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Chapter 8.

Hydrology, Geology & Hydrogeology Assessment

Contents

Glossary

Term	Definition
Above Ordnance Datum (AOD)	The mean sea level at Newlyn (UK) used as a base measurement on Ordnance Survey Maps for contours.
Aquifer	A rock formation that is sufficiently porous and permeable to yield a significant quantity of water to a borehole, well or spring. The aquifer may be unconfined beneath a standing water table or confined by an impermeable or weakly permeable horizon.
Catchment	A catchment boundary defines the area of land which drains to a given point (the catchment outlet).
Confluence	The point at which two watercourses meet.
EIA Regulations	The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017.
Environmental Impact Assessment	Environmental Impact Assessment (EIA) is a means of carrying out, in a systematic way, an assessment of the likely significant environmental effects from a development.
Environmental Impact Assessment Report	A document reporting the findings of the EIA and produced in accordance with the EIA Regulations.
Geographic Information System	Computerised data base of geographical information that can easily be updated and manipulated.
Groundwater Dependent Terrestrial Ecosystems	Terrestrial wetland ecosystem dependent upon a groundwater supply for their existence.
Natural Power	The lead consultant EIA co-ordinator is Natural Power Consultants Limited.
Peat	An organic surface horizon over 0.5m deep of partially decomposed remains of plants and organic matter that is formed in wet anaerobic ground.
Permeability	The ability of a fluid, like water or oil, to pass from one pore space to another.
Private Water Supply	Water not supplied by a statutory water undertaker such as a water company.
Proposed Development	The South Kyle II Wind Farm development.
Proposed Development Area	The area within the “Site boundary” as illustrated on Volume 2a, Figure 1.1 which the Proposed Development will be located.
Study Area	The Proposed Development Area with a 3 km buffer area immediately beyond the Proposed Development. As shown in Figure 8.1. Volume 2a.
Sub-catchment	A division of a catchment, to allow runoff to be managed as near to the source as is reasonable.
Superficial Deposits (geology)	These are the youngest form of geological deposit formed during the most recent period of geological time. These directly overlie the solid bedrock and can often be unconsolidated and highly permeable.
Sustainable Drainage Systems	A sequence of management practices and control structures designed to drain system’s surface water (SuDS) in a more sustainable fashion than some conventional techniques.
Tributary	An adjoining stream which flows into the main river.

List of Abbreviations

Abbreviation	Description
AOD	Above Ordnance Datum
BFI	Base Flow Index
BGS	British Geological Survey
CAR	Controlled Activities (Scotland) Regulations 2011
CC	Climate Change
CIRIA	Construction Industry Research and Information Association
EAC	East Ayrshire Council
ECoW	Environmental Clerk of Works
ECU	Energy Consents Unit
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
FEH	Flood Estimation Handbook
FEH RR	Flood Estimation Handbook Runoff Rainfall
GBR	General Binding Rule
GCR	Geological Conservation Review
GPP	Guidance for Pollution Prevention
GWDTE	Ground Water Dependant Terrestrial Ecosystems
HOST	Hydrology Of Soil Types
LDP	Local Development Plan
LUPS	Land Use Planning System
NGR	National Grid Reference
NPF4	National Planning Framework 4
NVC	National Vegetation Classification
PAN	Planning Advice Notes
PWS	Private Water Supply
PWSRA	Private Water Supply Risk Assessment
RBMP	River Basin Management Plan
SAC	Special Area of Conservation
SEPA	Scottish Environmental Protection Agency

Abbreviation	Description
SM	Scheduled Monument
SPA	Special Protection Area
SPR	Standard Percentage Runoff
SSSI	Site of Special Scientific Interest
SuDS	Sustainable urban Drainage Systems
WFD	Water framework directive
WX	Watercourse Crossing

8.1. Statement of Competence

8.1.1. The assessment and associated Technical Appendices were undertaken by Natural Power Consultants Ltd (Natural Power). Natural Power has an established reputation in providing assessment of hydrological, geological and hydrogeological environment considerations discussed in this chapter.

8.1.2. The author of this chapter has over 6 years of experience in the environmental consultancy sector. During this time, they have been involved with management of onshore wind and solar development projects, production of Environmental Impact Assessment Report (EIAR) hydrology chapters, scoping reports and technical reports as well as client and consultee liaison. They are a Senior Consultant with experience in hydrology, flood risk and renewables.

8.1.3. The author was assisted and supported by Principal Environmental Consultants one of whom who has been working as a consultant in the renewable development sector for over 7 years, and the other with over 17 years of experience in EIAR compilation.

8.2. Introduction

8.2.1. This chapter of the EIAR provides an assessment of the potential impact of the South Kyle II Wind Farm development (the Proposed Development) on the hydrological, geological and hydrogeological environment and assesses the likely environmental effects resulting from the construction, operation and decommissioning of the proposed turbines and associated infrastructure. The specific objectives of the chapter are to:

- Describe the assessment methodology and significance criteria used in completing the impact assessment;
- Describe the current baseline;
- Describe the potential effects, including direct, indirect and cumulative effects;
- Describe the mitigation measures proposed to address any potentially significant effects; and
- Assess the residual effects remaining following the implementation of mitigation measures.

8.2.2. The main effects in terms of hydrology, geology and hydrogeology are experienced during the construction phase, however impacts can persist into the operational and decommissioning phase of the Proposed Development. A summary of the main potential effects are as follows:

- Effects on conservation sites;
- Effects on surface water receptors;
- Effects on water resources;
- Effects on flood risk;
- Effects on geology and soils; and
- Effect on hydrogeology.

8.2.3. The chapter is supported by the following technical appendix:

- Technical Appendix 8.1: Peat Management Plan, Volume 3;
- Technical Appendix 8.2: Watercourse Crossing Assessment, Volume 3; and
- Technical Appendix 8.3: Peat Slide Risk Assessment, Volume 3.

8.2.4. The chapter is supported by the following figures which are referenced in the text where relevant:

- Figure 8.1: Hydrological Overview, Volume 2a;

- Figure 8.2: Predominant Soils, Volume 2a;
- Figure 8.3: Carbon and Peatland Soils, Volume 2a;
- Figure 8.4: Interpolated Peat Depth, Volume 2a;
- Figure 8.5: Bedrock Geology, Volume 2a;
- Figure 8.6: Superficial Geology, Volume 2a; and
- Figure 8.7: Potential Ground Water Dependant Terrestrial Ecosystems (GWDTE), Volume 2a.

8.3. Legislation Policy and Guidance

Policy Context

8.3.1. The assessment takes account of the requirements of the Water Framework Directive (2000/60/EC) (WFD). The requirements of various EU Directives such as the WFD (2000/60/EC), the European Liability Directive (2004/35/EEC) and the Groundwater Daughter Directive (2006/118/EEC) have been retained in domestic legislation following the United Kingdom leaving the EU by the Environment (EU Exit) (Scotland) (Amendment etc.) Regulations 2019 (the 'Environment Regulations 2019'). The WFD, as retained in domestic legislation by the Environment Regulations 2019, establish a legal framework for the protection, improvement and sustainable use of surface waters, transitional waters, coastal waters and groundwater resources. The WFD aims to protect and enhance the quality of surface freshwater (including lakes, rivers and streams), groundwater, GWDTE, estuaries and coastal waters. The key objectives of the WFD relevant to the assessment are:

- To prevent deterioration and enhance aquatic ecosystems; and
- To establish a framework for the protection of surface freshwater and groundwater.

8.3.2. The WFD resulted in The Water Environment and Water Services (Scotland) (WEWS) Act 2003, which gave Scottish Ministers powers to introduce regulatory controls (Section 20 of WEWS) over water activities to protect, improve and promote sustainable use of Scotland's water environment. These regulatory controls, in the form of The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) (CAR) have made it an offence to undertake certain activities (as listed in Schedule 2) without a CAR authorisation.

National Legislation and Policy

8.3.3. The assessment will take into account the following legislation and policy:

- Part IIA of the Environmental Protection Act 1990;
- The Water Environment and Water Services (Scotland) Act 2003 (as amended by the Environment Regulations 2019);
- Private Water Supplies (Scotland) Regulations 2006;
- Flood Risk Management (Scotland) Act 2009;
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended);
- Waste Management Licensing (Scotland) Regulations 2011;
- Pollution Prevention and Control (Scotland) Regulations 2012;
- Public Water Supplies (Scotland) Regulations 2014;
- The Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017;
- Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017, as amended;
- Land Use Planning System SEPA Guidance Note 4 (LUPS-GU4) 2017: Planning Guidance on Onshore Windfarm Developments;
- LUPS SEPA Guidance Note 31 (LUPS-GU31) 2017: Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems; and
- National Planning Framework 4 (NPF4) 2023;
- Scottish Environment Protection Agency (SEPA) Policies:
  - No. 19 Groundwater Protection Policy for Scotland; and
  - No. 41 Development at Risk of Flooding: Advice and Consultation.

Regional and Local Policy

8.3.4. The assessment takes into account the following local development plan policies:

- East Ayrshire Council (EAC) Local Development Plan 2 (LDP2); and
- EAC (2020) Minerals Local Development Plan.

8.3.5. The assessment also takes account of the following district plan:

- East Ayrshire Council (2022) Local Flood Risk Management Plan – Ayrshire Local Plan District (2022 – 2028).

Other Guidance and Good Practice

8.3.6. Table 8.1 lists other key guidance and good practice documentations considered as part of this assessment.

Table 8.1: Guidance and Best Practice

Topic	Source of Information
Scottish Government Planning Advice Notes (PANs)	• PAN 50: Controlling the Environmental Effects of Surface Mineral Workings • PAN 51 Planning, Environmental Protection and Regulation • PAN 1/2013 Environmental Impact Assessment • PAN 61 Planning and Sustainable Urban Drainage Systems • PAN 79 Water and Drainage
SEPA Guidance for Pollution Preventions (GPPs)	• GPP 1: Understanding your Environmental Responsibilities – Good Environmental practices • GPP 2: Above Ground Oil Storage Tanks • GPP 4 Treatment and Disposal of Wastewater Where there is no Connection to the Public Foul Sewer • GPP 5: Works and maintenance in or near water • GPP 6 Working at Construction and Demolition Sites • GPP 8: Safe Storage and Disposal of Used Oils • GPP 13: Vehicle Washing and Cleaning • GPP 21: Pollution Incident Response Planning • GPP 22: Dealing with Spills • GPP 26 Safe Storage – Drums and Intermediate Bulk Containers

SEPA Position Statements (Published) and Other Guidelines	• WAT-PS-06-02 Culverting of Watercourses • WAT-PS-07-02 Bank Protection • WAT SG-78 Sediment Management Authorisation. Construction Industry Research and Information Association (CIRIA) • CIRIA C692 Environmental Good Practice on Site (third edition) • CIRIA C753 The Sustainable Urban Drainage System Manual • CIRIA C532 Control of Water Pollution from Construction Sites • CIRIA C648 Control of Water Pollution from Linear Construction Projects • CIRIA C786 Culvert, Screen and Outfall Manual. • Scottish Renewables Joint Publication, (2019) Good Practice During Wind Farm Construction Version 4 • Scottish Renewables, Joint Publication (2012), Development of Peatland: Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste • SEPA, The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended), A Practical Guide, Version 9, March 2022 • SEPA, (2022) SEPA requirements for undertaking a Flood Risk Assessment, Version 13 June 2022 • SEPA Position Statement on Land Protection, Reference EP054 • River Crossings and Migratory Fish: Design Guidance, A Consultation Paper, The Scottish Executive • WAT-SG-23: SEPA (2008), Engineering in the Water Environment, Good Practice Guide – Bank Protection Rivers and Lochs, First Edition • WAT-SG-25: SEPA (2010), Engineering in the Water Environment, Good Practice Guide, River Crossings, Second Edition • WAT-SG-26: SEPA (2010), Engineering in the Water Environment, Good Practice Guide, Sediment Management, First Edition • WAT-SG-31: SEPA, (2006) Special Requirements for Civil Engineering Contracts for the Prevention of Pollution, Version 2 • WAT-SG-75: SEPA, (2018), Sector Specific Guidance: Construction Sites, Version 1 & Supporting guidance (WAT-SG-75) Water Run-Off from Construction Sites September 2021

8.4. Method of Assessment

Initial Scope of Assessment

Impacts Scoped out of the Assessment.

8.4.1. The impacts relating to the Carsfad Reservoir has been scoped out due to the distance between the Proposed Development and the reservoir. The distance is approximately 15 km from point-to-point and will be greater when considering the length of channel (i.e. meanders). Therefore, the effect of dilution would make any potential impact on the Carsfad Reservoir negligible.

8.4.2. No additional impacts have been scoped out from the hydrology, geology and hydrogeology assessment.

Impacts Scoped into the Assessment

8.4.3. The following matters are considered and an assessment of impacts in respect of these are provided in this chapter. The greatest risk of the Proposed Development affecting the hydrological, hydrogeological, geological and soil environment will occur during the construction phase, with effects reduced during the operational and decommissioning phase. Taking this into account the following issues will be addressed during all phases of development of the Proposed Development:

- Changes to existing drainage patterns;
- Effects on baseflow;
- Effects on run-off rates;
- Effects on erosion and sedimentation;
- Effects on groundwater and surface water quality (including GWDTE);
- Effects on groundwater levels; effects on water resources;
- Effects on impediments to flow;
- On-site and downstream flood risk;
- Pollution risk; and
- Effects on local geology.

Overview

8.4.4. The assessment has involved the following:

- Detailed desk studies and site investigation to establish baseline conditions of the area;
- Evaluation of the environmental impacts of the proposed development and the likely significant effects that these could have on the current site conditions;
- Identification of embedded good practice measures to avoid and mitigate against any identified adverse effects resulting from the Proposed Development;
- Evaluation of the likely significant environmental effects with consideration of the potential embedded mitigation measures, taking account of the sensitivity of the baseline features the potential magnitude of these effects and the probability of these effects occurring; and
- The residual significance of the environmental effects following the consideration of additional mitigation measures.

Baseline Assessment

8.4.5. A desktop survey to establish the baseline conditions was undertaken in order to:

- Describe surface water hydrology, including watercourses, springs and waterbodies;
- Identify existing catchment pressures (e.g. point source and diffuse pollution issues);

- Identify all private drinking water abstractions and public water supplies within 3 km of Proposed Development site;
- Identify all flooding risks;
- Describe the hydromorphological conditions of watercourses;
- Collate hydrological flow and flooding data for the immediate area and main downstream watercourses;
- Collect soil, geological and hydrogeological information; and
- Confirm surface water catchment areas and watersheds.

Study Area

8.4.6. Both desk study and survey data for this chapter of the EIAR have been gathered with respect to a defined Study Area. The Study Area includes the Proposed Development Area and a 3 km buffer area immediately beyond the Proposed Development (Figure 8.1, Volume 2a). Data for beyond the Study Area have also been collected where catchment areas for distant water features may intersect the Study Area, such as for abstractions and conservation sites. It should be noted that the Study Area sits entirely within the East Ayrshire Council (EAC) Local Authority area. **Note**: a portion of access track crosses boundary into Dumfries and Galloway local authority area. However, as this is an existing track no hydrological, hydrogeological or geological impacts will be seen and therefore, no assessment required.

Desk Study and Site Investigations

8.4.7. Published information sources used to characterise the baseline conditions within the Proposed Development Area in the surrounding area is outlined in Table 8.2.

Table 8.2: Baseline Information Sources

Topic	Source/Type of Data	Details
Topography	1:10,000 OS Raster Data 1:50,000 OS Raster Data	Mapping used for desk based analysis to understand baseline environment, during site visits and for figure production.
Climate	Met Office, https://www.metoffice.gov.uk/public/weather/climate/gcv3mcrf9	To predict rainfall volume and seasonal patterns.
Conservation Sites	In-house Designated Site Database. NatureScot, SiteLink website, Protected areas | NatureScot	Provides layers showing each designated site with details on its designation.
Surface Water Hydrology	Flood Estimation Handbook (FEH): FEH Web Service, https://fehweb.ceh.ac.uk/ UK SuDS, HR Wallingford. https://www.uksuds.com/	Provides details such as catchment area and watercourse length. Standard Average Annual Rainfall (SAAR) values provided.
Flooding	Flood Risk Management Map (SEPA) https://map.sepa.org.uk/floodmaps Flood Modeller Suite, https://www.floodmodeller.com/	Used for establishing and assessing on site, downstream and cumulative flood risk from various sources.
Water Quality	SEPA, Water Classification Hub, https://www.sepa.org.uk/data-visualisation/water-classification-hub SEPA, Water Environment Hub, https://www.sepa.org.uk/data-visualisation/water-environment-hub/	Provision of information on the existing water quality and catchment pressures.
Water Resources	Private Water Supply (PWS) information provided by EAC Scottish Water	Provision of information on the private water supplies in the vicinity of the Proposed Development.
Soils and Peat	James Hutton Institute, Soil Information For Scottish Soils, http://sifss.hutton.ac.uk/ Scotland's Soils Interactive Map, Carbon and Peatland 2016 and National Soil Map of Scotland, http://soils.environment.gov.scot/	Mapping used to establish and understand the baseline environment.
Bedrock and Superficial Geology	BGS Geoindex Onshore, http://mapapps.bgs.ac.uk/geologyofbritain3d/index.html	Mapping used to establish and understand the baseline environment.
Hydrogeology	Scotland's Environment Web Interactive Map, https://map.environment.gov.scot/sewebmap/ BGS Hydrogeology Map of the UK, https://mapapps2.bgs.ac.uk/geoindex/home.html?layer=BGSHydroMap BGS Geoindex Onshore https://mapapps2.bgs.ac.uk/geoindex/home.html SEPA, Water Classification Hub, https://www.sepa.org.uk/data-	For understanding effects on groundwater quality and quantity and flood risk.

