atmos CONSULTING

36405 R2

Environmental Impact Assessment

Sandy Knowe Wind Farm Extension

Chapter 8: Hydrology, Hydrogeology and Soils

ERG UK Holding Ltd

ERG

July 2022

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Glossary of Terms

Term	Definition
The Applicant	ERG UK Holding Limited
The Agent	Atmos Consulting Limited
Environmental Impact Assessment	Environmental Impact Assessment (EIA) is a means of carrying out, in a systematic way, an assessment of the likely significant environmental effects from a development
Environmental Impact Assessment Regulations	The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (EIA Regulations)
Environmental Impact Assessment Report	A document reporting the findings of the EIA and produced in accordance with the EIA Regulations
The Proposed Development	The Sandy Knowe Wind Farm Extension
The Proposed Development Footprint	The area within which the Proposed Development will be located
The Proposed Development Site	The full application boundary including Sandy Knowe Wind Farm and Sandy Knowe Wind Farm Extension

List of Abbreviations

Abbreviation	Description
BGS	British Geological Survey
CEMP	Construction Environment Management Plan
CMRA	Coal Mining Risk Assessment
DIA	Drainage Impact Assessment
DMP	Drainage Management Plan
DWS	Drinking Water Standards
ECoW	Ecological/Environmental Clerk of Works
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
ECU	Energy Consents Unit
EC	European Commission
EQS	Environmental Water Quality Standards
GWDTE	Groundwater Dependent Terrestrial Ecosystem
m AOD	Metres above Ordnance Datum
PSRHA	Peat Slide Risk Hazard Assessment
PPP	Pollution Prevention Plan
PWS	Private Water Supply
SAC	Special Area of Conservation
SEPA	Scottish Environment Protection Agency
Tx	Turbine (number)
WFD	Water Framework Directive

8 Hydrology, Hydrogeology and Soils

8.1 Introduction

8.1.1 Development Description

The full description of the Proposed Development is given in Section 1.2; Chapter 3: Description of Development; and shown on Figure 1-2. Of particular relevance to this assessment chapter are the following:

The Proposed Development will share infrastructure components with the Sandy Knowe Wind Farm including access tracks and substation.

New associated infrastructure includes:

- Six turbines foundations and crane hard standings;
- Approximately 3km of new excavated access tracks;
- Approximately 100m of new floating track;
- Nine Passing places;
- Four Temporary turning heads;
- Use of an existing borrow pit for the excavation of on-site aggregate to be used in the construction of the Proposed Development and for peat reinstatement. Any extraction of aggregate will be within the existing boundaries of the Borrow pit (See Chapter 3 Project Description);
- Underground cabling along track verge;
- Battery Storage compound on the eastern consented Sandy Knowe Wind Farm temporary construction compound;
- Three new watercourse crossings; and
- Use of the western temporary compound consented Sandy Knowe Wind Farm Temporary compound.

Construction traffic (including abnormal loads) will access the site via the constructed north western access point directly off the A76, while all other vehicles during operation will access the site from the constructed north eastern access via the Heads of the Valley Road.

8.1.2 Scope

The scope of the assessment is to:

- Describe and characterise the baseline current hydrology, hydrogeology and soil conditions;
- Identify sensitive water environment receptors;
- Assess potential effects on sensitive receptors from activities during the preparation, construction, operation and decommissioning of the Proposed Development;
- Report on Coal Mining Risk Assessment by GDG Geosolutions (Technical Appendix 8-3);
- Report on peat and Peat Landslide Hazard Risk Assessments by East Point Geo (Technical Appendix 8-1 and 8-2);

- Identify which potential effects can be controlled through embedded mitigation in design, and best practice;
- Identify appropriate additional mitigation measures to enhance beneficial effects or minimise or avoid and/or adverse effects;
- Assess cumulative effects on hydrology, hydrogeology and geology; and
- Assess residual effects.

This assessment should be read alongside the Chapter 3: Description of Development; Chapter 4: Planning and Energy Policy; and Chapter 6: Ecology.

The assessment excludes a Flood Risk Assessment (FRA), although information from SEPA Flood Risk online mapping for planning overview has been included.

8.2 Methodology and Approach

8.2.1 Study Area

The location of the Proposed Development is shown in Figure 1-1. The Proposed Development Footprint is shown in Figure 1-2.

This assessment is primarily concerned with a hydrological, geological and hydrogeological study area comprising the Proposed Development Footprint plus a 250m buffer for GWDTE assessment. These additional buffer zones are shown in Figure 8.3. However, where a hydrological or geological connection in respect of potential effects deems it necessary, the assessment has considered a wider Study Area, up to and beyond 2km, from the Proposed Development Footprint boundary. These wider areas are shown in Figures 8.1, 8.4 and 8.5.

Steps Followed in the Assessment Process

The following steps were iteratively followed and the findings considered in the assessment process:

- Completion/compilation of baseline surveys/data;
- Consultations with Stakeholders;
- Two site visits, in November 2020 and October 2021;
- Description of the current baseline hydrological and hydrogeological conditions;
- Identification of sensitive water environment receptors;
- Identification of activities with the potential to affect the sensitive receptors:
- Assessment of hydrological connectivity and potential impact pathways;
- Assessment and prediction of potential effects upon sensitive receptors:
  - Hydrology,
  - Hydrogeology and geology relating to the peat and water environment,
  - Groundwater dependent terrestrial ecosystems (GWDTE),
  - Peat private water supplies, and
  - Designated sites;
- Assessment of risks arising from:
  - Historic mining,
  - Peat hazards, and
  - Flooding;

- Reporting on embedded mitigation by design;
- Assessment of cumulative effects with other wind farms;
- Additional mitigation proposals to avoid, minimise or mitigate adverse effects and enhance positive effects; and
- Assessment of residual effects, which will remain after mitigation.

8.2.2 Receptor Sensitivity

Receptor sensitivity is determined from the baseline as informed by site surveys. International, national and local standards and an appreciation of the relationship with relevant planning policy are considered. Sensitivity criteria for the three grades of sensitivity, High, Medium and Low are given in Table 8-1.

Table 8-1: Sensitivity Criteria - Hydrology, Hydrogeology and Geology

Sensitivity	Criteria	Water and Soil Definition
High	Attribute has a high quality and rarity on a National or International scale	• Water bodies of good ecological status, watercourses or waterbodies with 'high' or 'good' Water Framework Directive (WFD) overall status. • Site protected/designated under European Commission (EC) or UK habitat legislation (Special Area of Conservation (SAC), Special Protection Area (SPA), Site of Special Scientific Interest (SSSI), Water Protection Zone (WPZ), Ramsar site, and Salmonid water. • Important on a European or global level/protected habitat sites, e.g. Atlantic salmon Salmo salar or Freshwater Pearl Mussel Margaritifera margaritifera. • National Nature Reserve (NNR). • Watercourse that supports species protected under EC or UK habitat legislation but is not a designated site. • Areas with a high risk of flooding. • Primary/high productivity aquifer with high aquifer vulnerability. • Groundwater that supports highly dependent groundwater dependent terrestrial ecosystems (GWDTEs), • Drinking water protected areas. • Local water supply sources, including private water supplies for human consumption where there is no alternative to private supplies and used for drinking water. • Pristine or active peat bog hydrological units; • Areas of High Development Risk, Shafts, adits and shallow mine workings on site due to historic mining.
Medium	Attribute has a high quality and rarity on a regional scale	• Water bodies of moderate WFD ecological status. • Highly productive aquifer with low to medium vulnerability or Secondary / minor aquifers • Groundwater that supports moderately dependent groundwater dependent terrestrial ecosystems (GWDTEs), • Areas with a medium risk of flooding. • Important in the context of the region/district; e.g. Local Nature Reserves • Private water supplies for non-potable supply. • Peat body hydrological unit which could recover to pristine status.
Low	Attribute has a low quality and rarity on	• Watercourses or waterbodies with WFD 'poor' or 'bad' overall status. • Low productivity aquifer/non aquifer/ low groundwater vulnerability. • Area at little or no risk of flooding.

Sensitivity	Criteria	Water and Soil Definition
	local scale	• Degraded drained peat; small isolated areas of peat.

8.2.3 Magnitude of Effect

Table 8-2 provides generic guidance as to the magnitude of potential effects on a receptor within the assessment of the Study Area.

Table 8-2: Magnitude of Effect - Generic

Magnitude of Effect	Definition
Substantial	Total loss of or major alteration to key elements or features of the pre-development conditions, such that the post-development character or composition of the feature would be fundamentally changed.
Medium	Loss of or alteration to key elements or features of the pre-development conditions, such that the post-development character of the feature would be partially changed.
Low	Minor alteration from pre-development conditions.
No change	No or unquantifiable change to pre-development conditions.

Specific magnitude of potential hydrology and hydrogeology effects is evaluated through a mixture of professional judgement and standards with reference to some or all of the criteria listed in Table 8-3.

Table 8-3: Impact Magnitude Criteria: Hydrology, hydrogeology and geology

Magnitude of effect	Substantial	Medium	low
Runoff and surface water flow regime	Change in proportion of site rainfall runoff, resulting in a measurable long term change in surface water flows, dilution capacity or flood risk.	Change in proportion of site rainfall runoff, resulting in a measurable temporary change in surface water flows, dilution capacity or flood risk.	No easily measurable change in proportion of site rainfall runoff and associated aspects.
Water quality	Long term change in SEPA WFD water quality status (SEPA 1, 2) due to e.g. (sediment, oil pollution).	Temporary change in SEPA WFD water quality status for < one month.	No measurable change in water quality and no change with respect to SEPA WFD Status.
Private Water Supply	Long term reduction in water pressure, flow or water quality affecting consumption and/or loss of supply requiring alternative supply or other intervention.	Temporary water pressure or flow reduction or water quality but not affecting consumption.	No easily measurable change in water pressure or flow or water quality.
Riverine Morphology and Habitat	Measurable changes in erosion, river bed, riverine habitats and risk to aquatic conservation interests.	Some change in deposition and erosion regimes, no measurable change to aquatic conservation or riverine habitats.	Very short term and minor change in river bed, minor rates of erosion. No change to riverine habitats or aquatic conservation risk.
Groundwater flow and levels	Long term change to the recharge, flow or	Measurable change to the recharge, flow or	Measurable change in groundwater levels,

Magnitude of effect	Substantial	Medium	low
	discharge of groundwater affecting water supplies, river or stream base flows and GWDTE.	discharge of groundwater but causing only temporary change to water supplies, GWDTE and base flows.	though no appreciable change to the recharge or discharge of groundwater. No effect on GWDTE or base flows or river supplies.
GWDTE	Direct or indirect loss of >10% of highly groundwater dependent GWDTE, or >25% loss of moderately groundwater dependent GWDTE.	Direct or indirect loss of >5% of highly groundwater dependent GWDTE or > 15% of moderately groundwater dependent GWDTE.	Loss of >1% of highly groundwater dependent GWDTE, or 10% of moderately groundwater dependent GWDTE.
Mining Risk	Site in High Risk Development Area AND Current or historic shallow mine workings or mine entries recorded on site, Risk of shallow unrecorded mine workings. Risk of mine gas and subsequent migration of voids to the surface. (CA1)	Site in High Risk Development Area. No recorded current or historic mine workings or mine entries. Low but unproven risk of mine gas.(CA1)	Not in High Risk Development Area. (CA1)
Geology and soils including peat	Direct or indirect loss of up t0% deep peat without reuse on site. Long term alteration to extent, structure and/or hydrology of peat bodies and/or High peat landslide likelihood.	Direct or indirect loss of >5% of deep peat without reuse on site. Localised largely temporary alteration to extent, structure and/or hydrology of peat bodies. Moderate peat slide risk likelihood.	Loss of minor volumes of deep peat and/or no alterations to peat hydrology. Low peat landslide likelihood.
Relevant Statutory Designation	Disturbance or loss of cited features of geological or hydrological features of nationally or internationally designated sites, e.g. SAC, SSSI.	No harm to the integrity of geological or hydrological features of designated sites. Minor harm to Regional or local sites.	No disturbance or loss to designated sites.

8.2.4 Prediction and Evaluation of Effects

The assessments have been split into the three development phases as each phase has the potential to give rise to different effects:

- **Construction** - generally temporary/short-term effects that occur during the construction of the Proposed Development;
- **Operation** - Effects resulting from the use of the Proposed Development;

- **Decommissioning** - Effects arising from the removal of infrastructure and restoration of the Proposed Development.

Predicted effects of the Proposed Development on the hydrology and hydrogeology are a function of magnitude of effects and receptor sensitivities. The degree to which receptors are affected will depend upon whether the receptor is present, in hydraulic and/or hydrogeological connectivity with and is potentially at risk from the Proposed Development. The assessment of effect takes into account effect duration and nature, for instance, whether it is:

- Short (construction), medium or long-term;
- Direct or indirect;
- Reversible or permanent;
- Adverse, neutral or beneficial; and
- In isolation, are cumulative or interactive.

Effects will be defined as:

- **Negligible** – no discernible deterioration or improvement to the existing environment;
- **Minor** (positive or negative) – where the Proposed Development will cause a small improvement (or deterioration) to the existing environment;
- **Moderate** (positive or negative) – where the Proposed Development will cause a noticeable improvement (or deterioration) to the existing environment; and
- **Major** (positive or negative) – where the Proposed Development will cause a substantial improvement (or deterioration) to the existing environment.

Table 8-4 shows the interrelationship between the magnitude and the sensitivity or importance of the feature.

Table 8-4: Assessment Criteria

Receptor Sensitivity Importance	Magnitude of Effects			
	Substantial	Medium	Low	No Change
High	Major	Major	Moderate	Negligible
Medium	Major	Moderate	Minor	Negligible
Low	Moderate	Minor	Negligible	Negligible
No importance	Minor	Negligible	Negligible	Negligible

8.2.5 Mitigation Measures

Mitigation measures are measures envisaged to prevent, reduce, control and/or offset adverse effects to particular aspects of the construction or operation of the Proposed Development on the hydrology and hydrogeology. Various forms of mitigation are applied at different stages:

- Embedded mitigation – changes to the Proposed Development design;
- Best Practice mitigation – physical measures applied on the Proposed Development;
- Embedded and Best practice mitigations are taken into account when assessing effects; and

- Additional Mitigation – Following embedded and best practice mitigation and initial effect prediction, and wherever reasonably practical, additional mitigation measures are proposed to reduce the effect level.

Where none of these are deemed possible, the Proposed Development will seek to include measures to offset residual adverse effects such that only negligible environmental effects are predicted.

8.2.6 Significance

A predicted level of effect is treated as 'Significant' if it is Moderate or Major.

8.2.7 Legislation, Planning Policy and Guidance

The relevant overarching legislation and policy has been laid out in Chapter 4 and reference should be made to this. Relevant statutory environmental legislation and regulation and established best practice guidance to this assessment, and which has been taken into account, includes the following.

