigned a Q-rating of Q4 (i.e. Good status) at this location. Further downstream the Cross (Roscommon) River also achieved at Q4 rating near Doyle's Bridge (Station Code: RS26C100300). Meanwhile, upstream of its confluence with the River Shannon, the Cross (Roscommon) River achieved a Q3 rating (i.e. Poor status) (Station Code: RS26C100400).

A map of the EPA monitoring stations for which recent data (2023) is available is included at Figure 7.4 (Annex 7.1).

Watercourse	Station Code	Easting	Northing	Year	Q-Value Score
River Shannon	RS26S021720	204117	240948	2023	Q4 (Good)
Cross (Roscommon) River	RS26C100200	198675	242140	2023	Q4 (Good)
Cross (Roscommon) River	RS26C100300	201085	240179	2023	Q4 (Good)
Cross (Roscommon) River	RS26C100400	203708	239202	2023	Q3 (Poor)

Table 7.10: EPA Q-Rating Values Downstream of Project Site

7.3.7.2 Surface Water Quality Monitoring

HES completed a round of 3 no. water samples on 28 August 2024. 1 no. sample was obtained from the Cross (Roscommon) River along the underground electricity line, while the remaining 2 no. samples were taken from a turlough and well in the vicinity of the electricity substation site.

Field hydrochemistry measurements of unstable parameters, electrical conductivity (µS/cm), pH (pH units), temperature (°C) and dissolved oxygen (DO-%) were taken with a calibrated YSI ProDSS and are listed for Cross River at Table 7.11 below. The monitoring locations are provided at Figure 7.4 (Annex 7.1).

Electrical conductivity (EC) in the Cross (Roscommon) River was recorded as 628µS/cm while pH was very slightly basic (7.4). Turbidity was recorded as being 1.74NTU with dissolved oxygen measured at 7.51mg/l. The field hydrochemistry indicates a relatively healthy watercourse.

Location	Temp (°C)	EC (µS/cm)	pH	Dissolved Oxygen (mg/L)	Turbidity (NTU)
Cross River	13.6	628	7.4	7.51	1.74

Table 7.11: Field Hydrochemistry on the Cross River (28/08/2024)

A surface water grab sample was also taken on the Cross (Roscommon) River for laboratory analysis on 28 August 2024. Results of the laboratory analysis are shown alongside relevant water quality regulations at Table 7.12 below. The laboratory reports are attached at Annex 7.3.

Suspended solid concentrations ranged were below the limit of detection of the laboratory and well below the S.I 293/1988 threshold limit of 25 mg/l. Ammonia, Biological Oxygen Demand (BOD) and Ortho-phosphate were found to be of High status with regards to their respective thresholds values as detailed in S.I. 272/2009. Nitrate concentration was recorded as 1.9mg/L while chloride concentrated was found to be 17.2mg/L.

Parameter	EQS	Cross River
Total Suspended Solids (mg/L)	≤25(+)	<5
Ammonia (mg/L)	≤0.065 to ≤ 0.04(*)	0.02
Nitrite NO_2 (mg/L)	-	<0.1
Ortho-Phosphate – P (mg/L)	≤ 0.035 to ≤0.025(*)	0.014
Nitrate - NO_3 (mg/L)	-	1.9
Chloride (mg/L)	-	17.2
BOD	≤ 1.3 to ≤ 1.5(*)	<1

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

Table 7.12: Summary of Surface Water Quality Data

7.3.8 Hydrogeology

7.3.8.1 Desk Study Hydrogeological Data

According to GSI mapping (www.gsi.ie), the majority of the project site is underlain by Dinantian Pure Bedded Limestones which are classified by the GSI as a Regionally Important Aquifer – Karstified (conduit). Meanwhile, a small section of the overall landholding to the north of the electricity substation is underlain by Dinantian Pure Unbedded Limestones which are classified by the GSI as a Locally Important Aquifer – Bedrock which is Moderately Productive only in Local Zones. A bedrock aquifer map is provided at Figure 7.5 (Annex 7.1).

The project site is underlain entirely by the Funshinagh Groundwater Body (GWB) (IE_SH_G_091) which has a karstic limestone flow regime. According to the GSI's Initial Characterisation Report of the Funshinagh GWB, both point and diffuse recharge occur in this GWB. Swallow holes and collapse features provide the means for point recharge. Diffuse recharge will occur over the entire GWB via rainfall percolating through the subsoil. The lack of surface drainage in several parts of this GWB indicates that potential recharge readily percolates into the groundwater system (GSI, 2003).

These rocks are generally devoid of intergranular permeability. Groundwater flows through fissures, joints, along bedding planes and conduits. In pure bedded limestones, the fissures and joints are enlarged by karstification which results in the formation of conduits and significantly enhances the permeability of the rock.

Dolomitisation will also locally enhance permeability by collapsing the void space and creating cavities. In some instances, an element of intergranular permeability can develop as a result of dolomitisation. Karstification can be accentuated along structural features such as fold axes and faults. Groundwater flow through karst areas is extremely complex and difficult to predict. As flow pathways are often determined by discrete conduits, actual flow directions will not necessarily be perpendicular to the assumed water table contours.

Flow path lengths can be up to a several kilometres in length. Overall groundwater flow will be towards Lough Ree, but the highly karstified nature of the bedrock means that locally groundwater flow directions can be highly variable (GSI, 2003).

There is a high degree of interconnection between groundwater and surface water in this GWB. Numerous karst features such as turloughs, swallow holes and enclosed depressions are evident.

7.3.8.2 Summary of Geological Data

A detailed description of the geology at the project site is provided at Chapter 6 of this EIAR. The following is a brief summary of relevant geological information that has a bearing on the hydrogeology of the site:-

- The site is underlain by thick overburden deposits which generally comprise of cohesive gravelly clay deposits with a varying cobble and boulder content over granular deposits consisting of gravelly fine to coarse sand with a medium to high cobble and boulder content;
- The total thickness of the overburden deposits ranged from 3.8m to 12.2m with an average of 8m across the 6 no. rotary core boreholes;
- A layer of potentially weathered bedrock was encountered in 3 no. rotary core boreholes at depths ranging from 3.8 to 9.8m. This layer, where present, is thin ranging from 1.1 to 3.35m in thickness;
- The underlying competent bedrock is noted to comprise of strong to very strong massive fossiliferous limestone which is interbedded with moderately weak to strong massive dolomitic limestone;
- The bedrock is notes to be generally fresh to slightly weathered;
- The total core recovery is good, typically 100%, with some of the runs dropping to 80% or 90% recovery were cavities are present; and,
- The occasional cavities are filled with clay or sand; however, no significant karst features were recorded.

7.3.8.3 Summary of Field Hydrogeological Data

The rotary core borehole drilling provides great detail on the depth of overburden and bedrock lithology/type at the electricity substation site. A summary of the rotary core borehole logs are provided at Table 7.13. The full logs are included at Annex 6.2. No groundwater strikes were recorded during the drilling of the boreholes. Meanwhile, groundwater monitoring installation was completed at RC02 to facilitate groundwater level monitoring.

No groundwater was encountered in any of the 5 no. trial pit excavations which extended to depths of between 2.6m and 4.1m below-ground-level (bgl). An additional trial pit excavation was completed to facilitate the soakaway test and also did not encounter any groundwater to a depth of 0.5mbgl.

The soakaway test completed at TP-SA01 was completed in accordance with BRE Digest 365 and recorded an infiltration rate of 1.38610^{-5}m/s. This infiltration rate is typical of sandy subsoils with TP-SA01 recording the presence of gravelly fine to coarse sand at a depth of 0.4mbgl.

Manual groundwater level monitoring was completed in the newly installed standpipe at RC02 and in the preexisting farm well in the vicinity of the electricity substation site between October 2023 and August 2024. The water level in the turlough to the south of the electricity substation site was also surveyed using a differential GPS on several dates during this monitoring period. The manual water level data is presented at Table 7.14 below.

Meanwhile continuous water level monitoring was completed in RC02 and the adjacent agricultural farm well from the 18 January to 25 July 2024. The data is presented graphically at Figure 7.6 below.

The groundwater monitoring illustrates that water levels in the vicinity of the electricity substation site fall to the south and east. The maximum water level of 71.31mOD was recorded in RC02 in March 2024. This water level is >3m below the existing ground level at this location. The water level is lower in the farm well (PW01) as this well is being pumped for agricultural uses. The water level in the turlough is up to 5m lower than the water level in RC02 during the winter months. During summer, the fall in water levels was greater at RC02 than in the turlough.

Rotary Core Borehole Number	Total Depth (m)	Overburden (m)	Bedrock	Karst Features	Groundwater Strike
RC01	23.3m	0–12.2m	12.2–14.3m: Strong massive fine grained fossiliferous LIMESTONE. Fresh to slightly weathered with clay infilled fractures; 14.3–15.8m: Moderately weak to medium strong massive medium grained DOLOMITIC LIMESTONE with vugs. Moderately weathered. 15.8–19.75m: Strong to very strong massive fine grained fossiliferous LIMESTONE. Fresh to slightly weathered. 19.75–23.3m: Medium strong to strong medium grained DOLOMITIC LIMESTONE with vugs. Fresh to slightly weathered.	None	None
RC02	20.3m	0–3.8m	3.8-6.35m: Possible weathered rock – very stiff slightly sandy slightly gravelly CLAY with high cobble content. 6.35-8.3m: Medium strong massive medium grained DOLOMITIC LIMESTONE with vugs. Moderately weathered with clay infilled fractures. 8.3 – 20.3m: Strong to very strong massive medium grained DOLOMITIC LIMESTONE with vugs. Fresh to slightly weathered.	None	None
RC03	20.3m	0-9.8m	9.8-10.9m: Possible weathered rock – slightly clayey slightly sandy fine to coarse GRAVEL with low cobble content. 10.9–12.2m: Medium strong massive medium grained DOLOMITIC LIMESTONE with vugs. Moderately weathered. 12.2–16.8m: Strong to very strong massive medium grained DOLOMITIC LIMESTONE with vugs. Slightly weathered. 16.8–19.25m: Strong to very strong massive fine grained fossiliferous LIMESTONE. Fresh to slightly weathered. 19.25–20.3m: Strong massive medium grained DOLOMITIC LIMESTONE with vugs. Slightly weathered.	None	None
RC04	20.3m	0–4.05m	4.05–20.3m: Strong to very strong massive medium grained DOLOMITIC LIMESTONE with vugs. Fresh to slightly weathered.	None	None
RC05	20.3m	0 – 5.3m	5.3-6.8m: Possible weathered rock – slightly sandy fine to coarse GRAVEL. 6.8-7.4m: Possible weathered rock – sandy gravelly CLAY with limestone boulders. 7.4-8.65m: Possible cavity infill of sandy gravelly CLAY. 8.65–9.95m: Strong to very strong massive fine grained fossiliferous LIMESTONE.	None	None

			Fresh to slightly weathered. 9.95–10.45m: Clay Infilled cavity. 10.45–12.0m: Medium strong to strong massive medium grained DOLOMITIC LIMESTONE with vugs. Moderately weathered. 12.0–13.2m: Strong to very strong massive medium grained DOLOMOTIC LIMESTONE with vugs. Fresh to slightly weathered. 13.2–13.5m: Clay infilled cavity. 13.5–15.45m: Strong to very strong massive medium grained DOLOMITIC LIMESTONE with vugs. Fresh to slightly weathered. 15.45–15.65m: Clay infilled cavity. 15.65–17.8m: Strong to very strong massive medium grained DOLOMITIC LIMESTONE with vugs. Fresh to slightly weathered. 17.8–18.3m: Very weak to weak massive medium grained DOLOMITIC LIMESTONE with vugs. Highly weathered. 18.3-20.3m Strong to very strong massive medium grained DOLOMITIC LIMESTONE with vugs. Fresh to slightly weathered.		
RC06	24.8	0–7.9m	7.9-10.0m: Possible weathered rock – slightly gravelly sandy CLAY with medium cobble content. 10.0–12.95m: Medium strong massive medium grained DOLOMITIC LIMESTONE with vugs. Moderately weathered. 12.95–13.15m: Sand infilled cavity. 13.15–15.8m: Strong to very strong massive medium grained DOLOMITIC LIMESTONE with vugs. Fresh to slightly weathered. 15.8–17.4m: Medium strong to strong massive medium grained DOLOMITIC LIMESTONE with vugs. Slightly to moderately weathered. 17.4–24.8m: Strong to very strong massive medium grained DOLOMITIC LIMESTONE with vugs. Fresh to slightly weathered.	None	None