Topic	Source/Type of Data	Details
	visualisation/water-classification-hub/	

Effects Evaluation

8.4.8. The likely significant environmental effects of the Proposed Development have been defined by taking account of the two main factors: the sensitivity of the receiving environment and the potential magnitude should that impact occur. The sensitivity of the receiving environment i.e. its baseline quality as well as its ability to absorb the effect without perceptible change is defined in Table 8.3.

Table 8.3: Definition of Sensitivity of the Receiving Environment

Sensitivity	Criteria	Receptor Type	Examples
High	Features with a high yield, quality or rarity with little potential for substitution.	Aquatic and geological environment	Conditions supporting a site with an international conservation designation (i.e. Special Area of Conservation (SAC), SPA), where the designation is based specifically on aquatic and geological (including peat) features. WFD surface water body (or part thereof) with overall High status, also any associated upstream non-reportable WFD surface water body or non-WFD surface water body. WFD surface water body (or part thereof) with High status for morphology. Class 1 – Nationally Important carbon-rich soils, deep peat and priority peatland habitat.
	Water use supporting human health and economic activity at a regional scale.	Water use	CAR-licensed public surface water or groundwater supply (and associated catchment) or permitted discharge.
	Features with a high vulnerability to flooding.	Flood risk	Land use type defined as ‘Essential Infrastructure’ (i.e. critical national infrastructure, such as essential transport and utility infrastructure) and ‘Most Vulnerable Use’ (e.g. police / ambulance stations that are required to operate during flooding, mobile homes intended for permanent residential use) in SEPA (2018) flood risk land use vulnerability classification.
Medium	Features with a medium yield, quality or rarity, with a limited potential for substitution.	Aquatic and geological environment	Conditions supporting a site with a national conservation designation (i.e. SSSI), where the designation is based specifically on aquatic and geological (including peat) features. WFD surface water body (or part thereof) with overall Good status / potential, also any associated upstream non-reportable WFD surface water body or non-WFD surface water body. WFD groundwater body (or part thereof) with overall Good status. Class 2 – 5 peat soils.
	Water use supporting human health and economic activity at a local scale.	Water use	CAR-licensed non-public surface water and groundwater supply abstraction (and associated groundwater catchment) e.g. industrial process water or permitted discharge. Unlicensed potable surface water and groundwater abstraction (and associated catchment) e.g. private domestic water supply, well, spring or permitted discharge.
	Features with a medium vulnerability to flooding.	Flood risk	Land use type defined as ‘Highly Vulnerable Use’ in SEPA (2018) flood risk land use vulnerability classification e.g. most types of residential development, hostels and hotels, landfill and waste management facilities.
Low	Features with a low yield, quality or rarity, with some potential for substitution.	Aquatic and geological environment	Conditions supporting a site with a local conservation designation i.e. Geological Conservation Review (GCR) site, where the designation is based specifically on aquatic and geological (including peat) features, or an undesignated but highly / moderately water-dependent ecosystem, including a GWDTE. WFD surface water body (or part thereof) with overall Moderate or lower status / potential, also any associated upstream non-reportable WFD

Sensitivity	Criteria	Receptor Type	Examples
			surface water body or non-WFD surface water body. Groundwater body (or part thereof) with overall Poor status.
	Water use supporting human health and economic activity at household / individual business scale.	Water use	Unlicensed non-potable surface water and groundwater abstraction (and associated catchment) e.g. livestock supply.
	Features with a low vulnerability to flooding.	Flood risk	Land use type defined as 'Least Vulnerable' in SEPA (2018) flood risk land use vulnerability classification e.g. most types of business premises.
Very Low	Commonplace features with very low yield or quality with good potential for substitution.	Aquatic and geological environment	Conditions supporting an undesignated and low water-dependent ecosystem, including a GWDTE, ancient woodland and pond. Non-reportable WFD surface water body (or part thereof), or non-WFD surface water body, not associated with any downstream WFD surface water body. Non-reportable WFD groundwater body (or part thereof), or non-WFD groundwater body including non-abstraction springs.
	Water use does not support human health, and of only limited economic benefit.	Water use	Unlicensed well shown on OS mapping.
	Features that are resilient to flooding.	Flood risk	Land use type defined as 'Water-compatible use' in SEPA (2018) flood risk land use vulnerability classification and undeveloped land e.g. flood control infrastructure; water transmission infrastructure.

**Receptor types map onto the Table 8.3 receptor lists as follows:*

- aquatic and geological environment – refers to aquifers and WFD groundwater bodies, watercourses and WFD surface water bodies, conditions supporting designated conservation sites and GWDTEs, GCR sites and Class 1 – 3 peat soils;

- water use – refers to springs, abstractions; and

- flood risk – refers to humans, properties and infrastructure.

8.4.9. The magnitude of change on the receptors is independent of the value of the receptor, and its assessment is semi-quantitative and again reliant, in part, on professional judgment. Table 8. provides examples of how various levels of change have been determined with respect to water features.

Table 8.4: Magnitude of Change

Magnitude	Criteria	Receptor Type	Example
High	Results in major change to feature, of sufficient magnitude to affect its use / integrity.	Aquatic and geological environment	Deterioration in river flow regime, morphology or water quality, leading to sustained, permanent or long-term breach of relevant conservation objectives (COs) or non-temporary downgrading (deterioration) of WFD surface water body status (including downgrading of individual WFD elements) or dependent receptors (including conservation sites), or resulting in the inability of the surface water body to attain Good status in line with the measures identified in the River Basin Management Plan (RBMP). Deterioration in groundwater levels, flows or water quality, leading to non-temporary downgrading of status of WFD groundwater body or dependent receptors (including conservation sites and GWDTEs), or the inability of the groundwater body to attain Good status in line with the measures identified in the RBMP. Disturbance of geology leading to non-temporary downgrading of status of GCR site or Class 1 – 3 peat soils.
		Water Use	Complete or severely reduced water availability and / or quality, compromising the ability of water users to abstract.
		Flood risk	Change in flood risk resulting in potential loss of life or major damage to the property or infrastructure.
Medium	Results in noticeable change to feature, of sufficient magnitude to affect its use / integrity in some circumstances.	Aquatic and geological environment	Deterioration in river flow regime, morphology or water quality, leading to periodic, short-term and reversible breaches of relevant COs, or potential temporary downgrading of surface water body status (including potential temporary downgrading of individual WFD elements), or dependent receptors (including conservation sites), although

Magnitude	Criteria	Receptor Type	Example
			not affecting the ability of the surface water body to achieve future WFD objectives. Deterioration in groundwater levels, flows or water quality, leading to potential temporary downgrading of status of WFD groundwater body or dependent receptors (including conservation sites and GWDTEs), although not affecting the ability of the groundwater body to achieve future WFD objectives. Disturbance of geology leading to potential temporary downgrading of status of GCR site or Class 1 – 3 peat soils.
		Water use	Moderate reduction in water availability and / or quality, which may compromise the ability of the water user to abstract on a temporary basis or for limited periods, with no longer-term impact on the purpose for which the water is used.
		Flood risk	Change in flood risk resulting in potential for moderate damage to the property or infrastructure.
Low	Results in minor change to feature, with insufficient magnitude to affect its use / integrity in most circumstances.	Aquatic and geological environment	Slight change in river flow regime or water quality, but remaining generally within COs, and with no short-term or permanent change to WFD surface water body status (of overall status or element status) or dependent receptors (including conservation sites). Slight deterioration in groundwater levels, flows or water quality, but with no short-term or permanent downgrading of status of WFD groundwater body or dependent receptors (including conservation sites and GWDTEs). Slight disturbance of geology but no consequences in terms of status of GCR site or Class 1 – 3 peat soils.
		Water use	Minor reduction in water availability and / or quality, but unlikely to affect the ability of a water user to abstract.
		Flood risk	Change in flood risk resulting in potential for minor damage to property or infrastructure.
Negligible	Results in little or no change to feature, with insufficient magnitude to affect its use / integrity	Aquatic and geological environment	None or very slight change in river flow regime or water quality, and no consequences in terms of COs or surface water body status or dependent receptors (including conservation sites).

8.4.10. The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 require that an overall judgement is made on the nature of the receptor (sensitivity) and the likely change (magnitude) resulting from the Proposed Development. The criteria are semi-quantitative and therefore professional judgement is required in the assessment. This judgement is based on evaluations of the individual aspects of value, susceptibility, size and scale, geographical extent, duration and reversibility. There are four main levels of hydrological effect that are used in this EIAR; Major, Moderate, Minor and Negligible. The evaluation of potential effects makes allowance for the use of professional judgement and experience.

8.4.11. In this assessment, effects are significant or not significant according to the matrix in Table 8.5, with those effects considered to be **Major** and some **Moderate** effects by virtue of the more sensitive receptors and the greater magnitude of change, considered to be significant in terms of EIA Regulations. Some **Moderate**, and all **Minor** and **Negligible** effects are considered to be **not significant**. Where a **Moderate** effect is deemed to be not significant, this was decided based on there being **High** receptor sensitivity, but a **Low** magnitude of change, meaning changes to baseline conditions are deemed to be only very little and therefore not significant.

Table 8.5: Significance of Effect

		Magnitude of Change			
		High	**Medium**	**Low**	**Negligible**
Sensitivity	**High**	Major (significant)	Major (significant)	Moderate (Not significant)	Minor (Not significant)
	Medium	Major (significant)	Moderate (Probably significant)	Minor (Not significant)	Negligible (Not significant)
	Low	Moderate (Probably significant)	Minor (Not significant)	Negligible (Not significant)	Negligible (Not significant)
	Very Low	Minor (Not significant)	Negligible (Not significant)	Negligible (Not significant)	Negligible (Not significant)

8.4.12. It should be noted that significant effects need not be unacceptable or necessarily adverse and may be reversible.

8.4.13. Furthermore, it is important to recognise that ‘significant’ effects on receptors in the aquatic environment do not necessarily mean that the same outcomes would occur in respect of the same receptors that may also be ecology receptors. Indeed, because of the different value and magnitude criteria used by the two assessments, it is possible that effects assessed as ‘not significant’ in one environmental topic assessment, e.g. the water environment, can still sit alongside effects assessed as ‘significant’ in another environmental topic assessment, e.g. ecology, and vice-versa.

Assessment of Residual Effects of Significance

8.4.14. As statement of residual effects, following consideration of any further specific mitigation measures where identified, is then given.

8.5. Consultation

8.5.1. The scoping and consultation responses relating to the hydrological, geological, and hydrogeological environment are summarised in Table 8.6.

Table 8.6: List of Consultee Responses Relating to Hydrology

Consultee	Scoping Response	Addressed in EIAR
EAC	In terms of flood risk, any potential for the release of water from peat excavation should be considered as a potential cause of flooding.	In Section 8.6 under the subheading Flood Risk, the existing flood risk of the Proposed Development Area and downstream has been detailed. Within Section 8.9 and 8.10, mitigation measures have been proposed to address any risk of increased flood risk as a result of excavation and other construction activities.
	In terms of any borrow pits, if these are taken forward as part of the proposed development, the EIA Report should include information on the location, size and nature of these borrow pits, including details of the depth of the borrow pit floor and an indicative borrow pit final reinstated profile. The impact of such features (including dust, blasting and impacts on hydrology) should be appraised as part of the overall impact of the proposal. Information on the proposed depth of excavations compared to the actual topography, the proposed restoration profile, proposed drainage and settlement traps, turf and overburden removal and storage for reinstatement should be included within the EIA Report. The Council's Minerals Local Development Plan includes a policy on borrow pits and information to address the requirements set out within that policy should form part of the EIA Report.	Details relating to the borrow pit can be found in Volume 1 Chapter 3: Project Description. The impact on hydrology can be found in Section 8.10 with the mitigation measures outlined in Section 8.9.
	The Council has also recently adopted new non-statutory guidance - Peat, excess soils and sewage sludge, which will be relevant to the proposed development.	Section 8.3 under the subheading Regional and Local Policy, the Minerals Local Development Plan has been referenced which contains
		Chapter 5: Conserving and enhancing the natural and built environment.
	The relevant fisheries boards should be consulted to discuss their expectations and requirements regarding the extent of hydrological assessment required to inform the assessment of hydrological impacts, including water quality impacts, which also links to the potential ecological impacts on aquatic life.	Both the Galloway Fisheries Trust and Nith District Salmon Fishery Board were consulted to inform this assessment. Details relating to their scoping response and how it has been addressed can be found later within this table.
	The application site features areas identified within the Coal Authority Mining Risk Assessment and the Coal Authority should be consulted to ascertain the scope of methodology and assessment required to address any potential risks for reporting in the EIA Report. The Planning Authority would also rely on detailed comments on such matters from NatureScot, SEPA and the Scottish Government's advisors on peat, Ironside Farrar Ltd. These bodies would be able to advise further on the appropriateness of the methodologies reported.	The Coal Authority were consulted for a Scoping Response, however it was concluded by the Coal Authority that the Proposed Development is situated in an area defined as low risk. This removed the requirement for a Coal Mining Risk Assessment by the Coal Authority.
NatureScot	The Scoping Report recognises that peat is present in the area of the proposed development site. This includes areas that are mapped as Class 1 peat on the Carbon & Peatland Map 2016. Class 1 areas are nationally important carbon-rich soils, deep peat and priority peatland habitat and are likely to be of high conservation value.	Within Section 8.6. under subheading Soils and Peat, details relating to the existing peat conditions can be found. This includes details relating to the peat depth surveys which is also presented in Figure 8.4: Interpolated Peat Depth, Volume 2a.
	While Scottish Planning Policy identifies such areas as 'areas of significant protection', the location of the proposal in the mapped area does not, in itself, mean that the proposal is unacceptable, or that carbon rich soils, deep peat and priority peatland habitat will be adversely affected. However the applicant will need to demonstrate in the EIA Report that any significant effects on the qualities of the area can be substantially overcome by siting, design or other mitigation.	It is noted that since Scoping Response, SPP has been replaced by NPF4. In Section 8.8 under subheading Avoidance of Deep Peat Deposits, the average peat depths have been presented in Table 8.20 that show the existing peat conditions are each proposed infrastructure element.
	The Carbon and Peatland Map 2016 is a strategic tool based on historical habitat and peat depth information. It is for the applicant to carry	Additionally, Section 8.9 presents a suite of mitigation measures that can be used to mitigate any impact on peatland.

Consultee	Scoping Response	Addressed in EIAR
	out relevant surveys to provide contemporary, site-specific information on the location of the different peat classes to inform site management. We therefore welcome the applicant having carried out peat probing work to date, and the proposal to carry out further site survey work to confirm the presence and depth of peat within the site. To inform the assessment of impacts and identification of appropriate mitigation, we advise that detailed peat surveys of the site, measuring the peat deposit to full depth, should be undertaken in accordance with Scottish Government guidance. The results should also be used to inform a peat slide assessment and peat management plan. We recommend early engagement with SEPA with regard to excavated peat reuse and disposal. The final siting and design of the proposed development and how this may affect peatland must be fully described and assessed in the EIA Report. How significant effects will be mitigated must also be fully described. At this stage, given the general dominance of commercial forestry within the site, we would encourage the applicant to consider the relocation of Turbine 6 from Class 1 peat soil to a less sensitive area.	To support this Proposed Development, Technical Appendix 8.1: Peat Management Plan and Technical Appendix 8.3: Peat Slide Risk Assessment, Volume 3 have been produced. For details relating to design and siting, Chapter 2: Site Selection and Design Evolution presents the process in which the final design was decided. There are currently no turbines or associated infrastructure located on Class 1 peat soil, with Turbine 6 now located in Class 5.
	Muirkirk Uplands SSSI and North Lowther Uplands SSSI are both of national importance. The designated features of Muirkirk Uplands SSSI comprise ornithology interests and blanket bog. The designated features of North Lowther Uplands SSSI comprise ornithology interests, fossil bearing rocks and upland habitats. The proposed development is out with the boundary of either SSSI and therefore we do not consider that the upland habitats/blanket bog or ecological interests of the site will be affected by the proposal, nor do we consider the ornithological interests of the SSSI will be affected for the reasons detailed in the SPA section above. Therefore we are satisfied that these sites do not require further consideration and can be scoped out of the EIA.	The Muirkirk Uplands SSSI and North Lowther Uplands SSSI have been scoped out of the assessment.
	Merrick Kells Site of Special Scientific Interest and Special Area of Conservation (SAC) Merrick Kells is designated as a SSSI for its invertebrate interests, blanket bog habitat and breeding bird assemblage. We consider that the notified features of the SSSI are unlikely to be affected by the proposal given the separation distance from the proposed development site. Merrick Kells is also designated as an SAC for its freshwater and upland habitats. We consider that the qualifying interests of the SAC are unlikely to be affected by the proposal given the separation distance from the proposed development site.	The Merrick Kells SSSI and SAC has been scoped out of the assessment.
SEPA	We consider that the following key issues must be addressed in the Environmental Impact Assessment process: a) Map and assessment of impacts upon Groundwater Dependent Terrestrial Ecosystems and buffers. b) Peat depth survey and table detailing re-use proposals. c) Map and site layout of borrow pits. d) Schedule of mitigation including pollution prevention measures. e) Decommissioning statement. Further details on these information requirements and the form in which they must be submitted can be found in the attached appendix. We also provide site specific EIA scoping and pre-application layout comments below which can help the developer focus the scope of the assessment and development of the proposals.	Please find below the details relating to the listed response by SEPA relative to the order provided: a) Details relating to GWDTE can be found in Section 8.6 under subheading Groundwater Dependent Terrestrial Ecosystems with Figure 8.1: Hydrological Overview, Volume 2a showing the location of the potential GWDTE. b) See Section 8.6 under subheading Soils and Peat for details relating to existing peat conditions. Technical Appendix 8.1: Peat Management Plan has also been provided that details re-use proposals. c) Figure 1.1: Site Layout, Volume 2a shows the location of the borrow pit relative to the Proposed Development Area. d) Within Section 8.9, mitigation measures have been provided that relate to the hydrological environment. e) Decommissioning considered in Section 8.14.