Legislation

- Agriculture Act, 186; Control of Pollution Act, 1974;
- COSHH Regulations, 2002 (amended);
- Dangerous Substances Directive, 2006/11/EC;
- Environment Act, 1995;
- Environmental Protection Act, 1990;
- Environmental Liability Directive, 2004/35/EEC;
- Environmental Liability (Scotland) Regulations, 2009;
- EU Water Framework Directive, 2000/60/EC;
- EC Freshwater Fish Directive, 2006/44/EC;
- Flood Risk Management (Scotland) Act, 2009;
- Flood Risk Regulations, 2009;
- Land Drainage Act, 1991 and 1994;
- Groundwater Daughter Directive, 2006/118/EEC;
- Groundwater Directive, 1980/168/EEC;
- Pollution Prevention and Control Act,1999;
- Nature Conservation (Scotland) Act, 2004;
- Pollution Prevention and Control (Scotland) Regulations, 2012;
- Private Water Supplies (Scotland) Regulations, 2006;
- Water Environment and Water Services (Scotland) Act 2003 (WEWS Act);
- Water Environment (Controlled Activities) (Scotland) Regulations, 2011 (as amended) (CAR);
- The Water Environment (Controlled Activities) (Scotland) Amendment Regulations 2021;
- Water Environment (Drinking water Protection) (Scotland) Act, 2013;
- Water Environment (Oil Storage)(Scotland) Regulations, 2006;
- Water Environment (Register of Protected Areas) (Scotland) Regulations 2014;

- Water Framework Directive, 2000/60/EC;
- Water (Scotland) Act 1980; and
- Water Quality (Scotland) Regulations, 2010;

Guidance

- CIRIA publications:
  - Control of groundwater for temporary works, R113;
  - Control of water pollution from construction sites, C532;
  - Control of Water from linear construction projects, C649;
  - Culvert Design and Operation Guide, C689;
  - Development and Flood Risk – guidance for the Construction Industry, C624;
  - Environmental Good Practice on site, C741;
  - Groundwater control: design and practice, C750;
  - SUDS Manual, C753; and
  - Site Handbook for the Construction of SUDS.
- Department for Environment, Food and Rural Affairs (DEFRA), 2009, Construction Code of Practice for the sustainable use of soils on construction sites;
- Forestry Commission (2017). The UK Forestry Standard;
- Forestry Commission Forests and Water, 2011 UK Forestry Standard Guidelines;
- Forestry Commission (2019). Managing forest operations to protect the water environment. Forestry Commission Practice Guide;
- Forestry Commission Scotland, SNH, 2010, Floating Roads on Peat;
- Ministry of Agriculture Food and Fisheries (MAFF), 2000, Good practice guide for handling soils;
- SEPA, Guidance for Pollution Prevention (GPP, and older PPG:
  - GPP 1: Understanding your environmental responsibilities - good environmental practices, (2020);
  - GPP 2: Above ground oil storage tanks, (2018);
  - PPG 3 Use and Design of Oil Separators in Surface Water Drainage Systems, (2006);
  - GPP 4: Treatment and disposal of wastewater where there is no connection to the public foul sewer (2017);
  - GPP 5 Works and maintenance in or near water in or water, (2018);
  - PPG 6 Working at construction and demolition sites (2012);
  - PPG 7 Safe storage - The safe operation of refuelling facilities (2011);
  - GPP 8: Safe storage and disposal of used oils, (2017);
  - GPP 13 Vehicle washing and cleaning, (2017);
  - GPP 21: Pollution incident response planning, (2021); and
  - GPP 22: Dealing with spills, (2018).
- SEPA, 2009, Groundwater protection policy for Scotland SEPA, Policy 19;
- SEPA, 2009, Engineering in the Water Environment, Good Practice Guide, Temporary Construction;
- SEPA, 2010, Regulatory Position Statement – Developments on Peat;

- SEPA, 2014, LUPS, Guidance Note 4 Planning guidance on on-shore windfarm developments, Guidance on the assessment of peat volumes, reuse of excavated peat and the minimisation of waste;
- SEPA, 2006, WAT-SG-31 Prevention of pollution from Civil Engineering Contracts, Special Requirements, version 2;
- SEPA, 2008, WAT–SG-23, Engineering in the Water Environment, Good Practice Guide, Bank Protection rivers and lochs;
- SEPA, 2009, WAT-SG-29, Temporary Construction Methods;
- SEPA, 2009, WAT-SG-26, Engineering in the Water Environment, Good Practice Guide, Sediment Management, version 1;
- SEPA, 2010, WAT-SG-25, Engineering in the Water Environment, Good Practice Guide, river Crossings, Version 2;
- SEPA, 2012, WAT-SG-78, Sediment Management Authorisation;
- SEPA, 2012, WAT-PS-07-02:Bank Protection;
- SEPA,2015, WAT-PS-06-02: Culverting of Watercourses;
- SEPA, 2022, CAR – A Practical Guide Version 9;
- SEPA, 2017, LUPS Guidance 31, Guidance on Assessment Impacts of Wind Farm Development Proposals on groundwater abstractions and GWDTE;
- SEPA, 2019, Development at Risk of Flooding, Advice and consultation;
- Scottish Government (SG), 2006, Peat Landslide Hazard and /Risk Assessment, Best Practice Guide for Proposed Electricity Developments;
- SG, 2010, Zero Waste Plan;
- SG, 2013, Specific Advice on Onshore Wind Turbines;
- SG, SNH SEPA, 2017, Peatland Survey. Guidance on Developments on Peatland;
- SNH, 2013, Constructed Tracks in the Scottish Uplands;
- Scottish Renewables, SNH, SEPA, FCS, MSC, HES, 2019, Good Practice during Wind Farm Construction; and
- SR, SEPA, 2012, Developments on Peatland: Guidance on the assessment of peat volumes, reuse of excavated peat and the minimisation of waste. Version 1.

8.2.8 Consultation

The assessment process has been informed by consultation with the ECU including the Scoping Opinion (October 2021). A summary of the key consultation responses is described in Table 8-5.

Table 8-5: Consultation Responses

Consultee	Summary of Response	Where addressed within this Report
SEPA	New turbines and associated infrastructure in the western portion of the site would be on an area of peat bog and marshy grassland. The applicant should give consideration to how the site can be designed to avoid direct impacts. SEPA also note that the road between T7 to T1 (referred to as T25); the road from T2 to T3 (referred to as T26 and	This feedback has been taken into account in the design iteration process (refer to Section 3.2). The overall design response is presented within the EIA report (Chapter 3 Description of Development). A Peat Management Plan and a Peat landslide Hazard Risk Assessment have been carried out along with extensive peat depth surveys. They are

Consultee	Summary of Response	Where addressed within this Report
	T27 respectively), and T3 (T26) itself all appear to be on peat of about 2m depth. They suggest these pieces of infrastructure should be removed or moved onto less valuable areas.	reported in Appendices 8-1 and 8-2 respectively, and summarised in the following Chapter under baseline, predicted effect and additional mitigation.
SEPA	There is an awareness of the potential ecological harm that windfarm developments may cause on wetlands and there are appropriate commitments to protect habitats and wildlife.	The water supply to wetlands has been assessed and reported below, particularly in reference to groundwater dependent terrestrial ecosystems and reported both in Chapter 6 and in this Chapter under baseline, predicted effect and additional mitigation.
SEPA response to Gatecheck report	Welcomed that feedback on the proposed site design has been taken into account in the design process and understand changes have been made to the site layout to address scoping comments, and noted changes to the design to avoid peat, GWDTE and water features. However, as no information has been provided with the report regarding underpinning site surveys, site constraints and intended buffers zones from sensitive receptors cannot fully comment on the appropriateness of the design freeze layout (Figure 4). The applicant will need to address all the issues listed in our generic scoping advice document (available here: https://www.sepa.org.uk/media/144547/lups-l-14-windfarm-scoping-letter.pdf) within the EIA.	Underpinning site surveys, constraints and mitigations are fully detailed in Chapter 8 of the report and are in full compliance with the generic SEPA scoping advice.
NatureScot	NatureScot would expect to see peat depth analysis of this area undertaken to inform the location of these proposed turbines. From the current figures, it appears that T3 (referred to as T27) is in very close proximity to an area of deeper peat. We advise that micro siting T3 (referred to as T27) to avoid disturbance of deep peat is prioritised. NatureScot note that the peat depth map accompanying the scoping report does not easily allow the turbine locations and peat depths to be compared as turbine locations are not superimposed on the peat depth map.	Phase 1 and Phase 2 peat probing has been undertaken for this area and has been considered in further design iteration and will be presented within (Chapter 3 Description of Development) and in the peat section. The turbine T27 (previously T3) has been micro sited to minimise deep peat disturbance. Maps have been prepared and presented with interpolated peat depth and infrastructure layout superimposed. A Peat Management Plan has been prepared which addresses peat avoidance, minimisation and mitigation.
Scottish Water	The development proposals impact on existing Scottish Water assets. The Applicant must identify any potential conflicts with Scottish Water assets	Scottish Water Asset maps have been provided by Site Investigation Services (UK) Limited. There are no Scottish Water assets within proximity of the

Consultee	Summary of Response	Where addressed within this Report
	and contact the Asset Impact Team via Scottish Water's Customer Portal to apply for a diversion. A review of our records indicates that there are no Scottish Water drinking water catchments or water abstraction sources, which are designated as Drinking Water Protected Areas under the Water Framework Directive, in the area that may be affected by the proposed activity.	proposed infrastructure and therefore no potential conflicts are identified. This is addressed in the Baseline Section 8.3.8.
East Ayrshire council	Supplied copy of the most up to date information, re Private Water Supplies on Register within 2 km plus copy of the annual PWS Return	Figure 8-4 has been prepared showing location of PWS and PWS risk assessment carried out and reported in Baseline Section 8.3.9.
Dumfries and Galloway Council	Response received re Private Water Supplies on Register for PWS located within 2 km.	Figure 8-4 has been prepared showing location of PWS whether they are in hydrological connectivity with the Proposed Development and reported in Baseline Section 8.3.9.
Dumfries and Galloway Council	The Flood Risk Management Team (FRMT) raised no objection to the proposed development but gave advice on the management of surface runoff from the site during and after construction.	
ECU	Scottish Ministers request that the company contacts Scottish Water (via EIA@scottishwater.co.uk) and makes further enquires to confirm whether there any Scottish Water assets which may be affected by the development and includes details in the EIA report of any relevant mitigation measures to be provided.	See Scottish Water response above.
ECU	Scottish Ministers request that the company investigates the presence of any private water supplies which may be impacted by the development. The EIA report should include details of any supplies identified by this investigation, and if any supplies are identified, the company should provide an assessment of the potential impacts, risks, and any mitigation which would be provided.	Dumfries and Galloway Council and East Ayrshire Council supplied information on PWS within a 2 km radius of the site. The PWS within 2km are assessed in the Baseline Section 8.3.9 to determine whether they are in potential hydrological continuity with the site and whether in scope for the assessment.
ECU	Ministers consider that where there is a demonstrable requirement for peat landslide hazard risk assessment, the assessment should be a clear understanding of whether the risks are acceptable and capable of being controlled by mitigation measures. Scottish Ministers are aware that the	Peat landslide hazard risk assessment (PLHRA) prepared ad reported in Appendix 8-2 in accordance with The Peat Landslide Hazard and Risk Assessments: Best Practice Guide with details of any mitigation measures.

Consultee	Summary of Response	Where addressed within this Report
	Proposed Development falls within Group 3 Peatlands.	
Coal Mining Authority	Part of the Proposed Development (including T6 – referred to as T30) is located within the defined Development High Risk Area. Part of the site has therefore been subject to past coal mining activity. In addition, the site is located within an area of coalmining legacy with surface coal resource and coal mining at shallow depth associated with a thick coal seam outcrop. The area may have also been subject to unrecorded coal mining. In accordance with the agreed risk-based approach to development management in Development High Risk Areas, the past coal mining activities and the presence of surface coal resources within the site should be fully considered as part of the ES; this should take the form of a risk assessment, together with any necessary mitigation measures.	A Coal Mining Risk Assessment in accordance with the request has been undertaken and is included as Technical Appendix 8-3 in Volume 2 of the EIA Report together with proposed mitigation measures required. The findings are summarised in Baseline 8.3.10 below. Impact Assessment has been carried out on those features deemed to be in scope and reported in 8.4.8 and mitigation in 8.6.12.
Nith District Salmon Fishery Board (NDSFB)	The proposed development falls within the district of Nith District Salmon Fishery Board (NDSFB) and Nith Catchment Fisheries Trust (NCFT) - The Board considers it essential to conduct further aquatic monitoring, both fish and aquatic invertebrates, on the lower Polhote Burn, downstream of the sites that have been surveyed previously. This is important to provide information to assist in preserving the limited populations of fish remaining in the vicinity of the extension site.	Potential effects in relation to aquatic species is considered within Chapter 6 Ecology. However, the embedded mitigation, best practice and additional mitigations which may be necessary are addressed in Chapter 8 Hydrology in protecting watercourses from effects due to the development.

8.2.9 Data Sources

The baseline is based upon the collection of information from a variety of data sources including published material. Table 8-6 details the data sources referred to throughout this assessment.

Table 8-6: Data Sources

Topic	Sources of Data and Information
Climate, Rainfall	CEH National River Flow Archive Data https://www2.sepa.org.uk/rainfall/ (Accessed 07/2/22)
Topography, Elevation, relief	Ordnance Survey mapping, https://www.bing.com/maps/ (Accessed 07/2/22)
Surface Water WFD Status	SEPA water Classification Hub https://www.sepa.org.uk/data-visualisation/water-classification-hub/ (Accessed 10/2/22)

Topic	Sources of Data and Information
	SEPA Water Environment Hub (Accessed 10/2/22) https://www.sepa.org.uk/data-visualisation/water-environment-hub/
Flooding	Flood Risk Management Maps SEPA ttps://map.sepa.org.uk/floodmap/map.htm (Accessed 10/2/22)
Groundwater	SEPA Water Classification Hub https://www.sepa.org.uk/data-visualisation/water-classification-hub/ (Accessed 10/2/22) Groundwater Vulnerability Mapping of Scotland (1:625,000) Hydrogeological Map of Scotland (scale 1:625,000)
Geology	BGS Geology of Britain Viewer – bedrock and superficial deposits https://mapapps.bgs.ac.uk/geologyofbritain/home.htmlr accessed 9/2/22 BGS 1:50,000 maps Natural Power, Borrow Pit Scheme of Works - Borrow Pit C, Sandy Knowe Wind Farm, 02 June 2020
Soil	Soil Survey of Scotland https://map.environment.gov.scot/Soil_maps/?layer=2 accessed 9/2/22
Environmental Designations	https://magic.defra.gov.uk/MagicMap.aspx [Accessed January and February 2022]. https://www.nature.scot/professional-advice/protected-areas-and-species/protected-areas/national-designations/sites-special-scientific-interest-sssis
Mining	Coal Authority Interactive Maps http://mapapps2.bgs.ac.uk/coalauthority/home.html (Accessed 9/2/22)
Private Water supplies	East Ayrshire and Dumfries and Galloway Council responses and public register extracts: Environmental Protection
Scottish Water Assets	Site Investigation Services (Limited)
Drinking Water Protection zone	https://www.gov.scot/publications/drinking-water-protected-areas-scotland-river-basin-district-maps/ (Accessed 20/9/21)
Nutrient Sensitive Areas	https://www.gov.scot/publications/nitrate-vulnerable-zones-maps/ (Accessed 20/9/21)

8.2.10 Surveys

Site Walkovers

Several hydrological site walkovers were conducted by Ferry Hydro. An initial visit was undertaken in the western extent of the Proposed Development Footprint on 4th November 2020.

A further visit was undertaken to the northern extent (T29 and T30) as well as revisiting the western extent on 6th October 2021. This visit was conducted alongside peat and ecology surveys (NVC survey of the northern extent). On the second visit, a number of the Sandy Knowe Wind Farm construction features were also observed.

The objective of the visits was to look at the Proposed Development Footprint hydrology, hydrogeology and groundwater dependent terrestrial ecosystems (GWDTE)

in advance of providing layout and design advice and to inform the hydrology and hydrogeology chapter.

Potential turbine locations and access routes and potential watercourse crossings were visited. A number of cores were taken using a hand operated Russian corer to investigate the subsurface superficial geology and saturation levels. Water features, wetland habitats and shallow subsurface geology and hydrogeology (via the hand coring) were examined.

NVC Surveys

The EIA Chapter relies upon NVC surveys of the Proposed Development area plus a 250m buffer from the edge of the site boundary, carried out on 18th of August 2020 and 5th and 6th October 2021. These are reported in Chapter 6: Ecology.

Peat Probing

The assessment baseline is also informed by two phases of peat probing (Phase 1 grid in March 2021 and a Phase 2 infrastructure grid in December 2021) and a site visit by East Point Geo. An interpolated peat depth plan was developed to identify the distribution of peat across the Proposed Development Footprint. This is reported in Technical Appendix 8-1.

8.3 Baseline Conditions

8.3.1 Topography, Setting and Land Use

The Proposed Development Footprint is up to 4 km east of Kirkconnel and Kelloholm in Dumfries and Galloway. It is located the south of the River Nith and the A76. Land use is grazing for cattle and sheep with adjacent forestry to the west, south and east. There are legacy areas of coal mining adjacent to the Proposed Development Footprint.

The Proposed Development Footprint is within the larger Proposed Development Site and comprises a western, northern and eastern extent (See Figure 3-1a to 3-1d). The Proposed Development Footprint is located on open upland moorland overlooking the valley of the River Nith.

The western extent comprises four turbines, T25, T26, T27 and T28 and three watercourse crossings. It is bounded on the west and south by plantation, in the east by open moorland and to the north by improved grassland. The south adjoins an east–west trending ridge south of the Proposed Development. This southern ridge stretches from High Cairn (553m Above Ordinance Datum (AOD)) east through Polnagrie Hill and Mynwhirr Hill (418m AOD) to Corserig Hill (395m AOD) and is a major watershed in the area. The elevation falls from a maximum 440m AOD in the south west to 250m AOD in the north on gently sloping land south of Nether Cairn and High Cairn farm buildings. The landform is a series of benches or steps with some steep hills and some flat areas. The terrain includes incised river valleys associated with Polhote Burn. The western extent is accessed by a new 500m WNW-oriented track connecting the Sandy Knowe Wind Farm T7 to the proposed T25 and a further 1.5km new track to T26, T27 and T28.

