White Hill Wind Farm Electricity Substation & Electricity Line

Environmental Impact Assessment Report

Chapter 7: Water

White Hill Wind Limited

Galetech Energy Services

Clondargan, Stradone, Co. Cavan Ireland

Telephone +353 (0)49 555 5050

www.galetechenergyservices.com

Contents

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 effects 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 Project Description

The project site is located in rural County Kilkenny and County Carlow, approximately 11 kilometres (km) northeast of Kilkenny City, c. 15km southwest of Carlow Town, c. 3km west of Muine Bheag and c. 1km north of Paulstown. In summary, the project comprises the following main components as described in full at **Chapter 3**:-

- A 110kV 'loop-in/loop-out' electricity substation;
- Approximately 320 metres (m) of 110kV underground electricity line between the electricity substation and the Kellis-Kilkenny overhead transmission line and the provision of 2 no. interface masts;
- An electrical control unit at the permitted White Hill Wind Farm site;
- Approximately 8.8km of underground electricity line between the electricity substation and the electrical control unit; and,
- All associated and ancillary site development, access, excavation, construction, landscaping and reinstatement works, including provision of site drainage infrastructure.

The project site traverses the administrative boundary between counties Kilkenny and Carlow; with the electricity substation and c. 3.3km of the underground electricity line located in County Kilkenny and c. 5.5km of the underground electricity line and the electrical control unit located in County Carlow. Electrical equipment suppliers, construction material suppliers and candidate quarries which may supply aggregates are located nationwide.

7.1.3 Statement of Authority

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

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

This chapter was prepared by Michael Gill and David Broderick who also prepared the Land/Soil and Water chapters for the White Hill Wind Farm EIAR.

Michael Gill (P. Geo., B.A.I., MSc, Dip. Geol., MIEI) is an Environmental Engineer with over 23-years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms in Ireland. He has also managed EIAR assessments for infrastructure projects and private residential and commercial developments. In addition, he has substantial experience in wastewater engineering and site suitability assessments, contaminated land investigation and assessment, wetland hydrology/hydrogeology, water resource assessments, surface water drainage design and SUDs design, and surface water/groundwater interactions. For example, Michael 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.

David Broderick (P. Geo., BSc, H. Dip Env Eng, MSc) is a Hydrogeologist/Environmental Engineer with over 17-years' experience in both the public and private sectors. Having spent 2-years working in the Geological Survey of Ireland, working mainly on groundwater and source protection studies, David moved into the private sector. David has a strong background in groundwater resource assessment and hydrogeological/hydrological investigations in relation to developments such as quarries and wind farms. David has also completed numerous geological and hydrological EIAR assessments for a range of commercial developments. David has been involved in the preparation of numerous EIS/EIAR for energy developments including Oweninny Wind Farm, Cloncreen Wind Farm, White Hill Wind Farm, Arderroo Wind Farm and Yellow River Wind Farm and over 80 no. other wind farm related projects across the country.

7.1.4 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 (2009) *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*;
- OPW (2009) *The Planning System and Flood Risk Management*;
- Department of Environment, Heritage and Local Government (2006) *Wind Energy Development Guidelines for Planning Authorities*;
- Inland Fisheries Ireland (2016) *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters*;
- Scottish Natural Heritage (2010) *Good Practice During Wind Farm Construction*;
- *PPG1 - General Guide to Prevention of Pollution* (UK Guidance Note);
- *PPG5 – Works or Maintenance in or Near Watercourses* (UK Guidance Note);

- CIRIA (Construction Industry Research and Information Association) (2006) *Guidance on Control of Water Pollution from Linear Construction Projects* (CIRIA Report No. C648, 2006);
- CIRIA 2006 *Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors* (CIRIA C532, 2006);
- *Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment* (DoHPLG, 2018);
- Forestry Commission (2004) *Forests and Water Guidelines, Fourth Edition*. Publ. Forestry Commission, Edinburgh;
- Coillte (2009) *Forest Operations & Water Protection Guidelines*;
- Forest Services *(Draft) Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures*;
- Forest Service (2000) *Forestry and Water Quality Guidelines* Forest Service, DAF, Johnstown Castle Estate, County Wexford; and,
- COFORD (2004) *Forest Road Manual – Guidelines for the Design, Construction and Management of Forest Roads*.

7.2 Methodology

7.2.1 Desk Study

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

- Environmental Protection Agency database (www.epa.ie);
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks & Wildlife Services Public Map Viewer (www.npws.ie);
- EPA/Water Framework Directive Map Viewer (www.catchments.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 19 (Bedrock Geology of Carlow - Wexford);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 16 (Geology of Kildare - Wicklow); Geological Survey of Ireland (GSI, 1994);
- Geological Survey of Ireland (2004) – Groundwater Body Initial Characterization Reports;
- OPW Flood Maps (www.floodinfo.ie);
- GSI Groundwater Flood mapping (www.gsi.ie); and,
- Aerial photography (www.bing.com/maps, www.google.com/maps).

7.2.2 Baseline Monitoring and Site Investigations

As part of the White Hill Wind Farm EIAR, baseline monitoring and drainage mapping were undertaken by HES on 31 August 2021 and on 10 and 30 March 2022. Trial pits were undertaken at the wind farm site on 6 October 2021, including at the location of the electrical control unit (refer to **Chapter 6**).

Specific site investigations, including additional trial pits and hydrological assessments, at the project site (described below) were undertaken on 24 October 2024.

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

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

7.2.3 Receptor Sensitivity/Importance/Impact Criteria

Using the National Roads Authority (NRA 2009) 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/effect magnitude is assessed using **Table 7.3** and **Table 7.4** and the impact/effect 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, 2009)

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, 2009)

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/effect 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/effect 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/effect 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/Effect (NRA, 2009)

Magnitude	Criteria	Typical Examples
Large Adverse	• Results in loss of attribute and /or quality and integrity of attribute	• Removal of large proportion of aquifer. • Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems. • Possible high risk of pollution to groundwater from routine run-off. • Calculated risk of serious pollution incident >2% annually.
Moderate Adverse	• Results in impact/effect on integrity of attribute or loss of part of attribute	• Removal of moderate proportion of aquifer Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems. • Possible medium risk of pollution to groundwater from routine run-off. • Calculated risk of serious pollution incident >1% annually.
Small Adverse	• Results in minor impact/effect on integrity of attribute or loss of small part of attribute	• Removal of small proportion of aquifer Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems. • Possible low risk of pollution to groundwater from routine run-off. • Calculated risk of serious pollution incident >0.5% annually.
Negligible	• Results in an impact/effect 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/Effect (NRA, 2009)

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

Table 7.5: Estimation of Impact/Effect Rating (NRA, 2009)

7.2.4 Consultation

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

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

Consultee	Summary of Consultee Response	Response Addressed in Section
Carlow County Council	• The EIAR and planning application for the substation and grid connection must address the direct effects and short, medium and long term, permanent and temporary, positive and negative, secondary cumulative and transboundary effects of the whole project, i.e. the wind energy development and the grid connection.	**Section 7.4**
Geological Survey of Ireland	• Our records show that there are groundwater drinking water abstractions (Paulstown Public Water Supply (PWS) and Castlewarren Group Water Scheme (GWS)) with zones of contribution/source within the grid connection route. Key to groundwater protection in general, and protection of specific drinking water supplies, is preventing ingress of runoff to the aquifer. Design of drainage will need to be cognisant of the public water schemes and the interactions between surface water and groundwater as well as run-off. Appropriate design should be undertaken by qualified and competent persons to include mitigation measures as necessary, such as SUDs or other drainage mitigation measures. • Any excavation/cuttings required for realignment should ensure that groundwater flow within the zones of contribution to the groundwater abstraction points is not disrupted, resulting in diminished yields. Note	**Sections 7.3.7, 7.3.12, 7.4.3.8, 7.5.1.7** & **7.6.1.7**

	that there could be other groundwater abstractions in the locality for which Geological Survey Ireland has not undertaken studies, and a robust assessment should be undertaken by qualified and competent persons including a survey of all current wells and water abstractions within the vicinity	
Inland Fisheries Ireland (IFI)	• During the construction and operational phases, the applicant should adhere to the recommendations and guidelines outlined in IFI's Guidelines on Protection of Fisheries during Construction Works in and adjacent to Waters 2016. • Existing watercourse crossings for the proposed grid connection route should be utilised where possible. • Where existing crossings must undergo alteration, IFI request that these are upgraded in the interests of habitat improvement and biodiversity enhancement. • Crossings should be designed to meet IFI's Fisheries Construction Guidelines referred to above. • The storage, management and conveyance of materials must not permit any deleterious matter to reach surface water systems either directly or indirectly. • Instream works may only take place during the period 1 July to 30 September. • SuDS principles should be incorporated into surface water management plans to attenuate any run-off of suspended solids or other deleterious matter.	**Sections 7.4.3.1, 7.4.3.6, 7.5.1.1,** & **7.5.1.6**
Uisce Éireann	• Based on the documentation submitted it does not appear that there are any Uisce Eireann assets in the vicinity of the proposed substation or cabling routes. • It is noted that there is a privately owned water infrastructure in close proximity to the proposed cabling to the west of Baunreagh at the entrance to the wind farm. • There is an existing Uisce Éireann abstraction point to the west downstream from the proposed cabling works in Bagenalstown. The EIAR must include and consider all direct, indirect and cumulative effects on the abstraction point. • Generic advice with respect protection of water supply infrastructure, surface waters and groundwater was provided.	**Sections 7.3.7, 7.3.12, 7.4.3.8, 7.5.1.7** & **7.6.1.7**

Table 7.6: Summary of Scoping Responses

7.2.5 Study Area

The study area (including cumulative assessment) for the water environment includes the Monefelin River, Paulstown Stream, Moanmore Stream and Old Leighlin Stream sub-catchments (refer to **Sections 7.3.3** and **7.3.4** below).

Any effects further downstream at the River Barrow are not expected due to large flows in the River Barrow (assimilative capacity) and due to the fact that the project is distributed across 4 no. sub-catchments and is not concentrated within a single sub-catchment. The hydrogeological study area is also covered by the above catchments.

7.2.6 Limitations and Difficulties Encountered

No limitations or difficulties were encountered during the preparation of the water chapter.

7.3 Description of the Existing Environment

7.3.1 Site Location and Description

The project site is located at the southern fringes of the Castlecomer Plateau. The Castlecomer Plateau is an elevated plateau located in south County Laois, northwest County Carlow and northeast County Kilkenny. The Castlecomer Plateau is characterised by undulating hills and steep escarpments at its fringes.

The lowlands to the south of the Castlecomer Plateau (route of the electricity line and substation location) are a mixture of pasture and tillage with fields typically bordered by mature broadleaf tree lines and hedgerows.

The electricity substation site is located in the townland of Shankill, Paulstown, County Kilkenny. The substation is situated within agricultural lands adjacent to the M9 motorway on its western side.

Topography at the substation location is mapped as relatively flat, with lands sloping slightly southeasterly. Overall site elevations range between approximately 68 and 73m OD (Ordnance Datum).