Table 7.13: Summary or Rotary Core Borehole Logs

Monitoring Location	10/10/2023		18/01/2024		28/08/2024	
	WL (mbgl)	WL (mOD)	WL (mbgl)	WL (mOD)	WL (mbgl)	WL (mOD)
RC02	9.03	66.09	6.62	68.49	N/A	N/A
Turlough	N/A	60.95	N/A	63.479	N/A	61.855
Farmers Wel (PW01)l	16.22	56.14	14.08	58.28	20.34	52.02

Table 7.14: Manual Water Level Monitoring

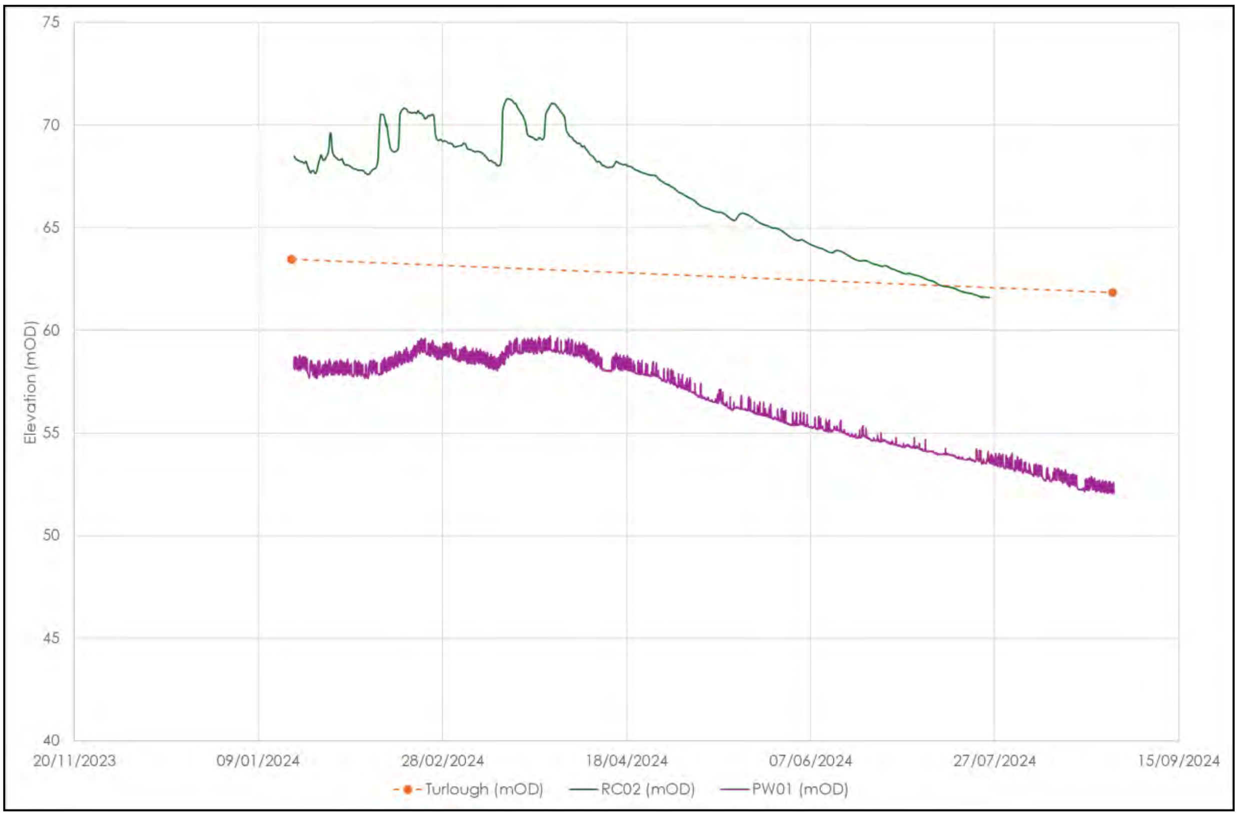


Figure 7.6: Groundwater Level Monitoring Hydrographs

7.3.9 Groundwater Vulnerability

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

The vulnerability rating of the bedrock aquifer underlying the electricity substation site is Extreme. However, the site investigation data indicates an average of 8m of subsoil cover at the electricity substation site (ranging from 3.9 to 12.02m). Based on the site investigation data, the groundwater vulnerability can be said to be Moderate to High due to the presence of c. 4-12m of clayey, sandy and gravelly subsoils (refer to Table 7.15).

Meanwhile, the mapped groundwater vulnerability along the underground electricity line ranges from Moderate to Extreme. A total of c. 2.7km of the route is mapped in areas of Extreme vulnerability.

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

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

Table 7.15: Groundwater Vulnerability Matric – Groundwater Protection Schemes Report (1999)

7.3.10 Karst

Karst features are mapped by the GSI and available through the GSI online viewer (www.gsi.ie). The Visean Limestones within Roscommon are known to be karstified with ubiquitous conduits or caves throughout the county such as Pollnagran cave towards the north of the county.

The GSI do not map the presence of any karst features within the immediate vicinity of project site (www.gsi.ie). The closest mapped karst features to the electricity substation include 2 no. enclosed depressions located c. 380m to the west and c. 550m to the southwest. The GSI also map a spring, referred to as St. Patricks Well, c. 1km to the northeast of the electricity substation.

There are several other enclosed depressions mapped to the west of the underground electricity line. The closest enclosed depression is located c. 750m to the west in the townland of Curraghboy. The GSI also map 3 no. springs c. 1.1km to the southeast and downstream of the underground electricity line along the Cross (Roscommon) River. Meanwhile, Corkip Lough (Turlough) is located c. 1km to the southwest of Brideswell village.

A traced underground connection from Lough Funshinagh shows that the overall groundwater flow in this area is to the south, with the Lough linked to the Cross (Roscommon) River. One of the springs downstream of the underground electricity line, referred to as the 'Mullagh Spring', was found to be linked via a water tracing experiment with Lough Funshinagh. The Mullagh Spring feeds the Cross (Roscommon) River near Milltown Pass some 5km south of the Lough, with a minimum flow rate of 70m/hr (Drew, D. and Burke, M., 1996). Lough Funshinagh Turlough is a large turlough which on occasion dries out completely, located c. 2.8km northwest of the electricity substation site.

With regards to the site investigations completed at the electricity substation site, no karst features were encountered during the drilling of the 6 no. boreholes. However, a turlough was recorded to the south of the electricity substation site. It should be noted that this turlough is not designated.

7.3.11 Groundwater Hydrochemistry

7.3.11.1 Desk Study Data

The project site is underlain by the Funshinagh GWB. The GSIs characterisation report (GSI, 2003) for this GWB states that:-

> "*The hydrochemistry of the carbonate rocks, especially pure limestones, is dominated by calcium and bicarbonate ions. Hardness can vary from slightly hard to very hard (typically ranging between 380–450 mg/l). Spring waters tend to be softer, as throughput is often quicker with less time for the dissolution of minerals into the groundwater. Groundwater alkalinity is variable but can be high. Alkalinity is generally less than hardness indicating that ion exchange (where calcium or magnesium are replaced by sodium) is not a significant process.*
>
> *These hydrochemical signatures are characteristic of clean limestone and are frequently associated with limescale problems. Like hardness and alkalinity, electrical conductivities (EC) can vary greatly. Typical limestone groundwater conductivities are of the order 500–700 µS/cm. Lower values suggest that groundwater residence times are very short. In some springs and boreholes in karst areas, high turbidity occurs after heavy rainfall (e.g. Killeglan PWS in the adjoining Suck South GWB to the west). Microbial pollution of groundwater in karstic aquifers is also a significant problem. Due to the high level of interaction between groundwater and surface water in karstic aquifers, microbial pollution can travel very quickly from the surface into the groundwater system. The normal filtering and protective action of the subsoil is often bypassed in karstic aquifers due to the number of swallow holes, dolines and large areas of shallow rock.*"

7.3.11.2 Groundwater Quality Monitoring

Groundwater sampling of the farm well and the turlough to the south of the electricity substation site was completed on 28 August 2024.

The field chemistry data, taken with a calibrated YSI ProDSS, are provided below at Table 7.16. The field hydrochemistry indicates that the water in the turlough is slightly different to the private well. Dissolved oxygen ranged between 9.5 – 9.81mg/L. Meanwhile, electrical conductivity ranges between 231 - 710µS/cm, with the highest conductivities recorded in the farm well. The lower conductivity in the turlough is likely a function of the intense rainfall which preceded the sampling on the 28 August 2024. pH was neutral to slightly basic, ranging from 7.2 to 7.8, slightly higher in the turlough.

Location	Temp (°C)	EC (µS/cm)	pH	Dissolved Oxygen (mg/L)	Turbidity (NTU)
Farm Well	12.3	710	7.2	9.5	2.67
Turlough	17.2	231	7.8	9.81	4.02

Table 7.14: Field Hydrochemistry of Groundwater Samples

The laboratory data of the 2 no. samples indicates that the water is of an acceptable chemical quality relative to the Groundwater Regulations (S.I 9 of 2010).

Ammonia ranges between 0.013 and 0.07mg/l, while Nitrite is below the limit of detection in all samples at <0.01mg/L. Nitrate ranges between <1 to 11.1mg/L, below the threshold value for groundwaters of 37.5mg/L. Chloride ranges between 12.1 and 18.4mg/L, below the EQS threshold of 24 mg/L. Hardness within the samples ranged between 144 and 459mg/L as $CaCO_3$, with the sample in the turlough having the lower hardness.

The lower hardness and electrical conductivity in the turlough samples may indicate more contribution from rainwater than from deep sourced groundwater.

Parameter	EQS	Farm Well	Turlough
Ammonia (mg/l)	-	0.013	0.07
Nitrite (mg/l)	0.375	<0.01	<0.01
Ortho-Phosphate (mg/l)	0.035	0.02	0.117
Nitrate mg/l NO_3	37.5	11.1	<1
Chloride (mg/l)	24	18.4	12.1
Hardness mg/l $CaCO_3$	-	459	144

Table 7.15: Summary of Groundwater Quality Data from Laboratory Analysis

7.3.12 Water Framework Directive Water Body Status and Objectives

The River Basin Management Plan was adopted in 2018 and has amalgamated all previous river basin districts into one national river basin management district. The River Basin Management Plan (2022 - 2027) objectives, which have been integrated into the design of the project, include the following:-

- Ensure full compliance with relevant EU legislation;
- Build on the achievements of the 2nd Cycle;
- Prevent deterioration and maintain a 'high' status where it already exists;
- Protect, enhance and restore all waters with aim to achieve at least good status by 2027;
- Ensure waters in protected areas meet requirements; and,
- Implement targeted actions and pilot schemes in focused sub-catchments aimed at restoring impacted waters and protecting waters from deterioration.

Our understanding of these objectives is that surface and ground 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. Furthermore, any development must not in any way prevent a waterbody from achieving at least good status by 2027.

A full WFD Compliance Assessment Report is enclosed at Annex 7.4.

7.3.12.1 Groundwater Body Status

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

The project site overlies the Funshinagh GWB (IE_SH_G_091). The Funshinagh GWB achieved 'Good Status' in all 3 no. WFD cycles. This GWB is deemed to be not at risk of failing to meet its WFD objectives. No significant pressures have been identified to be impacting this GWB.

