Chapter 6: Geology, Hydrology and Peat

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Chapter 6: Geology, Hydrology and Peat

Contents

6 Geology, Hydrology and Peat

6.1 Executive Summary

6.1.1 This chapter considers the potential effects of the Proposed Development on geology, hydrology and peat. The baseline environment is described based on desk studies and a comprehensive field survey, including hydrology surveys, peat surveys, Ground Water Dependent Terrestrial Ecosystem (GWDTE) surveys and Private Water Supply (PWS) surveys.

6.1.2 Many mitigation measures are embedded into project design (e.g. avoidance of deeper peat, 50 m buffers from watercourses, buffers from GWDTEs (where possible) and the implementation of Sustainable Drainage Systems (SuDS) for treatment and attenuation of surface water runoff). These embedded measures were considered to be in place for the assessment of effects.

6.1.3 With embedded mitigation measures effects on hydrology and peat receptors were assessed to be **negligible** or **minor** significance. Additional mitigation measures will be put in place at site-specific locations, where watercourse buffers or GWDTE buffers could not be achieved.

6.2 Introduction

6.2.1 This chapter considers the potential effects of the Appin Wind Farm (hereafter referred to as 'the Proposed Development') on geology, hydrology, hydrogeology and peat. It details the baseline environmental conditions, based on desk studies and a comprehensive suite of field surveys conducted between September 2021 and February 2025. A description of potential effects and their significance, together with mitigation measures is also provided, including an assessment of the cumulative and decommissioning effects.

6.2.2 This chapter should be read alongside **Chapter 7: Ecology** due to interactions between both chapters in terms of the potential effects on water quality and potential effects on Groundwater Dependent Terrestrial Ecosystems (GWDTEs). Potential effects on any GWDTEs are considered within this chapter. The assessment is based on the project description and construction methods described in **Chapter 4: Description of the Proposed Development.**

6.2.3 The chapter is supported by the following technical appendices*:*

- Technical Appendix 6.1 Watercourse Crossings;
- Technical Appendix 6.2 Peat Survey Report;
- Technical Appendix 6.3 Outline Peat Management Plan;
- Technical Appendix 6.4 Peat Landslide Hazard and Risk Assessment; and
- Technical Appendix 6.5 Groundwater Dependent Terrestrial Ecosystems Assessment.

6.3 Legislation, Policy and Guidelines

6.3.1 This assessment is carried out in accordance with relevant legislation, policy and guidance relating to the water and geological environment. It is noted that the following lists are not exhaustive.

6.3.2 Key legislation includes:

- The Flood Risk Management (Scotland) Act 2009;
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) (CAR);
- The Water Framework Directive (2000/60/EC) (WFD), and Water Environment and Water Services (Scotland) Act (WEWS Act) 2003;

6.3.3 Key policies and guidance include:

- Scottish Government 2024 National Planning Framework (NPF) 4: *Policy 5 (Soils), Policy 22 (Flood Risk Management)*;
- Scottish Renewables et al. 2024 Good Practice during Windfarm Construction;
- SEPA's Guidance for Pollution Prevention (GPPs), including GPPs 1, 2, 4, 5, 6, 8, 21, 22 and 26;
- SEPA: The Water Environment (Controlled Activities) (Scotland) Regulations. A Practical Guide, July 2024;
- SEPA: Engineering in the Water Environment Good Practice Guide – River Crossings, WAT-SG-25, 2010;

- SEPA: Flood Risk Standing Advice, July 2024;
- SEPA: Sector Specific Guidance: Supporting Guidance: Water Run-Off from Construction Sites, WAT-SG-75, 2021;
- SEPA: Guidance on Assessing the Impacts of Developments on Groundwater Dependent Terrestrial Ecosystems, 2024;
- SEPA: Guidance on Assessing the Impacts of Developments on Groundwater Abstractions, 2024;
- Forest Research: The UK Forestry Standard, 5th Edition, Forest Research, 2023;
- Construction Industry Research and Information Association (CIRIA): The SuDS Manual (C753) 2015;
- CIRIA: Control of water pollution from construction Sites: Guidance for consultants and contractors (C532) 2001;
- Scottish Government, Scottish Natural Heritage & SEPA: Peatland Survey – Guidance on Developments on Peatland, 2017; and
- Scottish Government (2017) Peat Landslide Hazard and Risk Assessments, Best Practice Guide for Proposed Electricity Generation Developments (Second Edition), Scottish Government.

6.4 Consultation

6.4.1 In undertaking the assessment, consideration has been given to the scoping responses and other consultation which has been undertaken as detailed in **Table 6.1**.

Table 6.1 - Consultee Responses

Consultee and Date	Scoping / Other Consultation	Consultation Response	Applicant Response
Scottish Environment Protection Agency (SEPA) – 14/04/2022	Formal Scoping Opinion	SEPA consider that the following key issues must be addressed in the EIA process. To avoid delay and potential objection, the information outlined below (and detailed further in the appendix of the response from SEPA) must be submitted in support of the application.	The information requested is provided in this EIA Report, as described below (with justification for any exclusions at this stage).
		a) Map and assessment of all engineering works within and near the water environment including buffers, details of any flood risk assessment and details of any related CAR applications.	– A map of all engineering activities is provided in **Figure 6.1**. The map shows all water environment features and proposed buffers. – Small parts of the Site lie within the SEPA Future Flood Map Surface water and small watercourses flood risk area. Flood risk is described in the baseline and assessment. CAR requirements are also covered in the assessment and **Technical Appendix 6.1**.
		b) Map and assessment of impacts upon GWDTEs and buffers.	– A map and assessment of impacts upon GWDTE and buffers is included in **Figure 6.3** and discussed in **Technical Appendix 6.5** and the effects assessment.
		c) Map and assessment of impacts upon groundwater abstractions and buffers.	– A map showing private water supplies (PWS) and abstractions near the Site is shown in **Figure 6.1** and is assessed within this chapter.
		d) Peat depth survey and table detailing re-use proposals.	– A peat depth survey is provided in **Technical Appendix 6.2** and reuse proposals described in **Technical Appendix 6.3**.
		e) Map and table detailing forest removal.	– Required forest removal for the Proposed Development is discussed in **Chapter 4**.
		f) Map and Site layout of borrow pits.	– Borrow pit layouts are shown in **Figures 4.2a-d**.
		g) Schedule of mitigation including pollution prevention measures.	– Pollution prevention measures are described in the Mitigation section of this

Consultee and Date	Scoping / Other Consultation	Consultation Response	Applicant Response
			chapter and **Technical Appendix 4.1**A summary is provided in the Schedule of Mitigation (**Technical Appendix 4.3**)
		h) Borrow Pit Site Management Plan of pollution prevention measures.	– A Borrow Pit Site Management Plan will support the OCEMP with regards to pollution prevention measures, which is provided in **Technical Appendix 4.4**.
		i) Map of proposed wastewater drainage layout.	– The Proposed Development will not generate wastewater, with wastewater held in a 'closed system' and then removed by a licensed contractor. Therefore, no wastewater drainage layout is provided.
		j) Map of proposed surface water drainage layout.	– The surface water drainage strategy is provided in **Technical Appendix 4.1**. A map of the typical substation compound drainage is shown in **Figure 3.8**
		k) Map of proposed water abstractions including details of the proposed operating regime.	– Concrete batching will be undertaken on-site which will require a water supply either from a water body on-site or imported in tankers and stored at the batching site. If this supply is sourced from within the Site a licence for abstraction will be obtained from SEPA post-consent in accordance with SEPA GBR and CAR licensing. The location of the proposed water abstraction is not confirmed at the time of writing.
		l) Decommissioning statement.	– Decommissioning will be discussed within **Chapter 4** and potential decommissioning effects to the water and soil environment are assessed within this chapter.
		SEPA expect that the Applicant demonstrates that areas of peat deeper than 1 m have been avoided. Class 1 and 2 peat should be fully avoided. The Applicant should outline the preventative/mitigation measures taken to avoid disturbance of peat. Peat depth maps, with infrastructure overlain, are expected to be submitted as part of the application. A table which details quantities of peat being excavated and details of where and how it will be reused should also be submitted.	– Detailed Phase 1 and Phase 2 peat surveys were undertaken to inform the Site layout and minimise the amount of peat disturbed. – Maps of the peat depths across the Site are provided in **Figure 6.7** and the **Technical Appendix 6.4**. – Evidence of the design iteration to avoid peat > 1 m and Class 1 and Class 2 peat during the design process is provided in **Chapter 3**. – Details of proposed excavation and re-use are provided in the chapter and in **Technical Appendix 6.3.**
		SEPA highlight concerns in relation to the high number of Shinnel Water tributaries and steep slopes within the Site with regard to pollution prevention and expect robust pollution prevention mitigation, alongside monitoring, to be put in place.	– All watercourses have been buffered by a minimum of 50 m, where practicable. Mitigation measures, such as construction Sustainable Drainage Systems (SuDS) and interceptor drainage ditches, will be utilised as part of embedded mitigation during construction and operation to mitigate surface water run-off. – Mitigation measures are outlined in this chapter and summarised in **Technical Appendix 4.3**. These measures will also be documented in the OCEMP.
		SEPA request that any part of the Site felled for infrastructure is surveyed for GWDTEs, and if found these areas should be avoided.	– Hydrological and ecological surveys have been conducted to identify and assess GWDTEs within the Site (with the exception of the area of potential felling near Manquhill which has no proposed

Consultee and Date	Scoping / Other Consultation	Consultation Response	Applicant Response
			infrastructure). No GWDTE were identified within the areas of forestry surveyed. – A map and assessment of impacts upon GWDTE and buffers is included in **Figure 6.3** and areas where buffers could not be achieved are discussed in **Technical Appendix 6.5** and the effects assessment.
		SEPA request a map showing: a) All proposed temporary or permanent infrastructure overlain with all lochs and watercourses. b) A minimum buffer of 50 m around each loch or watercourse. If this minimum buffer cannot be achieved each breach must be numbered on a plan with an associated photograph of the location, dimensions of the loch or watercourse and drawings of what is proposed in terms of engineering works. c) Detailed layout of all proposed mitigation including all cut off drains, location, number and size of settlement ponds.	– A map of all watercourses and lochs, 50 m watercourse buffers and all proposed mitigation with the Proposed Development overlain is shown in **Figure 6.2**. Further detail on watercourses and other features within the Site is provided within this chapter. – A 50 m buffer from watercourses has been incorporated from an early design stage to avoid watercourses and watercourse crossings. Where it was not feasible to maintain buffers, details of breaches are provided in **Technical Appendix 6.1**. – Mitigation measures, such as SuDS and interceptor drainage ditches, will be utilised as part of embedded mitigation during construction and operation to mitigate surface water run-off. Mitigation measures are outlined in this chapter and in the OCEMP (**Technical Appendix 4.1**).
		SEPA state that if water abstractions or dewatering are proposed, a table of volumes and timings of groundwater abstractions and related mitigation measures must be provided.	– As noted above, concrete batching will be undertaken on-site which will require a water supply either from a water body on-site or imported in tankers and stored at the batching site. If this supply is sourced from within the Site a licence for abstraction will be obtained from SEPA post-consent in accordance with SEPA GBR and CAR licensing. The location of the proposed water abstraction is not confirmed at the time of writing.
		SEPA state that watercourse crossings must be designed to accommodate the 1 in 200-year flood event (under the latest guidance, with an allowance for Climate Change as per NPF4). If it is thought that the development could result in an increased risk of flooding to a nearby receptor then a Flood Risk Assessment must be submitted in support of the planning application.	– All new permanent watercourse crossings will be designed to the 1 in 200-year flood event with an allowance for climate change. – Small parts of the Site lie within the SEPA Future Flood Map Surface water and small watercourses flood risk area. Flood risk is described in the baseline and assessment.
		SEPA require that a map demonstrating that all GWDTE are outwith a 100 m radius of all excavations shallower than 1 m and outwith 250 m of all excavations deeper than 1 m and proposed groundwater abstractions. SEPA highlight that if the minimum buffers above cannot be achieved, a detailed site specific qualitative and/or quantitative risk assessment will be required.	– A map and assessment of impacts upon GWDTE and buffers is included in **Figure 6.3** and where buffers could not be achieved this is discussed in **Technical Appendix 6.5** and the effects assessment.
Scottish Environment Protection Agency – 13/09/2022	Access to Information request – groundwater/surface water abstraction information	SEPA advised of one CAR (Controlled Activity Regulation) abstraction licence associated with the High Appin Hydro Scheme on the Appin Burn.	– The abstraction is located ~ 1.2 km from the nearest Site infrastructure (Construction Compound 2). The location of the Scheme is shown in **Figure 6.1**. – This is considered in the assessment.

