Chapter 9 Hydrology, Geology and Hydrogeology

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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
ECoW	Environmental Clerk of Works
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
NPF4	National Planning Framework 4
NVC	National Vegetation Classification
PAN	Planning Advice Notes
PD Site	Proposed Development Site
PWS	Private Water Supply
PWSRA	Private Water Supply Risk Assessment
RBMP	River Basin Management Plan
SAC	Special Area of Conservation
SBC	Scottish Borders Council
SEPA	Scottish Environmental Protection Agency
SNH	Scottish Natural Heritage (now NatureScot)

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

Glossary

Abbreviation	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 drawing together by the developer, in a systematic way, a description of the development and information relating to of the likely significant environmental effects arising from a proposed development.
Environmental Impact Assessment Report	A document reporting the findings of the EIA and produced in accordance with the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017
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 proposed Lees Hill Renewable Energy Park as described in Chapter 4, Volume 2 of this EIAR
Proposed Development Site	The project development area within the site boundary as shown in Figure 1.2, Volume 3a.
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.
Sub-catchment	A division of a catchment, to allow runoff to be managed as near to the source as is reasonable.
Tributary	An adjoining stream which flows into the main river.

9. Hydrology, Geology and Hydrogeology

9.1. Statement of Competence

9.1.1. 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, hydrogeological and soil environment considerations discussed in this chapter.

9.1.2. This document has been approved by Emma Bryder whose qualifications include PhD in Geography and MSc in Sustainability and Environmental Studies. Since 2017 Emma has been responsible for the writing and review of numerous Hydrology, Hydrogeology and Geology Environmental Impact Assessment chapters for onshore wind farm developments across the UK.

9.1.3. She has experience of offering advice and solutions to protect the water environment, hydrogeology, peat and soils during construction, operation and decommissioning of wind farm developments. Work carried out involves regular liaison with statutory consultees as well as collaborating with ecologists, geotechnical engineers and project managers to allow all work to be carried out in line with industry good practice, agreed consenting strategies and up-to-date legislation.

9.2. Introduction

9.2.1. This chapter of the Environmental Impact Assessment Report (EIAR) provides an assessment of the potential impact of Lees Hill Renewable Energy Park (the Proposed Development) on the hydrological, geological and hydrogeological environment and assesses the likely environmental effects resulting from the construction and operation of the proposed turbines, solar photovoltaic (PV) cells 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.

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

- Infrastructure is proposed within the specified Ground Water Dependent Terrestrial Ecosystem (GWDTE) buffers however with the correct mitigation and assessment (presented in Technical Appendix 9.2, Volume 4 in of this EIAR) effects have been reduced to minor and not significant.
- Effects on conservation sites located downstream of the Proposed Development can be reduced by the implementation of the recommended mitigation measures. The effects on Greenlaw Moor RAMSAR/Site of Special Scientific Interest (SSSI)/Special Protection Area (SPA) and Langtonlees Cleugh SSSI have been reduced to moderate/minor and not significant.
- Effects on surface water quality (notably the Langton Burn Water Framework Directive (WFD) surface waterbody) can be reduced with the implementation of the recommended mitigation measures. Effects in the Langton Burn WFD surface waterbody have been reduced to moderate/minor and not significant.

- Private Water Supplies were identified within the sub catchments of the Proposed Development. The majority of the Proposed Development Site is underlain by a moderately productive aquifer and uncertainty arises from the difficulty in tracking groundwater flow therefore extra mitigation and monitoring measures have been stipulated to safeguard Private Water Supply (PWS) water quality or quantity. Effects to PWS were reduced to moderate/minor, and not significant, with the recommended mitigation methods.
- The Proposed Development would largely be located on aquifers of good WFD status and of moderate groundwater potential. The recommended mitigation measures would reduce the effects on groundwater underling the Proposed Development to moderate/minor and not significant.

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

- Technical Appendix 9.1: Private Water Supply Risk Assessment, Volume 4;
- Technical Appendix 9.2: Ground Water Terrestrial Ecosystems Screening Assessment, Volume 4; and
- Technical Appendix 9.3: Borrow Pit Assessment, Volume 4.

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

- Figure 9.1: Hydrological Overview, Volume 3a;
- Figure 9.2: Predominant Soils, Volume 3a;
- Figure 9.3: Carbon and Peatland Soils, Volume 3a;
- Figure 9.4: Interpolated Peat Depth, Volume 3a;
- Figure 9.5: Bedrock Geology, Volume 3a;
- Figure 9.6: Superficial Geology, Volume 3a;
- Figure 9.7: Potential Groundwater Dependent Terrestrial Ecosystems, Volume 3a; and
- Figure 9.8: Hydrological Constraints, Volume 3a.

9.3. Legislation Policy and Guidance

Policy Context

9.3.1. The assessment takes into account the requirements of the Water Framework Directive (2000/60/EC) (WFD). The WFD aims to protect and enhance the quality of surface freshwater (including lakes, rivers and streams), groundwater, groundwater dependant terrestrial ecosystems (GWDTE), estuaries and coastal waters. The key objectives of the WFD relevant to this assessment are:

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

9.3.2. The WFD was transposed into Scottish law by The Water Environment and Water Services (Scotland) Act 2003, which gave Scottish Ministers powers to introduce regulatory controls over water activities in order 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) or CAR, which are applied out with the Electricity Act 1989 and Town and Country Planning Act 1997 consenting regime and made it an offence to undertake the following activities without a regulatory authorisation:

- discharges to all wetlands, surface waters and groundwaters;
- disposal to land;
- abstractions from all wetlands, surface waters and groundwaters;
- impoundments (dams and weirs) of rivers, lochs, wetlands and transitional waters; and
- engineering works in inland waters and wetlands.

National Legislation and Policy

9.3.3. The assessment takes into account the following legislation and policy (in chronological order):

- Part IIa of the Environment Protection Act 1990;
- Waste Management Licensing Regulations 1994;
- The Water Environment and Water Services (Scotland) Act 2003;
- Landfill (Scotland) Regulations 2003;
- Private Water Supplies (Scotland) Regulations 2006;
- Water Environment (Oil Storage) (Scotland) Regulations 2006;
- Flood Risk Management (Scotland) Act 2009;
- The Water Supply (Water Quality) (Scotland) Regulations 2010;
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended);
- Pollution Prevention and Control Regulations (Scotland) Regulations 2012;
- The Water Environment (Miscellaneous) (Scotland) Regulations 2017;
- The Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017;
- National Planning Framework 4 (NPF4); and
- Scottish Environment Protection Agency (SEPA) Policies:
  - No. 19 Groundwater Protection Policy for Scotland;
  - No. 22 Flood Risk Assessment Strategy;
  - No. 41 Development at Risk of Flooding: Advice and Consultation;
  - No. 54 Land Protection Policy; and
  - No. 61 Control of Priority & Dangerous Substances & Specific Pollutants in the Water Environment.

Regional & Local Policy

9.3.4. The assessment takes into account the following local development plan policies which are addressed in Chapter 5: Statutory and Policy Framework, Volume 2 and the Planning and Sustainable Place Statement:

- Scottish Borders Council Local Development Plan (LDP), Adopted May 2016 & Proposed September 2023 (see discussion in Chapter 5)
  - The adopted Local Development Plan supports sustainable development across the Scottish Borders. Of particular relevance is Policy ED9: Renewable Energy Development, Policy EP15: Development Affecting the Water Environment and Policy IS8: Flooding within the LDP.

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

- Scottish Borders Council (2022) Tweed Local Plan District, Local Flood Risk Management Plan.

Other Guidance and Good Practice

9.3.6. Table 9.1 lists other key guidance and good practice documentation considered as part of this assessment.

Table 9.1: Guidance and Best Practice

Topic	Source of Information
Scottish Government Planning Advice Notes (PANs)	PAN 50 (1996), Controlling the Environmental Effects of Surface Mineral Workings PAN 51 (2006), Planning, Environmental Protection and Regulation PAN 1/2013 (2013), Environmental Impact Assessment PAN 61 (2001), Planning and Sustainable Urban Drainage Systems Flood Risk (2015), Planning Advice PAN 79 (2006), Water and Drainage
SEPA Guidance for Pollution Prevention (GPPs)	GPP1 (2020), Understanding your environmental responsibilities – good environmental practices GPP2 (2018), Above Ground Oil Storage Tanks GPP4 (2017), Treatment and Disposal of Wastewater Where there is no Connection to the Public Foul Sewer GPP5 (2018), Works and maintenance in or near water GPP6 (2023), Working at Construction and Demolition Sites GPP 8 (2017), Safe Storage and Disposal of Used Oils GPP 13 (2017), Vehicle Washing and Cleaning GPP 21 (2021), Pollution Incident Response Planning GPP 22 (2018), Dealing with Spills GPP 26 (2019), Safe Storage - Drums and Intermediate Bulk Containers
SEPA Position Statements (Published)	WAT-PS-06-02: SEPA (2015), Culverting of Watercourses, Version 2 WAT-PS-07-02: SEPA (2012), Bank Protection, Version 2 WAT-SG- 78: SEPA (2012), Sediment Management Authorisation, Version 1 WAT-SG-23: SEPA (2008), Engineering in the Water Environment, Good Practice Guide - Bank Protection Rivers and Lochs, Version 1 WAT-SG-25: SEPA (2010), Engineering in the Water Environment, Good Practice Guide, Construction of River Crossings, Version 2 WAT-SG-26: SEPA (2010), Engineering in the Water Environment, Good Practice Guide, Sediment Management, Version 1 WAT-SG-29: SEPA (2009), Engineering in the Water Environment, Good Practice Guide, Temporary Construction Methods, 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
Construction Industry Research and Information	CIRIA C692 (2010), Environmental Good Practice on Site (third edition) CIRIA C753 (2015), The SuDS Manual CIRIA C532 (2001), Control of Water Pollution from Construction Sites

Association (CIRIA)	CIRIA C648 (2006), Control of Water Pollution from Linear Construction Projects CIRIA C786 (2019), Culvert, Screen and Outfall Manual
Other Guidelines	British Standards, (2009), BS6031: 2009 Code of Practice for Earth Works Forestry Commission Scotland (FCS) and Scottish Natural Heritage (SNH) (2010), Floating Roads on Peat NatureScot and Scottish Renewables Joint Publication (2019). Good Practice During Wind Farm Construction Version 4 SEPA and SGt (2010), Engineering in the Water Environment: Good Practice Guide – Sediment Management; SEPA and SGt (2010), Engineering in the Water Environment: Good Practice Guide – River Crossings; SEPA, The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended). A Practical Guide, Version 8.5, July 2021 SEPA Land Use Planning Guidance CC1 (LUPS-CC1) (2019). Climate change allowances for flood risk assessment in land use planning. Issue 1 SEPA Land Use Planning Guidance Note 4 (2017). Planning Guidance on On-Shore Windfarm Developments, Version 9 SEPA Land Use Planning Guidance Note 31 (2017). Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems, Version 3 SEPA Land Use Planning Guidance Note 24 (2018). Flood Risk and Land Use Vulnerability Guidance Scottish Government (SGt), SNH, SEPA (2017). Peatland Survey Guidance on Developments on Peatland, on-line version only SGt (2000), River Crossings and Migratory Fish: Design Guidance Scottish Renewables, SNH, SEPA, FCS, Historic Environment Scotland (HES), Marine Scotland Science (MSS) and Association of Environmental and Ecological Clerks of Works (AEECoW) (2019), Good Practice During Wind Farm Construction, Fourth edition SNIFFER (2009). WFD95 A Functional Typology for Scotland

9.4. Method of Assessment

Initial Scope of Assessment

Effects Scoped out of the Assessment

9.4.1. Following submission of the Lees Hill Energy Park (April 2022) Scoping Report (Technical Appendix 1.1, Volume 4), effects on peat, geology and fisheries have been scoped out of the EIAR. The requirement for detailed Phase 2 peat depth surveys, peat slide risk assessment and a peat management plan (PMP) were screened out in Scoping Report due to the lack of peat encountered following Site survey. Further details on peat are given in Section 9.6 with interpolated peat depths indicated from survey work in Figure 9.4, Volume 3a.

9.4.2. Due to the limited amount of infrastructure on peat >0.5 m, a Carbon Balance Assessment has been scoped out. The online assessment tool (Carbon Calculator) assumptions and default inputs lead to a misrepresentation of the site characteristics if used for sites where there is limited or no peat and should not be used in such instances (an approach considered appropriate by the

Energy Consents Unit during the Windy Standard I Repower application proposals[1], where deeper peat >1.5 m was found on site but where infrastructure was largely located on peat <0.5 m). As such, the assessment is most appropriately undertaken for sites where infrastructure is located on upland peatlands, an approach further supported by the assessment guidance[2].

Effects Scoped into the Assessment

9.4.3. 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 GWDTEs);
- 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

9.4.4. 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

9.4.5. 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;

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[1] *Application Document -Clarification regarding the use of the carbon calculator – Windy Standard I Repower Report (06 February 2023). Available at https://www.energyconsents.scot/ApplicationDetails.aspx?cr=ECU00003324 [Accessed 15/03/2024]*

[2] *Calculating potential carbon losses and savings from wind farms on Scottish peatlands: technical guidance. Available at https://www.gov.scot/publications/carbon-calculator-technical-guidance/ [Accessed 15/03/2024]*

- 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

9.4.6. 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 Site and a 3 km buffer area immediately beyond the Proposed Development (Figure 9.1, Volume 3a). 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 Scottish Borders Council (SBC) Local Authority area.

Desk Study and Site Investigations

9.4.7. Published information sources used to characterise the baseline conditions within the Proposed Development Site and in the surrounding area is outlined in Table 9.2 below.

Table 9.2: Baseline Information Sources

Topic	Sources of Information
Topography	1:10,000 OS Raster Data 1:50,000 OS Raster Data
Designated Nature and Conservation Sites	In-house Designated Site Database. NatureScot, SiteLink website, Protected areas | NatureScot
Bedrock and Superficial Geology	BGS Geology of Britain Viewer, http://mapapps.bgs.ac.uk/geologyofbritain3d/index.html
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/
Climate	Met Office, https://www.metoffice.gov.uk/public/weather/climate/gcv3mcrf9 Flood Estimation Handbook (FEH): FEH Web Service, https://fehweb.ceh.ac.uk/ Flood Modeller Suite, https://www.floodmodeller.com/
Surface Water Hydrology	1:10,000 OS Raster Data 1:50,000 OS Raster Data Flood Estimation Handbook (FEH): FEH Web Service, https://fehweb.ceh.ac.uk/
Flooding	Flood Risk Management Map (SEPA) https://map.sepa.org.uk/floodmaps
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/
Water Resources	Private Water Supply (PWS) information provided by SBC Scottish Water
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-visualisation/water-classification-hub/

Effects Evaluation

9.4.8. 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 9.3 below.

Table 9.3: 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.
	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 1 – 3 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 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 9.3 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.

9.4.9. 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 judgement. Table 9.4

provides examples of how various levels of change have been determined with respect to water features.

Table 9.4: 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 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). No or very slight change in groundwater levels or quality, and no consequences in terms of status of WFD groundwater body or dependent receptors (including conservation sites and GWDTEs). No or very slight disturbance of geology and no consequences in terms of status of GCR site or Class 1 – 3 peat soils.
	Water use	No or very slight change in water availability or quality and no change in ability of the water user to exercise licensed rights or continue with small private abstraction.
	Flood risk	Increased frequency of flood flows, but which does not pose an increased risk to property or infrastructure.