GWB	Overall Status (2010-2015)	Overall Status (2013 – 2018)	Overall Status (2016 – 2021)	3rd Cycle Risk Status	WFD Pressures
Funshinagh	Good	Good	Good	Not at risk	None

Table 7.16: Summary WFD Groundwater body Information

7.3.12.2 Surface Water Body Status

A summary of the WFD status and risk result for Surface Waterbodies (SWBs) in the vicinity and downstream of the project site are provided at Table 7.19.

The electricity substation site and a section of the underground electricity line are mapped within the Shannon (Upper)_110 WFD river sub-basin. This SWB was assigned 'Poor Status' in the latest WFD cycle. Along the underground electricity line the Ballybay_010, Cross (Roscommon)_010 and _020 SWBs achieved 'Moderate Status'. Meanwhile, Lough Ree is of 'Good Status'.

In terms of risk status, the Shannon (Upper)_110, Cross (Roscommon)_010 and _020 SWBs are at risk of failing to meet their respective WFD objectives. The risk status of the Ballybay_010 SWB is currently under review. The risk status of this SWB was also under review in the 2nd WFD cycle. Lough Ree is not at risk.

Agriculture and hydromorphology have been identified as significant pressures in the at risk waterbodies in the area of the project site.

SWB	Overall Status (2010-2015)	Overall Status (2013 – 2018)	Overall Status (2016 – 2021)	3rd Cycle Risk Status	WFD Pressures
Shannon (Upper)_110	Unassigned	Poor	Poor	At risk	Agriculture & Hydromorphology
Ballybay_010	Unassigned	Poor	Moderate	Under Review	None
Cross (Roscommon) _010	Poor	Poor	Moderate	At risk	Agriculture & Hydromorphology
Cross (Roscommon) _020	Good	Good	Moderate	At risk	Agriculture & Hydromorphology
Lough Ree	Moderate	Good	Good	Not at risk	Hydromorphology

Table 7.17: Summary WFD Surface Waterbody Information

7.3.13 Designated Sites & Habitats

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

The project site is not mapped within any designated conservation site.

The nearest designated sites to the electricity substation site include the Lough Ree SAC/pNHA (Site Code: 000440) and the Lough Ree SPA (Site Code: 004064). Lough Ree is the third largest lake in Ireland and is situated in an ice-deepened depression in carboniferous limestone on the River Shannon system between Lanesborough and Athlone. The site is designated for the following qualifying interests:

Lough Ree SAC:-

- Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation [3150];
- Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites) [6210];
- Active raised bogs [7110];
- Degraded raised bogs still capable of natural regeneration [7120];
- Alkaline fens [7230];
- Limestone pavements [8240];
- Bog woodland [91D0];
- Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) [91E0]; and,
- Lutra lutra (Otter) [1355].

Lough Ree SPA:-

- Little Grebe (Tachybaptus ruficollis) [A004];
- Whooper Swan (Cygnus cygnus) [A038];
- Wigeon (Anas penelope) [A050];
- Teal (Anas crecca) [A052];
- Mallard (Anas platyrhynchos) [A053];
- Shoveler (Anas clypeata) [A056];
- Tufted Duck (Aythya fuligula) [A061];
- Common Scoter (Melanitta nigra) [A065];
- Goldeneye (Bucephala clangula) [A067];
- Coot (Fulica atra) [A125];
- Golden Plover (Pluvialis apricaria) [A140];
- Lapwing (Vanellus vanellus) [A142];
- Common Tern (Sterna hirundo) [A193]; and,
- Wetland and Waterbirds [A999].

These designated sites are located c. 2km east of the electricity substation. However, as stated previously, there is a distinct lack of surface water features in the area of the electricity substation site, therefore there is no direct connection between the electricity substation site and Lough Ree. The only potential connection is via groundwater flowpaths in the underlying limestone bedrock aquifer, with the GSI stating that the overall direction of groundwater flow in the Funshinagh GWB is towards Lough Ree.

Lough Funshinagh SAC/pNHA (Site Code: 000611) is located c. 2km to the northwest of the electricity substation site. The lake, which is underlain by carboniferous limestone, is classified as a turlough because it fluctuates to a significant extent every year and occasionally dries out entirely (approximately two to three times every ten years). In most years, however, an extensive area of water persists. This is filled with vegetation, providing excellent breeding habitat for wildfowl, and the site is designated a Wildfowl Sanctuary. The lake is fed by springs and a small catchment to the west. It is mesotrophic in quality, with some marl (calcium carbonate) deposition, and is surrounded by pastures. The qualifying interests of the Lough Funshinagh SAC are:-

- Turloughs [3180]; and,
- Chenopodion rubric p.p and Bidention p.p vegetation [3270].

Traced underground connections show that groundwater flows southwards from Lough Funshinagh the Cross (Roscommon) River. Therefore, the project site is located downgradient of this SAC/pNHA.

The nearest designated site to the underground electricity line is the Ballynamona Bog and Corkip Lough SAC (Site Code: 002339). The site comprises a relatively small portion of what was once a large bog complex, and includes areas of high bog and cutover bog, and also the turlough, Corkip Lough. The site is mapped at an elevation of c. 55-58 m OD. The qualifying interests of the SAC are:-

- Turloughs [3180];
- Raised Bog (Active) [7110];
- Degraded raised bogs still capable of natural regeneration [7150];
- Depressions on peat substrates of the Rhynchosporion [7150]; and,
- Bog Woodland [91D0].

The Active Raised Bog is hydraulically isolated from the turlough due to the extent of the drainage works around its perimeter. The site is not listed as a groundwater dependent ecosystem, however the formation of the turloughs is due to the annual rise in local groundwater levels. This SAC is located c. 900m south of the southern end of the underground electricity line at Brideswell. There is no direct hydrological connection between the project site and this SAC. Furthermore, the EPA mapping database illustrates a small 1st order stream flowing to the northeast from the SAC and any groundwater flow from the areas of the underground electricity line is likely to emerge as baseflow in this surface water feature. However the possibility of groundwater reaching the SAC cannot be discounted.

Castlesampson Esker SAC/pNHA is located c. 3.8km south of the underground electricity line. There is no direct hydrological connection between this SAC/pNHA and the project site. However the possibility of groundwater reaching the SAC cannot be discounted. The SAC consists of eskers, deposited during the last Glacial Maximum, as well as raised bog and a turlough (Corraree). The site is designated as a SAC based on the following qualifying interests:-

- Turloughs [3180]; and,
- Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites) [6210].

Meanwhile, the underground electricity line has hydrological connections with the River Shannon Callows SAC/pNHA (Site Code: 000216) and the Middle Shannon Callows SPA (Site Code: 004096) via the Cross (Roscommon) River. The River Shannon Callows SAC/ pNHA and the Middle Shannon Callows SPA are situated c. 14.2km downstream (hydrological flowpath length) of the watercourse crossing along the underground electricity line. However, a quantitative analysis, based on flow volumes in the Cross (Roscommon) River (EPA Hydrotool Nodes – www.catchments.ie) has shown that there is no potential for effects downstream of EPA Node 26_4018, located c. 2.34km upstream of the SAC designation. This SAC is designated for the following qualifying interests:-

- Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae) [6410];
- Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis) [6510]
- Alkaline fens [7230];
- Limestone pavements [8240];

- Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) [91E0]; and,
- Lutra lutra (Otter) [1355].

The Middle Shannon Callows SPA is designated for the following qualifying interests:-

- Whooper Swan (Cygnus cygnus) [A038];
- Wigeon (Anas penelope) [A050];
- Corncrake (Crex crex) [A122];
- Golden Plover (Pluvialis apricaria) [A140];
- Lapwing (Vanellus vanellus) [A142];
- Black-tailed Godwit (Limosa limosa) [A156];
- Black-headed Gull (Chroicocephalus ridibundus) [A179]; and,
- Wetland and Waterbirds [A999].

Lough Slawn pNHA is located on the eastern side of Lough Ree and c. 10.5km northeast of the electrical substation site. This pNHA is located on the opposite lake shore (eastern shore) of Lough Ree in comparison to the project.

Local designated sites in the area and downstream of the project site are shown at Figure 7.7 (Annex 7.1).

7.3.14 Water Resources

7.3.14.1 Groundwater Resources

There are no Group Water Schemes (GWS), registered with the National Federation of Group Water Schemes, or Public Water Schemes (PWS) or an associated Source Protection Area identified, by the GSI, as being located within the project site or in the surrounding lands.

The 'Killeglan PWS Tobermore Spring' Public Supply Source Protection Area is the nearest public water scheme located c. 4km west of the underground electricity line and c. 7km southwest of the electricity substation site. This PWS is located in the Suck South GWB and generally the northern and eastern boundaries of the outer source protection area appears to be marked by the boundary between the Suck South and Funshinagh GWBs. More specifically, the Killeglan Water Supply Scheme (WSS) Groundwater Source Protection Zone Report (GSI, 2003) states that the northern and eastern boundaries of the outer source protection zone are defined by topographic ridges. It is considered that the project has no potential to effect the Killeglan PWS for the following reasons:-

- The absence of any works or infrastructure within the source protection area;
- The distance between the source (i.e. Tobermore Spring) and the project site (c. 6.7km from the underground electricity line and c. 11km from the electricity substation site);
- The topographic ridge which separates the source protection area from the project site; it is considered that the project has no potential to effect the Killeglan PWS; and,
- The Killeglan PWS is mapped within the Suck South GWB whilst the project site is within the Funshinagh GWB.

There are no other PWS and GWS within 10km of the project site.

The location of the source protection area associated with the Killeglan PWS is illustrated at Figure 7.8 (Annex 7.1).

Private well locations (accuracy of <50m only) were reviewed using GSI well database (www.gsi.ie). No groundwater wells or springs are mapped by the GSI (www.gsi.ie) within the electricity substation site. The nearest GSI mapped spring is St. Patricks Well (GSI Name: 1723NEW037) which has a locational accuracy of 20m and is c. 860m to the northeast of the electricity substation site.

3 no. boreholes with a locational accuracy of <50m are mapped along the underground electricity line in the townlands of Carrowncloghan and Carrowkeeny. These boreholes are listed as having agricultural and domestic uses. However, wells along the underground electricity line are not considered as sensitive as no effects on groundwater are expected due to the shallow nature of the proposed works.

GSI mapped wells with accuracy greater than 50m were not assessed due to the poor information/accuracy regarding their location. To overcome the poor accuracy, it is conservatively assumed that every private dwelling in the vicinity of the project site has a well supply and this impact assessment approach is described further below. Private dwellings (i.e. potential wells) along the underground electricity line were not identified due to the very low risk posed to any potential well.

7.3.14.2 Surface Water Resources

There are no surface water abstractions in the immediate vicinity of the project site.

The closest abstraction for drinking water is located on the River Shannon as it flows through Athlone. The Shannon (Upper)_120 SWB is listed in Article 7 Abstraction for Drinking Water. This Drinking Water Protected Area (DWPA) serves Athlone Water Supply (Athlone Water Treatment Plant) and is downstream of the electricity substation site via indirect groundwater flow from the site towards Lough Derg.

The Athlone Water Treatment Plant is located in Athlone town centre and is upstream of where the Cross (Roscommon) River discharges into the Shannon. Therefore, there is no likelihood of the works along the underground electricity line to impact this abstraction. Similarly, there is no likelihood of the works at the electricity substation site to effect this DWPA as Lough Ree acts as a hydrological buffer between the site and the DWPA. The large volumes of water within the lough will provide significant dilution.

7.3.15 Receptor Sensitivity and Importance

Due to the nature of electricity substation developments and associated underground electricity lines being near surface construction activities, impacts on groundwater are generally negligible and surface water is typically the main sensitive receptor assessed during impact assessments.

However, given the local hydrogeological regime, which is characterised by high rates of groundwater recharge, the proximity of the electricity substation to local groundwater fed turloughs and the mapping of the bedrock aquifer as a Regionally Important Karstified Aquifer, the hydrogeology of the site has been characterised by site investigation data and groundwater will be the main sensitive receptor. The primary risk to groundwater at the electricity substation site would be from cementitious materials, hydrocarbon spillage and leakages and the potential for foundations and hardstand areas to intercept and interfere with groundwater recharge and flows which are considered to be potentially linked to the nearby turloughs.