Consultee	Scoping Response	Addressed in EIAR
	We thank the developer for including the Phase 1 habitat information that has already been collected. Should new development be proposed within 250m of any of the habitats that are potentially groundwater dependant then section 4 of the appendix should be followed.	See Section 8.6 under subheading Groundwater Dependent Terrestrial Ecosystems for details relating to potential GWDTE habitats.
	We emphasise the need for good peat probing information in all areas where new infrastructure is proposed, including areas currently forested. We are happy to provide further advice on layout once the phase 1 peat probing has been completed and there is a clear idea of track layout.	A phase 2 peat depth survey was carried out in accordance with relevant guidance. Details can be found in Section 8.6 under subheading Soils and Peat.
	A peatland quality survey should also be provided for those areas of unforested peatland where development is currently proposed; T3, T6 and T14 may need to be moved.	An outline Ecological Management Plan (EMP) and Habitat Management Plan (HMP) to restore bog habitats has been considered in Chapter 6: Ecology. A peatland quality survey was not undertaken as the proposed development area is dominated by commercial forestry. This land use results in the presence of artificial drainage ditches that has degraded the peat.
	Any search areas for borrow pits must avoid areas of deep peat, groundwater dependant habitats and be at least 50 m from watercourses.	It is currently proposed to use an existing borrow pit/quarry area. This can be viewed in Figure 8.1: Hydrological Overview, Volume 2a that shows the proposed layout and this borrow pit with watercourses and 50 m buffers presented. See Section 8.8 under subheading Watercourse Buffer Zones that discuss the distance between this borrow pit and the nearest watercourse.
	Provided watercourse crossings are designed as oversized bottomless arched culverts or traditional style bridges, and other infrastructure is located well away from watercourses we do not foresee from current information a need for detailed information on flood risk or watercourse crossings.	See Technical Appendix 8.2: Watercourse Crossing Assessment, Volume 3 for details relating to watercourse crossing designs.
	We welcome the proposal to include a 50m buffer between watercourses and excavation works; we note that T13 and T16 may need to be relocated to meet this requirement. Remember also to take into consideration smaller watercourse not shown on the 1:50000 mapping.	See Section 8.8 under subheading Watercourse Buffer Zones that discuss the distance between each infrastructure element and the nearest watercourse.
	The site layout must be designed to avoid impacts upon the water environment. Where activities such as watercourse crossings, watercourse diversions or other engineering activities in or impacting on the water environment cannot be avoided then the submission must include justification of this and a map showing: a) All proposed temporary or permanent infrastructure overlain with all lochs and watercourses. b) A minimum buffer of 50m around each loch or watercourse. If this minimum buffer cannot be achieved each breach must be numbered on a plan with an associated photograph of the location, dimensions of the loch or watercourse and drawings of what is proposed in terms of engineering works. c) Detailed layout of all proposed mitigation including all cut off drains, location, number and size of settlement ponds.	See Figure 8.1: Hydrological Overview, Volume 2a that shows the proposed layout with watercourses and 50 m buffers presented. See Section 8.8 under subheading Watercourse Buffer Zones that discuss the distance between each infrastructure element and the nearest watercourse. Detailed layout of all proposed mitigation is not available at this phase of the Proposed Development, however any detailed mitigation layout will be discussed with SEPA and any relevant authorities prior to construction.
	If water abstractions or dewatering are proposed, a table of volumes and timings of groundwater abstractions and related mitigation measures must be provided.	Details relating to any proposed water abstractions and dewatering are not available at this stage. However, there is a commitment that details will be discussed with SEPA prior to construction. Mitigation measures for dewatering can be found in Section 8.9 under subheading Pumping and Dewatering of Excavations.
	Further advice and our best practice guidance are available within the water engineering section of our website. Guidance on the design of water crossings can be found in our Construction of River Crossings Good Practice Guide.	See Technical Appendix 8.2: Watercourse Crossing Assessment, Volume 3 for details relating to watercourse crossing designs.

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	Refer to our flood risk Standing Advice for advice on flood risk. Watercourse crossings must be designed to accommodate the 0.5% Annual Exceedance Probability (AEP) flows, or information provided to justify smaller structures. If it is thought that the development could result in an increased risk of flooding to a nearby receptor then a Flood Risk Assessment must be submitted in support of the planning application. Our Technical flood risk guidance for stakeholders outlines the information we require to be submitted as part of a Flood Risk Assessment. Please also refer to Controlled Activities Regulations (CAR) Flood Risk Standing Advice for Engineering, Discharge and Impoundment Activities.	See Technical Appendix 8.2: Watercourse Crossing Assessment, Volume 3 for details relating to watercourse crossing designs. Flood risk has been considered as part of the assessment with details found in Section 8.6 under subheading Flood Risk with proposed mitigation measures presented in Section 8.9.
	Scottish Planning Policy states (Paragraph 205) that "Where peat and other carbon rich soils are present, applicants must assess the likely effects of development on carbon dioxide (CO_2) emissions. Where peatland is drained or otherwise disturbed, there is liable to be a release of CO_2 to the atmosphere. Developments must aim to minimise this release."	It is noted that since Scoping Response, SPP has been replaced by NPF4.
	The planning submission must a) demonstrate how the layout has been designed to minimise disturbance of peat and consequential release of CO_2 and b) outline the preventative/mitigation measures to avoid significant drying or oxidation of peat through, for example, the construction of access tracks, drainage channels, cable trenches, or the storage and re-use of excavated peat. There is often less environmental impact from localised temporary storage and reuse rather than movement to large central peat storage areas.	For details relating to design and siting, Chapter 2: Site Selection and Design Evolution will present the process in which the final design was decided. Mitigation measures relating to peat can be found in Technical Appendix 8.1: Peat Management Plan.
	The submission must include: a) A detailed map of peat depths (this must be to full depth and follow the survey requirement of the Scottish Government's Guidance on Developments on Peatland - Peatland Survey (2017)) with all the built elements (including peat storage areas) overlain to demonstrate how the development avoids areas of deep peat and other sensitive receptors such as Groundwater Dependent Terrestrial Ecosystems. b) A table which details the quantities of acrotelmic, catotelmic and amorphous peat which will be excavated for each element and where it will be re-used during reinstatement. Details of the proposed widths and depths of peat to be re-used and how it will be kept wet permanently must be included.	See Section 8.6 under subheading Soils and Peat for details relating to existing peat conditions. Technical Appendix 8.1: Peat Management Plan features volumes for peat excavation and re-use with a breakdown for both acrotelmic and catotelmic peat.
	To avoid delay and potential objection proposals must be in accordance with Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and Minimisation of Waste and our Developments on Peat and Off-Site uses of Waste Peat.	See Technical Appendix 8.1: Peat Management Plan that details the approach to peat volumes (both excavation and re-use).
	Dependent upon the volumes of peat likely to be encountered and the scale of the development, applicants must consider whether a full Peat Management Plan (as detailed in the above guidance) is required or whether the above information would be best submitted as part of the schedule of mitigation. Please note we do not validate carbon balance assessments except where requested to by Scottish Government in exceptional circumstances. Our advice on the minimisation of peat disturbance and peatland restoration may need to be taken into account when you consider such assessments.	See Technical Appendix 8.1: Peat Management Plan that details the approach to peat volumes (both excavation and re-use).
	GWDTE are protected under the Water Framework Directive and therefore the layout and design of the development must avoid impact on such areas. The following information must be included in the submission: a) A map demonstrating that all GWDTE are outwith a 100m radius of all excavations shallower than 1m and outwith 250m of all excavations deeper than 1m and proposed groundwater abstractions. If micro-siting is to be considered as a mitigation measure the distance of survey needs to be extended by the proposed maximum extent of micro-siting. The survey	Details relating to GWDTE can be found in Section 8.6 under subheading Groundwater Dependent Terrestrial Ecosystems with Figure 8.7 showing the location of the potential GWDTE.

Consultee	Scoping Response	Addressed in EIAR
	needs to extend beyond the site boundary where the distances require it. b) If the minimum buffers above cannot be achieved, a detailed site specific qualitative and/or quantitative risk assessment will be required. We are likely to seek conditions securing appropriate mitigation for all GWDTE affected.	
	Please refer to Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems for further advice and the minimum information we require to be submitted. Excavations and other construction works can disrupt groundwater flow and impact on existing groundwater abstractions. The submission must include: a) A map demonstrating that all existing groundwater abstractions are outwith a 100m radius of all excavations shallower than 1m and outwith 250m of all excavations deeper than 1m and proposed groundwater abstractions. If micro-siting is to be considered as a mitigation measure the distance of survey needs to be extended by the proposed maximum extent of micro-siting. The survey needs to extend beyond the site boundary where the distances require it. b) If the minimum buffers above cannot be achieved, a detailed site specific qualitative and/or quantitative risk assessment will be required. We are likely to seek conditions securing appropriate mitigation for all existing groundwater abstractions affected.	Details relating to GWDTE can be found in Section 8.6 under subheading Groundwater Dependent Terrestrial Ecosystems with Figure 8.7 Potential Ground Water Dependant Terrestrial Ecosystems Volume 2a showing the location of the potential GWDTE.
	Please refer to Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems for further advice on the minimum information we require to be submitted.	Details relating to GWDTE can be found in Section 8.6 under subheading Groundwater Dependent Terrestrial Ecosystems with Figure 8.7 Potential Ground Water Dependant Terrestrial Ecosystems Volume 2a showing the location of the potential GWDTE.

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	One of our key interests in relation to developments is pollution prevention measures during the periods of construction, operation, maintenance, demolition and restoration. A schedule of mitigation supported by the above site specific maps and plans must be submitted. These must include reference to best practice pollution prevention and construction techniques (for example, limiting the maximum area to be stripped of soils at any one time) and regulatory requirements. They should set out the daily responsibilities of ECOWs, how site inspections will be recorded and acted upon and proposals for a planning monitoring enforcement officer. Please refer to Guidance for Pollution Prevention (GPPs).	
Ayrshire Road Alliance	It is noted that flood information provided by SEPA indicates that within the Proposed Development area there is a risk of flooding in the Cumnock Burn/Linn Water, Mossdale Burn, Pochriegavin Burn and River Nith catchments. We welcome the commitment to undertake a Flood Risk Assessment as part of a forthcoming planning application, and will review its contents in due course.	Flood risk has been considered as part of this assessment and is detailed in Section 8.6 under subheading Flood Risk.
Galloway Fisheries Trust	Any new water course crossing must ensure fish access is protected. If instream works are planned in a watercourse supporting trout then such works should avoid taking place between October – May to protect spawning redds. Also a fish rescue by electrofishing should take place prior to instream works in fish supporting water courses.	See Technical Appendix 8.2: Watercourse Crossing Assessment, Volume 3 for details relating to watercourse crossing designs. Chapter 6: Ecology Volume 1 provides further information relating to fish.
Nith District Salmon Fishery Board	There are some additional watercourses that it will be necessary to survey in relation to the South Kyle II proposals. These watercourses will need to be surveyed as part of the monitoring requirements for the South Kyle II project. Knockenlee Burn two sites (253512 609171) and (253181 608839); Peddinnan Burn one site (253979 608357); Polmath Burn one site (254436 609948); River Nith one site (253866 611246);	See Technical Appendix 8.2: Watercourse Crossing Assessment, Volume 3 for details relating to watercourse crossing designs. Figure 8.1: Hydrological Overview, Volume 2a also shows the location of watercourse crossings required for the Proposed Development.

Consultee	Scoping Response	Addressed in EIAR
	Knockburnie Burn one site (256266 610394).	
Scottish Water	A review of our records indicates that the proposed activity falls partly within a drinking water catchment where a Scottish Water abstraction is located. Scottish Water abstractions are designated as Drinking Water Protected Areas (DWPA) under Article 7 of the Water Framework Directive. Carsfad Reservoir supplies Lochinvar Water Treatment Works (WTW) and it is essential that water quality and water quantity in the area are protected. In the event of an incident occurring that could affect Scottish Water we should be notified immediately using the Customer Helpline number 0800 0778 778. The activity is a sufficient distance from our intake that it is likely to be of low risk to water quality. Only turbines 3, 11, 14 and 15 are within the catchment and it may be advisable to consider if these can or should be moved out with the catchment. Scottish Water have produced a list of precautions for a range of activities. This details protection measures to be taken within a DWPA, the wider drinking water catchment and if there are assets in the area. Please note that site specific risks and mitigation measures will require to be assessed and implemented. These documents and other supporting information can be found on the activities within our catchments page of our website at www.scottishwater.co.uk/slm We welcome receipt of this notification about the proposed activity within a drinking water catchment where a Scottish Water abstraction is located. The fact that this area is located within a drinking water catchment should be noted in future documentation. Also, anyone working on site should be made aware of this during site inductions. We would request further involvement at the more detailed design stages, to determine the most appropriate proposals and mitigation within the catchment to protect water quality and quantity. For reasons of sustainability and to protect our customers from potential future sewer flooding, Scottish Water will not accept any surface water connections into our combined sewer system. There may be limited exceptional circumstances where we would allow such a connection for brownfield sites only, however this will require significant justification from the customer taking account of various factors including legal, physical, and technical challenges. In order to avoid costs and delays where a surface water discharge to our combined sewer system is anticipated, the developer should contact Scottish Water at the earliest opportunity with strong evidence to support the intended drainage plan prior to making a connection request. We will assess this evidence in a robust manner and provide a decision that reflects the best option from environmental and customer perspectives.	See Section 8.4 under subheading Impacts Scoped Out of the Assessment for details relating to the Carsfad reservoir. The Proposed Development is approximately 15 km (point-to-point) which is a conservative estimate as it does not consider the length of the watercourse which would be greater due to meanders etc. Therefore, the significant distance would feature a dilution effect that would only feature negligible effect on the Carsfad reservoir. With the implementation of the mitigation measures outlined in Section 8.9, it is concluded that this DWPA would be unaffected by the Proposed Development. There are no proposed connections into the sewer system. However, if this was to change, Scottish Water would be consulted on any proposals.

8.6. Baseline

8.6.1. This section characterises the local hydrological, geological and hydrogeological environment so that the likely effects of the Proposed Development can be determined and appropriate mitigation identified. It also provides the point of reference against which the success of the adopted mitigation measures can be assessed.

8.6.2. The following description is based on the desk study utilising the data sources listed in Table 8.2.

Site Area

8.6.3. The Proposed Development (Figure 8.1, Volume 2a) includes eleven wind turbines (up to 200 m tip height) and associated foundations, on-site access tracks, crane hardstands, substation, electrical infrastructure, a temporary construction compound and borrow pit. Further details of the Proposed Development infrastructure is presented in Chapter 3: Project Description, Volume 1.

8.6.4. The Proposed Development is located to the east of Dalmellington and south-west of New Cumnock. The infrastructure is located across multiple hills, such as Benbrack and Clawfin Hill, with the max topographical height of the Proposed Development being 516 m with the Proposed Development Area spanning 21.8 hectares. The north-western edge of the Proposed Development Site is bound by the B741 with the southern extent consisting of other wind farm developments, including the South Kyle Wind Farm development.

Site Investigations

8.6.5. The phase 1 peat depth surveys and hydrological walkover were undertaken in August 2022, December 2022 and June to August 2023 which informed the feasibility and scoping assessments. Detailed phase 2 peat depth surveys were carried out in April 2024 with further hydrological surveys taking place following design freeze.