The electrical control unit is located to the south of the permitted White Hill Wind Farm, within the townland of Baunreagh, County Carlow. The location is also situated in agricultural lands. Forest and semi-natural areas surround the proposed location to the north and east. The electrical control unit is in an upland setting where topography in the area is hilly. The elevation of the electrical control unit is approximately 280m OD.

The underground electricity line will comprise c. 5,925m (c. 5.9km) located within private agricultural lands/forestry and c. 2,850m (c. 2.9km) with the carriageways of the L6673, L6738, L7117 and L71172 local roads.

The ground elevations along the electricity line generally decreases from c. 280m OD at the electrical control unit to c. 68m OD at the electricity substation. However, due to the hilly nature of the topography along the route, the highest elevation reaches c. 310m OD.

7.3.2 Water Balance

Long term rainfall and evaporation data was sourced from Met Éireann. The 30-year annual average rainfall (AAR; 1981-2010) recorded at Coon, approximately 6km northwest of the project site, are presented in **Table 7.7** below.

Coon												
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
99.2	75.2	84.4	75.8	74.1	78.3	73	89.2	82.2	113.8	107.8	103.2	1056.2

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

The closest synoptic[1] weather station where the average potential

[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.

evapotranspiration (PE) is recorded is at Kilkenny, approximately 13km southwest of the project site. The long-term average PE for this station is 448mm/yr. This value is used as a best estimate of the PE for the project site. Actual Evaporation (AE) at the site is estimated as 425mm/year (calculated as 0.95 × PE).

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

Effective rainfall (ER) = AAR – AE

= 1056mm/year – 425mm/year

ER = 631mm/year

Based on recharge coefficient estimates from the GSI (www.gsi.ie), an average estimate of 25% recharge is taken for the overall project site. This value is for 'Till overlain by poorly drained (gley) soil' (i.e. tills as described at **Chapter 6**).

The recharge coefficient of 25% was used to calculate values for key hydrological properties. Therefore, annual recharge (25%) and runoff rates (75%) for the project site area are estimated to be c. 158mm/year and c. 473mm/year respectively.

Table 7.8 presents return period rainfall depths for the project site. This data is taken from https://www.met.ie/climate/services/rainfall-return-periods and provides rainfall depths for various storm durations and sample return periods (10-year, 50-year, 100-year).

Duration	10-year Return Period (mm)	50-Year Return Period (mm)	100-Year Return Period (mm)
15 min	13	21	25.6
1 hour	21	32.6	39.1
6 hour	38.7	57.4	67.6
12 hour	49	71.5	83.6
24 hour	62.2	89.1	103.4

Table 7.8: Return Period Rainfall Depths for Project Site

7.3.3 Local and Regional Hydrology

On a regional scale, the electricity substation, electrical control unit and electricity line are located entirely within the River Barrow surface water catchment within Hydrometric Area 14. The River Barrow flows approximately 3.5km to the east of the electricity substation site.

On a more local scale, the substation is located in the Barrow_SC_120 sub-catchment and within the Moanmore_010 river waterbody sub-basin (Moanmore Stream catchment).

The electrical control unit is also mapped within the Barrow_SC_120 sub–catchment, whilst being situated more locally in the Monefelim_010 river sub-basin (Monefelim River catchment).

The majority of the electricity line is also located in the Barrow_SC_120 sub–catchment with the exception of 1.3km which is located in the Barrow_SC_110 sub-catchment and more locally within the Old Leighlin Stream_010 river waterbody sub-basin (Old Leighlin Stream catchment).

In all, the electricity line passes through 4 no. sub-basins; the Monefelim_010 (c.

1.4km), Monefelim_030/Paulstown Stream (c. 2.1km), Old Leighlin Stream_010 (c. 1.3km) and Moanmore_010 (c. 4.0km).

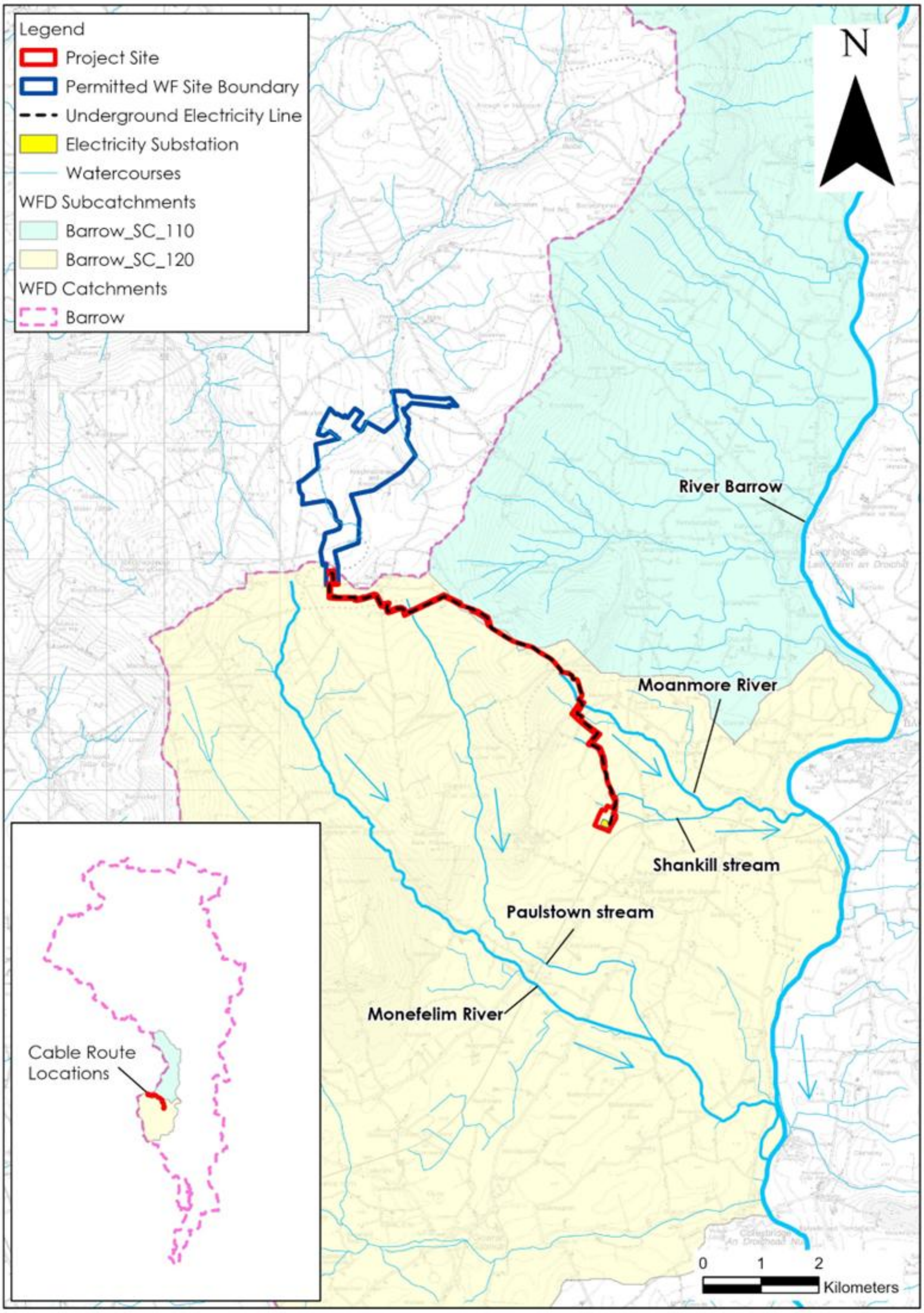


Figure 7.1: Regional Hydrology Mapping

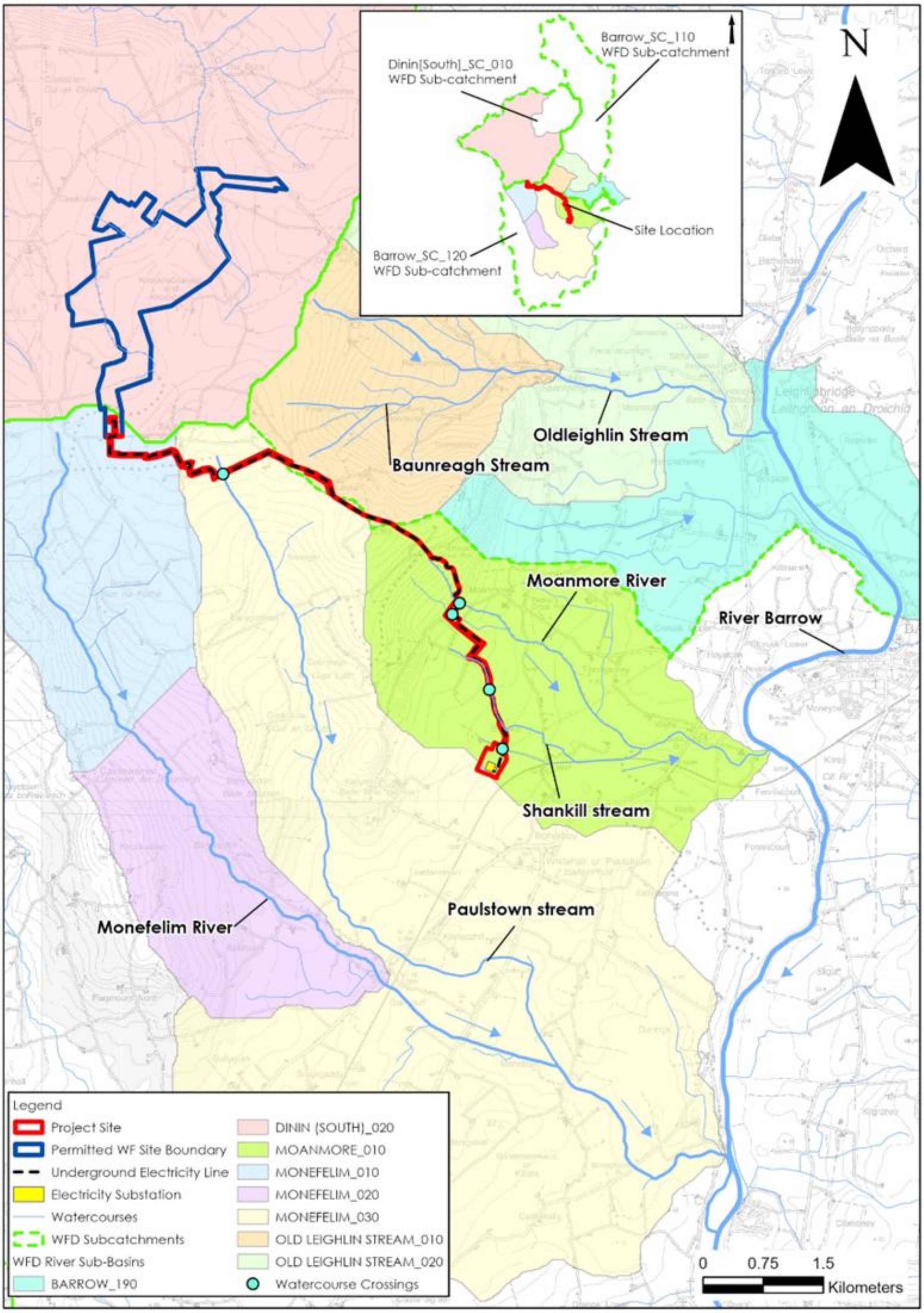


Figure 7.2: Local Hydrology Mapping

7.3.4 Site Drainage

An unnamed headwater stream of the Moanmore_010 flows in a southeasterly direction, c. 85m north of the electricity substation location. The unnamed stream confluences with the Shankill (14) Stream (EPA Code: 14S30), which in turn feeds into the Moanmore (14) Stream (EPA Code: 14M24).

