MWP

Chapter 07 Water

Carrownagowan 110 kV Grid Connection

7. Water

7.1 Introduction

Hydro-Environmental Services (HES) was engaged by MWP to undertake an assessment of the potential impacts of the Proposed Development on water aspects (hydrology and hydrogeology) of the receiving environment.

This chapter considers the potential effects on the existing water environment arising from the Proposed Development. The Proposed Development comprises a 25.16km long 110kV underground cable connection from the granted Carrownagowan Wind Farm substation to the existing ESB owned 110kV substation at Ardnacrusha, County Clare which will allow the electrical energy generated from the wind farm to be exported onto the national grid. A full description of the Proposed Development, and all associated project elements is provided in Chapter 2 of this Environmental Impact Assessment Report (EIAR). The nature and probability of effects on the existing water environment arising from the overall project has been assessed. The assessment comprises:

- A review of the existing receiving environment;
- Prediction and characterisation of likely impacts;
- Consideration of mitigation measures, where appropriate to avoid, remediate or reduce likely or significant negative effects; and
- Assess likely or significant cumulative effects of the Proposed Development as a result of other existing and approved developments listed in Appendix 1-5, Volume III.

7.1.1 Competency of Assessor

The assessment was completed by HES, a specialist geological, hydrological, hydrogeological and environmental practice which delivers a range of geological/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 water and geology. We routinely complete impact assessments for land soils and geology, hydrology and hydrogeology for a large variety of project types, including wind farms and associated grid connections.

This chapter was prepared by Michael Gill, Adam Keegan and Jenny Law.

Michael Gill (P. Geo., B.A.I., MSc, Dip. Geol., MIEI) is an Environmental Engineer with over 22 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms in Ireland. He has also managed EIAR assessments for infrastructure projects and private residential and commercial developments. In addition, he has substantial experience in wastewater engineering and site suitability assessments, contaminated land investigation and assessment, wetland hydrology /hydrogeology, water resource assessments, surface water drainage design and SUDs design, and surface water/groundwater interactions. For example, Michael has worked on the EIS/EIAR for Oweninny WF, Cloncreen WF, and Yellow River WF, and over 100 other wind farm-related projects.

Adam Keegan is a hydrogeologist with four years of experience in the environmental sector in Ireland. Adam has been involved in Environmental Impact Assessment Reports (EIARs) for numerous projects including wind farms, grid connections, quarries and small housing developments. Adam holds an MSc in Hydrogeology and Water

Resource Management. Adam has worked on several wind farm EIAR projects, including Croagh WF, Lyrenacarriga WF (SID), Cleanrath WF, Carrownagowan WF (SID), and Fossy WF.

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

7.1.2 Legislation

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

The requirements of the following legislation are complied with:

- Planning and Development Act, 2000, as amended;
- Planning and Development Regulations, 2001 (as amended);
- S.I. No 296/2018: European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 which transposes the provisions of Directive 2014/52/EU into Irish law;
- S.I. No. 293/1988: European Communities (Quality of Salmonid Waters) Regulations;
- S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy) and S.I. No. 722/2003 European Communities (Water Policy) Regulations which implement EU Water Framework Directive (2000/60/EC) establishing a framework for the Community action in the field of water policy and provide for implementation of 'daughter' Groundwater Directive (2006/118/EC) on the protection of groundwater against pollution and deterioration. Since 2000 water management in the EU has been directed by the Water Framework Directive (2000/60/EC) (as amended by Decision No. 2455/2011/EC; Directive 2008/32/EC; Directive 2008/105/EC; Directive 2009/31/EC; Directive 2013/39/EU; Council Directive 2013/64/EU; and Commission Directive 2014/101/EU ("WFD"). The WFD was given legal effect in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. No. 722/2003);
- S.I. No. 684/2007: Waste Water Discharge (Authorisation) Regulations 2017, resulting from EU Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances (the Groundwater Directive);S.I. No. 106/2007: European Communities (Drinking Water) Regulations 2007 and S.I. No. 122/2014: European Communities (Drinking Water) Regulations 2014, arising from EU Directive 98/83/EC on the quality of water intended for human consumption (the "Drinking Water Directive") and EU Directive 2000/60/EC;
- S.I. No. 9/2010: European Communities Environmental Objectives (Groundwater) Regulations 2010 (as amended by S.I. No. 389/2011; S.I. No. 149/2012; S.I. No. 366/2016; the Radiological Protection (Miscellaneous Provisions) Act 2014; and S.I. No. 366/2016); and,
- S.I. No. 296/2009: The European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 (as amended by S.I. No. 355/2018).

7.2 Methodology

7.2.1 Desktop Study

A desk study and hydrological review of the Proposed Development site has been completed. This involved collection of all relevant geological, hydrological, hydrogeological and meteorological data for the area. This included consultation with the following sources:

- Environmental Protection Agency (EPA) database (www.epa.ie);
- Geological Survey of Ireland (GSI) - Groundwater Database (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks & Wildlife Services (NPWS) Public Map Viewer (www.npws.ie);
- Water Framework Directive (WFD) "Catchments" Map Viewer (www.catchments.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 17 (Geology of the Shannon Estuary). Geological Survey of Ireland (GSI, 1999);
- GSI (2003) – Lough Graney Groundwater Body Initial Characterization Report;
- GSI (2003) – Tulla Newmarket-on-Fergus Groundwater Body Initial Characterization Report;
- GSI (2004) – Ardnacrusha Groundwater Body Initial Characterization Report;
- Office of Public Works (OPW) Indicative Flood Maps (www.floodmaps.ie);
- Environmental Protection Agency – "HydroTool" Map Viewer (www.epa.ie);
- CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie); and
- Department of Environment, Community and Local Government on-line mapping viewer (www.myplan.ie).

7.2.2 Field Surveys

Preliminary drainage mapping, constraints mapping and initial hydrological baseline monitoring of the Proposed Development site were undertaken by HES between August and December 2018. Detailed field mapping and hydrological monitoring continued during 2019, and additional hydrological monitoring was performed in November 2022. HES were on site along the grid connection route during 4 no. monitoring/walkover events (19/06/2018, 31/01/2019, 14/02/2019, and 28/11/2022) and completed over ~20 hours of site work/monitoring along the Proposed Development site.

Field work completed for the Proposed Development includes the following:

- Preliminary walkover surveys and hydrological mapping of the grid connection route and the surrounding area were undertaken whereby general water flow directions and drainage patterns were recorded;
- Field hydrochemistry measurements (electrical conductivity, pH, dissolved oxygen and temperature) were taken to determine baseline data of surface water flows along the Proposed Development site;
- 3 no. rounds of Surface water sampling was undertaken to determine the baseline water quality of the primary surface waters (2019-2022) at watercourse crossings along the Proposed Development site;

- A survey of culverts at existing watercourse crossings along the grid connection route was undertaken between January to February 2019.

7.2.3 Guidelines and Best Practice

This chapter is carried out in accordance with guidance contained in the following:

- EPA (2022): Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;
- Institute of Geologists Ireland (IGI) (2013): Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements;
- National Roads Authority (2008) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Department of Environment, Heritage and Local Government (DoEHLG); Wind Farm Development Guidelines for Planning Authorities (2006);
- Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (Inland Fisheries Ireland, 2016);
- Good Practice During Wind Farm Construction (Scottish Natural Heritage, 2010);
- PPG1 - General Guide to Prevention of Pollution (UK Guidance Note);
- PPG5 – Works or Maintenance in or Near Watercourses (UK Guidance Note);
- SEPA (2014): Guidance on Assessing the Impacts of Windfarm Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems;
- CIRIA (Construction Industry Research and Information Association) 2006: Guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006);
- CIRIA (2006): Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2006;
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (DoHPLG, 2018); and
- Environmental Impact Assessment of Projects: Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU), European Union, 2017.

7.2.4 Scope of Assessment

7.2.4.1 Assessment Criteria

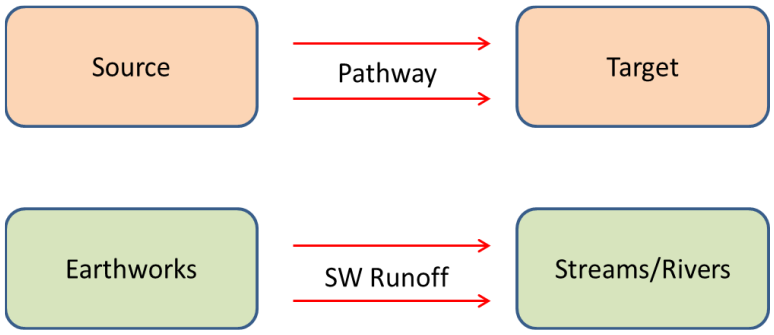
Please refer to Chapter 1 of the EIAR for details on the impact assessment methodology (EPA, 2022). The sensitivity of the water environment receptors was assessed on completion of the desk study and baseline study. Levels of sensitivity which are defined in Table 7-1 are then used to assess the potential effect that the Proposed Development may have on them.