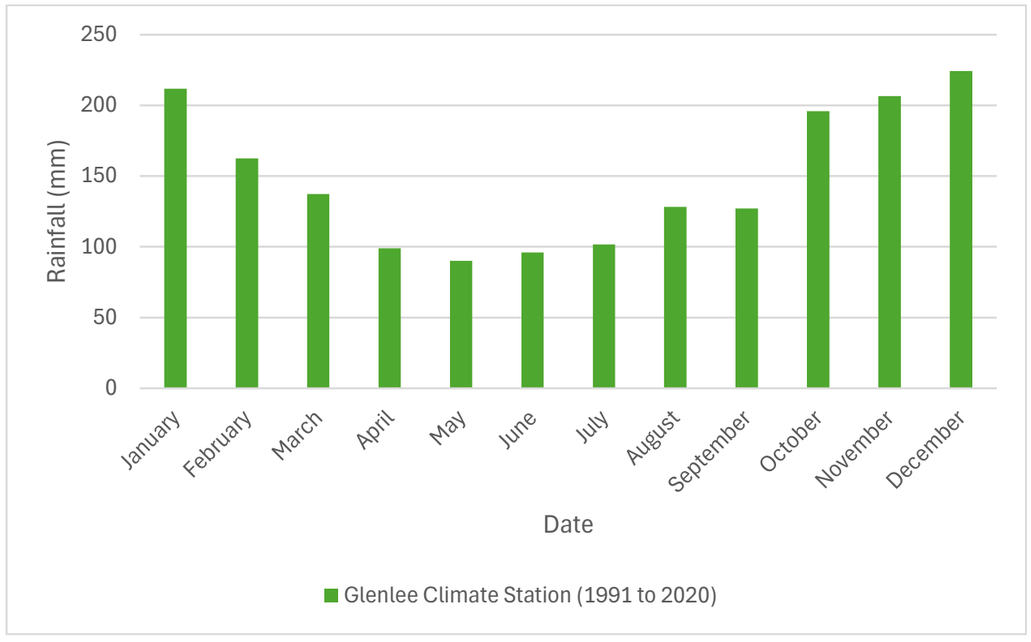
Climate

8.6.6. The standard average annual rainfall (SAAR) for the Proposed Development has been derived from the UK SuDS website[1] as approximately 1525 mm. To put this into context, rainfall in Scotland varies from under 800 mm a year on mainland Eastern Scotland in areas such as Fife to over 3000 mm on the mainland Western Highlands.

8.6.7. The Met Office 1991-2020 average annual rainfall total from the Glenlee Climate Station[2] (55 metres Above Ordnance Datum; mAOD) is 1780.61 mm with an average of 186.42 days of rainfall days greater than 1 mm recorded. The Glenlee Climate Station is positioned approximately 26 km to the south of the Proposed Development.

8.6.8. The highest rainfall totals, as shown in Graph 8.1., are typically experienced during the winter months with summer months reflecting a drier season. From October to February, the monthly rainfalls totals are greater than 150 mm. The lowest rainfall total occurs in May with only 90.15 mm recorded.

Source: Met Office (2024)



Graph 8.1: Average Monthly Rainfall Data for Climate Period 1991 to 2020: Glenlee Climate Station

Conservation Sites

8.6.9. There are five designated conservation sites of hydrological interest within 3 km of the Proposed Development. Their locations in relation to the Proposed Development are presented in Figure 8.1, Volume 2a and the details of each site, including their qualifying interests are presented in Table 8.7.

8.6.10. Benbeoch, Dalmellington Moss, Bogton Loch, Ness Glen and Loch Doon are designated as Sites of Special Scientific Interest (SSSI). Additionally, Benbeoch is classed a Geological Conservation Review (GCR) Site.

Table 8.7: Hydrological Designated Sites Within 3 km

Site	Designation	Distance from Proposed Development	Qualifying Feature	NGR
Benbeoch	SSSI / GCR	1.3 km	Geological: Igneous Petrology: Carboniferous-Permian Igneous.	NS 49348 08298
Dalmellington Moss	SSSI	1.4 km	Raised bog.	NS 46450 06429
Bogton Loch	SSSI	1.4 km	Breeding bird assemblage. Open water transition fen.	NS 46871 05381
Loch Doon	SSSI	2.1 km	Arctic charr.	NX 49883 99366
Ness Glen	SSSI	2.7 km	Atlantic woodland bryophyte assemblage. Upland mixed ash woodland.	NS 47713 02054

Source: NatureScot (2024)

Surface Water Hydrology

8.6.11. Hydrologically, the Proposed Development lies within the watershed of the River Doon, River Nith, and the River Dee. Figure 8.1, Volume 2a shows a hydrological overview of the Proposed Development that highlights the watercourses draining the Proposed Development Area and the associated main catchments.

River Doon Catchment

8.6.12. The River Doon catchment is the largest catchment within the Proposed Development Area with two primary watercourses known as the Mossdale Burn and the Linn Water that both feature multiple tributaries.

8.6.13. The source of Mossdale Burn is located at grid reference NS 52327 06186 and flows in a south-westerly direction where it connects to Muck Water at grid reference NS 49292 04079. There are multiple tributaries of the Mossdale Burn, this includes the Benbrack Burn (NS 51973 05860) which flows in a north-westerly direction from the Benbrack hill.

8.6.14. Additionally, the Sheil Burn acts a tributary to the Mossdale Burn and connects at grid reference NS 51046 05577 whilst flowing parallel to the Benbrack Burn. The source of Sheil Burn is situated from the slopes Slown's Cairn and Windy Standard with Black Burn and Harthorn Burn supplying the Sheil Burn.

[1] HR Wallingford (2024) UK SuDS [Online] Available from https://www.uksuds.com/ (Accessed 08/07/2024)

[2] Met Office (2024) UK Climate Averages [Online] Available from https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gcv12y3xn (Accessed 26/03/2024)

8.6.15. Mossdale Burn flows into the Corbie Craig Reservoir at grid reference NS 50139 04744 then extends to the Muck Water, with Trough Burn acting as a tributary prior to the Muck Water confluence point. However, the Trough Burn is sourced outwith the Proposed Development Area and runs parallel to the South West Scotland Overhead Transmission Line.

8.6.16. Muck Water flows in a north-westerly direction alongside the town of Dalmellington where it becomes the River Doon at grid reference NS 46100 06277. The Linn Water flows in a south-westerly direction where it connects to the Cumnock Burn. The Cumnock Burn converges with the Muck Water at NS 46700 06128 where it also becomes the River Doon.

8.6.17. The Linn Water source is located near the summit of Benbrack (approximately 495 m AOD) and flows primarily in a south western direction with multiple unnamed tributaries. Its confluence point with the Muck Water is at NS 46716 06124, with the watercourse changing name from Linn Water to Cumnock Burn as it flows through the town of Dalmellington. Along the Linn Water, there are a number of named watercourses, such as Bubbly Burn, Stony Burn, Red Cleuch Burn and White Burn, that feature catchments within the Proposed Development Area.

8.6.18. The River Doon features a catchment area of approximately 322 km^2 and a river length of 63 km.

River Nith Catchment

8.6.19. The River Nith is situated to the eastern extent of the Proposed Development Area with the source of the River Nith flowing between the Drumbrush Rig and Logan Hill. The River Nith flows in a northern direction with multiple tributaries within the Proposed Development Area, such as Loup Burn, Powkelly Burn, Peddinnan Burn and other unnamed watercourses. In addition, the Knockenlee Burn joins with the River Nith outside of the Proposed Development Area with the confluence point at grid reference NS 53700 09238.

8.6.20. The River Nith features a catchment area of approximately 1115 km^2 and a river length of 113 km.

River Dee Catchment

8.6.21. The River Dee is situated to the southern extent of the Proposed Development Area, primarily the area associated with the southern access route. The named watercourses draining the Proposed Development in the River Dee catchment is the Prickeny Burn, Pougherygown Burn, Stonecross Burn, Pochriegavin Burn, Saugh Gutter, Black Burn, Murray's Burn and Brownhill Burn. There are a number of unnamed watercourses, however all of which act as tributaries of the Water of Deugh.

8.6.22. Furthermore, the primary watercourse is the Pochiegavin Burn that features Pougherygown Burn, Stonecross Burn, Prickeny Burn and the Saugh Gutter as tributaries. Pochiegavin Burn flows in an easterly direction where it connects to the Water of Deugh at grid reference NS 56793 03575.

8.6.23. Black Burn is located to the east of the southern access route, at grid reference NS 54773 02592, and flows in an easterly direction to the Water of Deugh.

8.6.24. Murray's Burn is sourced to the north of the southern access route from the slopes of Birny Hill and slows southernly where it joins the Brownhill Burn at grid reference NS 54448 01654.

8.6.25. As stated previously, these watercourses are within the catchment of the River Dee which is approximately 900 km^2 with a river length of 61 km. The River Dee flows in a south-easterly direction where it connects to the Solway Firth.

Hydrological Regime

Effects of Forestry

8.6.26. The majority of the Site is dominated by commercial forestry, with lower reaches of the main catchments dominated mostly by open moorland.

8.6.27. Areas of existing mature commercial forestry help to attenuate peak flows due to the interception of precipitation by the closed canopy. Research into the effects on the hydrological regime of catchments suggests that forestry practices can have impacts on peak flows, and water quality.

8.6.28. The large areas of closed canopy also potentially help to attenuate peak flows and reduce downstream flood risk in the wider catchment. It can be concluded that due to the age and density of the existing forestry, flows are likely to have reduced since the initial installation of the drainage channels and subsequent maturation of the forestry.

8.6.29. Other effects of afforestation relate to water quality. Scavenging of atmospheric nitrogen and sulphur by trees can contribute to water course acidification.

Flood Risk

Fluvial Flood Sources

8.6.30. Flood information available on the SEPA Flood Map[3] indicates that the fluvial flood risk is of high likelihood (10% chance of flooding each year) along the River Nith, Linn Water, Mossdale Burn, Pochriegavin Burn and the Water of Deugh. As indicated previously, these are primary watercourses associated with the Proposed Development and feature a number of tributaries that have no mapped flood risk. Nevertheless, the flooding area in these locations are limited to the channel extent and the upland, commercial forestry environment within the respective catchments.

Pluvial Flooding Sources

8.6.31. Across the Proposed Development Area, there are localised pockets of medium and high likelihood (0.5 to 10% chance of flooding each year) pluvial (surface water) flooding on the SEPA Flood Map[3]. However, these are typically in areas between commercial forestry blocks within the Proposed Development Area.

Coastal Flooding Source

8.6.32. The Proposed Development is located approximately 25 km from the nearest coast and, due to this and the topographical elevation of the Proposed Development (>350 m AOD), it would not be affected by tidal flooding.

Groundwater Flooding Sources

8.6.33. Flooding can also result from high groundwater levels if the water table rises above the surface level. Groundwater flooding can occur in a variety of geological settings including river valleys with thick deposits of alluvium and river gravels. Groundwater flooding happens in response to a combination of already high groundwater levels (usually during mid- or late-winter) and intense or unusually lengthy storm events. Such flooding also often lasts much longer than flooding caused by a river over-flowing its banks.

8.6.34. Groundwater flooding is often associated with the shallow unconsolidated sedimentary aquifers that overlie non-aquifers with minimal permeability. Due to the nature of the superficial geology (as discussed below), it is unlikely

[3] SEPA (2024) SEPA Flood Maps [Online] Available at https://map.sepa.org.uk/floodmaps (Accessed 28/03/2024)

that there will be any widespread significant groundwater flooding risk within the site. This is because the superficial deposits across the majority of the Proposed Development Site are of glacial origin which typically has a low hydraulic conductivity. This is further underlain by moderately productive aquifers which have the potential to receive water that they are hydrologically connected to. Therefore, the risk of groundwater flooding within the Proposed Development is likely to be minimal and limited to areas of well-sorted fluvial deposits including alongside watercourses.

8.6.35. Groundwater flooding is difficult to predict as it rarely follows a consistent pattern. The response time between rainfall and groundwater flooding is also relatively long.

Flooding from Artificial Drainage Systems

8.6.36. Existing and previous land use is a combination of the South Kyle Wind Farm Development and commercial forestry. As a result, there are artificial drainage systems associated with these land uses, such as culverts and drainage ditches, which may cause localised flooding through blockages of these drainage systems. It should be noted that the artificial drainage systems associated with the South Kyle Wind Farm Development are newly implemented with the development inaugurated in June 2023. However, the artificial drainage systems associated with the commercial forestry may be more susceptible to flooding due to the condition and effectiveness decreasing with time (i.e. blockages from storm events).

Potentially Vulnerable Area

8.6.37. Dalmellington was identified by SEPA in the Ayrshire Local Plan District[4] as a Candidate Potentially Vulnerable Area (12/19c). This categorisation is based on the risk to people and properties that predominantly comes from the watercourses flowing through the town.

Cumulative Flood Risk

8.6.38. Without appropriate drainage management the Proposed Development has the potential to increase flood risk especially to vulnerable areas downstream by increasing existing runoff and altering the flow regime.

Water Quality

Water Quality WFD Classification

8.6.39. There are multiple watercourses with catchments containing the Proposed Development that have been assigned classifications under SEPA's River Basin Management Plans (RBMP). The RBMP are one of the requirements of the Water Framework Directive (WFD) (2000/60/EC) and are the plans designed for protecting and improving the water environment. The watercourses that feature classifications are the River Nith, Cumnock Water (Linn Water), Muck Water, Pochriegravin Burn, Water of Deugh (downstream of Pochiegravin Burn), River Doon (downstream of Muck Water and Linn Water) and Lane Burn. Lane Burn is not within the Proposed Development Area; however the catchment of the watercourse does run adjacent to the Proposed Development north-easterly extent. Additionally, there are three groundwater bodies underlying the Proposed Development Area, known as the Cumnock, Upper Nithsdale and the South Ayrshire Hill aquifers, that feature classifications. Table 8.8details the classification information for these WFD waterbodies. Current WFD status classifications below are derived from information available within SEPA's Water Classification Hub[5]. The projected status classification are derived from SEPA's Water Environment Hub[6]. Waterbody status classification can be either: High; Good; Moderate; Poor; or Bad.

Table 8.8: WFD Classification of Waterbodies Within or Downstream of the Proposed Development

WFD Water Body	Waterbody ID	Current Overall Status (2022)	Overall Ecology (2022)	Overall Hydrology (2022)	Projected Overall Status (2027)	Long Term Predicted Overall Status
River Nith		Moderate	Moderate	Good	Good	Good
Cumnock Water (Linn Water)	10443	Good	Good	High	Good	Good
Muck Water	10444	Good	Good	High	Good	Good
Pochriegavin Burn	10564	Poor	Poor	High	Good	Good
Water of Deugh (downstream of Pochriegavin Burn)	10563	Poor	Poor	Moderate	Good	Good
River Doon (downstream of Muck Water and Linn Water)	10924	Moderate	Moderate	Moderate	Good	Good
Lane Burn	10613	Good	Good	High	Good	High
Cumnock (GW)	150646	Poor	-	Poor	Poor	Good
South Ayrshire Hills (GW)	150660	Good	-	Good	Good	Good
Upper Nithsdale (GW)	150663	Poor	-	Poor	Good	Good

GW – Groundwater body

Source: SEPA (2022)

Water Resources

Water Resources WFD Classification

8.6.40. The Cumnock Water (Linn Water), Muck Water, Lane Burn, and the South Ayrshire Hills (GW) waterbodies have classification statuses of Good overall which reflect the absence of any pressures with their respective catchments.

8.6.41. The River Nith features a Moderate overall status, primarily due to the modifications to the beds, banks and shores along the watercourse. According to SEPA[6], it is technically infeasible to rectify this issue.

[4] SEPA – Flood Risk Management Strategies: Ayrshire Local Plan District [Online] Available at https://www2.sepa.org.uk/frmstrategies/ayrshire.html#:~:text=Scotland%20has%20been%20separated%20into,cross%20administrative%20and%20institutional%20boundaries. (Accessed 02/09/2024)

[5] SEPA (2022) Water Classification Hub [Online] Available from https://www.sepa.org.uk/data-visualisation/water-classification-hub/ (Accessed 29/03/2024)

[6] SEPA (2022) Water Environment Hub [Online] Available from https://www.sepa.org.uk/data-visualisation/water-environment-hub/ (Accessed: 29/03/2024)

8.6.42. The River Doon also features a Moderate overall status with a similar constraints as physical alterations to the watercourse (attributed to hydroelectricity generation) that impact the ecological environment[6].

8.6.43. The Pochriegavin Burn and the Water of Deugh feature a Poor overall status that is attributed to hydroelectricity generation activities taking place in the watercourse. This provides a barrier to fish and has been labelled technically infeasible by SEPA[6].

8.6.44. The Cumnock groundwater body and the Upper Nithsdale have been classified as Poor overall status which relates to the legacy pollution from previous land uses of mining and quarrying. Although these activities have ceased, there is still an impact on the groundwater bodies[6].

CAR Licenced Activities

8.6.45. SEPA were consulted regarding the presence of CAR licensed abstractions within a 3 km search area from the Proposed Development. As a result, eight abstractions were identified and are presented in Table 8.9.