The northern extent is surrounded by heathland. The land in this extent area comprises a gently domed plateau with high point of 292m AOD and low point of 280m AOD. It is located on the eastern slide of the incised gorge of Polneul Burn. The northern extent comprises two turbines, T29 and T30. Proposed track comprises a 700m long ENE-

oriented spur from just west of the track from the consented Knowe Wind Farm at T13 to proposed turbine T30, and a 230m long NNW-oriented spur from this new track to T29. Overall access is via the existing Sandy Knowe Wind Farm access, the Heads of Valley Road in the northeast, and a western access 500m or so east of High Cairn cottage.

The wider Proposed Development Site is extant and used for the Sandy Knowe Wind Farm but no new infrastructure is proposed. Use will be made of the consented and constructed Sandy Knowe Wind Farm substation, the consented temporary compound for construction and a further constructed temporary construction compound for battery storage, within the larger Proposed Development Site.

8.3.2 Geology

A map of the site geology is presented as Figure 8.2 showing Superficial Geology and the Geological SSSI in the area. An Interpolated peat depth plan as Figure 8.6.

Bedrock

The bedrock underlying the site in the majority of the western extent comprises greywacke (turbidite), sandstones, mudstones and siltstones of the Ordovician Kirkcolm Formation. They occur in poorly defined beds which range from thin to thick with laminated units.

A small area on the lower slopes underlying the north of the western extent of the Proposed Development Footprint comprises Carboniferous Clackmannan Group and Lower Coal Measures bedrock of the Sanquhar Coalfield. Lower Coal Measures underlie all of the northern extent. These deposits belong to the south-western margin of the Sanquhar Coalfield, a basin inlier of Carboniferous strata. These coal deposits were historically mined in the area for fossil fuel use. The Coal Measures here generally dip at shallow angles northwards. The crop of coal seams in the wider area indicates that there are shallow coal seams in the area.

A number of bedrock outcrops are present and visible across the area on elevated hummocks and in the banks of steep gorges.

The Polhote and Polneul Burns are a geological SSSI designated for gorge exposures of the most continuous and fossiliferous sequence of Upper Carboniferous strata in southwest Scotland are present in immediately west of the northern extent.

Superficial

The Superficial deposits within the Proposed Development Footprint comprise glacial diamicton, overlain in part by peat deposits. Peat is generally found on top of diamicton but sometimes onto rock directly. There are some areas of bare rock with no superficial deposits around the incised river valleys.

The diamicton is a result of Late Pleistocene (Devensian) glaciation (approximately 20,000 years before present). Where observed in surface exposures in the western extent, mostly in river banks, the diamicton or glacial till consisted of brown and grey, silty, sandy, and gravelly till containing lenses of fluvio-glacial sand and gravel. The tills are compact, poorly stratified, containing angular to rounded clasts up to boulder size. The till is of varying permeability and is up to 4 m thick but more generally 1-2 m thick.

The northern extent is underlain by a soft, pure, very plastic creamy white yellow diamicton with a tinge of blue which is very clayey and relatively impermeable clay. This was seen in all cores and on ditch sides and bases.

Soil

The soils on the majority of the Proposed Development Footprint, are Peaty Gleys of the Ettrick Soil Association. These are derived from the Ordovician Lower Palaeozoic greywackes and shales. Gleys are greyish or bluey-grey mottled wetland soils which have developed under conditions of intermittent or permanent waterlogging, in the absence or very low levels of oxygen. The upper soil horizons are wet for much of the year and the soils are generally rich in organic matter grading into shallow peat (peat >50cm).

Soils on the lower slopes on the western extent are also gleys but of the Rowanhill soil Association and are derived from Carboniferous sandstones, shales and limestones.

In the far south of the western extent, soils are peaty gleyed podzols also of the Ettrick Soil Association. Podzols are associated with acid parent material and semi-natural heath or coarse grassland vegetation and coniferous woodland. They develop where aerobic conditions prevail and water can percolate freely through the upper part of the profile. The gleying here suggests some waterlogging still occurs in this location.

8.3.3 Peat

Full details of peat on site are found in the Peat Management Plan, Technical Appendix 8-1. The interpolated peat depth plan derived from peat probing is presented as Figure 8-6. A summary of the peat baseline is given below.

BGS online mapping identifies peat as present only in the northern extent. Peat Depth probing however indicates that areas of peat are more widespread.

Peat occurs mainly on the western extent at depths between 0.6m and 1.0m with distinct areas of deeper peat between 1.5m and 3m depth. There are also several very small areas >3m depth.

The peat occurs on either side of the Polhote Burn and is especially prevalent on the east and west in the western extent.

There is much less coverage of peat in the northern extent. Here, peat is patchier at higher elevations where there are multiple tributaries to the Polhote Burn. There is an area of deep peat in the centre and in the far west of the northern extent. The peat is <2m deep at its deepest, however generally <1m.

The peat is of post-glacial age and when cored overlies the underlying Diamicton and on occasion bedrock. A review of site conditions indicated that much of the Proposed Development Footprint comprises relatively intact planar peat, and although there are numerous drains cut into the peat deposits, ground conditions are sufficiently wet and drain gradients sufficiently shallow (being cut oblique to or along contour) that they have recovered and appear to be relatively ineffective.

The NatureScot Carbon and Peatland map (NatureScot, 2016) identifies the area of the site as being underlain by Class 3 carbon-rich soils where Class 3 is defined as

'Dominant vegetation cover is not priority peatland habitat but is associated with wet and acidic type.' Occasional peatland habitats can be found. Most soils are carbon-rich soils, with some areas of deep peat. The Inidcative Soil for this Class is: Predominantly peaty soil (i.e. <50cm) with some peat soil (i.e.>50cm), The Indicative vegetation for this Class is Peatland with some heath.

This Peatland Class is confirmed by the site specific ecological assessment and peat depths and cores as described above and in Chapter 6 ecology.

8.3.4 Hydrology

Rainfall

Average annual rainfall at Sanquhar is 1000mm of rainfall. The wettest month is January with 166mm and the driest month is April with 86mm rainfall.

Watercourses and Catchments

A Water Features Plan showing surface water catchments is presented as Figure 8-1.

The River Nith flows from west to east 1.5 km to the north of the Proposed Development Site boundary. The whole Proposed Development Footprint lies within the River Nith catchment which covers an area of approximately 1,230 km^2. The Nith flows from New Cumnock in South Ayrshire and south to Dumfries. The River Nith is a productive salmon and sea trout river and provides a habitat for a wide range of other species. However, the stretch immediately downstream of the Proposed Development is only classified as Moderate for fish although High for fish migration by SEPA (1, 2).

The Proposed Development is located within three north flowing sub-catchments of the River Nith. From west to east these are Polhote Burn, Polneul Burn and Polmeur Burn sub-catchments.

The Kello Water catchment lies south and east of the Proposed Development boundary on the south of the east west trending ridge and has no hydrological connectivity with the Proposed Development Footprint. The Kello Water catchment does however drain a number of nearby wind farms. It comprises a number of sub catchments including the Polnagie, Gibbon, Polstacher and Polbroc Burns.

The northern extent drains almost exclusively into the Polhote Burn via a number of tributaries before forming a single channel just beyond T28. The Polhote Burn rises in the shallow valley between Polnagrie Hill and Mynwhirr Hill immediately to the south west of the Proposed Development Site. The Polhote Burn flows for approximately 2km downstream of the site before flowing via an offsite waterfall under the A76 at Cairn Bridge and then eventually into the River Nith 2km north of the northernmost turbine T28.

The Polhote Burn is formed by a number of small watercourses which rise within plantation forestry on the north-eastern slopes of Gibbon's Hill and Polnagrie Hill. It is generally less than 1m in width and approximately 0.5 m in depth for the first 2 km of its length before widening to up to 2 m in width and 0.5 m in depth. It is fast flowing and contains rocky bed material with occasional boulders. The main stem flows through narrow channels (0.5 m wide) but in deep sided valleys and gorges in a north-easterly direction, approximately 250 m from and parallel to the western edge of the Proposed Development Site boundary.

The deep gorge of Polneul Burn forms the western boundary of the northern extent. The valley sides reach up to 20m in height. The Polneul Burn is generally 1m to 2m in width

and 0.5m to 1m in depth. It is fast flowing, with several waterfalls and has a rocky substrate with numerous boulders within the watercourse. Parts of the banks and valley sides have exposed rock features. The north and west of the northern extent drain west and southwest drain into the Polneul Burn catchment, The Rotten Sike rises in the centre of the northern extent and flows north into the downstream reaches of the Polneul Burn. The Polneul Burn drains south into the River Nith parallel to the Polhote Burn.

The eastern and southern parts of the northern extent drain into the Polmeur Burn which rises just south of the northern extent. Above, within and east of the northern extent, the Polmeur Burn catchment has been heavily modified through the excavation of a series of long straight land drains. These are approximately 0.5 m in width and depth, although occasionally deeper. Beyond this, the Polmeur Burn flows northeast through a steeply incised valley to discharge into the River Nith.

There are many drainage ditches in the Polhote and Polmeur Burn catchment, mostly with east west orientation and which drain into the main burns and their tributaries. They are more common at lower elevations in the wetter areas in the north where they seem to be at intervals of 10-15m. Elsewhere, drains are extensive and can be over 100m but aerial photography suggests they can extend over 1km. Over 41km of drains can be mapped from satellite imagery. While they are relatively clear on these images, they were frequently difficult to locate on the ground, particularly in the large flushed areas below spring lines in the mid slopes. The drains are of varying age across the site. They are up to 50cm deep by 50cm wide and generally dug onto clay. Water is flowing in many of the drains and ditches.

There are also a number of new drains, of recent origin in the northern extent. These follow the route of Sandy Knowe tracks.

WFD Status of Surface Waters

The SEPA Interactive River Basin Management Plans mapping (SEPA 1.2) does not provide a water quality classification for the Polhote, Polneul or Polmeur Burns which therefore do not have a specific SEPA WFD Classification.

The receiving watercourse, the River Nith (Sanquhar – New Cumnock) is therefore the relevant classified WFD surface water body. It is defined as a river (ID: 10611), in the River Nith catchment of the Solway Tweed river basin district whose main stem is approximately 18.9km in length.

The River Nith (Sanquhar – New Cumnock) WFD Status is given in Table 8-7.

Table 8-7: WFD Status – River Nith (Sanquhar – New Cumnock)

Parameter	SEPA Classification Hub 2020	SEPA Environment Hub conditions in 2021	2021 Objective (not yet reported)
Overall Status	Moderate ecological potential	Good	Good
Overall Ecology	Poor	Does not apply	Does not apply
Fish	Moderate	Does not apply	Does not apply
Access for fish migration		High	High
Water Flows and Level	Poor	High	High
Physical condition	Poor	Good	Good
Freedom from Invasive Species		High	High

Parameter	SEPA Classification Hub 2020	SEPA Environment Hub conditions in 2021	2021 Objective (not yet reported)
Water Quality	High	Good	Good

The section of the River Nith between Sanquhar and New Cumnock (water body identifier code 10611) has been classified as Poor under the SEPA Environment Hub, and as having an overall status of Moderate Ecological Potential under the SEPA Classification Hub. It is Poor for Ecology and Physical condition and Moderate for Fish under the SEPA Classification Hub (SEPA 2), and High for Water Flow and levels and Access for Fish Migration under the SEPA water Environment Hub (SEPA 1).

SEPA objective is that, by 2021, which is not yet reported, the overall Status will move from Poor to Good. This will be achieved by Partnership activities which are ongoing and assessing modifications to bed, banks and shores as a result of rural and urban land uses.

Notwithstanding the absence of formal WFD status on the Polhote, Polneul and Polmeur Burns on site, invertebrate monitoring as reported in Chapter 6 Ecology notes that the Fish Habitat Survey (Technical Appendix 6-5), found 'good to excellent' densities of trout and that the diversity and quality of the aquatic invertebrate communities indicated high water quality in these watercourses.

Ecological surveys also reveal that tributary watercourses in the area are of 'good' quality in respect of salmonid habitats, particularly downstream of the Proposed Development. Trout parr were identified on the Polmeur burn on the eastern side of the northern extent and trout fry/parr and, to a lesser extent, salmon fry/parr were found in other locations downstream of the Proposed Development). Fish were also absent from several locations.

Overall, however, it is considered unlikely that the Proposed Development Footprint is suitable for salmonids due to limited areas of available productive habitat and obstacles to migration. This is particularly true for the western extent where the Polhote burn is dominated by run-cascade sections and a lack of gravelly substrate for spawning beds. The northern extent, flanked by the Polneul and Polmeur burns, is more suitable although drought conditions have affected the Polmeur burn in recent years.

For the purposes of this assessment, it is considered that all of the watercourses present within and near to the Proposed Development Site, notwithstanding the receiving River Nith Poor classifications, have an overall status of Medium.

8.3.5 Hydrogeology

Upper Nithsdale Groundwater Body

All of the western extent and the west of the northern extent are underlain by the eastern edge of the Upper Nithsdale groundwater body (ID: 150663), of the Solway Tweed river basin district. It is 377.8km2 in area. This is the main regional groundwater body.

The Upper Nithsdale groundwater body coincides with the Ordovician Kirkcolm greywackes. These are identified on the BGS Hydrogeological map of Scotland (BGS 1) as impermeable, generally without groundwater, except at shallow depth.

Borrow pit investigations near White Hill close to the western extent (Natural Power, 2020) confirmed this assessment. The report described the bedrock as competent rock mass with small scale variation in groundwater, weathering grade and fracture state across the borrow pit area. The fracturing was especially evident at shallow depth below the weathered zone. The thickness of the weathered zone was 0.5m up to 1.1m.

The Upper Nithsdale groundwater body SEPA WFD classification is given in Table 8-8. The Overall status is Poor under both the Water Classification and Water Environment Hubs. The Quantitative Status for Water Levels and Flow under the Water Classification Hub is Good. Although Water Quality is Good under the Water Environment Hub, Chemical Status is Poor under Water Classification Hub. The Poor water quality is due to legacy mining pollution with heavy metals, zinc, lead and cadmium.

SEPA have an objective to return the groundwater body quality and therefore overall status to Good Status by 2027. This will be done in partnership with the Coal Authority and other Public Bodies.

Table 8-8: WFD Status – Upper Nithsdale groundwater body

Parameter	Water Classification Hub 2020	Water Environment Hub 2014	Water Environment Hub Objective 2027
Overall status	Poor	Poor	Good
Water Flows and Level	n/a	Good	Good
Water Quality	Poor	Poor	Good
Quantitative Status	Good	n/a	n/a
Chemical Status	Poor – Zinc, Cadmium, Lead	n/a	n/a

Sanquhar Groundwater Body

The groundwater body underlying the centre, east and north of the northern extent and the north of the western extent is the Sanquhar groundwater body (ID: 150518), in the Solway Tweed river basin district. It is relatively small at 52.1km2 and is centred on the Nith Valley and surrounding slopes.

The Sanquhar groundwater body bedrock coincides with the Coal Measure mudstones, siltstones, sandstones, coal, and ironstones. The BGS Hydrogeological map of Scotland identifies the Coal Measures in this groundwater body as Locally Important Carboniferous Westphalian aquifers where the flow is dominantly in fissures and other discontinuities. Large volumes of water have been pumped from the coalmines adjacent to and immediately east and north of the northern extent, but that yields were low and quality poor.

The Sanquhar groundwater body also includes some localised sand and gravel aquifers in the Nith Valley along the river several kilometres north of the Proposed Development Site boundary.

The SEPA WFD classification is given in Table 8-9. This groundwater body is also of Poor overall status under both the SEPA Classification and Environment Hubs. The Quantitative Status under the Classification Hub is Good as are the water level and flow Status under the Water Environment Hub. Water Quality and Chemical Status respectively under the both Hubs are classified as Poor.

Mining and quarrying of coal has been identified as a diffuse source of Cadmium pollution to groundwater in this area.

SEPA have concluded that although the pressure has ceased, action is not possible. They have determined that return of the Status to good will not be possible by 2027 and will only be possible in the long term via natural recovery conditions.

Table 8-9: WFD Status – Sanquhar groundwater body

Parameter	Water Classification Hub 2020	Water Environment Hub 2021	Water Environment Hub Long term Objective
Overall status	Poor	Poor	Good
Water Flows and Level	n/a	Good	Good
Water Quality	Poor	Poor	Good
Quantitative Status	Good	n/a	n/a
Chemical Status	Poor - Cadmium	n/a	n/a

Superficial Hydrogeology

Diamicton till and peat largely cover the Proposed Development Footprint except in the incised river valleys where bedrock can be exposed and in various small outcrops across the footprint. These deposits have a variable but generally low permeability depending upon the local composition of the diamicton.