Table 7-1 Receptor Sensitivities (adapted from www.sepa.org.uk)

	Sensitivity of Receptor
Not sensitive	Receptor is of low environmental importance (e.g. surface water quality classified by EPA as A3 waters or seriously polluted), fish sporadically present or restricted). Heavily engineered or artificially modified and may dry up during summer months. Environmental equilibrium is stable and is resilient to changes which are considerably greater than natural fluctuations, without detriment to its present character. No abstractions for public or private water supplies. GSI groundwater vulnerability "Low" – "Medium" classification and "Poor" aquifer importance.
Sensitive	Receptor is of medium environmental importance or of regional value. Surface water quality classified by EPA as A2. Salmonid species may be present and may be locally important for fisheries. Abstractions for private water supplies. Environmental equilibrium copes well with all natural fluctuations but cannot absorb some changes greater than this without altering part of its present character. GSI groundwater vulnerability "High" classification and "Locally" important aquifer.
Very sensitive	Receptor is of high environmental importance or of national or international value i.e. NHA or SAC. Surface water quality classified by EPA as A1 and salmonid spawning grounds present. Abstractions for public drinking water supply. GSI groundwater vulnerability "Extreme" classification and "Regionally" important aquifer

7.2.4.2 Overview of Impact Assessment Process

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



Where potential impacts are identified, the classification of impacts in the assessment follows the descriptors provided in the Glossary of Impacts contained in the following guidance documents produced by the 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 potential impact source, namely its character, magnitude, duration, likelihood and whether it is of a direct or indirect nature.

In order to provide an understanding of the stepwise impact assessment process applied below (Section 7.4.1 and 7.4.2), we have firstly presented below a summary guide that defines the steps (1 to 7) taken in each element of the impact assessment process. The guide also provides definitions and descriptions of the assessment process and shows how the source-pathway-target model and the EPA impact descriptors are combined.

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

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

7.2.5 Statement on Limitations and Difficulties Encountered

No difficulties were encountered during preparation of this assessment.

7.3 Baseline Environment

7.3.1 Water Balance

Long term rainfall and evaporation data was sourced from Met Éireann. The most recent 30-year annual average rainfall (1981 - 2010) recorded at Shannon Airport rainfall station approximately 20km west of Ardnacrusha, are presented in Table 7-2.

The closest synoptic station where the average potential evapotranspiration (PE) is recorded is also at Shannon Airport. The long-term average PE for this station is 562.6mm/yr. This value is used as a best estimate of the site PE. Actual Evaporation (AE) at the site is estimated as 534.47mm/yr (which is 0.95 × PE).

Table 7-2 Local Average long-term Rainfall Data (mm) at Shannon Airport

Station		X- Co-ord		Y Co-ord		Ht(MAOD)		Opened		Closed		
Shannon Airport		137900		160300		15		1937		N/A		
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
102.3	76.2	78.7	59.2	64.8	69.8	65.9	82.0	75.6	104.9	94.1	104.0	977.5 (AAR)

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

= 977.5mm/yr – 534.47mm/yry

ER = 443.03mm/yr

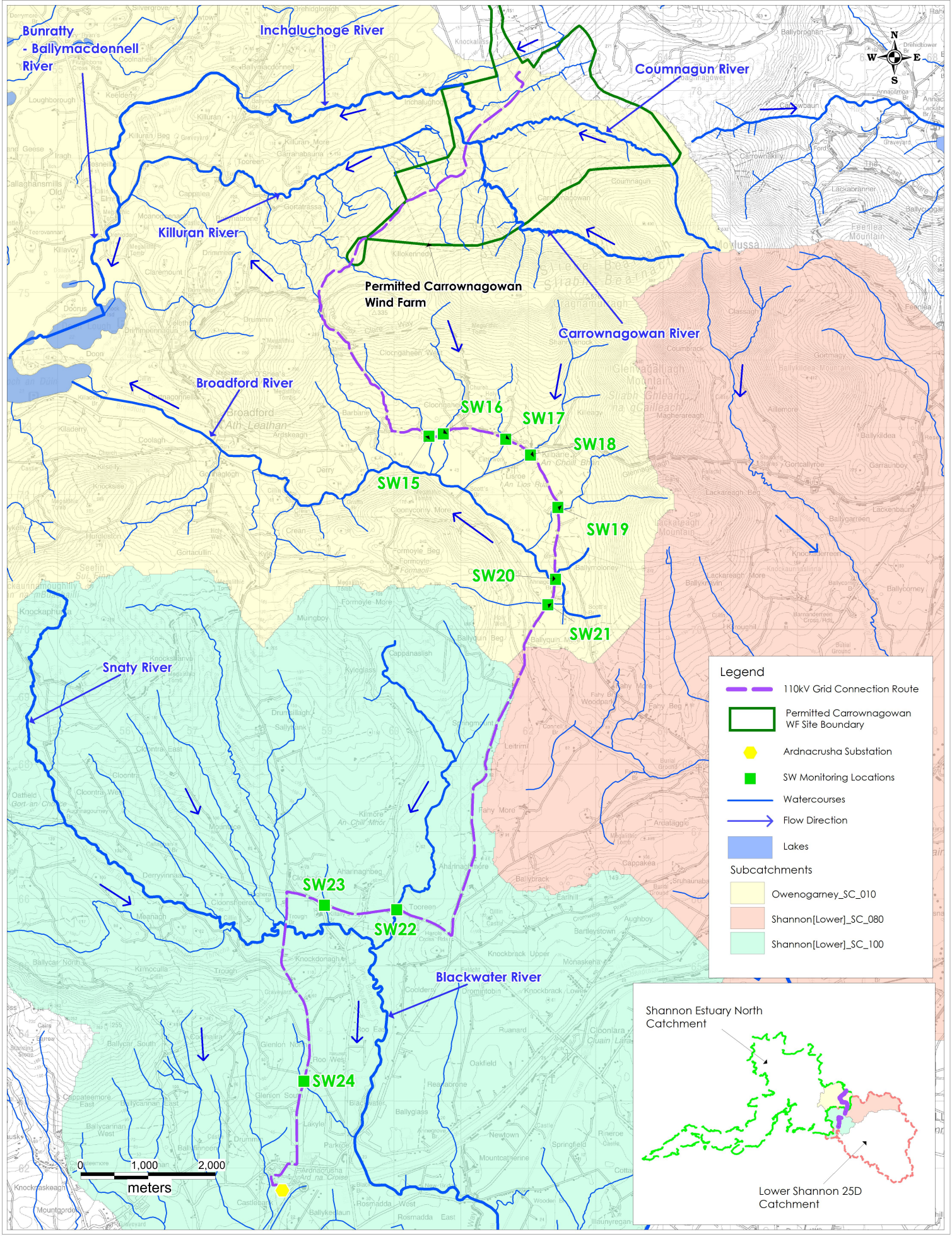
Based on recharge coefficient estimates from the GSI (www.gsi.ie), an estimate of 15% recharge is taken for the northern half of the proposed route. Recharge rates increase in the southern portion of the site ranging from 22.50% (Moderate permeability subsoils) - 80% (Areas where rock is at or near the surface). A recharge coefficient of 40% is therefore taken as an overall average for the whole Proposed Development.

Therefore, annual recharge and runoff rates for the proposed route are estimated to be 177.21 mm/yr (0.40% X 443.03) and 265.81mm/yr (0.60% X 443.03) respectively.

7.3.2 Regional Hydrology

The Proposed Development lies within 2 no. WFD catchment units. The Shannon Estuary North (catchment ID 27) contains the northern section of the Proposed Development site while the southern section is mapped in the Lower Shannon (catchment ID 25D). A map of regional hydrology is included in **Figure 7.1**. The Proposed Development extends further south towards the southern boundary of the Lower Shannon catchment at Parteen (Ardnacrusha).

The Proposed Development is mapped within the Owenogarney_SC_010 sub-catchment within the Shannon Estuary North catchment, and within the Lower Shannon catchment is mapped in the Shannon[Lower]_SC_100 and briefly mapped within the Shannon[Lower]_SC_080 sub-catchments.



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Job: Carrownagowan 110kV Grid Connection Route, Co. Clare	Sheet Size: A3	Project No: P1444-2
Title: Regional Hydrology Map	Scale: 1:50,000	Drawn By: GD
Figure No: 7.1	Date: 08/06/2023	Checked By: MG

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7.3.3 Local Hydrology

The Proposed Development will be installed primarily along a series of public road networks, along with sections of agriculture, forestry lands and commercial forestry track where the Proposed Development deviates off the public road, between the Carrownagowan wind farm site and the existing substation in Ardnacrushna (refer to Section 1.2). Therefore, drainage regimes will remain as before within pre-existing ditches/dykes along these roads. The Proposed Development site is drained by the Killuran River and the Broadford River within the Shannon Estuary North catchment and Owenogarney sub-catchment and the Blackwater River within the Lower Shannon River catchment.