Consultee and Date	Scoping / Other Consultation	Consultation Response	Applicant Response
Scottish Government Energy Consents Unit (ECU) – June 2022	Formal Scoping Consultation	Scottish Ministers request details of mitigation measures taken with regard to the partial location of the Site within a Drinking Water Protection Area (DWPA) associated with a Scottish Water Abstraction. Scottish Ministers request the Applicant investigates the presence of any PWS which may be impacted by the development, alongside any mitigation provided should a PWS be affected by the Proposed Development.	– Further consultation with Scottish Water (24 February 2025) has confirmed that the Site does not lie within a DWPA (see below). – PWS data was obtained from DGC and PWS questionnaires were sent to all properties within 1 km of the Site boundary to inform the assessment.
Dumfries and Galloway Council (DGC)	Formal Scoping Opinion	The DGC Flood Risk Management Team have no objection to the Proposed Development. The Flood Risk Management Team state surface water run-off should mimic existing conditions and not increase. It is noted that significant increases to the rate of run-off into surrounding watercourses may increase flood risk.	– Mitigation measures, such as SuDS and interceptor drainage ditches, will be utilised as part of embedded mitigation during construction and operation to mitigate surface water run-off. Surface water run-off will be attenuated to greenfield rates and will not increase flood risk (see **Technical Appendix 4.1**).
NatureScot – 21/04/2022	Formal Scoping Opinion	Based on the Phase 1 peat survey in the Scoping Report, NatureScot advise that areas of peat deeper than 50 cm are avoided by the Proposed Development. Advised that a Pollution Prevention Plan be put in place, particularly to manage the risk of sedimentation and chemical pollution to the watercourses and peat found on and around the Proposed Development site.	– Detailed maps of the peat depths across the Site are provided in **Figure 6.7** and in **Technical Appendix 6.4.** – Evidence of the design iteration to avoid deeper peat during the design process is provided in **Chapter 3**. – A Pollution Prevention Plan is provided in the OCEMP (**Technical Appendix 4.1**).
Scottish Water – 11/04/2022	Formal Scoping Opinion	Scottish Water records indicate that the Proposed Development falls partly within a DWPA associated with an Scottish Water abstraction. Scottish Water request that site specific risks and mitigation measures are assessed and implemented. Scottish Water also request Grid Reference coordinates for each of the proposed turbines. Scottish Water will not accept any surface water connections into the combined sewer system.	– Further consultation was undertaken with Scottish Water to see if the Proposed Development is within the DWPA, including the provision of the design freeze turbine coordinates. – No combined sewer system connections are planned as part of the Proposed Development.
Scottish Water – 24/02/2025	Scoping Response	Upon the receipt of grid coordinates for each turbine, Scottish Water confirmed that the Proposed Development does not lie within a DWPA for a Scottish Water abstraction.	– Noted and used to inform the baseline.
Tynron Community Council	Formal Scoping Opinion	Tynron Community Council request that every residential property within the area, including farms, should be consulted for accurate information regarding their PWS. Further concerns are raised about the consideration given to effects to downstream PWS. Homeowners should also be consulted on effects to micro-hydro schemes. Tynron Community Council state the need for avoidance of peat areas greater than 0.5 m in depth.	– PWS questionnaires have been sent to all residents within a 1 km radius of the Proposed Development, as well as an extended area encompassing the valley of the Shinnel Water. – Information on the High Appin micro-hydro scheme has been collected and has been included in this assessment. The location of the Scheme is shown in **Figure 6.1.** – Peat was avoided, where practicable during the design process.

6.5 Assessment Methodology and Significance Criteria

Study Area

6.5.1 The Site is located within the Appin Burn, Dalwhat Water, Stroanfreggan Burn, Auchrae Burn and Water of Ken catchments (**Figure 6.1**). Most of the Proposed Development is within the Appin Burn catchment; the Appin Burn flows in an easterly direction towards the Shinnel Water and lies within the wider catchment of the Shinnel Water. There are many watercourses within the Site, including the Conrick Burn, Ramscleugh Burn, Back Burn, Fingland Burn and Lagdubh Burn (tributaries of the Dalwhat Water), the Magmallach Burn (a tributary of the Appin Burn), and numerous smaller named and unnamed tributaries. A small bog pool lies within the Site on the hilltop at Transparra.

6.5.2 The study area for the geology, hydrology, hydrogeology assessment is shown in **Figure 6.1**. The study area for the hydrology and hydrogeology assessment comprises the Site itself and watercourses/waterbodies downstream. The study area for geology and peat comprises the locations of proposed infrastructure with buffers, although a wider area was surveyed to cover early design iterations.

6.5.3 The study area for detailed assessment of groundwater abstractions, including PWS, and GWDTE is within a 250 m buffer zone from the permanent infrastructure, as per SEPA (2024a and 2024b) guidance. However, a wider search area for PWS was undertaken for the assessment, including an area within the wider Shinnel Water valley downstream of the Site.

Desk Study

6.5.4 The following data sources have informed the assessment:

- Ordnance Survey (OS) mapping at 1:10,000 and 1:25,000 scales;
- British Geological Survey (BGS) online digital mapping at 1:50,000 and 1:625,000 scales;
- Scottish Soil mapping at 1:250,000 scale;
- NatureScot Carbon and Peatland 2016 mapping at 1:250,000 scale;
- Aerial imagery of the Site and surrounding area;
- The Flood Estimation Handbook (FEH) Web-service;
- SEPA Future Flood Maps[1];
- OS Terrain 5 Topographic Data (5 m resolution), in addition to Phase 3 0.5m LiDAR DTM data from the Scottish LiDAR Remote Sensing datasets;
- Scotland's Environment Website and Interactive Map;
- Scottish Water Asset Plans of the Site;
- SEPA Licenced Abstraction Data;
- Private Water Supply Data (PWS) provided by DGC; and
- Responses to PWS questionnaires from local residents.

Field Survey

6.5.5 The following field surveys were carried out to inform the assessment:

- 21st to 22nd September 2021 - Phase 1 peat and hydrology;
- 5th to 6th October 2022 - Phase 1 peat and hydrology;
- 30th June 2022 – GWDTE ground truthing;
- 30th November 2022 – Phase 1 peat and hydrology;
- 2nd to 3rd December 2024 – Phase 2 peat and hydrology;
- 17th to 18th December 2024 – Phase 2 peat and hydrology; and
- 11th to 13th February 2025 – Phase 2 peat and hydrology.

[1] It is noted that SEPA Future Flood Maps were updated in March 2025. The updated future flood maps (Surface Water and Small Watercourses) now include flood risk from small watercourses and has slightly increased the indicative future flood risk areas. It is noted that the updated information on flood risk from small watercourses was not available during the early project stages but has been used to inform the assessment.

Assessment of Potential Effect Significance

Sensitivity

6.5.6 The criteria used to assess the sensitivity of water and geological features are summarised in **Table 6.2**.

Table 6.2 - Criteria to Assess the Sensitivity of Receptor

Sensitivity of Receptor	Typical indicators
High	– Receptor is of national or international value (i.e., Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC), Special Protection Area (SPA), and RAMSAR). – Overall water quality classified by SEPA as high and salmonid spawning grounds present. – Abstractions for public water supply. – Groundwater classified under the WFD as 'good' or groundwater resource with numerous sensitive users/receptors – The flooding of property (or land use of great value) that has been susceptible to flooding in the past. – Watercourse floodplain/hydrological feature that provides critical flood alleviation benefits. – Natural channel and of high morphological diversity. – Receptor supports GWTDE confirmed as highly groundwater dependent, and ecological importance of the community assessed to be High in accordance with SEPA (2024a) guidance[2]. – Class 1 or 2 priority peatland or peat >2.0 m depth.
Medium	– Receptor is of regional or local value (e.g. Local Nature Reserve). – Overall water quality classified by SEPA as good or moderate, salmonid species may be present and may be locally important for fisheries. – Smaller watercourse lying upstream of larger river that is an SSSI, SAC SPA or RAMSAR. May be subject to improvement plans by SEPA. – Abstractions for private water supplies for domestic use. – Groundwater resource with sensitive users/receptors. – Environmental equilibrium copes well with natural fluctuations but cannot absorb some changes greater than this without altering part of its present character. – The flooding of property (or land use of great value) that may be susceptible to flooding. – Watercourse/floodplain/hydrological feature that provide some flood alleviation benefits. – Semi-natural channel, with morphological diversity. May have some minor morphological constraints. – Receptor supports GWTDE confirmed as moderately groundwater dependent, and ecological importance of the community assessed to be Moderate in accordance with SEPA (2024a) guidance. – Unmodified active peatland. – Deep (>1.0 m depth) peat, unless minor area or an area modified to poor condition through previous management (e.g. drainage, forestry) with associated degraded habitats.
Low	– Receptor is of low environmental importance (e.g., water quality classified by SEPA as bad or poor, fish sporadically present or restricted). – Not subject to water quality improvement plans by SEPA. – Environmental equilibrium is stable and is resilient to changes which are considerably greater than natural fluctuations, without detriment to its present character. – Abstractions for non-potable use. – No significant groundwater resource and no identified sensitive users/receptors. – No flooding of property or land use of great value. – Watercourse/floodplain/hydrological feature that provides minimal flood alleviation benefits. – Heavily engineered or artificially modified and may dry up during summer months. – No GWDTE confirmed as either moderately or highly groundwater dependent, and ecological importance of the community assessed to be at most Low in accordance with SEPA (2024a) guidance. – No peat / shallow peat (0.5 m to <1.0 m depth) in degraded and/or modified condition.

[2] Ecological importance of a GWDTE receptor is assessed in accordance with SEPA guidance (2024) on factors such as designated sites, conservation status (e.g. Scottish Biodiversity List), connectivity, extent within Scotland, and supporting notable or particularly sensitive species. Where the ecological importance of a GWDTE is assessed to be lower than the groundwater-dependency status of the receptor, a lower sensitivity may be selected and presented with the corresponding rationale.

Sensitivity of Receptor	Typical indicators
Negligible	– Receptor is of low environmental importance (e.g., water quality classified by SEPA as Bad or Poor, fish sporadically present or restricted). – Not subject to water quality improvement plans by SEPA. – Environmental equilibrium is stable and is resilient to changes which are considerably greater than natural fluctuations, without detriment to its present character. – No abstractions. – No groundwater resource and no identified sensitive users/receptors. – No flooding of property or land use of great value. – Watercourse/floodplain/hydrological feature that provides no flood alleviation benefits. – Heavily engineered or artificially modified and may dry up during summer months. – No peat or GWDTE.