The BGS Hydrogeological map of Scotland identifies the sands and gravels in the Nith Valley as a permeable sand and gravel river alluvium aquifer. This aquifer however is located several kilometres north of the site boundary except for parts of the road in the western extent. The diamicton and peat are not aquiferous.

There are extensive wet gleyed soils on both extensions with many surface saturated areas. Water tracks and seepage flushes are common. Further south springs arise. With increasing elevation, the ground is somewhat drier but coring indicates saturation, either at the surface or <1m depth. The widespread clays and organic peat soils together with the relatively impermeable bedrock prevent significant infiltration and help to maintain this mainly anaerobic shallow and/or surface saturation and wetlands by restricting infiltration.

8.3.6 GWDTE

Definition

UKTAG (2004) guidance defines GWDTE as:

> *"a terrestrial ecosystem of importance at Member State level that is directly dependent on the water level in or flow of water from a groundwater body (that is, in or from the saturated zone). Such an ecosystem may also be dependent on the concentrations of substances (and potential pollutants) within that groundwater body, but there must be a direct hydraulic connection with the groundwater body."*

The Water Framework Directive (2006) defines a groundwater body as:

> *"a distinct volume of groundwater within an aquifer or aquifers where an aquifer is a subsurface layer or layers of rocks or other geological strata that is capable*

of supporting abstraction of 10 cubic meters per day on average or sufficient to serve 50 or more people; or provides a flow of groundwater the reduction of which may result in a significant diminution of the ecological quality of an associated surface water body, or significant damage to a directly dependent terrestrial ecosystem."

Ecological GWDTE Assessment

The habitats were mapped according to their dominant NVC community, as shown on Figure 6-5. The ecological assessment of potential groundwater dependency of habitats on site is carried out in Chapter 6: Ecology, and Technical Appendix 6-2: National Vegetation Classification Survey.

Each habitat type was classified as likely to be moderately or highly groundwater dependent according to SEPA (2017) Land Use Planning System SEPA Guidance Note 31, 11/09/2017 Guidance on assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystem. Where communities were not identified within this Guidance, classification followed the current general consensus for non-NVC communities. This identified habitat communities, which, if present, indicate that a wetland is likely to be groundwater dependent, depending on the hydrogeological setting.

Six communities were identified as potentially of moderate groundwater dependency and two communities as having a potential for high groundwater dependency. Their compositions are described in detail in Chapter 6. They include:

- Mires and flushes: Ja, Je, M6, M15, M23 and M25
- Grasslands and tall herb communities: MG9 & MG10

Table 8-10 lists the potential GWDTE in the respective areas.

Table 8-10: Potential GWDTE communities

Community code	Community name	Ecological GWDTE potential
Western extent		
Ja	Juncus acutiflorus – acid grassland community	Moderate
Je	Juncus effusus – acid grassland community	Moderate
MG9	Holcus Lanatus – Deschampsia cespitosa pasture	Moderate
MG10	Holcus lanatus - Juncus effusus rush pasture	Moderate
M15	Trichophorum germanicum – Erica tetralix wet heath	Moderate
M25	Molinia caerulea – Potentilla erecta mire	Moderate
M6	Carex echinata – Sphagnum fallax mire	High
M23	Juncus effusus/acutiflorus - Galium palustre rush pasture	High
Northern extent		
Ja	Juncus acutiflorus – acid grassland community	Moderate
Je	Juncus effusus – acid grassland community	Moderate
MG9	Holcus Lanatus – Deschampsia cespitosa pasture	Moderate
MG10	Holcus lanatus - Juncus effusus rush pasture	Moderate
M15	Trichophorum germanicum – Erica tetralix wet heath	Moderate
M25	Molinia caerulea – Potentilla erecta mire	Moderate
M6	Carex echinata – Sphagnum fallax mire	High

Community code	Community name	Ecological GWDTE potential
M23	Juncus effusus/acutiflorus - Galium palustre rush pasture	High

In reality, many habitats comprise mosaics of NVC communities. Hence when determining whether a particular habitat was potentially groundwater dependent, the composition of the mosaic was taken into account, using the classification outlined in Table 2 Technical Appendix 6-2. This allocates a potential GWDTE score to the mosaic depending upon its various communities.

The resulting spatial occurrence is overlain with the proposed infrastructure and shown on Figure 6-6 GWDTE Sensitivity Scores.

GWDTE Hydrogeological Risk Assessment

Those potential GWDTE within 250m of all excavations deeper than one metre and within 100m of excavations less than one metre were reviewed as part of design layout iteration and avoided as far as possible, given other competing constraints, as discussed in section 8.4.1.

Those potential GWDTE within the buffer zones of proposed infrastructure including temporary works, which could not be avoided, are shown on Figure 8-3a. In accordance with SEPA (2017) Guidance, these areas of potential GWDTE have been subjected to a detailed site specific hydrogeological risk assessment.

The potential GWDTE within the buffer zones on the western and northern extents are all semi natural wetland communities. They are dominated by mires, flushes, wet modified bog and marshy grassland. The widespread wetland conditions are reinforced by the evidence of the bluey-grey mottled wetland soils which have developed under conditions of intermittent or permanent waterlogging.

Where the upper soil horizons are wet for much of the year, they are generally rich in organic matter and form peat when >0.5m thick. The deeper peat >1m thick is typically covered in wet modified ombrogenous M20 bog, by definition not groundwater fed. The M20 is extensive on the western extent, especially on the upper slopes but not so prevalent on the northern extent. Further down the slope on the western extent and in the northern extent, M25 mires predominate.

The potential GWDTE in the western extent comprise patches of M23 rush pasture and linear M6 flushes. M25 is found lower and some MG9/10 outside the site boundary on gentler enclosed farmland. In the flatter northern extent potential GWDTE also comprise mosaics of M23, M25 with M6 flushes with large areas of intermediate Ja/Je rush dominated habitats.

Overall, there are no regional groundwater discharges at the surface. The Nithsdale groundwater body is not aquiferous and although the Sanquhar groundwater body is aquiferous and there may be deep groundwater, the glacial clay prevents any upward groundwater discharge within the Proposed Development Footprint. It is possible that outside the Proposed Development Site boundary closer to the River Nith there will be upwardly discharging groundwater where the clays are absent. This may also be the case within the gorges where groundwater base flow may sustain the watercourse flows in the Polhote, Polneur and Polneul Burns which have cut through the diamicton

layer barriers. There are also a number of small springs in the lower areas where Coal Measures outcrop.

The clay forms a barrier both to vertical infiltration of rainwater and upward discharge of any groundwater from the upper slopes. The bedrock itself is generally impermeable except for weathering and fissures. Soils overlying the clays or bare rock are thin except where peaty. Infiltration is therefore limited and the ground is very wet.

There will be some discontinuous and very shallow saturated horizontal groundwater flow along the top of the clay and in the more fibrous upper peat layers. There will also be a small component of saturated groundwater flow in the very thin weathered and fissures bedrock.

There are many areas of seepages and flushes, where these shallow groundwaters discharge. These occur adjacent to or in watercourses, and drains as base flow and at breaks in slope coinciding with more permeable till and absent clay and peat. Flow paths of this groundwater will be short and very local.

In the northern extent, given the gentle slope gradients and the shallow soil zone above the ubiquitous very shallow clay, it is only in the deeper drains and watercourses where there is some shallow partly saturated groundwater supply to the habitats.

There are considered to be no highly dependent GWDTE, given the absence of any regional or long groundwater flow. Overall, the dominant water supply mechanism is rainfall and surface water run-off. There is much evidence of storm overflow flattening rushes. However, several communities will be partially supplied by lateral flow from very shallow groundwater.

Ja and Je

This rush habitat is recorded in the northern extent where they occur on a terraced domed landform. The habitat is not defined in the western extent. Ja/Je habitats were considered by the surveyor to be intermediate to M23. Water tracks and flushes are common. There are no springs. The habitat sits on very thin <50cm shallow moist to wet soils, overlying a ubiquitous yellow diamicton clay with very little peat.

There is evidence of many old drains, up to 50cm deep by 50cm wide, in the Ja/Je. The drains are generally dug onto clay and water is flowing in many. They are naturally being reclaimed with sphagnum and rushes and often contain M6.

Given the gentle slope gradients and the shallow ubiquitous clay, it is considered that the key water supply mechanism is rainfall with surface storm run off when infiltration capacity is reached (quite quickly in this case). There may be some discontinuous and very shallow saturated horizontal groundwater flow along the top of the clay. This discharges in the many drains and flushes across the site and eventually in the many streams rising and flowing alongside the area.

True groundwater dependency is considered Low.

MG9

This community is found east of and adjacent to the northern extent adjacent to plantation on the banks of the Polmeur Burn close to old opencast restored mine. It is located on thin organic soils overlying clay. The area has been historically much disturbed.

The community is not considered to be groundwater dependent.

MG10

This community is found only on the moderate slopes in the far north of the western extent, on diamicton clays above the sands and gravels of the Nith Valley. It is sometimes enclosed and sometimes not, but is extensively grazed and close to farm buildings. However it is not within 250m of infrastructure; therefore it is not considered further.

M15

There is no M15 in the western extent. There is only a very small area in mosaic with M20 in the northern extent.

M15 is a wet heath community characteristic of moist and generally acid and oligotrophic shallow peats and peaty mineral soils. It is associated with thinner or better drained areas of ombrogenous peat with a surface pH typically between 4 and 5.

It is not considered to be groundwater dependent on the Proposed Development Footprint as it is essentially rain fed degraded blanket mire.

M25

The M25 purple moor grass dominated mire and marshy grassland M25 mire is a community of moist, but well aerated, acid to neutral peats and peaty mineral soils over gently-sloping ground, marking out topogenous mires and the fringes of ombrogenous mires which are grazed and drained (JNCC, 2004).

On the western extent the M25 occurs in large areas by itself on thin peats on diamicton clay and in association with M23 on the lower northern slopes. It occurs below the degraded M20 degraded ombrogenous (rain fed) mire dominating the higher slopes of the western extent.

On the northern extent it occurs in in conjunction with Ja, M6, M23 and M20 as well as on its own.

In both areas, it is considered to be substantially rainfall dependent with only a very small component of local very shallow groundwater supply as such of low groundwater dependency.

M6

M6 flushes typically occur in elongated thin strips along the margins of small watercourses, in drains and depressions and at the bottom of slopes in both the western and northern extents areas. It occurs as a small percentage of mosaics with M25, M20 and M23.

JNCC (2004) notes that M6 is a soligenous mire found on peat substrates that are fed primarily by base-deficient water in valley bottoms and sloping valley sides or channels where water flows slowly over a peaty surface. The water supply to the M6 is from lateral local movement of shallow surface water and groundwater and in some interception of storm return flow.

As such the groundwater dependency is considered Low - Moderate.

M23

M23 rush pasture occurs amongst the M20 bog on the upper slopes of the western extent. It occurs in patches amongst M25, Ja, Je ad M6 flushes in the northern extent.

Rodwell (1991) considers M23 rush-pasture as occurring over a variety of moist, moderately acid to neutral, peaty and mineral on gently-sloping ground around the margins of soligenous flushes, as a zone around topogenous mires and wet heaths and especially widespread in ill-drained, comparatively unimproved or reverted pasture.

M23 within the proposed development footprint is typically aligned with the prevailing drainage within the valleys and on the banks and slopes of the Polneul and Polmeur Burns and their many tributary watercourses.

It is generally found on thin peats and watercourse zones on peaty soil or areas of mineral soil at the edges of deeper peat. The water supply mechanism is a combination of surface water and shallow groundwater flowing off the blanket bog peats.

As such the M23 is considered to be partially groundwater dependent, i.e. Moderate.

GWDTE Hydrogeological Assessment Summary

The results of the GWDTE hydrogeological assessment are shown in Table 8-11.

Figure 8-3a shows all potential high or moderate dependency GWDTE by NVC within a 250m radius of potential infrastructure works.

Figure 8-3b shows those GWDTE which, following hydrogeological risk assessment, are assessed as moderately dependent. This assessment did not find any groundwater dependent terrestrial ecosystems within the buffer zones of infrastructure

Table 8-11: GWDTE within GWDTE Buffer Zone

Potential GWDTE	SEPA LUPS Dependency (SEPA, 2017) see Chapter 6 Ecology	Assessed Dependency after assessment
Ja *and* Je *Juncus acutiflorus – Juncus effusus – acid grassland community*	Moderate	Low
MG9 *Holcus Lanatus – Deschampsia cespitosa pasture*	Moderate	Not GWDTE
M15 *Trichophorum germanicum – Erica tetralix wet heath*	Moderate	Not GWDTE
M25 Molinia caerulea - Potentilla erecta mire	Moderate	Low
M6 Carex echinata - Sphagnum recurvum mire	High	Moderate
M23 Juncus effusus/acutiflorus - Galium palustre rush-pasture	High	Moderate

8.3.7 Flooding

The SEPA Indicative River & Coastal Flood Map has been reviewed for the vicinity of the Proposed Development. This is a screening tool for planning applicants, developers and planning authorities designed to '*support decision making in land use planning to avoid development in flood risk areas as a first principle and identify where further assessment of risk may be required*'.

The maps illustrate the areas where there is a 10%, 0.5 % or 0.1% probability of surface water (pluvial) or river flooding (fluvial) in any given year, i.e. the 1:10, 1:200 and 1:1000 year flooding event.

This map does not indicate that any flooding would occur throughout the Proposed Development Footprint.

There is some river flooding on the Polneul Burn north of the A76 and on the Polmeur Burn in the east alongside the A76. These are distant from the Proposed Development Footprint by >1km.

The burns and their tributaries are located in valleys and deep gorges. In extreme events where the flows within the burns would be high, the capacity of these gorges to contain the water and route it will account for the low risk of flooding.

As a large proportion of the Proposed Development Footprint consists of peaty soil and or gleys on clay, the ground is generally saturated. Drainage channels have been constructed to assist in draining the land historically although many of these are grown over. Localised low spots around the site could potentially be susceptible to pluvial flooding.

Flood Sensitivity is considered low and it is not considered that a site specific Flood risk Assessment is required.

8.3.8 Public Water Supply

Scottish Water Asset maps have been provided by Site Investigation Services (UK) Limited. There are no Scottish Water assets within proximity of the proposed infrastructure other than water distribution pipework as identified in 8.3.9 below. Therefore no potential conflicts are identified.

8.3.9 Private Water Supplies

Private Water Supplies (PWS) for the 2km radius around the Proposed Development Footprint boundary were identified through consultation with East Ayrshire Council and Dumfries and Galloway Council. Extracts from their PWS registers were obtained. The findings are shown on Figure 8-4.

SEPA were also approached to share records of PWS in the area but advised that they were unable to respond in the statutory timescales.

Four properties were identified within the 2km radius search area. All were in Dumfries and Galloway Council area and are Type B, i.e. they serve domestic premises with less than 50 persons supplied as defined by the Private Water Supply (Scotland) Regulations 2006.

Some additional PWS were identified outside of this search area in East Ayrshire Council area. None of the properties had associated descriptions of the source. i.e. whether well, borehole, spring or surface water abstraction.

As there is no requirement to register a Type B private water supply, East Ayrshire Council advise that all properties within the search area should be checked additionally. A review of Scottish Water utility plans was therefore conducted. Searches were conducted for those properties in areas potentially within hydrological connectivity of the Proposed Development Footprint which did not have identified PWS on the Council Registers. The aim was to check there are water supply mains to these properties. This identified water supply mains to cottages and farmhouse at High Cairn and Nether Cairn, properties down gradient and within hydrological connectivity.

None of the PWS identified are in hydrological connectivity with the Proposed Development Footprint, when considering both surface and groundwater potential connectivity.

Three of the four properties are on the opposite side of the River Nith. The nearest PWS to the site, 99790, is located 1km south of the southern boundary of the western extent and 1.2km from the nearest turbine. However, it is located on the other side of the main east west ridge running from Polnagrie hill to White Hill to Mynwhirr Hill. The PWS is therefore in a different hydrological catchment (Kello Water) and has no connectivity to the shallow groundwater within the site, as can be seen on Figure 8-1, Water Features Plan.

The East Ayrshire PWS similarly, are all greater than 2km distant and in different surface water and groundwater catchments and have no hydraulic connectivity with the site.

Therefore, no risk to PWS has been identified associated with the Proposed Development Footprint and therefore PWS is not considered further in this assessment.