A survey of culverts at existing watercourse crossings was undertaken between January 2019 to November 2022 which included taking flow measurements and surface water samples. The locations (refer to Figure 7-1) of these sampling points are included in Table 7-3 below, which includes recorded flow measurements along the Proposed Development site.

Table 7-3 Flow measurements at locations along Proposed Development site

Sample Location	R1 – 30/01/2019		R2 – 14/02/2019		R3 – 28/11/2022	
	Flow (l/s)	pH	Flow (l/s)	pH	Flow (l/s)	pH
SW15	100	7.48	90	7.78	100	7.72
SW16	200	7.21	60	7.59	80	8.02
SW17	150	7.03	50	7.46	150	7.65
SW18	400	6.72	100	7.57	200	7.82
SW19	150	7.29	70	7.64	100	7.86
SW20	11	7.54	60	7.18	30	7.85
SW21	70	7.69	30	7.78	40	7.73
SW22	450	7.37	250	7.67	500	7.48
SW23	100	7.36	40	7.52	100	7.44
SW24	100	7.27	40	7.5	70	7.45

7 of the 10 no. sampling points (SW15 - SW21) along the Proposed Development were located along the L7004 local road, which runs parallel to the R466, east of Broadford. These monitoring points were generally along streams/ small rivers that discharge to the Broadford River, which flows northwest towards Broadford, adjacent to the R466. Flows ranged from 11 – 400 l/s, with pH ranging between 6.72 – 8.02. 6 of these 7 samples had a pH of >7 and can be considered to be generally neutral-basic. The low pH of SW18 is likely related to these waters being sourced from the peat dominated high ground of Slieve Bernagh and the high flows of ~400- l/s may reflect some dilution from rainfall which would generally reduce the pH of the waters. Most pH values are above 7.0, indicating surface waters which are generally neutral to slightly alkaline. The recorded pH of the surface waters is typical for an area of generally carbonate bedrock, along with subsoils derived from these parent materials.

A further 3 no. monitoring points (SW22 – SW24) were located along small streams and rivers which join the River Blackwater, north of Ardnacrusha. Flows at these monitoring locations ranged between 40 – 500 l/s, and all pH values are above 7.0, once again indicating surface waters which are generally neutral to slightly alkaline

7.3.4 Flood Risk

No recurring flood events or other flood risk information was noted during the desk study.

National Indicative Fluvial mapping for the present day extents are mapped along parts of the Broadford and Blackwater Rivers that drain the Proposed Development. With the exception of a minor area along the Blackwater River, mapped along an unnamed road, towards the south of the Proposed Development site, the Proposed Development is not mapped within any of the National Indicative Fluvial mapping for the present day extents.

7.3.5 Surface Water Hydrochemistry

Surface water sampling was undertaken on 31st January and 14th February 2019 and 28th November 2022 along the Proposed Development. 7 of the 10 no. sampling points were selected along the path of the Proposed Development site where waterbodies are crossed along the L7004 existing road. 3 no sampling events were located along small streams and rivers which join the River Blackwater, north of Ardnacrusha. Field chemistry and flow estimates were completed on all 10 no. locations.

Water samples for laboratory analysis were taken at 4 of the 10 no. locations on 31st January 2019 (SW15, SW18, SW22 and SW23) and also at all 10 no. locations on 28th November 2022. The results of the field data and laboratory data are included in Table 7-4, Table 7-5 and Table 7-6 respectively. Original laboratory reports are attached in Appendix 7-1, Volume III.

Table 7-4 Field chemistry results along Proposed Development sampling locations

Location	EC (µS/cm)			DO (mg/l)		
Date	31/01/19	14/02/19	28/11/22	31/01/19	14/02/19	28/11/22
	R1	R2	R3	R1	R2	R3
SW15	91.4	131.7	111.7	12.43	11.64	11.5
SW16	102.5	142.9	114.4	12.18	11.51	11.55
SW17	107.2	130.6	128.2	12.12	11.31	11.29
SW18	119.8	132.4	114.4	11.94	11.23	11.09
SW19	130.2	130.3	113.3	11.68	11.38	11.13
SW20	124.9	169.2	118.5	11.89	10.06	11.22
SW21	183.5	170.1	192.9	11.94	11.54	11.09
SW22	135.8	186.9	151.5	11.87	11.39	11.15
SW23	99.2	133.1	117.3	12.15	11.29	10.98
SW24	139.6	219.3	219.3	11.63	11.03	10.81

Electrical conductivity (EC) values for the samples taken range from 91.4 – 219.3 µS/cm. This is indicative of surface water, which is mainly derived from precipitation, with some minimal input from any groundwater sources. The highest conductivity value of 219 µs/cm recorded at SW24 was observed within a stream situated in an urban area alongside a road and housing estate near Ardnacrusha, Co. Clare. The higher EC value is most likely due to runoff from this urban area. The lowest value of 91 µs/cm is essentially rainwater.

Dissolved oxygen at sampling locations along the grid route ranges from 10 – 12.4 mg/l. These values are typical of unpolluted, well oxygenated surface waters.

Table 7-5 Analytical results of surface water samples from grid connection on 31/01/2019 (R1)

Parameter	EQS	Sample ID			
		R1 SW15	R1 SW18	R1 SW22	R1 SW23
TSS (mg/L)	25(+)	88	16	46	36
Ammonia (mg/L)	≤0.065 to ≤ 0.04(*)	0.06	0.08	0.13	0.14
Nitrite NO_2 (mg/L)	-	<0.05	<0.05	<0.05	<0.05
Ortho-P – P (mg/L)	≤ 0.035 to ≤0.025(*)	<0.02	<0.02	<0.02	0.04
Nitrate - NO_3 (mg/L)	-	8.3	6.2	<5	<5
Nitrogen (mg/L N)	-	6.8	1.5	2.0	2.9
Phosphorus (mg/L)	-	0.25	<0.10	0.14	0.18
Chloride (mg/L)	-	12.6	12.0	17.3	11.3
BOD	≤ 1.3 to ≤ 1.5(*)	10	1	3	3

(+) S.I. No. 293/1988: European Communities (Quality of Salmonid Waters) Regulations
(*) S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy).

Table 7-6 Analytical results of surface water samples from grid connection on 28/11/2022 (R2)

Parameter	EQS	Sample ID									
		R2 SW15	R2 SW16	R2 SW17	R2 SW18	R2 SW19	R2 SW20	R2 SW21	R2 SW22	R2 SW23	R2 SW24
TSS (mg/L)	25(+)	6	16	<5	22	<5	<5	<5	<5	<5	<5
Ammonia (mg/L)	≤0.065 to ≤ 0.04(*)	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	0.02	0.04	<0.02	0.06
Nitrite NO_2 (mg/L)	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.07
Ortho-P – P (mg/L)	≤ 0.035 to ≤0.025(*)	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.04
Nitrate - NO_3 (mg/L)	-	<5	5.2	9.5	<5	<5	<5	<5	<5	<5	9.4
Nitrogen (mg/L N)	-	1.3	1.7	2.3	1.5	1.7	1.4	1.8	1.5	1.7	2.4
Phosphorus (mg/L)	-	<0.10	<0.10	<0.10	0.22	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Chloride (mg/L)	-	17.9	18.0	14.6	13.9	15.3	17.3	14.0	18.4	15.0	20.2
BOD	≤ 1.3 to ≤ 1.5(*)	<1	<1	<1	8	<1	<1	<1	<1	<1	3

(+) S.I. No. 293/ 1988: European Communities (Quality of Salmonid Waters) Regulations
(*) S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy).

7.3.5.1 Surface Water sample results – 31/01/2019

Total suspended solids (TSS) recorded on 31st January 2019 at the 4 no. locations were relatively high, ranging from 16 – 88 mg/l. These results are significantly higher than those recorded during round 2 of sampling (28/11/2022), likely a reflection of high flows in the streams following heavy rainfall. The results, in the baseline

environment, are above the water quality standards required by S.I. No. 293/1988 (25mg/L TSS). Nitrate levels within the 4 no. samples ranged between <5 mg/l to 8.3 mg/l.

Ammonia levels ranged between 0.06 mg/l – 0.14 mg/l, and are above the EQS values set out in S.I. No. 272/2009 for "good" and "high" status waters. Orthophosphate levels were below the detection limit of 0.02 mg/l in 3 of the 4 no. samples. Orthophosphate measured from the sample at SW23 exceeded the EQS values for "good" and "high" status waters set out in S.I. No. 272/2009 at 0.04 mg/l.

Total Phosphorous from the 4 no. samples ranged from below the detection limit of 0.1 mg/l to 0.25 mg/l.