Based on criteria set out at Table 7.2, groundwater at the site can be classed as being Important as the aquifer is mapped as a Regionally Important Karstified aquifer and groundwater vulnerability is mapped as Extreme. This classification is based on generic, assumed conditions inferred from regional mapping of the bedrock geology and aquifer type, without any site-specific data. The site-specific data for the areas of infrastructure indicate the groundwater aquifer is not regionally karstified and that groundwater vulnerability is generally more towards Moderate to High. Notwithstanding this, and based on the precautionary principle, groundwater is regarded as very sensitive.

The following groundwater receptors are identified for impact assessment:-

- The Regionally Important Aquifer underlying the electricity substation site and the underground electricity line. This aquifer can be considered as being of High Importance;
- The Locally Important Aquifer underlying a section of the electricity substation site. This aquifer can be considered as being of Medium Importance;
- The WFD status of the underlying Lough Funshinagh GWB;
- Local private groundwater abstractions in the lands surrounding the electricity substation site; and,
- The local turloughs and karst features in the surrounding lands.

Surface waters such as the Cross (Roscommon) River are also sensitive to potential contamination. These rivers are known to be of trout potential and are locally important for fishing (refer to Chapter 5). We note the lack of any streams or rivers in the vicinity of the electricity substation site which could potentially be receptors. The River Shannon downstream of Lough Ree is scoped out of the assessment due to the large volumes of water in the lake and a quantitative analysis of flow volumes along the Cross (Roscommon) River.

The following surface water receptors are identified for impact assessment:-

- The Cross (Roscommon) River in the vicinity and downstream of the underground electricity line. This river can be considered to be of Very High Importance based on its Q-ratings; and,
- The WFD status of all SWBs downstream of the project site.

In terms of designated sites, no designated sites are hydrologically connected by surface water pathways to the electricity substation site. Any potential connections are indirect and will be via groundwater flowpaths over a long distance (several kms). Meanwhile, a direct hydrological connection exists between the underground electricity line and the River Shannon Callows SAC/pNHA and the Middle Shannon Callows SPA. Based on the precautionary principle, the following designated sites will be included in the impact assessment:-

- Lough Ree SAC/SPA/pNHA;
- Ballynamona Bog and Corkip Lough SAC; and,
- Castlesampson Esker SAC/pNHA.

Lough Funshinagh has been scoped out of the impact assessment as traced underground connections have revealed that the groundwater from the lough flows to the south and discharges in the vicinity of the Cross (Roscommon) River. Therefore, the project site is downgradient of the Lough Funshinagh SAC/pNHA and cannot affect the conservation objectives of this SAC.

Lough Slawn pNHA, on the eastern side of Lough Ree, has been scoped out of further assessment as it is located upgradient of the substation site and electricity line, is located on the opposite lake shore (eastern shore) of Lough Ree and is located c. 10.5km northeast of the substation site.

Furthermore, the River Shannon Callows SAC/pNHA and the Middle Shannon Callows SPA have been scoped out of the impact assessment due to Lough Ree acting as a hydrological buffer between the electricity substation site and these designated sites. Furthermore, increasing flow volumes in the Cross (Roscommon) River will provide adequate dilution and will prevent any potential contamination sources associated with the underground electricity line from reaching these designated sites.

7.4 Description of Likely Effects

7.4.1 Characteristics of the Project

The project assessed within this EIAR comprises of a 110kV electricity substation, including all associated development works to accommodate its construction, operation, maintenance and the export of electricity to the national grid via the existing Athlone-Lanesborough overhead electricity transmission line, and c. 7.5km of underground electricity line. The project is described in full at Chapter 3.

The main characteristics of the project that could affect the water environment comprise the following:-

- Establishment of the temporary construction compound within the electricity substation site, which will involve the excavation of spoil and the emplacement of the compound. Runoff from these construction areas have the potential to affect water quality. In addition, welfare facilities will be provided at the temporary construction compound. Wastewater effluent will be collected in a wastewater holding tank and periodically emptied by a licenced contractor;
- Construction of the proposed site access tracks and upgrade of existing site entrance. These activities have the potential to affect water quality;
- Replacement of the existing wooden pole-set with 2 no. lattice-type interface masts has the potential to affect water quality;
- Construction of the electricity substation and compound will be completed with a ground bearing foundation. Wastewater effluent will be collected in an underground concrete holding tank and periodically emptied by a licenced contractor for the operational phase of the project. Construction of the sub-station and associated compound has the potential to affect water quality;
- Construction of the underground electricity line will involve the excavation of a trench predominately within the public road, placement of ducting and backfilling with lean-mix concrete and compacted engineered fill. These works have the potential to affect water quality; and,
- Storage of excavated spoil within the 2 no. spoil deposition areas within the electricity substation site has the potential to affect water quality.

During the operational phase, the water supply for the control building at the substation site will be obtained from Uisce Éireann infrastructure. Uisce Éireann have confirmed that the existing local infrastructure has sufficient capacity to serve the project. There will be no requirement for a groundwater well.

7.4.1.1 Proposed Drainage Management

Surface water runoff control and drainage management are key elements in terms of mitigating against impacts on the underlying groundwater aquifer. Two distinct methods will be employed to manage drainage water within the project site. The first method involves 'keeping clean water clean' by avoiding disturbance to natural drainage and recharge patterns. The second method involves collecting any drainage waters from works areas within the site that might carry silt or sediment, and nutrients, to route them towards settlement ponds prior to controlled diffuse release over vegetated surfaces and subsequent infiltration through the subsoil. As per the prevailing baseline conditions at the site, there will be no direct discharges to surface waters (as there are none local to the electricity substation site).

During the construction phase, all drainage water from works areas (i.e., potential dirty water) will be attenuated and treated to a high quality prior to being allowed to slowly percolate to ground. Silt fencing (3 no. lines of Terrastop silt fence) will be erected to the south of the electricity substation site to provide a physical separation between the works and the nearby turloughs. This will trap suspended sediment entrained in water flowing downhill from the works area.

Further means of drainage management include:-

- No surface water will leave the project site. All drainage measures will incorporate water infiltrating back to ground within the site boundary;
- Excavations will be limited as much as possible in order to minimise the volume of spoil generated;
- Sand blinding, damp proof membrane (DPM) and concrete blinding will be provided at formation level to create a vertical cut-off barrier and to mitigate the risk of concrete leakage into the ground below; and,
- Hardstands will be lined with Terram geotextile to limit direct discharge to the subsoil/bedrock.

Drainage management along the underground electricity line will include the following methods:

- Use of small working areas;
- Site specific controls at watercourse crossing;
- No direct discharges to watercourses;
- Use of temporary silt fencing, check dams, and temporary blocking of drainage pathways; and,
- Reinstatement of works areas and house-keeping including road sweeping.

7.4.2 Do-Nothing Scenario

In the do-nothing scenario, there would be no alteration to the hydrological and hydrogeological environment. The hydrological regime 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 Drainage Recharge

Construction phase activities will require earthworks resulting in removal of vegetation cover and excavation of topsoil and subsoils.

Due to the generally shallow nature of excavations, substantial volumes of spoil are not predicted to be generated. Subsoil will, insofar as possible, be utilised to make up levels at the electricity substation compound; while topsoil will be used in the post-construction reinstatement of the project. Any excess subsoils will be stored at the 2 no. designated spoil deposition areas at the electricity substation site; while excess material from the excavation of trenches for the underground electricity line will be disposed of at an approved waste management facility.

Potential sources of sediment laden water include:-

- Drainage and seepage water resulting from excavations;
- Stockpiled excavated material providing a point source of exposed sediment;
- Construction of the underground electricity line including trench 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 generation of suspended solids in drainage water and, as there are no drainage outlets at the electricity substation site (other than recharge to ground), there is a risk that sediment laden recharge water can enter the underlying bedrock aquifer. To reiterate, there are no recorded surface water features of concern directly occurring within the electricity substation site.

Surface watercourses are absent within the electricity substation site, however any effects in relation to potential overland flow towards surface water bodies such as turloughs will nonetheless be mitigated against. Additionally, local water runoff that will occur near lower permeability site infrastructure that will recharge locally into subsoils will also require treatment. This recharge water will occur close to source and can migrate vertically to groundwater below the electricity substation site. The likely effects on groundwater quality are assessed separately below.

There is also the possibility of runoff along the underground electricity line entering nearby watercourses, including the Cross (Roscommon) River. The likely effects associated with the directional drilling over the Cross (Roscommon) River are assessed at Section 7.4.3.8.

Attribute	Description
Receptors	Underlying groundwater systems and downgradient turloughs near the electricity substation site. Downgradient rivers along the underground electricity line.
Pathway/Mechanism	Natural Drainage channels and surface water discharge routes – these are absent at the electricity substation site. Surface water drainage system along the underground electricity line.
Pre-Mitigation Effect	Negative, slight, indirect, short-term, unlikely effect within the electricity substation site due to the grassland/vegetation acting as a silt filter/trap for suspended sediment and the absence of surface water pathways. Negative, slight, indirect, short-term, unlikely effects along the underground electricity line due to the scale of the works (1.2m deep trench), the temporary nature of any excavation and the roadside vegetation acting as a silt filter/trap.

Table 7.20: Earthworks Resulting in Suspended Solids Entrainment in Drainage Recharge

7.4.3.2 Groundwater Flows and Levels due to Alteration of Recharge Rates

Groundwater flow within a recognised karst environment is difficult to fully quantity without significant datasets, as spatial variations in the degree of karstification can alter the permeability and transmissivity (essentially the volume of groundwater flowing through a particular unit of rock) by orders of magnitude.

The bedrock below the electricity substation site does not contain an abundance of karst flow systems:-

- A comprehensive site investigation dataset has been accrued within the site of the electricity substation and has not identified any significant karst features within the underlying bedrock;
- The data from the rotary core drilling shows that the bedrock is generally strong limestone or dolomitic limestone;
- Groundwater monitoring has revealed that groundwater levels are below the existing ground level (c. 3mbgl at RC02), and hence below the formation levels for the proposed infrastructure; and,
- No water strikes were recorded during the drilling of the rotary core boreholes.

Groundwater levels may be affected by any change in recharge within a groundwater catchment. A reduction in recharge, which would be accompanied by an increase in surface water drainage, would reduce the volume of water infiltrating to the bedrock aquifers and therefore lead to a reduction in local groundwater levels. The drainage management design of the project has been designed to ensure the volume of rainfall infiltrating through the subsoils to the groundwater aquifer will not change.

The works along the underground electricity line will be completed above the groundwater table. No impacts on groundwater levels or groundwater flow will occur due to the shallow depth of the works (1.2m deep trench) along an existing roads.

Attribute	Description
Receptors	Water levels in the Funshinagh GWB and the nearby turlough.
Pathway/Mechanism	Groundwater flowpaths and groundwater recharge.
Pre-Mitigation Effect	Negative, moderate, indirect, long-term, very unlikely.

Table 7.21: Groundwater Flows and Levels due to Alteration of Recharge Rates

7.4.3.3 Groundwater Levels During Excavation Works

No significant groundwater level effects are assessed as likely to occur due to the shallow nature of the excavations at the electricity substation site (c. 1-2m). Any minor dewatering works, should they be necessary, will be of a short duration. Any likely effects will be localised and of a very small magnitude due to the scale of the works and the lack of any groundwater inflows recorded during the trial pit investigations. Any minor effects will be contained within the immediate vicinity of the electricity substation site.

Furthermore, no groundwater level impacts will occur from the construction and installation of the underground electricity line due to the shallow nature of the excavation (i.e. c. 1.3m), the excavation of the trench predominately within the road carriageway and the unsaturated nature of the road material/subsoil to be excavated.