Magnitude

6.5.7 The magnitude of change has been assessed based on the criteria presented in **Table 6.3**. These criteria are based on professional judgement and experience of other similar studies.

Table 6.3 - Criteria for Estimating the Magnitude of Effect

Magnitude of Effect	Typical indicators
Major	– Fundamental changes to the hydrology, water quality, geology, peat or hydrogeology (in terms of quantity, quality, and morphology). – A >10% change in average or >5% change in flood flows. – The extent of flood risk areas (as classified by NPF4 – i.e. land or built form with an annual probability of being flooded of greater than 0.5% including an appropriate allowance for future climate change) will be significantly increased. – Change that would render water supply unusable for longer than month. – Change resulting in total loss of feature or integrity of feature or use.
Moderate	– Material but non-fundamental changes to the hydrology, water quality, geology, peat or hydrogeology (in terms of quantity, quality, and morphology). – A >5% change in average and minimal change in flood flows. Extent of flood high risk areas will be moderately increased/or decreased. – Change that would render water supply unusable for days or weeks with no alternative.
Minor	– Detectable but non-material changes to the hydrology, water quality, geology, peat or hydrogeology (in terms of quantity, quality, and morphology). – A >1% change in average flows and no increase in flood flows. – Change that would render water supply unusable for short period (days) or for longer period if alternative supply put in place.
Negligible	– No perceptible changes to the hydrology, water quality, geology, peat or hydrogeology (in terms of quantity, quality, and morphology). – A <1% change in average and no change in flood flows. – No change in water supply or minor change (days) where alternative is put in place.

Significance

6.5.8 The predicted significance of the effect was determined through a standard method of assessment based on professional judgement, considering both sensitivity and magnitude of change as detailed in **Table 6.4** below. Major and moderate effects are considered significant in the context of the EIA Regulations.

Table 6.4 - Significance Criteria

Magnitude	Sensitivity			
	High	Medium	Low	Negligible
Major	Major	Major - Moderate	Moderate	Negligible
Moderate	Moderate	Moderate	Minor	Negligible
Minor	Minor	Minor	Minor - Negligible	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

Assessment Assumptions

6.5.9 It has been assumed that the depth of excavation for turbine foundations will be approximately 4 m deep on average. Borrow pits are assumed to have excavations greater than 1 m. It is assumed that all other Site infrastructure, including tracks, will require excavations of less than 1 m.

Limitations to Assessment

6.5.10 Peat depth surveys were not conducted on a small section of the existing western access track due to buried utilities. Based on walkover of the area and desk-based studies, it is considered that there is sufficient information to enable an informed decision to be taken in relation to the identification and assessment of likely significant environmental effects on peat in this area.

6.5.11 No hydrology, GWDTE or peat surveys were conducted in the potential area of felling near the proposed access in the west of the Site, north of Manquhill Hill however no proposed infrastructure is located in this area.

6.5.12 The assessment was based on existing, available data, supplemented by hydrology and peat depth surveys of the Site. It is considered that there is sufficient information to enable an informed decision to be taken in relation to the identification and assessment of likely significant environmental effects on geology, hydrology, hydrogeology and peat.

6.6 Baseline Conditions

Climate

6.6.1 The average annual temperature in Dumfries is between 6.1 °C and 13.1 °C (Met Office, n.d.).The average annual rainfall on the Site is approximately 1780 mm[2].

Topography

6.6.2 The Site is located on steep and largely afforested hills which drain to the Appin Burn, a headwater stream that flows in a south-easterly direction to join the Shinnel Water. The Appin Burn valley is surrounded by adjacent summits which comprise a series of rounded hills that align north-west to south-east leading to pronounced undulating topography along each side of the valley. The highest point within the Site lies near the hilltop at Lamgarroch at ~ 573 m AOD (Above Ordnance Datum). The lowest elevation at which main Site infrastructure is proposed is ~ 400 m AOD, while the western proposed access track originates at a low of ~ 225 m AOD near the Water of Ken. The topography of the Site is shown in **Figure 6.2**.

Watercourses, Surface Water and Existing Site Drainage

6.6.3 The main watercourses within and close to the Site typically flow from west to south-east though the Site and discharge into either the Appin Burn, Dalwhat Water or the Water of Ken:

- The Appin Burn is the main watercourse at the Site and drains a catchment of ~ 7.6 km^2 as it joins the Shinnel Water. The majority of the Proposed Development infrastructure, apart from Borrow Pit 1, Borrow Pit 2, the western access track and some sections of new access track, lie within the Appin Burn catchment. The Appin Burn joins the Shinnel Water to the east of the Site.
- The Magmallach Burn is a tributary to the Appin Burn and originates in the saddle of Transparra and Green Hill, between Turbines 8 and 9. The Magmallach Burn flows to the north-east, joining the Appin Burn downstream of the proposed Construction Compound 2.
- The Shinnel Water lies to the north of the Site, flowing to the south-east in a steep, sloping valley. There are numerous small, named tributaries that feed the Shinnel Water, such as the Grain Burn, Lamgarroch Strand and White Burn. The Appin Burn is a tributary of this watercourse and drains the majority of the Site before its confluence with the Shinnel Water to the east of the Site.
- A large portion of the proposed western access track lies within the catchment of the Dalwhat Water, including stretches of new access track. Proposed new access tracks that approach Turbines 3, 4, 5, 6, and 9 lie within this catchment, as well as the proposed location of Borrow Pit 2.
- A small portion of existing access track lies within the northern section of the catchment of the Stroanfreggan Burn, a watercourse formed at the confluence of the Benbrack Burn and Corlae Burn. The Stroanfreggan Burn joins the Water of Ken approximately 5 km downstream of the existing track.
- A small portion of new and existing access track lies within the catchment of the Auchrae Burn, which is crossed by the existing access track. The Auchrae Burn joins the Water of Ken ~ 2 km downstream of the track.

- A small portion of new access track, a section of existing access track and Borrow Pit 1 lie within the catchment of the Water of Ken.

6.6.4 The hydrology walkover surveys identified an extensive network of drainage features and minor watercourses not shown on the 1:25,000 scale OS mapping within the catchments of the Appin Burn, Dalwhat Water, Stroanfraggan Burn, Auchrae Burn and the Water of Ken. These were mapped in Geographic Information System (GIS) using aerial imagery and then ground-truthed on site to feed into the PLHRA, **Technical Appendix 6.4**. The network of drains and minor watercourses within the survey area are shown in **Figure 4** in **Technical Appendix 6.3**. Much of this drainage is artificial and serves to lower the water table on the peatland within the Site to facilitate tree growth in the conifer plantation to the detriment of the natural hydrology of the Site.

Watercourse Crossings

6.6.5 New watercourse crossings were reduced as far as practicable by using existing tracks where possible and minimising the number of crossings during initial design iterations. The Proposed Development will use 48 existing crossings and proposes six new crossings; this includes crossing small watercourses not shown on the OS mapping but mapped in the field and watercourses shown on OS mapping data. Details and photographs of all watercourse crossings (existing and proposed) are provided in **Technical Appendix 6.1** with the locations shown on **Figure 6.2**.

6.6.6 There are a number of tracks already on-site currently used to access the commercial conifer plantations. Access to the Site will be from the public road north of Strahanna Bridge. The Proposed Development will share the forestry access tracks created for the conifer plantations, utilising existing crossings.

Hydrology and Flood Risk

6.6.7 SEPA updated their Future Flood maps (SEPA, March 2025 update) for rivers and surface water and small watercourses in March 2025. Before this update, the Future Flood maps did not explicitly include flood risk from small watercourses (catchment areas <3 km^2). The March 2025 update includes small watercourses and has increased the mapped flood risk areas close to the Proposed Development. The SEPA Future Flood maps show the 1 in 200-year flood risk extent plus an allowance for climate change.

6.6.8 The SEPA future flood maps indicate that there are no areas with Proposed Development infrastructure identified to be at risk of fluvial flooding within the Site. There are areas of fluvial flooding around the Appin Burn, Dalwhat Water, Stroanfreggan Burn and Water of Ken, however no Site infrastructure is proposed within these areas.

6.6.9 The SEPA flood maps predict very small areas of the Site are at risk of pluvial (surface water) flooding and flooding from small watercourses. The areas identified as being at pluvial flood risk are generally located along the low-lying areas close to the watercourses. There are a number of small areas within the Site that are shown to be at risk of surface water flooding in a 200-year plus climate change event, as shown in **Figure 6.2**. These will be taken into consideration during the final detailed design of the Proposed Development to ensure they are avoided during construction where possible.

Water Supplies, Abstractions, Discharges and Services

6.6.10 PWS data on properties and supplies held by DGC, alongside a review of remote properties, were used to identify properties within a 1 km buffer of the Site that may use a PWS. In response to concerns raised at consultation by Tynron Community Council, the search was extended to an area downstream of the Appin Burn within the Shinnel Water valley to include properties that could be affected through potential effects downstream in the Appin Burn and Shinnel Water catchment.

6.6.11 Twenty-one properties were identified within the wider Appin Burn / Shinnel Water valley downstream of the Site as having a PWS. Twelve were found to have PWS sources that are not hydrologically connected to the Shinnel Water. Of the remainder, the closest source location is 1.2 km from proposed infrastructure on the Site, while the furthest identified PWS from the Site lies approximately 5.5 km downstream. Taking into account embedded mitigation and additional measures to mitigate sedimentation and pollution effects to the Appin Burn (such as construction SuDS, silt fences etc.), in combination with the large distances between the PWS and the Site, it is considered that the Proposed Development will have no effect on PWS within the wider Appin Burn / Shinnel Water valley and these are not considered further in the assessment.

6.6.12 Ten properties were identified as having a PWS within a 1 km buffer of the Site, as shown in **Figure 6.1**. **Table 6.5** shows the PWS data collected for each identified property. Three remote buildings within 1 km of the Site were confirmed to be uninhabited and do not have a PWS; these include the bothy and sculpture at Cairnhead and the derelict property at Meikle Auchrae.

Table 6.5 - Private Water Supplies Within 1 km of the Site

Property Address	Source Coordinates (Easting, Northing)		Source type	Distance from Proposed Infrastructure	Comment and initial assessment	Scoped in/out
Manquhill Cottage, Castle Douglas, DG7 3UF	Unknown	Unknown	Unknown	~ 1 km south of existing access track	A questionnaire was sent to the property but no response was received. Source is assumed to be at the property location. The elevation of the existing access track is ~ 85 m higher than the property. Surface water flow paths indicate that run-off from the access track does not drain towards the property.	**Scoped out** due to large elevation difference, distance from proposed infrastructure and lack of surface flow connectivity.
Auchrae, Dalry, Castle Douglas, DG7 3UF	265500	596300	Domestic supply	675 m north-west of existing access track	The PWS source lies ~ 70 m above the existing access track. Surface water flow paths indicate that the access track does not drain towards the property or source location.	**Scoped out** due to large elevation difference, distance from proposed infrastructure and lack of surface flow connectivity.
Blairoch, Cairnhead, Moniaive, Thornhill, DG3 4JE	270768	596593	Domestic Supply – Stream near property	~ 1 km south of access track to Turbine 6	The PWS source lies ~ 250 m below the proposed access track for Turbine 6. Surface water flow paths indicate that the access track does not drain towards the property or source location.	**Scoped out** due to large elevation difference, distance from proposed infrastructure and lack of surface flow connectivity.
Craigengillan and Old Cottage, Craigengillan, Dalry, Castle Douglas, DG7 3UF	263553	594954	Domestic supply – Ground water spring	~ 1 km west of existing access track	The PWS source supplies two properties and lies on the other side of the Water of Ken from the Site and is not hydrologically connected to the Site.	**Scoped out** as not hydrologically connected to the Site.
Benbui, Moniaive, Thornhill, DG3 4JE	271140	596213	Domestic Supply – Ground water spring	~1.2 km southwest of Turbine 7	The elevation of the PWS source is ~ 260 m lower than Turbine 7 and ~1.2 km away Surface water flow paths indicate that the access track does not drain towards the property or source location.	**Scoped out** due to large elevation difference, distance from proposed infrastructure and lack of surface flow connectivity.
Strathanna Farm, Dalry, Castle Douglas, DG7 3UF	264023	596057	Domestic supply	765 m west of existing access track	The PWS source lies on the other side of the Water of Ken from the Site and is not hydrologically connected to the Site.	**Scoped out** as not hydrologically connected to the Site.
High Appin, Tynron, Thornhill, DG3 4LF	274653	597401	Domestic Supply – Ground water Spring	1.25 km east of Construction Compound 2	The PWS source lies on the other side of the Appin Burn from the Site infrastructure and is not	**Scoped out** as not hydrologically connected to the Site.