8.3.10 Mining

BGS 1:50,000 maps show that Turbines 25 – 28 are underlain by non-coal bearing strata, and are therefore not considered to be at risk from coal mining activity.

The presence of the Scottish Lower Coal Measures beneath T29 and T30, and crop of coal seams in the wider area indicates that there are shallow coal seams in the area. The Coal Authority do not have any record of mine entries, shallow mine workings or probable shallow mine workings at either turbine location.

However, T30 is within a Development High Risk Area (DHRA). This DHRA is associated with an opencast coal mine that operated between 1986 and 1993 (Wardell Armstrong, 2013). Assessment of available information indicates that the extent of the opencast mine lies approximately 50m to 150m to the east of T30.

Figure 8-5 shows the key Coal mining features in the area.

Given the above, the Coal Authority considered that a Coal Mining Risk Assessment (CMRA) should be carried out to assess whether the coal mining legacy issues can potentially pose a risk to the Proposed Development. The CMRA is reported in Appendix 8-3.

8.3.11 Designated Sites

The following designated sites are present within 10km of the Proposed Development. Site. These are identified below with distance from the Proposed Development Footprint boundary.

- Fountainhead SSSI (1.9km west) – Earth sciences – mineralogy of a disused antimony mine;
- Largrae Burn SSSI (2.5km north) – Earth sciences – stratigraphy of Upper Carboniferous (Namurian (part)-Westphalian);
- Muirkirk and North Lowther Uplands Special Protection Area (SPA) (4.6km north) – breeding populations of Hen harrier Circus cyaneus, Merlin Falco columbarius, Peregrine Falco peregrinus, Short-eared owl Asio flammeus and Golden plover Pluvialis apricaria and non-breeding populations of Hen harrier;

- North Lowther Uplands SSSI (4.6km north) Biological – designated for breeding populations of Hen harrier and upland breeding bird assemblage;
- Back Wood SSSI (7.4km east) Biological – Upland oak woodland; and
- Nith Bridge SSSI (9.4km west) – Earth sciences – Quaternary of Scotland.

None of these are considered to be affected by the Proposed Development and are not considered further.

However, there is one environmental designation contained with the Proposed Development Footrpint and Site: the Polhote and Polneul Burns SSSI. Large parts of the SSSI are within the northern extent as shown on Figure 8-2. It is considered further below.

The Polhote and Polneul Burns SSSI (site code: 1298) is an earth sciences or geological site. It incorporates the gorge exposures lower parts of the Polneul and much of the Polmeur Burn and a nominal area of the banks on either side.

The citation for the SSSI (Nature Scot 2) states that

> *"this locality shows key exposures through the Namurian and Westphalian strata of the Sanquhar Coalfield, complementing the sequence of higher strata at Lagrae Burn. Its rocks in the Passage Group and the Coal Measures (Westphalian A and B) yield important data on the fauna, flora and stratigraphy of the Upper Carboniferous and represent the most continuous and fossiliferous sequence of Namurian and Westphalian A strata in southwest Scotland."*

The Site Management Statement notes that

> *"the rocks were laid down around 313 million years ago, during the Carboniferous geological period. At that time, the area appears to have been part of a large tropical delta, which was heavily wooded. Much of the accumulated vegetation was subsequently covered in sand, mud and silt.*
>
> *From an analysis of the layers of small fossils, such as 'Mussel Bands' and the 'Skipsey Marine Band' within these sediments, it has been found that the sediment was deposited from both rivers and the sea. These fossils occur throughout most of the coalfields in Scotland and further afield. This allows comparisons to be drawn with other coalfields where the geological history is understood in greater detail .As there was little oxygen, the layers of vegetation did not break down but were compressed as the sediments built up and progressively formed thin seams of coal. Since their formation, these rock layers have been undisturbed by movements in the Earth's crust, and remain horizontal".*

The The Polhote and Polneul Burns SSSI is the best exposure of the rocks forming the lower part of the Sanquhar Coalfield. The junction between the Upper Carboniferous rocks and much older Ordovician rocks, which underlie the Sanquhar Coalfield, is exposed within the SSSI.

It is reported in the Site Management Statement that the landowners manage the majority of the land for rough grazing, although the whole of the SSSI is under NatureScot management agreements, to encourage access and to provide interpretation of the geological interests.

NatureScot management aims include the prevention of tipping which can obscure rock exposures, appropriately planned tree planting also to avoid obscuring rock exposures, control of mineral extraction and maintenance of access for visiting researchers.

For the purposes of this assessment, the SSSI is considered to have a High sensitivity to damage from construction works.

8.3.12 Sensitivity of Potential Receptors

Receptor sensitivities are assigned in Table 8-12. These are assessed with respect to the foregoing baseline findings and the sensitivity criteria in Table 8-1.

Table 8-12: Receptor Sensitivity

Receptor	Sensitivity	Reason
Watercourse Water Quality	Medium	Aquatic surveys indicated healthy fish populations and invertebrate communities which identify the Polhote Burn as having High water quality. The receiving watercourse to the Burns draining the Proposed Development has Poor Overall Status but has component High classifications. There is a SEPA objective for this to become Good in 2027 and the long term.
River morphology	High	Due to the SSSI being centred on the gorge exposures, it is important that no impact on the gorges of the Polhote and especially the Polmeur Burn.
Groundwater bodies	Medium	There is no regional groundwater body and the current Status is Poor. However there is a SEPA objective to return the water quality to Good in 2027.
GWDTE	Medium	The groundwater supports moderately dependent NVC M23 GWDTE in places.
Private Water Supply (PWS)	Low	There are no PWS in hydrological continuity with the Proposed Development.
Public Water Supply	Low	There are no public water supply assets in the area which could be impacted by construction works and no abstractions for public water supply in hydrological continuity.
Flooding	Low	There is no flood risk within the Proposed Development Footprint nor within 1km.
Statutory Sites	High	Much of the Polhote and Polmeur Burns SSSI designated for geology are within the Proposed Development Site.
Peat	Medium	Degraded species and unlikely to be highly active or capable of restoration. However does represent a significant source of carbon sequestration.
Peat Landslide	Low to Medium	Landslide likelihood was found to be Low to Moderate across a majority of the site, with no High or Very High areas. Key receptor would be run out affecting the SSSI gorges.
Legacy Mine Workings	High	High overall risk of collapse within underlying mine or mine entries and subsequent migration of voids to the surface, causing subsidence and harm to site user or surface installations. There is also a High Risk that mine gas is presents with potentially severe risk to human health).

8.4 Predicted Effects

This section assesses and predicts the potential effects of the Proposed Development on each of the following sensitive hydrology, geology and hydrogeology receptors (as identified in the Baseline section 8.3):

- Watercourses and aquatic fauna and flora – quality and morphology;
- Groundwater flow and quality;
- Water supply to groundwater dependent M23 GWDTE;
- Geological SSSI;
- Carbon rich peat, peat soils and peat hydrology;

- Peat Landslide Hazard; and
- Historic coal mining legacy issues.

Private and public water supply and flooding are scoped out as sensitive receptors.

The assessment takes into account both standard best practice measures as required in legislation and embedded mitigation in design. These were discussed in Chapter 3: Description of Development and are outlined in section 8.4.1. Whilst the incorporation of these measures in design has helped to reduce the magnitude or likelihood of some potential effects occurring, it was not possible to avoid all potential effects.

Those activities which, after embedded mitigation in design, still have the potential to cause effects on the sensitive receptors, and the type of potential effect are identified in section 8.4.2.

The predicted effects are then assessed in consideration of the possible interactions between the Proposed Development and existing and future site conditions. They are discussed through Sections 8.4.3 to 8.4.8 for each set of sensitive receptors. The predicted effects are summarised in Sections 8.9 and 8.10 in Tables 8-13, 8-14 and 8-15 for construction, operation and decommissioning respectively.

8.4.1 Embedded Mitigation

On the basis of the findings of the desk and field-based baseline, the design of the Proposed Development has iteratively taken into account sensitive hydrological, hydrogeological and geological receptors.

Where possible, sensitive receptors have been avoided, thereby reducing potential effects arising from the Proposed Development. The range of embedded mitigation in the context of the project design evolution is discussed in Chapter 3: Description of Development and summarised below are specific infrastructure design commitments relevant to hydrology and hydrogeology.

General

- Infrastructure components are shared with Sandy Knowe Wind Farm where practicable in order to minimise the potential impact on sensitive receptors;
- Infrastructure has been positioned to minimise cut and fill requirements; and
- Secondary crane pads (boom assemblies), blade fingers and turning heads have all been specified as temporary infrastructure (and therefore will not involve permanent excavation of peat).

Turbines and Hard Standing

- All positioned to maintain a minimum buffer of 50m from watercourses;
- T25 was moved several times onto shallower peat. The hardstand area was positioned to avoid high potential GWDTE and deeper areas of peat;
- T26 was moved east to avoid the need for an additional watercourse crossing and onto slightly shallower peat. The hardstand area was positioned to avoid high potential GWDTE;
- T27 was moved several times onto shallower peat and to avoid high potential GWDTE. Hardstand area was positioned to avoid high potential GWDTE habitat and deeper areas of peat;

- T28 hardstand area was positioned and moved several times to avoid high potential GWDTE habitat and to minimise location on deeper areas of peat;
- T29 was moved south to avoid peat. The hardstand area was positioned to avoid deeper areas of peat; and
- T30 was moved east to avoid high potential GWDTE habitat and hardstand area positioned to avoid deeper areas of peat.

Access Tracks

- All were positioned to maintain a minimum buffer of 50m from watercourses, unless approaching a watercourse crossing;
- Proposed link track between T25 and Sandy Knowe Wind Farm infrastructure was re-routed south to reduce overlap with a 1.0 – 2.0 m peat depth area;
- Track between T25 and T26 was redesigned to maximise deep peat avoidance;
- Track between T27 and T28 was realigned west to avoid deeper areas of peat and to overlap with shallower peat;
- Floating track was investigated for the Proposed Development, but much of the site is on a moderate north facing slope over which floated surfaces may be more difficult to construct. One section of floating track has been specified between T27 and T28 over the deepest area of peat;
- The three-way junction on the track approaching T29 and T30 was removed and the track to T29 realigned to avoid potential high GWDTE. Subsequent low impact turning heads were introduced at T29 and T30;
- The T29 – T30 junction was relocated to shallower peat; and
- Tracks between turbines will be micro-sited onto locally shallower peat where possible following detailed pre construction site surveys.

Watercourse Crossings

- The number of watercourse crossings was minimised. T27 was moved to avoid the need for an additional watercourse crossing;
- There will be no new crossing of the gorges which form the geological on site SSSI;
- Bottomless stone arch culverts will be used on all three new watercourse crossings;
- Crossings will be designed to mimic natural pre-existing conditions with no change in water flow upstream or downstream and not to exacerbate erosion;
- The crossings will be WAT-SG-25 compliant and sized for 1:200 events and with 20% added for climate change over next 25 years; and
- Abutments to the culverts will be sufficiently set back so as not to affect the bed and banks, ecology, and water levels of the watercourse.

8.4.2 Activities with Potential for Effects

The activities which could give rise to potential effects are:

Construction

- Duration one year;
- Excavation and construction of 3.1 km of new access tracks, 5 m wide with 0.5m verge either side with nine passing places, 20m x 5.5m;

- Excavation and construction of six turbine foundation approx. 25m x 25m in area and approximately 3m deep;
- Excavation and construction of six permanent crane hard standings, 62.5m x 25m;
- Installation of three watercourse crossings, one within Polhote burn (W1) and two tributaries to the Polhote burn (W2 and W3);
- Cable laying within track verges at a depth of 50cm;
- Development and use of a Battery Storage compound on a consented temporary construction compound;
- Use of temporary construction compounds, storage and use of oils, fuels and chemicals;
- Stockpiling of soils and peat;
- Exposure of bare earth;
- Installation of cut-off drains;
- Installation of drains, temporary and permanent;
- Dewatering of excavations and trenches;
- Discharge of water;
- Temporary watercourse diversions;
- Concrete mixing and pouring;
- Site reinstatement; and
- Vehicle use.

No extraction of aggregate is proposed.

Temporary compounds from the consented Sandy Knowe wind farm will be used.

There will be no upgrades to existing site access and consented Sandy Knowe Wind Farm tracks.

Operation

- Duration 40 years;
- Use of Battery Storage area and substation;
- Ongoing use of access tracks;
- Use of permanent compound with fuels, hydrocarbons and chemicals;
- Permanent Drainage; and
- Maintenance of turbines, access tracks and cables.

Decommissioning

- Duration 12 months;
- Removal of all major equipment and structures;
- The upper sections of the foundations will be removed to a depth which will permit the continuation of current land use practices;
- Additional on-site access tracks will be removed and the affected area reinstated, unless required for land management;
- All underground cables will be left in place and de-energised;
- The crane hardstanding adjacent to a turbine will be removed, and reinstated;
- Some drainage will remain;
- Removal and reinstatement of Battery storage compound;

- Use of reactivated temporary compounds, storage and use of oils, fuels and chemicals;
- Stockpiling of soils and peat; and
- Vehicle use.

8.4.3 Potential Effects – Surface Water

Flooding

There is a no risk of flooding on the site or within 1 km. The Dumfries and Galloway Flood Management Team have no objection to the proposal. They did however give some advice on surface water management. This has been included in Proposed Mitigation.

Sediment Pollution of Watercourses

There is a high potential for turbid sediment laden surface water run-off from rainfall onto exposed bare earth, exposed peat, stockpiles of excavated materials, including peat, and use of access track. The sediment run off could occur during construction from excavations works for turbine, hardstanding foundations, cabling and access tracks. Further risks from sediment to water quality will arise from watercourse crossing construction, temporary watercourse diversions and drainage discharge.

Sediment run off could degrade surface water quality and associated hydro morphology, fauna and flora and other users of water where the fine sediments and other pollutants can smother or poison plants and animals directly or smothering the habitats they depend on. There are no private or public water supplies in hydrological continuity with the Proposed Development.

The risk of impact is particularly likely during construction and heavy rainfall periods where mobilisation of this sediment by rainfall run-off can overwhelm drainage protection. The effect may occur but to a much lesser effect during operation of access tracks, and during decommissioning.

There is a large body of best practice guidance for construction management, drainage design and control for the avoidance and minimisation of this potential effect. As well as best practice there is embedded mitigation including attenuation due to watercourse buffers, and design of watercourse crossings.

During *Construction* the effects occurring are probable and the magnitude of the predicted effects is *Medium*. Given the medium sensitivity of watercourses, the predicted effect is *Moderate* and therefore *Significant*.

During *Operation* it is considered that there will be very much reduced sediment available for mobilisation, with a functioning permanent drainage system installed with settlement ponds and swales as necessary. The magnitude of the predicted effect is *Low*. Consequently, the predicted effect during operation is *Minor* and therefore *Not Significant*.

Decommissioning will have slightly increased risks over operation but as there will still be very limited excavation and bare earth due to leaving buried infrastructure in the ground and allowing track to naturally regenerate, the magnitude will be *Low*. The predicted effect is *Minor* and therefore *Not Significant*.

Chemical and hydrocarbon pollution of surface water

There is potential for accidental spills, leakage and spillage of polluting substances. If realised, these could lead to potential pollution of surface water and associated flora and fauna. The risks would arise from vehicle and plant movement, pouring or leaching of concrete, use of temporary compounds including for refuelling, the use and storage of fuels, oils and other potentially polluting substances. This risk will be exacerbated by the increased pathways for such pollution to move fast given the extensive temporary and permanent drainage.

It is probable the effects could occur during *Construction* given the high level of activity necessitating chemicals, fuel etc. on site. The magnitude of the predicted effects is considered *Medium*. Given the medium sensitivity of watercourses, the predicted effect is *Moderate* and therefore *Significant*.

During *Operation* it is considered that there will be reduced use and storage of polluting substances on site and the magnitude is considered to be *No Change*. The predicted effect during operation is *Negligible* and therefore *Not Significant*.

Decommissioning will have slightly increased risks over operation but as there will be very limited excavation and bare earth, the magnitude will be *Low*. Therefore, the predicted effect is *Minor* and *Not Significant*.

Change in surface water flow

Increased surface water run-off is likely from the increased areas of new permanent hardstanding and access tracks and increase in drainage structures both temporary and permanent. Further increases will arise from dewatering of excavations, discharge of water and temporary watercourse diversions. Changes in surface water flow will also arise from removal or blocking of existing field drains by access track and other infrastructure.

The consequent change in the surface water flow regime could affect hydro-morphology, fish, other fauna and flora and the WFD Status of the receiving watercourses including the River Nith. Surface water PWS are not sensitive receptors as there are none in hydrological continuity so they are not considered here.