Attribute	Description

Receptor	Water levels in the Funshinagh GWB and the nearby turlough.
Pathway/Mechanism	Groundwater flowpaths.
Pre-Mitigation Effect	Negative, indirect, imperceptible, short-term, very unlikely effect on groundwater levels.

Table 7.22: Groundwater Levels During Excavation Works

7.4.3.4 Surface Watercourses

Surface water draining from an active construction site can contain elevated levels of suspended sediment, which can impact on downstream surface water bodies. The surface water can also contain cementitious drainage water and/or hydrocarbons depending on the nature of the construction activity. Any alteration in the drainage regime can impact on the volume of drainage water which leaves the site via recharge to groundwater. These impacts can affect the quantity and quality of the underlying aquifer or downstream surface waterbodies (where a flow path exists between the site and the waterbody).

However, as noted above, no direct surface water pathways exist between the electricity substation site and downgradient watercourses. Therefore, no surface water runoff currently leaves the site and all pathways are via groundwater recharge and groundwater flow. As all surface waters will continue to recharge to ground, following treatment, it is assessed that there will be no alteration to the surface water drainage regime.

Attribute	Description
Receptor	Downgradient watercourses
Pathway/Mechanism	Surface recharge and groundwater flow
Pre-Mitigation Effect	Negative, indirect, slight, short-term, very unlikely effect

Table 7.23 Surface Watercourses

7.4.3.5 Accidental Release of Hydrocarbons

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

Hydrocarbons will be present at the electricity substation site and will be stored at the temporary construction compound where construction plant and machinery will also be refuelled. At the electricity substation site, the pathways for the rapid transport of any spilt chemicals are limited due to the absence of any surface water drainage network. At the electricity substation site, the primary pathway is through infiltration into the subsoil and bedrock.

Hydrocarbon storage will not occur during the construction of the underground electricity line as the works are transient; however, refuelling of plant and machinery will occur as necessary along the route.

Attribute	Description
Receptor	Groundwater quality within the Funshinagh GWB. Watercourses (Cross (Roscommon) River) along the underground electricity line
Pathway/Mechanism	Groundwater recharge and flowpaths at the electricity substation site. Groundwater recharge and surface water drainage along the underground electricity line.
Pre-Mitigation Effect	Negative, slight, indirect, short-term, unlikely effect on local groundwater quality. Negative, slight, indirect, short-term, likely effect on downstream surface water quality in the Cross (Roscommon) River along the underground electricity line.

Table 7.24: Accidental Release of Hydrocarbons

7.4.3.6 Wastewater Disposal

Release of effluent from wastewater treatment systems has the potential to impact on groundwater and surface waters if site conditions are not suitable for an on-site percolation unit. A temporary construction compound is proposed within the electricity substation site which will accommodate chemical toilets. 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.

Attribute	Description
Receptor	Groundwater quality
Pathway/Mechanism	Groundwater flowpaths and site drainage network
Pre-Mitigation Effect	Negative, slight, indirect, short-term, unlikely effect.

Table 7.25: Wastewater Disposal

7.4.3.7 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.

At the electricity substation site, this pathway (to surface waters) is not present, however, the release of cement-based products to the site drainage system will percolate to ground. The washing out of transport and placement machinery are the activities most likely to generate a risk of cement-based pollution to the underlying groundwater system and downstream GWDTEs.

Attribute	Description
Receptor	Groundwater quality within the Funshinagh GWB. Surface water quality (Cross (Roscommon) River) along the underground electricity line.

Pathway/Mechanism	Recharge to ground at the electricity substation site. Watercourses along the underground electricity line.
Pre-Mitigation Effect	Negative, moderate, indirect, short-term, very unlikely effect on groundwater quality at the electricity substation site. Negative, moderate, indirect, short-term, likely effect on surface water quality along the underground electricity line.

Table 7.26: Release of Cement-Based Products

7.4.3.8 Directional Drilling Works

Adverse effects on surface water quality in local watercourses may occur during directional drilling and associated groundworks at the crossing location of the Cross (Roscommon) River.

It is proposed that directional drilling under the river and bridging structure will be undertaken to prevent direct effects on the Cross (Roscommon) River. However, there is a risk of indirect effects from sediment laden runoff during the launch pit and reception pit excavation works. There is also the unlikely risk of fracture blow out and contamination of the watercourse with drilling fluid.

Attribute	Description
Receptor	Cross (Roscommon) River.
Pathway/Mechanism	Surface water flows.
Pre-Mitigation Effect	Negative, moderate, indirect, temporary, likely effect on surface water quality

Table 7.27: Directional Drilling Works

7.4.3.9 Effects on Karst Features

There are no GSI mapped karst features in the immediate vicinity of the electricity substation site. However, a turlough is present c. 300m to the south of the electricity substation. This turlough is located downgradient of the substation works areas but is not designated. The relatively thick subsoils identified during the borehole drilling, trial pitting and correlated with the geophysical survey provides confidence in the level of subsoil protection to the underlying groundwater aquifer at the electricity substation site.

In addition, the underground electricity line is underlain by a Regionally Important Karst Aquifer. The closest GSI mapped karst features are located c. 750m from the route.

Any possible alteration in local groundwater quality is likely to impact the Karstic Bedrock Aquifer. Furthermore, any alteration in groundwater recharge is likely to alter the water levels in the turlough to the south of the electricity substation site.

Attribute	Description
Receptor	Turlough water levels, water quality and dependent ecosystems.
Pathway/Mechanism	Alteration of groundwater volumes through change of recharge patterns. Alteration of groundwater quality due to hydrocarbons/wastewater/ cement-based products etc.
Pre-Mitigation Effect	Negative, slight, indirect, short-term, unlikely effect.

Table 7.28: Effects on Karst Features

7.4.3.10 Effects on the WFD Status

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

The WFD status for GWBs and SWBs underlying and downstream of the project are defined in Section 7.3.12.1 and Section 7.3.12.2 respectively.

A detailed WFD Compliance Assessment Report has been prepared and is enclosed at Annex 7.4.

Attribute	Description
Receptor	WFD status of downstream SWBs and the underlying Funshinagh GWB.
Pathway/Mechanism	Groundwater recharge and groundwater flow. Surface water flowpaths along the underground electricity line.
Pre-Mitigation Effect	Negative, imperceptible, indirect, short term, likely effect on WFD status.

Table 7.29: Effects on WFD Status Effects

7.4.3.11 Effects on Designated Sites

The groundwater dependent designated sites in the vicinity of the project include:-

- Ballynamona Bog and Corkip Lough SAC; and,
- Castlesampson Esker SAC (turlough)

The surface water dependent designated site in the vicinity of the project include:-

- Lough Ree SAC/SPA/pNHA

The surface and groundwater connections from the project site could, in the absence of mitigation, transfer poor quality surface and groundwaters that may affect the conservation objectives of these designated sites.

The other designated sites listed at Section 7.3.13 above are excluded from further assessment.

Attribute	Description
Receptor	Down-gradient water quality and designated sites.
Pathway/Mechanism	Alteration of groundwater recharge. Effects on groundwater quality. Effect on surface water quality.
Pre-Mitigation Effect	Indirect, negative, imperceptible, short term, unlikely effect on designated sites.

Table 7.30: Effects on Designated Sites

7.4.3.12 Effects on Groundwater Supplies

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

No effects on groundwater levels/quantity will occur due to the shallow nature of the proposed works. No significant dewatering works are likely to occur.

As detailed in Section 7.3.14.1, there are no downgradient PWS or GWS that are likely to be affected by the project.

With regards to local private groundwater well supplies, the closest inhabitable dwelling is located 300m to the southeast of the electricity substation.

According to the GSI's Initial Characterisation Report of the Funshinagh GWB, the highly karstified nature of the bedrock means that, locally, groundwater flow directions can be highly variable, but overall groundwater flow will be towards Lough Ree (GSI, 2003). The private well assessment assumes that the groundwater flow direction will generally be towards Lough Ree, situated c. 2km east of the substation location.

Using this conceptual model of groundwater flow, dwellings that are potentially located downgradient of the electricity substation are identified and an impact assessment for these actual and potential well locations is undertaken if required.

A number of private dwelling houses were identified along the local roads to the east and downgradient (i.e., downslope) of the electricity substation site.

Due to the shallow nature of the proposed works along the underground electricity line, no effects on private groundwater well supplies will occur.

Attribute	Description
Receptor	Local private groundwater wells.
Pathway/Mechanism	Groundwater levels and groundwater quality.
Pre-Mitigation Effect	Negative, imperceptible, indirect, short term, unlikely effect.

Table 7.31: Effects on Groundwater Supplies

7.4.4 Operational Phase

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

7.4.4.1 Progressive Replacement of Natural Surface with Lower Permeability Surfaces

Progressive replacement of the vegetated surface with impermeable surfaces could result in an increase in the proportion of surface water runoff reaching the downstream surface water drainage network, if the drainage design included surface water runoff leaving the site. However, at the electricity substation site, the drainage design has been optimised to allow for all rainfall which may fall on impermeable surfaces (such as electricity substation building or concrete-surfaced access track within the substation compound) to recharge to ground as would normally occur at the site.

The majority of the underground electricity line will be installed within the existing road network, an established impermeable surface. Therefore, there will no likely effect associated with the underground electricity line during the operational phase.

Attribute	Description

Receptor	Groundwater recharge and surface waters (turlough).
Pathway/Mechanism	Site drainage and recharge to the Funshinagh GWB.
Pre-Mitigation Effect	Negative, imperceptible, direct, permanent, likely effect.

Table 7.32: Progressive Replacement of Natural Surfaces with Lower Permeability Surfaces

7.4.4.2 Contaminated Runoff/Recharge

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

During such 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.

The storage of oils or other hydrocarbons at the substation could leak during the operational phase and result in effects on water quality.

The release of wastewater could also affect local water quality.

Attribute	Description
Receptor	Underlying groundwater systems and downgradient turloughs near the electricity substation site.
Pathway/Mechanism	Natural drainage channels, overlain surface flow and groundwater recharge. Note that surface water discharge routes are absent at the electricity substation site.
Pre-Mitigation Effect	Negative, imperceptible, indirect, short-term, unlikely effect within the electricity substation site.

Table 7.33: Hydrocarbons Spillages Leakages during the Operational Phase

7.4.4.3 WFD Status

There will be no direct discharge to surface waters or groundwaters during the operational phase of the project. Mitigation for the protection of groundwater during the operational phase will ensure that the qualitative and quantitative status of the receiving GWB will not be altered.

A full assessment of the likely effects of the operational phase on the status of the receiving waterbodies is provided at Annex 7.4.

Attribute	Description
Receptor	WFD status of downstream SWBs and the underlying Funshinagh GWB.
Pathway/Mechanism	Groundwater recharge and groundwater flow. Surface water flowpaths along the underground electricity line.
Pre-Mitigation Effect	Negative, imperceptible, indirect, short term, likely effect on WFD status.

Table 7.34: WFD Status Effects

7.4.4.4 Karst Features

During the operational phase, the likelihood of effects are more limited that those associated with the construction phase as there is no further excavation/movement of soil/subsoil and the drainage system is fully constructed and operational.

There is no likelihood of effects associated with the underground electricity line.

Attribute	Description
Receptor	Turlough water levels, water quality and dependent ecosystems.
Pathway/Mechanism	Infiltration to ground.
Pre-Mitigation Effect	Negative, imperceptible, indirect, temporary, unlikely effect to groundwater fed turlough.

Table 7.35: Karst Features

7.4.5 Decommissioning Phase

As set out at Chapter 3 (Sections 3.2 and 3.7), the project will form part of the national electricity network and decommissioning of the project is not proposed. Therefore, decommissioning phase effects will not occur.

7.4.6 Health Effects

Potential health effects are assessed as likely to arise through surface and groundwater contamination which may have negative effects on public and private water supplies. There are no PWS or GWS in the immediate vicinity of the project site. Nevertheless, the project design and mitigation measures will ensure that the likelihood of 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 detailed Flood Risk Assessment (see Annex 7.2) has also shown that the risk of the project contributing to downstream flooding is very low. The drainage design for the electricity substation will ensure that greenfield runoff rates are maintained and that water recharges to ground at the electricity substation site. The on-site drainage control measures will ensure no downstream increase in flood risk.