The Moanmore Stream discharges into the River Barrow c. 3.5km east of the substation site. The site of the substation itself is drained by a network of field boundary drains that flow north towards the unnamed headwater stream.

The Monefelim River rises c. 0.6km to the southwest of the electrical control unit. The Monefelim River flows to the southeast and discharges into the Barrow River approximately 12.5km from the project site. The Paulstown Stream is a sub-catchment of the Monefelim River.

The route of the underground electricity line crosses 5 no. natural watercourses, 4 no. of which are EPA mapped watercourses:-

- Paulstown Stream (EPA Code: 14P06) within the Monefelim_030 river sub basin;
- Moanmore Stream (EPA Code: 14M24) within the Moanmore_010 river sub basin;
- An unmapped watercourse that flows into the Moanmore Stream approximately 1km downstream of the above crossing location;
- Shankill (14) Stream (EPA Code: 14S30) within the Moanmore_010 river sub basin; and;
- The unnamed watercourse north of electricity substation location within the Moanmore_010 river sub basin.

The 5 no. watercourse crossing locations is illustrated at **Figure 7.2** above.

There are no existing culverts at any of the proposed crossing locations and therefore the proposed method for crossing at all 5 no. locations is via Horizontal Directional Drilling (HDD). A bottomless culvert will be installed over the unnamed stream to the north of the electricity substation to accommodate its crossing by an access track.

7.3.5 Flood Risk Assessment

The following section is a summary of a site-specific Stage 2 Flood Risk Assessment for the project which is provided at **Annex 7.1** (**Volume II**).

To identify any areas of being at risk of flooding, the OPW's Past Flood Events Maps, the National Indicative Fluvial Mapping (NIFM), CFRAM River Flood Extents, historical OSI mapping (i.e. 6" and 25" base maps) and the GSI Surface Water and Groundwater Flood Maps were consulted. These flood maps are available to view at Flood Maps - Floodinfo.ie.

There are no areas on the historical OSI 6" or 25" mapping in the project site that are identified as "*Liable to Floods*".

No recurring flood incidents were identified near the electricity substation or the electrical control unit. A recurring flood event is however mapped along the electricity line route at the L7117 local road in the townland of Lacken (Flood ID: 2959). The road is noted to be periodically impassable within the Bagenalstown Area Engineer Meeting Minutes. OPW's Past Flood Event Map for the area is illustrated at **Figure 7.4** below.

There is no CFRAM River Flood Extents mapping available for the project site. The nearest available CFRAM mapping is found along the main channel of the River Barrow c. 3.5km to the east of the project site, as illustrated at **Figure 7.5** below.

There is also no National Indicative Fluvial Mapping available for the immediate vicinity of the project. NIFM river flood zones are mapped along the Moanmore Stream approximately 1.8km east and downstream of the electricity substation location, before its confluence with the River Barrow.

NIFM flood zones are also mapped along the Monefelim River and Paulstown Stream, however these are at significant downstream distances from the project. For example, river flood zones are mapped along the Monefelim_010 approximately 2.6km south and downstream of the electrical control unit.

Additionally, flood zones are mapped along the Monefelim_030 approximately 2.7km southeast and downstream of where the electricity line crosses the Paulstown Stream (EPA Code: 14P06).

The GSI's Winter 2015/2016 Surface Water Flood Map shows surface water flood extents for this winter's 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 flood zones in the area of the project site. The nearest mapped surface water flood zones are mapped along the main channel of the River Barrow further east and downstream of the project site.

No modelled or historic groundwater flooding is mapped in the vicinity of the project site or surrounding lands.

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

A walkover of the project site was undertaken on 24 October 2024 during which it was surveyed for any signs or anecdotal evidence of flooding. No such signs were noted.

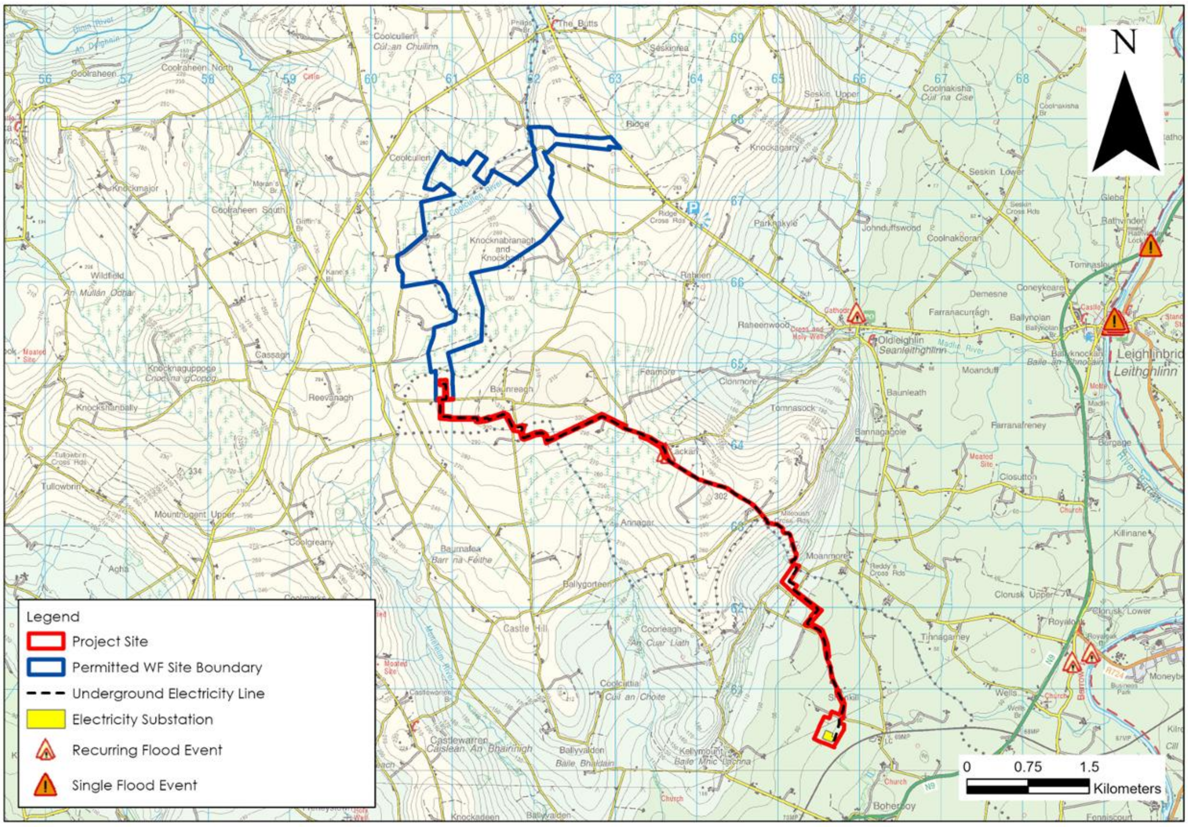


Figure 7.4: OPW Past Flood Event Mapping

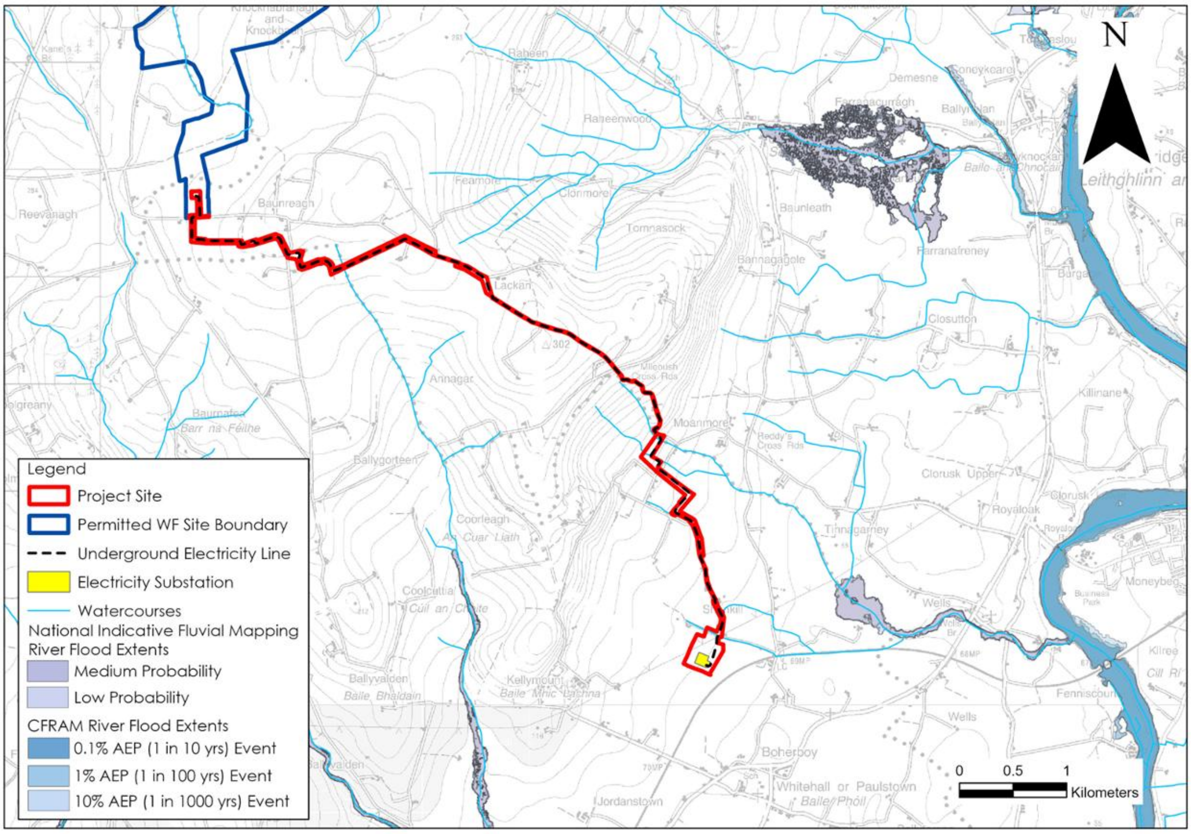


Figure 7.5: OPW Flood Extent Mapping & NIFM

7.3.6 Surface Water Hydrochemistry

EPA Biological Q-rating data for EPA monitoring points are available for the Monefelim River downstream of the project site. The most recent data available (2023) show that the Q-rating ranges from 'Moderate' to 'High' downstream of the electrical control unit and electricity line route.

Approximately 3.8km south of the electrical control unit, at Castlewarren Bridge, the Monefelim River achieves a Q-rating of 4-5 i.e. 'High Status'. The status of the Monefelim River reduces, with the Monefelim_030 river segment achieving a Q-rating of 3-4 i.e. 'Moderate' status. The latest Q-rating data (2020) for the Old Leighlin Stream range from Q3-4 to Q4-5.