Table 8.9: CAR Licenced Abstractions

Authorisation No.	Name	Authorisation Date	Category	Activity	NGR	Distance from Proposed Development
CAR/R/1038128	Glenmuck	April 20, 2009	Registration	Abstraction - Hydropower	NS 51240 02131	0.6 km
CAR/L/10844584	Glenmuck	November 22, 2010	Licence	Abstraction - Hydropower	NS 51330 02104	0.6 km
CAR/R/5004053	Benbrack Wind Farm	December 8, 2022	Registration	Engineering - Abstraction and/or Borehole Construction and Operation for a Registration level abstraction	NX 51821 99700	1.5 km
CAR/R/5004442	Enoch Wind Farm	February 14, 2023	Registration	Engineering - Abstraction and/or Borehole Construction and Operation for a Registration level abstraction	NS 56208 06745	1.1 km
CAR/R/5006330	North Kyle Wind Farm	October 24, 2023	Registration	Engineering - Abstraction and/or Borehole Construction and Operation for a Registration level abstraction	NS 54990 12480	0.7 km
CAR/R/SEPA2021-047	South Kyle Wind Farm	March 29, 2021	Registration	Engineering - Abstraction and/or Borehole Construction and Operation for a Registration level abstraction	NS 52019 01474	On site
CAR/R/5006483	North Kyle Wind Farm	November 6, 2023	Registration	Water Resources - Abstraction	NS 54990 12480	0.7 km
CAR/R/5004625	Benbrack Wind Farm	March 14, 2023	Registration	Water Resources – Abstraction (borehole)	NS 53655 00279	2.0 km

Source: SEPA (2024)

Private Water Supplies

8.6.46. The East Ayrshire Council and Dumfries & Galloway Council were consulted regarding the presence of Private Water Supplies (PWS) within a 3 km search area from the Proposed Development. Responses were received, and 12 properties were identified, potentially on a PWS. Table 8.10 provides details relating to these identified properties and whether further assessment is required.

Table 8.10: Private Water Supplies Located Within a 3 km Buffer

PWS ID	Property ID	Supply Name	Type of Supply	Multiple Properties	Property within same hydrological sub catchment occupied by infrastructure	Property Distance from Infrastructure (km)	Property Requires Further Assessment
Information Provided by East Ayrshire Council							
A	-	Glenmuck Farm	Type B	Unknown	No*	0.6	No
B	-	Knockburnie Farm	Regulated	Unknown	No	3.4	No
C	-	Lanehead Farm	Type B	Unknown	No	3.4	No
D	-	Meiklehill Farm	Type B	Unknown	Yes	1.3	Yes
E	-	Nith Lodge Farm	Type B	Unknown	No	1.6	No
F	-	Knockenlee	Type B	Unknown	Yes	1.7	Yes
G	-	Craighouse Cottage	Regulated	Unknown	No	3.0	No
Information Provided by Dumfries & Galloway Council							
-	1	Brownhill	Unknown	Unknown	No	1.0	No
-	2	Eriff Farm	Unknown	Unknown	No	0.7	No
-	3	Lamford	Type B	No	No	2.0	No
-	4	Meadowhead	Type B	No	No	1.8	No
-	5	Waterhead	Type B	No	No	2.7	No

* - PWS is within the same sub-catchment of the existing access track for the South Kyle Wind Farm with no works expected to take place on this access track.

Soils and Peat

8.6.47. Peat is a soft to very soft, highly compressible, highly porous organic material that can consist of up to 90 – 95% water, with 5 – 10% solid material. Unmodified peat consists of two layers; a surface acrotelm which is usually 10 – 30 cm thick, highly permeable and receptive to rainfall. Decomposition of organic matter within the acrotelm occurs aerobically and rapidly. The acrotelm generally has a high proportion of fibrous material and often forms a crust in dry conditions.

8.6.48. A second layer, or catotelm, lies beneath the acrotelm and forms a stable colloidal substance which is generally impermeable. As a result, the catotelm usually remains saturated with little groundwater flow. Peat is thixotropic, meaning that the viscosity of the material decreases when stress is applied. The thixotropic nature of peat may be considered less important where the peat has been modified through artificial drainage or natural erosion and is drier but will be significant when the peat body is saturated.

8.6.49. The distribution of soils across the Proposed Development is dependent upon land use, geology, topography and hydrological regime of the area. Information on the site soils has been provided by the James Hutton Institute, specifically from its online soil information for Scottish soils (SIFSS) portal and is summarised in Table 8.11.

Table 8.11: Summary of Soil Types

Soil Association	Parent Material	Component of Soils
Hindsward	Drifts derived from Carboniferous sediments and basic igneous rocks	Peaty gleys with dystrophic blanket peat
Craigdale	Drifts derived from greywackes, shales and basic lavas	Noncalcareous gleys with peaty gleys
Organic Soils	Organic deposits	Dystrophic blanket peat
Ettrick	Drifts derived from Lower Paleozoic greywackes and shales	Peaty gleyed podzols with peaty gleys
Knockskae	Drifts derived from felsites and allied igneous rocks	Humus-iron podzols

Source: SIFSS (2024)

8.6.50. According to the Carbon and Peatland 2016 Map[7], the Proposed Development Area features multiple classifications of peat. The predominant class of peat is Class 5 which is described as featuring no peatland habitat recorded and may include bare soil. Soils are carbon-rich and deep peat where soil information takes precedence over vegetation data. There are small pockets of other classes of peat, however the proposed infrastructure is sited on Class 4 and Class 3 in addition to the Class 5.

Peat Survey Results

8.6.51. As indicated in subsection *Site Investigations*, the phase 1 peat depth surveys and hydrological walkover were undertaken in August 2022, December 2022 and June to August 2023 which informed the feasibility and scoping assessments. Detailed phase 2 peat depth surveys were carried out in April and August 2024 with further hydrological surveys taking place following design freeze. The results of the peat surveys are shown in Table 8.12.

[7] Scottish Government (2023) Scotland Soils – Carbon and Peatland 2016 Map. Available from https://soils.environment.gov.scot/maps/thematic-maps/carbon-and-peatland-2016-map/ (Accessed 17/04/2024)

Table 8.12: Peat Survey Results

Depth Range	Total	Percentage
≤0.5	2,114	41.9%
>0.5 to ≤1.0	1,778	35.2%
>1.0 to ≤2.0	903	17.9%
>2.0 to ≤3.0	241	4.8%
>3.0	13	0.3%
Total	**5,049**	**100%**

8.6.52. There was a total of 5,147 peat depth locations identified for the peat depth surveys, however 98 locations were unable to be surveyed due to fallen trees associated with the existing commercial forestry land use. Of the remaining 5,049 locations, the average peat depth was calculated to be 0.80 m with the maximum peat depth recorded as 3.8 m.

Geology

Bedrock Geology

8.6.53. Following information has been obtained using the British Geological Survey (BGS) GeoIndex Onshore resource that provides 1:50,000 bedrock geology map[8] and 1:1,000,000 bedrock engineering geology map[9]. A summary of this information is presented in Table 8.13.

Table 8.13: Bedrock Geology Underlying the Proposed Development

Unit Name	Lithology	Depositional Environment	Description	Engineering Classification
Western Midland Valley	Dolerite and trace basalt and olivine-microgabbro.	Igneous – Intrusion	These igneous rocks are magmatic (intrusive) in origin. Poor in silica, they form intruded batholiths, plutons, dykes and sills.	Gabbroic-rock
Scottish Lower Coal Measures Formation	Sandstone, Siltstone and Mudstone Featuring Coal Seams	Sedimentary - Swamps, estuaries and deltas	These sedimentary rocks are fluvial, palustrine and shallow-marine in origin. They are detrital, forming deposits reflecting the channels, floodplains and deltas of a river in a coastal setting (with periodic inundation from the sea).	Mudstone and Strong Sandstone (Coal-bearing) 2:1
Scottish Middle Coal Measures Formation	Sandstone, Siltstone and Mudstone Featuring Coal Seams	Sedimentary - Swamps, estuaries and deltas	These sedimentary rocks are fluvial, palustrine and shallow-marine in origin. They are detrital, forming deposits reflecting the channels, floodplains and deltas of a river in a coastal setting (with periodic inundation from the sea).	Mudstone and Strong Sandstone (Coal-bearing) 2:1
Carrick Volcanic Formation	A volcanic succession of basalt and basaltic andesite sheets and flows with subordinate volcaniclastic and epiclastic sandstones and conglomerates.	Igneous - Extrusive	These igneous rocks are volcanic (extrusive) in origin. Poor in silica, they form fluid flows of lava with feeder dykes and sills.	Basaltic-rock
Lanark Group	Mainly terrestrial red-bed sequence of sandstones and conglomerates with intercalated calc-alkaline volcanic extrusive rocks.	Fluvial	These sedimentary rocks are fluvial in origin. They are detrital, ranging from coarse- to fine-grained and form beds and lenses of deposits reflecting the channels, floodplains and levees of a river or estuary (if in a coastal setting).	Rhyolitic-rock
Southern Midland Valley Felsite Sills	Felsite	Igneous - Intrusive	These igneous rocks are magmatic (intrusive) in origin. Rich in silica, they form intruded batholiths, plutons, dykes and sills.	Rhyolitic-rock
Tappins Group	Alternating greywackes and shales, red mudstones, sandstones, lava breccias and conglomerates.	Deep Marine	These sedimentary rocks are marine in origin. They are detrital and comprise coarse- to fine-grained slurries of debris from the continental shelf flowing into a deep-sea environment, forming distinctively graded beds.	Strong Sandstone and Slate 1:1

[8] BGS (2024) Geoindex Onshore – 1:50,000 Bedrock Geology Map [Online] Available from www.bgs.ac.uk/map-viewers/geoindex-onshore/ (Accessed 29/03/2024)

[9] BGS (2024) Geoindex Onshore – 1:1,000,000 Bedrock Engineering Map [Online] Available from www.bgs.ac.uk/map-viewers/geoindex-onshore/ (Accessed 29/03/2024)

Unit Name	Lithology	Depositional Environment	Description	Engineering Classification
Marchburn Formation	Wacke sandstones, siltstones and sporadic conglomerates (turbidite succession).	Deep Marine	These sedimentary rocks are marine in origin. They are detrital and comprise coarse- to fine-grained slurries of debris from the continental shelf flowing into a deep-sea environment, forming distinctively graded beds.	Strong Sandstone and Slate 1:1
Kirkcolm Formation	Sandstone/siltstone turbidite sequence.	Deep Marine	These sedimentary rocks are marine in origin. They are detrital and comprise coarse- to fine-grained slurries of debris from the continental shelf flowing into a deep-sea environment, forming distinctively graded beds.	Strong Sandstone and Slate 1:1
Moffat Shale Group	Black shale, grey shale, bentonite, tuff	Open seas with pelagite deposits	These sedimentary rocks are marine in origin (pelagic). They are detrital, comprising very-fine grained accumulated deposits of silica, carbonate or biogenic material, forming thinly laminated or structureless beds.	Strong Sandstone and Slate 1:1

Source: BGS (2024)

Superficial Geology

8.6.54. Following information has been obtained using the BGS GeoIndex Onshore resource that provides 1:50,000 superficial geology map[8] and 1:1,000,000 bedrock engineering geology map[9]. A summary of this information is presented in Table 8.14.

Table 8.14: Superficial Geology Underlying the Proposed Development

Unit Name	Lithology	Depositional Environment	Description	Engineering Classification
Peat	Peat	Rich in plant remains	These sedimentary deposits are lacustrine and palustrine in origin. They comprise accumulated (and detrital) organic material, forming beds and lenses within lagoons, bogs and swamps.	Organic Soil
Till	Diamicton	With glacial tills deposited by ice	These sedimentary deposits are glacigenic in origin. They are detrital, created by the action of ice and meltwater, they can form a wide range of deposits and geomorphologies associated with glacial and inter-glacial periods during the Quaternary.	Fine Till (layered)
Alluvium	Silt, sand and gravel	With deposits forming today's floodplain alluvium	These sedimentary deposits are fluvial in origin. They are detrital, ranging from coarse- to fine-grained and form beds and lenses of deposits reflecting the channels, floodplains and levees of a river or estuary (if in a coastal setting).	Fine Soil
Glaciofluvial Deposits	Gravel, sand and silt	With outwash deposits formed from melting ice	These sedimentary deposits are glaciofluvial in origin. They are detrital, generally coarse-grained, they form beds, channels, plains and fans associated with meltwater.	Fine Till (layered)

Source: BGS (2024)

Linear Features

8.6.55. According to the BGS Geoindex Onshore resource that provides 1:50,000 linear feature geology map[10], there are multiple inferred faults across the Proposed Development Area. These generally strike in a south-westerly to north-easterly direction with multiple perpendicular faults branching off. To the north-westerly extent of the Proposed Development, there are a number of faults concentrated in this area due to Scottish Coal Measures Formations which also features inferred coal seams.

Hydrogeology

8.6.56. Following information has been obtained using the BGS Geoindex Onshore resource that provides 1:625,000 hydrogeology map[11]. A summary of this information is presented in Table 8.15.

[10] BGS (2024) Geoindex Onshore – 1:50,000 Linear Features [Online] Available from www.bgs.ac.uk/map-viewers/geoindex-onshore/ (Accessed 02/04/2024)

[11] BGS (2024) Geoindex Onshore – 1:625,000 Hydrogeology [Online] Available from www.bgs.ac.uk/map-viewers/geoindex-onshore/ (Accessed 02/04/2024)

Table 8.15: Hydrogeology Underlying the Proposed Development

Rock Unit	Aquifer Characteristics	Summary
Unnamed Igneous Intrusion, Carboniferous to Permian	Low productivity aquifer	Small amounts of groundwater in near surface weathered zone and secondary fractures, rare springs.
Scottish Coal Measures Group	Moderately productive aquifer	Regional, cyclic multi-layered aquifer with low yields from sandstones. Higher yields where mined but poor quality water, including high iron and fluoride.
Unnamed Extrusive Rocks, Silurian to Devonian	Low productivity aquifer	Small amounts of groundwater in near surface weathered zone and secondary fractures, rare springs yielding up to 2 L/s.
Lanark Group	Moderately productive aquifer	Regional aquifer of sandstones, in places flaggy, with siltstones, mudstones and conglomerates and interbedded lavas. Locally yields up to 12 L/s.
Unnamed Igneous Intrusion, Late Silurian to Early Devonian	Low productivity aquifer	Small amounts of groundwater in near surface weathered zone and secondary fractures; rare springs.
Tappins Group	Low productivity aquifer	Highly indurated greywackes with limited groundwater in near surface weathered zone and secondary fractures.
Kirkcolm Formation	Low productivity aquifer	Highly indurated greywackes with limited groundwater in near surface weathered zone and secondary fractures.

Source: BGS (2024)

Groundwater Dependent Terrestrial Ecosystems

8.6.57. A review and assessment of GWDTE of the Proposed Development has been undertaken with details provided in the following sections.

8.6.58. A buffer search distance of 250 m from all proposed new infrastructure was adopted for all elements deemed to require excavations >1 m bgl (below ground level); this was applied to turbine foundations and the borrow pit. A 100 m buffer was applied to all access tracks, including existing tracks which may be subject to local widening and typically may require excavations <1 m bgl. National Vegetation Classification (NVC) habitat data (refer to Chapter 6: Ecology) and SEPA's list of potential groundwater (GW) dependent communities was used to identify potential GWDTE within the Proposed Development (Figure 8.7, Volume 2a). For a habitat to be designated as a GWDTE there is a requirement for hydraulic connectivity between the GW body and that habitat.

8.6.59. Review of the NVC data highlighted a number of potential GWDTEs using the list of communities identified in the SEPA guidance document LUPS-GU 31[12]. It is acknowledged in this document that the listed communities 'may be considered GWDTEs only in certain hydrogeological settings'. The identified potentially GW dependent NVC communities are summarised in Table 8.16.

[12] SEPA (2017), Land Use Planning System, Guidance Note 31, Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems

Table 8.16: NVC Communities and Potential GW Dependency (Within 250 m and 100 m Buffer Zones)

NVC Community	Potential Level of GW Dependency
M23a - *Juncus effusus/acutiflorus–Galium palustre* rush-pasture	High
M23b - *Juncus effusus/acutiflorus–Galium palustre* rush-pasture	High
M25a - *Molinia caerulea - Potentilla erecta* mire	Moderate
M25b - *Molinia caerulea - Potentilla erecta* mire	Moderate
M6c - *Carex echinata - Sphagnum recurvum* mire	High

8.6.60. The NVC communities are primarily located within the riparian corridors of the watercourses within the Proposed Development Area. However, there are areas out with these corridors and have been assessed in the Table 8.17.

Table 8.17: Potential GWDTE within LUPS Buffer Zone and Outside of Riparian Corridor

ID	NVC Code	NGR	Underlying Aquifer Characteristics	Assessed GW Dependency
1	M25b	251695 605849	Low productivity aquifer	None
2	M23a	252453 605912	Low productivity aquifer	None
3	M23b	252961 606378	Low productivity aquifer	None
4	M23a	252535 607645	Low productivity aquifer	None
5	M23b	251801 607608	Low productivity aquifer	None

Source: Natural Power (2024)

8.6.61. As shown in the table above, the potential GWDTE areas that are out with the riparian corridors and within the LUPS-GU 31 buffer zones have underlying low productivity aquifers. When considered with the wider context of the Proposed Development Area, it suggests that these areas are ombrotrophic (i.e. surface water fed) in nature. The existing land-use features drainage systems that may be the driving pathway for surface water to support these NVC communities, especially considering the lack of groundwater available in the underlying geology.