7.4.7 Risk of Major Accidents and Disasters

Flooding can result in downstream accidents and disasters. However, due to the small scale of the project footprint and with the implementation of mitigation and drainage measures, there is no increased flood risk associated with the project.

7.4.8 Cumulative Effects

The electricity substation site is located in the River Shannon regional surface water catchment. However, in term of hydrological cumulative impacts arising from the electricity substation infrastructure, none are anticipated as there is no proposed surface water discharge from the electricity substation site, with all rainfall and stormwater percolating to ground and following the regional groundwater flow direction.

The catchment area of Lough Ree is c. 581km^2. Given the scale of the electricity substation in comparison with this catchment area, the likelihood of cumulative hydrological effects is assessed to be imperceptible. Similarly, the total area of the Funshinagh GWB (354km^2) in comparison to the footprint of the electricity substation means that the likelihood of cumulative hydrogeological effects is imperceptible.

Regardless of the above, the implementation of the proposed drainage measures will ensure that there will be no significant cumulative negative effects on the water environment during construction of the electricity substation, and other developments within the River Shannon catchment.

During the operational phase, all excavation and construction related work will have ceased and therefore there is no likelihood of water quality impacts from these sources. Also, the proposed drainage measures will ensure there is no runoff from the electricity substation site and that all rainfall percolates back to ground, as is the natural hydrological regime of the area. No cumulative negative effects on the water environment are likely to occur during the operational phase.

With regards to the underground electricity line, the assessment undertaken finds that significant effects are very unlikely due to the localised nature of the construction works along the underground electricity line. Impacts on the water environment are assessed as not likely to extend beyond the immediate vicinity of the underground electricity line excavations. Due to the characteristics of the underground electricity line, cumulative effects are not likely to occur during the operational phase.

Therefore, it is assessed that no cumulative impacts on the water environment, between the underground electricity line, the electricity substation and any other development will occur.

7.5 Mitigation & Monitoring Measures

7.5.1 Construction Phase

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

Mitigation by Avoidance

A key mitigation adopted during the design phase is the avoidance of infrastructure close to turloughs and surface water features at the electricity substation site. All areas of the electricity substation site are located significantly away from surface watercourses. The closest surface water feature is a turlough located to the south of the site. This is a temporary surface water feature which is only likely to be present during certain months of the year, and may not exist between ~May–November, thus construction proposed between May-November is not likely to affect the turlough.

The large setback distances between sensitive hydrological features and any element of the project means that adequate room is maintained for the proposed drainage design/mitigation measures (discussed below) to be properly installed and operate effectively. No works will be undertaken within any surface water feature which will:-

- Avoid physical damage to turloughs and watercourses and associated release of sediment;
- Avoid excavations within close proximity to turloughs and surface watercourses (again, absent at the electricity substation site);
- Avoid the entry of suspended sediment from earthworks into turloughs and watercourses; and,
- Avoid the entry of suspended sediment from the construction phase drainage system into watercourses, achieved in part by ending drain discharge outside the buffer zone and allowing percolation via infiltration areas.

Mitigation by Design

The overall approach to the management of surface water runoff during the construction phase will be to collect and treat on-site and then divert to ground locally within the project site.

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 earthworks, silt fencing will be placed down-gradient of the construction areas, as required, until the full range of construction phase measures are installed;
- These will be embedded into the local soils to ensure all site water is captured and filtered;
- Clean water drains will include check dams to control flow rates and avoid erosion or scouring of the drain;
- Water from the clean drains will be discharged by a buffered outfall or level spreader at greenfield runoff rates;
- Water will be discharge from the clean drains over natural grassland which will provide filtration;
- All surface water runoff from works areas, excavations, stockpiles at the electricity substation site will be intercepted by downslope drains which will also include check dams;
- These dirty water drains will direct water to settlement ponds for treatment and attenuation;
- The treated water will then be discharged via a buffered outfall or level spreader, at greenfield rates, over natural grassland which will provide additional filtration and treatment;
- The precise design, sizing and sitting of the drainage infrastructure will be confirmed as part of the post-consent detailed design process, however the design will be reflective of predicted rainfall levels with an appropriate allowance for climate change;
- Daily monitoring of the excavation/earthworks, the water treatment and pumping system and the discharge areas will be completed by a suitably qualified person during the construction phase. All necessary preventative measures will be implemented to ensure no entrained sediment, or deleterious matter will enter the main drainage channel;
- If high levels of silt or other contamination is noted in the pumped water or the treatment systems, all construction works will be stopped. No works will recommence until the issue is resolved and the cause of the elevated source is remedied;
- Earthworks will take place during periods of low rainfall to reduce run-off and potential siltation of watercourses; and,

- The fluvial glacial deposits (i.e. sand and gravels) located under the glacial tills in part of the site will act as a natural filter.

Silt Fences

Silt fences will be placed downgradient of the work areas at the electricity substation site. This will act to prevent entry to any active turloughs or surface water features, of sand and gravel sized sediment, released from excavation of mineral subsoils of glacial and glacio-fluvial origin, and entrained in drainage water runoff. Inspection and maintenance of these structures during construction phase is critical to their functioning to stated purpose. Inspection of the silt fencing will be carried out weekly or daily during periods of heavy rainfall (>15mm in 24 hours). This monitoring will be a requirement of the contract for the contractor carrying out the works on site. The silt fences will remain in place throughout the entire construction phase.

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. The discharge from the silt bags will be directed to the settlement ponds.

Management of Drainage from Spoil Deposition Areas

Excavated subsoil will be used for fill throughout the site and any excess will be stored at 2 no. spoil deposition areas.

The deposition areas will be sealed with a digger bucket and vegetated as soon possible to reduce sediment entrainment in drainage water. Once re-vegetated and stabilised, the deposition areas will no longer be a likely source of silt laden water.

Timing of Site Construction Works

Construction of the site drainage system will only be carried out during periods of low or no rainfall. This will minimise the risk of entrainment of suspended sediment in drainage water. Construction of the drainage system during this period will also ensure that attenuation features associated with the drainage system will be in place and operational for all subsequent construction works.

Weather monitoring is a key input to the successful management of the drainage and treatment system during the construction of the substation. This, at a minimum, will involve 24-hour advance meteorological forecasting linked to a trigger-response system. When a pre-determined rainfall trigger level is exceeded (e.g. 1 in 5-year storm event), planned responses should be undertaken. These responses will involve control measures including the cessation of construction until the storm event has passed over and flood flows have subsided. Dedicated construction personnel should be assigned to monitor the weather.

Monitoring

An inspection and maintenance plan for the on-site drainage system will be prepared in advance of the commencement of any works. Regular inspections of all installed drainage systems will be undertaken, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water in parts of the systems where it is not intended.

Any excess build-up of silt levels at check dams, the settlement ponds, or any other drainage features that may decrease the effectiveness of the drainage feature, will be removed.

Settlement ponds will require inspected and cleaning when necessary. This will be carried out under low or no flow conditions so as not to contaminate the clean effluent from the pond. The water level would first be lowered to a minimum level by pumping without disturbing the settled sediment. The sediment would then be removed by a mechanical excavator and disposed of in areas designated for the deposition of spoil.

Underground Electricity Line

The majority of the underground electricity line is >50m from any nearby watercourse. The only section within 50m of a watercourse is at the crossing over the Cross (Roscommon) River. This is an existing crossing along a public road and it is proposed to limit any works in this area including the stockpiling of excavated soils and subsoils.

No in-stream works are required at the crossing location; however, due to the proximity of the river to the construction works, there is a potential for surface water quality impacts during trench excavation work. Mitigation measures which are outlined above will be implemented to ensure that silt laden or contaminated surface water runoff from the excavation work does not discharge directly to the watercourse.

Furthermore, working near watercourses along the underground electricity line during or after intense or prolonged rainfall events will be avoided.

Specific mitigation measures relating to the directional drilling at the crossing location are detailed in Section 7.5.1.8.

7.5.1.2 Groundwater Flows and Levels due to Alteration of Recharge Rates

The critical driver of groundwater levels and the likelihood of affecting them is through groundwater recharge. The drainage design of the project has been designed to mimic the existing hydrological regime within the site, whereby surface water pathways are generally short and rainfall readily percolates to ground. The drainage design incorporates check dams to reduce velocities, and outflow from the drains being dispersed over a wide area of vegetation.

The net effect of the drainage design will be that all rainfall falling within the electricity substation site will remain on the site and infiltrate to ground and will not exit the site as runoff to surface watercourses.

Having regard to the characteristics of the underground electricity line, no mitigation measures are required in relation to the maintenance of recharge rates.

7.5.1.3 Groundwater Levels due to Excavation Works

Whilst the electricity substation site is mapped to be underlain by a Regionally Important Karstified Aquifer, there is little likelihood of effects for the following reasons:-

- The shallow nature of the proposed excavations (c. 0-2m);
- The lack of any shallow groundwater inflows in the trial pits;
- No bedrock excavations are proposed;

- The local bedrock comprises generally hard limestone and dolomitic limestone and has been shown to be generally unproductive during site investigations;
- No regional groundwater flow regime, i.e. large volumes of groundwater flow, will be encountered at these elevations (as proven by the site investigation drilling);
- Shallow groundwater inflows, should they occur, will largely be fed by recent rainfall, and possibly by limited seepage from localised permeable subsoils;
- Any shallow groundwater seepage (within the subsoils) will be small in comparison to the expected surface water flows following any heavy rainfall events; and,
- The management of surface water will form the largest proportion of water to be managed and treated, although where permeable subsoils are encountered, rainfall may infiltrate to ground rather than ponding at any excavation.

Direct rainfall and surface water runoff will be the main inflows that will require water volume and water quality management. For the avoidance of doubt, we would generally 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.

Therefore, it is assessed that no mitigation measures are necessary regarding groundwater levels.

Meanwhile, the underground electricity line trench depth will be approximately 1.2m in depth, the excavation will be temporary and transient, and the trench will be backfilled with imported aggregates and resurfaced with bituminous material. Therefore, there will be no net loss of permeability. As a result, and given the shallow depth, it is assessed that no mitigation measures are required regarding groundwater levels.

7.5.1.4 Surface Watercourses

The primary mitigating factor in relation to downgradient surface water bodies is the distinct lack of surface watercourses which drain the electricity substation site and the surrounding area. The rainfall falling on the site recharges to the underlying groundwater aquifer. There are no small streams (10-50l/s) which would typically be seen on upland slopes.

To ensure the continuation of the existing hydrological regime, whereby rainfall percolates to ground and does not discharge as surface water runoff, the drainage design has incorporated natural attenuation of flows and allows for collected rainwater to be recharged back into the underlying aquifer rather than leaving the site through man-made drains. The drainage design also includes mitigation measures to ensure that any collected surface water is treated prior to discharge/recharge back into the ground, and therefore will not contain suspended sediment.

7.5.1.5 Accidental Release of Hydrocarbons

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

- No refuelling or maintenance of construction vehicles or plant at the electricity substation site will take place outside of the dedicated bunded refuelling area.

Any off-site refuelling (i.e. along the route of the underground electricity line) will occur at a controlled fuelling station located on an area of impermeable hardstanding;
- Each vehicle will carry fuel absorbent material and pads in the event of any accidental spillages;
- Onsite refuelling will be carried out by trained personnel only;
- Fuels stored on site will be minimised. Fuel storage areas within the temporary construction compound will be bunded appropriately for the fuel storage volume for the time period of the construction and fitted with a storm drainage system and an appropriate oil interceptor;
- Drainage water from temporary construction compounds will be collected and drained via silt traps and hydrocarbon interceptors prior to recharge to ground;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose; and,
- An emergency plan for the construction phase to deal with accidental spillages is contained within Construction and Environmental Management Plan (see Annex 3.4). Spill kits will be available to deal with and accidental spillage in and outside the re-fuelling area.