BOD ranged from 1 to 10 mg/l in the 4 no. samples. The sample from SW15 was recorded at 10 mg/l, significantly above the EQS values set out in in S.I. No. 272/2009.

Chloride ranged from 11.3 to 17.3 mg/l, which is generally considered within the normal range of chloride for surface waters and indicates no issues with pollution from agricultural runoff or other sources.

7.3.5.2 Surface Water sample results – 28/11/2022

Total suspended solids (TSS) recorded on 28th November 2022 at the 10 no. locations ranged from <5 - 22mg/l. The general weather conditions on this date and the days preceding sampling were varied with some rainfall. The results are below the water quality standards required by S.I. No. 293/1988 (25mg/L TSS). Nitrate levels within the 10 no. samples ranged from <5 to 9.5mg/l, are similar to nitrate levels obtained in round 1 of surface water sampling (<5 mg/l to 8.3 mg/l).

Ammonia levels ranged between <0.02mg/l – 0.06mg/l. The majority of samples are below the EQS values set out in S.I. No. 272/2009 for "high" status waters, whereas SW22 (0.04mg/l) and SW24 (0.06mg/l) are within these EQS values.

Orthophosphate levels were below the detection limit of 0.02mg/l in 8 of the 10 no. samples. Orthophosphate measured from the sample at SW24 exceeded the EQS values for "good" and "high" status waters set out in S.I. No. 272/2009 at 0.04 mg/l.

Total Phosphorous from the 10 no. samples ranged from below the detection limit of 0.1 mg/l to 0.22mg/l at SW18.

BOD ranged from <1 to 8mg/l in the 10 no. samples. The sample from SW18 was recorded at 8mg/l, significantly above the EQS values set out in in S.I. No. 272/2009.

Chloride ranged from 13.9 to 20.2 mg/l, which is generally considered within the normal range of chloride for surface waters and indicates no issues with pollution from agricultural runoff or other sources.

7.3.6 Hydrogeology

The geology along the northern section of the Proposed Development site transitions through alternating bands of Devonian-Carboniferous Old Red Sandstones (undifferentiated) and Silurian meta-sediments including the Slieve Bernagh Formation, the Broadford Formation and the Cratloes Formation. The Old Red Sandstones are mapped within a Locally Important Aquifer (LI) - Bedrock which is Moderately Productive only in Local Zones, whilst the Silurian meta-sediments are within a Poor Aquifer (PI) - Bedrock which is Generally Unproductive except for Local Zones. For a brief period along the L7004 local road east of Broadford the Proposed Development is mapped to overly a Locally important gravel aquifer.

Groundwater flow towards the southern section of the grid route is likely to differ. Groundwater flow is expected to be in a southerly direction towards the Shannon River. Towards the very southern end of the grid route, near

Ardnacrusha, there is a transition into a Regionally Important Karstified Aquifer (Rkd) as the mapped bedrock changes to Carboniferous Limestones. A bedrock aquifer map for the Proposed Development is included as Figure 7.2.

7.3.6.1 Groundwater Vulnerability

Groundwater vulnerability along the Proposed Development site ranges from low to extreme, dependent on the depth of soil/subsoil. In some areas the Proposed Development is mapped to have rock at or near the surface.

7.3.6.2 Groundwater Recharge

Groundwater recharge is mapped as varying between 5 – 80%, with the majority of the Proposed Development site mapped as ~15% in the north, and in the south recharge gradually increases to coefficients of 60-80%.

7.3.6.3 Groundwater Hydrochemistry

There is no available specific information on groundwater hydrochemistry along the Proposed Development. Groundwater chemistry is expected to be similar to that of the Nenagh and Slieve Felim GWB's that are situated east from the Proposed Development site.

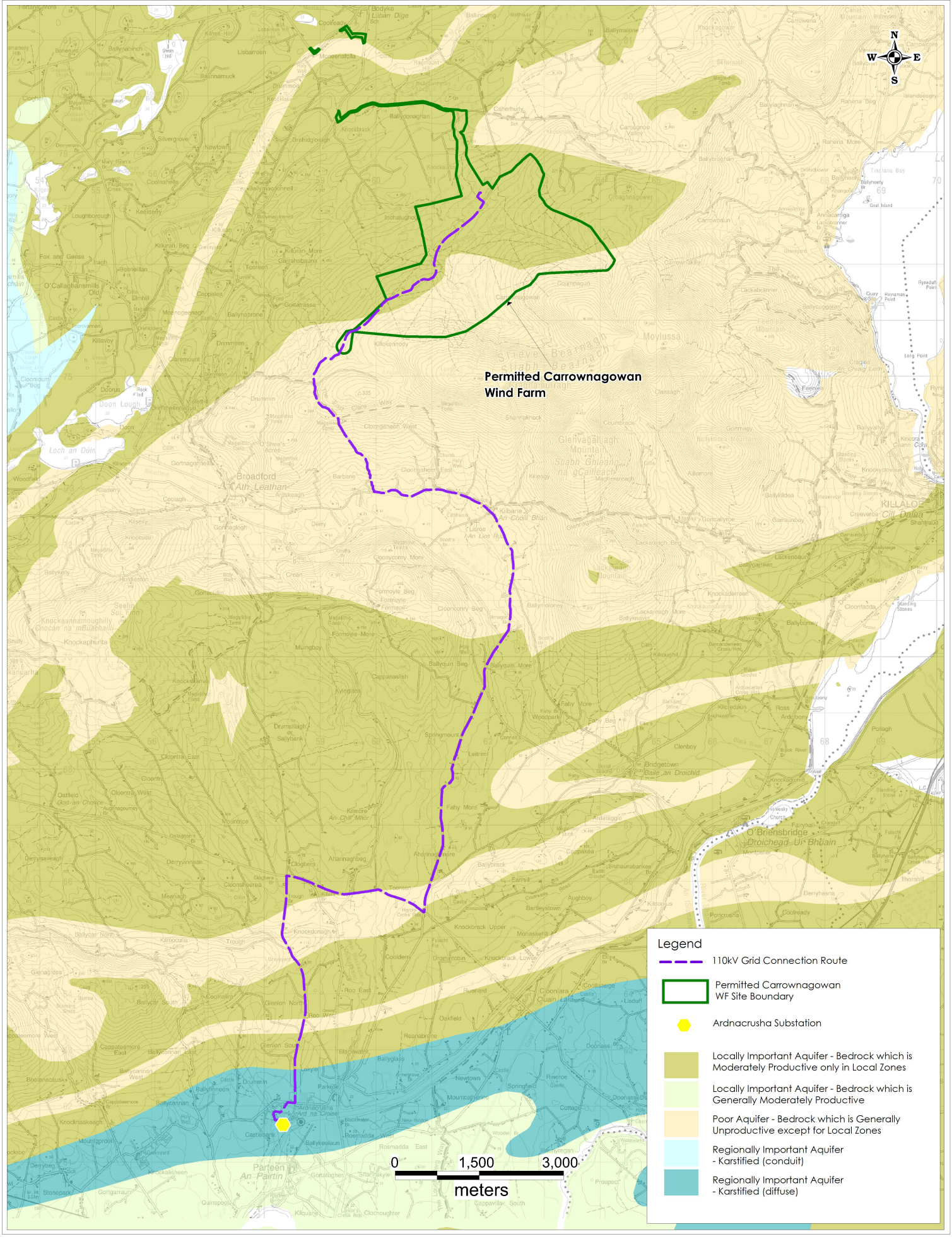
Data is available on groundwater hydrochemistry from the Tulla-Newmarket GWB (Groundwater Body) and the Lough Graney GWB report. Groundwaters within these aquifers are likely to have a calcium bicarbonate signature. In the Old Red Sandstone aquifers, groundwaters are moderately hard (145-235 mg/l as CaCO3) with moderate alkalinities (140-225 mg/l as $CaCO_3$) and electrical conductivities (310-440 µS/cm), and neutral pHs. Groundwaters from the Silurian strata will tend to range from slightly hard to hard (90 – 360 mg/l $CaCO_3$), with alkalinities from 60 to 270 mg/l (as $CaCO_3$) and EC in the range of 260-600 µS/cm. In the ORS aquifers, groundwaters are moderately hard (145-235 mg/l $CaCO_3$), with moderate alkalinities (140-225 mg/l (as $CaCO_3$) and EC in the range of 310-440 µS/cm.

At Ardnacrusha, the most southern part of the Proposed Development, there are no data available to assess the Ardnacrusha GWB. The hydrochemistry of groundwaters from the nearby Fedamore GWB indicates Very Hard (370–430 mg/l as $CaCO_3$), calcium-bicarbonate type waters with high alkalinities (330–380 mg/l as $CaCO_3$) and electrical conductivities ranging between between 720– 900+ µS/cm, and neutral pHs. In general, background chloride concentrations will be higher than in the Midlands, due to proximity to the sea.