No Q-value monitoring stations are located within the Moanmore_010 river sub-basin, downstream of the electricity substation and southern end of the electricity line route.

Downstream of the Moanmore_010, the Barrow River achieved a Q-rating of Q3-4 'Moderate'.

Surface water samples were taken at 2 no. locations downstream of the project site. A sample was taken from Monefelim River downstream of the electrical control unit (SW1) and one from the Shankill Stream along the route of the electricity line (SW2). Refer to **Figure 7.3** for the sampling locations.

Sampling was undertaken on the 24 October 2024. Field hydrochemistry measurements of unstable parameters, electrical conductivity (µS/cm), pH (pH units) and temperature (°C) were taken at each location and the results are listed in **Table 7.9** below.

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

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

Location	EC (µS/cm)	pH	Temperature
SW1	147	7.2	8.3
SW2	139	7.3	8.4

Table 7.9: Summary of Surface Water Chemistry Measurements

The results of analyses carried out on the water samples are shown alongside relevant water quality regulations in **Table 7.10** below. In addition, applicable limits from the Environmental Objectives Surface Water Regulations (S.I. 272 of 2009 as amended) are provided at **Table 7.11** below. Laboratory reports are provided at **Annex 7.2.**

Parameter	EC DIRECTIVES			Sample ID	
	2006/44/EC		EC DW Regs 2007	SW1	SW2
	Salmonid	Cyprinid			
Total Suspended Solids (mg/L)	≤ 25 (O)	≤ 25 (O)	-	<10	<10
Ammonia N	≤0.04	≤0.02	0.3	0.38	<0.02

(mg/L)					
Nitrite NO_2 (mg/L)	≤ 0.01	≤ 0.03	0.5	<0.05	0.05
Ortho-Phosphate – P (mg/L)	-	-	-	<0.02	0.03
Nitrate - NO_3 (mg/L)	-	-	50	6.3	13.3
Nitrogen (mg/L)	-	-	-	1.7	3.5
Phosphorus (mg/L)	-	-	-	<0.10	<0.10
Chloride (mg/L)	-	-	250	13.3	21.1
BOD	≤ 3	≤ 6	-	<1	<2

Table 7.10: Analytical Results of Surface Water Sampling

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

Table 7.11: Chemical Conditions Supporting Biological Elements*

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

Total suspended solids were reported at <10mg/L in both samples which is below the Freshwater Fish Directive (2006/44/EC) MAC of 25mg/L.

Nitrite was below or at the laboratory detection limit of 0.05 mg/L in both samples. Nitrate ranged between 6.3 and 13.3mg/L and was slightly higher in the SW1 but remains substantially below the threshold level of 50mg/L.

Ortho-phosphate ranged between <0.02 to 0.03mg/L. In comparison to the Environmental Objectives Surface Water Regulations (S.I. 272 of 2009 as amended), the respective results are reflective of a 'High Status' and 'Good Status'.

Ammonia N ranged between <0.02 and 0.38mg/L and was more elevated in SW1. SW1 exceeded both the 'Good Status' and 'High Status' threshold while SW2 was below the 'High Status' threshold.

BOD ranged between <1 and <2mg/L, where SW2 exceeded both the 'Good status' and 'High status' threshold limits. SW1 was below the 'High status' threshold.

7.3.7 Hydrogeology

The Dinantian limestones that underly the electrical substation location and southernmost section of the electricity line route are classified by the GSI (www.gsi.ie) as a Regionally Important Aquifer – Karstified (diffuse) (Rkd). Regional groundwater flows are likely to occur in this aquifer type.

The Westphalian Shales and Sandstones which underlie the electrical control unit and the northern section of the electricity line route are classified by the GSI (www.gsi.ie) as a Poor Aquifer - Bedrock which is Generally Unproductive (Pu) and Locally Important Aquifer – Bedrock which is Generally Moderately Productive (Lm).

Namurian Sandstones, Siltstones and mudstones which underlie the central section of the electricity line route are classified as a Poor Aquifer – Bedrock which is Generally Unproductive except for Local Zones (Pl) and Bedrock which is Generally Unproductive (Pu).

In terms of local Groundwater Bodies (GWBs), the electrical control unit and the northern section of the electricity line route are located in the Castlecomer GWB (IE_SE_G_034). The central section of the electricity line route is mapped in the Shanragh GWB (IE_SE_G_124). The substation location and southernmost section of the electricity line route are mapped within the Bagenalstown Lower GWB (IE_SE_G_157).

The Namurian and Westphalian rocks generally have an absence of inter-granular permeability and most groundwater flow is expected to be in the uppermost part of the aquifer comprising a broken and weathered zone typically less than 3m thick, a zone of interconnected fissuring 10m thick.

During the trial pit investigation (refer to **Chapter 6**), no groundwater inflows were noted in the trial pits carried out at the electricity substation or the electrical control unit.

Groundwater flowpaths in the Namurian and Westphalian rocks are likely to be short (30-300m), with groundwater discharging to nearby streams and small springs. Water strikes deeper than the estimated interconnected fissure zones suggest a component of deep groundwater flow, however shallow groundwater flow is considered to be dominant.

Groundwater flow directions are anticipated to follow topography; and, therefore, groundwater directions within the site are expected to be towards the primary streams within the valleys of the study area (GSI, 2004).

Baseflow contribution to streams tends to be low, particularly in summer as the groundwater regime cannot sustain summer baseflows due to low storativity within the aquifer. In winter, low permeabilities will lead to a high water table and possible water logging of soils.

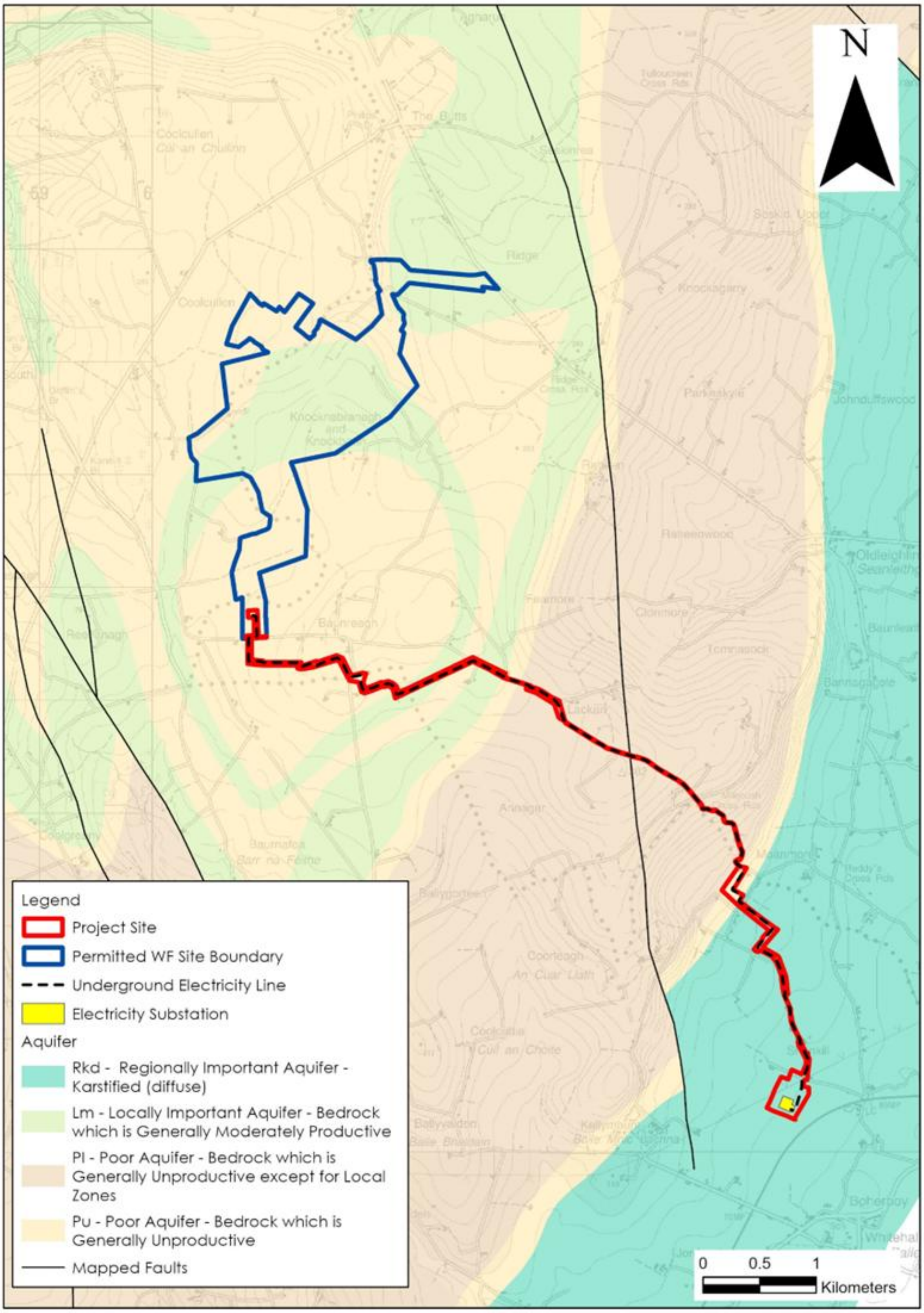


Figure 7.6: Bedrock Aquifer Mapping

7.3.8 Groundwater Vulnerability

The vulnerability rating of the aquifer at the project site, as classified by the GSI, ranges between Low (L) to Extreme (X/E) which is reflective of the varying depth of local subsoils.

An Extreme (X) vulnerability rating is given where bedrock is at or close to the surface. An Extreme (E) vulnerability rating is given where subsoils are present with a maximum thickness of 3m. A Low vulnerability rating is given where depths of overburden exceed 10m.

The GSI mapped groundwater vulnerability rating at the electrical control unit is Extreme (X) which is consistent with the trial pitting where bedrock was encountered at depths ranging from 0.5m to 1m (see **Chapter 6**).

The mapped groundwater vulnerability rating of Extreme (X/E) continues south along the electricity line route for approximately 6.2km. The rating then reduces to Low for the remainder of route including the electricity substation location.

Trial pitting carried out at the substation confirm subsoil depths are in excess of 2.5m.

7.3.9 Groundwater Body Status

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

The electrical control unit and the northern section of the electricity line route are located in the Castlecomer GWB (IE_SE_G_034).

The central section of the route is mapped in the Shanragh GWB (IE_SE_G_124). The substation location and southernmost section of the electricity line route are mapped within the Bagenalstown Lower GWB (IE_SE_G_157).

All GWBs in the area of the project as assigned 'Good Status', which is defined based on the quantitative status and chemistry.

7.3.10 River Waterbody Status and Risk

River Waterbody status and risk information is available for view from www.catchments.ie.

A WFD Compliance Assessment report for the project is attached as **Annex 7.3**.

A summary status (2016-2021) of the river waterbodies immediately downstream of the project are provided below. Refer to **Annex 7.3** for identification and screening assessment of all river waterbodies downstream of the project.