7.5.1.6 Wastewater Disposal

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

- Self-contained chemical toilets with an integrated waste holding tank will be installed at the temporary construction compound, maintained by the providing contractor, and removed from site on completion of the construction works;
- Water supply, for use in site offices and for other sanitation purposes, will be brought to site and removed after use and disposed of 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.

7.5.1.7 Release of Cement-Based Products

Mitigation by Avoidance

The following mitigation measures are proposed:-

- No batching of wet-cement products will occur on site. Ready-mixed supply of wet concrete products and where possible, emplacement of pre-cast elements, will take place;
- Where possible pre-cast elements for concrete works will be used;
- Where concrete is delivered on site, only the chute will be cleaned, using the smallest volume of water practicable. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed. Chute cleaning water will be undertaken at lined cement washout ponds located within the temporary construction compound;
- Weather forecasting will be used to plan dry days for pouring concrete; and,
- The pour site will be kept free of standing water and plastic covers will be ready in case of sudden rainfall event.

Mitigation by Design

The following mitigation measures are proposed:-

- No in-stream excavation works are proposed and therefore there will be no impact on the Cross (Roscommon) River at the proposed crossing along the underground electricity line;
- Any guidance/mitigation measures required by the OPW or Inland Fisheries Ireland will be incorporated into the detailed project design proposals;
- As a further precaution, near stream construction work, will only be carried out during the period permitted by Inland Fisheries Ireland for in-stream works according to the Eastern Regional Fisheries Board (2004) guidance document *Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites* i.e., May to September inclusive. This time period coincides with the period of lowest expected rainfall, and therefore minimum surface water flows (note within the electricity substation site there are no watercourses, and all rainwater will percolate to ground). This will minimise the risk of entrainment of suspended sediment in drainage water, and transport via this pathway to surface watercourses (any deviation from this will be completed in consultation with the IFI);
- During the near stream construction work (along the underground electricity line) double row silt fences will be emplaced immediately down-gradient of the construction area for the duration of the construction phase. There will be no batching or storage of cement allowed in the vicinity of the crossing construction areas; and,
- No new stream crossings or culverts will be required. No Section 50 Applications are required for this project.

7.5.1.8 Directional Drilling Works

The following mitigation measures are proposed:-

- Although no in-stream works are proposed, the drilling works will only be done over a dry period between July and September (as required by IFI for in-stream works) to avoid the salmon spawning season and to have more favourable (dryer) ground conditions;
- The crossing works area will be clearly marked out with fencing or flagging tape to avoid unnecessary disturbance;
- There will be no storage of material/equipment or overnight parking of machinery inside a 15m buffer zone which will be imposed around the Cross (Roscommon) River;
- Before any ground works are undertaken, double silt fencing will be placed upslope of the watercourse channel along the 15m buffer zone boundary;
- Additional silt fencing or straw bales (pinned down firmly with stakes) will be placed across any natural surface depressions/channels that slope towards the watercourse;
- Silt fencing will be embedded into the local soils to ensure all site water is captured and filtered;
- The area around the bentonite batching, pumping and recycling plant will be bunded using terram (as it will clog) and sandbags in order to contain any spillages;
- Drilling fluid returns will be contained within a sealed tank/sump to prevent migration from the works area;

- Spills of drilling fluid will be clean up immediately and stored in an adequately sized skip before been taken off-site;
- If rainfall events occur during the works, there will be a requirement to collect and treat small volumes of surface water from areas of disturbed ground (i.e. soil and subsoil exposures created during site preparation works);
- This will be completed using a shallow swale and sump down slope of the disturbed ground; and water will be pumped to a proposed percolation area at least 50m from the watercourse;
- The discharge of water onto vegetated ground at the percolation area will be via a silt bag which will filter any remaining sediment from the pumped water. The entire percolation area will be enclosed by a perimeter of double silt fencing;
- Any sediment laden water from the works area will not be discharged directly to a watercourse or drain;
- Works shall not take place during periods of heavy rainfall and will be scaled back or suspended if heavy rain is forecasted;
- Daily monitoring of the compound works area, the water treatment and pumping system and the percolation area will be completed by a suitably qualified person during the construction phase. All necessary preventative measures will be implemented to ensure no entrained sediment, or deleterious matter is discharged to the watercourse;
- If high levels of silt or other contamination is noted in the pumped water or the treatment systems, all construction works will be stopped. No works will recommence until the issue is resolved and the cause of the elevated source is remedied;
- On completion of the works, the ground surface disturbed during the site preparation works and at the entry and exit pits will be carefully reinstated;
- The silt fencing upslope of the river will be left in place and maintained until the works area has been fully reinstated;
- There will be no batching or storage of cement allowed at the watercourse crossing;
- There will be no refuelling allowed within 100m of the watercourse crossing; and,
- All plant will be checked for purpose of use prior to mobilisation at the watercourse crossing.

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.

7.5.1.9 Karst Features

The following mitigation measures are proposed:-

- Site drainage management will be put in place in order to prevent any poor quality drainage water reaching the turlough during the construction phase. This includes 3 no. layers of silt fencing downgradient of works areas, as well as the general separation of clean and dirty water, while maintaining the overall hydrological regime of rainfall recharge to ground; and,
- Mitigation measures relating to hydrocarbons, wastewater and cementitious materials, as detailed at Sections 7.5.1.5, 7.5.1.6 and 7.5.1.7, will provide a high level of protection to groundwater and surface water quality and ensure that groundwater quality and karst features will not be significantly affected, thus protecting the groundwater quality of the Karstic Bedrock Aquifer.

7.5.1.10 WFD Status

Due to the hydrogeological regime at the electricity substation site, the Funshinagh GWB is the most sensitive receptor. SWBs downstream of the electricity substation site will be less susceptible to effects due to the lack surface water pathways between the site and downstream surface water receptors. However, a watercourse crossing is proposed along the underground electricity line, and as a result, the Cross (Roscommon) River is more at risk.

Strict mitigation measures in relation to the protection of surface and groundwaters are outlined above in Sections 7.5.1.1 to 7.5.1.8. The implementation of these mitigation measures during the construction phase of the project will ensure the qualitative and quantitative status of the receiving groundwaters and surface waters will not be altered by the project.

There will be no change in GWB or SWB status in the underlying GWBs or downstream SWBs. There will be no change in quantitative (volume) or qualitative (chemical) status, and the underlying GWBs are protected from any potential deterioration from chemical pollution.

As such, the project is assessed to be compliant with the requirements of the Water Framework Directive (2000/60/EC).

7.5.1.11 Designated Sites

Mitigation measures have been outlined within Sections 7.5.1.1 to 7.5.1.8 which will ensure the protection of groundwater quality and quantity leaving the project site. These mitigation measures include:-

- Site specific drainage design ensuring all water recharges to ground and mimics the existing hydrological regime;
- Protection of groundwater from cement-based materials; and,

- Protection of groundwater from the potential release of silt and hydrocarbons.

Furthermore, mitigation for the protection of surface water quality along the underground electricity line associated with the directional drilling is detailed at Section 7.5.1.8.

Lough Ree SAC/SPA/pNHA

It is assessed that there will be no likely significant effect on Lough Ree SAC/SPA/pNHA for the following reasons:-

- The small scale and shallow nature of the proposed works;
- The lack of any direct hydrological connection between the project site and Lough Ree (the only potential connection is via groundwater flowpaths);
- The separation distance between the electricity substation site and Lough Ree (c. 2.3km);
- The scale of the project in comparison with the scale and volume of water within the Funshinagh GWB within which groundwater flows towards Lough Ree – the likelihood of significant effects is limited due to dilution;
- The scale of the project in comparison with the scale and volume of water within Lough Ree and the River Shannon – the likelihood of significant effects is limited due to dilution; and,
- Nevertheless, mitigation measures for the protection of surface and groundwater water quality will be implemented during the construction phase of the project to ensure that there is no deterioration in local water quality.

Ballynamona Bog and Corkip Lough SAC

It is assessed that there will be no likely significant effect on Ballynamona Bog and Corkip Lough SAC for the following reasons:-

- The small scale, shallow and transient nature of the proposed works along the underground electricity line;
- The works will be located in the carriageway of the existing road network;
- The trench excavations will be shallow and above the groundwater table;
- No groundwater dewatering is proposed along the underground electricity line;
- The lack of any direct hydrological connection between the underground electricity line and this SAC;
- The separation distance between the underground electricity line and the SAC (c. 900m);
- The scale of the proposed works along the underground electricity line in comparison with the scale and volume of water within the Funshinagh GWB within which supplies groundwater to Corkip Lough; and,
- Nevertheless, mitigation measures for the protection of surface and groundwater water quality will be implemented during the construction phase of the project to ensure that there is no likelihood of a deterioration in local water quality.

Castlesampson Esker SAC (turlough)

Please note the sand and gravel element of the SAC is not groundwater dependent, and therefore will not be impacted directly or indirectly by the proposed development. The text below relates to potential to impact on the turlough qualifying interest of the SAC.

It is assessed that there will be no likely significant effect on Castlesampson Esker SAC for the following reasons:-

- The small scale, shallow and transient nature of the proposed works along the underground electricity line;
- The trench excavations will be shallow and above the groundwater table;
- No dewatering is proposed along the underground electricity line;
- The lack of any direct hydrological connection between the underground electricity line and this SAC);
- The separation distance between the underground electricity line and the SAC (c. 3.8km);
- The scale of the proposed works along the underground electricity line in comparison with the scale and volume of water within the Funshinagh GWB within which supplies groundwater to the turlough; and,
- Nevertheless, mitigation measures for the protection of surface and groundwater water quality will be implemented during the construction phase of the project to ensure that there is no likelihood of a deterioration in local water quality.

7.5.1.12 Groundwater Supplies

Mitigation measures have been outlined within Sections 7.5.1.1 to 7.5.1.8 which will ensure the protection of groundwater quality and quantity leaving the project site. These mitigation measures include:-

- Site specific drainage design ensuring all water recharges to ground and mimics the existing hydrological regime;
- Protection of groundwater from cement-based materials; and,
- Protection of groundwater from the potential release of silt and hydrocarbons.

Regardless, if private wells are located downgradient of the electricity substation site or not (or if wells are installed in the future), the likelihood of significant effects is negligible for the following conclusive reasons:-

- The electricity substation is underlain by strong limestones;
- No karst features were identified during the site investigations;
- There will be no interference with groundwater flowpaths or alteration of groundwater recharge rates and therefore there is no potential to effect local groundwater levels; and
- Mitigation measures are provided to deal with typical construction phase groundwater hazards such as oils and fuels;
- Therefore, based on the hydrogeological assessment of the electricity substation site and the prescribed mitigation measures, it can be robustly determined that the potential to effect local wells/water supplies is negligible.

7.5.2 Operational Phase

7.5.2.1 Progressive Replacement of Natural Surface with Lower Permeability Surfaces

As summarised at Section 7.4.1.1, the drainage design for the electricity substation site provides for the release of any surface water captured to be recharged back to ground, with a very nominal spatial diversion of the water (10's of metres). In doing so, all rainfall which falls on the site will continue to infiltrate to ground. There will be no net increase in runoff from the electricity substation site.

The operational phase drainage system will be installed and constructed in conjunction with the road and hardstanding construction work as described below:-

- The surface of the vast majority of access tracks (other than a short section within the substation compound) will be permeable and will allow for incident rainfall to percolate to ground, thus avoiding significant run-off generation;
- The use of permeable materials will avoid changes to the natural drainage regime at the electricity substation site;
- Interceptor drains will be installed up-gradient of all proposed infrastructure to collect clean local drainage water, in order to minimise the amount of rainfall reaching areas where suspended sediment could become entrained. Collected drainage water will then be directed to areas where it can be slowly re-distributed over the ground surface and infiltrate through the soil and subsoils;
- Swales/road side drains will be used to collect drainage from access tracks, likely to have entrained suspended sediment, and channel it to settlement ponds for sediment settling; and,
- Check dams will be used along sections of access track drains to attenuate flows and intercept silts at source. Check dams will be constructed from a 4/40mm non-friable crushed rock.