Property Address	Source Coordinates (Easting, Northing)		Source type	Distance from Proposed Infrastructure	Comment and initial assessment	Scoped in/out
					hydrologically connected to any Site infrastructure.	
Appin Lodge, Tynron, Thornhill, DG3 4LF	275210	597461	Domestic Supply – Ground water spring	1.8 km east of Construction Compound 2	The PWS source lies on the other side of the Appin Burn from the Site infrastructure and is not hydrologically connected to any Site infrastructure.	**Scoped out** as not hydrologically connected to the Site.
High Auchenbrack, Tynron, Thornhill, DG3 4LF	Unknown	Unknown	Unknown	2.2 km east of Construction Compound 2	Source location unknown – assumed same as property. The PWS property is on the other side of the Appin Burn from the Site infrastructure and is not hydrologically connected to any Site infrastructure.	**Scoped out** as not hydrologically connected to the Site.
Kilnmark, Tynron, Thornhill, DG3 4LF	Unknown	Unknown	Unknown	2.7 km east of Construction Compound 2	Source location unknown – assumed same as property. Given the large distance between the PWS and the Site, this property is not considered hydrologically connected.	**Scoped out** as not hydrologically connected to the Site.

6.6.13 None of the PWS within the search area lie within 250 m of excavations associated with the Proposed Development. Surface water flow path analysis using available DTM data indicates that no proposed excavations drain towards any of the PWS. Therefore, PWS are scoped out and not considered further in this assessment.

6.6.14 Details of the High Appin Hydro Scheme were provided by SEPA as part of the consultation process. The Hydro Scheme abstracts from the Appin Burn at the location shown on **Figure 6.1**, via a gravity-fed pipe. The Hydro Scheme has a maximum permitted abstraction rate of 0.035 m^3/s and a maximum daily volume of 3,024 m^3.

6.6.15 The Site is not located within a surface water DWPA or where a Scottish Water abstraction is located, as confirmed by consultation with Scottish Water (see **Table 6.1**). A review of Scottish Water asset plans online does not show any pipework or infrastructure within the Site.

6.6.16 The Site is within the Moniaive DWPA for groundwater. However, it is noted that the whole of Scotland is a DWPA for groundwater.

Water Quality and Protected Areas

6.6.17 Under the terms of the WFD, all river basin districts are required to be characterised, a process which requires SEPA to produce an initial assessment of the impact of all significant pressures acting on the water environment. Surface water bodies are defined as being whole or parts of rivers, canals, lochs, estuaries or coastal waters. The main purpose of identifying water bodies is so that their status can be described accurately and compared with environmental objectives.

6.6.18 The SEPA Water Classification Hub (SEPA, n.d.) has characterised surface water quality status under the terms of the WFD. Classification by SEPA considers water quality, hydromorphology, biological elements including fish, plant life and invertebrates, and specific pollutants known to be problematic. The classification grades watercourses through High, Good, Moderate, Poor and Bad status. This provides a holistic assessment of aquatic ecological health. Within the Site there are numerous watercourses/water bodies large enough to be classified by SEPA As of 2023, the Dalwhat Water (Waterbody ID: 10605) and Shinnel Water (Waterbody ID: 10628) are classified as 'Good', while the Stroanfreggan Burn (Waterbody ID: 10561) and the Water of Ken are classified as 'Poor' (Waterbody ID: 10559).

6.6.19 There are no geological or hydrological SSSI or SAC within or downstream of the Site that could be affected by the Proposed Development.

Geology and Soils

6.6.20 The bedrock geology underlying the Site is shown in **Figure 6.4**. The Site is dominated by sedimentary rock (wacke) of the Portpatrick Formation (British Geological Survey, n.d). A small portion of the south-east of the Site, around Turbine 9, is underlain by the Shinnel Formation of sedimentary greywacke. Both are derived from deep sea, continental shelf origins with graded bedding. A seam of Moffat Shale Group (Mudstone) underlies the Site, running from north-east to south-west near Turbine 4. The Igneous North Britain Siluro-devonian Calc-alkaline Dyke Suite is present within the Site and underlies a small portion of the western access track near the Dalwhat Water.

6.6.21 The drift deposits within the Site, shown in **Figure 6.4**, are dominated by Devensian till and diamicton derived from Quaternary glaciogenic origins (British Geological Survey, n.d.), which dominate the lower lying ground around the valley floor and the watercourses. The valley floor of the Dalwhat Water is dominated by unconsolidated alluvium: silt, sand, and gravel from fluvial origins. The higher ground and hilltops generally have no drift deposits based on the BGS mapping, with the exception of two small areas of peat on Mid Hill and Lamgarroch in the north-west of the Site. These deposits are likely associated with a much larger area of peat located to the north of the Site, which underlies in part a section of the access track leading to Turbine 2 and Turbine 3.

6.6.22 Scottish Soil mapping (James Hutton Institute, n.d.) (**Figure 6.5)** shows that the Site is underlain by several soil types including:

- peaty gley podzols, which dominate the majority of the Site throughout the conifer plantation and upper slopes;
- brown earths, found on valleys sides of the Dalwhat Water and Appin Burn; and
- dystrophic blanket peats, found along the western access track.

Peat

6.6.23 The NatureScot Carbon and Peatland Map (NatureScot, 2016) (**Figure 6.6**) indicates that carbon-rich soils and areas of peatland are present within the Site. The NatureScot map was developed to be used as a high-level planning tool and is indicative only with site surveys of peat depth, condition and ecology superseding the classes shown on the map. Prior to survey, the map indicated Class 1 (nationally important carbon-rich soils, deep peat and priority peatland habitat) in the west of the wind turbine area with localised Class 2 (nationally important carbon-rich soils, deep peat and priority peatland habitat with potential for restoration) in the south of the wind turbine area. Lower value classes 3, 4 and 5 are present over much of the remainder and at 6 of the 9 turbine locations.

6.6.24 Peat surveys have been undertaken on the Site following the Scottish Government (2017) peat survey guidance. The results of the peat survey are shown in **Figure 6.7** and presented in full in **Technical Appendix 6.2.** Peat is less extensive than implied by the Carbon and Peatland Map, particularly on Colt Hill and Mulwhanney, being almost entirely absent on the latter summit. The peat survey results can be summarised as follows:

- 64.6% of probes were recorded as having a depth of less than or equal to 30 cm. These probes are not classified as peat.
- 22.2% of probes were recorded as having a peat depth of between 30 – 50 cm. These probes are classified as organo-mineral soils and not formally considered to be peat.
- 10.7% of probes were recorded as having a peat depth of between 50 – 100 cm.
- 2.5% of the probes were recorded as having a peat depth of over 100 cm.
- The deepest probe depth recorded on the Site was 400 cm (adjacent to existing track at the western end of the proposed access track).

6.6.25 A total of 18 cores were taken across the peat survey area at the locations shown in **Figure 6.7**. The cores are described in detail in **Technical Appendix 6.2**. The coring determined that the acrotelm layer was between 10 cm and 70 cm in the cores surveyed, with a mean acrotelm depth of 26 cm. 66% of the cores had a gravel base, 17% had a bedrock base and 17% had a clay base.

6.6.26 A peatland condition survey showed that the majority of the peat within the Site is restricted to hilltop areas not in use for commercial forestry. These areas comprise modified peatland that has been extensively drained by artificial channels. Other smaller areas of the Site found to contain peat were typically associated with the valley floor of watercourses, such as the Auchrae Burn.

6.6.27 The Phase 1 and Phase 2 peat survey results were used to inform the design layout during the iterative design process (deeper peat was avoided where possible - see **Chapter 3**) and also to inform the Peat

Management Plan (**Technical Appendix 6.3**) and Peat Landslide Hazard and Risk Assessment (**Technical Appendix 6.4**).

Groundwater

6.6.28 There are two groundwater bodies underlying the Site. The western access track is underlain by the Galloway groundwater body, while the remainder of the Site is underlain by the Moniaive groundwater body. Both are part of the same low to very low productivity greywacke aquifer body of Silurian to Ordovician age. With the aquifer flow is fracture-based, with essentially no intergranular permeability (Ó Dochartaigh, B É *et al,* 2015). Both aquifers are deemed by SEPA to be of 'Good' overall condition as of 2023 (SEPA, n.d.).

6.6.29 SEPA groundwater flood maps indicate that the Site is not at risk of groundwater flooding (SEPA, n.d).

Groundwater Dependent Terrestrial Ecosystems (GWDTEs)

6.6.30 Areas of potential GWDTEs were identified during the ecology NVC surveys and are shown and described in **Chapter 7** and **Technical Appendix 7.1** A walkover survey of potential GWDTE polygons and target notes within 250 m of the proposed infrastructure was undertaken by a team of two hydrologists in June 2022.

6.6.31 Further details of the GWDTE within the survey area are contained in **Technical Appendix 6.5**. Based on field observations, the majority of the potential GWDTE habitats were found to have at most a low dependency on groundwater and are not considered to be GWDTE, as they are associated with surface water drainage within the forestry rides.

6.6.32 However, one groundwater flush/spring was identified during the field survey and was confirmed as a moderately dependent GWDTE. The GWDTE lies at the top of the Appin Burn valley, between Blackcraig Hill and Colt Hill. The identified area is shown on **Figure 6.3** with recommended buffers from infrastructure as per SEPA guidance (SEPA, 2024a). Where roads, tracks, trenches and compounds (<1 m excavation) are within 100 m, or proposed turbines and borrow pits (>1 m excavation) are within 250 m of the GWDTE area, it is described and assessed in detail in **Technical Appendix 6.5**.

6.7 Implications of Climate Change for Existing Conditions

6.7.1 The assessment takes into account the implications of climate change for the Proposed Development. Based on UK Climate Change Projections 2018 (UKCP18) for Scotland:

- temperatures are projected to increase, particularly in summer;
- winter rainfall is projected to increase and summer rainfall is most likely to decrease;
- heavy rain days (rainfall greater than 25 mm) are projected to increase, particularly in winter;
- near surface wind speeds are expected to increase in the second half of the 21st century with winter months experiencing more significant effects of winds; however, the increase in wind speeds is projected to be modest; and
- an increase in frequency of winter storms.

6.7.2 SEPA guidance (SEPA, 2024c) on climate change in Scotland provides a regional based approach to estimate uplift in future river flows in Scotland. For large river catchments (over 50 km^2), the peak (200-year) design flow should be increased by 53% in the Solway Basin to account for projected climate change increases to the year 2100. The peak rainfall intensity allowance for the Solway region of Scotland is 38% to the year 2100. Thus, this part of Scotland, which includes the Site, is likely to get wetter with higher peak flows in the watercourses in the future.