It is probable the effects could occur during *Construction*. The magnitude of the predicted effects is considered *Low*. Given the medium sensitivity of watercourses, the predicted effect is *Minor* and therefore *Not Significant*.

During *Operation* it is considered that there will be little further change in surface water flow. The magnitude is considered to be *No Change*. The predicted effect during operation is *Negligible* and therefore *Not Significant*.

Decommissioning will have slightly increased risks over operation but as there will be very limited excavation and bare earth, the magnitude will be *No Change* and therefore predicted effect is *Negligible* and therefore *Not Significant*.

8.4.4 Potential Effects – Groundwater

Change in groundwater flow regime affecting base flow to streams

Changes in groundwater recharge and flow regime could potentially affect base flow to watercourses. Activities which could cause the effect include the construction of buried foundations, linear groundwater flow barrier effects of excavated access tracks

and cable runs, groundwater dewatering and discharge from excavations and access track construction. The increased hard standings will also change shallow groundwater recharge patterns locally.

The site is underlain by low permeability diamicton, peat and bedrock with only very shallow groundwater. Groundwater flow paths are short. Parts of the Proposed Development are underlain by a locally important aquifer (the Sanquhar groundwater body) but the diamicton clays will provide a substantial barrier to downward infiltration and recharge to this aquifer.

No groundwater fed PWS wells and springs or boreholes are at risk, The shallow groundwater does however provide base flow to the watercourses in the area, both from above the diamicton but also from the weathered bedrock below the diamicton when exposed in incised watercourse valleys.

During *Construction,* the magnitude of the predicted effects is considered *Low* as there is unlikely to be any identifiable change to stream flow due to changes in groundwater base flow. The predicted effect is *Minor* and therefore *Not Significant*.

During *Operation* it is considered that there will be little further change in ground water flow. The magnitude is considered to be *No Change*. The predicted effect during operation is *Negligible* and therefore *Not Significant*.

Decommissioning will have no further effect. The magnitude will be *No Change* and therefore predicted effect is *Negligible* and therefore *Not Significant*.

Change in groundwater quality

This effect would be caused by chemical, fuel and other spills and leaks transported by the drainage system and discharged into the groundwater. It could affect streams via contaminated base flow. Some GWDTE are also sensitive to changes in quality of groundwater supply, but no highly sensitive GWDTE are identified. Groundwater quality is historically already poor due to mining legacy. There are no hydrologically connected PWS sensitive groundwater receptors.

Activities which could cause the effect are contaminated drainage and dewatering discharge, spills from vehicle and plant movement, mixing, pouring and leaching of concrete and use of Temporary Compounds. All these have the potential to use and store fuels, oils and other potentially polluting substances.

By far the most use of potential polluting substances will be in the *Construction* phase. The magnitude of the predicted effects is considered *Low* as the groundwater flow paths are short especially in comparison to surface drainage and flow. The predicted effect is *Minor* and therefore *Not Significant*.

During *Operation* it is considered that there will be low risk of spills to groundwater. The magnitude is considered to be *No Change*. The predicted effect during operation is *Negligible* and therefore *Not Significant*.

Decommissioning will have slightly more chemicals etc. than operationally, on site. Magnitude is considered *Low*. Therefore, the predicted effect is *Minor* and therefore *Not Significant*.

8.4.5 Potential Effects on GWDTE

Direct loss of GWDTE Habitat

Building on, excavating and/or dewatering GWDTE habitat would lead to permanent loss of GWDTE habitat. Embedded Mitigation has avoided this as much as possible.

There are no high dependency GWDTE within the study area. There are 44ha of moderately dependent (M23 and M6) within the buffer area as shown on Figure 8-3b. This is a conservative calculation taking into account mosaics which include these two habitats despite the presence in the mosaics of other low dependency or non GWDTE habitats.

Direct loss due to permanent infrastructure built over these, plus a 10m proximal amount due to indirect dewatering will be 0.9 ha. This constitutes just over 2% of moderately dependent GWDTE identified within the Proposed Development Footprint. This is a low magnitude against the criteria in Table 8-3.

During *Construction* the effects occurring are certain and the magnitude of the predicted effects is *Low*. The predicted effect is *Minor* and therefore *Not Significant*.

During *Operation* it is considered there will be no further direct loss of GWDTE over that during construction. The magnitude of the predicted effect is *No Change*. Consequently, the predicted effect during operation is *Negligible* and therefore *Not Significant*.

Decommissioning will also have a magnitude of *No Change* in respect of direct loss of GWDTE. The predicted effect is *Negligible* and therefore *Not Significant*.

Change in groundwater flow regime, causing loss and disturbance of GWDTE

The shallow groundwater in the Proposed Development partly supports a conservatively estimated 44ha of moderately groundwater dependent GWDTE, M23 rush pasture and M6 flush habitats via seepages. A change in the groundwater flow regime supplying these habitats could indirectly cut off the groundwater flow component of supply to the GWDTE.

Activities which could cause this potential effect are barrier effect to groundwater flow from sub surface foundations and excavations and access road, diversion of groundwater flow due to dewatering from excavations, increased hardstanding causing reduction in local recharge, and diversions of shallow groundwater and drainage cut offs and temporary and permanent drainage.

The areas potentially at risk of impact are shown in Figure 8-3b. These areas comprise approximately 6ha. This is approximately 13% of the total moderately dependent GWDTE on the Proposed Development Footprint. The magnitude of this when compared against the criteria in Table 8-3 is Low.

However when added to the 2% direct and indirect loss of the habitat identified above, this comprises a total potential effect on 15% which is a Moderate magnitude according to the criteria on Table 8.3.

During *Construction* therefore the overall potential effect on GWDTE and which are probable and likely to be long term have a *Low* magnitude of predicted effects. The predicted effect is *Moderate* and therefore *Significant*.

During *Operation* there will be no further change to conditions other than establishing those set during construction. The magnitude of the predicted effect is *No Change*. Consequently the predicted effect during operation is *Negligible* and therefore *Not Significant*.

Decommissioning likewise will not alter the underground flow regime any further. The magnitude will be *No Change*. The predicted effect is *Negligible* and therefore *Not Significant*.

8.4.6 Potential Effects on Geological SSSI

Integrity of SSSI watercourse gorge geology and geomorphology

Polhote and Polneul Burn gorges are designated for their geomorphology and geology. The SSSI is located within the Proposed Development Footprint. The northern extent is within 25m of the extensive Polneul Burn part of the SSSI whilst the western extent is 600m upslope from the Polhote Burn SSSI gorge.

Construction activities, including excavation, dewatering, discharge of water, watercourse crossings, stockpiling of excavated materials on or close to the sides of the Polhote and Polneul Burns watercourses and their gorges could potentially affect the structural integrity of these Geological designated SSSI.

These could cause damage of exposed rock faces either through direct damage to bankside material or indirectly. Indirect effects could include loosening of soil structure thus impacting on the localised morphology and water quality of the watercourse and/or disturbance of stream banks and/ or substrate with increased erosion, and local changes to fluvial geomorphology.

During *Construction* the effects occurring are possible and could be either temporary or permanent. The magnitude of the predicted effects is *Low - Medium*. The predicted effect is *Moderate* and therefore *Significant*.

During *Operation* there will be no further change to conditions other than those set during construction. The magnitude of the predicted effect is *No Change*. Consequently the predicted effect during operation is *Negligible* and therefore *Not Significant*.

Decommissioning likewise will have the potential to impact the SSSI if appropriate precautions not taken. However, there will be a much reduced volume of excavation and materials and the magnitude will be *Low*. The predicted effect is *Moderate* and therefore *Significant.*

8.4.7 Potential Effects - Peat

Loss, disturbance and degradation of peat and peat soils and their hydrology

The potential effects on peat with respect to geology, hydrogeology and hydrology are the loss of carbon rich peat and changes to the hydrology of the peat causing deterioration in peat and further carbon loss. These losses would include direct loss from excavation and indirect loss due to changes in saturation hydrology which is crucial to the integrity of carbon storage in peat from adjacent excavations.

At the Proposed Development Footprint, much of the site is covered in peat, and opportunities to avoid it altogether are limited. However, specific design decisions to minimise peat impacts were taken to minimise this as much as possible.

A PMP has been prepared for the Proposed Development (Technical Appendix 8-2).

The PMP concludes that:

- 778m^3 of acrotelm and 1,440m^3 of catotelm will be temporarily excavated prior to being directly reinstated at the point of excavation.
- 5,280m^3 of acrotelm and 13,462m^3 of catotelm will be permanently excavated and require reuse.

The bulk of the potential effects will occur during *Construction* and will be a combination of permanent and temporary. The magnitude of the potential effect on peat, given the volumes above is *Medium*. This would result in a *Moderate* predicted effect which is therefore *Significant.*

During *Operation* there will be no further change to the peat resource conditions other than those set during construction. The magnitude of the predicted effect is *No Change*. Consequently, the predicted effect during operation is *Negligible* and therefore *Not Significant.*

Decommissioning likewise will not alter the status of peat any further. The magnitude will be *No Change*. The predicted effect is *Negligible* and therefore *Not Significant*.

Peat Landslide Hazard

A peat landslide hazard and risk assessment (PLHRA, Technical Appendix 8-1) was undertaken for the Proposed Development. It was informed by detailing Phase 1 and Phase 2 peat depth probing, a high resolution digital terrain model and site mapping.

The assessment comprised both qualitative (contributory factor/ landslide susceptibility) and quantitative (limit equilibrium/factor of safety) approaches to determine a combined likelihood of peat landslides across the area proposed for new infrastructure.

A consequence assessment was undertaken based on receptors within and adjoined to the site. Risk was calculated as a product of landslide likelihood and consequence for each receptor. Key receptors were identified as watercourses within and adjoining the site, the Polhote and Polneul Burns geological SSSI, and terrestrial habitats (including potential GWDTEs).

Landslide likelihood was found to be Low to Moderate across a majority of the site, with no High or Very High areas (Figure 8.1.9). Six infrastructure locations overlapped with Moderate likelihood areas (which have the potential to be associated with Medium or High risks).

Runout analysis was undertaken to determine the extent and thickness of potential landslide debris in the event a landslide were to be triggered at any of these six locations.

The analysis indicated that three of these six locations (runout zones 1, 2 and 5) were sufficiently close to the upper reaches of the Polhote and Polneul Burns that debris may enter these watercourses if a landslide were to occur. There was no risk of debris entering the watercourse from the other locations should landslides occur (Technical Appendix 8-1, Figure 8.1.10).

However, volumes of material would be small, and the SSSI is more than 900 m downstream of the nearest source zone. It is expected that thin, low density mobilised organic material within the watercourse would have little or no effect on the qualifying

features of the SSSI (mineral exposures), certainly not over and above that caused by natural erosion in these relatively steep slopes and watercourses.

There are no public or private water supplies within runout distance of the potential landslide source zones.

Comparison of runout zones with potential GWDTEs indicates overlap with a number of High potential GWDTEs, This is inevitable given the widespread occurrence of this ecological GWDTE classification across the site. However as indicated in Section 8.3.6 none of these GWDTE, after hydrogeological risk assessment, are considered to be highly dependent.

Landslide debris may have a short to medium term effect on habitats over which it passes, however in most reports of peat landslides, the in-situ vegetation remains post runout and recovers to its former condition (except where buried by larger blocks of material). It is unlikely that there would be any major disruption to groundwater sources from landslide occurrence.

Based on this assessment, risks associated with peat landslides have been calculated to be Low, and post-consent good practice should be sufficient to minimise landslide risks to tolerable levels.

In *Construction* therefore, the magnitude of a peat landslide is considered as *Low* with respect to M23 and M6 moderate GWDTE and watercourses and *Negligible* with respect to the geological SSSI. Overall therefore the magnitude is *Low*. The potential effects ae therefore *Minor* and *Not Significant*.

It is likely that any peat landslide risks would be largely realised during the one year construction period although some effects could increase over time such as mine gas migration, if present. Thus, the risk magnitude during *Operation* is assessed at *No Change*. The predicted effect is therefore *Negligible* and *Not Significant*.

During *Decommissioning* there would be no added risk thus the magnitude would be *No Change*. The Predicted Effect would be *Negligible* and *Not Significant*.

8.4.8 Potential Effects – Coal Mining

A Coal Mining Risk Assessment (CMRA) has been carried out in accordance with the requirements of the Coal Authority. It has been prepared by GDG Geosolutions, a "competent body" as assessed by the Coal Authority. The CMRA is presented in Appendix 8-3.

The CMRA is the agreed risk-based approach to development management. It considered:

- The location and stability of abandoned mine entries;
- The extent and stability of shallow mine workings;
- Outcropping coal seams and unrecorded surface mine workings; and
- Hydrogeology, mine water and mine gas.

In summary the CMRA found that Turbines 25 to 28 in the western extent are not at risk of historic coal mining.

T29 and T30 are unlikely to be underlain by shallow mine workings or be impacted by a mine entry. T30 is not considered to lie within the footprint of the backfilled opencast mine, which is conjectured to lie to the east.

Although no mine entries or workings are recorded in the northern extent below T29 and T30, the potential presence of shallow coal in the area presents a hazard if it has been worked without record. Where shallow mine workings or mine entries are present there is a risk of collapse within the mine or mine entry and subsequent migration of voids to the surface, causing subsidence and harm to site user or surface installations. The consequences, if unrecorded mining features are in fact present, puts the turbines and associated roads at Medium to Medium High Risk.

There is a risk of mine gas associated with the backfilled opencast mine to the east of T30, and where unrecorded workings could be present below the T29 and T30 development footprint. A Conceptual Site Model was developed within Appendix 8-3. This shows that linkages are present between the potential Sources (quarry derived mine gas and mine gas from unrecorded shallow workings) and Receptors (future site users of T30 and the structure itself) via Pathways (migration through fracture/permeable strata and backfill, and subsequent accumulation in the turbine).

The mine gas hazard is considered to pose a Medium High Risk, on the basis that the likelihood of gas is possible and the impact of the gas to receptors may be severe (possibly fatal with regard to human health). It could also cause significant damage to the turbine structure. There is a Medium High risk of mine gas at the proposed turbine locations.

The magnitude of unrecorded mine workings risk during *Construction* in the northern extent is *Medium* in that it is unlikely but the consequences would be serious if realised. The magnitude of mine gas risks also in the northern extent are considered to be *Medium* give the combination of low probability but high consequence. The Predicted Effect is *Moderate* and therefore *Significant*.

It is likely that any risks would be largely realised during the one year construction period although some effects could increase over time such as mine gas migration, if present. Thus the risk magnitude during *Operation* is assessed at *Low*. The predicted effect is therefore *Minor* and *Not Significant*.

During *Decommissioning* there would be no added risk thus the magnitude would be *No Change* and the Predicted Effect would be *Negligible* and therefore *Not Significant*.

8.4.9 Summary of Predicted Effects - Construction

The construction phase has the potential to alter the hydrology and hydrogeology of the Proposed Development Footprint and is the highest risk phase of the wind turbine development.

The construction of the Proposed Development is anticipated to take approximately 12 months. Many of the activities with potential to give rise to the effects (8.4.2) will be carried out concurrently to reduce the overall length of the construction programme.

The predicted effects of the proposed development during construction, taking into account embedded mitigation and best practice are summarised in Table 8-13. The prediction takes into account direct and indirect effects on sensitive receptors, magnitude of effect (timing, scale, size and duration) and likelihood of the potential effect occurring.

Table 8-13: Potential Effects During Construction Phase

Potential Effect	Sensitivity	Magnitude	Duration	Effect	Additional Mitigation Required
Sediment pollution of watercourses	Medium	Medium	Temporary	Moderate	Yes
Chemical and hydrocarbon pollution of surface water	Medium	Medium	Temporary	Moderate	Yes
Change in surface water flow	Medium	Low	Temporary	Minor	No
Change in groundwater flow regime affecting base flow to streams	Medium	Medium	Long Term	Moderate	Yes
Change in groundwater quality	Medium	Low	Temporary	Minor	No
Direct loss of GWDTE Habitat	Medium	Low	Permanent	Minor	No
Change in groundwater flow regime, causing loss and disturbance of GWDTE	Medium	Low	Temporary and Permanent	Moderate	Yes
Integrity of SSSI watercourse geology and geomorphology	High	Low - Medium	Permanent	Moderate	Yes
Loss, disturbance and degradation of peat and peat soils and their hydrology.	Medium	Medium	Permanent and Temporary	Moderate	Yes
Peat Landslide Hazard	Medium	Low	Temporary	Minor	No
Coal Mining Risks	High	Medium	Temporary	Moderate	Yes

8.4.10 Summary of Predicted Effects - Operation

The operation of the Proposed Development is anticipated to be 40 years after which the turbines will be decommissioned and the site restored.