9.4.10. 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.

9.4.11. In this assessment, effects are significant or not significant according to the matrix in Table 9.5, 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 Negligible magnitude of change, meaning changes to baseline conditions are deemed to be only very little or minor.

Table 9.5: Significance of effect

		Magnitude of Change			
		High	**Medium**	**Low**	**Negligible**
Sensitivity	**High**	Major (Significant)	Major (Significant)	Moderate (Probably 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)

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

9.4.13. 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

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

9.5. Consultation

9.5.1. The scoping and consultation responses relating the hydrological, geological and hydrogeological environment are summarised in Table 9.6 below.

Table 9.6: List of Consultee Responses

Consultee	Scoping Response	Addressed in EIAR
Scottish Borders Council	No objection to the proposal in terms of flood risk provided a Flood Risk Assessment is submitted.	Flood risk assessment has been carried out and is included in Section 9.6: Flood Risk.
	A buffer zone – ideally 50m- is adhered to between turbines and watercourses.	See Figure 9.1, Volume 3a for 50 m watercourse buffer. This Figure demonstrates that with exception of essential watercourse crossings that the 50m buffer of mapped watercourses has been adhered to.
	Any new hard surfaces such as access roads should be attenuated to at least existing greenfield runoff rates so that there is no increased effect on downstream receptors. Any discharges from SuDS and other drainage should be kept to existing Greenfield runoff rates.	Included in Section 9.7: Embedded Mitigation. It is confirmed that greenfield runoff rates would be maintained. Detailed design of drainage and SuDS would be provided by the Appointed Contractor post-consent.
	Watercourse crossings or alterations to crossings, these must not reduce the flow conveyance of the watercourse.	Watercourse crossings have been minimised to one crossing. See Section 9.7: Watercourse Crossing for further details. This crossing will be designed to accommodate the 1 in 200 year + Climate Change flood event.
	Details of the silt traps and any other functions that the applicant proposes to minimise the amount of sediment entering the watercourse should be submitted.	It is confirmed that there would be adequate silt mitigation. The principles are provided in Section 9.6: Embedded Mitigation. Further details would be included in CEMP post submission. To provide information on what would be included in the CEMP, an outline CEMP has been provided in Technical Appendix 4.1: Outline CEMP, Volume 4.
	Properties within 3 km of the Proposed Development must be identified and assessed.	Figure 9.1, Volume 3a shows the 3 km buffer from the Proposed Development Site and the PWS within this area. These PWS are assessed in Technical Appendix 9.1: Private Water Supply Risk Assessment, Volume 4.
NatureScot	The windfarm development could have connectivity with the River Tweed SAC/SSSI. Consideration needs to be given to the potential effects of construction, operation and decommissioning of the development (including access tracks). The SAC is sensitive to silt and sediment entering the watercourse and smothering gravel beds, suspended solids in the water column, pollution events and changes to water chemistry and quality.	Designated sites are considered within Section 9.6: Designates Sites. Section 9.7: Embedded Mitigation outlines measures to protect water quality during construction and operation. This would be detailed further in a site specific CEMP and through application to SEPA under CAR for a Construction Runoff Permit post consent.
	We note the consideration to be given to impacts on peat, and the proposal for a Peatland Management Plan to be included in the EIA Report should further survey work suggest that this is required.	Peat and peat management have been scoped out following justification in the submitted Lees Hill Energy Park (April 2022) Scoping Report.
	The preparation of CEMP, to be overseen by an ECoW.	This will be provided in the CEMP, the outline mitigation within Section 9.7 will be incorporated into a full CEMP post consent. Furthermore, an outline CEMP is provided in Technical Appendix 4.1: Outline CEMP, Volume 4. The full

		CEMP will be available for review by the appointed ECoW prior to the commencement of the construction phase.
SEPA	If an issue can be scoped out then evidence as to why it has been scoped out should be provided.	Phase 2 peat surveys and further peat assessment have been screened out with evidence for doing so provided in the Lees Hill Energy Park (April 2022) Scoping Report and in Section 9.6: Soils.
	Map and assessment of all engineering works within and near the water environment including buffers, details of any flood risk assessment and details of any related applications made under the Controlled Activities Regulations (CAR) should be included.	Buffers shown in Figure 9.1, Volume 3a. Flood risk considered within this Section 9.6: Flood Risk. Any necessary licenses under CAR including a Construction Runoff Permit would be applied for within the relevant timeframes before construction commences.
	If the only apparent issue related to flooding is related to watercourse crossings, then provided crossings are designed to accommodate the 1 in 200 year event and other infrastructure is located well away from watercourses it is unlikely that there will be a need for detailed information on -flood risk.	Water crossings will be designed to accommodate the 1 in 200 year event plus climate change and flood risk has been considered within Section 9.6 Flood Risk.
	Map and assessment of impacts upon Groundwater Dependent Terrestrial Ecosystems and buffers must be included.	See Figure 9.7, Volume 3a for GWDTE extent on site. GWDTE have been considered in Technical Appendix 9.2: Ground Water Terrestrial Ecosystems Screening Assessment, Volume 4.
	Map and assessment of impacts upon groundwater abstractions and buffers may be included. Where there are no abstractions within 250 m of excavations then this should be confirmed in the EIA Report.	See Technical Appendix 9.1: Private Water Supply Assessment, Volume 4 and Figure 9.1, Volume 3a for details on private water supplies. Including SEPA LUPS buffers. It is confirmed that there are no planned abstractions within 250 m of any excavations.
	Peat depth survey and table detailing re-use proposals. Where much of the site is on peat, we expect the application to be supported by a comprehensive site specific Peat Management Plan.	Peat and a PMP have been Scoped Out and this are detailed within the Lees Hill Energy Park (April 2022) Scoping Report.
	Map and site layout of borrow pits must be included.	See Figure 1.2, Volume 3a for borrow pit location. Refer to Chapter 4 – Project Description, Volume 2 for further details.
	A schedule of mitigation including pollution prevention measures must be included.	This would form part of CEMP post EIAR submission. To provide information on what would be included in the CEMP, an outline CEMP has been provided in Technical Appendix 4.1: Outline CEMP, Volume 4.
	A Borrow Pit Site Management Plan of pollution prevention measures must be included.	Technical Appendix 9.3: Borrow Pit Assessment, Volume 4 provides details on proposed techniques for developing and restoring the borrow pits, including measures to protect the environment.
	A map of proposed water abstractions including details of the proposed operating regime.	The requirement for a water abstraction would be considered by the Contractor and, if required, an abstraction licence would be applied for before the start of construction, or as required.
	Engineering works within the water environment may require authorisation under The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended).	Regulations considered as part of Water Crossing Assessment in Chapter 9, Volume 2. All necessary permits and licences would be applied for pre-construction within the appropriate time frames

	Layout should be designed to avoid the extent of work in previously undisturbed ground.	The track layout has been designed to minimise the number of new watercourse crossings to one (See Figure 9.1, Volume 3a)
	Site layout must be designed to reduce the impact on the water environment and a 50m buffer should be applied. When this cannot be achieved it must be justified and a map must be included that shows: • Infrastructure overlain with all lochs/watercourses and associated buffers. • Each breach (numbered) on a plan with associated photographs of the locations, dimensions and drawings of the watercourse/loch alongside what is proposed there. • A layout of proposed mitigation including cut off drains and the location, number and size of settlement ponds.	Figure 9.1, Volume 3a shows waterbodies and watercourses, 50 m buffers and infrastructure. There is one watercourse crossing with information detailed in Section 9.7: Watercourse Crossing Layout of proposed mitigation will be detailed post submission in the CEMP.
	Reference should be made to SEPAs Standing Advice for flood risk and Controlled Activities Regulations (CAR) Flood Risk Standing Advice for Engineering, Discharge and Impoundment Activities.	Flood risk has been considered in Section 9.6: Flood Risk.
	Watercourse crossings should be designed to accommodate 1 in 200 year flow or information provided to justify smaller structures.	Watercourse crossing will be designed to accommodate 1 in 200 year flow plus climate change as discussed in Sections 9.7 Watercourse Crossing and Embedded Mitigation.
	The submission must a) demonstrate how the layout has been designed to minimise disturbance of peat	Peat and peat management was considered in Lees Hill Energy Park Scoping Report and subsequently scoped out.
	A detailed map of peat depths should be included.	See Figure 9.4, Volume 3a for interpolated peat depths.
	A table detailing quantities of acrotelmic, catotelmic and amorphous peat which will be excavated for each element and where it will be re-used during reinstatement.	Section 9.6, together with Figure 9.4, Volume 3a (Interpolated Peat Depths) indicate that there is no significant peat underlying infrastructure and therefore a peat management plan, in which this information would normally be included, has been scoped out.
	Groundwater dependent terrestrial Ecosystems (GWDTE) are protected under the Water Framework Directive and therefore the layout and design of the development must avoid impact on such areas. Assessment Guidance should be followed.	GWDTE discussed in Technical Appendix 9.2: Ground Water Terrestrial Ecosystems Screening Assessment, Volume 4 and displayed in Figure 9.7, Volume 3a.
	A map demonstrating that all GWDTE are outwith a 100 m radius of all excavations shallower than 1 m and outwith 250 m of all excavations deeper than 1m and proposed groundwater abstractions. If the minimum buffers cannot be achieved, a detailed site-specific risk assessment will be required.	Refer to Technical Appendix 9.2: Ground Water Terrestrial Ecosystems Screening Assessment, Volume 4. GWDTE are also discussed in Chapter 7: Ecology, Volume 2 and displayed in Figure 9.7, Volume 3a.
	Excavations and other construction works can disrupt groundwater flow and impact on existing groundwater abstractions. Include a map demonstrating that all existing groundwater abstractions are outwith a 100 m radius of all excavations shallower than 1 m and outwith 250 m of all excavations deeper than 1m and proposed groundwater abstractions.	SEPA LUPS-GU31 buffers shown in Figure 9.7, Volume 3a.

	Key hole felling must be used to limit impact on local water quality. Refer to the current Forest Plan if one exists and measures should comply with the Plan where possible.	No forestry in the Proposed Development Site.
	Borrow pits should only be used in line with Scottish Planning Policy.	It is confirmed that relevant policy and legislation would be adhered to and good practice would be implemented during construction and operation.
	The EIA Report submission for borrow pits should include information in accordance with PAN 50.	Information in relation to borrow pits is provided in Chapter 4: Project Description, Volume 2 and Technical Appendix 9.3: Borrow Pit Assessment, Volume 4.
	A map of proposed borrow pits must be submitted.	One borrow pit proposed as shown in Figure 9.1, Volume 3a. Furthermore, details of Borrow Pits are presented in Technical Appendix 9.3: Borrow Pit Assessment, Volume 4.
	A schedule of mitigation supported by site specific maps and plans must be submitted. They should include details of best practice pollution prevention and construction technique and regulatory requirements. They should set out the daily responsibilities of the Environmental Clerk of Works (ECoWs) and how site inspections will be recorded and any proposal for a planning monitoring enforcement officer.	Mitigation outlined in Section 9.7 Embedded Mitigation and will be incorporated into a Schedule of Mitigation as part of the CEMP. Furthermore, an outline CEMP is provided in Technical Appendix 4.1, Volume 4: Outline CEMP.
RSPB	Disturbance of deep peats should be mitigated through design.	Section 9.6, together with Figure 9.4, Volume 3a for (Interpolated Peat Depths) indicate that there is no significant peat underlying infrastructure and therefore further peat work e.g. a PMP, has been scoped out.
Marine Scotland Science	An outline of the potential impacts on water quality within and downstream of the proposed development.	Potential impacts on water quality are considered in Section 9.7 and assessed in Table 9.17: Assessment of Construction Effects and Table 9.18: Assessment of Operational Effects
	Any potential cumulative impacts on the water quality associated with adjacent (operational and consented) developments.	Cumulative impacts discussed in Section 9.10 Cumulative Effects.
	Any proposed site specific mitigation measures as outlined in MSS generic scoping guidelines and the joint publication “Good Practice during Wind Farm Construction”.	The Guidance has been considered and referenced within Section 9.8. Furthermore, mitigation measures are outlined in Technical Appendix 4.1: Outline CEMP, Volume 4.
	Full details of proposed monitoring programmes with map showing proposed sampling and control sites.	This would be included in post consent documentation (CEMP and Water Quality Monitoring Plan). Requirement for CEMP and Water Quality Plan outlined within Section 9.8.
	A decommissioning and restoration plan outlining proposed mitigation/monitoring for water quality.	This would be included in post consent documentation (CEMP and Water Quality Monitoring Plan). Requirement for CEMP and Water Quality Plan

		stipulated within Sections 9.8 and 9.11, respectively. An outline CEMP has been provided in Technical Appendix 4.1: Outline CEMP, Volume 4.
Gavinton, Fogo & Polwarth Community Council	Local residents have concerns around the health and environmental effects of living close to a wind farm.	See Technical Appendix 9.1: Private Water Supply Risk Assessment, Volume 4.

9.6. Baseline

9.6.1. This section characterises the local hydrological, hydrogeological and geological 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.

9.6.2. The following description is based on the desk study utilising the data sources listed in Table 9.2 together with the findings of the survey works introduced earlier.

Site Area

9.6.3. The Proposed Development (centred at NT 72697 52867) lies approximately 5 km west of Duns, in the Scottish Borders.

9.6.4. The Proposed Development (Figure 9.1, Volume 3a) includes six wind turbines (up to 200 m tip height) and associated foundations, battery/energy storage, ground mounted solar PV, on-site access tracks, crane hardstands, substation, electrical infrastructure, a temporary construction compound and a temporary concrete batching plant. Further details of the Proposed Development infrastructure is presented in Chapter 4: Project Description, Volume 2.

9.6.5. The Proposed Development is located to the south of the Lammermuir Hills. The valley side rises relatively gently from the west to east to a height of approximately 250 m Above Ordnance Datum (AOD). The southern edge of the Proposed Development Site is bound by the B6456 and to the north by an unnamed road between Longformacus and Duns. There is also an existing wind farm to the north of the Proposed Development on Blackhill.

Site Investigations

9.6.6. The phase 1 peat depth surveys and hydrological walkover were undertaken in August 2020 to inform the site feasibility and scoping assessments. Details of the peat survey work are presented in Section 9.6. Further surveys, including a watercourse crossing assessment and a further hydrological walkover survey including visiting of PWSs were undertaken in August 2023.

Climate

9.6.7. The standard average annual rainfall (SAAR) for the Proposed Development has been derived from the Flood Estimation Handbook (FEH) web service as ranging from 795 - 834 mm based on the Proposed Development catchments. 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.