6.7.3 Hydrological implications of the UKCP18 predictions and the SEPA guidance (SEPA, 2024c) are that river flows will increase as weather events grow more extreme. Baseline hydrological conditions for flood events are likely to become flashier and more intense. This is accounted for when applying SEPA climate change uplifts to hydrological estimates and drainage / watercourse crossing design and adhering to SEPA guidance on watercourse buffers.

6.7.4 Increased temperatures and disruption to seasonal rainfall is likely to lead to increased peatland degradation as localised water table decreases are exacerbated. Micro-siting of proposed turbine locations to avoid areas of deeper peat has been incorporated to mitigate peatland degradation.

6.7.5 The National Planning Framework 4 (NPF4) notes "Development proposals will be sited and designed to adapt to current and future risks from climate change" (Scottish Government, 2024).

6.8 Future Baseline in the Absence of the Proposed Development

6.8.1 Without the Proposed Development, the main change to the future baseline would be as a result of climate change. Drain blocking proposed on the summits would require an alternative form of funding and landowner support to deliver the resulting peatland restoration. Without this, the existing status quo of deterioration of peatland habitats to non-priority NVC communities would remain, and possibly develop further.

6.8.2 In summary, the climate change projections highlight that summer and winter temperatures are likely to be greater that the current baseline, with winter rainfall increasing and summer rainfall decreasing. Increased rainfall will result in higher peak flows in the watercourses in the future. In addition, there may be more drought periods in the summer months, with drier, hotter conditions predicted resulting in lower flows during the summer months.

6.9 Embedded Mitigation

6.9.1 A 50 m infrastructure buffer from all blue-line ('major') watercourses and water features shown on 1:25,000 OS maps was applied at the early project design phase. OS water feature data was obtained for the Site area and buffered accordingly. Smaller watercourses and drains identified during the survey work were considered and buffered wherever possible. Locations where the recommended buffers could not be met are assessed in detail in **Technical Appendix 6.1** and summarised in the Effects Assessment within this chapter.

6.9.2 From the outset of the project, the presence of deep peat has been treated as a key constraint to siting and routing of the Proposed Development infrastructure. Through a series of design workshops, the overlap of infrastructure with the deepest peat deposits has been minimised. Details of the iterative design approach are provided in **Chapter 3: Site Selection and Design Strategy** of the EIA Report and form the first tier of the peat management strategy ('prevent') at the Proposed Development. Mean peat / soil depth within the main hardstanding / foundation area of the nine turbines is <0.5 m in all but one turbine (Turbine 8).

6.9.3 The second tier of the strategy is to reuse excavated peat, and the approach to reuse is described in the Peat Management Plan (**Technical Appendix 6.3**). No need has been identified for recycling or disposal of excavated materials.

6.9.4 Through careful design, including consideration of early PLHRA likelihood results, the vast majority of proposed infrastructure has been sited or routed away from areas of Moderate peat landslide likelihood or Factor of Safety <1.4 (using best estimate parameters).

6.9.5 Watercourse crossings were avoided and minimised as much as possible during early iterations of the turbine and track layouts.

6.9.6 A 100 m buffer was maintained where possible between all GWDTE from the track and turbine layouts where excavation was to be less than 1 m deep. Where excavation was to be over 1 m depth (e.g. turbine foundations) a buffer of 250 m from GWDTE was applied where possible. Locations where the recommended buffers could not be met are assessed in detail in **Technical Appendix 6.5** and summarised in the Effects Assessment within this chapter.

6.10 Good Practice Measures

6.10.1 A number of good practice pollution prevention and control measures will be put in place during the construction phase. These 'embedded mitigation measures' reflect best practice guidance and recognised industry standards, as well as the Applicant's experience of constructing wind farms. Many of the measures mitigate several potential effects (e.g. mitigation to minimise sedimentation and pollution such as SuDS which can also serve to attenuate surface water run-off and minimise flood risk). Embedded mitigation measures are described in the Schedule of Mitigation (**Technical Appendix 4.3**) and the OCEMP (**Technical Appendix 4.1**) and include:

- SuDS to minimise/attenuate surface run-off from new hardstanding and tracks;
- SuDS to reduce sedimentation and erosion;
- SuDS to reduce pollution and accidental spillage;
- pollution control measures to be put in place at watercourse crossings;
- peat management measures; and
- measures to reduce sedimentation, erosion, and pollution during forestry felling.

6.10.2 Drainage measures for new access tracks and infrastructure include (but are not limited to):

- appropriately sized culverts passing under the tracks that do not restrict flow and allow small watercourses, intercepted field drains and ephemeral streams/surface water flow pathways to pass under the tracks;
- interceptor drainage ditches on the upgradient side of all proposed infrastructure to intercept and divert 'clean' surface water run-off draining towards the construction areas; and
- installation and maintenance of swales and track drains to intercept, collect and treat run-off from access tracks and hardstanding areas of the Site and channel run-off to stilling ponds for sediment settling.

6.10.3 Forestry felling and removal will follow the good practice guidance and legal requirements set out in Section 8 (Forests and Soil) and Section 9 (Forests and Water) of the UK Forestry Standard (Forest Research, 2023).

6.10.4 As a minimum, the Contractor will be required to follow the guidance contained in SEPA Guidance for Pollution Prevention (GPPs) and to follow the SEPA's general binding rules (GBR) under the Water Environment (Controlled Activities) (Scotland) Regulations 2011, as amended (CAR Regulations) (Scottish Government, 2011).

6.10.5 Concrete batching will be undertaken on-Site which will require a water supply either from a waterbody on-Site or imported in tankers and stored at the batching site. Specific measures will be put in place to manage run-off from these operations, which is highly alkaline and can cause pollution if it gets into watercourses. Good practice described in SEPA wat-sg-75 guidance (SEPA, 2021) will be followed to isolate, collect, reuse and dispose of run-off from concrete operations. Concrete wash water and waste will be sent off-Site to a licensed facility for treatment and/or disposal, in accordance with the Duty of Care for Waste.

6.10.6 If the water supply for concrete batching is sourced from within the Site a licence for abstraction will be obtained from SEPA post-consent, in accordance with SEPA GBR and CAR licensing.

6.10.7 In terms of watercourse crossings, engineering activities on minor watercourses do not normally require authorisation under the SEPA CAR Regulations. SEPA defines minor watercourses as those not shown on the 1:50,000 scale OS maps (SEPA, 2024d). Of the six new crossings required for the Proposed Development, two are over small, minor watercourses and fall under General Binding Rules 6 and 9. These crossings will not require registration or a licence under CAR; however, the work will follow general good construction practice and SEPA GBR 6 and GBR 9.

6.10.8 The remaining four watercourse crossings will either require registration or a simple licence under CAR and will require specific mitigation measures. Bridging solutions will be designed to avoid affecting the bed and banks of watercourses. Fording of watercourses will be avoided. Design and implementation of crossings will follow best practice, including recommendations in Engineering in the Water Environment Good Practice Guide - River Crossings (SEPA, 2010), Good Practice during Windfarm Construction (Scottish Renewable *et al,* 2024) and Constructed tracks in the Scottish Uplands (SNH, 2015).

6.10.9 Existing watercourse crossing will be reviewed for their capacity and structural capability and if possible, will be left in place and used as part of the design. Should the existing crossings be determined to be inadequate, they will be replaced with an appropriately designed crossing (bottomless arched culvert or single span bridge).

6.10.10 During construction, temporary construction SuDS will be put in place at each watercourse crossing to ensure no sedimentation from construction works or pollution from plant or machinery can enter the watercourse. This could be a series of settlement ponds or settlement tanks and silt fences.

6.10.11 A Construction Site Licence (CSL) will be obtained from SEPA under the CAR Regulations in advance of the construction works. This will include a detailed Pollution Prevention Plan (PPP) to ensure that any discharges of water run-off from the Site to the water environment do not cause pollution. This will be prepared in advance of construction and authorisation from SEPA is required before construction commences.

6.10.12 Prior to construction and on completion of ground investigations and micro-siting, a site waste management plan shall be produced, including for site soil and peat management good practice. Any excavated peat will be appropriately managed and re-used. This is detailed further in the Peat Management Plan (**Technical Appendix 6.3**).

6.10.13 A detailed CEMP will be developed and agreed with DGC and SEPA in advance of the works. An Outline CEMP is provided as **Technical Appendix 4.1.** The CEMP will establish a framework to ensure that health and safety and environmental best practices are adopted throughout the works and will include:

- A Surface Water Management Plan, or similar, which will detail proposed surface drainage measures to treat and deal with all the surface run-off from the Site, to be designed in accordance with SuDS principles and all best practice guides and recognised industry standards.
- The approved PPP which will detail the proposed mitigation measures as identified within this EIA to address each identified pollution risk.
- A plan to monitor and plan the timing of works to avoid construction during periods of the heaviest rainfall.
- A plan to detail emergency procedures in the event of spillages or any other breach.
- A plan to detail monitoring and inspections of the water quantity and quality of sensitive private water supplies and water courses. All actions will be recorded.
- A Site Waste Management Plan to detail proposals for managing the extraction and storage of waste.
- A Peat Management Plan (see **Technical Appendix 6.3**)

6.10.14 The assessment of effects is undertaken assuming that good practice embedded mitigation is an integral part of project design. Additional mitigation is identified during the assessment to address localised site or issue specific likely significant adverse effects and is described within the 'Additional Mitigation' sections.

6.11 Micrositing

6.11.1 In accordance the Standard Conditions for the Proposed Development, a 100 m micrositing allowance will be used for the Proposed Development's infrastructure (refer to **Chapter 4**), i.e. a 100 m allowance on any side of all infrastructure. However, it should be noted that micrositing of infrastructure closer to watercourses/GWDTE within a watercourse or GWDTE buffer will not be undertaken. All micrositing would be subject to approval of the ECoW. Any changes within 50 m – 100 m of the consented locations will require approval of DGC in consultation with statutory consultees or will be treated as a formal variation to the permission. Micrositing within the allowance will be undertaken to move infrastructure further away from sensitive water features, GWDTE and deeper peat, where possible.

6.12 Scope of the Assessment

Effects Assessed in Full

6.1.1 The following effects were identified for consideration in this assessment:

- direct and indirect effects during construction on surface and ground water quality, hydrology (flood risk), channel morphology, GWDTEs and peat;
- direct and indirect effects during construction and operation on the Appin Hydro Scheme;
- direct effects during operation on hydrology;
- cumulative effects during construction on water quality, hydrology and peat; and
- decommissioning effects.

Effects Scoped Out

6.1.2 On the basis of the desk based and field survey work undertaken, the professional judgement of the EIA team, experience from other relevant projects and policy guidance or standards, and feedback received from consultees, the following topic areas have been 'scoped out' of detailed assessment:

- effects on bedrock geology during both construction and operation;
- effects on groundwater abstractions, including PWS; and
- operational effects on surface water quality and quantity, GWDTEs and channel morphology.

6.13 Assessment of Effects

6.13.1 The assessment of effects is based on the project description as outlined in **Chapter 4**. Unless otherwise stated, potential effects identified are considered to be negative.

Construction

Predicted Construction Effects

6.13.2 The following effects have been assessed in full:

- effects during construction on surface and ground water quality and quantity;
- effects on channel morphology (bank erosion and channel form) during construction;
- effects during construction on run-off rates and flood risk;
- effects during construction on GWDTEs; and
- direct and indirect disturbance of peat during construction.