During operation the activities with potential to give rise to effects (Section 8.4.2) will comprise use and maintenance of access tracks, turbines and cabling. The potential effects from the operation of the Proposed Development are summarised in Table 8-14. Much of these effects will be initiated in the Construction Phase.

Table 8-14: Potential Effects During Operational Phase

Potential Effect	Sensitivity	Magnitude	Duration	Effect	Additional Mitigation
Sediment pollution of watercourses	Medium	Low	Long term	Minor	No
Chemical and hydrocarbon	Medium	No change	Temporary	Negligible	No

Potential Effect	Sensitivity	Magnitude	Duration	Effect	Additional Mitigation
pollution of surface water					
Change in surface water flow	Medium	Negligible	N/a	Negligible	No
Change in groundwater flow regime, affecting stream base flow.	Medium	No change	N/a	Negligible	No
Change in groundwater quality	Medium	Negligible	N/a	Negligible	No
Direct loss of GWDTE Habitat	Medium	No change	N/a	Negligible	No
Change in groundwater flow regime, causing loss and disturbance of GWDTE	Medium	No change	Long term	Negligible	No
Integrity of SSSI watercourse geology and geomorphology	High	No Change	n/a	Negligible	No
Loss, disturbance and degradation of peat and peat soils and their hydrology.	Medium	No Change	n/a	Negligible	No
Peat Landslide Hazard	Medium	No Change	n/a	Negligible	No
Coal Mining Risks	High	Low	Permanent	Minor	No

8.4.11 Summary of Predicted Effects – Decommissioning

Activities associated with a 12 month decommissioning period with potential to give rise to effects are set out in Section 8.4.2 above. The potential effects from the decommissioning of the Proposed Development are summarised in Table 8-15.

Table 8-15: Potential Effects During Decommissioning Phase

Potential Effect	Sensitivity	Magnitude	Duration	Effect	Additional Mitigation
Sediment pollution of watercourses from turbid surface water run-off.	Medium	Low	Long term	Minor	No
Chemical and hydrocarbon pollution of surface water	Medium	Low	Temporary	Minor	No
Change in surface water flow	Medium	No change	N/a	Negligible	No
Change in groundwater flow regime, affecting stream base flow.	Medium	No change	N/a	Negligible	No

Potential Effect	Sensitivity	Magnitude	Duration	Effect	Additional Mitigation
Change in groundwater quality	Medium	Low	N/a	Minor	No
Direct loss of GWDTE Habitat	Medium	No change	N/a	Negligible	No
Change in groundwater flow regime, causing loss and disturbance of GWDTE	Medium	No change	Long term	Negligible	No
Integrity of SSSI watercourse geology and geomorphology	High	Low	n/a	Moderate	No
Loss, disturbance and degradation of peat and peat soils and their hydrology.	Medium	No change	n/a	Negligible	No
Peat Landslide Hazard	Medium	No change	n/a	Negligible	No
Coal Mining Risks	High	No change	n/a	Negligible	No

8.5 Assessment of Cumulative Effects

In accordance with the EIA Regulations, cumulative effects of the Proposed Development in conjunction with other existing or approved developments are considered.

All wind farm developments within a 10km radius of the Proposed Development are assessed for cumulative hydrology, hydrogeology or geology effects. The locations of developments considered for cumulative effects are shown on the map in Figure 5-2 and are listed in Table 8-16.

Table 8-16: Cumulative Developments

Site Name	No of Turbines	Approx. Distance from Proposed Dev elopement Footprint	Status
Sandy Knowe Wind Farm	24	Adjacent	Construction
Euchanhead	21	3 km SSE	Application
Hare Hill	20	1.7 km S	Operational
Hare Hill Extension	35	500 m S	Operational
Sanquhar	9	2.5 km E	Operational
Glenmuckloch Farm	8	3.5 km N	Approved
Magheugan Rig	6	2.5 km S	Operational
Lethans Tip Increase	22	3.2 km N	Approved
Lethans Extension	10	5.5 km N	Application
Sanquhar II	44	5.5 km S	Appealed
Sunnyside Farm	2	5 km ENE	Operational

Site Name	No of Turbines	Approx. Distance from Proposed Dev elopement Footprint	Status
Afton	25	7 km SE	Operational
Pencloe Forest Variation	19	7 km ESE	Approved
Whiteside Hill	10	4.5 km SE	Operational

The combined or cumulative effects are assessed against whether there could be potential combined effect from the identified developments on the same receptor. The assessment is based on the principle that there would be similar predicted effects for individual wind farms to that for the Proposed Development as laid out in 8.4 above, pro rata to the number of turbines.

The cumulative assessment is considered to be particularly relevant in terms of sediment pollution and/or changes in flow to surface watercourses given the long potential pathways for potential effects.

Other predicted significant effects for the Proposed Development relate to relatively local effects and are considered only for Sandy Knowe Wind Farm.

Surface water quality

For surface water significant effects predicted before mitigation relate to sediment and hydrocarbon and chemical pollution during the construction phase only.

Apart from Sandy Knowe Wind Farm, there are no proposed or operational wind farms which are directly hydrologically connected to the watercourses within the Proposed Development Site.

Lethans Tip wind farm on the north of the River Nith drains west into the River Ayr via Guelt Water, Glenmuir and Logan Waters. The Lethans Extension similarly largely drains into west into the same catchments although there may be a small component draining into Fingland Water. The Lethans and its extension have no hydrological connectivity with the River Nith apart from this small minor westward component and so are not considered further.

The remaining developments, although not directly connected hydrologically, drain into the River Nith, either upstream or downstream of the Polhote, Polneul and Polmeur Burns draining the Proposed Development Footprint. As such there could be some indirect cumulative effects on the River Nith itself. The Developments are listed below.

- The Sanquhar II Wind Farm drains into the catchment of the Scaur Water, which joins the River Nith 15km or more SE. However, given this large distance and the large dilution and sediment deposition effects, cumulative effects from this wind farm are not considered further;
- Pencloe Forest Extension and Afton developments are distant from the Proposed Development but do drain north via the Afton Water discharging at New Cumnock into the River Nith, approximately seven km upstream of the Polhote Burn;
- Glenmuckloch Farm development is on the opposite side of the River Nith from the Proposed Development and drains south via several tributaries into the River Nith opposite the Polneul and Polmeur Burns. Sunnyside Farm, also on the opposite side to the River Nith from the Proposed Development also drains south into the River Nith but further east between Kelloholm and Sanquhar;

- The constructed Hare Hill Wind Farm and Extension, Sanquhar Community Wind Farm Magheugan Rig and Euchanhead developments all drain east to the Kello Water catchment. The Kello Water discharges into the River Nith at Kelloholm 2km downstream of the Polmeur Burn; and
- Whiteside Hill development drains into the Euchan Water then into the River Nith at Sanquhar.

Those Developments considered to be in scope by virtue of draining indirectly into the River Nith in the relatively near vicinity of the Proposed Development are: Pencloe Forest, Afton, Sanquhar, Glenmucklock, Sunnyside, Euchanhead, Magheugan Rig and Whiteside Hill,

it is not considered that there would be a significant further cumulative effect for the following reasons:

- Of these sites, five are already operational with only minor or negligible effects predicted, and it would be difficult to measure any change in quality;
- The remaining three have no set construction date. These developments comprise 48 turbines of which 21 are in Pencloe Forest extension with a relatively distant discharge upstream into the River Nith;
- There are long distances from the individual wind farm sites to the River Nith, with multiple opportunities for dilution and settlement;
- There is substantial dilution capacity in the River Nith itself; and
- It is assumed that appropriate mitigation (under good practice) would be implemented for those sites under construction.

The combined cumulative magnitude is considered *Low - Negligible* which would lead to a *Minor – Negligible* predicted effect and therefore *Not Significant*.

Sandy Knowe Wind Farm

Sandy Knowe Wind Farm is adjacent to the Proposed Development Footprint and within the Proposed Development Site. It is clearly in scope and is considered below.

In terms of predicted water quality effects, the 24 turbines associated track and watercourse crossings of this consented Sandy Knowe Wind Farm under construction drain into the Polnuel and Polmeur Burns then into the River Nith. Only the two turbines and track of the northern extent also drain into these burns with no new watercourse crossings.

There is no direct hydrological connectivity of Sandy Knowe with the western extent other than via a small amount of track in the Polneul Burn catchment. The western extent drains into the Polhote Burn only. There will be use of the existing Sandy Knowe Borrow pit and of the consented and existing temporary compounds for construction and battery storage.

Overall, there is an indirect opportunity for a combined effect on surface water quality with Sandy Knowe via the combined effect of discharge into the River Nith of the Polhote, Polmeur and Polneul Burns of the combined Proposed Development and Sandy Knowe Wind Farm. However significant predicted water quality effects will occur only during construction. The construction of Sandy Knowe Wind Farm is advanced and will be complete and the site will be operational before the Proposed Development would be constructed.

In light of the fact there will not be parallel construction and as the Proposed Development is relatively small compared to the activities of Sandy Knowe itself, there is not considered to be a significant predicted cumulative effect on the water quality.

Predicted significant effects on Sandy Knowe Wind Farm relate to peat loss, direct loss of GWDTE, changes in the groundwater flow affecting GWDTE, risks from legacy mining and risk to the integrity of the Polhote and Polneul Burn geological SSSI on site.

Effects on GWDTE from direct loss and change in groundwater flow affecting GWDTE and from legacy mining are all considered to be relatively local, especially given the shallow short flow paths of groundwater and the well mapped restricted location of legacy mining. Similarly effects on the SSSI have been mitigated in the construction of Sandy Knowe and there should be no further significant cumulative predicted effects.

Therefore no additional mitigation measures over and above those committed to in this Chapter are considered necessary to address potential cumulative effects on hydrology, hydrogeology or geology.

8.6 Additional Mitigation Measures

8.6.1 General

To ensure that mitigation during construction is funded, contractors will be requested to explicitly include for mitigation in their cost tenders. The same will be applied for Decommissioning tenders.

It is anticipated that the preparation of a series of environment plans will be conditioned as part of the consent. These plans will be approved by SEPA before commencing construction. These plans apply to the integrated environmental topics addressed in this EIA. Only those parts relevant to hydrology, hydrogeology and geology are itemised below.

8.6.2 Environment Clerk of Works (ECOW)

Construction works will be overseen by an Environmental Clerk of Works (ECOW). Their role and responsibilities will be detailed in the CEMP. Those activities relevant to hydrology and hydrogeology are outlined below.

The ECOW will:

- Ensure that activities remain compliant with legislation, planning conditions and good practice;
- Be responsible, alongside the Contractor's Environmental Manager for ensuring the requirements of the integrated plans detailed in section 8.6.3 are implemented;
- Be present during construction to undertake regular site inspections as required by the various environmental plans;
- Pay particular attention to water management and pollution control;
- Review the need for culverting of the many unmarked drains and channels which will have to be crossed to avoid blockages and local flooding;
- Oversee all peat stripping and removal;
- Identify GWDTE at risk and oversee GWDTE drainage mitigation;

- Have the authority to stop works where significant GWDTE, water or peat related impacts are considered likely to occur, and to instigate control/mitigation measures to rectify noncompliance;
- Oversee monitoring according to the WQMP;
- Be part of the team responsible for Emergency Spill Response;
- Be part of the team providing induction, briefings and toolbox talks; and
- Provide regular weekly reports.

8.6.3 Construction Environmental Management Plan

Construction will be controlled through a Construction Environmental Management Plan (CEMP). This will be linked to Construction Method Statements and the Construction Risk Register. The CEMP will be a dynamic document.

It will implement specific measures to ensure good practice and set out mitigation as required during construction. There will be a number of sub plans to the CEMP.

An outline of its main functions and contents are given below:

- Role of CEMP in contract documents;
- CEMP supporting Plans and Related Plans, not limited to, but including:
  - Drainage Management Plan (DMP);
  - Pollution Prevention Plan(PPP);
  - Peat Management Plan (PMP);
  - Habitat Management Plan (HMP);
  - Emergency Response Plan (ERP); and
  - Water Quality Monitoring Programme (WQMP).
- Planning Conditions and licences e.g. CAR;
- Environmental responsibilities and contact details, including ECoW;
- Laying out relevant Guidance and legislation for each Topic;
- Environmental Induction and Training;
- Environmental setting and sensitivity including surveys;
- Micro siting Protocols;
- Environmental Monitoring requirements;
- Phasing of Activities;
- Controls on water abstraction and dewatering;
- Drainage, storm water and sediment control;
- Materials management including excavation, stockpiles and other storage;
- Temporary watercourse diversions; and
- Environmental Reporting procedures and frequency including reference to an Emergency Incident Response Plan.

An Outline CEMP can be found in Appendix 14-1. Given the need for the CEMP to be a dynamic document this Outline CEMP will be subject to review at various stages post consent and pre- and during construction.

8.6.4 Pollution Prevention Plan (PPP)

A Pollution Risk assessment will be carried out identifying materials, areas and activities of greatest risk and laying out controls on these. From this a Pollution Prevention Plan (PPP) will be prepared. The PPP will be a sub plan of the CEMP.

It will reference the extensive guidance and outline protocols for pollution control. It will include reference to fuel, oils, cementitious materials, other hazardous substances and prohibited materials.

It will address such activities as use and storage, spillage kit and emergency procedures for chemical and hydrocarbon pollution of surface water, safe refuelling locations and protocols, concrete pouring and mixing protocols and use of construction compounds

Inspection and maintenance regimes will be identified for implementation.

8.6.5 Drainage Impact Assessment (DIA)

A Drainage Impact Assessment (DIA) will be prepared in advance of construction and submitted for agreement with SEPA.

The DIA will identify sensitive issues and areas. These will include all watercourses, areas of potential peat instability, down gradient GWDTE, the watercourse gorges of the geological SSSI and 'pinch' points which are likely to cause issues during construction such as long straight slopes or where the access track is particularly close to water courses or conduits.

The DIA will develop outline SuDS Principles for the site and lay out design criteria (where applicable). It will give a broad overview of possible site drainage layout systems that conform to the topography and the likely grading of site tracks. It would advise on drainage features for site tracks, watercourse crossings, construction compounds, turbines and associated crane hard standings. It will assess preliminary Impacts from surface water drainage and advise upon principal construction and operation and maintenance requirements.

The DIA will inform the temporary and permanent drainage design to be prepared by the appointed contractor in advance of the construction commencing. The drainage design will comply with General Binding Rules (GBR's) 10, 11 and 21 for the track drainage, under the Water Environment (Controlled Activities) (Scotland) Regulations (CAR) 2011 (as amended) (Scottish Government), 2011 and 2021).

Site drainage (during construction, and then for the operational stage) will be designed to take account of the likely Storm Event Intensity for an area and infrastructure appropriately designed for a 1:200 year event. The design will be in accordance with sustainable drainage systems (SuDS) principles which mimic natural systems by providing storage, flow attenuation and biological treatment.

Requirements for CAR Authorisations will be assessed and the necessary notifications, authorisations and permits as necessary will be sought.

8.6.6 Drainage Management Plan (DMP)

The approved DIA will also inform the preparation of a Drainage Management Plan (DMP). The DMP will be submitted for approval by SEPA. The DMP will comprise procedures and detailed methods for the collection and treatment of all surface water runoff from excavated land, hard standing areas and access tracks.

The DMP will be a sub plan of the CEMP. An outline of its functions and contents is given below. The DMP will:

- Cover pre earthworks drainage, temporary construction drainage and installation of permanent drainage;
- Identify and provide mitigation for high risk pinch points;
- It will seek to avoid large capacity build ups of surface water that could lead to additional loadings being placed on the surrounding ground that may lead to soil failure, especially in areas with peat stability concerns;
- Runoff should mimic that of existing conditions and not be increased;
- Lay out the design and specification for pre-earthworks temporary cut off drains around working areas to minimise sediment laden water from entering excavations;
- All culverts that form part of the development should be hydrologically assessed to ensure there will be no capacity issues during peak flow e.g. 1 in 200 year storm events;
- Seek to install permanent drainage before or during track construction;
- Lay out optimal ditch and drain locations and profile;
- Require silt traps, straw bales, silt fencing in series and sediment ponds to collect sediment during construction. Avoid long runs and erosion by check dams, angled clean water run offs and/or swales;
- Outline weather dependent actions to minimise risk, especially during storm events;
- Ensure no direct discharge to natural or existing drains, channels or watercourses;
- Propose culverts or pipes and regular cross drainage under tracks to avoid up gradient build-up of groundwater and to maintain flow to downgradient GWDTE;
- Avoid direct Infiltration of sediment laden into vegetation, until after a period of settlement treatment;
- Discharge clean water, post settlement or from cut-off drains downslope and >50m from any channels;
- Seek to avoid watercourse diversions, bank modifications and dams as much as possible;
- Set out cabling trenches founded on sand with regular check dams of clay and run-offs to avoid fast access flow pathways for collected drainage and polluted run-off;
- Lay out an Inspection and maintenance programme for permanent and temporary track drainage;
- Identify protocols for sediment structure maintenance; and
- Address reinstatement of temporary drainage.