The Moanmore_010 has been assigned an overall 'Good Status'. The Monefelim_010 achieved 'High Status' downstream of the electrical control unit and the northern section of the electricity line.

As the electricity line route travels in a southeasterly direction towards the electricity substation, it is also located within the Monefelim_030 (Paulstown Stream) and the Old Leighlin Stream_010.

The Monefelim_030 achieved 'Moderate Status' whilst the Old Leighlin Stream_010 is assigned 'Good Status'.

With regards to the risk of river waterbodies failing to meet their WFD objectives by 2027, the Monefelim_010 is 'Not at Risk' while the lower reaches are 'Under Review'.

The Monefelim_030 is 'At Risk', while the Moanmore_010 is also 'Under Review'. The Old Leighlin Stream_010 is 'Not at Risk'.

7.3.11 Designated Sites & Habitats

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

The project site is not located within any designated conservation site. Designated sites in the wider vicinity of the project site are illustrated at **Figure 7.7**.

All of the river waterbodies that drain the project site flow into the River Barrow and River Nore cSAC (Site Code: 002162) to the southeast.

At its closest point, this designated site is located approximately 2.7km to the east (as crow flies) and downstream of the substation location.

The Whitehall Quarries pNHA (Site Code: 000855) is situated c. 500m to the southwest of the electricity line at its nearest point and is c. 1.5km northwest of the substation. There is no hydrological connectivity to this designated site.

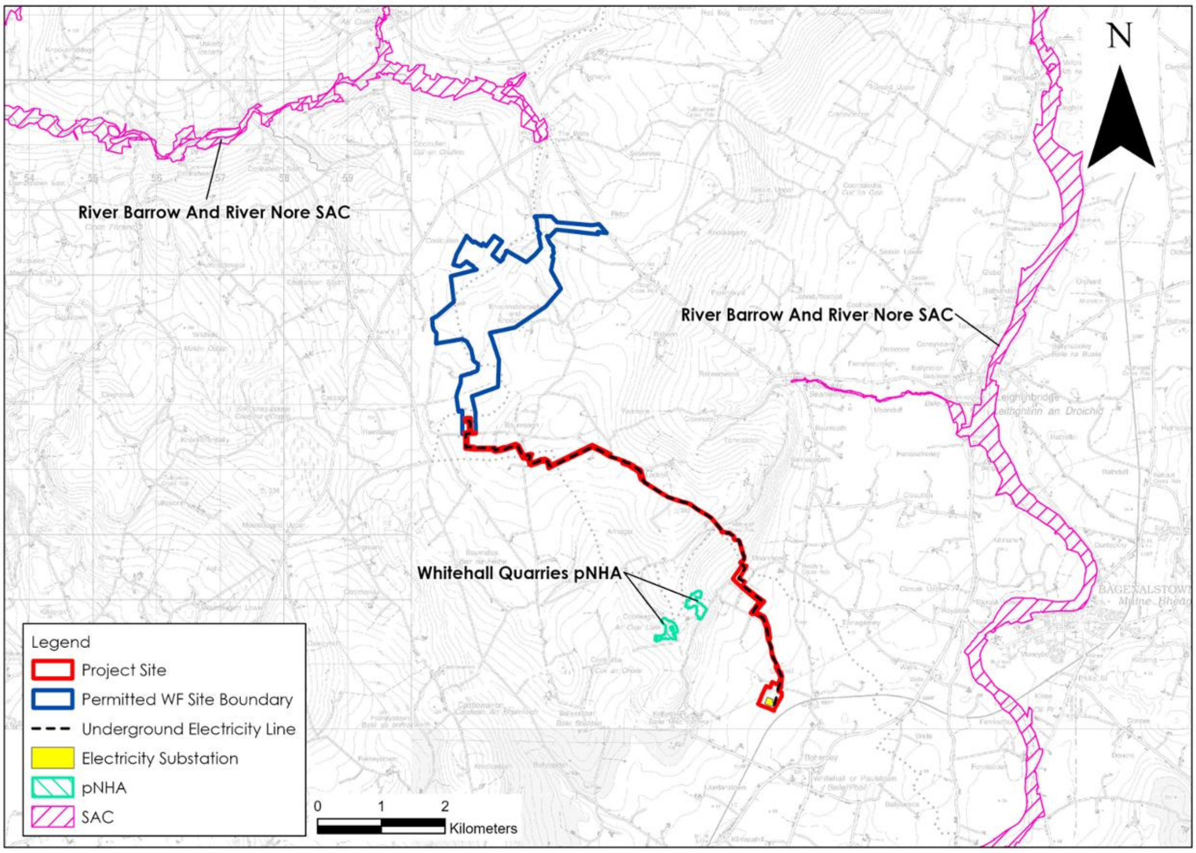


Figure 7.7: Designated Sites

7.3.12 Water Resources

According to the GSI online groundwater protection area mapping, the Castlewarren Group Water Scheme (GWS) source protection area is located immediately to the southwest of the electrical control unit; however, no component of the electrical control unit is located within the mapped Castlewarren GWS source protection area.

According to the National Federation of Group Water Schemes (NFGWS), the Castlewarren GWS supplies water to approximately 180 no. houses and 50 no. farms in the local area. The GWS is supplied by 5 no. boreholes (BH1–BH5) and 1 no. spring source, located across 4 no. separate sites north of the village of Castlewarren.

The locations of the source protection area, boreholes and spring are illustrated at **Figure 7.8**. 4 no. of the boreholes (BH1–BH3 & BH5) are located approximately 500m to the southwest of the electrical control unit and 1 no. borehole (BH4) is located c. 850m to the northwest. The spring is located c. 2.1km to the south of the electrical control unit.

However, c. 1.3km of the electricity line route is located inside the Castlewarren GWS source protection area. The infrastructure, located within the source protection area, will be located within the carriageways of local public roads and on private lands.

The Paulstown Public Water Supply (PWS) outer source protection area is located c. 0.8km to the southeast of the electrical control unit, while the electricity substation is located c. 0.9km to the northeast of the inner source protection area. No component of the electrical control unit or electricity substation are located within the Paulstown PWS source protection area.

However, approximately 1.6km of the underground electricity line is located inside the Paulstown GWS outer source protection area. The route of the electricity line within the source protection area is predominately off-road and private lands.

The Monefelim River and Paulstown Stream channels are included in the inner protection zone for the Paulstown Public Water Supply. The electrical control unit, in addition to the northern portion of the electricity line, is located in the Monefelim River catchment. The Monefelim River rises approximately 0.6km to the southwest of the electrical control unit. There is also 1 no. watercourse crossing of the Paulstown Stream (Monefelim_030) by the electricity line.

Based on the GSI *Paulstown PWS Source Protection Report* (May 2002), the streams/rivers flowing off the Castlecomer Plateau indirectly recharge the limestone aquifer from which the spring source emerges. However, the proportion coming from the Monefelim River (including the Paulstown Stream) catchment is reported to be less important:-

> "*As the streams flow off the Castlecomer Plateau and onto the karstic aquifer, a proportion of streamflow will sink back down into groundwater before flowing to the springs. Most of this river recharge will occur from the Acore catchment to the north of the springs, rather than from the Monefelim catchment to the north west*".

The Shankill Group Water Scheme (GWS) abstracts from a spring which is located approximately 420m to the northeast of the electricity substation compound. There is no GSI mapped source protection area available for this source. Refer to **Figure 7.8** below for the location of the spring.

Based on local topography and the surface water drainage regime, groundwater flow is expected to be to the southeast and therefore the electricity substation is not in the groundwater catchment to the spring.

The section (0.5km) of the electricity line to the northwest (upslope) of the spring is potentially within the groundwater catchment to the spring.

Based on the GSI well database, groundwater is likely to be used locally as a private drinking water source, but the overall mapped well density is low in the area. A search of private well locations (wells with a mapped accuracy of 1–50m were only considered) in the GSI well database (www.gsi.ie) was also undertaken. No private wells with a mapped accuracy of 1–50m are present within 1km of the project site.

Also, according to the Uisce Éireann scoping response, there is an abstraction point on the River Barrow at Bagenalstown. Within the project study area, only the Old Leighlin Stream flows into the River Barrow upstream of Bagenalstown. The length of the electricity line route within the Old Leighlin Stream catchment is c. 1.3km.

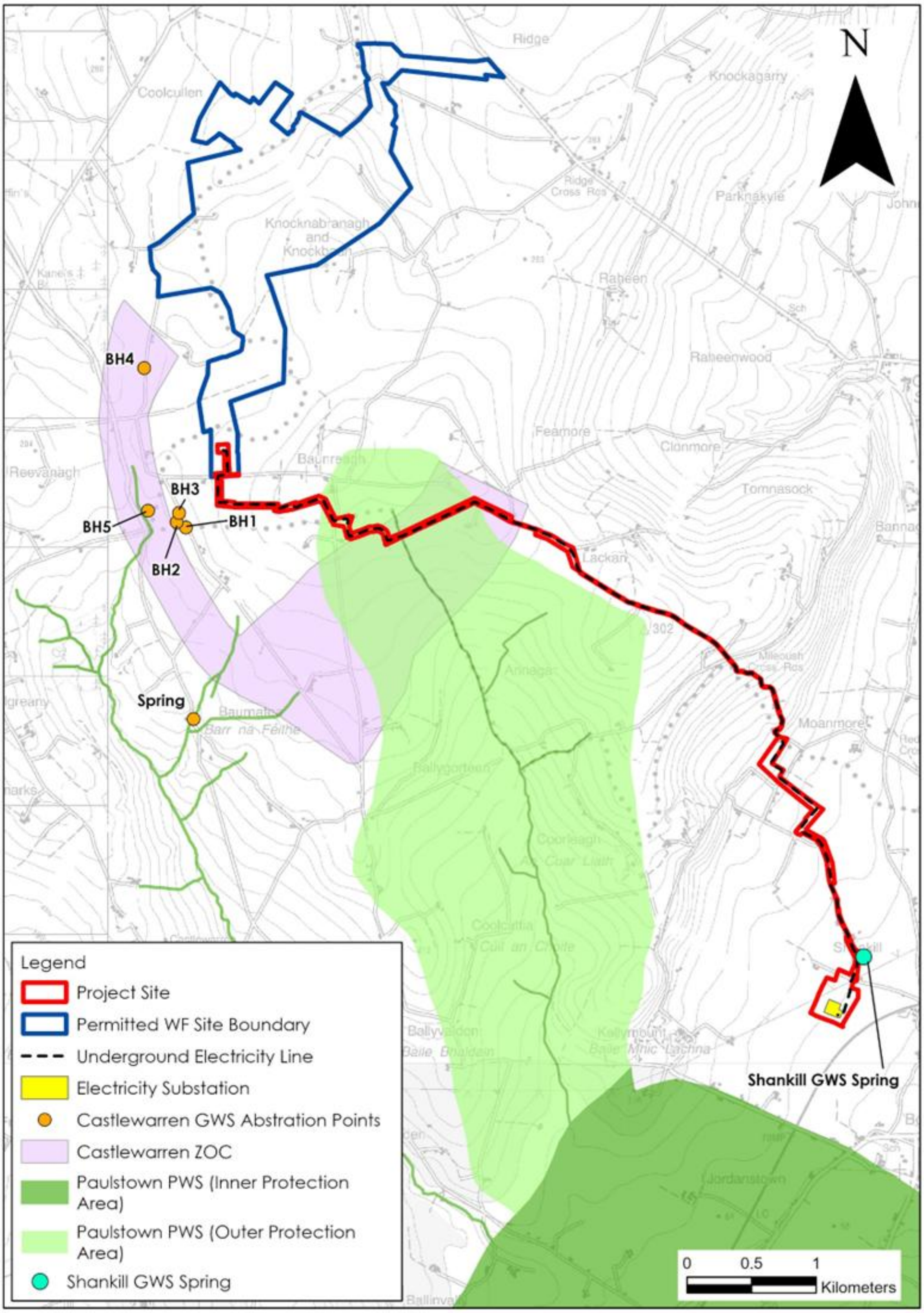


Figure 7.8: Water Supplies

7.3.13 Receptor Sensitivity

Due to the nature of the project, being near surface construction activity, effects on groundwater are generally imperceptible. The primary risk to groundwater at the project site would be from cementitious materials, hydrocarbon spillage and leakages, albeit the volumes present on-site will be small.