Modifying Influences

8.6.62. Changes could potentially occur to the Study Area in the future in relation to climate and land use. Section 8.7 below defines the period for which the assessment needs to be carried out and the developments / changes that need to be considered within the assessment.

8.6.63. The conditions at the Proposed Development will be affected by climate change, which could affect the amount and intensity of rainfall, and temperature and evapotranspiration. Information regarding climate change was obtained from the UK Climate Projections (UKCP18) website. The UKCP18 is a climate analysis tool which features comprehensive projections for different regions of the UK. General climate change trends projected over UK land for the 21st century show an increased chance of warmer, wetter winters and hotter, drier summers along

with an increase in the frequency and intensity of weather extremes. This is seen in the Probabilistic (25 km), Global (60 km), Regional (12 km) and Local (2.2 km) projections.

8.6.64. Warmer and wetter winters suggest less snow and more rain. This will create increased risk for flood events, and issues with water quality as less precipitation will be held in its frozen state during the winter season. If climate predictions are correct, summer months will become drier. This will create pressure on the needs of water abstractions and on sensitive ecosystems that rely on aquatic habitats. Evidence also suggests that although the summer months will have an average decrease in rainfall, summer storms will be more frequent and intense. This may lead to more extreme flow values during and immediately following such events, with consequential flooding and water quality issues. This is of key importance for the hydrological environment during summer construction periods.

8.6.65. Given the nature of the terrain and distance from any major urban areas land use change from its current rural nature is unlikely over the lifespan of the Proposed Development.

8.7. Scope of Assessment

Spatial Scope

8.7.1. The spatial scope of the assessment of Hydrology, Geology, and Hydrogeology covers the Study Area (i.e. the Proposed Development Area including a 3 km buffer area), for which the baseline is described in Section 8.6, on the basis that the effects on the water environment due to the Proposed Development are considered unlikely to extend beyond this area. The only potential receptors identified outside this Study Area are downgradient watercourses and conservation sites on the basis that any changes in the surface and groundwater environment arising as a result of the Proposed Development could theoretically affect their flows / quality and water support respectively.

Temporal Scope

8.7.2. The temporal scope of the assessment of Hydrology, Geology and Hydrogeology is consistent with the construction and operational periods for the Proposed Development (see Chapter 3: Project Description). The construction period for the Proposed Development would be approximately 18 months in duration, with decommissioning anticipated at the end of a 40 year operational period.

Potential Receptors Requiring Assessment

8.7.3. Following establishment of the baseline setting, the receptors that are considered as requiring impact assessment (i.e. Scoped In) are listed in Table 8.18, ordered broadly in accordance with their first appearance in the Section 8.6 baseline.

8.7.4. It is important to note that this chapter examines potential changes of the Proposed Development on the water environment supporting GWDTEs, not the habitats themselves, which is instead a matter for Chapter 6: Ecology and Biodiversity).

Table 8.18: Hydrology, Geology and Hydrogeology Receptors Requiring Assessment

Receptor	Details	Sensitivity
Flood Risk		
Proposed Development	There are multiple primary watercourses that feature a high risk of flooding. These watercourse feature infrastructure within their associated catchment. This flood risk applies to downstream of the Proposed Development.	Medium
Downstream of Proposed Development	There are multiple primary watercourses that feature a high risk of flooding. These watercourse feature infrastructure within their associated catchment. Downstream of the Proposed Development is the town of Dalmellington that is a Candidate Potentially Vulnerable Area.	High
Water Quality		
River Nith	WFD classification of Moderate.	Low
Cumnock Water	WFD classification of Good.	High
Muck Water	WFD classification of Good.	High
Pochriegavin Burn	WFD classification of Poor.	Low
Water of Deugh	WFD classification of Poor.	Low
River Doon	WFD classification of Moderate.	Low
Lane Burn	WFD classification of Good.	High
Cumnock (GW)	WFD classification of Poor.	Low
South Ayrshire Hills (GW)	WFD classification of Good.	Medium
Upper Nithsdale	WFD classification of Poor.	Low
Water Resources		
Private Water Supplies	There are a number of properties (see Table 8.10) that have been scoped in as part of the initial assessment.	High
Soils and Peat		
Site soils and peat >0.5 m depth	Predominantly Class 5 peat with small pockets of Class 3 and 4 featuring proposed infrastructure. Survey results indicate deep peat across the Proposed Development Area.	Medium
Site soils (≤0.5 m depth)	45% of the recorded peat depths are less than 0.5 m deep and therefore not classified as peat.	Low

8.7.5. Details relating to the receptors that have not been including in the assessment can be found below in Table 8.19.

Table 8.19: Hydrology, Geology and Hydrogeology Receptors Not Requiring Assessment

Receptor	Details
Conservation Sites	
Sites within the Study Area	These conservation sites were determined to be not connected to the Proposed Development. Therefore, no impact will occur on these sites as a result of the activities relating to the Proposed Development.
Flood Risk	
Pluvial Flooding	According to the available information, there are limited areas across the Proposed Development Area that feature pluvial flooding. These are typically associated with existing drainage systems relating to existing land use. Flooding from artificial drainage systems have been considered for this assessment, with proposed mitigation applying to pluvial flooding areas.
Coastal Flooding	Topographic characteristic of the Proposed Development combined with the significant distance from the nearest coast has negated any potential for coastal flooding.
Groundwater Flooding	Groundwater flooding is difficult to predict and typically exacerbates other flooding sources. Considering that the highest risk of flooding is fluvial and artificial drainage systems, the assessment and proposed mitigation will reduce the potential impact of groundwater flooding by proxy. It should be noted that the productivity associated with the underlying hydrogeology is low which will affect the occurrence of groundwater flooding.
Geology	
On-site Geology	Geology is typical of wider area with no designated sites of geological interest located within the Proposed Development Area. There are conservation sites with geological significance within the Study Area, however the Proposed Development activities are suitable distanced from providing any potential impact.
Hydrogeology	
GWDTE	NVC communities that feature a potential for GWDTE are located within riparian corridors or feature low productivity aquifers in the underlying geology. Existing land-use feature artificial drainage systems which may supply surface water to these communities

Assessment of Potential Effects

Proposed Development Indicators

8.7.6. The Proposed Development would introduce physical changes which have the potential to alter the hydrological characteristics within the Proposed Development Area. During the construction phase and to a lesser extent during the operational and decommissioning phase potential sources of pollution would be present. Hydrological surveys have been undertaken to establish the existing on-site baseline conditions and associated areas downstream to assess the likely significant environmental effects of the Proposed Development on the identified receptors, the significance of these effects on the receptors and the potential for mitigation to reduce the significance of the identified effects.

Construction / Operation / Decommissioning

8.7.7. The Proposed Development would consist of the erection, 40 year operation, and subsequent decommissioning of 11 wind turbines with tip heights of up to 200 m. The Proposed Development includes associated turbine foundations and transformers, substation, battery energy storage system (BESS), hardstanding areas for erecting cranes at each turbine locations, a series of on-site tracks connecting each turbine, underground cables linking the turbines to the grid connection, an on-site substation, construction compound, and the use of an existing borrow pit.

8.7.8. Typically, the construction phase would involve a period of earthworks inclusive of track construction and excavations for forming turbine bases. Following this, the turbine bases and infrastructure would be installed and finally the turbines would be transported to site and erected.

8.8. Environmental Measures Embedded into the Development Proposals

8.8.1. Embedded mitigation proposals are those mitigation measures that are inherent to the Proposed Development. Embedded mitigation includes all mitigation usually assumed to be in place during construction, operation and decommissioning, and is generally regarded as industry standard or “Best Practice”. Construction and environmental management plans are introduced in Volume 1 Chapter 3: Project Description with an outline CEMP provided in the following sections. Hydrology-specific embedded mitigation measures are presented below.

Introduction

8.8.2. A qualitative, preliminary screening assessment for the potential location of the Proposed Development's wind turbines and infrastructure was undertaken as part of a desk-based study. The purpose of this study was to identify potential significant constraints which may be posed by the baseline conditions of the Proposed Development, so that the construction plan and layout of the Proposed Development (as described in Volume 1 Chapter 3: Project Description) could be developed /refined to account for these constraints, and so minimise the potential risks and impacts to certain receptors during construction and operation.

8.8.3. A review of the baseline information for the Study Area (Section 8.6) identified potential development constraints associated with the Proposed Development. This led to areas being discounted for the siting of turbines and access tracks and other areas being considered for development only if appropriate mitigation could be provided.

8.8.4. The preliminary constraints map generated as part of the screening process was used to ‘scope out’ potential locations for the wind turbines and Site infrastructure. To establish an indicative layout, buffer zones were placed around specific areas of the Proposed Development where significant constraints were identified to exclude these from the possible areas of the Proposed Development.

Avoidance of Deep Peat Deposits

8.8.5. Table 8.20 indicates that the proposed infrastructure has been sited in areas of shallower peat (≤1.0 m), where practicable (as visually depicted in Figure 8.4, Volume 2a).

Table 8.20: Recorded Depths at Infrastructure Elements

Infrastructure Element	Mean Peat Depth (m)
Turbines (including crane pad)	
T1	0.80
T2	0.40
T3	1.82
T4	0.47
T5	0.55
T6	0.74
T7	0.74
T8	1.04
T9	0.54
T10	0.70
T11	0.58
Ancillary Infrastructure	
Borrow Pit	0.00
Temporary Construction Compound	0.99
Substation	0.37
Access Track Segments	
T1 to T3	0.71
T2 to Junction of T1/T3	0.83
T3 to Junction of T5/T11	0.80
T6 to Junction	0.85
Junction to T11	0.65
T11 to T4	0.48
T7 to T8 to Existing Track	0.67
T09 to Existing	0.56
T10 Track to Existing	0.73
T5 to Junction	0.37

Watercourse Buffer Zones

8.8.6. The hydrological desktop study and site visits have identified an upland hydrological environment dominated commercial forestry and existing renewable energy developments which include hydrological pathways and natural watercourses. A series of buffer distances have been adopted to help reduce effects of the Proposed Development on the water environment.

8.8.7. For turbines and associated infrastructure, a 50 m buffer was implemented for all identified natural hydrological features. Infrastructure has been sited outside these buffers except where access necessitates. Watercourse crossings associated with the new access track required as part of the Proposed Development have been minimised to four new crossings, with three existing crossings that may require an upgrade to accommodate the construction traffic.

8.8.8. The distances presented in Table 8.21 shows that all turbines are located out with the 50 m watercourse buffers. Distances were calculated using the functionalities provided within QGIS. Watercourses are linear features that were identified from the OS 1:10,000 raster data.

Table 8.21: Distance From Infrastructure Element to Nearest Watercourse

Infrastructure	Turbine distance from watercourse (m) (inclusive of 50m buffer)
Turbine	
T1	354
T2	197
T3	206
T4	99
T5	275
T6	227
T7	170
T8	240
T9	268
T10	168
T11	210
Ancillary Infrastructure	
Borrow Pit	26
Temporary Construction Compound	55
Substation and BESS	126

8.8.9. There is an impingement of the 50 m watercourse buffer for the proposed borrow pit and the temporary construction compound. The proposed infrastructure has been sited in existing hardstanding areas or along existing access tracks which would reduce the level of impact on the wider environment.

Excavations and Associated Drainage

8.8.10. Where possible, excavations required to facilitate the construction of foundations for the wind turbines, service trenches and each crane base would be designed so that they can freely drain by gravity. Cut-off drains would be installed around the excavation areas to prevent surface run-off entering the excavations.

8.8.11. Measures based on Best Practice guidelines from SEPA would be adopted during construction to prevent pollution, with all contractors aware of a pre-planned pollution incident response procedure, as detailed in GPP21. The turbine foundation design minimises excavation requirements in accordance with BS6031: 2009 Code of Practice for Earth Works.

8.8.12. Turbine construction would adopt mitigation measures, as detailed in the CEMP, to prevent contaminants entering the shallow groundwater system. The main potential groundwater effect arising from the construction of the wind turbine foundations and adjacent crane pads is the risk of leaching concrete residues into the water environment

and impediments to surface flow to watercourses. To minimise the potential of concrete leaching and alkaline pollution of groundwater, suitable sulphate-resistant concrete would be used. The foundation design would be checked with SEPA, and if necessary, the foundation excavations would incorporate an adequate barrier to prevent the migration of any on-site pollutants to the underlying groundwater. Furthermore, the use of cut-off drains installed around the excavation areas would prevent surface run-off entering the excavations and maintain flow around the excavation and maintain the surface flow to watercourses.

8.8.13. Should ground conditions occur during excavation where gravity drainage is not possible (i.e. where low permeability rock or superficial deposits are present), the excavations would be dammed and drained by pumping. These dewatering activities would be undertaken in accordance with Best Practice (including WAT-SG-29 on Temporary Construction Methods), which would be detailed in the CEMP to be agreed by SEPA and the Ecological Clerk of Works (ECoW).

8.8.14. The design for the dewatering would ensure collection and settling of suspended sediment i.e. use of silt traps, fences, straw bales or lagoons. Any water removed from the excavation would be treated and pumped to a bunded and vegetated settlement and infiltration swale, downgradient of the excavation and away from watercourses, and there would be no discharge of water directly into a watercourse. The potential for infiltration would need to be carefully assessed due to the potential presence of saturated soils across the Proposed Development. Should this be an issue, a number of these swales could be used with a wide spatial distribution to prevent oversaturation. If large volumes of water are expected from dewatering, other SuDS elements such as french drains could also be utilised (subject to ground conditions). Should local topography or ground conditions prove unsuitable for construction of either infiltration swales or settlement lagoons, the use of portable silt trap devices such as 'Siltbuster' type tanks could be considered for removal of elevated suspended solids from water pumped from excavations. These activities would be designed and implemented in consultation with SEPA on a foundation-specific basis following completion of detailed ground investigations and micro-siting prior to construction.

8.8.15. The locations of swales or settlement lagoons, where required, would be on stable areas of shallow slope, to reduce the risk of failure. The size of the settlement lagoons would be appropriate to the amount of dewatering, but if large quantities of dewatering are anticipated, the potential for more than one lagoon or the use of portable silt trap devices would be considered on a foundation-by-foundation basis. If any discharge to surface watercourses is required, the water would be treated beforehand and the need for any consent from SEPA agreed (it is expected that in most cases the activities would be covered by General Binding Rules GBR3 and/or GBR15).

8.8.16. The proposed borrow pit would be located on an existing quarry and would be accessed by an existing heavy goods vehicle track associated with the existing renewable energy development. By utilising an existing quarry area, rather than opening up new ground, this would ensure that disturbance is minimised. The borrow pit is situated immediately adjacent to the Linn Water 50 m buffer, however the reuse of existing quarry would provide less of environmental impact compared to a new borrow pit location that may be further away from watercourses.

Watercourse Crossing

8.8.17. Details relating to the proposed watercourse crossings can be found in Technical Appendix 8.2: Watercourse Crossing Assessment, Volume 3. However, the crossings would be constructed in adherence to Engineering in the Water Environment Good Practice Guide – River Crossings: Second Edition (SEPA, 2010), River Crossings and Migratory Fish: Design Guidance (Scottish Executive 2000) and CIRIA Culvert, Screen and Outfall Manual (C786) which helps to minimise potential hydrological (including morphological) effects. The watercourse crossing would be designed to convey a 1 in 200-year return period flood event with an allowance for climate change, and the watercourse/flow pathway crossing has been considered with respect to topography and hydrology.

Avoidance of Flood Zones

8.8.18. All areas identified as being located within a high to medium likelihood of surface water flooding were considered to be unsuitable for development and were in proximity to the watercourses. Indeed, developments should not be permitted in the 1 in 200-year (medium) flood zone unless it can be demonstrated that it would not affect the ability of the floodplain to store and convey water.