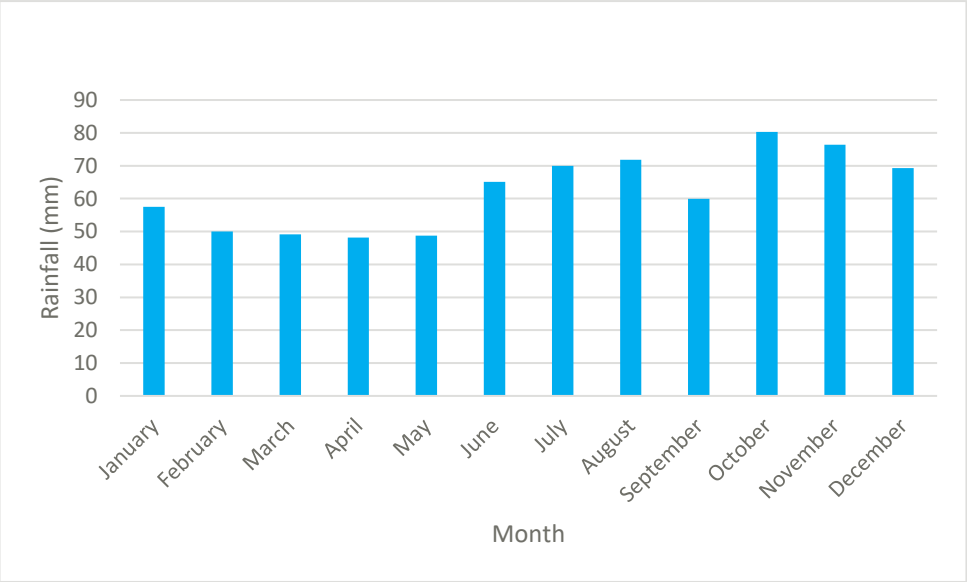
9.6.8. The Met Office 1991-2020 average annual rainfall total from the Charterhall Climate Station[3] (112 metres Above Ordnance Datum; mAOD) is 746.37 mm with an average of 138.3 days of rainfall days greater than 1 mm recorded. The Charterhall Climate Station is positioned approximately 5.5 km south-east of the Proposed Development. It is found at a reasonably comparable altitude giving a good indication of rainfall totals expected at the Proposed Development Site.

9.6.9. The highest rainfall totals as shown in Graph 9.1, are typically experienced during the winter months with a secondary peak found during the summer. From October to November the average monthly rainfall totals are highest at 80.29 mm and 76.43 mm, respectively. The lowest rainfall totals are recorded during the late winter into early spring (February to May) with the lowest average monthly rainfall recorded in April with 48.16 mm. An increase in rainfall is also observed

[3] *Met Office (2023) UK Climate Averages [Online] Available from* https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gcykcv8b2 *[Accessed: 11/09/2023]*

in the summer months peaking at 71.83 mm in August. Generally, there is little seasonal variation in rainfall.

Graph 9.1: Average monthly rainfall data for climate period 1991-2020: Charterhall Climate Station



Conservation Sites

9.6.10. There are seven designated conservation sites within 5 km of the Proposed Development. Their locations in relation to the Proposed Development are presented in Figure 9.1, Volume 3a and the details of each site, including their qualifying interests are presented in Table 9.7[4].

9.6.11. Dogdon Moss is designated as a SAC and Langtonlees Cleugh, Crook Burn and Oxendean Burn are SSSI. The River Tweed is designated as both a SAC and SSSI. Greenlaw Moor is designated a Ramser site, a SSSI and a SPA. Furthermore, Greenlaw Moor contains a Geological Conservation Review (GCR) site named Bedshiel Kaims.

[4] *Nature Scot (2023) Protected Areas [Online] Available from https://www.nature.scot/professional-advice/protected-areas-and-species/protected-areas [Accessed 11/09/2023]*

Table 9.7: Conservation Sites within 5 km of the Proposed Development Site

Site	Designation	Distance from Site	Qualifying interest	NGR
Dogdon Moss	SAC	3.1 km	Active raised bogs.	NT 68610 49620
River Tweed	SAC/SSSI	4.8 km	River lamprey, brook lamprey, otter, sea lamprey, Atlantic salmon and river with floating vegetation dominated by water-crowfoot.	NT 79600 51895
Langtonlees Cleugh	SSSI	0 km	Upland mixed ash woodland.	NT 73900 52400
Greenlaw Moor	Ramser / SSSI / SPA	0 km	Raised bog wetlands. Habitat for pink footed goose and waterfowl.	NT 71200 49500
Bedshiel Kaims	GCR	1.3 km	A single-ridged esker with a high conservation value due to its isolated upland location, its association with subglacial meltwater channels of the same age and its relatively intact state.	NT 70590 50820
Oxendean Burn	SSSI	3.5 km	Fossilised fish in bedrock.	NT 77100 56000
Crook Burn	SSSI	4.8 km	Fen meadow, with a variety of wetter and meadow habitats which holds several nationally declining species.	NT 69900 59100

Surface Water Hydrology

9.6.12. Hydrologically, the Proposed Development lies within the watershed of the River Tweed which discharges in to the North Sea at Berwick Upon Tweed. Figure 9.1, Volume 3a shows a hydrological overview of the Proposed Development including the sub-catchments of the watercourses draining the Proposed Development Site.

9.6.13. The site lies within the catchments of tributaries of the Langton Burn, Fangrist Burn, and the Whiteadder Water. All the catchments ultimately flow into the River Tweed SAC and SSSI.

9.6.14. Within the Fangrist catchment there are no mapped watercourses within the Proposed Development Site however there is small area within the western-most part of the site that falls within the catchment for this watercourse. This area forms the headwater for the Washingpool Burn which drains towards the south into the Fangrist Burn. The Fangrist Burn eventually flows into the Blackadder Water which also forms part of the River Tweed SAC and SSSI.

9.6.15. There are two sub-catchments of the Whiteadder Water which sit adjacent to the northern section of the Proposed Development Site, these are the Stobswood Burn and Mill Burn. The Whiteadder Water forms part of the River Tweed SAC.

9.6.16. The majority of the site drains into the Langton Burn, via the Foul Burn, Well Clough Burn, Leescleugh Burn, Raecleugh Head Burn and the Blackrig Burn. The Langton Burn eventually forms part of the River Tweed SAC downstream of the Proposed Development Site. The Wellclough Burn, Blackrigg Burn and Raecleigh Head Burn also form part of the Langton Leescleugh SSSI, found both within and out with the Proposed Development Site.

9.6.17. During site surveys two small pond features were noted to be present within the Proposed Development that were not present on any OS mapping. Given the geological setting of these ponds, underlain by clay-rich soils and within agricultural fields with no evidence of springs in the surrounding area, these features are considered to be ephemeral ponds which are simply rain-fed depressions in the topography. The most significant of these is located at NT 72302 51987, which is approximately 5 m from the proposed access track at its closest point. Further details of this pond are given is Chapter 7: Ecology, Volume 2. It should be noted that the ephemeral nature of these ponds mean they are not considered to be potential receptors for this assessment.

Langton Burn Catchment

9.6.18. The catchment of the Langton Burn makes up 95 % of the Proposed Development Site. The named watercourses within this catchment are the Foul Burn, the Wellcleugh Burn and the Western and Eastern Nick, which join to form Blackrig Burn within the Proposed Development Site.

9.6.19. The Foul Burn drains in the southerly direction across gently sloping moorland on the eastern slopes of Lees Hill (see photograph 9.1 & 9.2). Foul Burn is included within the Langton Burn classification of Good under SEPAs RBMP.

Photograph 9.1 & 9.2: Riparian corridor of Foul Burn facing downstream (left) and upstream from NT 72048 52604 (right).

9.6.20. The Wellcleugh Burn drains from the southeastern area of the Proposed Development. The watercourse flows eastwards through farmland and forestry (see photographs 9.3 & 9.4) and is confluent with the Blackrig Burn at NT 73980 52264 thus forming the Leescleugh Burn. The Leescleugh Burn flows eastward until its confluence with the Langton Burn at NT 74932 52337.

Photograph 9.3 & 9.4: Wellcleugh Burn facing upstream (left) and downstream (right) at NT 73255 5043.

9.6.21. Rising from Hardens Hill in the north of the Proposed Development, Western Nick (NT 73350 54335) and Eastern Nick (NT 73435 54135) flow in a southerly direction and are both confluent with the Blackrig Burn at NT 73076 53450 (see photograph 9.5 & 9.6). Blackrig Burn continues to flow in a southeasterly direction towards the Langton Burn beyond the Site boundary. The watercourse confluences with the Raecleugh Head Burn at NT 74120 52820 and continues south where it meets the Wellcleugh Burn at NT 73980 52264. At this point, the watercourse, now named Leescleugh Burn, flows eastwards where it connects to the Langton Burn at NT 74932 52337. The Langton Burn is eventually confluent with the Blackadder Water at Mouth Bridge (NT 82505 52920) approximately 8 km east of the Proposed Development.

Photograph 9.5 & 9.6: Western Nick facing downstream at NT 72951 53771 (left) and Black Rig Burn facing upstream where Eastern and Western Nick confluence at NT 73076 53450 (right).

Kettelshiel Burn Catchment

9.6.22. The Kettelshiel Burn catchment makes up only 4 % of the Proposed Development Site. There are no mapped watercourses located within this portion of the Site. The most westerly section of the area (approximately 21 hectares) drains into the Washingpool Burn which flows in the south westerly direction where it is confluent with the Stonypark Burn at NT 70227 52624 to form the Kettelshiel Burn. This watercourse continues to flow in a southerly direction and becomes the Fangrist Burn at NT 70111 51177 approximately 2 km from the site boundary. The Fangrist Burn is eventually confluent with the Blackadder Water at NT 69230 48070 approximately 4.6 km south west of the Proposed Development.

Whiteadder Water Catchment

9.6.23. The Whiteadder Water Catchment makes up approximately 1 % of the Proposed Development Site with approximately 8 hectares draining into this catchment. The Stobswood Burn rises on the northern Site boundary (NT 72435 54360) and flows in a north-westerly direction, confluencing with other burns before it joins the Whiteadder Water at NT 71527 59530. Also rising to the north of the Proposed Development boundary, and flowing north from Harden's Hill (NT 73540 54695), Hell's Cleugh is confluent with Mill Burn at NT 74330 56135. This then flows north then east and is eventually confluent with the Whiteadder Water, approximately 4.8 km north east of the Proposed Development at NT 77440 57685.

Hydrological Regime

Flow Estimation

9.6.24. The Langton Burn Catchment encompasses the onsite sub-catchments of Foul Burn, Wellclough Burn and Blackrig Burn. The Langton Burn catchment has been clipped at NT 73477 52444 in Gavinton which provides coverage of the Proposed Development Site (14.4 km^2). For reference the Langton Burn catchment area is 31.3 km^2. The Whiteadder Burn catchment has not been

assessed below as only 0.08 km^2 of the catchment lies within the Proposed Development Site and no infrastructure is located within this catchment.

9.6.25. Peak flows (up to 200 year + climate change) have been estimated for the key catchments described above using the FEH Rainfall Runoff (FEH RR) method for a range of return periods, with the results presented in Table 9.8 below. Catchment descriptors were derived from the FEH Web Service and used for calculating peak flows for the identified catchments. The annual median flood flow (QMED) is presented as the greenfield run-off rate.

9.6.26. The Q200+CC is the 200-year return period flow plus a 20 % uplift for climate change (CC) as per SEPA Land Use Planning Guidance CC1 (LUPS-CC1) (2019).

Table 9.8: Estimated Peak Run-off for Site Catchments Calculated using the Methodology Prescribed by the FEH RR Method.

Catchment	Area (km^2)	Method	Estimated peak run-off (m^3 s-1) for stated return period							
			2 (QMED)	5	10	30	50	100	200	200+CC
Langton Burn	14.4	FEH RR	4.9	6.5	7.8	10.4	12.1	14.7	17.1	21.3
Kettelshiel Burn	6.03	FEH RR	2.9	3.9	4.6	6.1	7.1	8.7	10.5	12.6

Source: Natural Power

9.6.27. Base Flow Index (BFI) and Standard Percentage Runoff (SPR) data for the catchments covering the Proposed Development were also taken from the FEH Web Service. The BFI is taken from the updated BFI Hydrology of Soil Types (HOST19) and is a measure of the proportion of a catchment's long-term run-off that derives from stored sources, with the BFI ranging from 0.1 in relatively impermeable catchments to 0.99 in highly permeable catchments. The SPR values represent the percentage of rainfall that is likely to contribute to run-off. The Whiteadder catchment has not been assessed here because it forms a very small part of the Proposed Development Site and, with no infrastructure to be located within these catchments, any potential impacts are not considered to be likely.

9.6.28. The BFI values are relatively low ranging from 0.30 to 0.37. This indicates that about a third of streamflow is derived from stored sources such as groundwater and as such groundwater contribution is of limited importance in the Proposed Development Site. The SPR value for the site catchments ranges from 37 % - 47 % indicating that approximately a third to a half of the rainfall during a rainfall event contributes to run-off.

Flood Risk

Fluvial Flood Sources

9.6.29. Flood information available on the SEPA Flood Map[5] indicates that the fluvial flood risk where the Foul Burn and Wellcleugh Burn exit the Proposed Development Site are high – 0.5 % (1 in 200 year) likelihood of fluvial (watercourse) flooding in any given year. High risk areas are confined within the riparian zones of the main channel. Downstream from the Proposed Development Site there are areas with high flooding risk in the lower course of the Whiteadder Water, most notable in Preston, Chirnside Bridge and Allanton. The flooding area in these locations mostly consists of farmland and woodland however there are areas where housing, industry and roads are also found within the high-risk zone.

[5] *SEPA (2023) SEPA Flood Maps [Online] Available at: https://scottishepa.maps.arcgis.com [Accessed: 11/09/23]*

9.6.30. The Proposed Development is found within the SBC Tweed Local Plan District Flood Risk Management Plan, as it forms part of the River Tweed Catchment, however it is not found upstream of any Potentially Vulnerable Areas[6].

Pluvial Flooding Sources

9.6.31. Across the Proposed Development Site a few small and scattered patches of medium and high likelihood pluvial (surface water) flooding are indicated on the SEPA Flood Map, however these are limited in spatial extent and primarily occur on the bank of the main stem and tributaries of the Foul Burn and Blackrig Burn with very few areas of likelihood mapped away from watercourses.

Coastal Flooding Sources

9.6.32. The Proposed Development is located approximately 19 km from the coast and, due to this and the topographical elevation of the Site (>200 m AOD), it would not be affected by tidal flooding.

Groundwater Flooding Sources

9.6.33. 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.

9.6.34. 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 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.

9.6.35. 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

9.6.36. Aerial photography and site survey observations indicate that the hydrology of the sections of the Proposed Development Site has been altered by a network of man-made drainage channels in the north of the site, notably in the headwaters of the Eastern Nick where a motocross track has been created. There is the potential that this artificial drainage could cause some localised flooding by increasing runoff rates to the natural watercourses within the catchments. At the time of the site visits there was no flow observed within the artificial drainage channels.

[6] *Scottish Borders Council (2022) Tweed Local Plan District – Local Flood Risk Management Plan [Online]* https://www.scotborders.gov.uk/downloads/file/2257/tweed_local_flood_risk_management_plan *[Accessed 19/09/23]*

9.6.37. Watercourses across the site have been altered at crossing points (e.g. see Photograph 9.7). This can lead to a slight increased risk in localised flooding as culverts can become blocked and the water can back up upstream of crossing points.

Photograph 9.7: Black Rigg Burn crossing point at NT 73073 53452.

Cumulative Flood Risk

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

Water Quality

Water Quality WFD Classification

9.6.39. The Foul Burn, which is confluent with and part of the Langton Burn WFD waterbody (NT 72220 52825), is the only watercourse within the Proposed Development Site that is classified 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. Furthermore, the Langton Burn is confluent with the Blackadder Water approximately 8 km downstream, which, in turn, is confluent with the Whiteadder Water a further ~4.5 km downstream of the Proposed Development. The classification information for these WFD waterbodies are summarised in Table 9.9 below. Current WFD status classifications discussed below are derived from information available within SEPA's Water Classification Hub[7]. The projected status classifications are derived from SEPA's Water Environment Hub[8]. Waterbody status classifications can be either: High; Good; Moderate; Poor; or Bad.