6.13.3 The sensitivity of receptors has been assessed in **Table 6.6**, using the criteria in **Table 6.2**.

Table 6.6 - Sensitivity of Receptors

Receptor	Sensitivity	Comment
Watercourse and Waterbodies Appin Burn Shinnel Water Dalwhat Water Stroanfreggan Burn Auchrae Burn Water of Ken Smaller named and unnamed watercourses and drainage features within the Site Unnamed Bog Pool	Water quality – Medium Flood risk – Low Morphology – Medium	– The Dalwhat Water and Shinnel Water are classified by SEPA as 'Good' Overall Status. The Stroanfreggan Burn and Water of Ken are classified as 'Poor' Overall Status, while the Appin Burn and numerous smaller named and unnamed watercourses within the Site are not large enough to be classified by SEPA. – There are no properties immediately downstream of the Proposed Development infrastructure that are at currently at risk of flooding from the named and unnamed watercourses within the Site. – The watercourses within the Site are a mix of natural channels and artificial forestry drainage and are generally of low morphological diversity. – A small, unnamed bog pool lies to the north of Green Hill near the hilltop of Transparra.
Peat	Low	– Peat is present locally on some summits within the Site, though less extensively than implied by the Carbon and Peatland Map. – Peat depths are less than 1.0 on Colt Hill, Blackcraig Hill and other than in local areas on Transparra. – Ecological surveys indicate peatland to be degraded by drainage and lacking NVC communities indicative of priority peatland habitat.] – There is a very localised/isolated strip of priority peatland (M20) in the north of the Site at Peat Rig which will not be affected by the Proposed Development. This area is degraded due to the presence of ditches and lacks NVC communities indicative of notable priority peatland habitats. Peat depths in this area are around 50 cm.
Groundwater	Low	– The Proposed Development is located on low productivity aquifers. The groundwater body is classified by SEPA as 'Good'. – There are no groundwater abstractions or PWS within the Site. – The area is within a DWPA for groundwater (as is the whole of Scotland). However there is no significant groundwater resource and no identified sensitive users/receptors.
Groundwater Dependent Terrestrial Ecosystems (GWDTE)	Low	– A GWDTE Polygon was identified as moderately dependent on groundwater, with surface water contribution from upslope peat drainage also a factor. Based on ecological classification of the Polygon as a 'Low Importance'[3] GWDTE, with only partial, mosaiced M23 habitat present, the sensitivity of this receptor has been classified as 'Low'.

6.13.4 The main environmental effects are predicted to occur during construction. The activities that will occur during construction that may have an impact on the water environment and peat include:

- site clearance and vegetation removal (including forestry);
- use of heavy plant machinery;
- increase of hardstanding areas;
- construction and upgrading of access tracks;
- watercourse crossings; and

[3] As per the latest SEPA guidance (SEPA, 2024a), a designation of 'Low Importance' is equivalent to 'Low' sensitivity.

- associated earthworks/excavation/re-profiling and construction traffic on access tracks.

6.13.5 There are nine turbines (the foundations of which will require excavation of approximately 4 m deep over a typical foundation diameter of approximately 30 m), and associated crane hardstanding, two temporary construction compounds, three borrow pit search areas, and a new substation. There is 14.8 km of existing track that will be upgraded along with 13 km of new access track.

6.13.6 During the initial design stage, a buffer of 50 m was applied to all watercourses and water features identified from OS mapping wherever possible. Watercourses were also identified during the site walkover survey and where possible a 50 m buffer from these small watercourses was achieved. Therefore, apart from the exceptions below (labelled A-E on **Figure 6.2** and described in detail in **Technical Appendix 6.1**), all infrastructure is at least 50 m away from watercourses and water features:

- A – A short section of new access track leading to Turbine 8 could not achieve the 50 m watercourse buffer. Due to other constraints (primarily associated with engineering and the gradient at this location) the track section encroaches to within 44 m of an unnamed bog pool.
- B - Turbine 8 hardstanding. The turbine location itself is over 50 m from the watercourse. However, due to other constraints (including localised areas of deep peat and engineering constraints associated with the alignment of the access track), a ~660 m^2 area of permanent hardstanding encroaches to within 21 m of a small, unnamed, minor watercourse identified during hydrology surveys. This small headwater to an OS-marked Appin Burn tributary will be crossed by proposed access track leading to Turbine 7.
- C – Earthwork fill for Turbine 6 hardstanding. The hardstanding itself is located outwith the buffer and was repositioned in order to do so. However, a 225 m^2 area of fill lies 39 m from a small headwater that contributes to a tributary of the Appin Burn.
- D - Earthwork fill for Turbine 2 hardstanding. The hardstanding itself is located outwith the buffer and was repositioned in order to do so. However, a 141 m^2 area of fill lies 42 m from a semi-naturalised drainage channel that contributes to the Appin Burn ~ 420 m to the east.
- E - There is a ~40 m section of new access track along the western access track that could not achieve the 50 m water feature buffer. Due to other constrains (primarily associated with engineering and the gradient at this location) the track section encroaches to within 35 m of an OS-marked artificial forestry drain that at the time of the hydrology walkover did not contain any flows.

6.13.7 Existing access tracks were used as much as possible to avoid new watercourse crossings and land take. However, given the hydrological setting and remote nature of the Proposed Development, six new watercourse crossings are required. Construction of new watercourse crossings could potentially impact channel morphology during construction.

6.13.8 There are 54 watercourse track crossings required, of which 48 are existing track crossings. Existing watercourse crossing structures will be reviewed in advance of construction for their capacity and structural capability and if possible, will be left in place and used as part of the design. Six are new crossings (**Technical Appendix 6.1**); two of which are over minor watercourses and will be covered by SEPA's General Binding Rules. These crossings will not require registration or a licence under CAR; however, the work will follow general good construction practice and GBR 6 and GBR 9.

6.13.9 Four new watercourse crossings will require authorisation under the CAR Regulations (either registration or a simple licence depending on the culvert/bridge design). These include crossings of two unnamed tributaries of the Appin Burn (ID8 and ID15), Conrick Burn (ID16) and Dalwhat Water (ID23). If upgrades to any of the 48 existing crossings are required, the Applicant will consult with SEPA to obtain the relevant CAR authorisation in advance of construction, if required. Full details of crossings and CAR requirements are provided in **Annex 6.1.1**, **Technical Appendix 6.1**.

6.13.10 Catchment areas upstream of watercourse crossings were calculated based on watershed analysis using the available topographic data, supplemented by field observations. The catchment areas at crossing locations range from less than 0.01 km^2 at minor watercourses to 1.42 km^2, the largest catchment at the proposed crossing ID52, where the existing track crosses the Auchrae Burn.

Potential effects During Construction on Surface and Ground Water Quality and Quantity

6.13.11 The potential effects on surface water quality during construction are:

- Pollution of surface waters caused by the release of sediment to watercourses from excavated material during construction, heavy plant movement on the access tracks and construction compounds and the felling of forestry/vegetation.
- Pollution of surface water caused by the release of hydrocarbon pollution resulting from accidental oil or fuel leaks or spillages. There is also a risk posed by concrete (and other construction material) spillages during concrete batching and during the formation of hardstanding areas at the turbine bases.

- Pollution/sediment run-off at existing watercourse crossings (where these are being upgraded), during construction of new watercourse crossings for access tracks.

6.13.12 The potential effects on groundwater quality include:

- The risk of hydrocarbon pollution of groundwater resulting from accidental oil or fuel leaks from construction traffic and construction works. There are also potential pollution effects caused by silt and sediment disturbed during construction infiltrating into the groundwater and pollution from concrete batching and concrete spillages.

6.13.13 Risks to surface water quality will be greatest during construction when works involve the exposure of bare earth which could result in increased erosion and sedimentation. Without mitigation, the increase in sediment concentration in run-off from construction areas and access tracks may result in excessive levels of suspended sediment in watercourses.

6.13.14 Felling can result in increased surface water run-off and sediment run-off. Direct construction felling of an area of 62.52 ha of forestry is required for the construction of the Proposed Development.

6.13.15 Pollutants can enter the watercourses in the event of accidental spills or leaks from machinery and vehicles and in the event of an accidental release of concrete or other building materials. Pollutants and silt/sediment could enter watercourses directly, or via the network of artificial drains though the Site or via overland flow pathways. Shallow groundwater could also be affected.

6.13.16 An assessment of the potential effects on watercourses and water features at locations where the 50 m buffer could not be achieved is set out in **Annex 6.1.2** of **Technical Appendix 6.1** and summarised below:

- A - This is a small waterbody/bog pool that sits at the same elevation as a proposed new access track which has been aligned with the contours of the Site to facilitate delivery of the turbine components. Flow path analysis indicates that there is no hydrological connectivity between the pool and the proposed track location. Additional mitigation will be put in place to reduce the risk of sediment/silt run-off during construction. The buffer width achieved (44 m) is considered adequate for the size of the water feature and the hydrological setting.
- B - This is a watercourse headwater that sits in a depression between two hilltops, downgradient of proposed infrastructure which has been aligned, as far as possible, to avoid deeper pockets of peat and follow the contours of the Site to facilitate the engineering design and construction of the Proposed Development. Flow path analysis indicates that surface water run-off paths are from the infrastructure towards the watercourse. The buffer width achieved (21 m from permanent hardstanding) is considered adequate for size of water feature and the hydrological setting, however additional mitigation will be put in place to reduce the risk of sediment/silt run-off during construction.
- C - This is a watercourse headwater that sits in a depression between two hilltops at Mullwhanny, ~ 3 m downgradient of proposed infrastructure which has been aligned, as far as possible, to avoid deeper pockets of peat and follow the contours of the Site to facilitate the engineering design and construction of the Proposed Development. Flow path analysis indicates that surface water run-off paths are from the infrastructure towards the watercourse. The buffer width achieved (39 m from earthwork fill for Turbine 6 hardstanding) is considered adequate for size of water feature and the hydrological setting, however additional mitigation will be put in place to reduce the risk of sediment/silt run-off during construction.
- D – This is an artificial peat drain that shows some signs of naturalisation. There is an elevation difference of ~ 10 m between the fill earthworks required for the Turbine 2 hardstanding, with the infrastructure upgradient of the watercourse. A buffer width of 42 m has been achieved. Flow path analysis indicated run-off will flow from the hardstanding to the drain. Additional mitigation will be put in place to reduce the risk of sediment/silt run-off during construction.
- E – This is an artificial forestry drain with minimal flow that lies ~ 6 m lower than a short section of proposed new access track which has been aligned with the contours of the Site to facilitate delivery of the turbine components. Flow path analysis does not indicate that surface water run-off paths are from the proposed track towards the drain. The buffer width achieved (35 m) is considered adequate for the size of the water feature and the hydrological setting.

6.13.17 With the embedded mitigation measures described above in place, including buffers, following good practice construction and site drainage management guidance from relevant bodies (e.g. SEPA, CIRIA, Scottish Renewables (2024) and The UK Forestry Standard (Forest Research, 2023)), the magnitude of the effect of increased sediment/silt run-off causing a deterioration in surface water quality in waterbodies and watercourses within and downstream of the Site during construction is considered to be minor and of short duration. The sensitivity of all downstream receptors is medium, with respect to water quality, and the significance of the effect is **minor.**

6.13.18 Embedded mitigation measures to minimise the risk of pollution and accidental spillage will minimise the likelihood and severity of such incidents happening, however, there is still a residual risk. The magnitude of effect of pollution of surface water and groundwater caused by the release of hydrocarbon pollution and concrete resulting from accidental oil or fuel leaks or spillages is considered to be minor and of short duration and the significance of the effect is **minor**.