8.9. Mitigation Measures

Outline Construction and Environment Management Plan

8.9.1. A site-specific CEMP will provide details on industry good practice measures to be put in place to manage activities in such a manner as to prevent or minimise effects on the surface and groundwater environment. The CEMP will be prepared prior to commencement of construction but will include information as follows:

- Drainage – all runoff derived from construction activities and site infrastructure will not be allowed to directly enter the natural drainage network. All runoff will be adequately treated via a suitably designed drainage scheme with appropriate sediment and pollution management measures. The Proposed Development is situated in an upland hydrological area and it is imperative that the drainage infrastructure is designed to accommodate storm flows based on a 1 in 200-year event (plus climate change) to help maintain the existing hydrological regime;
- Storage – all soil/peat stockpiles as well as equipment, materials and chemicals will be stored well away from any watercourses. Chemical, fuel and oil stores will be sited on impervious bases with a secured bund;
- Vehicles and Refuelling – standing machinery will have drip trays placed underneath to prevent oil and fuel leaks causing pollution. Where practicable, refuelling of vehicles and machinery will be carried out in designated areas, on an impermeable surface, and well away from any watercourse;
- Maintenance – only emergency maintenance to construction plant will be carried out within the Site, in designated areas, on an impermeable surface well away from any watercourse or drainage, unless vehicles have broken down necessitating maintenance at the point of breakdown, where special precautions will be taken;
- Welfare Facilities – on-site welfare facilities will be adequately designed and maintained to allow for sewage to be disposed of appropriately. This may take the form of an on-site septic tank with soakaway, or tankering and off-site disposal depending on the suitability of the Site for a soakaway and prior agreement with SEPA;
- Cement and Concrete – fresh concrete and cement are very alkaline and corrosive and can be lethal to aquatic life. The use of wet concrete in and around watercourses will be avoided and carefully controlled;
- Monitoring Plan – to provide environmental compliance, activities undertaken as part of the Proposed Development will be monitored throughout the construction phase. Water quality monitoring will also occur throughout each phase of the Proposed Development and will help to maximise the effectiveness of mitigation measures whilst monitoring effects on the hydrological environment;
- Contingency Plans – plans will provide information on emergency equipment and where it is available on the Site i.e. spill kits and absorbent materials, advice on action to be taken and who should be informed in the event of a pollution incident; and
- Training – All relevant staff personnel will be trained in both normal operating and emergency procedures and be made aware of highly sensitive areas on the Site.

8.9.2. Further details regarding the pollution prevention and mitigation measures that will be adopted during the construction and operation of the Proposed Development are detailed in the following paragraphs.

Runoff and Sediment Management

8.9.3. The following measures will be adopted to appropriately attenuate and treat runoff during construction and operation of the Proposed Development.

8.9.4. The Proposed Development drainage system will convey water away from construction activities as well as the proposed infrastructure. However, due to the nature of the works associated with the Proposed Development and the negligible infiltration and storage capacity of the underlying peat and bedrock, there is a significant potential for sediment and other pollutants to become entrained in the surface runoff.

8.9.5. To reduce this potential, prior to the commencement of work and during construction, plans showing the Proposed Development drainage and hydrologically sensitive areas should be regularly checked to review potential for runoff and ponding of water within the Site to make sure that runoff patterns are well known.

8.9.6. The drainage systems installed within the Proposed Development Area will also have sediment management measures incorporated into their design to help reduce or wholly mitigate effects on the hydrological environment. The type of sediment management will depend on the volume of construction activities occurring in particular areas within the Proposed Development. For all of the suggested control measures regular inspection and maintenance is necessary, particularly after prolonged heavy rainfall.

8.9.7. Silt traps will be installed within the Proposed Development drainage system. Silt traps could take the form of terram fences or clean stone. However, the ability of the silt traps to successfully treat runoff will be dependent upon the permeability of the terram geotextile material and the size and source of the clean stone.

8.9.8. The ability of the silt traps to effectively treat runoff will depend upon the volume of runoff within the drainage channel, the type of material used and the frequency of monitoring and replacement of the measures.

8.9.9. If required, flocculents could also be used to treat runoff. Flocculents are very effective at removing suspended sediment from water but they can also have effects on water chemistry. As such, SEPA will be consulted prior to the use of flocculents and only considered as a last resort. If their use is proposed, SEPA will be consulted and a method statement agreed prior to use. This method statement must detail the type of floc, how dosing is controlled, record keeping (dates used, location, volume/weight used etc) and how the precipitated silt will be disposed of.

Pumping and Dewatering of Excavations

8.9.10. All pumping operations e.g. removal of water from turbine base excavations, will be carried out in line with good practice and where necessary in line with the requirements of The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) prior to the works being undertaken. Suitable measures to minimise the impact of the pumped water on the hydrological environment shall be taken. These measures shall include, but are not limited to, the following techniques.

8.9.11. Due to the expected low permeability of the soils within the Proposed Development Area, it is expected that the potential for groundwater ingress would be low. The ingress of surface water into the excavations will be minimised through the use of upgradient drainage measures e.g. cut-off ditches. It is recognised that water can still enter the excavation and would need to be removed. This can be achieved by allowing the water to gravity drain to a designated area before being pumped from the excavation to a predesigned settlement lagoon or other suitable silt treatment area. The settlement lagoons would attenuate and treat runoff before discharging back into the natural drainage network.

8.9.12. Due to peaty soils on Site the throughput rate of runoff within the settlement treatment areas would be reduced to give longer settlement time within the excavations and settlement tanks. If required, a series of settlement lagoons or other silt treatment measures can be deployed to allow maximum settlement of sediment during the construction period.

8.9.13. The treated water from the settlement lagoons or other silt treatment measures will not be discharged directly into watercourses but directed onto vegetated surfaces where appropriate. Any sediment within the treated water will be deposited amongst the rough surface vegetation, away from sensitive habitats or watercourses.

8.9.14. To reduce the likelihood of erosion channels being formed by the discharge from the sediment treatment outfalls it is recommended that the water is discharged at a slow rate or spread evenly across a surface. For discharge onto rough vegetation to be effective the discharge must be spread efficiently, and the vegetation, soils and topography be carefully considered to determine an appropriate discharge location.

8.9.15. To maximise the efficiency of the settlement measures or other holding lagoons or tanks, the sediment sludge that collects at the base will be removed as required.

Refuelling

8.9.16. A fuel bowser will be used for refuelling on the access tracks or hardstanding. The bowser driver shall be responsible for ensuring that refuelling of mobile plant does not take place within 50 m of a watercourse. The bowser driver will receive extra training on spill prevention and response.

8.9.17. The refuelling bowser shall be equipped with a mobile spillage control kit containing oil absorbent booms and mats. All site personnel will be trained in their use as part of the Site induction training or toolbox talks. Special attention will be paid to spillage control at watercourses.

Vehicle Maintenance and Management

8.9.18. All plant used during the construction of the Proposed Development will be in suitable condition and fit for purpose to carry out the works and will be maintained as per manufacturers guidelines.

8.9.19. Maintenance of construction plant to be carried out in designated areas, on an impermeable surface away from any watercourse or drainage. Only if vehicles have broken down will maintenance be permitted out with a designated area, and this would only be carried out after implementing special precautions. Such precautions include, but are not limited to:

- Drip trays will be placed underneath vehicles during maintenance;
- As a precautionary measure, straw bales or entrapment matting can be placed downstream of the maintenance area;
- All heavy construction plant will be inspected daily by the operating personnel and any defects or issues resolved immediately prior to starting works. All heavy construction plant shall be issued with spill-kits. Should a spillage occur, larger spill kits shall also be positioned at various areas within the Site which will be highlighted to all operatives during the Site induction; and
- Standing machinery and plant will have drip trays placed underneath to prevent oil and fuel leaks causing pollution. Where practicable refuelling of vehicles and machinery will be carried out at a central designated area, on an impermeable surface, which will be located at least 50 m away from any watercourses.

Concrete Works

8.9.20. Concrete would be required for the construction of the wind turbine foundations. The following section provides good practice measures that are required to be implemented to prevent detrimental effects to the hydrological environment.

8.9.21. Care will be taken during the transportation of concrete to the turbine and building foundations using good practice measures. Freshly mixed concrete and/or dry cement powder will not be allowed to enter any watercourse. This will be implemented by:

- Locating turbines, concrete batching (if considered) or wash out areas at least 50 m from watercourses;
- Concrete wagons will only be permitted to wash-out into specifically designed wash-out areas and predetermined at agreed locations Site wide;
- The drivers will be informed at their Site induction of the location of the designated wash-out areas and issued with a location map;
- Loads will be managed and assessed with regards to the size of vehicle and ground conditions whilst keeping at appropriate speed limits to avoid spillage.
- Tools and equipment will not be cleaned in watercourses. Should it be necessary to clean tools and equipment on the Site, this will be done in the predetermined wash-out areas;
- A designated concrete wash out will be constructed within the Site at a location agreed with the relevant consultees to protect the watercourses. The design and construction of these wash out areas will be agreed with SEPA; and
- Wash out areas will be continually monitored, and findings recorded to prevent a rise in effluent levels and avoid a spill over into the environment.

Welfare Facilities/Foul Water

8.9.22. The following measures will be adopted for the design of the foul water drainage system:

- Any sewage associated with the temporary construction compound and welfare facilities will be collected in appropriately sized interceptor tanks and shall be located at the construction compound. All wash basins, toilets and shower areas shall also be connected to an interceptor tank; and
- The interceptor tanks and the tanks within any Site portable toilets, which shall be situated not less than 50 m from any watercourse, will be emptied regularly by a suitably licensed contractor. Sewerage from these facilities will be disposed offsite in accordance with waste management legislation.

Site Drainage

8.9.23. The following section discusses the conventional Site drainage measures that can be installed during the construction and operation of the Proposed Development.

8.9.24. Surface drainage ditches will be installed alongside tracks only where necessary. The length, depth and gradient of individual drains will be minimised to avoid intercepting large volumes of diffuse overland flow and generating high velocity flows during storm events. Sediment traps, settlement ponds and buffer strips will be incorporated into the drainage system as necessary and will serve the dual purpose of attenuating peak flows, by slowing the flow of runoff through the drainage system and allowing sediment to settle before water is discharged from the drainage system.

8.9.25. As well as utilising sediment traps, structures such as v-notched weirs and/or check dams will be installed within the drainage channels. Such structures will throttle the flow within the channel, thus reducing erosive potential of any runoff and allowing sediment and/or pollutants to settle.

8.9.26. To reduce the impact of the Proposed Development on the natural hydrological regime, the Site drainage will mimic greenfield runoff response through the use of sustainable drainage practices.

8.9.27. Sustainable Drainage Systems (SuDS) will be taken into consideration as part of the water management and details of the proposed SuDS regime would be included in the CEMP that will be produced post-consent to discharge planning conditions and the Pollution Prevention Plan (PPP) that will be produced as part of the application that would be made to SEPA for a construction runoff permit (CRP).

8.9.28. SuDS are used to attenuate rates of runoff from development sites and can also have water purification benefits. The implementation of SuDS as opposed to conventional drainage systems provides several benefits by:

- Reducing peak flows to watercourses and potentially reducing risk of flooding downstream;
- Reducing the volumes and frequency of water flowing directly to watercourses;
- Improving water quality by removing pollutants;
- Reducing potable water demand through rainwater harvesting; and
- Replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

8.9.29. Whilst it is understood that the scope for SuDS measures is limited as a result of the hydrological environment, it is recommended that the installed drainage measures adopt the principles highlighted above.

8.9.30. Access tracks crossing slopes will disrupt surface flow that consequently will collect in drains constructed upslope of the tracks. Cross-drains and/or water bars will be constructed at regular intervals to conduct this surface flow below or across the track where it will be discharged back into the drainage system, although all efforts will be made to segregate this runoff from more-silty runoff originating from track surfaces and other exposed construction areas, thus reducing the silt load and volume discharging to all silt treatment areas. Regular discharge points will limit the concentration of surface runoff and the diversion of flows between catchments. Such cross drains need to be strong enough to withstand the expected traffic loadings.

8.9.31. During storm events there is likely to be some ponding on the uphill side of tracks, as percolation alone is unlikely to be able to accommodate surface flows. To minimise this ponding, small diameter cross drains or perforated pipes (similar to plastic pipe field drains) would be incorporated into the track base at regular intervals to allow more flow to pass through the track and maintain the current flow regime. It is recommended that such pipes are surrounded by free draining material that is wrapped in a separator geotextile. The number of pipes and associated dimensions will be dependent upon the width of the flush/boggy area, proximity to GWDTE and the hydrological regime.

8.9.32. Prior to track construction, site operatives will identify flush areas, depressions or zones which may concentrate water flow. These sections will be spanned with plastic pipes to help maintain hydraulic conductivity under the road and reduce water flow over the road surface during heavy precipitation.

8.9.33. Due to the poor permeability of the surrounding peat, peaty soils and bedrock, it is also recommended that drains and/or cut-off drains are installed on the upstream/upgradient sides of the turbine foundations, crane hardstands, and other excavations required across the Proposed Development. The purpose of this will be to help reduce the volume of surface water runoff entering the excavations and minimise any subsequent contamination.

8.9.34. The constructed drainage system will not discharge directly to any natural watercourse, but will discharge to buffer strips, trenches or SuDS measures, preferably on flatter, lower lying ground. These buffers will act as filters and will minimise sediment transport, attenuate flows prior to discharge and maximise infiltration of water back into the soils and peat.

8.9.35. Drainage from the construction compounds, welfare facilities, borrow pits and concrete wash out areas will be collected and treated separately from the main Site drainage, as the runoff from these areas is more likely to be contaminated and therefore will require treatment. Appropriate treatment, such as oil interceptors and treatment for high alkalinity, will be installed.

8.9.36. Mitigation will follow industry good practice. All mitigation and drainage will be subject to detailed design and approved by SEPA prior to construction with the ECoW ensuring compliance. The Proposed Development will also be subject to a CRP. Further suggested measures include ensuring the detailed design includes buffer areas indicating “no construction zones” whereby the micrositing of infrastructure is not permitted. This will also include construction activities, including stockpile storage areas, refuelling areas are not located within buffers of watercourses or the catchments of private water supplies.

Emergency Water Management Measures

8.9.37. A large volume of oils and chemicals will be stored on Site during the construction phase and to a lesser extent the operational phase. Site traffic will also be present in significant numbers during the construction phase of the Proposed Development, with traffic volumes significantly reduced during Wind Farm operation.

8.9.38. The appropriate storage of oils, chemicals and maintenance of Site plant has been discussed above. However, despite these measures, accidents can happen, and these can have significant impacts upon the quality of the surface and groundwater environment. The following emergency procedures can be implemented to allow protection of the surface and groundwater environment during the construction and operation of the Proposed Development:

- All relevant on-site staff to be trained in both normal operating and emergency procedures and be made aware of highly sensitive areas on Site. The staff training and implementation of Site procedures will be overseen by the Infrastructure Contractor. These measures should be carried out effectively to minimise the risk of a pollution incident;
- Contingency plans should provide information on where emergency equipment is available on site (i.e. spill kits and absorbent materials), and that provide advice on actions to be taken and who would be informed, in the event of a pollution incident;
- Contingency planning procedures must be regularly reviewed to include changes to site operations that were not foreseen during design;
- The procedures set out in Site contingency plans need to be prepared in conjunction with the assessment of the risk of a pollution incident occurring and the measures to be taken to minimise pollution. The location of the procedures will be publicised, and it is essential that they are set out clearly so that they can easily be understood and acted upon; and
- The emergency procedures can include the following:
  - Containment measures;
  - Emergency discharge routes;
  - List of appropriate equipment and clean-up materials;
  - Maintenance schedule for equipment;
  - Details of trained staff, location, and provision for 24-hour cover;
  - Details of staff responsibilities;
  - Notification procedures to inform the relevant environment protection authority;
  - Audit and review schedule;
  - Telephone numbers of statutory and local water company; and
  - List of specialist pollution clean-up companies and their telephone numbers.

8.10. Potential Construction Effects

8.10.1. The potential for significant environmental effects on the hydrological environment is greatest during the construction phase due to the high levels of activity on-site and when there is greatest change to the existing environment. The construction of the Proposed Development is discussed in the following paragraphs, this information is considered in the mitigation and management measures outlined in the mitigation measure section below.

8.10.2. The evaluation of construction effects is provided in Table 8.21 below. The table assumes the successful implementation of the mitigation measures provided in Section 8.9.

Pollution incidents

8.10.3. During the construction phase, a number of potential pollutants will be present onsite, including oil, fuels, chemicals, unset cement and concrete, waste and waste water from construction activities and staff welfare facilities. Most potential pollutants will be located or stored within the construction compound. In addition, there is the potential for contamination of the hydrological and terrestrial environment caused by spillages along the access tracks and construction areas.

Erosion and sedimentation

8.10.4. Soil and sediment generation may occur in areas where the ground has been disturbed, particularly where surface runoff has been concentrated. Drainage ditches are particularly prone to this, due to the high velocities of surface water runoff passing through the drainage network. Considerable sediment generation is expected where the ground has been excavated for the Proposed Development infrastructure.

8.10.5. Sediment transport in watercourses can result in high turbidity levels which can impact on the water quality, particularly affecting the ecological potential of the watercourses. High turbidity in watercourses can reduce the light and oxygen levels in the watercourses, while sediment deposition can smother plant life and spawning grounds. Sediment deposition can also reduce the flood storage capacity of the watercourses and block culverts, resulting in an increased flood risk.

8.10.6. Felling would be required in a small section of the forestry to allow for the construction of the access tracks. Forestry felling has the potential to expose soils. The removal of closed canopy will result in reduced levels of interception and transpiration of precipitation. As such, felling has the potential to increase the volume of runoff entering watercourses, with increased soil erosion and sedimentation.

8.10.7. As a result of the construction operations, all catchments with new and upgraded infrastructure present are vulnerable to erosion and sedimentation.

Acidification & Water Quality

8.10.8. Tree removal also can increase nitrogen mineralisation and nitrification, which can promote nitrate leaching and enhance acidity in waters draining some soils. The effect can last between two to five years after felling, depending upon the rate at which vegetation re-establishes. The filling of trenches with fresh brash could accentuate the effect by promoting leaching below the rooting zone.