[7] *SEPA (2020) Water Classification Hub [Online] Available from* https://www.sepa.org.uk/data-visualisation/water-classification-hub/*[Accessed 17/08/23]*

[8] *SEPA (2020) Water Environment Hub [Online] Available from* https://www.sepa.org.uk/data-visualisation/water-environment-hub/ *[Accessed: 17/08/23]*

Table 9.9: WFD Classification of Waterbodies within or downstream of the Proposed Development

WFD Water Body	Waterbody ID	Current Overall Status (2020)	Overall Ecology (2020)	Overall Hydrology (2020)	Projected Overall Status (2027)	Long Term Predicted Overall Status
Langton Burn and associated tributaries including Foul Burn	5108	Good	Good	Good	Good	Good
Mill Burn	5117	Poor	Poor	High	Good	Good
Blackadder Water (Howe confluence to Whiteadder Water)	5105	Moderate	Moderate	Good	Moderate	Good
Whiteadder Water (Billie Burn Confluence to tidal limit)	6844	Moderate	Moderate	Moderate	Good	Good

9.6.40. Other watercourses within the Study Area are not classified within the RBMP.

Water Resources

Water Resources WFD Classification

9.6.41. The Langton Burn WFD waterbody has a classification of good for overall status, reflecting the absence of any pressures present within the catchment.

9.6.42. The Mill Burn WFD waterbody (NT 73540 54695) is classified as of Poor overall status, reflecting issues related to fish migration in the watercourse.

9.6.43. Both the Blackadder Water (NT 82505 52920) and Whiteadder Water (NT 71527 59530) WFD waterbodies are classified as of moderate for overall status, reflecting anthropogenic pressures, including water abstraction, within their catchments.

CAR Licenced Activities

9.6.44. CAR licenced activities within 3 km of the Proposed Development boundary are shown in Table 9.10, and these potential receptors are also shown on Figure 9.1, Volume 3a.

Table 9.10: WFD Classification of Waterbodies within or downstream of the Proposed Development

Ref	Licence No.	Site	NGR	Activity Type
L1	CAR/L/1010302	Marchmont Farms, Geenlaw, Duns	NT 74676 48457	Abstraction
L2	CAR/L/1010306	Cothill Farm, Greenlaw, Duns	NT 76203 49965	Abstraction
L3	CAR/L/1010586	Wellrig PHD Duns Berwickshire	NT 76707 53222	Discharge
L4	CAR/L/1015438	Irrigation Lagoon, Woodheads Farm, Greenlaw	NT 72726 48654	Abstraction
R1	CAR/R/1010923	The Auld Kirk, Duns	NT 76523 52142	Discharge
R2	CAR/R/1026588	2 New Plots @ Cothill Farm, Duns	NT 76270 50000	Discharge

Ref	Licence No.	Site	NGR	Activity Type
R3	CAR/R/1026593	2 Conversions @ Cothill Farm, Duns	NT 76214 49982	Discharge
R4	CAR/R/1028149	Rathowen, Duns	NT 76721 53526	Discharge
R5	CAR/R/1030711	Campmoor Cottage	NT 74086 50985	Discharge
R6	CAR/R/1030993	Cotlands House	NT 75926 49897	Discharge
R7	CAR/R/1032730	Woodend Farm, Duns, Berwickshire	NT 75970 51540	Discharge
R8	CAR/R/1032731	1 Woodend Farm	NT 75912 51564	Discharge
R9	CAR/R/1032732	Woodend Steading	NT 75930 51470	Discharge
R10	CAR/R/1032733	Woodend Farm Cottages	NT 76017 51346	Discharge
R11	CAR/R/1036004	Land adj to (West of) Cothill Farmhouse	NT 76100 49910	Discharge
R12	CAR/R/1049625	Polwarth Rhodes, Greenlaw, Duns	NT 75134 50349	Discharge
R13	CAR/R/1070492	Scurdyness, Polwarth Rhodes, Greenlaw, Duns	NT 75072 50416	Discharge
R14	CAR/R/1099117	Gordon House, Duns	NT 75141 50413	Discharge
R15	CAR/R/1104117	Stobswood Culvert, Scottish Borders	NT 70950 55380	Engineering
R16	CAR/R/1105059	Langton Field, Duns	NT 76160 53850	Discharge
R17	CAR/R/1112735	Milne Graden, Cothill Farm, Greenlaw	NT 76153 49933	Engineering
R18	CAR/R/1123535	Langton Burn Road Bridge, Near Gavinton	NT 76530 52260	Dredging
R19	CAR/R/1145555	Borthwick Gate, 1 Old Quarry Road, Duns	NT 77006 53464	Discharge
R20	CAR/R/1162541	The Bungalow, Cothill, Greenlaw, Duns	NT 76056 49937	Discharge
R21	CAR/R/1166636	Kidshielhaugh Farm, Duns	NT 74616 57140	Discharge
R22	CAR/R/1168017	Old Langtonlees, Duns	NT 73449 52484	Discharge
R23	CAR/R/1170052	Hardens View, Hardens Road, Duns	NT 76050 53850	Discharge
R24	CAR/R/1173056	Black Hill Wind Farm, Berwickshire	NT 73021 55474	Discharge
R25	CAR/R/1174002	West Bastlebog House, South Street, Gavinton	NT 77024 52147	Discharge

Ref	Licence No.	Site	NGR	Activity Type
R26	CAR/R/1191343	Wellrig, Hardens Road, Duns	NT 76999 53435	Registration
R27	CAR/R/3003446	Hardens Hall, Duns	NT 76332 53734	Discharge
R28	CAR/R/5004487	Proposed Dwelling, Plot North East of Woodend, Duns	NT 75993 51576	Discharge
R29	CAR/R/5004513	New House at Plot 1, Land East of Langton Field, Hardens Road, Duns	NT 76192 53793	Discharge
R30	CAR/R/SEPA2021-732	Plot 2, Hardens Road, Duns, Berwickshire	NT 76088 53857	Discharge
L5	CAR/S/1020166	Plots 1-3, Stobswood	NT 70990 56170	Discharge
L6	CAR/S/1083943	Stobswood Farm, Longformacus, Duns	NT 71124 56312	Discharge
L7	CAR/S/1087971	Polwarth Crofts, Greenlaw	NT 74513 50226	Discharge
R31	PSTS/7c9e20	Dronshiel, Longformacus	NT 70711 55596	Discharge
R32	PSTS/b89f58	Polwarth Manse, Duns, Greenlaw	NT 74802 49575	Discharge
E1	WML/XS/1195583	1 Woodheads Farm Cottages, Duns	NT 72688 48842	Waste exemption

9.6.45. Table 9.10 shows that of the forty licensed activities indicated by SEPA, within 3 km of the Proposed Development, are for thirty-two are for discharges, three are for abstractions, two are for engineering activities, one is for dredging, one is a waste exemption and the other is a registration only. The purpose for the majority of the discharge licences is for sewage discharge, with one for sheep dip to land. The three abstractions are noted by SEPA to be agricultural, specifically for irrigation purposes, rather than potable water supply. The engineering activities include one for a bridging culvert and one for river bank reinforcement works. Finally, there is a single licence for dredging (Langton Burn), one for a business waste exemption and one is a registration only.

9.6.46. Scottish Water confirmed that there are no Scottish Water assets or abstractions within the Study Area. The Proposed Development is also not within a Drinking Water Protected Area and therefore Scottish Water assets will not be considered further in this assessment.

Private Water Supplies

9.6.47. Scottish Borders Council were consulted regarding the presence of Private Water Supplies (PWS) within a 3 km search area from the Proposed Development Site. A response was received, and forty-three properties were identified, potentially on a PWS. Table A9.1.5 of Technical Appendix 9.1: Private Water Supply Risk Assessment, Volume 4 lists the twenty-four properties that were initially screened out of the assessment and rationale for doing so including, for example, the supply catchment lying outside that of the Proposed Development, property on mains water supply etc. A further nineteen properties, relating to ten PWS were taken forward for individual consultation, via a questionnaire, and risk assessment. Table A9.1.5 of Technical Appendix 9.1: Private Water Supply Risk Assessment, Volume 4 summarises the PWS details and results of the questionnaire responses. At this stage a further two PWS were scoped out of the assessment, namely Kidshielhaugh spring (6) and Scotston (8a), due to distance from Proposed Development and being on a mains water supply, respectively.

9.6.48. The Private Water Supply Risk Assessment (PWSRA) identified that the following PWS was at Low risk from the Proposed Development:

- Langtonlees agricultural spring (9iii).

9.6.49. The Private Water Supply Risk Assessment identified that all of the following PWSs were at Negligible risk from the Proposed Development:

- Henlaw spring (4);
- Kettleshiel borehole (5i);
- Kettleshiel spring (5ii);
- North Lodge spring (8b);
- Langtonlees spring (9i);
- Langtonlees borehole (9ii); and.
- Old Langtonlees borehole (11).

Fisheries and Recreation

9.6.50. Watercourses draining from the Proposed Development Site are part of the River Tweed catchment. The River Tweed is considered a good salmon and trout fishery. Current areas of concern to The River Tweed Commission and The Tweed Foundation include water scarcity in the Tweed and its tributaries due to abstractions and changing climate patterns[9].

Geology

Soils and Peat

9.6.51. The soils found on Site according to the National Soil Map of Scotland are brown earth, podzol and gleys (see Figure 9.2, Volume 3a). The podzol soil can be further sub-grouped into peaty gleyed and humus-iron podzols. Brown Earth soils are found in the southern and southeastern part of the Proposed Development Site and are located within the Foul Burn and Wellcleugh catchments which ultimately drain into the Langton Burn. Brown earth soils are moderately acidic free or imperfectly drained soils.

9.6.52. Humus-iron podzol soils are found in the western part of the Proposed Development Site within the Foul Burn catchment. The majority of the proposed infrastructure is underlain by these podzol soils. Humus-iron podzols are generally free draining and acidic. They typically have a thin organic layer at the surface although this may not be present when the land is cultivated. There may be some degree of waterlogging but this is only typical in the lower horizons.

9.6.53. Peaty podzol soils are found in the central and northwestern part of the Proposed Development Site predominately within the catchments of the Blackrigg and Foul Burn. Peaty podzols are also typically well-draining and acidic. They can have a slightly thicker organic layer at the surface that is up to 0.5 m thick. There may be some degree of waterlogging but this is typical in the lower horizons.

9.6.54. Noncalcareous gley soils are found in the northeastern part of the Proposed Development Site from the northern Site boundary at Hardens Hill (NT 73680 54530) to Henlaw Bogs (NT 72490 53950) and the eastern Site boundary north of Old Langtonlees (NT 73370 52780). These soils are typically pale grey in colour, wet and have poor drainage of surface waters.

[9] *The River Tweed Commission and The Tweed Foundation (2023) Focussing in on water temperature, The River, Issue 49, p1 [Online] Available from: https://www.rivertweed.org.uk/media/dafdvw5i/june.pdf [Accessed 11/09/23]*

9.6.55. The NatureScot Carbon and Peatland 2016 map[10] shows that the Proposed Development Site is underlain by pockets of Class 0 and Class 4 soils. As shown in Figure 9.3, Volume 3a, the Proposed Development Site is only underlain by Class 0 (peatland habitats are not typically found on such soils) and Class 4 (area unlikely to be associated with peatland habitats or wet and acidic type. Area unlikely to include carbon-rich soils). No Class 1, 2 or 3 soils are present on site. The majority of the Proposed Development Site is underlain on Class 4 which is predominantly mineral soil with some peat soil. Beyond this, the Proposed Development Site is predominately underlain by Class 0 mineral soils.

9.6.56. A phase 1 peat survey (100 m grid) for the Proposed Development has been carried out. A summary of the results are shown in Table 9.11 below with interpolated peat depths for the Proposed Development presented in Figure 9.4, Volume 3a. This shows that the infrastructure of the Proposed Development is underlain by peaty soils rather than peat. This assessment has been made in line with the Scottish Government 2017 Peatland Survey Guidance which defines peat as 'an organic soil which contains more than 60 percent organic matter and exceeds 50 centimetres in thickness'. In line with this guidance the results of the survey show that 92 % (436 out of a total of 475) of survey locations demonstrate that the site is underlain by soils rather than peat.

Phase 1 Survey Results

9.6.57. In August 2020, a Phase 1 investigation was undertaken, in accordance with Scottish Government guidance[11] whereby peat depths were recorded on a 100 m grid spacing across the Proposed Development Site. The survey area covered 475 points.

9.6.58. Table 9.11 provides a summary of the depths of the 475 points surveyed and Figure 9.4, Volume 3a provides a visual representation of this.

Table 9.11: Total number of locations surveyed within each category.

Soil / Peat Depth Range (m)	Results	% of Points Surveyed
≤0.5	436	92
>0.5 - ≤1.0	34	7
>1.0	5	1
Total	**475**	**100**

9.6.59. The phase 1 peat depth survey indicates that 92 % of the peat probed area recorded a depth of ≤ 0.5 m. The maximum soil depth measured was 1.4 m and was found at the northeastern slopes of Lees Hill in the Blackrig Burn catchment. All proposed infrastructure, with the exception of some hardstanding and access track to the east of T5 and minute pockets within the solar PV areas, are indicated to lie on soils of <0.5 m depth. The average recorded depth across the entire Proposed Development Site was 0.20 m. In Scotland, where soils of less than 0.5 m are recorded, these are categorised as mineral soil and/or organo-mineral soil[12].

[10] *Scotland's Environment (2016) Carbon and peatland map. [Online] Available from* http://map.environment.gov.scot/Soil_maps/?layer=10 *[Accessed 11/09/2023]*

[11] *Scottish Government, Scottish Natural Heritage, SEPA (2017) Peatland Survey, Guidance on Developments on Peatland. [Online] Available from* Guidance+on+developments+on+peatland+-+peatland+survey+-+2017.pdf (www.gov.scot)*. [Accessed 11/09/2023]*

[12] *Joint Nature Conservation Committee (2011) Report 445 Towards an assessment of the state of UK Peatlands. [Online] Available from:* https://data.jncc.gov.uk/data/f944af76-ec1b-4c7f-9f62-e47f68cb1050/JNCC-Report-445-FINAL-WEB.pdf *[Accessed 11/09/23]*

9.6.60. For each turbine location and the proposed solar PV areas the average soil depths have been calculated from the phase 1 survey results and are presented in Table 9.12. Soil depths are shown to be less than 0.5 m at all turbine locations and therefore can be classed as mineral soil and/or organo-mineral soil.

Table 9.12: Average soil depths at turbine locations and the solar PV areas calculated from phase 1 peat survey results

Location	Average Soil Depth (m)
T1	0.10
T2	0.10
T3	0.20
T4	0.10
T5	0.10
T6	0.10
Solar PV areas	0.24

Source: Natural Power

9.6.61. The requirement for detailed Phase 2 peat depth survey across the entirety of the Proposed Development Site was screened out in Scoping Report due to the lack of peat encountered. However, due to the area near to turbine T5 being named “Henlaw Bog” on OS mapping, the crane pad and turbine locations were probed in greater resolution (10 m intervals) to confirm the lack of peat. This was confirmed as the average soil depth in the vicinity of T5 was 0.35 m. Furthermore, as indicted in Figure 9.4, Volume 3a, the more detailed survey indicated that the location for T5 would not be within potentially peat soils (i.e. soils greater than 0.5 m depth).

9.6.62. Photographs 9.8 and 9.9 show soil profiles observed at various locations across the Proposed Development Site. The figures are typical of horizons observed across the site.