7.3.6.4 Environmental Protection Agency Groundwater Body status

The northern section of the Proposed Development passes through the Tulla-Newmarket GroundWater Body (GWB) which achieved "Good" status in the latest WFD cycle (2016-2021). For a brief period along the L7004 local road east of Broadford the Proposed Development is mapped to overly the Broadford Gravels GWB which also achieved "Good" status in the latest WFD cycle.

The southern section of the Proposed Development passes through the Lough Graney GWB and the very southern section of the Proposed Development is mapped within the Ardnacrusha GWB, all of which received a "Good" status under the WFD 2016-2021.



Client: FuturEnergy Ireland	Drawing No: P1444-2-0623-A3-702-0A	
Job: Carrownagowan 110kV Grid Connection Route, Co. Clare	Sheet Size: A3	Project No: P1444-2
Title: Local Bedrock Aquifer Map	Scale: 1:60,000	Drawn By: GD
Figure No: 7.2	Date: 08/06/2023	Checked By: MG

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7.3.7 Designated Sites and Habitats

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

Local designated sites in the area and downstream of the Proposed Development site are shown on Figure 7.3 below.

The Proposed Development passes along the boundary of the Slieve Bernagh Bog SAC (Site Code: 002312) (within 30m at the northern end of the Proposed Development, the SAC is upgradient of the grid route at this location). The Proposed Development is also located within the existing road in the Glenomra Wood SAC and pNHA (Site Code: 001013) near Fahymore.

Surface waterbodies draining the grid connection in the northern section of the Proposed Development drain into the Doon Lough NHA (Site Code: 000337). At its closest point this designated site is located approximately 1.3km as the crow flies from the Proposed Development site and is hydrologically connected with the site via the Owenogarney and Broadford Rivers.

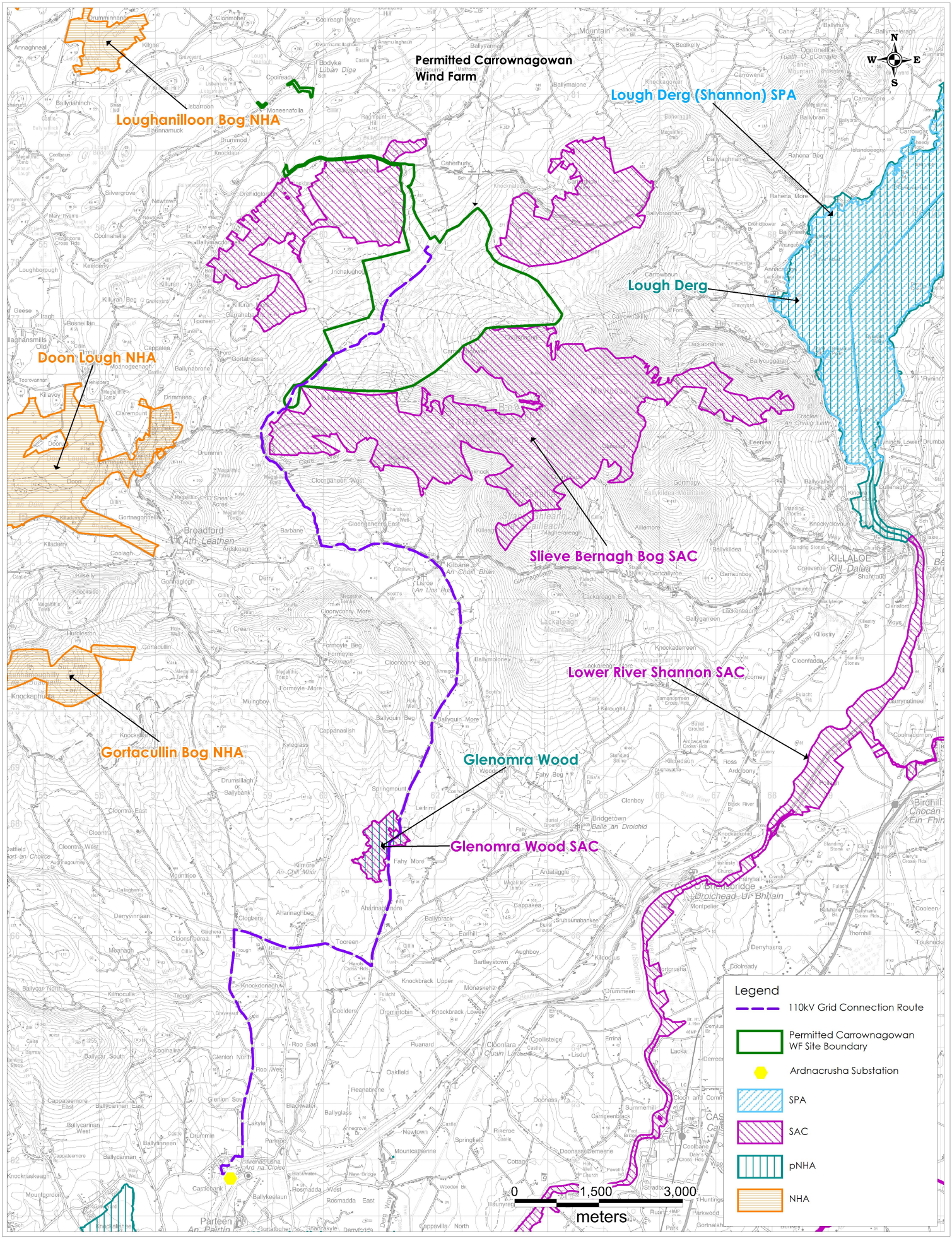
Surface waterbodies draining the Proposed Development in the southern section of the Proposed Development drain into the Lower River Shannon SAC (Site Code: 002165). At its closest point this designated site is located approximately 6.7km downstream of the Proposed Development site and is hydrologically connected with the site via the Glenlon South, the Blackwater [Clare] and the Shannon (Lower) Rivers respectively.

7.3.8 Water Resources

There are 2 no. Group Water Schemes (GWS), and their subsequent abstraction points are mapped within 5km of the very northern section of the Proposed Development. The Bodyke GWS is situated ~3.3km north-northwest of the Proposed Development, as well as Raheen Road GWS ~ 4.2km northeast of the Proposed Development. The separation distances, changes in ground elevation and the intermediate surface water streams between the Proposed Development and the local public water supply source locations and their respective Zones of Contributions (ZoC's), as well as the shallow nature of the grid connection trench works means that potential impacts on groundwater flows, levels and quality are not anticipated. There are no other groundwater supplies including group schemes mapped within 10km of the Proposed Development site.

Private well locations (accuracy of <50m only) were reviewed using GSI well database (www.gsi.ie). There are 12 no. mapped wells identified within 2 km of the Proposed Development. All wells are for private use and the majority (8 no.) are located upgradient of the Proposed Development, with the remainder located down gradient of the Proposed Development site.

Due to the shallow nature of the trench works (<1.5m), impacts on groundwater flows and levels will not occur as all excavations will be above the groundwater table. However, the potential for impacts on groundwater quality from fuels and other chemicals during the construction phase exists. This assessment applies to any groundwater wells that exist along the Proposed Development. All individual groundwater wells are not identified or audited, but this is not considered necessary considering the very shallow depth of the works and the lack of potential for any significant effect. The Proposed Development trench is shallow in nature, and will not intercept the bedrock groundwater table, as excavations are within the overburden. The construction works along the Proposed Development trench are transient and temporary. The works are similar in nature to water pipe laying works, or electricity cable works which are completed along roads across the country. Standard mitigation measures in respect of normal construction site risks to groundwater quality are prescribed in Section 7.5.1.3.



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Job: Carrownagowan 110kV Grid Connection Route, Co. Clare	Sheet Size: A3	Project No: P1444-2
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7.3.9 Receptor Sensitivity

Due to the nature of the Proposed Development, being near surface construction activities, impacts on groundwater are generally negligible and surface water is generally the main sensitive receptor assessed during impact assessments. The primary risk to groundwater at the site would be from cementitious materials, hydrocarbon spillage and leakages. These are common potential impacts on all construction sites (such as road works and industrial sites). All potential contamination sources are to be carefully managed at the site during the construction and operational phases of the development and mitigation measures are proposed below to deal with these potential minor impacts.

Based on criteria set out in **Table 7-1**, groundwater along the majority of the Proposed Development can be classed as **Sensitive** to pollution as permeabilities in the upper few metres of the bedrock are often high, and in places along the Proposed Development bedrock is classified as a Locally Important Aquifer and in the very southern portion of the Proposed Development the underlying bedrock is classified as a Regionally Important Aquifer. The ground water along the section of the grid route within the Ardnacrusha GWB can also be classed as **Sensitive**, as there may be areas where the bedrock is karstified. In general, it is likely that any contaminants which may be accidently released during the construction works are more likely to travel to nearby streams within surface runoff.