Potential Effects on Channel Morphology (Bank Erosion and Channel Form) During Construction

6.13.19 For the majority of watercourses, the effect on channel morphology (bank erosion and channel form) during construction is assessed to be of negligible magnitude, as embedded mitigation measures, including a minimum 50 m buffer zone (where possible) and environmentally sensitive bridge design, have been incorporated into the Proposed Development design. Locations where the 50 m buffer could not be met are described and assessed in **Technical Appendix 6.1**; none of the locations where the buffer has been encroached will result in effects on channel morphology.

6.13.20 The watercourses in the Site are considered to be of medium sensitivity in terms of morphology. New and upgraded crossings will be designed as bottomless arch culverts or single span bridges, which have a negligible effect on channel morphology. Therefore the effect is considered to be of **negligible** significance.

Potential Effects during Construction on Run-Off Rates, Flood Risk and Ground-Water Levels/Recharge

6.13.21 In accordance with National Planning Framework 4 (Scottish Government, 2024), there should be no new development in flood risk areas. NPF4 defines a flood risk area as one that lies within the 200-year floodplain, including an appropriate allowance for future climate change. The SEPA flood maps predict very small areas of the Site are at risk of pluvial (surface water) flooding and flooding from small watercourses. The areas identified as being at pluvial flood risk are generally located along the low-lying areas close to the watercourses. A 50 m buffer from watercourses and surface water bodies has been achieved for most of the proposed infrastructure, apart from the exceptions described above and in **Annex 6.1.1** of **Technical Appendix 6.1**.

6.13.22 New permanent watercourse crossings will be designed to accommodate the 200 year return period flow, plus an allowance for climate change and will follow an environmentally sensitive bridge design (i.e. single span bridges with no effect on the channel bed or banks). The Site is rural and there are no properties or assets at risk of flooding immediately downstream of the Site.

6.13.23 Compaction of soils and increased areas of hardstanding reduces the infiltration rate and can lead to a greater rate and volume of surface water run-off. Clear felling forestry and other vegetation can also lead to an increase in surface water run-off rates. This results in a 'flashier' catchment response and could increase flood risk downstream. However, the magnitude of the change will not be anticipated to be great due to the small area of hardstanding or semi-permeable surfaces (**Table 6.7**) compared to the total catchment area of the downstream watercourses.

Table 6.7 - Areas of Land Take for the Proposed Development within each Main Watercourse Catchment

Main River Catchment	Catchment Area (km^2)	Land take within catchment* (km^2)	Land take as a % of catchment area
Appin Burn	7.6	0.27	3.52
Dalwhat Water	33.6	0.10	0.30
Stroanfreggan Burn	2.24	0.01	0.42
Auchrae Burn	3.7	0.02	0.47
Water of Ken	33.6	0.01	0.04

** This includes all proposed hardstanding (temporary and permanent), construction compounds, borrow pits, substation, earthworks and proposed track extents.*

6.13.24 The construction of infrastructure, such as access tracks, could affect (block or realign) natural flow pathways, resulting in changes to the local run-off rate and volume and potentially resulting in the change in contributing catchment areas. This would also have an effect on the rate and volume of water reaching receiving watercourses and other downstream receptors.

6.13.25 Changes to the rate and volume of infiltration due to the construction of infrastructure could also affect recharge rates to the groundwater body. Excavations for turbine foundations and in the borrow pits during construction could also result in local changes to groundwater levels, as water would tend to fill up the excavated areas and could temporarily modify local shallow groundwater flow paths.

6.13.26 The Proposed Development incorporates SuDS and other embedded good practice mitigation measures to minimise the risk of increased run-off and flood risk (see **Section 6.10: Good Practice Measures Section** above) and the discharge of attenuated surface water run-off from the working

areas and access tracks into the watercourses will be limited to greenfield run-off rates entering each watercourse from the Site at present.

6.13.27 The catchment areas the main watercourses downstream of the Site are provided in **Table 6.7**. The total area of proposed hardstanding or semi-permeable surfaces within each catchment ranges from 0.01 km^2 to 0.27 km^2 (see **Table 6.7**). This represents between 0.042 - 3.52% of the total catchment areas; the Appin Burn catchment being the highest.

6.13.28 Based on the small percentage of the total catchment areas impacted by temporary and permanent hardstanding and the embedded mitigation, including SuDS, which will attenuate run-off to greenfield rates, the effect of construction on run-off rates and flood risk is considered to be of negligible magnitude and the effect significance will be **negligible** on watercourses, waterbodies and the High Appin Hydro Scheme downstream of the Proposed Development.

6.13.29 Excavations for turbine foundations and borrow pits could temporarily impact local groundwater recharge levels. The effect is considered to be of short duration, highly localised and reversible and is considered to be of negligible magnitude, resulting in an effect of **negligible** significance on the groundwater body as a whole. Effects on specific groundwater receptors (i.e. GWDTE) are discussed below.

Potential Effects During Construction on GWDTEs

6.13.30 Based on the results of the GWDTE survey by hydrologists and ecologists and the desk-based assessment, a number of adjustments were made to the turbine and track locations to consider the presence of GWDTEs. Where possible, the 250 m buffer has been avoided for siting turbines and borrow pits, and 100 m buffer has been avoided for siting roads, tracks and trenches, as per SEPA guidance (SEPA, 2024a). However, it has not been possible to avoid these for one GWDTE. **Chapter 3** provides more detail on why it was not possible to avoid the 100 m and 250 m buffer areas, largely due to the presence of other constraints on the Site, such as topography and deep peat.

6.13.31 There is one area of moderately dependent GWDTE area – 'GWDTE Polygon 1' - where infrastructure is proposed within the recommended buffers, located near Colt Hill within the headwaters of the Appin Burn valley. This area is shown in **Figure 6.3** and assessed in detail in **Technical Appendix 6.5**. The assessment methodology and results are summarised below.

6.13.32 A qualitative risk assessment of GWDTE Polygon 1 was carried out based on the available data on local geology, hydrology, ecology and hydrogeological regime at each location. There is no available data on sub-surface flows and in the absence of data, it is considered that the movement of sub-surface water is primarily driven by topography.

6.13.33 Flow routing analysis was carried out in QGIS software using 50 m-resolution OS Terrain data. In the absence of data on ground water levels and flow paths, analysis of topography and surface water flows paths was used to infer hydrological and hydrogeological connectivity to the Proposed Development infrastructure.

6.13.34 The assessment of impact on a groundwater flow path is made with reference to distance, slope, aspect, typical water table levels and features such as watercourses. The assessment is made with imperfect knowledge of the exact extent that a particular impact may have and imperfect knowledge of specific sub-surface flow paths. As such, it takes a precautionary approach using the available information.

6.13.35 The summarised results of the assessment are as follows. Proposed new access track leading to T1, T2 and T3 falls within the 250 m buffer to the south, west and north of the GWDTE. The new access track also passes 44 m to the west of the GWDTE. The hardstanding for T3 is within 50 m of the GWDTE at its closest, while T3 itself is ~ 100 m from the GWDTE. T2 and the associated hardstanding are 140 m and 150 m, respectively from the GWDTE. Based on Site surveys (see **Table 6.2**), the GWDTE is considered to be moderately dependent on groundwater, as it is likely that there is both surface water and groundwater contribution to the flow.

6.13.36 The infrastructure ranges from 7 m to 32 m upgradient of the GWDTE polygon. Surface water flow paths, based on available topography data (**Image 1**, **Technical Appendix 6.5**), indicate that run-off from the proposed infrastructure flows towards the GWDTE polygon from the south, west and east. It is considered unlikely that excavation for infrastructure between 40 m (access track) and 150 m (T2) away from the GWDTE and sitting 7 m to 32 m higher than GWDTE will have a significant effect on groundwater flows to the GWDTE. Given the unknowns regarding groundwater levels and flow paths and the moderate groundwater dependence of the GWDTE, the effect on the GWDTE is considered to be of minor magnitude, but temporary, resulting in an effect of **minor significance** during construction.

Potential Effects due to Direct and Indirect Disturbance of Peat During Construction

6.13.37 Construction work on peat has the potential to cause peat instability, which may affect both peat soils (and their inherent carbon stores), peatland habitats and nearby watercourses, infrastructure or land uses. A PLHRA has been undertaken and is documented in **Technical Appendix 6.4**. The PLHRA

includes detailed site mapping and field walkover, qualitative and quantitative assessment of peat stability, identification of on- an off-Site receptors and calculation of risk associated with peat landslides.

6.13.38 Risks are calculated to be Low or Negligible due to both the lack of high sensitivity receptors and due to the presence of mature forestry or brash covered lower slopes that will arrest debris movement from 14 potential source zones identified across the Site (primarily at the head of the valley and around Transparra and Green Hill in the south-east of the Site).

6.13.39 The excavation of the subsoil and peat required to build the infrastructure such as turbine bases, construction compounds, access tracks, borrow pits and felling will result in some disturbance of soils. In particular, any underlying topsoil and peat may be temporarily removed and will need to be managed appropriately.

6.13.40 Activities, or effects of activities, which have the potential to alter the geological environment include:

- earthworks and site drainage;
- reduction in water table levels resulting in the drying out, oxidation and potential erosion of peat;
- excavation and removal of peat;
- the disturbance and loading of peat by vehicle tracking; and
- forest felling activities.

6.13.41 The PMP (**Technical Appendix 6.3**) considers the excavation and reuse of peat based on a peat depth model interpolated from Phase 2 peat depth data across the Site. Excavation calculations have been undertaken for all site infrastructure, including permanent excavations (turbine foundations and the main hardstandings, the main compound with substation and all tracks of cut and fill construction) and temporary excavations (secondary crane hardstandings and laydowns, the construction compounds and borrow pits). Earthwork footprints (both cut and fill) surrounding infrastructure have also been included in the calculations.

6.13.42 Excavation calculations treat all soils ≥0.5 m as peat, with the uppermost 0.3 m as acrotelm, and all soils <0.5 m as organic soils. All peat and soils that are temporarily excavated will be stored locally and directly reinstated at their point of origin following construction. All permanently excavated peat and soils require alternative uses, ideally as restoration materials. In total, 24,374 m^3 of peat will be permanently excavated (10,231 m^3 of acrotelm and 14,043 m^3 of catotelm), with up to 51,939 m^3 of non-peat soils also temporarily displaced. Temporary excavations total 6,298 m^3 of peat (2,731 m^3 of acrotelm and 3,567 m^3 of catotelm) with 23,554 m^3 of soil.

6.13.43 The majority of permanently excavated peat will be reused in reinstating temporary compound areas adjacent to the proposed Substation where forestry has degraded existing peat deposits. The remaining peat will be placed in a small number of reinstatement areas where good hydrological connectivity with upslope deposits can be maintained and the peat can remain wet, support higher quality habitats and retain its carbon storage function. The magnitude of effect is considered to be Moderate with a Low sensitivity and therefore **Minor** effect.

Committed Additional Mitigation

6.13.44 With embedded mitigation measures incorporated into project design, including SuDS pollution control and attenuation measures, there are no potentially significant effects on hydrology, water quality, morphology or PWS. Details of the embedded mitigation will be set out in detail prior to construction in the PPP, OCEMP and construction method statements. The PPP will require approval by SEPA to obtain a CAR CSL. The PPP will also contain details of the location specific additional mitigation for relevant infrastructure and the Contractor will be legally obliged to comply with the pollution control and drainage measures agreed in the PPP and CSL. An ECoW will be present on-site during construction to monitor and assess the works and check the mitigations outlined in the PPP are adhered to and function properly. If monitoring or assessment identifies non-compliance, ineffective mitigations, or impacts beyond those predicted in the EIA Report, this will be raised with the Contractor who will be required to demonstrate and deliver compliance.