Photograph 9.8 & 9.9 Soil horizon observed by the Well Clough Burn at NT 73403 52041 (left) and by the Foul Burn at NT 72016 52099 (right)

Superficial Geology

9.6.63. The majority of the Proposed Development Site is underlain by Glacial till that comprise of variably sorted boulders, gravel, sand, silt and clay (diamicton) that were deposited in the Devensian period (Figure 9.6, Volume 3a). No superficial deposits lie on the topographic high of Blacksmill Hill and Tups Knowe (northern area).

Bedrock Geology

9.6.64. The bedrock geology is presented in Figure 9.5, Volume 3a. This indicates that the northern portion of the Proposed Development is underlain by rocks of the Great Conglomerate Formation. These comprise interbedded conglomerate and sandstone. The southern portion of the Proposed Development is underlain by the Stratheden Group and Inverclyde Group which comprises interbedded sandstone and argillaceous rocks. To the northwest of the Proposed Development and underlying Hen Law, a felsitic sill outcrops, known as the Dirrington Great Law Sill. Approximately 0.75 km east of the Proposed Development a general north-south trending fault is present, with rocks of the Ballagan Formation occurring to the east of it. These comprise sandstone, siltstone and dolomitic limestone.

9.6.65. Based on the results presented in the Lees Hill Energy Park Scoping Report (see Technical Appendix 1.1, Volume 4), it was concluded that no specific geological features of interest were identified within the Proposed Development Site. Therefore, although having an understanding of the subsurface geology is important, specific mitigation to protect geodiversity during construction, operation and decommissioning is not required. It is noted, however, that a GCR site is present downstream of the Proposed Development, and this described in the following section.

9.6.66. As previously mentioned, Bedshiel Kaims (NT 71200 49500), which is located within the Greenlaw Moor SSSI, is a designated GCR site. The Bedshiel Kaims located are considered the best example of a single-ridged esker in Scotland. Although the esker is relatively small (c. 5 km long) and isolated compared to other notable esker systems in Scotland, it has a high conservation value because of its isolated upland location, its association with subglacial meltwater channels of the same age and its relatively intact state. The Bedshiel Kaims document the early stages of

englacial and subglacial meltwater drainage associated with an ice stream draining the Scottish sector of the Dimlington Stadial ice sheet. Moreover, the spatial continuum of nearby meltwater channels and the esker provides clear evidence of waning discharge and sediment carrying capacity due to changes in subglacial bed slope. It should be noted that The Bedshiel Kaims GCR site is located out with the catchment of the Proposed Development and is not in hydrological connectivity with it. In addition, its designation is for a geological interest rather than a water environment purpose.

Hydrogeology

9.6.67. The presence of water within both the bedrock and the superficial deposits underlying the Proposed Development is closely controlled by the hydrogeological characteristics of the hosting lithology. According to the Hydrogeology 1:625,000 data set majority of the Proposed Development Site is underlain by two separate aquifers of moderate productivity, generally situated to the north and to the south of the Proposed Development. The southern aquifer (Stratheden Group), including Lees Hill, is described as having significant intergranular flow due to the presence of sandstone, siltstone and mudstone and produces a moderate amount of groundwater. The northern aquifer (Reston Group), including Hardens Hill, features sandstones, siltstones, mudstones and conglomerates that are interbedded with lavas (likely relating to the nearby igneous intrusion) that can produce groundwater yields up to 1 litres per second.

9.6.68. The geology underlying Blacksmill Hill, in the north west of the Proposed Development, is classified as a low productivity aquifer with flow virtually all through fractures and other discontinuities. The British Geological Survey summarise the aquifer as an unnamed igneous intrusion with limited groundwater in near surface weathered zone and secondary fractures, rare springs.

9.6.69. According to SEPA RBMP mapping, the majority of the Development Site lies within the Greenlaw WFD groundwater body (ID: 150564) and the Longformacus WFD groundwater body (ID: 150543) which are both classified as of Good for overall status.

9.6.70. The superficial aquifer in the Proposed Development Site is not identified as a WFD groundwater body and so is not considered a potential receptor.

Groundwater Dependant Terrestrial Ecosystems

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

9.6.72. 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. It should be noted that the construction of solar PV arrays would not require ground excavation and therefore the buffers were not applied to the solar PV development areas. National Vegetation Classification (NVC) habitat data (refer to Chapter 7: Ecology, Volume 2) and SEPA's list of potential groundwater (GW) dependent communities was used to identify potential GWTDE within the Proposed Development. For a habitat to be designated as a GWDTE there is the requirement for hydraulic connectivity between the GW body and the habitat.

9.6.73. 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[13]. It is acknowledged in this document

[13] *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*

that the listed communities 'may be considered GWDTEs only in certain hydrogeological settings'. The identified potentially GW dependent NVC communities are summarised in Table 9.13.

Table 9.13: NVC communities and potential GW dependency (within 250 m and 100 m buffer zones)

NVC Community	Potential Level of GW Dependency
M23 - *Juncus effusus/acutiflorus - Galium palustre* rush-pasture	High
M25 - *Molinia caerulea - Potentilla erecta* mire	Moderate
M32 - *Philonotis fontana - Saxifraga stellaris* spring	High
U6 - *Juncus squarrosus - Festuca ovina* grassland	Moderate

9.6.74. Given the geology and shallow groundwater potential within the Proposed Development, it is considered that many of these habitats are more likely to be fed, almost entirely, by precipitation or very near-surface groundwater within shallow drift deposits and soils. It is considered that the groundwater component supporting these habitats therefore more resembles a surface (or near-surface) water regime, with very local and shallow rain-fed catchments for each GWDTE.

9.6.75. Nonetheless, despite the low productivity superficial aquifer and absence of any significant geological faulting within the Proposed Development, due to the presence of moderately productive bedrock aquifers, flow pathways and the potential for some weathered bedrock providing localised groundwater storage in areas where rock is close to, or at, ground surface, some habitats may be truly groundwater dependent. As such, further assessment has been undertaken of all the potentially highly or moderately groundwater dependent habitats identified.

9.6.76. The GWDTE assessment has indicated that four truly groundwater dependent habitats are present within the Proposed Development, with details of the assessment presented within Technical Appendix 9.2, Volume 4. These are GWDTEs 13, 14, 31 and 32.

Modifying Influences

9.6.77. Changes could potentially occur to the Study Area in the future in relation to climate and land use. Section 9.7 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.

9.6.78. 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.

9.6.79. 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.

9.6.80. 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. Neither the SBC's

adopted nor proposed LDPs give any indication of future land use changes in the Proposed Development Site.

9.7. Scope of the assessment

Spatial scope

9.7.1. The spatial scope of the assessment of Hydrology, Geology and Hydrogeology covers the Study Area (i.e. the Proposed Development Site including a 3 km buffer area), for which the baseline is described in Section 9.6, 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

9.7.2. 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 4: Project Description, Volume 2). The construction period for the Proposed Development would be approximately 18 months in duration, with decommissioning anticipated at the end of a 35 year operational period.

Potential receptors requiring assessment

9.7.3. Following establishment of the baseline setting, the receptors that are considered as requiring impact assessment (i.e. 'scoped in') are listed in Table **9.14: Hydrology, Geology and Hydrogeology receptors requiring assessment**

Receptor	Details	Location (NGR where appropriate)
Water conditions supporting conservation sites and GWDTEs		
Langtonlees Cleugh SSSI	Upland mixed ash woodland	NT 73900 52400
Greenlaw Moor Ramsar / SSSI / SPA	Raised bog wetlands. Habitat for pink footed goose and waterfowl.	NT 71200 49500
GWDTEs 13, 14, 31 and 32	Truly groundwater dependent GWDTEs	See Figure 9.8, Volume 3a
Watercourses and associated WFD surface water bodies		
Langton Burn WFD surface water body	Langton Burn WFD water body and associated tributaries including the Foul Burn, Wellcleugh Burn, Blackrig Burn, Kettleshiel Burn, Raecleugh Head Burn and the Western and Eastern Nick which drain from within the Proposed Development	Within and downstream of the Proposed Development
Water Resources		
PWSs	Langtonlees agricultural spring (9iii)	NT 73038 52052

Aquifer and associated WFD groundwater body		
Greenlaw and Longformacus WFD groundwater bodies	The underlying aquifers are classified as Good overall status and generally moderately productive	Beneath the Proposed Development

9.7.4. 9.14, ordered broadly in accordance with their first appearance in the Section 9.6 baseline. They are also shown on Figure 9.8, Volume 3a.

9.7.5. 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 7: Ecology, Volume 2.

Table 9.14: Hydrology, Geology and Hydrogeology receptors requiring assessment

Receptor	Details	Location (NGR where appropriate)
Water conditions supporting conservation sites and GWDTEs		
Langtonlees Cleugh SSSI	Upland mixed ash woodland	NT 73900 52400
Greenlaw Moor Ramsar / SSSI / SPA	Raised bog wetlands. Habitat for pink footed goose and waterfowl.	NT 71200 49500
GWDTEs 13, 14, 31 and 32	Truly groundwater dependent GWDTEs	See Figure 9.8, Volume 3a
Watercourses and associated WFD surface water bodies		
Langton Burn WFD surface water body	Langton Burn WFD water body and associated tributaries including the Foul Burn, Wellcleugh Burn, Blackrig Burn, Kettleshiel Burn, Raecleugh Head Burn and the Western and Eastern Nick which drain from within the Proposed Development	Within and downstream of the Proposed Development
Water Resources		
PWSs	Langtonlees agricultural spring (9iii)	NT 73038 52052
Aquifer and associated WFD groundwater body		
Greenlaw and Longformacus WFD groundwater bodies	The underlying aquifers are classified as Good overall status and generally moderately productive	Beneath the Proposed Development

9.7.6. The following theoretical receptors have been ‘scoped out’ from being subject to further assessment because the potential effects are not considered likely to be significant:

- Dogdon Moss SAC, Oxendean Burn SSSI and Crook Burn SSSI are located outwith the catchment of the Proposed Development and are therefore not in hydrological connectivity with it. The Bedshiel Kaims GCR site is also located out with the catchment of the Proposed Development and is not in hydrological connectivity with it. In addition, the reason for its designation is a geological interest rather than a water environment purpose. The geology outside the Proposed Development would not be impacted by it. Therefore, the Bedshiel Kaims GCR is ‘scoped out’ of the assessment. The River Tweed SAC and SSSI is located a significant distance (approximately 5 km direct distance from the Proposed Development Site and >10 km of flowing distance, as the watercourse meanders) downstream such that, with the effects of dilution and attenuation upstream of this designated site, impacts on water quality and / or flows such a distance from the Proposed Development are considered to be unlikely. Therefore, these designated sites are ‘scoped out’ of the assessment.
- Surface watercourses located either out with a 250 m buffer of the Proposed Development infrastructure, up gradient of Proposed Development infrastructure and / or in separate surface water catchments from development activities include the Blackrig Burn, Wellcleugh Burn, Kettleshiel Burn, Stobswood Burn and Mill Burn WFD waterbody. Therefore, with no hydrological connection, impacts on water quality and / or flows to these watercourses are not considered likely, and the features are ‘scoped out’ from further assessment. Furthermore, the Blackadder Water and Whiteadder Water WFD waterbodies

are located a significant distance downstream from the Proposed Development or outwith the catchment of Proposed Development activities. With the effects of dilution and attenuation within the upper reaches of these watercourses, impacts from the proposed development are considered unlikely and, as such, and these features are also 'scoped out' from further assessment.

- SEPA flood risk mapping indicates that there are currently no flood risk issues potentially affecting the Proposed Development's infrastructure and watercourse crossing locations. Provided watercourse crossings are designed to accommodate the 1 in 200 year event and other infrastructure is located well away from watercourses, SEPA do not foresee, from current information, a need for detailed information on flood risk. Furthermore, any potential effect of the Proposed Development on the downstream flood risk was also considered because unmitigated, elevated run-off from the Proposed Development could potentially be discharged to the fluvial network and give rise to flashier hydrographs and potentially increased incidences of flooding downstream. However, the increase in impermeable area would be minor, and design and adoption of standard best practice (including appropriately sized watercourse crossings) would ensure that construction and post-development run-off would not exceed pre-development rates. Furthermore, there are few property receptors immediately downstream. Therefore, flood risk has been 'scoped out' from further assessment.
- The PWSRA (Technical Appendix 9.1, Volume 4) has identified that, with embedded mitigation and good practice measures, risks to the PWSs Henlaw spring (4), Kettleshiel borehole (5i), Kettelshiel spring (5ii), North Lodge spring (8b), Langtonlees domestic spring (9i), Langtonlees borehole (9ii) and Old Langtonlees borehole (11) from Proposed Development impacts during construction and operation are negligible. On this basis, these PWSs have been 'scoped out' of the assessment.
- There are no CAR licensed activities located within the Proposed Development Site nor are there any within 250 m of any Proposed Development infrastructure. The three abstraction licenses L1, 2 and 3 (listed in Table 9.10) have been 'scoped out' as they located outwith the catchment of the Proposed Development and a significant distance (>2 km) from it and therefore would not be impacted by it. Furthermore, all other CAR licenced activities (E1, L3, L5-7 and R1-32) have been 'scoped out' because they are for purposes e.g. discharge of sewage, engineering activities etc, rather than abstraction, that would not be impacted by Proposed Development activities.
- The soils across site are identified as Class 0 (Mineral soil) or 4 peat (unlikely peatland habitat), and, as such, peat soils are 'scoped out' of the assessment;
- The underlying solid geology predominantly comprises a variety of sedimentary lithologies and some volcanics outcropping in the northwest of the Proposed Development. But, the geology, within the Proposed Development Site is not considered to be of local or regional importance. A single designated GCR Site (Bedshiel Kaims) is located downstream of the Proposed Development. However, it is considered that any construction or operation effects would not impact the qualifying interests of this GCR. Additionally, disturbance of the geology during project construction would be minimal, sufficient only to establish building, track and turbine foundations. On this basis, any geological effect would be insignificant, and it is proposed that geology is 'scoped out' as a receptor.
- Groundwater within the till deposits on-site is a low productivity aquifer. Where no superficial deposits are mapped or peat is present, the BGS do not consider these as aquifers that would be considered receptors. Therefore, the superficial aquifer is 'scoped out' from further assessment. However, this groundwater is still taken account of in the assessment in terms of its role in supporting the GWDTE;
- A number of GWDTEs have been 'scoped out' as they have been assessed as either not truly groundwater dependent or because their potential catchments, defined as part of the GWDTE Screening Reviews (Technical Appendix 9.2, Volume 4), do not intercept proposed infrastructure. This includes potential receptor habitats GWDTE 1-11, 15-30 and 33-50.

Assessment of Potential Effects

Proposed Development Indicators

9.7.7. The Proposed Development would introduce physical changes which have the potential to alter the hydrological characteristics within the Proposed Development Site. 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

9.7.8. The Proposed Development would consist of the erection, 35 year operation, and subsequent decommissioning of six wind turbines, with tip heights of up to 200 m and ground mounted solar PV. The Proposed Development includes associated turbine foundations and transformers, battery storage, hardstanding areas for erecting cranes at each turbine location, a series of on-site tracks connecting each turbine, underground cables linking the turbines to the grid connection, an on-site substation, construction compound, a borrow pit, and a permanent meteorological mast.

9.7.9. 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. The solar PV cells would be mounted on frames elevated from the ground. The frames are supported by spiked galvanised steel piles that would be driven or screwed into the ground without prior excavation.