These are common possible effects on all construction sites (such as road works and industrial sites). All contamination sources are to be carefully managed at the project site during the construction, operational and decommissioning phases of the project and mitigation measures are proposed below to avoid and manage any likelihood of effects.

The majority of the project site is also covered in poorly draining soil, poorly productive bedrock or thick glacial tills (i.e. substation) which acts as a protective cover to the underlying aquifer. Any contaminants which may be accidently released on-site are more likely to affect local surface water features, via runoff, rather than infiltrate groundwaters.

Surface waters such as the Monefelim River, Paulstown Stream, Moanmore Stream and Old Leighlin Stream are classed as High to Very High Importance and are very sensitive to potential contamination.

Sections of the electricity line route are located inside the Castlewarren GWS SPA and the Paulstown PWS SPA. Furthermore, the electrical control unit and sections of the underground electricity is located within the Monefelim River/Paulstown Stream catchment which forms part of the Paulstown PWS SPA. A 0.5km section of the electricity line is also likely to be located within the groundwater catchment of the Shankill GWS spring.

The likelihood of effects on both these groundwater supplies is relatively low due to the localised and shallow nature of the electricity line and electrical control unit (in terms of groundwater flow disturbance), the poor productivity of the bedrock aquifers along the electricity line route within the SPAs, as well as the large set back distance of the majority of the project from the Monefelim River and Paulstown Stream.

The sensitivity of the Uisce Éireann abstraction point on the River Barrow at Bagenalstown is also low due to the large assimilative capacity of the River Barrow (large flows) and the fact that only 1.3km of the electricity line is located within the potential catchment to this source.

The designated sites that are hydraulically connected (surface water flow paths only) to the project include the River Barrow and River Nore cSAC and has an Extremely High Importance. This designated site can be considered very sensitive in terms of potential effects

Comprehensive surface water and groundwater protection measures and controls are outlined below to ensure protection of all downstream receiving waters and groundwater supplies.

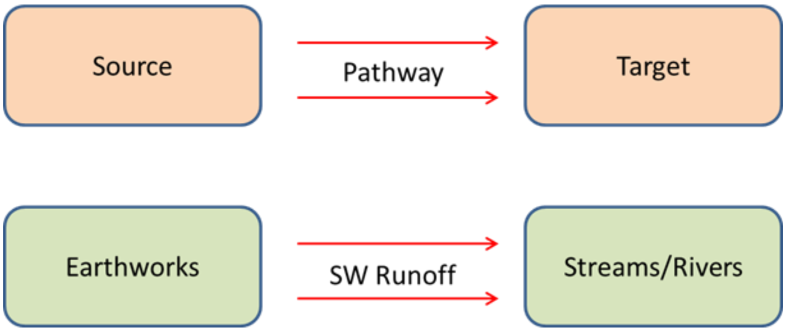
Mitigation measures will ensure that surface runoff from the project site will be of a high quality and will not affect the quality of downstream surface water bodies. Any introduced drainage works at the project site will mimic the existing hydrological regime thereby avoiding changes to flow volumes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

7.4 Description of Likely Effects

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

7.4.1 Overview of Impact/Effect Assessment Process

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



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

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

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

In order to provide an understanding of the stepwise impact assessment process applied below (**Sections 7.4.3, 7.4.4** and **7.4.5**), we have firstly presented below a summary guide that defines the steps (1 to 7) taken in each element of the impact assessment process (see **Table 7.12**). The guide also provides definitions and descriptions of the assessment process and shows how the source-pathway-target model and the EPA impact/effect descriptors are combined.

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

Step 1	Identification and Description of Impact/Effect Source This section presents and describes the activity that brings about the likely impact/effect or the source of pollution. The significance of impacts/effects is briefly described.	
Step 2	Pathway/ Mechanism:	The route by which a source of effect can transfer or migrate to an identified receptor. In terms of this type of development, surface water and groundwater flows are the primary pathways, or for example, excavation or soil erosion are physical mechanisms by which a likely effect is generated.
Step 3	Receptor:	A receptor is a part of the natural environment which could be impacted upon, e.g. human health, plant / animal species, aquatic habitats, soils/geology, water resources, water sources. The effect can only arise as a result of a source and pathway being present.

Step 4	Pre-mitigation Effect:	Effect descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the effect before mitigation is put in place.
Step 5	Proposed Mitigation Measures:	Control measures that will be put in place to prevent or reduce all identified significant adverse effects. In relation to this type of development, these measures are generally provided in 2 no. types: (1) mitigation by avoidance, and (2) mitigation by engineering design.
Step 6	Post Mitigation Residual Effect:	Effect descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the effects after mitigation is put in place.
Step 7	Significance of Effects:	Describes the likely significant post mitigation effects of the identified effect source on the receiving environment.

Table 7.12: Effect Assessment Approach

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, including runoff rates, would remain unchanged and current land use practices would continue. Existing land drainage arrangements would continue to function in their current manner.

7.4.3 Construction Phase

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

Construction phase activities that will require earthworks resulting in removal of vegetation cover and excavation of soil and mineral subsoil are detailed at **Chapter 3**.

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 and electrical control unit; 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 or at the permitted White Hill Wind Farm; while excess material which cannot be used for reinstatement will be disposed of at an approved waste management facility.

Potential sources of sediment laden water include:-

- Drainage and seepage water resulting from infrastructure excavation;
- Stockpiled excavated material providing a point source of exposed sediment;
- Construction of the electricity line including cable trench and HDD works resulting in entrainment of sediment from the excavations during construction; and,
- Erosion of sediment from emplaced site drainage channels.

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

Given the projects linear distribution, spread-out nature over a relatively large geographical area and the fact the electricity substation and electrical control unit are not adjacent to a natural watercourse, the effects are unlikely to be significant in the absence of mitigation. Other than at the locations at which the underground electricity line crosses a watercourse and the crossing of the unnamed stream by the access track leading to the electricity substation, no infrastructure is located within 50m of a natural surface water feature.

There is also a possibility of runoff along the underground electricity line entering nearby watercourses at the 5 no. watercourse crossing locations.

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

Table 7.13: Earthworks

7.4.3.2 Excavation Dewatering and Likely Effects on Surface Water Quality

Some minor surface water seepages and direct rainfall input will likely occur in excavations and trenching which will create additional volumes of water to be treated by the runoff/surface water management system. The trial pits carried out at the electricity substation and electrical control unit suggest groundwater ingress will not be significant.

These minor inflows may require management and treatment to reduce suspended sediments. No contaminated land was noted at the project site and therefore pollution issues are not assessed as likely to occur.

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

Table 7.14: Excavation Dewatering

7.4.3.3 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 where it will be stored at the temporary construction compound. Construction plant and machinery will also be refuelled at the construction compound. The pathways for the rapid transport of any spilt chemicals are limited due to the absence of any surface water drainage network.

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 with appropriate controls being implemented.

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

Table 7.15: Release of Hydrocarbons

7.4.3.4 Groundwater and Surface Water Contamination from Wastewater

Release of effluent from wastewater treatment systems has the potential to affect groundwater and surface waters if not properly contained.

However, the temporary construction compound at the electricity substation site will accommodate chemical toilets/portaloos. The toilets will comprise sealed units to ensure that no discharges escape into the local environment and will be supplied and maintained by a licensed supplier. There is no requirement for the storage of wastewater along the underground electricity line.

Attribute	Description
Receptor	Groundwater quality and surface water quality
Pathway/Mechanism	Groundwater flowpaths and site drainage network
Pre-Mitigation Effect	No effect

Table 7.16: Contamination from Wastewater

7.4.3.5 Release of Cement-Based Products

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

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

Attribute	Description
Receptor	Surface water hydrochemistry and ecosystems

Pathway/Mechanism	Site drainage network
Pre-Mitigation Effect	Indirect, negative, moderate, brief, likely effect on surface water

Table 7.17: Release of Cement-Based Products

7.4.3.6 Morphological Changes to Surface Watercourses & Drainage Patterns

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

5 no. natural watercourse crossings will be required along the electricity line route. The watercourses to be crossed are all small lower order streams. However, no instream works are required, as horizontal directional drilling will be employed at all crossing locations.

A bottomless culvert/bridging structure will be installed at the unnamed watercourse north of the substation to accommodate the construction of the access track.

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

Table 7.18: Morphological Effects

7.4.3.7 Hydrological Effects on Designated Sites

The project site is hydrologically connected to the River Barrow and River Nore cSAC (Site Code: 002162). At its closest point, this designated site is located approximately 2.7km to the east (as crow flies) of the electricity substation and is downstream (hydrologically connected) via the Moanmore Stream, Monefelim River, Paulstown Stream and Old Leighlin Stream.

Surface water effects in the downstream River Barrow are assessed as unlikely to be significant due to dilution/assimilation capacity effects in the River Barrow channel. Also, the project drains to the River Barrow via several sub-catchments (i.e. Moanmore Stream, Monefelim River, Paulstown Stream and Old Leighlin Stream) which also significantly dilutes any potential of significant effects in the River Barrow.

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

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

Table 7.19: Effects on Designated Sites

7.4.3.8 Effects on Drinking Water Supplies (i.e. Castlewarren GWS, Shankill GWS, Paulstown PWS and Bagenalstown IW Abstractions

The electricity line route passes through the Castlewarren GWS and Paulstown source groundwater protection areas. The electricity line also passes through the groundwater catchment to the Shankill GWS source for 0.5km (assumed based on topography). Also, according to the Uisce Éireann scoping response, there is an abstraction point on the River Barrow at Bagenalstown. Within the project study area, only the Old Leighlin Stream flows into the River Barrow upstream of Bagenalstown. The length of the electricity line route within the Old Leighlin Stream catchment is 1.3km.

The electricity line infrastructure, located within the source protection areas, will require a shallow trench (c. 1.2m); and associated excavations are not assessed to be of a sufficient depth to result in any negative effects on groundwater flows. The bedrock aquifers within the source protection areas are also poorly productive with localised groundwater flowpaths, meaning groundwater flows at the project site will not directly feed into the sources.