The stormwater management plan was designed so that storm water will be attenuated with discharge being limited to greenfield rates with storm-water storage facilities and SuDS elements incorporated to allow for a reduction of run-off volumes where possible. In particular:-

- The stormwater drainage management plan includes the provision of an attenuation system designed to cater for a 1 in 100-year storm event;
- This system will temporarily store stormwater and gradually release it back into the local drainage system at greenfield runoff rates; and,
- The proposed attenuation system reduces the risk of downstream flooding.

7.5.2.2 Contaminated Runoff/Recharge

- A stormwater piped network will be installed during the construction phase and will be used in the operational phase to collect all stormwater from the impermeable areas of the electrical substation site. Runoff from the tracks and other hardstand areas will continue to be directed towards the settlement ponds which will be left in place after the construction phase. Check dams will also be left in place in the drainage channels. This infrastructure will ensure that runoff is both attenuated and treated prior to release across the existing vegetation and recharging to ground;
- Onsite re-fuelling of machinery will not be carried out during the operational phase of the development. All plant/machinery will be refuelled offsite;
- Fuels stored on site will be minimised and any diesel or fuel oils/hydrocarbons stored on-site will be bunded within the control building. The bund capacity will be sufficient to contain 110% of the storage tank's maximum capacity;
- The electrical control building will be bunded appropriately to the volume of oils likely to be stored, and to prevent leakage of any associated chemicals and to groundwater or surface water. A storm drainage system and an appropriate oil interceptor will be installed at the compound of the electricity substation to avoid any discharges from the site of hydrocarbons;

- Any plant used during the operational phase will be regularly inspected for leaks and fitness for purpose;
- Spill kits will be available to deal with accidental spillages;
- A hydrocarbon interceptor will be located upstream of the stormwater attenuation system; and,
- Wastewater arising from the control building will be stored in a sealed sub-surface tank and will be removed from the site as required by a local licenced waste collector.

7.5.2.3 WFD Status

The likelihood of effects during the operational phase is reduced in comparison to the construction phase.

During the operational phase, the only plant which will be required on site will be maintenance/inspection vehicles (jeeps/vans). Mitigation measures are prescribed for the protection of surface and groundwaters from hydrocarbon spillage, wastewater disposal and the use of cement based products during the construction phase (Sections 7.5.1.5, 7.5.1.6 and 7.5.1.7) will also be implemented during the operational phase. The implementation of these mitigation measures during the operational phase will ensure the qualitative status of the receiving groundwaters waters will not be altered.

There will be no change in GWB or SWB status in the underlying GWBs or downstream SWBs resulting from the project. There will be no change in quantitative (volume) or qualitative (chemical) status, and the underlying GWBs are protected from any potential deterioration from chemical pollution.

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

7.5.2.4 Karst Features

The likelihood of effects during the operational phase is reduced as there are no further construction activities along with the associated likely sources such as hydrocarbons/cement/ exposure of subsoils/bedrock.

During the operational phase, the only plant which will be required on site will be maintenance/inspection vehicles (jeeps/vans), thus reducing the likelihood of effects due to hydrocarbon spills. There will be no discharge of wastewater from the site during the operational phase. Mitigation measures relating to hydrocarbons, cementitious materials and wastewater disposal, as outlined at Sections 7.5.1.5, 7.5.1.6 and 7.5.1.7 will continue to provide a high level of protection to groundwater and surface water quality during the operational phase and ensure that groundwater quality will not be impacted, thus protecting the groundwater quality of any hydraulically downgradient turloughs.

Any hydrocarbons (oil) stored within the substation will be enclosed within a bund with 110% capacity.

7.5.3 Decommissioning Phase

As set out at Chapter 3 (Sections 3.2 and 3.7), the project 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 all mitigation measures, the residual effect is assessed to be negative, indirect, imperceptible, short term, unlikely effect on the underlying groundwater systems and down gradient turloughs near the electricity substation site and down gradient rivers along the underground electricity line.

For the reasons outlined above, and with the implementation of the above outlined mitigations measures, no significant effects on the aforementioned receptors are likely to occur due to the suite of drainage mitigation measures which will be put in place.

7.6.1.2 Groundwater Flows and Levels due to Alteration of Recharge Rates

Following the implementation of all design measures incorporated within the drainage management proposals, it is assessed that there will be no likely significant residual effects on groundwater flows or groundwater levels.

7.6.1.3 Groundwater Levels due to Excavation Works

Based on site investigation data and the characteristics of the project, there will be no requirement for substantial dewatering; however, there may be an occasional requirement for dewatering of ponded surface water in the base of excavations. Any pumped water will be directed (by temporary pumping) to a settlement pond for treatment and to infiltrate to ground slightly downgradient of the excavation. Consequently, recharge rates will not be altered and it is assessed that there will be no likely significant residual effects on groundwater levels.

7.6.1.4 Surface Watercourses

Due to the lack of surface water drainage from the electricity substation site, as well as the drainage management proposals which ensures the continuation of the existing hydrological/hydrogeological regime (groundwater recharge, with no runoff), along with treatment proposals such as check dams, settlement ponds and Terrastop silt fencing, it is assessed that there will be no likely significant residual effect on downgradient surface waterbodies.

7.6.1.5 Accidental Release of Hydrocarbons

Based on the prescribed mitigation measures, the appropriate safe use and handling of hydrocarbons on-site where necessary including fuel bunds and the inclusion of hydrocarbon interceptors within the drainage system, the residual effects are assessed to be indirect, negative, imperceptible, short term, very unlikely effect.

For the reasons outlined above, and with the implementation of the listed mitigation measures, no significant effects on surface water and groundwater quality are likely to occur.

7.6.1.6 Wastewater Disposal

Based on the fact that there will be no discharge of wastewater at the electricity substation site or along the underground electricity line and that wastewater will be managed by an appropriately licensed waste contractor, it is assessed that there will be no likely significant residual effect as a consequence of wastewater disposal.

For the reasons outlined above, no significant effects on groundwater quality are likely to occur.

7.6.1.7 Release of Cement-Based Products

Based on the absence of surface watercourses at the electricity substation site, as well as the mitigation measures to reduce the likelihood of concrete leakage, the residual effect is assessed to be negative, indirect, imperceptible, short term, very unlikely impact on groundwater quality in the Funshinagh GWB.

Based on the absence of in-stream works and the mitigation measures to prevent the release of concrete-laden water, the residual effect along the underground electricity line route is assessed to be negative, indirect, imperceptible, short term, likely impact to surface water.

For the reasons outlined above, and with the implementation of the listed mitigation measures, no significant effects on groundwater quality, and no significant effects on stream morphology or stream water quality, are assessed as likely to occur.

7.6.1.8 Directional Drilling Works

Due to the absence of instream works, the works being mainly carried out in the corridor of a public road along with the proposed mitigation measures, the residual effect is assessed to be negative, imperceptible, indirect, temporary, likely effect on surface water in the downstream watercourses.

For the reasons outlined above, it is assessed that significant effects as a result of directional drilling works are not likely to arise.

7.6.1.9 Karst Features

Due to the extensive site-specific data on subsoils and bedrock within the electricity substation site obtained from site investigations, coupled with the mitigation measures associated with drainage management and the protection of water quality, the residual effect is assessed to be indirect, negative, imperceptible, short term, unlikely impact to groundwater fed turloughs.

No significant effects are likely to occur on downgradient non-designated turloughs.

7.6.1.10 WFD Status

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

There will be no change in GWB or SWB status in the underlying GWB or downstream SWBs resulting from the project. There will be no change in quantitative (volume) or qualitative (chemical) status, and the underlying GWB and downstream SWBs are protected from any potential deterioration.

It is assessed that no residual effect on Groundwater Body WFD status will occur.

It is assessed that no residual effect on Surface Water Body WD status will occur.

7.6.1.11 Designated Sites

The likelihood of effects are limited due to the short-term and transient nature of the proposed works. Furthermore, proven and effective measures to mitigate the risk of surface and groundwater contamination have been proposed which will break the pathway between the likely source and downstream receptors. These mitigation measures will ensure that surface water runoff and groundwater recharge will be equivalent to baseline conditions and will therefore have no impact on water quality and/or the status or ecology of protected species and habitats within designated sites. The residual effects are assessed to be negative, imperceptible, indirect, short-term, unlikely effect on designated sites.

For the reasons outlined above, no significant effects are assessed as likely to occur.

7.6.1.12 Groundwater Supplies

For the reasons outlined above (prevailing geology, shallow nature of the works, and prescribed mitigation measures), considerate is assessed that the residual effect is likely to be negative, imperceptible, indirect, long-term, unlikely effect in terms of quality or quantity on local groundwater abstractions.

Therefore, it is assessed that significant effects on existing groundwater supplies are not likely to occur.

7.6.2 Operational Phase

7.6.2.1 Progressive Replacement of Natural Surface with Lower Permeability Surfaces

Due to the absence of changes to the groundwater recharge regime, with no surface water drainage from the electricity substation site, as well as the relatively short displacement of any rainfall before it infiltrates and the mitigation measures to ensure the quality of the drainage discharge water, the residual effect is assessed to be indirect, negative, imperceptible, permanent, unlikely effect on groundwater quality and quantity within the Funshinagh GWB.

No significant effects on surface or groundwater quality or quantity are likely to arise during the operational phase.

7.6.2.2 Contaminated Runoff/Recharge

Proven and effective measures to mitigate the risk of releases of hydrocarbons have been proposed above and will break the pathway between the likely source and each receptor. The residual effect is assessed to be negative, indirect, imperceptible, short term, unlikely effect on surface water quality and groundwater quality.

For the reasons outlined above, no significant effects on surface water or groundwater quality as a result of contaminated runoff/recharge are assessed as likely during the operational phase.

7.6.2.3 WFD Status

Due to the characteristics of the local hydrological and hydrogeological regime, the minor and infrequent nature of works during the operational phase, coupled with the implementation of the proposed mitigation measures for the protection of groundwater recharge and water quality, considerate is assessed that there will be no residual effect on the WFD status of the underlying Funshinagh GWB.

With the implementation of the mitigation measures outlined above, there will be no change in the GWB or SWB status in the underlying GWBs or downstream SWBs resulting from the project. The project will not result in the deterioration in the WFD status of any surface or groundwater body nor will it jeopardise the attainment of good status in the future.

7.6.2.4 Karst Features

With the implementation of the mitigation measures associated with drainage control and the protection of water quality, combined with the absence of any construction type activities during the operational phase, the residual effect is assessed to be not significant on downgradient karst features (turloughs).

For the reasons outlined above, no significant effects are likely to occur.

7.6.3 Decommissioning Phase

As set out at Chapter 3 (Sections 3.2 and 3.7), the project will form part of the national electricity network and decommissioning of the substation is not proposed. Therefore, no decommissioning phase residual effects are likely to occur.

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 affect the hydrological/hydrogeological regime or water quality at the site or its vicinity. These effects generally arise from sediment input from runoff and other pollutants such as hydrocarbons and cement based compounds.

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. The existing hydrological regime is characterised by high rates of groundwater recharge and low rates of surface water runoff. There are no surface water streams or rivers in the vicinity of the electricity substation site. A turlough is located ~300m to the south of the electricity substation.

The management of water is the principal means of significantly reducing sediment runoff arising from construction activities and to control runoff and recharge rates. The key surface water control measure is that there will be no direct discharge of runoff from any works area. This will be achieved by design methods (i.e. surface water treatment measures – drains, check dams, settlement ponds and buffered outfalls) which will ensure that all water generated at the site will recharge to ground as per existing greenfield rates.

Preventative measures also include fuel, concrete and wastewater management which will be incorporated into the detailed CEMP to be prepared prior to the commencement of project.

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 and operated 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 or operation of the project.