Surface waters such as the Killuran River, the Broadford River and the Blackwater River, and associated tributaries are **very sensitive** to potential contamination.

The designated sites that are mapped within, and in close proximity of and hydraulically connected (surface water flow paths only) to the Proposed Development are the Slieve Bernagh Bog SAC, Glenomra Wood SAC and pNHA, Doon Lough NHA and the Lower River Shannon SAC. These designated sites can be considered very sensitive in terms of potential impacts.

Comprehensive surface water mitigation and controls are outlined below to ensure protection of all downstream receiving waters. Mitigation measures will ensure that surface runoff, specifically during the construction phase will be of a high quality and will therefore not impact on the quality of downstream surface water bodies. Any introduced drainage works at the site will mimic the existing hydrological regime thereby avoiding changes to flow volumes leaving the Proposed Development site.

7.4 Assessment of Impacts and Effects

7.4.1 Construction Phase

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

Construction phase activities that will require earthworks resulting in removal of vegetation cover/ road pavement and excavation of mineral subsoil (where present), are detailed in the Civil Engineering Chapter (Chapter 3). 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 grid connection cable trench 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. However, given the relatively small, localised scale of the works, the volume of runoff from the construction works will be minimal in relation to the overall runoff to local waterbodies. Potential effects are significant if not mitigated against.

Pathways: Drainage and surface water discharge routes.

Receptors: Down-gradient rivers (water quality in the Killuran River, the Broadford River and the Blackwater River) and dependant ecosystems.

Pre-Mitigation Potential Effect: Negative, indirect, significant, short term, likely effect on down-gradient rivers (water quality) and dependent aquatic ecosystems.

7.4.1.2 Potential Impacts on Groundwater Levels and Local Well Supplies During Excavation works

Dewatering of deep excavations have the potential to impact on local groundwater levels. No groundwater level impacts will occur from the construction of the underground cabling trench due to the shallow nature of the excavation.

Pathway: Groundwater flowpaths.

Receptor: Groundwater levels.

Pre-mitigation Potential Impact/Effect: None predicted due to shallow and temporary nature of the proposed works.

7.4.1.3 Potential Release of Hydrocarbons during Construction and Storage

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a significant pollution risk to groundwater, surface water and associated ecosystems, and to terrestrial ecology. The accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, including fish, and is persistent in the environment. It is also a nutrient

supply for adapted micro-organisms, which can rapidly deplete dissolved oxygen in waters, resulting in death of aquatic organisms.

Pathway: Seepage through soils into Groundwater flowpaths and site drainage network.

Receptor: Surface water flows, stream morphology (in the Killuran River, the Broadford River and the Blackwater River, and associated tributaries).

Pre-Mitigation Potential Effect: Negative, indirect, slight, short term, unlikely effect to local groundwater quality. Negative, indirect, significant, short term, unlikely effect to surface water quality.

7.4.1.4 Release of Cement-Based Products

Concrete and other cement-based products are highly alkaline and corrosive and can have significant negative impacts on water quality. They generate very fine, highly alkaline silt (pH 11.5) that can physically damage fish by burning their skin and blocking their gills. A pH range of ≥ 6 ≤ 9 is set in S.I. No. 293/1988 Quality of Salmonid Water Regulations, with artificial variations not in excess of ± 0.5 of a pH unit. Entry of cement-based products into surface water runoff or seepage to groundwater represents a risk to the aquatic and groundwater environment during grid connection works. Batching of wet concrete on site and washing out of transport and placement machinery are the activities most likely to generate a risk of cement-based pollution.

Pathway: Runoff to surface water and seepage to groundwater.

Receptor: Surface water quality (in the Killuran River, the Broadford River and the Blackwater River, and associated tributaries), underlying groundwater quality in the Ardnacrusha GWB.

Pre-Mitigation Potential Effect: Negative, indirect, moderate, short term, likely effect to surface water quality, and Negative, indirect, slight, short term, likely effect to groundwater quality.

7.4.1.5 Potential Hydrological Effects from Directional Drilling Works

Construction phase activities along the Proposed Development include directional drilling at 8 no. watercourse crossings, which will require earthworks resulting in removal of vegetation cover and excavation of any minor local pockets of organic soil/subsoils. All the crossings are existing bridges and culverts along the public road. No in-stream works are required at any of these crossing locations, however due to the proximity of the streams to the construction work at the crossing locations, there is a potential for surface water quality impacts during trench excavation work. The main risk from directional drilling will be from frac-out.

Pathway: Surface water runoff and groundwater flow.

Receptor: Surface water quality and aquatic habitats.

Pre-Mitigation Potential Impact: Negative, indirect, slight, temporary, likely effect on surface water quality. Negative, indirect, slight, temporary, unlikely impact on groundwater quality.

7.4.1.6 Morphological Changes to Surface Watercourses & Drainage Patterns by Watercourse Crossings and Culverts

There are a total of 9 no. watercourse crossings along the Proposed Development, eight (8) no. will be completed by means of Horizontal Directional Drill (HDD) which will require a service trench (launch pit) for the drill in the road either side of the watercourse; and one (1) of the watercourse crossings will be completed by means of over-bridge in road solution. There will be no interactions with any watercourse.

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

Pathway: Wind Farm drainage network, local streams and rivers.

Receptor: Surface water flows, stream morphology (in the Killuran River, the Broadford River and the Blackwater River, and associated tributaries).

Pre-Mitigation Potential Effect: Negative, direct, slight, long term, unlikely effect on stream flows, stream morphology and surface water quality.

7.4.1.7 Potential Effects on Hydrology of Designated Sites

Approximately 434m of the Proposed Development site is located within the Glenomra Wood SAC boundary. All of which is located in the existing county road, which while within the designated area, the road itself carries no ecological value. The excavation and reinstatement of the grid route trench along this section will take less than 1 week of work, and the works will be temporary and transient. The shallow nature of the trench excavation works means that no impacts on groundwater will occur, and the main pathway for transmission of impacts to the water environment is via surface water.

The Slieve Bearnagh SAC (Site code: 002312) briefly borders the Proposed Development for less than 40m towards the northern section of the Proposed Development site. Slieve Bearnagh SAC is upgradient of the grid route at this location, therefore no part of the site will drain towards this section of the bog.

Surface waterbodies draining the grid connection in the northern section of the Proposed Development drain into the Doon Lough NHA (Site Code: 000337). At its closest point this designated site is located approximately 1.3km as the crow flies from the Proposed Development site and is hydrologically connected with the site via the Owenogarney and Broadford Rivers. Indirect water quality impacts could potentially occur, but effects are not expected to be significant as no in-stream works are proposed at any of the water crossing locations and also because the works are minor and localised.

The Proposed Development is hydrologically connected to the Lower River Shannon SAC (Site Code: 002165). At its closest point, this designated site is located approximately 1.5km to the south (as crow flies) of the Proposed Development and is downstream (hydrologically connected) via the Glenlon South, the Blackwater [Clare] and the Shannon (Lower) Rivers respectively. Surface water effects on downstream designated sites are unlikely to be significant due to dilution/assimilation capacity effects over such distances.

Pathway: Surface water flowpaths and groundwater levels and flowpaths.

Receptor: Water quality at designated sites (Glenomra Wood SAC, Doon Lough NHA and Lower River Shannon SAC).

Pre-Mitigation Potential Effect: Negative, direct, imperceptible, short term, likely effect on surface water quality within Glenomra Wood SAC, Doon Lough NHA and Lower River Shannon SAC.

Negative, indirect, imperceptible, long term, unlikely effect on groundwater levels and groundwater quality within Glenomra Wood SAC, Doon Lough NHA and Lower River Shannon SAC.

7.4.2 Operational Phase

The potential impacts associated with operational phase of the Proposed Development will be similar to those associated with construction but of a reduced magnitude, due to the reduced scale of the proposed operation works in comparison to construction phase works.

Minor maintenance works may be performed along the Proposed Development in which case potential impacts would be similar to the potential impacts from the construction phase as described above. However, these works would be temporary and short in duration, therefore significant impacts will not occur. Mitigation measures incorporated into the Proposed Development as described below (Section 7.5) will be implemented for any required emergency repair works on the Proposed Development during the operational phase.

Potential impacts on the water environment during operation are limited by virtue of the fact that the Proposed Development site is relatively static during the operational phase, with all construction works being complete, and drainage and runoff will be clean therefore no impacts will occur. Some minor maintenance works may be completed throughout the operational phase. These works would be of a very minor scale and would be very infrequent. Mitigation measures will be put in place during any maintenance works throughout the operational phase, including drainage control measures, sediment control measures and mitigation measures related to spills/chemical releases which will ensure that the quality of runoff from along the grid route during maintenance will be good.