8.6.7 Water Quality Monitoring Programme (WQMP)

A Water Quality Monitoring Programme (WQMP) will be designed as part of the CEMP. The water quality monitoring will be implemented before and during construction to record the existing water condition and ensure no deterioration to water quality during construction.

The WQMP will be accompanied by a specific Emergency Response Plan for water environment incidents.

It will address both surface and ground water quality and protection and include measures for different rainfall and flow conditions.

8.6.8 Peat Management (PMP)

A Peat Management Plan (PMP) to address peat excavation and reinstatement requirements has been prepared and is presented as Technical Appendix 8-2. The PMP will be a sub plan of the CEMP. It will be implemented under the overall control of the ECoW during construction.

The PMP includes reference to mitigation during peat excavation and peatland GWDTE disturbance and lays out responsibilities for aspects which may go beyond the construction period.

Temporary storage and reinstatement of temporary excavations (boom assemblies, blade fingers and turning heads) for infrastructure will apply to 778m^3 of acrotelm and 1,440m^3 of catotelm, 2,218m^3 in total.

There are no opportunities to use surplus peat in drain reinstatement, as the drains are typically partially or fully vegetated or of insufficient dimensions to accommodate translocated peat material.

It is proposed that, as part of the Peat Management Plan for the Proposed Development, the existing Borrow Pit of Sandy Knowe Wind Farm will be used for peat reinstatement. The existing Borrow Pit is in use for the construction of Sandy Knowe Wind Farm and is within the Proposed Development Footprint.

The Borrow Pit will be only partially restored as part of the consented development. There is sufficient space within its footprint to accommodate the residual peat excavated for the extension and the borrow pit is at the same elevation and in the same landscape setting as peat soils on the wider hillside.

It is therefore considered appropriate for reinstatement of a peat surface within its footprint and the remaining 19,890 m^3 of excavated peat will be reinstated in the existing Sandy Knowe Wind Farm borrow pit. Details of the borrow pit restoration will depend on the final geometry of the borrow pit, which has a borrow pit restoration plan which allows for up to 2m of peat reinstatement (Roadbridge, 2021a).

Full details of procedures and controls on both forms of reinstatement are given in the Technical Appendix 8-2.

8.6.9 Habitat Management Plan (HMP)

A Habitat Management Plan (HMP) will be prepared as identified in Chapter 6: Ecology. It will be submitted to NatureScot for agreement.

The HMP will jointly address ecological and hydro-ecological mitigations, it will specifically relate to maintenance of groundwater supply to GWDTE and to peat reinstatement.

The HMP will be implemented alongside the CEMP and other sub plans, especially the DMP and the PMP. It is likely that some aftercare actions within the HMP will extend into the Operational Phase.

An Outline HMP is presented in Technical Appendix 14-2.

8.6.10 SSSI Integrity

The Polhote Burn gorges which form part of the Polhote and Polmeur Burns SSSI is approximately 600m north of the nearest infrastructure. However parts of the SSSI gorges of the Polmeur Burn are immediately adjacent and indeed form the western boundary of the northern extent of the Proposed Development Footprint.

The under-construction Sandy Knowe Wind Farm also contains a significant portion of the Polmeur Burn SSSI gorge exposures. The Polmeur Burn is currently fenced near construction activities. Clearly labelled 'No Entry' signs are placed on the fences and all site staff and visitors are briefed on the importance of these watercourses and nearby field drains.

During construction of the Proposed Development Footprint the fence and signage around the Polmeur Burn will be maintained and extended to cover the frontage within the Proposed Development to ensure that there is no incursion towards the burn. It is not considered necessary to fence the Polhote Burn, but markings will be placed at its southern extent to ensure there is no incursion.

The SSSI will be marked on the DMP and drainage from construction activities will be marked on site using coloured pegs to ensure that construction staff are aware of their presence.

The markings and 50m minimum watercourse and drainage buffers will be rigorously enforced to avoid accidentally emplacing waste excavated material near the banks threatening the integrity of the SSSI. Similarly, discharge of drainage and dewatering discharge will not be allowed within 50m of the SSSI gorge.

8.6.11 GWDTE

A number of small areas of moderately dependent GWDTE (mostly M23 and some M6) in the western extent are at risk of having their groundwater supply cut off, shown on Figure 8-3b. The effect would be caused by excavated tracks, turbine and crane hard standings excavations and foundations acting as barriers to groundwater flow,

Mitigation will be considered where access tracks or other below ground infrastructure cross or are located above GWDTE flushes and wetter areas of groundwater connectivity. These areas are identified on Figure 8-3b.

The overall aim of mitigation is to maintain the natural pre-existing shallow groundwater flow paths supporting the GWDTE or to replicate as close to the infrastructure areas as possible, and up gradient of the GWDTE.

Possible mitigations will include:

- Micro siting to minimise wetland take for turbines and associated infrastructure;
- Installation of permeable layers in track bases;
- Cross drains under track at regular intervals up gradient of moderately dependent GWDTE. The cross drains will initially catch the water on the uphill side of the track or yard and transfer it to a suitable diffuse outfall above the GWDTE on the down gradient side of the track where it will not cause new erosion or runoff issues;
- Pumping of Shallow groundwater encountered during construction to a small holding sump to allow removal of suspended sediment. Once the solids have been removed, groundwater could either be discharged direct to or via a small down-slope trench up-gradient of, the surrounding GWDTE allowing infiltration back into the ground; and
- Indirect loss of habitats caused by dewatering at turbines will also be minimised by minimising any period of dewatering and designing dewatering in compliance with the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended).

The work will be supervised by the ECOW and mandated in a CEMP. Designs will be incorporated into the DMP.

A monitoring regime will be developed by the ECoW to measure potential effects of permanent and temporary works on GWDTE and within a format which may be provided to regulators upon request. Monitoring would also ensure that sediment blockages in the cross drains ae regularly cleaned.

8.6.12 Coal Mining

In order to reduce the estimated risk to development associated with mining hazards, the following mitigations are proposed.

Site investigations should be undertaken to confirm the absence of shallow mine workings below T29 and T30, and by default prove the absence of opencast backfill at T30.

Ground gas monitoring should be undertaken in the (non-peat) soils and bedrock adjacent to T30 to determine the level of carbon dioxide and methane possibly being produced in the backfilled quarry, along with the flow potential.

During any soil stripping as part of the site investigation or development works at T29 and T30, a watching brief for unrecorded mine entries should be undertaken.

On the basis that site investigations be carried out prior to development to prove the absence of unrecorded shallow coal mines, unrecorded mine entries, and mine gas, there shall be considered negligible risk to the development.

In the unlikely event that either mine workings or mine gas are encountered, further mitigation measures would be required to reduce risk to development and to enable the development to continue. These measures will include:

- Stabilisation of shallow mine workings, typically drilling and grouting;

- Relocation of turbines / roads to avoid mine entries, and thereby avoid requirement to treat and cap the mine entry; and
- Ground gas protection measures in turbine foundations.

8.6.13 Mitigation Schedule

A Mitigation Schedule for the minimisation of potential effects arising from the Proposed Development on hydrology, hydrogeology and soil, including peat is given in Table 8-17.

Table 8-17: Schedule of Mitigation

Item	Mitigation measure	Reason
8.1	Contractors to explicitly include for mitigation in their cost tenders.	To ensure that mitigation during construction is funded and correctly implemented.
8.2	All infrastructure and drainage to be positioned a minimum of 50m from watercourses.	To protect watercourses from sediment pollution and flow disturbance.
8.3	Micositing allowance to mimic the micrositing allowance condition for the existing Sandy Knowe Wind Farm (See Section 3.3.14)	To further minimise steep watercourse crossings, disturbance of deep peat and moderately groundwater dependent GWDTE.
8.4	All three watercourse crossings to be bottomless arch designed based on best practice guidelines	To avoid any impact on the flow, bottom, banks and ecology of the Polhote Burn watercourse.
8.5	Develop and implement Construction Environmental Management Plan (CEMP) pre-construction. Particular emphasis on environmental roles and responsibilities, dewatering, excavation and storage of materials. To include Emergency Response Plan and refer to supporting and associated plans.	To contain specific measures to ensure good practice and mitigation as required during construction to maintain legal, planning, best practice and the integrity of sensitive environmental receptors.
8.6	Pollution Prevention Plan	To identify activities of greatest risk and prepare controls.
8.7	Drainage Impact Assessment	The DIA will inform the temporary and permanent drainage design
8.8	Develop and implement a Drainage Management Plan (DMP) with detailed methods for the collection and treatment of all surface water runoff.	To provide drainage mitigation for high risk areas such as watercourses and peat instability and geological SSSI.
8.9	Water Quality Monitoring Plan (WQMP)to address surface and ground water quality and protection and include measures for different rainfall and flow conditions.	To record the existing water condition and ensure no deterioration to water quality during construction.
8.10	Peat Management Plan (PMP) for peat excavation and reinstatement requirements. To include in site restoration of temporary works on peat and to use existing Sandy Knowe Borrow Pit for peat reinstatement.	To ensure that, after avoidance and minimisation, residual peat is beneficially used for reinstatement and carbon sequestration.
8.11	Revised Borrow Pit Restoration and Monitoring Plan	To be prepared prior to construction of the extension, with updated target ground levels and a revised mass

Item	Mitigation measure	Reason
		balance.
8.12	Include in the Habitat Management Plan (HMP) prepared for Ecology to address ecological and hydro-ecological plans, specifically maintenance of groundwater supply to GWDTE and to peat reinstatement.	To be used alongside DMP and CEMP to image mitigations for peat and GWDTE.
8.13	Fencing and signage for gorges of the Geological SSSI.	To avoid any incursion or accidental damage to the SSSI.
8.14	Appointment of ECOW ensuring the requirements of the integrated plans in Section 8.6.3 are implemented, undertake regular site inspections. Pay particular attention to water management and pollution control, works on peat and GWDTE. Carry out monitoring and reporting.	To ensure that activities remain compliant with legislation, planning conditions and good practice.
8.15	GWDTE Mitigation comprising: installation of permeable layers in track bases, cross drains under track at regular intervals and groundwater discharge infiltration trenches.	To maintain the natural pre-existing shallow groundwater flow paths supporting the GWDTE or to replicate these as close to the infrastructure areas as possible, and up gradient of the GWDTE.
8.16	Legacy Coal Mining Site Investigation comprising: Site investigations to confirm the absence of shallow mine workings below T29 and T30. Establish a watching brief for unrecorded mine entries during soil stripping at T29 and T30, and ground gas monitoring in the (non-peat) soils and bedrock adjacent to T30.	To reduce the risk to development associated with mining hazards.
8.17	In the unlikely event that either mine workings or mine gas are encountered, - Stabilisation of shallow mine workings, typically drilling and grouting. - Relocation of turbines / roads to avoid mine entries, and thereby avoid requirement to treat and cap the mine entry. - Ground gas protection measures in turbine foundations.	To reduce risk to development associated with mining hazards

8.7 Residual Effects

Those effects that are expected to remain following implementation of mitigation measures are presented in Table 8-18.

Table 8-18: Residual Effects

Potential Residual Effect	Sensitivity	Effect		
		Construction	Operation	Decommissioning
Sediment pollution of watercourses	Medium	Minor	Minor	Minor
Chemical and	Medium	Minor	Negligible	Minor

Potential Residual Effect	Sensitivity	Effect		
hydrocarbon pollution of surface water				
Change in surface water flow	Medium	Minor	Negligible	Negligible
Change in groundwater flow regime affecting base flow to streams	Medium	Negligible	Negligible	Negligible
Change in groundwater quality	Medium	Minor	Negligible	Negligible
Direct loss of GWDTE Habitat	Medium	Minor	Negligible	Negligible
Change in groundwater flow regime, causing loss and disturbance of GWDTE	Medium	Minor	Negligible	Minor
Integrity of SSSI watercourse geology and geomorphology	High	Negligible	Negligible	Negligible
Loss, disturbance and degradation of peat and peat soils and their hydrology.	Medium	Minor	Negligible	Negligible
Peat Landslide Hazard	Medium	Minor	Negligible	Negligible
Coal Mining Risks	High	Minor	Negligible	Negligible

8.8 Summary and Statement of Significance

8.8.1 Construction

The following potentially Significant effects on sensitive receptors were predicted during Construction.

- A potential moderate effect due to sediment pollution of watercourses from turbid surface water run-off;
- A potential moderate effect due to chemical and hydrocarbon pollution of surface water;
- A potential moderate effect due to loss, disturbance and degradation of peat and peat soils and their hydrology;
- A potential minor to moderate effect due to potential impacts on the Integrity of SSSI watercourse geology and geomorphology; and
- A potential moderate effect due to legacy coal mining risks.

After additional mitigation measures were developed to mitigate the magnitude of the potential impacts as laid out in 8.6 above, the predicted potential effects on the receptors were reduced to either *Minor* or *Negligible*. These are *Not Significant* in EIA terms.

No Significant effects were predicted for the other sensitive receptors during construction. Predicted effects due to change in surface water flow, change in groundwater base flow, direct and indirect loss of GWDTE or risks due to peat landslide hazard were all either *Minor* or *Negligible* (although additional mitigation was proposed

for the indirect effect of loss of GWDTE due to reduction in groundwater supply) and therefore *Not Significant* in EIA terms.

8.8.2 Operation

There are no predicted Significant effects on sensitive receptors during Operation. Apart from *Minor* predicted sediment pollution risk to watercourses, all predicted effects on sensitive receptors during Operation are *Negligible*. This is consistent with the experience that key risks to the water environment are substantially greater during construction with very much reduced activities and disturbance during Operation. No additional mitigation recommendations for Operation were therefore made beyond Best Practice and compliance with Guidelines as proposed.

8.8.3 Decommissioning

There are no Predicted Significant Effects During Decommisioning. *Minor* predicted effects on sediment and chemical pollution of watercourses and risks of altering groundwater flow to GWDTE were predicted. Again, this is in line with the understanding that there are increased activities on site during Decommissioning over Operation; these would present a risk to the water environment but still substantially less than during Construction.

8.8.4 Cumulative Effects

Eleven wind farm developments located within a 10km radius of the Proposed Development were assessed for cumulative hydrology, hydrogeology or geology effects.

The cumulative assessment is considered to be particularly relevant in terms of sediment pollution and/or changes in flow to surface watercourses given the long potential pathways for predicted effects. Other potentially significant effects relate to relatively local effects and were considered only for the adjacent Sandy Knowe Wind Farm, currently under construction.

Apart from Sandy Knowe, there are no proposed or operational wind farms which are directly hydrologically connected to the watercourses within the Proposed Development Site.

Nine of the remaining windfarms within a 10 km radius are located in the River Nith catchment and drain indirectly into the Nith, between 10 km upstream and twenty km downstream of the eventual discharge Polhote, Polneul and Polmeur Burns draining the Proposed Development Footprint.

Of these sites, five are already operational with only *Minor* or *Negligible* effects predicted. The remaining three are still to be constructed. There are long distances from the individual wind farm sites to the River Nith, with multiple opportunities for dilution and settlement and additional substantial dilution capacity in the River Nith itself. When appropriate mitigation is implemented for those sites under construction, the combined cumulative magnitude is considered *Low* to *Negligible* which would lead to a *Minor* to *Negligible* predicted cumulative effect and therefore *Not Significant*.

The 24 turbines and infrastructure of the under construction Sandy Knowe Wind Farm drain into the Polnuel and Polmeur Burns then into the River Nith. Only the two turbines and track of the northern extent also drain into these burns. As there will not be parallel

construction and as the Sandy Knowe extension is relatively small compared to the activities of Sandy Knowe itself, the predicted cumulative effect on the water quality is considered to be *Not Significant*.

Other potential effects such as on peat, GWDTE, SSSI and legacy coal mining risks are all considered to be relatively local, especially given the shallow short flow paths of groundwater and the well mapped restricted location of legacy mining. The cumulative predicted effects are therefore *Not Significant*.

8.9 References

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