9 Geology, Peat, Hydrology and Hydrogeology

Contents

This page is intentionally blank.

9 Geology, Peat, Hydrology and Hydrogeology

9.1 Executive Summary

9.1.1 The Proposed Development is located in a highland setting approximately 8 km north of Lairg and 4 km east of Loch Shin. The site slopes gently down in a south-westerly direction with elevation across the site ranging from approximately 155 m above ordnance datum (AOD) in the north-east site area to approximately 130 m AOD in the south-west.

9.1.2 The site comprises mainly forestry plantation and scrub birch interspersed with areas of open moorland. One watercourse, Feith Osdail, flows from north-east to south-west, from the central part of the eastern site boundary, through the southern portion of the site before joining the River Tirry, just outside the site boundary.

9.1.3 Site geology comprises the Altnaharra Psammite Formation, comprising psammite and micaceous psammite overlain by glacial till, morainic deposits and peat. Alluvial clays, silts, sands and gravels are indicated to be present on the banks of Feith Osdail.

9.1.4 The Scottish Natural Heritage (SNH)) Carbon and Peatlands Map (2016) identifies Class 1 Peat across much of the site. However, peat depth surveys have identified peat thickness as zero or less than 0.5 m at the majority of probe locations and having been degraded by drainage and forestry activities.

9.1.5 The Proposed Development avoids any infrastructure being sited on deep peat, with almost all infrastructure elements sited on areas with peat depth less than 0.5 m. A pegat slide risk assessment has identified negligible to low risks at all proposed turbine and infrastructure locations across the site.

9.1.6 There are no private water supplies located within 1 km of the site.

9.1.7 Habitats indicative of potential groundwater dependency have been identified locally across the site, although based on the site geology and pattern of habitat occurrence, the habitats are interpreted as mostly being surface water or rainwater fed. Localised areas of potentially groundwater dependent habitats have been identified in the south of the site, however the significance of effects on the groundwater resource are assessed as non-significant given the low productivity aquifer status, minimal groundwater anticipated to be present within bedrock at shallow depth, and absence of private water supplies in the vicinity.

9.1.8 Standard/embedded mitigation measures include design and layout decisions taken through the design iteration process, standard good construction and design practice detailed pre-construction site investigations, agreement and implementation of a Construction Environmental Management Plan, appropriate design of the proposed watercourse crossings, and development of a detailed Drainage Strategy for the site.

9.1.9 The potential effects on hydrological, geological and hydrogeological receptors, taking account of the standard mitigation measures, have been assessed as negligible to minor (not significant). However, some additional specific mitigation measures have been proposed to further reduce the effect significance/. These include: appropriate peat management and re-use on-site, additional dewatering and construction-phase surface run-off control, and establishing and demarcating working areas and corridors. Additionally, a Habitat Management Plan would be implemented, to restore degraded peatland in a specified area of the site post-felling.

9.1.10 The significance of residual effects on hydrological, geological and hydrogeological receptors is considered to be negligible to minor (not significant).

9.1.11 No cumulative effects on hydrology, hydrogeology and geology are predicted.

9.2 Introduction

9.2.1 This chapter outlines the potential geological, peat, hydrological and hydrogeological effects of the construction and operation of the Proposed Development. An assessment is provided based on the sensitivity of the receptor and the magnitude of the impact giving the significance of the effect. Where appropriate, mitigation measures to prevent, minimise or control identified effects are presented.

Statement of Confidence

9.2.2 The assessment was led by Jenny Hazzard, Environmental Planning Director at ITPE. Jenny has a BSc in Geological Engineering and an MSc in Engineering Geology, and she is a Practitioner Member of IEMA. Jenny has 20 years of experience in environmental consultancy including EIA, geo-environmental assessment, ground investigations, and assessment of geology, hydrology and hydrogeology impacts. She has led on hydrology, hydrogeology and peat assessment work for several renewable energy and transmission & distribution projects across Scotland, including peat slide risk assessments and peat management plans for several proposed Scottish wind farm projects.