9.8. Environmental Measures Embedded into the Development Proposals

9.8.1. 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 Chapter 4: Project Description, Volume 2, with an outline CEMP provided in Technical Appendix 4.1: Outline CEMP, Volume 4. An overview of some of the general (not project specific) environmental management considerations is also included in Chapter 4: Project Description, Volume 2. Water-specific embedded mitigation measures are presented below.

Introduction

9.8.2. 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 Chapter 4: Project Description, Volume 2) could be developed /refined to account for these constraints, and so minimise the potential risks and impacts to certain receptors during construction and operation.

9.8.3. A review of the baseline information for the Study Area (Section 9.6) 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.

9.8.4. 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. A map of water environment constraints for the Proposed Development is presented in Figure 9.8, Volume 3a.

Avoidance of deep peat deposits

9.8.5. From the phase 1 peat survey and detailed site survey it is known that the majority of the site (94% of surveyed points) is underlain by shallow soils of <0.5 m peat depth. Table 9.12 and Figure 9.4, Volume 3a shows that all turbines have been located only on soils that have <0.5 m peat depth.

Watercourse buffer zones

9.8.6. The hydrological desktop study and site visits have identified a gently sloping upland hydrological environment of open moorland and improved agricultural farmland which includes 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.

9.8.7. For turbines and associated infrastructure (hardstanding, substation, construction compound, battery storage area and access tracks) 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 one crossing only.

9.8.8. The distances presented in Table 9.15 show 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 9.15: Distance from turbine to nearest watercourse

Turbine ID	Turbine distance from watercourse (m) (inclusive of 50m buffer)
T1	490
T2	80
T3	135
T4	550
T5	410
T6	90

Placement of solar PV

9.8.9. All ground mounted solar PV are located greater than 20 m from watercourses. This buffer will provide an area to allow rainwater infiltration and dissipation before entering the watercourse.

9.8.10. The solar PVs will be suitably spaced to allow rainfall along the drip line to infiltrate the soil and dissipate. The banks of solar panels would typically be arranged in sets of 24 – 48 panels and then organised into rows or arrays. Each string would be mounted on racks described above with a distance of no more than 3-6 m between strings to avoid any shadowing occurring from one panel to another and to allow for maintenance. The solar PV are mounted in an elevated position

which will allow vegetation to continue to grow below them which will attenuate overland flow and reduce peak flow in nearby watercourses.

9.8.11. The racks on which the PV cells are arranged are narrow and would be piled to a shallow depth therefore they will have negligible impact on displacement or change to ground water flow, due to the thin nature of the piles.

9.8.12. As the Proposed Development Site is already vegetated, there is a reduced risk of soil erosion and sediment laden runoff entering watercourses throughout construction.

9.8.13. The PV cells will be located outwith flood risk areas so surface or groundwater encroachment is highly unlikely.

Excavations and associated drainage

9.8.14. 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.

9.8.15. 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.

9.8.16. 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. This is particularly important at turbine T6 which it is located near the headwaters of Foul Burn and in an area described as shallow bog with very slow flow feeding the burn. Therefore, 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.

9.8.17. 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 ECoW.

9.8.18. 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.

9.8.19. 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).

9.8.20. Two optional borrow pit locations (BP1 and BP2) and a preferred borrow pit area (BP5) have been proposed in the south and northern area of the Proposed Development Site, shown on Figure 1.2: Site Layout, Volume 3a. In addition, two additional optional borrow pit search areas (BP3 and BP4) were identified following the TA9.3: Borrow Pit Assessment however these were not viable to progress due to their location within the Proposed Development Site and were scoped out of the EIA.

9.8.21. It is anticipated that the excavation of borrow pits may involve a small amount of dewatering during rock removal, certainly for BP5 where the aquifer is of low permeability and, as such, impacts on groundwater resources would be limited. BP1 and BP2 would be located in a moderately productive aquifer and may therefore require higher dewatering rates should shallow groundwater be encountered. Similar controls to those detailed above would be employed to prevent contamination of surface waters with suspended sediment. The dewatering of excavations at greater than 10 m^3/day would require CAR Registration, while over 50 m^3/day would require a CAR licence. Abstractions smaller than 10 m^3/d would comply with GBR3.

9.8.22. The preferred borrow pit, BP5, would be located adjacent to an existing quarry and would be accessed by a newly constructed heavy goods vehicle track in conjunction with the Proposed Development tracks. By utilising an existing quarry area, rather than opening up new ground, this would ensure that disturbance is minimised. All preferred/optional borrow pits would be located outside the 50 m watercourse buffer.

Watercourse Crossing

9.8.23. Adherence to the 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) 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. A description of the watercourse at the proposed crossing location, as shown in Figure 9.1, Volume 3a, is summarised in Table 9.16.

9.8.24. A simple culvert type construction is proposed using a cross sectional area that would not impede flow of water, where the trackway crosses the watercourse. The culvert would have a buried design such that one quarter of the culvert diameter is placed below the waterline with the culvert set in granular fill material. The design of the culvert would be to at least CIRIA Culvert, Screen and Outfall Manual (C786) standard and the culvert structure would not affect either the channel or banks. The existing alignment of the watercourses would remain unchanged.

9.8.25. The culvert would require some level of authorisation under CAR. Registration is required for “pipe or box culverts used for footpaths, cycle route or single-track road in rivers <2 m wide”. Pipe or box culverts for watercourses exceeding 2 m in width would require a Simple Licence.

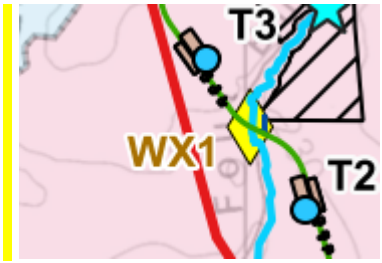
9.8.26. All turbine cables need eventually to lead to the substation that is proposed to be located at NT 372768 651902. This means that the cables from turbines to northwest and north of the Foul

Burn will need to cross this watercourse at some point. In the interest of minimising impacts on the water environment, the cables would be incorporated into the proposed access track and culvert in favour of potentially disruptive cable laying methods such as Horizontal Directional Drilling beneath the watercourse or trenching through it.

Table 9.16: Watercourse Crossing Details

Watercourse Crossing (WX)1 (NT 72016 52512)

Crossing Location



Crossing Description

- **Existing Crossing:** No
- **Channel Type:** Incised
- **Gradient:** Gentle
- **Valley form:** Shallow vee
- **Bank condition:** Undercut (no evidence of recent collapse)
- **Bed material:** Fine sand/silt, Coarse gravel, Vegetation
- **Riparian corridor:** Moorland, Agricultural Grazing
- **Flow condition:** Slow

CAR Auth. Level: Registration

Proposed Cross. Type: Bottomless Arch Culvert

- **Water width (m):** 0.55
- **Water depth (m):** 0.09
- **Bankfull width (m):** 0.40
- **Bankfull height (m):** 0.55
- **Flooded Bankfull width (m):** ~5.0
- **Flooded Bankfull height:** ~1.0

Note: Evidence of flattened reeds approximately 5 m across burn indicating flooding. Direction of reeds indicates very low flows at these times and probably more likely to resemble a bog than a flooded river.

Crossing Photographs

Upstream

Across

Downstream

Avoidance of flood zones

9.8.27. The study has not identified any potential significant fluvial flood constraints within the Proposed Development. However, as a precaution, all areas identified as being located within a high to medium likelihood of surface water flooding were considered to be unsuitable for development. 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.

Conservation sites and GWDTE buffer zones

9.8.28. No significant constraints are identified regarding risks to designated conservation sites within the Proposed Development. However, the proposed site layout aimed to minimise (though was not able to entirely avoid) incursions of SEPA (LUPS-GU31) 100 m (shallow excavation, <1 m deep) and 250 m (deep excavation, >1 m deep) buffer areas around the potential GWDTEs identified earlier (Section 9.6).

Groundwater/surface water abstraction and PWS buffer zones

9.8.29. The study has not identified any potential licenced abstractions within, or close to the Proposed Development Site. However, one PWS is located within the Proposed Development Site and the layout has avoided incursion of the LUPS-GU31 100m and 250m buffer areas around the source.

Micro-siting

9.8.30. As discussed in Chapter 4: Project Description, Volume 2, high-level micro-siting of proposed turbine locations has been carried out to ensure that ecological, hydrological, hydrogeological and geotechnical aspects were optimised on the basis of a 50 m micro-siting allowance. The final turbine locations are shown in Figure 9.1, Volume 3a. In addition, there is the potential for further micro-siting (Section 9.11) as a result of further on-site surveys and further baseline data collection prior to construction.

Construction Site Licence

9.8.31. Under CAR, a proposed construction site may need to obtain a Construction Site Licence (CSL), prior to commencing work. A CSL for the proposed development is likely to be required since the construction site is greater than 4 hectares (4ha) in area and includes trackways of greater than 5 km in length. This licence application requires the holder to adhere to a Pollution Prevention Plan (PPP) that SEPA has reviewed and must consider the potential impacts of construction on the water environment. Further details of SEPA's requirements for a PPP to accompany a CSL is provided in guidance document WAT-SG-75. A PPP would be included in the CEMP that would be produced prior to the construction phase. Further details of this can be found in Technical Appendix 4.1: Outline CEMP, Volume 4.

Run-off and Sediment Management

9.8.32. The following measures will be adopted to appropriately attenuate and treat run-off during, construction and operation of the Proposed Development:

- The Proposed Development drainage system will convey water away from construction activities and built infrastructure, however, due to the nature of the works at the Proposed Development there is potential for sediment and other pollutants from exposed soil and bedrock to become entrained in the surface run-off.
- To reduce this potential, prior to the commencement of and during construction, plans showing site drainage and hydrologically sensitive areas (e.g. watercourse buffers, GWDTE) will be regularly checked to review potential for run-off and ponding of water within the Proposed Development so that that run-off patterns are well known.

- The drainage systems installed within the Proposed Development 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 the suggested control measures, regular inspection and maintenance will be undertaken, particularly after prolonged heavy rainfall.
- 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 run-off will be dependent upon the permeability of the terram geotextile material and the size and source of the clean stone.
- The ability of the silt traps to effectively treat run-off will depend upon the volume of run-off within the drainage channel, the type of material used and the frequency of monitoring and replacement of the measures.
- If required, flocculents could also be used to treat run-off. Flocculents are very effective at removing suspended sediment from water but they can also have effects on water chemistry. The option to use flocculants would be determined by the contractor and applied for by them post consent as part of the application to SEPA for a Construction Runoff Permit.

Concrete Works

9.8.33. Concrete would be required for the construction of the turbine and building foundations. The use of concrete as part of watercourse crossing construction would be minimised as far as practical, favouring non-cementitious material or a pre-cast concrete culvert pipe which would precluding the requirement for in-channel cement use. This section provides good practice measures that would be implemented to minimise the potential for any negative effects to the water environment from concrete works.

9.8.34. Care would be taken during the transportation of concrete to the turbine and building foundations and will be carried out following good practice measures. Freshly mixed concrete and/or dry cement powder will not be allowed to enter any watercourse. This will be avoided by the following actions:

- Turbines, concrete batching or wash out areas would be located at least 50 m from watercourses.
- Concrete wagons would only be permitted to wash-out into specifically designed wash-out areas and predetermined at agreed locations site wide, as stipulated in the CEMP.
- The drivers would be informed at their site induction of the location of the designated wash-out areas and issued with a location map.
- Loads would 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 would not be cleaned in watercourses. Should it be necessary to clean tools and equipment on site, this would be done in the designated wash-out areas.
- The designated concrete wash-out area would be constructed within the Proposed Development at a location agreed with the relevant consultees. The design and construction of these wash out areas would be agreed with SEPA.
- Wash out areas would be continually monitored, and findings recorded to reduce the chances of effluent spilling over into the water environment.

Track design

9.8.35. On areas of peat depths greater than 1 m, for example, to the east and southeast of Turbine T5, floating roads would be considered. In a floating road, the weight of the road is supported by the peat beneath, thereby avoiding the need to construct foundations extending through to the underlying solid stratum. The floating roads would be constructed in line with the good practice

guidance produced by FCS and SNH (2010) and SR et al (2019) and would include the use of geogrids and geotextiles. The geotextile used would be selected to maintain load distribution, ensure separation of aggregate and peat, and prevent peat rutting, erosion and drainage. Aggregate choice would be sensitive to peat geochemistry and would be of sufficient grade to allow infiltration through to the geotextile.

9.8.36. Even with floating roads, some interruption of surface and near-surface flows can occur. The track layout has been designed to minimise the total track length, and to avoid, where possible, intersecting catchment areas in a manner that could significantly interrupt flow paths. Cross-drainage would be provided in areas where access tracks unavoidably intersect dominant flow pathways, as discussed below.

Site Drainage

9.8.37. The following section discusses the conventional site drainage measures that would be installed during the construction and operation of the Proposed Development.

9.8.38. Surface drainage ditches would be installed alongside tracks only where necessary. The length, depth and gradient of individual drains would 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 would be incorporated into the drainage system as necessary and will serve the dual purpose of attenuating peak flows, by slowing the flow of run-off through the drainage system and allowing sediment to settle before water is discharged from the drainage system.

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

9.8.40. To reduce the impact of the Proposed Development on the natural hydrological regime, the site drainage would mimic greenfield run-off response using sustainable drainage practices.

9.8.41. SuDS would be integrated into the water management and details of the proposed SuDS regime would be included in the CEMP and PPP that will be produced as part of the application.

9.8.42. SuDS are used to attenuate rates of run-off 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.

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

9.8.44. Access tracks crossing slopes could disrupt surface flow such that water collects in drains constructed upslope of the tracks. Cross-drains and/or waterbars would 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. However, all efforts would be made to segregate this run-off from more-silty run-off originating from track surfaces and other exposed construction areas, thus reducing the silt load and volume discharging to the silt treatment areas. Regular discharge points would limit the concentration of surface run-off and the diversion of flows between catchments. Such cross drains need to be strong enough to withstand the expected traffic loadings.

9.8.45. 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) will be incorporated into the track base at regular intervals as required to allow more flow to pass through the track and maintain the current flow regime. Such pipes would be 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.

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

9.8.47. Drains and/or cut-off drains would be 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 run-off entering the excavations and minimise any subsequent contamination.

9.8.48. 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.

9.8.49. Drainage from the construction compound, welfare facilities, the borrow pit and concrete wash out areas will be collected and treated separately from the main site drainage, as the run-off 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 water, would be installed.

9.8.50. All mitigation and drainage would 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 construction runoff permit.

9.8.51. One new watercourse crossing would be required as part of the access tracks associated with the Proposed Development (see Table 9.15). The crossing would be appropriately designed so that they do not alter the natural drainage, hinder the passage of aquatic fauna and can accommodate flow at a minimum of 1:200yr + CC event. It would be designed with edge upstands or bunds e.g. sandbags or silt fences to prevent sediment laden run-off from construction plant movement from directly entering watercourses.

Peat excavations and storage

9.8.52. As indicated in Section 9.6, the only area of the Proposed Development where excavation of peat soils may be required would be to the east of turbine T5. Measures that would be employed to minimise impacts on any peat are outlined below.

9.8.53. Surface run-off from stockpiles of any excavated peat, whether temporarily stored prior to backfilling or permanent stored in peat storage areas, has the potential to affect surface water quality due to the transportation of suspended solids in surface water run-off. Therefore, Best Practice measures e.g. Good Practice during Wind Farm Construction (SR et al, 2019) would be implemented to ensure that peat is appropriately stored.