7.4.3 Do-Nothing

Under the Do-Nothing scenario, the area will continue to be used as a public road, except where it deviates off the road into existing access tracks (within Ardnacrusha), private forestry access tracks, private agricultural lands and permitted internal wind farm access roads. There will be no alteration of the existing hydrological regime.

7.4.4 Cumulative Impacts and Effects

Other developments assessed with regard cumulative effects are listed Appendix 1-5, Volume III. The majority of the Proposed Development is along the carriageway of existing public roads which significantly reduces the potential for water quality impacts. Therefore, as listed above, there are many mitigating factors that rule out the potential for significant hydrological cumulative effects.

The Proposed Development has the potential to interact with the proposed Fahey Beg Wind Farm Development Grid Connection in two locations and in one location within Ardnacrusha with the Drummin Solar Farm Grid Connection (Figure 1-2 and 1-3, Chapter 1).

As outlined in Chapter 1, each project that progresses with a grid connection located within the public road network will have to apply to the local authority for a Road Opening Licence, where timelines will be agreed, and connections sequenced. Early engagement with the local authority will allow them to decide on how the sections of public road are managed during the laying of the UG grid trenching, so as to avoid disruption. In the event that the Fahy Beg UG Grid and the Carrownagowan UG Grid works need to be done at similar times within the public road network then the Local Authority through the Road Opening Licence process will agree the best solution. The solution may be to close a short section of road and do a traffic diversion, or it may dictate each developer stagger the duration of the overlap on the public road so as to control and mange impacts locally; thereby avoiding any significant cumulative effects.

Any interaction with these developments and the Proposed Development within Ardnacrusha substation will be controlled by the Ardnacrusha Eirgrid Station Manager who will implement their own traffic management measures thereby avoiding potential cumulative impacts.

From a cumulative perspective, the following factors will ensure that no significant cumulative effects will occur:

- The Proposed Development footprint is spread out over a large geographical area;
- Works are distributed between several no. sub-catchments;

- In-stream works will be avoided at the watercourse crossing locations;
- The transient nature of the works across several sub-catchment which will be carried out over several months;
- Due to the protection provided to comply with WFD requirements and surface water regulations; and
- All residual effects will be brief to temporary in duration and reversible.

In summary, the potential cumulative water quality impacts of the Proposed Development during the construction and operational phase will not have significant effects on downstream watercourses owing to the environmental protection measures and drainage design of the Proposed Development described in Section 7.5 below.

We have considered potential cumulative impacts with the permitted wind farm development, and due to hydrological separation and also that the proposed grid works within the wind farm site will be constructed as part of the permitted wind farm development, the potential for cumulative impacts on the water environment does not exist.

7.5 Mitigation Measures

7.5.1 Construction Phase

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

Temporary silt fencing/silt trap arrangements (with straw bales) will be placed within existing roadside/field drainage features along the grid connection to capture any suspended sediments from the works area. The trapped sediment will be removed and disposed at an appropriate licenced facility. The bare ground re-seeded/reinstated immediately and silt fencing temporally left in place if necessary.

Any excavated topsoil/subsoil associated with the trench and access tracks in off road sections of the Proposed Development that isn't removed off-site to a licenced facility will be temporarily stored near the excavations and reused for reinstatement works.

7.5.1.2 Potential Impacts on Groundwater Levels and Local Well Supplies During Excavation works

No groundwater level impacts will occur from the construction of the underground cabling trench due to the shallow nature of the excavation (i.e. ~1.2m) and temporary nature of the proposed works, therefore mitigation measures are not required.

7.5.1.3 Potential Release of Hydrocarbons during Construction

Mitigation By Avoidance

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

- Due to the ease of access along the grid connection route, it is unlikely that any refuelling on site will be necessary. Nevertheless, if required, storage areas will be bunded appropriately for the fuel storage volume for the time period of the construction and fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose;

- Spill kits will be available to deal with any accidental spillage from plant or equipment; and
- An emergency plan for the construction phase to deal with accidental spillages is included within the CEMP (refer to Appendix 2-2, Volume III). Spill kits will be available to deal with any accidental spillage in and outside the re-fuelling area.

7.5.1.4 Release of Cement-Based Products

Mitigation By Avoidance

The following mitigation measures are proposed:

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

7.5.1.5 Potential Hydrological Effects from Directional Drilling Works

Mitigation By Design

The following mitigation measures are proposed:

- For directional drilling the area around the bentonite batching, pumping and recycling plant will be bunded using terram (as sediment will accumulate against the surface of the terram) 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 cleaned up immediately and stored in an adequately sized skip before been taken off-site;
- The drilling fluid/bentonite will be non-toxic and naturally biodegradable (i.e., Clear Bore Drilling Fluid or similar will be used);
- The drilling process / pressure will be constantly monitored to avoid 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.

7.5.1.6 Morphological Changes to Surface Watercourses & Drainage Patterns by Watercourse Crossings

Mitigation By Avoidance

General Best Practice Pollution Prevention Measures will also include:

- Protection of the riparian zone watercourses by implementing a constraints zone around stream crossings, in which construction activity will be limited to the minimum, i.e. works solely in connection with duct laying at the stream crossing;
- No stockpiling of construction materials will take place within the constraints zone;
- No concrete truck chute cleaning is permitted in this area;
- Works shall not take place at periods of high rainfall, and shall be scaled back or suspended if heavy rain is forecast;
- Plant will travel slowly across bare ground at a maximum of 5km/hr. Bog mats will be employed to protect tracked areas as necessary;
- Machinery deliveries shall be arranged using existing structures along the public road;
- All machinery operations shall take place away from the stream and ditch banks, apart from where crossings occur. Although no instream works are proposed or will occur;
- Any excess construction material shall be immediately removed from the area and taken to an appropriately licensed facility;
- No stockpiling of materials will be permitted in the constraint zones;
- Spill kits shall be available in each item of plant required to complete the stream crossing; and,
- Silt fencing will be erected on ground sloping towards watercourses at the stream crossings if required.

Mitigation Measures relating to the use and storage of fuels and chemicals in terms of groundwater protection:

- The plant used will be regularly inspected for leaks and fitness for purpose; and,
- Spill kits will be available to deal with accidental spillage.

7.5.1.7 Potential Hydrological Impacts on Designated Sites

Mitigation Measures

As the Slieve Bearnagh SAC is upgradient of the Proposed Development site at this location, no part of the site will drain towards this section of the bog; however, due to the proximity of the SAC to the Proposed Development, mitigation measures outlined in Section 7.5.1.1 to Section 7.5.1.6 above will be implemented.

The Proposed Development has potential to effect downstream and hydrologically connected designated sites (Glenomra Wood SAC, Doon Lough NHA and Lower River Shannon SAC). Mitigation measures must be put in place during the construction phase, as surface waters from sections of the Proposed Development will potentially drain towards these areas.

Mitigation measures are outlined in Section 7.5.1.1 to Section 7.5.1.6 above which, when implemented, will provide the necessary protection to these hydrologically sensitive areas.

The proposed mitigation measures which will include drainage control measures, sediment control measures and mitigation measures related to spills/chemical releases will ensure that the quality of runoff from along the grid

route during construction will be 'Good'. As stated in Impact Section 7.4.1.1 above, there could potentially be a "short term, likely impact" on local streams and rivers but this would be very localised and over a very short time period (i.e. hours). Therefore, significant direct, or indirect impacts on the SAC's will not occur. The hydrological regime locally will not be affected by the proposed works and so the regime of the SACs will not be affected.

- No significant dewatering is proposed during construction. Any pumping required will be temporary and at a very shallow depth.
- All building and trenching works are proposed at or very near existing ground levels with minimal ground disturbance proposed.
- No deep foundations are required or are proposed. As such there will be no interruption or blocking of shallow or deep groundwater pathways below the site.

7.5.2 Operational Phase

Minor maintenance works may be performed along the Proposed Development in which case the mitigation measures as described in Sections 7.5.1 for the construction phase of the Proposed Development will be implemented. Maintenance works will be temporary and short in duration.

The proposed mitigation measures which will include drainage control measures, sediment control measures and mitigation measures related to spills/chemical releases will ensure that the quality of runoff from along the grid route during maintenance will be good.

7.6 Residual Effects

7.6.1 Construction Phase

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

Residual Effects: The potential for the release of suspended solids to watercourse receptors is a risk to water quality and the aquatic quality of the receptor. Proven and effective measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect is considered to be - Negative, imperceptible, indirect, short term, unlikely on down-gradient rivers (water quality), and dependent aquatic ecosystems.

Significance of Effects: For the reasons outlined above, no significant effects on the surface water quality will occur.

7.6.1.2 Potential Impacts on Groundwater Levels and Local Well Supplies During Excavation works

Residual Effects: For the reasons outlined in Section 7.5.1.2 above, no significant effects on the groundwater levels or existing private and public groundwater supplies will occur

Significance of Effects: For the reasons outlined above, no significant effects on groundwater levels or water supplies will occur.