9.3 Legislation, Policy and Guidelines

9.3.1 With regard to hydrology, management of water-borne pollution and protection of natural heritage areas, the Scottish Environment Protection Agency (SEPA) has statutory obligations in terms of the management and control of pollution into water resources in Scotland. Where careful design has avoided sensitive receptors, it would be reasonable to assume that the adoption of the SEPA's Good Practice Guidelines will, in general, prevent pollution to acceptable standards and make the majority of any 'significant' effects unlikely. Specific mitigation measures may be required in certain areas or at certain times of the site development.

Legislation

9.3.2 There is a range of environmental legislation that the Proposed Development must adhere to throughout its life cycle. Relevant legislation and guidance documents have been reviewed and taken into account as part of this geological, hydrogeological and hydrological assessment. Key legislative drivers which have been considered within this assessment are listed below:

- Control of Pollution Act 1974;
- Environmental Protection Act 1990;
- Environment Act 1995;
- Water Framework Directive 2000/60/EC;
- Groundwater Daughter Directive 2006/118/EC;
- Water Environment and Water Services (Scotland) Act (WEWSA) 2003;
- Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended in 2018) (CAR);
- The Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017 (amends and revokes the Private Water Supplies (Scotland) Regulations 2006);
- The Flood Risk Management (Scotland) Act 2009; and
- The Town & Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017.

9.3.3 The Water Framework Directive has been implemented in Scotland through WESWA and CAR. The primary objective of the Directive is for all surface and coastal water bodies to achieve good chemical and ecological status, and ground water bodies to achieve good quantitative and chemical

status, by 2015 or 2021. This required assessment of a much wider set of water quality parameters than had previously been used. SEPA has published River Basin Management Plans (RBMPs) which detail the current and target status of water bodies, and the means of achieving these targets.

Planning Policy

9.3.4 Scottish Planning Policy (SPP) (Scottish Government, 2014) identifies the range of considerations likely to be relevant to the determination of energy projects, including onshore wind developments (paragraph 169). These include:

- effects on hydrology, the water environment and flood risk; and
- impacts on carbon rich soils.

9.3.5 It also states that the planning system should *'promote protection and improvement of the water environment, including rivers, lochs, estuaries, wetlands, coastal waters and groundwater, in a sustainable and co-ordinated way'* (paragraph 194); and *'Development management decisions should take account of potential effects on landscapes and the natural and water environment, including cumulative effects'* (paragraph 202).

9.3.6 With respect to flooding, SPP paragraph 255 promotes a precautionary approach to flood risk from all sources and states that the planning system should prevent development which would have a significant probability of being affected by flooding or would increase the probability of flooding elsewhere. Policy 264 sets out aspects to be taken account for development management, in respect of flood risk. This includes consideration of the design and use of the proposed development. Policy 266 notes that Flood Risk Assessments should be required for development in the medium to high category of flood risk (annual probability of coastal or watercourse flooding is greater than 0.5% or 1:200 years).

9.3.7 The following Planning Advice Notes, issued by the then Scottish Executive, are also relevant to the assessments made in this chapter:

- Planning Advice Note 50: Controlling the Environmental Effects of Surface Mineral Workings, 1996 (in respect of borrow pit workings);
- Planning Advice Note 61: Planning and Sustainable Urban Drainage Systems, 2001; and
- Planning Advice Note 79: Water and Drainage, 2006.

9.3.8 The Caithness and Sutherland Local Development Plan (CaSPlan) (The Highland Council, 2018), identifies a substantial renewable energy potential in the area, including onshore wind developments. Specifically applicable to geology, hydrology and hydrogeology, paragraph 83 of the CaSPlan notes, "*Peatland is a vital carbon store and Caithness and Sutherland's peatland resource is of international importance*."