Increase in runoff

8.10.9. Turbine bases, hardstanding areas and access tracks will act as impermeable areas, restricting the natural movement of water within the hydrological environment, potentially resulting in increased rates of runoff into the onsite catchments.

8.10.10. In the areas which are to be felled, localised runoff responses have the potential to increase due to the reduction in precipitation being intercepted by the closed canopy forestry. The effects on runoff will be dependent upon the extent of forestry management and the felling techniques adopted. Felling and extraction would also be planned to minimise the number of drain crossings and reduce any increases in runoff.

8.10.11. Localised increases could cause issues for downstream flood storage capacity and/or pollution incidents. Increases in the volume of runoff entering watercourses could also cause erosion and sedimentation, therefore having detrimental effects on surface water hydrology.

Modification of surface drainage patterns

8.10.12. The interception of diffuse overland flow by the Proposed Development and associated drainage may disrupt the natural drainage regime of the area, concentrating flows and potentially diverting flows from one catchment to another. This may have implications on flood issues downstream of the Proposed Development.

Impediments to surface water flow

8.10.13. The construction of watercourse crossings may restrict flow in the various channels and reduce hydraulic capacity, resulting in an increase in flood risk, and promotion of erosion and sedimentation. In addition, poorly designed watercourse crossings may impede the migration of fish and mammal movement in the riparian corridor.

Modification of groundwater flows and levels

8.10.14. Deep excavations, such as those required for the turbine foundations are likely to disrupt the shallow groundwater systems and bedrock geology. Surface water ingress will be minimised utilising upgradient cut-off drains or other drainage measures. The installation of cut-off drains as well as dewatering excavations has the potential to lower local groundwater levels within surrounding peat and peat dominated soils.

8.10.15. Access tracks have the potential to disrupt flow pathways, such as interrupting shallow groundwater flow or altering the hydrological regime.

8.10.16. Actual GWDTE habitats have been assessed as having a low dependency on groundwater. Construction of the Proposed Development may have the following potential effects on the quantity and quality of groundwater supplying GWDTE habitats:

- Turbine foundations, borrow pits and hardstand areas located up-gradient from GWDTE could disrupt shallow groundwater flow from dewatering and diversion of flow paths;
- Turbine foundations, borrow pits and hardstand areas located down-gradient from GWDTE could cause temporary lowering of the water table from dewatering;
- Access tracks, drainage ditches and cable trenches located up-gradient from GWDTE could disrupt and divert shallow groundwater flow-paths;
- Infrastructure located directly over GWDTE habitats could contaminate and lower the quality of groundwater supplying GWDTE through pollution and sedimentation; and
- Runoff from construction areas up-gradient of GWDTE may infiltrate into shallow groundwater aquifers and contaminate and lower the quality of groundwater supplying GWDTE through pollution and sedimentation.

Compaction of soils

8.10.17. The movement of construction traffic within the Site is likely to cause localised compaction of the ground surface, leading to changes in both the hydrological and hydrogeological regime. The impacts of compaction are likely to be highly localised but will damage the vegetation and result in a reduction in the soil permeability and rainfall infiltration, thereby increasing the potential for flood risk and erosion.

8.11. Assessment of Construction Effects

8.11.1. Table 8.22 identifies the likely construction effects on the identified receptors and their significance assuming the successful implementation of good practice and mitigation measures. The assessment is based on the criteria outlined in Section 8.4: Method of Assessment.

Table 8.22: Assessment of Construction Effects

Potential Effect	Identified Receptor	Potential Effect Assuming Implementation of Mitigation Measures			Additional Mitigation	Potential Effect Assuming Implementation of Additional Mitigation		
		Sensitivity	Magnitude of Effect	Significance of Effect		Sensitivity	Magnitude of Effect	Significance of Effect
Flood Risk								
• Increase in runoff	Proposed Development	Medium	Low	Minor	-	-	-	-
• Modifications to Surface Drainage Patterns • Impediments to Surface Water Flow • Compaction of Soil	Downstream of Proposed Development	High	Low	Moderate (Not Significant)	-	-	-	-
Water Quality								
	River Nith	Low	Low	Negligible	-	-	-	-
	Cumnock Water	High	Low	Moderate (Not Significant)	-	-	-	-
• Pollution incidents	Muck Water	High	Low	Moderate (Not Significant)	-	-	-	-
• Erosion and sedimentation	Pochriegavin Burn	Low	Low	Negligible	-	-	-	-
• Acidification	Water of Deugh	Low	Low	Negligible	-	-	-	-
• Increase in Runoff	River Doon	Low	Low	Negligible	-	-	-	-
• Modifications to Surface Drainage Pattern	Lane Burn	High	Low	Moderate	-	-	-	-
• Impediments to Surface Water Flow	Cumnock (GW)	Low	Low	Negligible	-	-	-	-
	South Ayrshire Hills (GW)	Medium	Low	Minor	-	-	-	-
	Upper Nithsdale	Low	Low	Negligible	-	-	-	-
Water Resources								
• Pollution incidents • Erosion and sedimentation • Changes in Water Quality • Increase in Runoff • Modifications to Surface Drainage Pattern • Impediments to Surface Water Flow • Modification of Groundwater Flows and Levels • Compaction of Soils	Private Water Supplies	High	Low	Moderate (Not Significant)	-	-	-	-
Soils and Peat								
• Pollution incidents • Modifications to Surface Drainage Patterns	Site soils and peat >0.5 m depth	Medium	Low	Minor	-	-	-	-
• Modification of Groundwater Flows and Levels • Compaction of Soils	Site soils (≤0.5 m depth)	Low	Low	Negligible	-	-	-	-

8.12. Potential Operational Effects

8.12.1. The effects of the Proposed Development are expected to be substantially lower during the operational phase.

8.12.2. Following the construction of the Proposed Development, all infrastructure will be left in-situ to permit maintenance.

8.12.3. The potential operational effects of the Proposed Development are associated with the permanent site infrastructure, including the turbine foundations, access tracks and any required maintenance work during operation.

8.12.4. The assessment of operational effects considers that the pollution prevention controls, and permanent drainage installed during the construction will remain in place during operation and would be safe guarded through the provision of an Operational Environmental Management Plan (OEMP).

8.12.5. The following paragraphs discuss the potential effects that may occur during the operational phase of the Proposed Development.

Pollution Incidents

8.12.6. The potential risk of pollution is substantially lower during operation than during construction because of the decreased levels of activity in the operational phase. The majority of potential pollutants will have been removed when construction is complete. The majority of potential pollutants will have been removed when construction is complete; however, lubricants for turbine gearboxes, transformer oils and possible fuel leaks from maintenance vehicles will remain.

Erosion and Sedimentation

8.12.7. Levels of erosion and sedimentation during operation will be much lower than construction as there will be no excavations or base exposed ground. Some erosion and sedimentation is still possible on site tracks and drainage ditches as a result of scouring during extreme rainfall events. Similarly, there could be some erosion and sedimentation around new stream crossing as watercourses reach new equilibrium.

Modifications of Surface Drainage Patterns

8.12.8. Modification of surface runoff will occur as a result of the construction of the new infrastructure associated with the Proposed Development. The operational effects are likely to result in changes to volume and/or changes to runoff rate.

8.12.9. Poorly designed site tracks and associated drainage could allow surface water to travel through a catchment much faster than if it were to travel as diffuse overland flow. This could result in an increase in runoff rates, peak flows and influence response times during storm events. The utilisation of many of the existing tracks reduces the magnitude of the changes expected to the drainage regime.

Impediments to Surface Water Flows

8.12.10. During the operational phase, impediments to flows can generally occur as a result from blockages to watercourse crossing, ditches and watercourses resulting from vegetation and erosion debris.

Modification of Groundwater Flow and Levels

8.12.11. Tracks and their drainage as well as turbine foundations and hardstandings will potentially alter the water table within the upslope and downslope peat and upper bedrock aquifers, which can also have implications for the long term functionality of peatland environments. Backfilled cable trenches can also provide preferential flow pathways for groundwater.

Compaction of Soils

8.12.12. The compaction of soils/peat is likely to be significantly reduced during the operational phase as a result of less heavy traffic movement.

8.13. Assessment of Predicted Operational Effects

8.13.1. Table 8.23 below identifies the likely operational and ongoing effects on the identified receptors and their significance assuming the successful implementation of good practice and mitigation measures. The assessment is based on the criteria outlined in Section 8.4.

Table 8.23: Assessment of Operational Effects

Potential Effect	Identified Receptor	Potential Effect Assuming Implementation of Mitigation Measures			Additional Mitigation	Potential Effect Assuming Implementation of Additional Mitigation		
		Sensitivity	Magnitude of Effect	Significance of Effect		Sensitivity	Magnitude of Effect	Significance of Effect
Flood Risk								
• Increase in runoff	Proposed Development	Minor	Negligible	Negligible	-	-	-	-
• Modifications to Surface Drainage Patterns • Impediments to Surface Water Flow • Compaction of Soil	Downstream of Proposed Development	High	Negligible	Minor	-	-	-	-
Water Quality								
	River Nith	Low	Negligible	Negligible	-	-	-	-
	Cumnock Water	High	Negligible	Minor				
• Pollution incidents	Muck Water	High	Negligible	Minor				
• Erosion and sedimentation	Pochriegavin Burn	Low	Negligible	Negligible	-	-	-	-
• Acidification	Water of Deugh	Low	Negligible	Negligible	-	-	-	-
• Increase in Runoff	River Doon	Low	Negligible	Negligible	-	-	-	-
• Modifications to Surface Drainage Pattern	Lane Burn	High	Negligible	Minor	-	-	-	-
• Impediments to Surface Water Flow	Cumnock (GW)	Low	Negligible	Negligible	-	-	-	-
	South Ayrshire Hills (GW)	Medium	Negligible	Negligible	-	-	-	-
	Upper Nithsdale	Low	Negligible	Negligible	-	-	-	-
Water Resources								
• Pollution incidents • Erosion and sedimentation • Changes in Water Quality • Increase in Runoff • Modifications to Surface Drainage Pattern • Impediments to Surface Water Flow • Modification of Groundwater Flows and Levels • Compaction of Soils	Private Water Supplies	High	Negligible	Minor	-	-	-	-
Soils and Peat								
• Pollution incidents • Modifications to Surface Drainage Patterns	Site soils and peat >0.5 m depth	Medium	Negligible	Negligible	-	-	-	-
• Modification of Groundwater Flows and Levels • Compaction of Soils	Site soils (≤0.5 m depth)	Low	Negligible	Negligible	-	-	-	-

8.14. Decommissioning

8.14.1. During decommissioning of the Proposed Development potential impacts on the hydrological, geological, and hydrogeological environment are expected to be less than those encountered during the construction phase and therefore, 'not significant'. No specific mitigation measures are therefore identified. The decommissioning of the Proposed Development would adhere to the latest legislative and guidance requirements at the time.

8.15. Cumulative Effects and Interaction of Effects

8.15.1. The application of a hydrological catchment methodology enables a logical evaluation of the potential for cumulative effects of the hydrological environment.

8.15.2. There are a number of wind farm developments within 10 km of the Proposed Development and within the catchments of identified watercourses. These developments are detailed in Table 8.24.

Table 8.24: Developments Within 10 km Search Area and Within Relevant Catchments

Development	Distance from Proposed Development	Phase of Development	Hydrological Catchment
Afton Wind Farm	~7 km East	Operational	River Nith
Benbrack Wind Farm	~1 km South	Construction	River Dee and River Doon
Dersalloch Wind Farm	~7 km West	Operational	River Doon
Enoch Hill Wind Farm	Immediately adjacent East	Construction	River Nith
Euchanhead Renewable Energy Development	~10 km East	Application	River Nith
Greenburn Wind Park	~4 km north	Consented	River Nith
Hare Hill I & II Wind Farm	~10 km East	Operational	River Nith
Knockkippen Wind Farm	~5 km Northwest	Application	River Doon
Lorg Wind Farm	~8 km East	Application	River Nith
North Kyle Wind Farm	~700 m North	Construction	River Doon, River Nith
Over Hill Wind Farm	~700 m North	Consented	River Nith
Pencloe Wind Farm	~6 km East	Consented	River Nith
Quantans Hill Wind Farm	~4 km South	Application	River Dee
Sanquhar II Wind Farm	~10 km East	Consented	River Nith
Sclenteuch Wind Farm	~7 km West	Application	River Doon
South Kyle Wind Farm (Phase 1)	Within Proposed Development Area	Operational	River Dee, River Doon and River Nith
Windy Rig Wind Farm	~7 km Souteast	Operational	River Dee
Windy Standard Wind Farm Complex	~5 km Southeast	Operational (repower proposed)	River Dee

Source: Natural Power (2024)

8.15.3. The construction and subsequent operation of the schemes outlined above as well as the Proposed Development has the potential to cumulatively affect the water quality, flooding and groundwater resources associated with the three main catchments identified within the assessment.

8.15.4. However, these operational and proposed wind farm developments are at various stages of development and would unlikely be concurrent in terms of construction. It is assumed that detailed mitigation and monitoring plans (following industry good practice) would be successfully implemented. Therefore, it is expected that any cumulative effects would be of minor significance and **not significant** in EIA terms.

8.16. Monitoring

8.16.1. A programme of surface water quality and PWS monitoring will be finalised post consent, prior to construction. A breakdown of the proposed monitoring methodologies has been provided to consider sensitivities of the on-site and downstream environments.

8.16.2. The details of any required monitoring will be discussed and agreed with SEPA, and EAC prior to commencement. The extent and the frequency of the monitoring will be proportionate to the level of activity on-site during the construction, operation and decommissioning of the Proposed Development. Appropriate monitoring is important to:

- provide reassurance that established in-place mitigation measures are effective and that the Proposed Development is not having any significant adverse effect upon the environment;
- indicate whether further investigation is required and, where pollution is identified, the need for additional mitigation measures;
- reduce or remove any impacts on the water environment; and
- understand the long-term effects of the Proposed Development on the natural environment.

8.16.3. A baseline surface water monitoring programme will be undertaken prior to the commencement of construction works. The establishment of a baseline is very important as it provides a suite of parameters against which to compare samples taken during the Proposed Development's lifetime, and with which to assess any impacts and the requirement for any appropriate remedial measures. However, due to the variance in climatic conditions, recording like for like water quality prior to and during construction is likely to be unusual. Therefore, it is also recommended that control sites, situated outside the area affected by the Proposed Development infrastructure, are also established at the same time.

8.16.4. A suitably qualified ECoW will be employed throughout the construction of the Proposed Development. The appointed ECoW can provide advice to the contractors about how environmental effects can be minimised, and what methods can be employed to reduce effects on water quality, soils and associated habitats.

8.16.5. Monitoring will be undertaken throughout construction of the Proposed Development. The monitoring will help to identify areas where infrastructure is having a negative effect on peat and soils and utilise the appropriate methods to prevent further deterioration and/or promote further enhancement.

8.16.6. All construction management and water management techniques are agreed prior to construction. The techniques would be agreed following consultation with SEPA, and EAC.

8.17. Licensing Requirements

8.17.1. SEPA recently amended the requirements under CAR brought in by the Water Environment (Miscellaneous) (Scotland) Regulations 2017 to impose the need for individual sites to require a site-specific runoff permit relating to surface water drainage, rather than individual activities required to adhere to the regulations. This requirement is linked to specific criteria for a construction site, including access tracks, of >4 hectares, or >5 km or which includes any area >1 hectare or >500 m on ground with slope >25º.

8.17.2. It is acknowledged that to support the site licence application, further information on the drainage and environmental management requirements is likely to be required. It should be acknowledged within this chapter of the assessment that the information relating to good practice has been provided, but that the level of detail to support a CAR licence application would follow post-determination of the application.

8.18. Conclusions

8.18.1. An assessment has been carried out of the likely impacts of the Proposed Development on the hydrological, hydrogeological and geological environment. The assessment has considered site preparation, construction and operation of the Proposed Development.

8.18.2. The potential effects on the hydrological, geological and hydrogeological environment have considered, pollution incidents, erosion and sedimentation, changes in water quality, changes to water resources i.e., modification of surface water and groundwater flows, modification of natural drainage patterns, impediments to flow and flood risk, peat instability and compaction of soils.

8.18.3. Following the identification and assessment of the key receptors, considering the potential effects listed above, mitigation and good practice measures have been incorporated into the design, including extensive buffer areas and avoidance of siting infrastructure on deep peat wherever possible. In addition, a site-specific CEMP as well as detailed design of infrastructure and associated mitigation will be implemented to protect the groundwater and surface water resources from pollution and minimise changes to the hydrological environment.

8.18.4. The impact assessment has considered the hydrological regime, highlighting that the principal effects will occur during the construction and operational phase. Following the successful design and implementation of mitigation measures the significance of construction and operational effects on all identified receptors are as assessed as not significant.

8.18.5. Good practice design and construction of the Proposed Development delivered through a skilled team of competent workers, with mitigation and compliance monitored in collaboration with SEPA and EAC and other engaged stakeholders, will result in residual effects that are considered to be not significant in terms of the EIA Regulations.