The Monefelim River and Paulstown Stream channels are included in the inner protection zone for the Paulstown Public Water Supply as the they provide, an albeit limited, recharge to the limestone aquifer which sustains the spring source.

Based on the GSI *Paulstown PWS Source Protection Report* (May 2002), the streams/rivers flowing off the Castlecomer Plateau indirectly recharge the limestone aquifer from which the spring source emerges. However, the proportion coming from the Monefelim River (and Paulstown Stream) catchment is reported by the GSI to be less important.

The electrical control unit and northern section of the electricity line route are located in the Monefelim River catchment. However, all works inside the Monefelim River catchment are remote from the Monefelim watercourse with the exception of 1 no. watercourse crossing on the Paulstown Stream along the electricity line route.

During the construction phase, hydrocarbons (oils, fuels, etc.) will be stored within the temporary construction compound and no storage of hydrocarbons will be permitted along the electricity line route within the protection zones of either the Castlewarren GWS or Paulstown PWS.

Attribute	Description
Receptor	Down-gradient groundwater quality and PWS/GWS drinking water sources
Pathway/Mechanism	Groundwater and surface water flowpaths
Pre-Mitigation Effect	Indirect, negative, imperceptible, short term, unlikely effect

Table 7.20: Public & Group Water Scheme Drinking Water Supplies

7.4.3.9 Effects on the WFD Status

The electrical control unit and the northern section of the electricity line route are located in the Castlecomer GWB (IE_SE_G_034). The central section of the route is mapped in the Shanragh GWB (IE_SE_G_124). The substation location and southernmost sections of the electricity line route are mapped within the Bagenalstown Lower GWB (IE_SE_G_157).

All GWBs are currently assigned 'Good Status' which is defined on the basis of the quantitative status and chemical status of the GWB.

River Water Body status and risk information for the Monefelim River, Moanmore River and Old Leighlin Stream in the area of the project are detailed in **Section 7.3.10** above.

Given the linear distribution and spread-out nature of the project over a relatively large geographical area and within several river waterbodies and groundwater bodies, the effects on waterbodies are assessed as unlikely to be significant even in the absence of mitigation.

There may be a requirement for an on-site water supply well, subject to the availability of a connection to the Shankill GWS; however the required yield will be significantly less than 25m^3/day (EPA abstraction register threshold) and, therefore, will be akin to as domestic well source. The abstraction will have no likelihood of affecting the local hydrogeological regime or GWB WFD status (during either construction or operation of the substation).

Attribute	Description
Receptor	Down-gradient groundwater and surface water bodies status
Pathway/Mechanism	Groundwater and Surface water flowpaths
Pre-Mitigation Effect	Indirect, negative, slight, short term, unlikely effect

Table 7.21: WFD Status Effects

A full WFD compliance assessment has been undertaken and is provided at **Annex 7.3**.

7.4.4 Operational Phase

The replacement of vegetated surfaces with impermeable surfaces could result in an increase in the proportion of surface water runoff reaching the downstream surface water drainage network. Given the linear distribution and spread-out nature of the project over a relatively large geographical area and within several river waterbodies, the effects on waterbodies are assessed as unlikely to be significant.

The placement of the underground electricity line within the existing road network is an established impermeable surface and therefore there can be no additional effects. The electricity line route within private lands will be reinstated closely back to the baseline conditions and therefore no effects on drainage or recharge are likely.

Pre-mitigation effects on surface water flows from site runoff are likely to result in a likely, indirect, negative, long term, reversible, slight effect.

The primary risk to surface water and groundwater quality during the operational phase will be from hydrocarbon/chemical spillage. Pre-mitigation effects are assessed as resulting in an unlikely, indirect, negative, short term, reversible, slight effect.

It is proposed that all wastewater effluent, associated with welfare facilities in the substation and electrical control unit (see **Chapter 3**), will be stored on-site in a sealed tank, and will be removed by tanker on a regular basis by a licensed waste management company to a licensed wastewater facility for treatment and disposal. There will be no discharges of wastewater on-site.

7.4.5 Decommissioning Phase

As set out at **Chapter 3** (**Sections 3.2** and **3.7**), the electricity substation will form part of the national electricity network and decommissioning will not occur. The underground electricity line will be decommissioned upon decommissioning of the White Hill Wind Farm. The electricity line will be removed from its ducting and transported to an approved waste handling facility for re-use or recycling. The electrical control unit will be decommissioned and removed from site for re-use or recycling.

Works involving removal/demolition during the decommissioning phase will take place predominantly above ground and will largely mimic the construction phase, in reverse order.

Effects on surface water quality, albeit much less likely than the construction phase, could result from the increase in suspended solids from demolition site runoff and chemical effects may arise from pollutants such as hydrocarbons and chemicals.

Pre-mitigation effects on surface water quality are likely to result in an unlikely, indirect, negative, temporary, reversible, slight effect.

Pre-mitigation effects on surface water and groundwater quality from hydrocarbons and chemicals are assessed to be unlikely, indirect, negative, temporary, reversible, slight effect.

7.4.6 Health Effects

Health effects potentially arise through surface water and groundwater contamination which may have negative effects on public and private water supplies. However, electrical developments are not typically associated with health effects due to water contamination.

As described above the project has very limited interaction with the Castlewarren GWS, Shankill GWS and Paulstown PWS source protection areas including the Bagenalstown surface water abstraction and any pre-mitigation effects will be imperceptible at worst. No effects on private wells are assessed as likely as a result of the project.

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 7.1**) has assessed that the likelihood of the project contributing to downstream flooding is very low. The drainage design for the electricity substation and electricity control unit will ensure that greenfield runoff rates are maintained.

The on-site drainage control measures will ensure no downstream increase in flood risk.

7.4.7 Cumulative Effects

The likelihood for cumulative effects is assessed to be hydrological (surface water quality) rather than hydrogeological (groundwater). Due to the hydrogeological setting of the project site (i.e. generally poorly draining soils overlying poor bedrock aquifers or thick mineral subsoils over more productive aquifers) and the near surface nature of construction activities, cumulative effects with regard groundwater quality or quantity arising from the project are assessed as not likely. Similarly, no cumulative effects are likely on the Castlewarren GWS or Paulstown PWS.

The water study area for the cumulative assessment includes the Monefelin River, Paulstown Stream, Moanmore Stream and Old Leighlin Stream catchments which all drain into the River Barrow.

The closest wind farm development (aside from White Hill Wind Farm) is the proposed Sheskin Wind Farm c. 5km to the northeast of the project site. The proposed Sheskin Wind Farm is located in the Dinin River catchment which drains into the River Nore and therefore cumulative effects with the project are not expected.

With regard cumulative hydrological effects arising from the project and the permitted White Hill Wind Farm, no effects are expected either as the wind farm is largely located (including all the 7 no. turbines) in the River Nore catchment.

In terms of cumulative hydrological effects arising only from elements of the project (electrical substation, electricity line and electricity control unit), no significant effects are expected due to the linear distribution and spread-out nature of the project over a relatively large geographical area and within several sub-basins (i.e. Monefelin River, Paulstown Stream, Moanmore Stream and Old Leighlin Stream catchments).

Also due to the construction methodologies, construction programme (i.e. the electricity line trench will be excavated in stages) and the transient nature of the works over several kilometres, significant surface water quality effects are not anticipated as a result of the construction methodologies to be implemented, the surface water control measures to be put in place and the general remoteness from watercourses.

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

7.5 Mitigation & Monitoring Measures

The overarching objective of the proposed mitigation measures is to ensure that all surface water runoff is comprehensively attenuated such that no silt or sediment laden waters or deleterious material is discharged into the local drainage system. A Surface Water Management Plan (SWMP), incorporating the surface water drainage design has been prepared for the electricity substation and electrical control unit, see **Annex 3.5** (**Volume II**), and incorporates the principles of Sustainable Drainage Systems (SuDS) through an arrangement of surface water drainage infrastructure.

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

- Clean water drains will be installed upslope of the works area to intercept clean surface water to prevent it becoming contaminated by silt/sediment from construction activities;
- All surface water runoff from construction areas will be directed to specially constructed downslope dirty water drains surrounding all areas of ground

proposed to be disturbed (including areas for the temporary storage of material);
- The swales will direct runoff into stilling ponds and, subsequently, lagoon-type settlement ponds[2] where silt/sediment will be allowed to settle; and,
- Following the settlement of silt/sediment, clean water will be discharged to the local drainage network or to ground via buffered outfalls or level spreaders thus ensuring that no scouring occurs.

The suite of surface water drainage infrastructure will include *inter alia* upslope clean water drains, downslope dirty water drains, sedimats, flow attenuation and filtration check dams, stilling ponds, lagoon-type settlement ponds and buffered outfalls or level spreaders.

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

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

7.5.1 Construction Phase

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

Electricity Substation and Electrical Control Unit

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

- Prior to the commencement of 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;

[2] The design of the lagoon-type sediment ponds shall generally accord with the principles Altmüller R. & Dettmer, R. (2006) *Successful species protection measures for the Freshwater Pearl Mussel (Margaritifera margaritifera) through the reduction of unnaturally high loading of silt and sand in running waters – Experiences within the scope of the Lutterproject*.

- Water will be discharged from the clean drains over natural grassland or to existing agricultural drains which will provide further filtration;
- All surface water runoff from works areas, excavations, stockpiles at the electricity substation site and electrical control unit site will be intercepted by downslope drains which will also include check dams;
- These dirty water drains will direct water to stilling ponds where water for treatment and attenuation;
- From the stilling ponds, water will be discharged to lagoon-type settlement ponds for final treatment. The settlement ponds will follow a design outlined by Altmuller and Dettmer (2006);
- 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; and,
- Earthworks will take place during periods of low rainfall to reduce run-off and potential siltation of watercourses.

The construction of the site drainage system will be carried out, at the respective locations, prior to other activities being commenced. The construction of the drainage system will only be carried out during periods of, where possible, no rainfall, therefore avoiding runoff. This will avoid the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses. Construction of the drainage system during this period will also ensure that attenuation features associated with the drainage system will be in place and functional for all subsequent construction works.

Electricity Line

The majority of the underground electricity line is in excess of 50m from any nearby watercourse with the exception of the 5 no. watercourse crossings.

No in-stream works are required at the crossing locations as HDD is proposed, however due to the proximity of the watercourses to the construction works, there is a risk of surface water quality effects during trench excavation work.

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

- All existing dry drains that intercept the works area will be temporarily blocked down-gradient of the works using temporary check dams/silt traps (e.g. straw bales);

- Clean water diversion drains will be installed upgradient of the works areas, as required;
- Check dams/silt fence arrangements (silt traps or straw bales) will be placed in all existing drains that have surface water flows and also along existing roadside drains; and,
- A double silt fence perimeter will be placed down-slope of works areas that are located inside the watercourse 50m buffer zones such as at watercourse crossing locations.

Specific mitigation measures relating to the directional drilling at the crossing location are detailed in **Section 7.5.1.6** below.