7.6.1.3 Potential Release of Hydrocarbons during Construction and Storage

Residual Effects: The potential for the release of hydrocarbons to groundwater and watercourse receptors is a risk to surface water and groundwater quality, and also the aquatic quality of the surface water receptors. Proven and effective measures to mitigate the risk of releases of hydrocarbons have been proposed above and will break the pathway between the potential source and each receptor. The residual effect will be negative, imperceptible, indirect, short term, unlikely impact to surface water quality.

Significance of Effects: For the reasons outlined above, no significant effects on surface water or groundwater quality will occur.

7.6.1.4 Release of Cement-Based Products

Residual Effects: The potential for the release of cement-based products or cement truck wash water to groundwater and watercourse receptors is a risk to surface water and groundwater quality, and also the aquatic quality of the surface water receptors. Proven and effective measures to mitigate the risk of releases of cement-based products or cement truck wash water have been proposed above and will break the pathway between the potential source and each receptor. The residual effect will be negative, imperceptible, indirect, short term, unlikely effect to surface water quality, and negative, imperceptible, indirect, short term, unlikely effect to grundwater quality.

Significance of Effects: For the reasons outlined above, no significant effects on surface water quality or groundwater quality will occur.

7.6.1.5 Potential Hydrological Effects from Directional Drilling Works

Residual Effects: Due to the proximity of the streams to the construction work at the crossing locations, there is a potential for surface water quality impacts during trench excavation work. The potential for the release of suspended solids and frac-out to watercourse receptors is a risk to water quality and the aquatic quality of the receptor. Proven and effective measures to mitigate the risk of releases of sediment have been proposed above in **Section 7.5.1.5,** and will break the pathway between the potential sources and the receptor. The residual effect is considered to be - Negative, imperceptible, indirect, short term, unlikely on down-gradient rivers (water quality), and dependent aquatic ecosystems.

Significance of Effects: For the reasons outlined above, no significant effects on the surface water quality at crossing locations will occur.

7.6.1.6 Morphological Changes to Surface Watercourses & Drainage Patterns by Watercourse Crossings

Residual Effects: With the application of the best practice mitigation outlined above (**Section 7.5.1.6**), the residual effect at the Proposed Development will be negative, imperceptible, direct, long term, unlikely on stream flows, stream morphology and surface water quality.

Significance of Effects: For the reasons outlined above, no significant effects on stream morphology or stream water quality will occur at crossing locations.

7.6.1.7 Potential Hydrological Impacts on Designated Sites

Residual Effects: Potential for Significant effects on designated sites (see impact assessment at Section 7.4.1.7) can be mitigated with the application of the best practice mitigation outlined above. Water level impacts in Slieve Bernagh Bog SAC are prevented by buffering, and also by the elevation differences between the SAC boundary (upgradient) and Proposed Development. Water quality and hydrological impacts to the Glenomra Wood SAC

and to downstream Doon Lough NHA and Lower River Shannon SAC will be prevented by implementation of construction phase drainage mitigation as described in in Section 7.5.1.1 to Section 7.5.1.6.

Significance of Effects: For the reasons outlined above, no significant effects on designated sites will occur.

7.6.2 Operational Phase

Residual Effects: With the implementation of the Proposed Developments mitigation measures as outlined in Section 7.5 above, the residual effect will be negative, imperceptible, indirect, long-term, unlikely effect on all downstream surface water bodies.

Significance of Effects: For the reasons outlined above, no significant effects on the water environment in the vicinity and downstream of the Proposed Development will occur.

7.6.3 Decommissioning Phase

Residual Effect Assessment: The avoidance of any major excavation works during the decommissioning phase means the residual effect will be negative, direct, imperceptible, unlikely, temporary on the water environment.

Significance of Effects: For the reasons outlined above, no significant effects on the water environment will occur during the decommissioning phase.

7.7 Risk of Major Accidents and Disasters

Incidents, accidents and disasters are unplanned events. Incidents and (major) accidents usually occur within a relatively short time frame but with greater intensity than under normal operating conditions. Incidents such as flooding can result in liabilities such as contaminated surface and groundwaters, loss of infrastructure and loss of life. Proactive risk management reduces the potential for an incident to occur, and therefore the CEMP for the Proposed Development sets out the Emergency Response Procedure to be adopted in the event of a water emergency including water contamination, extreme weather events and flooding.

The Proposed Development has been designed and will be built in accordance with the best practice measures set out in this EIAR and, as such, mitigation against the risk of major accidents and/or disasters is embedded through the design.

7.7.1 Meteorological

Major accidents and disasters may occur due to storm and gale force winds, heavy snow, severe cold/ frost, extreme temperatures, thunder and lightning, persistent fog, heat waves and droughts. Such meteorological events can lead to poor driving conditions, loss of infrastructure, flooding, falling trees, blizzards, poor visibility icy roads /impassable roads, hypothermia, freezing of supply networks, public health risks, road traffic collisions and water shortages.

Meteorologically Ireland has a temperate, oceanic climate, resulting in mild winters and cool summers. The Proposed Development is located approximately 58km east of the Atlantic Ocean. The dominant influence on Ireland's climate is the Atlantic Ocean. As a consequence, Ireland does not suffer from the extremes of temperature experienced by many other countries at similar latitude The hills and mountains, many of which are near the coasts, provide shelter from strong winds and from the direct oceanic influence. As described above in Section 7.3.1, the Met Eireann weather station at Shannon Airport, Co. Clare, is the nearest weather and climate monitoring station to the Proposed Development site that has meteorological data recorded for the 30- year

period from 1981-2010. The monitoring station is located approximately 20 kilometres west of the site from Ardnacrusha. Meteorological data recorded at Shannon Airport over the 30-year period from 1981 - 2010 is shown in Table 7-1 above. The wettest months are October and December, and April is usually the driest. July is the warmest month with a mean daily temperature of 16.3° Celsius(°C) and January is the coldest with a mean daily temperature of 6.0°C. The average annual temperature is 10.7°C. The works programme for the construction stage of the development will take account of weather forecasts and work will be suspended in the case of extreme weather events (such as heavy rainfall) as described above in the pre-emptive site drainage management plans within Section 7.5.1.1. The forecasting and weather warning systems (i.e. General Forecasts, MeteoAlarm, 3-hour Rainfall Maps, Rainfall Radar Images, and Met Eireann Consultancy Service) are available and will be used on a daily basis at the site to direct proposed construction activities.

7.7.2 Hydrological

Heavy rainfall has the potential to cause major accidents and disasters via flooding in low lying areas and on on-site rivers such as the Broadford River and the Blackwater River within the Proposed Development.

As detailed in Section 7.3.4, no recurring or historic flood incidents are recorded within the Proposed Development site. No recurring flood incidents within the Proposed Development boundary or immediately downstream were identified from OPW's Flood Hazard Mapping. National Indicative Fluvial mapping for the present day extents are mapped along parts of the Broadford and Blackwater Rivers that drain the Proposed Development. With the exception of a minor area along the Blackwater River, mapped along an unnamed road, towards the south of the Proposed Development site, the Proposed Development is not mapped within any of the National Indicative Fluvial mapping for the present day extents. There are no areas of pluvial flood extents mapped near the site.

Based on the information gained through the flood identification process, with the exception of a minor area along the Blackwater River mapped towards the south of the Proposed Development site, no parts of the site are mapped within any fluvial flood zones (Flood Zones A - B). Also, with the exception of watercourse crossings along the Proposed Development, all Proposed Development locations are at least 50m from a watercourse. The overall risk of flooding posed at the Proposed Development site and downstream is estimated to be very low. A low risk would typically relate to the probability of being impacted by a 1000-year flood (i.e. the majority of the Proposed Development footprint located in fluvial Flood Zone C).

7.7.3 Contamination

The Proposed Development has the potential to cause contamination and pollution of groundwater and surface water from potential release of hydrocarbons, earthworks and excavations on site.

The risk of the Proposed Development contributing to an increased risk of contamination to surface and groundwaters within the vicinity and downstream of the site is very low as robust waste management and pollution prevention measures for refuelling and managing hazardous materials and cement-based products will be implemented (as outlined in Sections 7.5.1.1, 7.5.1.3, 7.5.1.4, 7.5.1.5). These will ensure that no significant effects on the surface water quality and groundwater quality within the vicinity and downstream of the site will occur.

7.8 Summary

HES have completed a thorough assessment of the Proposed Development in respect of the water environment.

It was concluded that no significant effects on the water environment from the Proposed Development will occur during construction, operational or decommissioning phases.

The assessment also confirms that there will be no cumulative effects on the water environment as a result of the Proposed Development when assessed in conjunction with all other existing, approved or proposed projects, including all other elements of the overall project.

The Proposed Development will not impact upon any surface water or groundwater body as it will not cause a deterioration of the status of the body and/or it will not jeopardise the attainment of good status.

7.9 References

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