6.13.45 Additional mitigation and SuDS (e.g. silt fences, settlement ponds) will be installed around the following working areas, crossings and access tracks during construction to reduce the risk of sediment/silt run-off to the water environment during construction:

- Watercourse crossings of the proposed and existing tracks;
- Buffer encroachment A – proposed new access track associated with Turbine 8;
- Buffer encroachment B – proposed hardstanding associated with Turbine 8;
- Buffer encroachment C – Proposed fill earthworks associated with Turbine 6 hardstanding;

- Buffer encroachment D – Proposed fill earthworks associated with Turbine 2 hardstanding; and
- Buffer encroachment E – proposed new access track on the western access track.

6.13.46 The bed and banks of watercourses and crossing locations will be re-established to their previous condition immediately after construction.

6.13.47 Additional mitigation and monitoring are proposed to minimise the effects on GWDTEs, as follows:

- The track leading to Turbines 2 and 3 will be designed to enable subsurface flows to be maintained, with suitable drainage installed under the track so that it does not cut off natural flow pathways. Monitoring will be put in place to assess the quantitative and chemical effect of the infrastructure to ensure that the groundwater flow and quality to GWDTE are not statistically significantly changed post construction. Monitoring will be carried out based on SEPA (2024a) guidance and will comprise groundwater monitoring at the flush line and at a series of groundwater monitoring wells.
- Pre-construction monitoring at the GWDTE will commence at least 12 months before construction commences. Monitoring reports will be prepared, and remedial actions identified if statistically significant changes to the groundwater flow or chemistries to sensitive receptors are identified.

6.13.48 Any excavated peat will be stored appropriately and re-used as soon as possible for reinstatement or restoration. Reinstatement will result in minor changes to condition relative to the current degraded state, while reuse in restoration of the compound areas may result in improvement in the peatlands in this area relative to their baseline afforested condition, or at worst, no deterioration relative to the baseline.

6.13.49 Mitigation of peat landslide risk may be achieved through further micro-siting and / or careful construction management and through such mitigation, landslide risks are interpreted to be negligible post-mitigation.

6.13.50 Additional mitigation in the form of drain blocking in the summit peatland areas will benefit an area of 22.96 ha.

6.13.51 An ECoW (or equivalent) will be on site throughout the construction to monitor the effectiveness of the embedded and additional mitigation measures.

Residual Construction Effects

6.13.52 With embedded mitigation, additional mitigation, including the peat restoration and enhancement plans, and monitoring described above, the residual construction effects are either minor, minor (beneficial), negligible or none and are summarised in **Table 6.8**.

Table 6.8 - Summary of Residual Construction Effects

Effect	Significance before additional mitigation (including embedded mitigation measures)	Additional Mitigation	Significance after additional mitigation
Effects during construction on surface and ground water quality and quantity	Minor	Additional mitigation/ SUDS (e.g. silt fences, settlement ponds) will be put in place during the construction and working at: – Watercourse crossings; – Water buffer encroachments (A - E) o Turbine 8 access track close to unnamed bog pool o Turbine 8 hardstanding near unnamed minor watercourse o Working areas at Turbine 6 hardstanding o Working areas at Turbine 2 hardstanding o Proposed new access track on western access route	Negligible
Effects on channel morphology (bank erosion and channel form)	Negligible		Negligible
Effects of Proposed Development on run-off rates, flood risk and High Appin Hydro Scheme	Negligible		Negligible

Effect	Significance before additional mitigation (including embedded mitigation measures)	Additional Mitigation	Significance after additional mitigation
Effects on ground-water levels and recharge	Negligible		Negligible
Effects on GWDTEs	Minor	The tracks leading to Turbines 1, 2 and 3 will be designed to enable subsurface flows to be maintained. Pre- and post-construction groundwater monitoring will be undertaken at GWDTE 1.	Negligible
Effects on Peat	Minor	Post-consent detailed restoration design (restoration within compound footprints and drain blocking on summits) (see **Technical Appendix 6.3**) will be undertaken to maximise potential benefits to the peat resource and habitats.	Minor (beneficial)

Operation

Predicted Operation Effects

6.13.53 Following construction of the Proposed Development, all infrastructure will be left in situ to permit maintenance, with the exception of the construction compounds which will be restored.

6.13.54 The potential operational impacts of the Proposed Development are associated with the permanent Site infrastructure, including the access tracks, turbine bases, substation and hardstanding areas and any required maintenance work during operation.

6.13.55 The assessment of operational effects considers that the pollution prevention controls, and permanent drainage installed during construction will remain in place during operation. Hence, operational effects on peat, hydrogeology and surface water quality are considered to be **negligible**.

6.13.56 During operation, the increase in hardstanding areas (turbine bases, substation and tracks) could potentially result in an increase in the rate and volume of surface water run-off, leading to an increase in flood risk downstream. However, given the permanent SuDS drainage measures at the substation and permanent infrastructure and the size of the areas of hardstanding compared to the catchment areas of the downstream watercourses (See **Table 6.7**), the magnitude of the effect on flood risk downstream is considered to be negligible and thus is assessed to have an effect significance of **negligible**.

6.13.57 There is not expected to be any long-term effect on sub-surface flows during operation, hence the effect on GWDTEs is considered to be negligible and thus is assessed to have an effect significance of **negligible**.

Committed Additional Mitigation

6.13.58 No additional mitigation is proposed during operation.

Residual Operation Effects

6.13.59 There are **negligible** residual operational effects on the water and soil environment.

Decommissioning

6.13.60 A description of the decommissioning methodology is provided as part of **Chapter 4**. This outlines the decommissioning requirements relevant to the soil and water environment for the proposed infrastructure on-Site. In summary, where appropriate, all new proposed infrastructure will be removed, with the top 1 m of material underlying new tracks, foundations and hardstanding disposed of appropriately before being reprofiled and re-seeded. Where infrastructure lies deeper than 1 m (i.e. buried utilities, turbine foundations), it is considered preferential not to excavate materials due to the potentially lower environmental impacts when compared with excavating, processing and removing concrete from the Site. When dismantling turbines, turbine oils or any other oils would be removed from the Site and disposed of appropriately.

6.13.61 Potential effects during decommissioning are expected to be no greater than during construction. Embedded and proposed additional mitigation left in place will still function as intended, and in combination with the decommissioning approach outlined above decommissioning effects are assessed to have an effect significance of **negligible**.

6.14 Cumulative Assessment

Construction

Predicted Cumulative Effects During Construction

6.14.1 There are a number of proposed and completed developments within the surrounding area, the majority of which are in different catchments than the Site, meaning that there is less chance of a cumulative effect occurring. However, the (consented) Manquhill and Cornharrow wind farms lie across the Straonfreggan Burn and Dalwhat Water catchments. The Lorg wind farm (application submitted) to the north of the Site lies within the wider Shinnel Water catchment, which the Appin Burn is a tributary of.

6.14.2 Assuming that nearby wind farm schemes are designed and constructed in line with NPF4 and national guidelines with respect to SuDS and GPPs, there should be **negligible** cumulative effect on the downstream catchments.

6.14.3 Cumulative Effects on peat are not anticipated, given proposed restoration plans and avoidance/minimisation of peat.

Committed Additional Mitigation

6.14.4 No specific mitigation is proposed.

Residual Cumulative Effects During Construction

6.14.5 There are **negligible** residual cumulative effects on the water and soil environment.

Operation

6.14.6 There are **negligible** predicted cumulative effects during operation.

Decommissioning

6.14.7 Assuming that nearby wind farm schemes are decommissioned in line with policy, national guidelines and best practice of the time, there should be no cumulative decommissioning effect on the downstream catchments.

6.15 Interrelationship Between Effects

6.15.1 Excessive levels of suspended sediment in watercourses as a result of construction activities can have an indirect effect on watercourse ecology and fish. However, with embedded and additional site-specific mitigation (e.g. adherence to GPPs, SuDS, buffers etc) there is considered to be no significant residual effect on water quality of the downstream watercourses. Therefore, effects on fisheries remain scoped out of this assessment (see **Chapter 7**).

6.16 Further Survey Requirements and Monitoring

6.16.1 A detailed water quality monitoring plan will be submitted in advance of construction as per the Standard Conditions. Based on the effects assessment, it is recommended that water quality monitoring is carried out on the Appin Burn downstream of the Proposed Development, as well as at selected locations downstream of new watercourse crossings and buffer encroachments. These will be defined in the OCEMP.

6.16.2 Groundwater monitoring will be put in place to assess the quantitative and chemical effect of the infrastructure to ensure that the groundwater flow and quality to GWDTE 1 is not statistically significantly changed post construction. Monitoring will be carried out based on SEPA guidance and will comprise groundwater monitoring at the spring/flush line and at a series of groundwater monitoring wells. Details of the monitoring will be agreed with SEPA and set out in the CEMP.

6.16.3 Mitigation of residual peat instability risks will be supported by good practice construction measures and by monitoring both during and after construction. Further details are provided in **Technical Appendix 6.4**.

6.16.4 Satisfactory implementation of the PMP in order to mitigate peat loss / disturbance will be assured by monitoring both during and after construction. Further details are provided in **Technical Appendix 6.3**.

6.16.5 An ECoW (or equivalent) will be on site throughout the construction to monitor the effectiveness of the embedded and additional mitigation measures.

6.17 Summary of Effects

6.17.1 **Table 6.9** below summarises the likely predicted effects of the Proposed Development on Geology, Hydrology, Hydrogeology and Peat. There are no significant effects and most of the potential effects

prior to mitigation were either of **negligible** or **minor** significance, assuming embedded good practice mitigation measures are in place during construction.

6.17.2 With additional mitigation, the likely residual effects were either of **negligible** or **minor** significance.

Table 6.9 - Summary of Effects

Effect	Significance before additional mitigation (including embedded mitigation measures)	Additional Mitigation	Significance after additional mitigation
Construction			
Effects during construction on surface and ground water quality and quantity	Minor	Additional mitigation/ SUDS (e.g. silt fences, settlement ponds) will be put in place during the construction and working at: – Watercourse crossings; – Water buffer encroachments (A - E) ○ Turbine 8 access track close to unnamed bog pool ○ Turbine 8 hardstanding near unnamed minor watercourse ○ Working areas at Turbine 6 hardstanding ○ Working areas at Turbine 2 hardstanding ○ Proposed new access track on western access route	Negligible
Effects on channel morphology (bank erosion and channel form)	Negligible		Negligible
Effects of Proposed Development on run-off rates, flood risk	Negligible		Negligible
Effects on ground-water levels and recharge	Negligible		Negligible
Effects on GWDTEs	Minor	The tracks leading to Turbines 1, 2 and 3 will be designed to enable subsurface flows to be maintained. Pre- and post-construction groundwater monitoring will be undertaken at GWDTE 1.	Negligible
Effects on Peat	Minor (negative)	Post-consent detailed restoration design restoration within compound footprints and drain blocking on summits) (see **Technical Appendix 6.3** and **Technical Appendix 7.6: Outline Nature Enhancement Management Plan**) will be undertaken to maximise potential benefits to the peat resource and habitats.	Minor (positive)
Operation			
Operational effects of Proposed Development on run-off rates, flood risk, water quality, peat and GWDTEs	Negligible	n/a	Negligible
Cumulative			
Cumulative effects of Proposed Development on run-off rates, flood risk, water quality, peat and GWDTEs	Negligible	n/a	Negligible
Decommissioning			
Decommissioning effects of Proposed Development on run-off rates, flood risk,	Potential effects during decommissioning are expected to be		Negligible

Effect	Significance before additional mitigation (including embedded mitigation measures)	Additional Mitigation	Significance after additional mitigation
Construction			
water quality, peat and GWDTEs	no greater than during construction, ranging from minor to negligible.		

6.18 References

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