Pre-emptive Site Drainage Management

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

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

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

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

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

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

Prior to works being suspended, the following control measures should be completed:-

- Secure all open excavations;

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

7.5.1.2 Excavation Dewatering and Effects on Surface Water Quality

The management of excavation dewatering (pumping), particularly in relation to any accumulation of water in foundations or electricity line trenches, and subsequent treatment prior to discharge into the drainage network will be undertaken as follows:-

- Appropriate interceptor drainage, to prevent upslope surface runoff from entering excavations, will be installed as relevant;
- The interceptor drainage will not be discharged directly to surface waters to ensure that Greenfield runoff rates are mimicked;
- If required, pumping of excavation inflows will prevent build up of water in the excavation;
- All pumped water will be directed to the surface water drainage system for treatment prior to discharge. In the case of the electricity line, any pumped waters will be discharged over grassland to allow for filtration;
- There will be no direct discharge to local drains, and therefore no risk of hydraulic loading or contamination will occur;
- Daily monitoring of site excavations by the EM will occur during the construction phase. If high levels of seepage inflow occur, excavation work at this location will cease immediately and a geotechnical assessment undertaken; and,
- A mobile 'Siltbuster' or similar equivalent specialist treatment system will be available on-site for emergencies. Siltbusters are mobile silt traps that can remove fine particles from water using a proven technology and hydraulic design in a rugged unit. The mobile units are specifically designed for use on construction-sites and will be used as final line of defence, if required.

7.5.1.3 Release of Hydrocarbons during Construction and Storage

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

- The volume of fuels or oils stored on site will be minimised. All fuel and oil will be stored in an appropriately bunded area within the temporary construction compounds. Only an appropriate volume of fuel will be stored at any given time. The bunded area will be roofed to avoid the ingress of rainfall and will be fitted with a storm drainage system and an appropriate oil interceptor;
- All bunded areas will have 110% capacity of the volume to be stored;
- On site re-fuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer, will be re-filled at the temporary compound and will be towed around the site by a 4x4 jeep to where plant and machinery is located. The 4x4 jeep will also be fully stocked with fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations to avoid any accidental leakages;

- All plant and machinery used during construction will be regularly inspected for leaks and fitness for purpose;
- Spill kits will be readily available to deal with and accidental spillage;
- All waste tar material arising from road cuttings (from trenching or other works in public roads) will be removed off-site and taken to a licensed waste facility. Due to the possibility of contamination of soils and subsoils, it is not proposed to utilise this material for any reinstatement works or for storage within the spoil deposition areas; and
- An outline emergency plan for the construction phase to deal with accidental spillages is contained within the Planning-Stage CEMP (**Annex 3.5**). This emergency plan will be further developed prior to the commencement of development, and will be agreed with the Planning Authority as part of the detailed CEMP.

7.5.1.4 Groundwater and Surface Water Contamination from Wastewater Disposal

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

- Self contained portaloos (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 the site office and other sanitation will be brought to site and removed after use to be discharged at a suitable off-site treatment location; and,
- No water will be sourced on the site during construction, nor will any wastewater be discharged to the site.

7.5.1.5 Release of Cement-Based Products

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

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

7.5.1.6 Morphological Changes to Surface Watercourses & Drainage Patterns

Temporary silt fencing/silt trap arrangements (e.g. straw bales) will be placed within existing roadside/field drainage features along the electricity line route to remove any suspended sediments from the works area.

The trapped sediment will be removed and disposed of at an appropriate licenced facility. Any bare-ground will be re-seeded/reinstated immediately and silt fencing temporally left in place if necessary.

The following mitigation measures are proposed in respect of the installation of the culvert over the unnamed stream to the north of the electricity substation:-

- The stream crossing will be a clear span bridge (bottomless culvert) and the stream bed will remain undisturbed. No in-stream excavation works are proposed or anticipated as being required and therefore there will be no effect on the stream;
- At the time of construction, all guidance/best practice requirements of the Office of Public Works (OPW) or Inland Fisheries Ireland will be incorporated into the design/construction of the proposed watercourse/culvert crossings;
- As a further precaution, in-stream construction work (if required) will only be carried out during the period permitted by Inland Fisheries Ireland for in-stream works according to *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (2016) (i.e., July to September inclusive). This time period coincides with the period of lowest expected rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses (any deviation from this will be done in discussion with the IFI); and,
- The installation of the culvert will require a Section 50 license application to the OPW in accordance with the Arterial Drainage Act 1945. The stream crossing will be designed in accordance with OPW guidelines/requirements on applying for a Section 50 consent.

Directional Drilling

- 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 areas 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 10m buffer zone which will be imposed around the watercourses;
- Before any ground works are undertaken, double silt fencing will be placed upslope of the watercourse channel along the 10m 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 watercourses;
- 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 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.

7.5.1.7 Effects on the Castlewarren GWS, Shankill GWS and Paulstown PWS Water Supplies and Bagenalstown Abstraction

Due to the significant setback distance from the Monefelim River inner protection zone to the electrical control unit (c. 0.6km), the limited construction works to be undertaken within the catchment (i.e. electrical control unit and electricity line), the lack of direct surface water pathways (i.e. drains/streams) between the project site and the Monefelim River in addition to the comprehensive array of drainage control measures and pollution prevention measures (discussed above), it is assessed that the project will have no effects on the Paulstown Public Water Supply.

It should also be highlighted that the proportion of water coming from the Monefelim River catchment which supplies the Paulstown PWS spring is reported by the GSI to be less important than the portion coming from the Acore catchment (in which there are no elements of the project).

The fact that the electricity line route within the Monefelim River catchment is limited to only 3.5km, will be installed at a shallow depth and that no instream works are required at the 1 no. watercourse crossing (Paulstown Stream), means that no effects on the Paulstown Public Water Supply will occur.

As an additional pollution prevention measure, no fuel storage will be permitted along the electricity line located within the Monefelim River catchment.

In addition, approximately 1.3km of the electricity line route is located inside the Castlewarren GWS source groundwater protection area. Due to the shallow nature of the works and poorly productive aquifers with short groundwater flowpaths, there is no potential to affect groundwater flowpaths towards the source wells.

As above, no fuel storage will be permitted along the electricity line route within the Castlewarren GWS source protection area.

Similarly, due to the short distance (0.5km) of electricity line route immediately upslope of the Shankill GWS source, there is no likelihood of affecting groundwater serving the source spring.

7.5.1.8 Hydrological Effects on Designated Sites

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

Surface water quality effects in the downstream River Barrow and River Nore cSAC, even in the absence of mitigation, are unlikely to be significant due to dilution/assimilation capacity effects in the River Barrow channel.

Also, the project drains to the River Barrow via several sub-catchments (i.e. Moanmore Stream, Monefelim River, Paulstown Stream and Old Leighlin Stream) which also significantly dilutes the likelihood of significant effects on the cSAC.

Considering the above hydrological setting and the wide ranging and comprehensive set of mitigation measures outlined above and further detailed at **Annex 3.5**, it is concluded that there is no likelihood of significant hydrological or water quality effects on any downstream designated site including the River Barrow and River Nore cSAC.

7.5.1.9 Likely Hydrological Effects on 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 is not likely to be significantly affected.

7.5.2 Operational Phase

7.5.2.1 Progressive Replacement of Natural Surface with Lower Permeability Surfaces

Stormwater Runoff

Stormwater control measures are as follows:-

- During the operational phase, stormwater from the substation and electrical control unit compound areas will be discharged to local drains or to ground via soakaways following attenuation;
- Stormwater discharge from the project site will be limited to greenfield runoff rates, therefore there will be no increase in storm water runoff rates entering the local environment;
- Runoff from the compound areas will also be passed through an oil interceptor to prevent any discharge of hydrocarbons.

Hydrocarbons and Chemicals

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

- All storage containers will be labelled appropriately, including hazardous markings;
- All holding tanks will be constructed of material appropriate for fuel/chemical storage and will be bunded to at least 110% of the maximum tank volume;
- All bulk tanks will be located within an impervious bund;
- Bunds will be to standard specified in CIRIA Report 163 'Construction of bunds for oil storage tanks' and CIRIA Report C535 'Above-ground proprietary prefabricated oil storage tank systems;
- Barrels and bunded containers will be stored upright and internally where appropriate and always on drip trays or sump pallets;
- Appropriate spill kits will be available at all storage locations;
- All fuel/chemical storage facilities will be subject to weekly inspection; and,
- Leaking or empty drums will be removed from the site immediately and disposed of via a registered waste disposal contractor.

7.5.3 Decommissioning Phase

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

7.6 Residual Effects

7.6.1 Construction Phase

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

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

7.6.1.2 Excavation Dewatering and Likely Effects on Surface Water Quality

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

7.6.1.3 Likely Release of Hydrocarbons during Construction and Storage

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

No significant effects on surface water or groundwater quality are assessed as likely.

7.6.1.4 Groundwater and Surface Water Contamination from Wastewater Disposal

No significant residual effects are assessed as likely to occur.

7.6.1.5 Release of Cement-Based Products

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

7.6.1.6 Morphological Changes to Surface Water Courses & Drainage Patterns

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

7.6.1.7 Effects on the Castlewarren GWS, Shankill GWS and, Paulstown PWS Water Supplies and Bagenalstown Abstraction

Due to the relatively small scale and shallow depth of the works within the Castlewarren GWS and Paulstown PWS source protection areas, the prevailing hydrology and hydrogeology (which limits pathways for potential effects), in addition to the proven and effective measures to mitigate the risk of releases of sediment and contaminants to surface water and groundwater, no effects on the either Castlewarren GWS and Paulstown PWS are expected.

Due to the large assimilative capacity of the River Barrow (large flows) at Bagenalstown, the fact that only 1.3km of the electricity line is located within the catchment to this source and the mitigation measures proposed above; no significant effects on the Bagenalstown abstraction are assessed as likely.

7.6.1.8 Hydrological Effects on Designated Sites

Considering the hydrological setting of the project (i.e. works spread across several sub catchments and the high dilution capacity of the River Barrow), transient works and the wide ranging and comprehensive set of mitigation measures outlined above and further detailed at **Annex 3.5**, it is assessed that there is no likelihood of significant hydrological or water quality effects on any downstream designated site including the River Barrow and River Nore cSAC.

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

7.6.1.9 Likely Hydrological Effects on WFD Status

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 likely 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.

7.6.2 Operational Phase

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

7.6.3 Decommissioning Phase

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

7.7 Monitoring

Ongoing monitoring of the surface water drainage system will be the responsibility of the EM. Prior to the commencement of development, a detailed Water Quality Inspection & Monitoring Plan (WQIMP) will be agreed with the Planning Authority as part of the detailed CEMP. The monitoring programme will comprise field testing and laboratory analysis of a range of agreed parameters.

The civil works contractor, who will be responsible for the construction of the site drainage system, and EM will undertake regular inspections of the drainage system to ensure that all measures are functioning effectively. Regular inspections of all installed drainage systems will be undertaken, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water in parts of the systems where it is not intended.

Any excess build-up of silt levels at any drainage features that may decrease the effectiveness of the drainage feature will be removed and disposed of at a licensed waste management facility.

7.8 Summary

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

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

The management of surface water is the principal means of significantly reducing sediment runoff arising from construction activities and to control runoff rates. The key surface water control measure is that there will be no direct discharge of site runoff into local watercourses.

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

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