9.8.54. During the design phase of the Proposed Development the selection of appropriate turbine sites has avoided areas, wherever possible, where potential peat soils (i.e. >0.5 m depth) have been identified. This helps to reduce the volumes of peat that are required to be excavated for the construction of concrete foundation slabs and therefore the need to manage materials.

9.8.55. Surface run-off from any stockpiled material excavated has the potential to affect surface water quality if these are inappropriately excavated and stored. Any peat storage areas would be located at a distance from any watercourses and would be contained to prevent sediment or nutrient run-off from eventually reaching downstream watercourses.

9.8.56. Any storage of peat during construction would minimise slumping and maintain stratification, where possible using water derived from dewatering activities to keep the peat adequately saturated to prevent desiccation and degradation. It is anticipated that all excavated peat can be re-used on-site. It is not therefore expected that any peat would need disposal or long-term storage, by way of a waste management licence. Neither is it expected that there would need to be storage of 'waste peat' for a period greater than three years (or where storage prior to disposal is greater than one year) and thus no requirement for a permit in accordance with the Landfill (Scotland) Regulations 2003.

Cable trench design

9.8.57. Cables would be run alongside access tracks. The trenches would be installed at the minimal depth practical, although this may reach 0.5 – 1 m deep. They would be dug and left open for the minimum time possible to ensure that they do not create open drainage routes. The trenches would be backfilled as far as possible with the excavated soils, to minimise the change to flow paths. Where other material is used to backfill the trenches, clay cut-off barriers would be installed across the trench to prevent them creating preferential flow paths.

9.8.58. Cable laying methods that do not require a dug trench would be considered. FCS/SNH (2010) suggest that it may be possible to inset the cable in peat flanks alongside the edges of the floating roads, so that they are protected but do not need to be dug into the ground, disturbing the peat and associated flow paths.

Site working practices

9.8.59. Site activities during construction and operation have been identified to have potential effects. These can be controlled by the implementation of pollution prevention and control measures and Best Practice, based on the guidance outlined earlier. Further information on these measures are presented in the Technical Appendix 4.1: Outline CEMP, Volume 4.

9.8.60. The site induction for contractors would include a specific session on good practice to prevent and control water pollution from construction activities. Contractors would be made aware of their statutory responsibility not to "cause or knowingly permit water pollution". As discussed earlier, a PPP and a Pollution Incident Response Plan (PIRP) would be prepared for the Proposed Development, the latter in line with GPP 21, and all contractors would be briefed on these plans, with copies made available on-site. Equipment to contain and absorb spills would also be readily available.

9.8.61. Fuel and oil may enter the groundwater by migration vertically into the underlying groundwater or by run-off into nearby surface waters, if accidentally released or spilled during storage and refuelling. To minimise potential releases into the water environment, fuel would be stored in either a bunded area or a self-bunded above-ground storage tank (AST) kept on-site during the course of the construction phase in accordance with the Water Environment (Oil Storage) (Scotland) Regulations 2006 and other SEPA Pollution prevention guidelines, and GBR9. The bunded area would have a capacity of 110 % of the fuel tank. All stores would be located at least 50 m from any watercourses.

9.8.62. In areas where there is a potential for hydrocarbon residues from run-off/isolated leakages, such as in plant storage areas and around fuel storage tanks and in refuelling zones in the proposed temporary Site compound, surface water drainage would be directed to a hydrocarbon interceptor prior to discharge. The interceptor would filter out hydrocarbon residues from drainage water and

retain hydrocarbon product in the event of a spillage to prevent release into surface waters at the discharge point and deterioration of downstream water quality.

9.8.63. Plant and machinery used during the construction phase would be maintained to minimise the risks of oils leaks or similar. Maintenance and refuelling of machinery would be undertaken off-site or within designated areas of temporary hardstanding. In these designated areas contingency plans would be implemented to ensure that the risk of spillages is minimised. Placing a drip tray beneath a plant and machinery during refuelling and maintenance would contain small spillages.

9.8.64. The main potential hydrological effects during the operational phase of the Proposed Development relate to the servicing of the turbines and storage of oils and lubricants involved in the process which may be accidentally released into the water environment. This includes during the turbine gearbox oil changes during the lifetime of the Proposed Development. The frequency of these oil changes will be decided post submission, following confirmation of turbine candidate.

9.8.65. The potential risks posed to surface water and groundwater quality, specifically related to operation, are likely to be limited and localised based on the planned works and the nature and volume of substances required. Any potential risk to the environment would be identified by the operator prior to servicing being undertaken. The operator would ensure a site-specific risk assessment is completed and that control measures are implemented to ensure all environmental risks are minimised. However, as a pre-requisite the storage, use and disposal of oils would be done in accordance with best practice and SEPA guidance (GPP 8) (see earlier).

9.8.66. Potential ongoing effects in relation to infrastructure remaining on the Proposed Development during operations (including the turbine locations and access tracks) were addressed during the discussion of construction mitigation above. Ongoing maintenance would be carried out, for example, to maintain drainage and settlement ponds.

Welfare Facilities / Foul Water

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

- Any sewage associated with the temporary construction compounds, control buildings and welfare facilities will be collected in appropriately sized interceptor tanks and shall be located at the construction compounds. All wash basins, toilets and shower areas shall also be connected to an interceptor tank.
- 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. Sewage from these facilities will be disposed offsite in accordance with waste management legislation.
- The discharge volumes will be small however it will comply with the requirements of the CAR and in consultation with SEPA.

Construction Environmental Management Plan

9.8.68. A site-specific CEMP will facilitate the implementation of industry good practice measures in such a manner as to prevent or minimise effects on the surface and groundwater environment and would be written and approved by stakeholders in advance of the construction phase. An outline CEMP has been provided in Technical Appendix 4.1: Outline CEMP, Volume 4. In summary, the full CEMP would include information as follows:

- Drainage – all run-off derived from construction activities and site infrastructure will not be allowed to directly enter the natural drainage network. All run-off 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 help maintain the existing hydrological regime.

- Storage – all 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 at a designated location (likely to be construction compounds).
- 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 – maintenance to construction plant will be carried out in designated zones, 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 the appropriate disposal of sewage. 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 Proposed Development for a soakaway. Any discharge requirements will comply with relevant requirements under SEPA's CAR.
- 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 through implementation of the buffer zones where applicable and good practice construction methods.
- Monitoring Plan – all activities undertaken as part of the Proposed Development will be monitored throughout the construction phase to monitor environmental compliance. Water quality monitoring will also occur throughout each phase of the Proposed Development and will help to maximise the effectiveness of embedded mitigation measures whilst monitoring effects on the hydrological environment. The frequency and duration of monitoring will be agreed following discussion with SEPA and other relevant authorities.
- Contingency Plans – a site specific Emergency Response Plan will be implemented to allow plans to be put in place to manage a spill or other pollution incident. The plans will ensure that emergency equipment is available on 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.
- Training – All relevant staff personnel will be trained in both normal operating and emergency procedures and be made aware of highly sensitive areas on site.

Summary

9.8.69. A range of environmental measures have been embedded into the development proposals as outlined above. A summary of how these embedded measures relate to each of the receptor groups in the assessment is presented in Table 9.17.

Table 9.17 Summary of embedded environmental measures

Receptor	Changes and effects	Embedded measures
Water conditions supporting conservation sites and GWDTEs (groundwater)	Soil compaction and the introduction of areas of hardstanding during construction and throughout operation reducing recharge and groundwater levels, leading to reduced groundwater support	Avoidance of the single area of deep peat within the Site GWDTE buffer zones CEMP
	Dewatering during construction associated with the excavation of the turbine foundations leading to a decline in groundwater levels	Avoidance of the single area of deep peat within the Site GWDTE buffer zones CEMP Excavations and associated drainage
	Site activities during construction and operation resulting in the	Avoidance of the single area of deep peat within the Site

	release of pollutants and the subsequent contamination of groundwater	GWDTE buffer zones CEMP Site working practices
	Physical disturbance of the peat and groundwater throughflow could occur as a result of excavation works and peat stockpiling/removal, and result in reduced groundwater support for peatlands	Avoidance of the single area of deep peat within the Site GWDTE buffer zones CEMP Peat excavation and storage
Water conditions supporting conservation sites and GWDTEs (surface water)	Soil compaction and the introduction of areas of hardstanding during construction and throughout operation increasing runoff and sediment loading, leading to changed/polluted surface water support	Avoidance of steep gradients Avoidance of the single area of deep peat within the Site GWDTE buffer zones Micro-siting CEMP Track design Drainage design Cable trench design Watercourse crossing design
	Disruption of flow paths and changes to drainage regime during construction and throughout operation can be associated with increases in runoff and less on-site water retention, leading to reduced surface water support	Avoidance of steep gradients Avoidance of the single area of deep peat within the Site GWDTE buffer zones Micro-siting CEMP Track design Drainage design Cable trench design Watercourse crossing design Peat excavation and storage
	Disruption of ground during construction leading to increased sediment loading leading to polluted surface water support	Avoidance of steep gradients Avoidance of the single area of deep peat within the Site GWDTE buffer zones Micro-siting CEMP Track design Drainage design Cable trench design Watercourse crossing design Peat excavation and storage
	Dewatering and/or drainage during construction disrupting groundwater support (baseflow) to watercourses leading to reduced surface water support	Avoidance of the single area of deep peat within the Site GWDTE buffer zones Micro-siting CEMP Excavations and associated drainage
	Discharge to surface water of groundwater intercepted during construction associated with the excavation of the turbine foundations increasing flows and	Avoidance of steep gradients Avoidance of the single area of deep peat within the Site GWDTE buffer zones

	sediment loading, leading to changed and polluted surface water support	Micro-siting CEMP Excavations and associated drainage
	Site activities during construction and operation resulting in the release of pollutants and the subsequent contamination of surface waters and polluted surface water support	Avoidance of steep gradients Avoidance of the single area of deep peat within the Site GWDTE buffer zones Micro-siting CEMP Watercourse crossing design Site working practices
Watercourses and associated WFD surface water body	Soil compaction and the introduction of areas of hardstanding during construction and throughout operation increasing runoff and sediment loading, leading to changes in watercourse flow, quality and morphology	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients Micro-siting CEMP Track design Drainage design Cable trench design Watercourse crossing design
	Disruption of flow paths and changes to drainage regime during construction and throughout operation can be associated with increases in runoff and less on-site water retention, leading to changes in watercourse flow and morphology	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients Micro-siting CEMP Track design Drainage design Cable trench design Watercourse crossing design Peat excavation and storage
	Disruption of ground during construction resulting in increased sediment loading, leading to changes in watercourse quality and morphology	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients Micro-siting CEMP Track design Drainage design Cable trench design Watercourse crossing design Peat excavation and storage
	Dewatering and/or drainage during construction disrupting groundwater support (baseflow), leading to changes in watercourse flow	Avoidance of flood zones Watercourse buffer zones Micro-siting CEMP Excavations and associated drainage
	Discharge to surface water of groundwater intercepted during construction associated with the excavation of the turbine foundations, leading to changes in	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients

	watercourse flow, quality and morphology	Micro-siting of turbines and tracks CEMP Excavations and associated drainage
	Site activities during construction and operation resulting in the release of pollutants and the subsequent contamination of surface waters, leading to changes in watercourse quality and morphology	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients Micro-siting CEMP Watercourse crossing design Site working practices
Aquifer and associated WFD groundwater body	Soil compaction and the introduction of areas of hardstanding during construction and throughout operation reducing recharge and groundwater levels, leading to a loss of water resource	CEMP
	Dewatering during construction associated with the excavation of the turbine foundations leading to a decline in groundwater levels	CEMP Dewatering of excavations and associated drainage consistent with requirements of GBRs 3 and 15.
	Site activities during construction and operation resulting in the release of pollutants and the subsequent contamination of groundwater, leading to a loss of water resource	CEMP Site working practices
Water resources (groundwater)	Soil compaction and the introduction of areas of hardstanding during construction and throughout operation reducing recharge and groundwater levels, leading to abstraction derogation	Groundwater abstraction buffer zones CEMP
	Dewatering during construction associated with the excavation of the turbine foundations leading to a decline in groundwater levels	Groundwater abstraction buffer zones CEMP
	Site activities during construction and operation resulting in the release of pollutants and the subsequent contamination of groundwater, leading to abstraction pollution	Groundwater abstraction buffer zones CEMP Site working practices
Water resources (surface water)	Soil compaction and the introduction of areas of hardstanding during construction and throughout operation increasing runoff and sediment loading, leading to abstraction pollution	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients CEMP Watercourse crossings design
	Disruption of ground during construction leading to increased sediment loading and abstraction pollution	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients CEMP

		Watercourse crossing design
	Dewatering and/or drainage during construction disrupting groundwater support (baseflow) to watercourses, leading to abstraction derogation	Avoidance of flood zones Watercourse buffer zones CEMP
	Discharge to surface water of groundwater intercepted during construction associated with the excavation of the turbine foundations increasing flows and sediment loading, leading to abstraction pollution	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients CEMP
	Site activities during construction and operation resulting in the release of pollutants and the subsequent contamination of surface waters, leading to abstraction pollution	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients CEMP Watercourse crossing design Site working practices

9.9. Assessment of Hydrology and Hydrogeology Effects

Potential Resultant Effects – Construction

9.9.1. The potential for effects on the water 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 has taken account of the environmental measures embedded into the Proposed Development outlined above in the Section 9.8.

9.9.2. Details of the potential construction effects is provided below and summarised in Table 9.17 below. The table assumes the successful implementation of the embedded mitigation measures outlined in Section 9.8.

Pollution Incidents

9.9.3. During the construction phase, several potential pollutants will be present on-site, including oil, fuels, chemicals, unset cement and concrete, waste and wastewater from construction activities and staff welfare facilities. Many of these potential pollutants will be located or stored within the construction compound located predominantly within the Langton Burn catchment but also in the Wellcleugh Burn catchment. 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

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

9.9.5. The solar PV panels have the potential to concentrate rainfall under the drip lines. Research in the United States by Cook & McCuen[14], suggests that the increase in run-off rates would not be

[14] *Hydrologic Response of Solar Farms" J. Hydrol. Eng., 18(5), 536–541. 2013*

great but is an increase nonetheless. This would increase the chance of soil erosion along drip lines and the potential creation of rills which funnel water downslope. Subsequent increased velocities of surface water run off can be more erosive leading to increased erosion and entrainment of soils.

9.9.6. 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.

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

Increase in Run-off

9.9.8. Turbine bases, hardstand areas, ground mounted solar PV and access tracks will act as impermeable areas, restricting the natural movement of water within the hydrological environment, potentially resulting in increased rates of run-off into the onsite catchments.

9.9.9. The PV cells have the potential to concentrate rainfall under the drip lines. Research in the United States by Cook & McCuen, suggested that the increase in run-off rates would not be great but is an increase, nonetheless.

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

Modification of Drainage Patterns

9.9.11. The interception of diffuse overland flow by the Proposed Development infrastructure 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 for water quality and on flood issues downstream of the Proposed Development.

9.9.12. GWDTE and other surface water dependent habitats such as watercourses and riparian zones present a potential engineering constraint, and the necessary precautions should be taken to avoid them where possible and maintain them where avoidance is not possible. This should include bespoke drainage arrangements that maintain surface water flows and prevent dewatering of adjacent habitat.

9.9.13. Construction of the Proposed Development may have the following potential effects on the quantity and quality of groundwater supplying GWDTEs and to a lesser extent in the case of the Proposed Development PWS sources:

- Turbine foundations and hardstand areas located up-gradient from GWDTE, and other sensitive habitats could disrupt shallow groundwater flow from dewatering and diversion of flow paths;
- Turbine foundations and hardstand areas located down-gradient from GWDTE, and other sensitive habitats 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;
- Ground mounted solar PV cells located directly overhead or upstream of GWDTE could disrupt and divert surface water infiltration by concentrating or shielding areas from rainwater ingress;
- Infrastructure located directly over wetland habitats could contaminate and lower the quality of groundwater through pollution and sedimentation; and

- Runoff from construction areas may infiltrate into shallow groundwater aquifers and contaminate and lower the quality of groundwater through pollution and sedimentation.

Impediments to Surface Water Flow

9.9.14. The construction of the watercourse crossing may restrict flow in the channel of the Foul Burn 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.

9.9.15. Ground mounted solar PV cells may reduce rainwater ingress into areas with panels overhead. Along drip lines soil may be eroded and rills could form which funnel water downslope. Subsequent increased velocities of surface water run off may contribute to increased overland flow into watercourses and increased peak flows within and downstream of the Proposed Development resulting in increased flood risk.

9.9.16. Although turbine T6 is not located on a mapped watercourse it is located near the headwaters of the Foul Burn. During a hydrological survey in August 2023, this area was identified as being a shallow bog with very slow flow feeding the Foul Burn. The construction the turbine in this location will require to be carefully considered to maintain the flow of water towards the Foul Burn.

Degradation of Water Quality

9.9.17. The risk from pollution via the accidental and uncontrolled release of sediment due to increased exposed soil as well as via leakages and spillages remains a risk despite embedded mitigation. The pouring of concrete and cement may also impact the chemical balance of shallow groundwater.

9.9.18. The Foul Burn is at most risk as there is a crossing on this watercourse and turbine 6 is located near the headwaters.

Modification of Groundwater Flows and Levels

9.9.19. Deep excavations, such as those required for the turbine foundations, have the potential to disrupt the shallow groundwater system and bedrock geology. Surface water ingress is minimised by utilising upgradient cut-off drains or other drainage measures. The installation of cut-off drains have the potential to lower local groundwater levels within surrounding soils.

9.9.20. Access tracks have the potential to disrupt flow pathways, such as interrupting shallow GW flow or altering the hydrological regime. This may have implications for PWS reliant on shallow groundwater for supply such as springs.

9.9.21. The truly groundwater dependent GWDTE habitats (13, 14, 31 and 32) as assessed in Technical Appendix 9.2: GWDTE Assessment, Volume 4, have been assessed as having a moderate dependency on GW. Construction of the Proposed Development may have the following potential effects on the quantity and quality of GW supplying GWDTE habitats:

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

Compaction of soils

9.9.22. The movement of construction traffic within the Proposed Development 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.

Assessment of Potential Construction Effects

9.9.23. Table 9.18 below identifies the likely construction effects on the identified receptors and their significance assuming the successful implementation of good practice and embedded mitigation measures (including the implementation of a CEMP), described in Section 9.8. Definitions for receptor sensitivity and magnitude of change are provided in Tables 9.3 and 9.4, respectively.

Table 9.18: Assessment of Construction Effects

Potential Effects	Identified Receptor(s)	Potential Effect Assuming Implementation of Standard Good Practice and Embedded Mitigation		
		Sensitivity	Magnitude of Impact	Significance of Effects
Water conditions support conservation sites and GWDTEs				
Pollution incidents Erosion and sedimentation Acidification Increase in run-off Modification to surface and groundwater drainage patterns Impediments to surface water flow	Greenlaw Moor Ramsar / SSSI / SPA	High	Negligible	Minor – Not significant
	Langtonlees Cleugh SSSI	Medium	Low	Minor – Not significant
	GWDTEs 13, 14, 31 and 32	Low	Low	Negligible – Not significant
Watercourses and associated WFD surface water bodies				
Pollution incidents Erosion and sedimentation Increase in run-off Modifications to surface drainage pattern Impediments to surface water flow Degradation of water quality	Langton Burn (and associated tributaries) and associated WFD surface water body	Medium	Low	Minor – Not significant
Water Resources				

Potential Effects	Identified Receptor(s)	Potential Effect Assuming Implementation of Standard Good Practice and Embedded Mitigation		
		Sensitivity	Magnitude of Impact	Significance of Effects
Pollution incidents Modification to surface drainage patterns Impediments to surface water flow Modification of groundwater flows and levels Compaction of soils	Langtonlees agricultural spring (9iii)	Medium	Negligible	Negligible – Not significant
Aquifer and associated WFD groundwater body				
Pollution incidents Modification of groundwater flows and levels Compaction of soils	Greenlaw and Longformacus WFD groundwater bodies	Medium	Low	Minor – Not significant

Potential Resultant Effects – Operational

9.9.24. The effects of the Proposed Development will be substantially lower during the operational phase. The following paragraphs discuss the potential effects that are predicted to occur during the operational phase of the Proposed Development. The assessment of operational effects, assuming the successful implementation of the good practice and embedded mitigation measures (including the implementation of a CEMP), described in Section 9.8, is presented in Table 9.18. Definitions for receptor sensitivity and magnitude of change are provided in Tables 9.3 and 9.4, respectively.

Pollution Incidents

9.9.25. The potential risk of pollution is substantially lower during operation than during construction because of the reduced levels of activity in the operational phase. Most potential pollutants will have been removed when construction was completed; however, lubricants for turbine gearboxes, and transformer oils may be stored on-site and there is the risk of possible fuel leaks from maintenance vehicles whilst on-site.

Erosion and Sedimentation

9.9.26. Levels of erosion and sedimentation during operation will be much lower than construction as there will be no excavations or bare exposed ground. Some erosion and sedimentation are still possible on the access tracks and drainage ditches as a result of scouring during extreme rainfall events. Similarly, there could be some short-term increases to erosion and sedimentation around new stream crossings as watercourses reach new equilibrium primarily within the construction and early in the operational phases of the Proposed Development.

9.9.27. Furthermore, the solar PV panels have the potential to concentrate rainfall under the drip lines. Research in the United States by Cook & McCuen[15], suggested that the increase in run-off rates would not be great but is an increase, nonetheless. This would increase the chance of soil erosion along drip lines and the potential creation of rills which funnel water downslope. Subsequent increased velocities of surface water run off can be more erosive leading to increased erosion and entrainment of soils.

Increase in Run-off

9.9.28. The PV cells have the potential to concentrate rainfall under the drip lines. Research indicates that the increase in run-off rates is minimal, but increases are still observed. Localised increases in run-off could cause issues for downstream flood storage capacity and/or pollution incidents. Increases in the volume of run-off entering watercourses could also cause erosion and sedimentation, therefore having detrimental effects on surface water hydrology.

Modification of Surface Drainage Patterns

9.9.29. Modification of surface run-off will occur as a result of the construction of the new infrastructure associated with the Proposed Development. The operational effects can result in changes to volume and/or changes to run-off rate.

Impediments to Surface Water Flows

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

[15] *Hydrologic Response of Solar Farms" J. Hydrol. Eng., 18(5), 536–541. 2013*

9.9.31. Ground mounted solar PV cells reduce rainwater ingress into areas with panels overhead. Along drip lines soil may be eroded and rills could form which funnel water downslope. Subsequent increased velocities of surface water run off contribute to increased overland flow into watercourses and increased peak flows within and downstream of the Proposed Development resulting in increased flood risk.

Degradation of Water Quality

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

Modification of Groundwater Flow and Levels

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

Compaction of Soils

9.9.34. The compaction of soils/peat will be significantly reduced during the operational phase as a result of significantly reduced traffic movements.

Assessment of Potential Operational Effects

9.9.35. Table 9.19 below identifies the likely operational and ongoing effects on the identified receptors and their significance assuming the successful implementation of the good practice and embedded mitigation measures, described in Section 9.8.

Table 9.19: Assessment of Operational Effects

Potential Effects	Identified Receptor(s)	Potential Effect Assuming Implementation of Standard Good Practice and Embedded Mitigation		
		Sensitivity	Magnitude of Impact	Significance of Effects
Water conditions support conservation sites and GWDTEs				
Pollution incidents Erosion and sedimentation Acidification Increase in run-off Modification to surface and groundwater drainage patterns Impediments to surface water flow	Greenlaw Moor Ramsar / SSSI / SPA	High	Negligible	Minor – Not significant
	Langtonlees Cleugh SSSI	Medium	Negligible	Negligible – Not significant
	GWDTEs 13, 14, 31 and 32	Low	Negligible	Negligible – Not significant
Watercourses and associated WFD surface water bodies				
Pollution incidents Erosion and sedimentation Increase in run-off Modifications to surface drainage pattern Impediments to surface water flow Degradation of water quality	Langton Burn (and associated tributaries) and associated WFD surface water body	Medium	Low	Minor – Not significant

Potential Effects	Identified Receptor(s)	Potential Effect Assuming Implementation of Standard Good Practice and Embedded Mitigation		
		Sensitivity	Magnitude of Impact	Significance of Effects
Water Resources				
Pollution incidents Modification to surface drainage patterns Impediments to surface water flow Modification of groundwater flows and levels Compaction of soils	Langtonlees agricultural spring (9iii)	Medium	Negligible	Negligible – Not significant
Aquifer and associated WFD groundwater body				
Pollution incidents Modification of groundwater flows and levels Compaction of soils	Greenlaw and Longformacus WFD groundwater bodies	Medium	Negligible	Negligible – Not significant

Assessment of Potential Decommissioning Effects

9.9.36. During decommissioning of the Proposed Development, potential impacts on the water 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 follow an approved decommissioning plan and adhere to the latest legislative and guidance requirements at the time.

9.10. Cumulative Effects

9.10.1. Consideration has been given as to whether any of the Hydrology and Hydrogeology receptors that have been taken forward for assessment in this chapter are likely to be subject to cumulative effects because of equivalent effects generated by other consented (but not yet built) and proposed developments for which applications have been submitted.

9.10.2. The application of a hydrological catchment methodology enables a logical evaluation of the potential for cumulative effects of the hydrological environment. Within 10 km of the Proposed Development, only two schemes are present. The closest, Black Hill Wind Farm, is an operational wind farm located approximately 1 km north of the Proposed Development. No infrastructure related to the Proposed Development shares an upland catchment with the Black Hill Wind Farm, with the watercourses of Black Hill draining towards the north. Blackhill and the Proposed Development wind farms ultimately drain into the Whiteadder Water. However, this occurs at a significant distance downstream of both sites (approximately 12 km east of the Proposed Development). The other development, Wedderlie Farm, is located approximately 6 km west of the Proposed Development Site and the application is at the scoping stage. No infrastructure related to the Proposed Development would share an upland catchment with the Wedderlie Farm development. Despite the fact that both developments would ultimately drain into the Whiteadder Water, this occurs at a significant distance downstream of both sites such that no effect would be considered likely.

9.10.3. The most likely theoretical off-site cumulative hydrological effects that could occur would be changes in water quality, affecting downstream watercourse or surface water abstractions and increases in flood risk. Mitigation has been presented in Sections 9.8 and 9.11 aimed at protecting on-site hydrological receptors. These measures would therefore also be suitable to ensure the protection of downstream potential receptors and ensure that the Proposed Development will not contribute to any effects arising from other developments, such as those mentioned above. With regards to flood risk specifically, the design of the drainage will mimic the existing hydrological and greenfield regime of the Proposed Development. Opportunities for natural flood management through habitat restoration have also been identified.

9.10.4. It is concluded that following the successful implementation of the mitigation outlined in Sections 9.8 and 9.11, cumulative impacts of the Proposed Development during construction and during operation would be negligible and not significant.

9.11. Additional Mitigation & CAR Licence Application

9.11.1. Although no significant effects have been identified upon any water environment receptor as a result of the construction or operation of the proposed development, it is sensible to consider implementing some further precautionary measures to minimise any lesser effects. These measures have been identified through the iterative process of scheme design and would be in addition to those outlined in Section 9.8. The additional measures outlined below have not been included in the significance assessment presented earlier (Section 9.9).

Micro-siting

9.11.2. Prior to construction micro-siting allowances would be utilised to ensure that turbine T6 is not within the headwater area that feeds the Foul Burn.

9.11.3. The locations of GWDTE have been avoided, where possible, though the infrastructure design process. However, it has not been possible to avoid all such features due to a range of other environmental, and technical constraints that also require consideration during the design process. It is important to note, for example, that many of the acid flush habitats (particularly M6c/d), whilst being sensitive to local changes to hydrology, are botanically species-poor. Where it has not been possible to avoid these features, a mitigation strategy would be implemented to further avoid/reduce direct and indirect impacts on GWDTE habitats and the hydrological conditions supporting them. The approach would include a commitment to micro-site infrastructure (within the agreed limits) to further avoid these features prior to and during the construction phase under the advice of an onsite ECoW. Also, prior to construction, location-specific detailed designs for infrastructure drainage will be developed, to avoid/minimise impacts on GWDTEs as much as possible. Further details would be provided in the CEMP prior to construction. The CEMP would also set out that the disruption of local ground and surface water hydrology supporting these habitats is minimised through appropriate environmental design and construction methods. Furthermore, an outline CEMP is included in Technical Appendix 4.1: Outline CEMP, Volume 4.

Water Quality Monitoring/ECoW

9.11.4. A Water Quality Monitoring (WQM) programme would be used to establish whether there are any effects on surface water quality within and immediately downstream of the proposed development that require further mitigation. Such a programme would 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.

9.11.5. The details of any required monitoring will be discussed and agreed with relevant stakeholder e.g. SEPA, SBC, MSS etc, 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.

9.11.6. The baseline WQM programme would 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 lifetime of the Proposed Developments, 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.

9.11.7. A suitably qualified ECoW would be employed throughout the construction of the Proposed Development. The appointed ECoW would ensure implementation of measures outlined in the CEMP, for example, provision of 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. As part of the WQM programme and usually undertaken by the ECoW, a programme of visual monitoring would be undertaken to ensure that the designed drainage systems are compliant with the requirements under CAR with respect to GBR 10 and in particular, clauses d, g and h. Further details of the roles and responsibilities of the ECoW are provided in Technical Appendix 4.1: Outline CEMP, Volume 4.

Licensing Requirements

9.11.8. SEPA 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.

9.11.9. 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 is acknowledged that within this chapter and Technical Appendix 4.1: Outline CEMP, Volume 4, some information relating to mitigation measures and standard good practice has been provided. However, further detail to support a CAR licence application would follow post-determination of the application including the production of a CEMP document which would be a 'site specific' document which should be 'live' for the duration of construction and the post construction restoration of the development. This document would also include a Drainage Management Plan (DMP) and a PPP.

9.12. Conclusions

Summary

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

9.12.2. Furthermore, a standalone assessment was undertaken for PWS (Technical Appendix 9.1: PWSRA, Volume 4). The PWSRA concluded that a single PWS (Langtonlees agricultural spring, 9iii) was at low risk from the Proposed Development and therefore warranted further assessment. Further assessment in the EIA has indicated that the significance of effects of the Proposed Development for the construction and operation phases are negligible and not significant.

9.12.3. Based on the environmental baseline and embedded mitigation described in Sections 9.6 and 9.8 respectively, there are no likely significant adverse effects related to the Proposed Development in isolation. Section 9.10 indicates that there are also no cumulative water effects with other developments within the Proposed Development or wider Study Area or in the same surface catchments.