9.3.9 In addition, the CaSPlan must be read in coordination with the Highland-Wide Local Development Plan (The Highland Council, 2012) which presents the following policies which are relevant to geology, hydrology and hydrogeology:

- Policy 53 – Minerals (relevant to borrow pits);
- Policy 55 – Peat and Soils;
- Policy 63 – Water Environment;
- Policy 64 – Flood Risk;
- Policy 66 – Surface Water Drainage;
- Policy 67 – Renewable Energy Developments; and
- Policy 72 – Pollution.

9.3.10 The Highland Council Supplementary Guidance: *Flood Risk and Drainage Impact Assessment* (2013) provides information for addressing flood risk and drainage for proposed development projects.

9.3.11 The Highland Council Supplementary Guidance: *Onshore Wind Energy* (2016 with 2017 addendum) sets out guidance specifically for development of onshore wind energy projects, including considerations relating to the water environment, peat, borrow pits, and construction environmental management.

9.3.12 Full details of relevant planning policy can be found in Chapter 5.

Guidance

9.3.13 A review plan for Pollution Prevention Guidance documents (PPGs) is currently underway by Natural Resources Wales (NRW), the Northern Ireland Environment Agency (NIEA) and SEPA, replacing them with a replacement guidance series: Guidance for Pollution Prevention (GPPs). GPPs provide environmental good practice guidance for the whole UK, and environmental regulatory guidance directly to Northern Ireland, Scotland and Wales only.

9.3.14 The PPGs and GPPs include the documents referred to below, which are the principal documents used for guidance on preventing contamination of surface water from construction activities. Those relevant to this Proposed Development include:

- PPG1: General guide to the prevention of pollution (EA, SEPA & EHSNI, 2013);
- GPP2: Above ground oil storage tanks (EA, SEPA & EHSNI, January 2018);
- GPP5: Works and maintenance in or near water (EA, SEPA & EHSNI, January 2017);
- PPG6: Working at construction and demolition sites (EA, SEPA & EHSNI, 2012); and
- GPP21: Pollution incidence response planning (EA, SEPA & EHSNI, 2017).

9.3.15 The following SEPA Guidelines are also relevant:

- SEPA Supporting Guidance (SAT-SG-75) – Sector specific guidance: construction sites (SEPA, 2018);
- Temporary Construction Methods, WAT-SG-29 (SEPA, 2009);
- Flood Risk and Planning Briefing Note (SEPA, 2014);
- Position Statement: The role of SEPA in natural flood management (SEPA, Feb 2012);
- Technical flood risk guidance for stakeholders, version 12 (SEPA, May 2019);
- Land Use Planning System Guidance Note 4 (LUPS GU4) - Planning guidance on on-shore windfarm developments (SEPA, September 2017);
- Land Use Planning System Guidance Note 31 (LUPS-GU31)- Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems (SEPA, October 2014);
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011 as amended in 2018 - A practical guide (SEPA, 2011 as amended in 2019);
- River Crossings, Engineering in the water environment: good practice guide (SEPA,2010);
- Development of a groundwater vulnerability screening methodology for the Water Framework Directive, Project WFD28 Final Report (SEPA 2004); and
- The River Basin Planning Strategy for the Scotland River Basin District (SEPA, 2009/2015).

9.3.16 Other relevant guidance includes:

- Control of water pollution from constructions sites. Guidance for consultants and contractors C532 (CIRIA, 2001);
- Environmental good practice on site C650 (CIRIA, 2010);
- Good practice during windfarm construction (Scottish Renewables, SNH, SEPA & Forestry Commission Scotland, 4th Edition 2019);
- Code of Practice for the sustainable use of soils on construction sites (DEFRA, 2011);
- Private Water Supplies: Technical Manual, Scottish Executive, 2006;
- Special Requirements for Civil Engineering Contracts for the Prevention of Pollution, Version 2, (SEPA, 2006);
- UK Technical Advisory Group on the WFD, UK Environmental Standards and Conditions Final Report, November 2013;
- Guidance on Developments on Peatland - Site Surveys (SNH, SEPA and The James Hutton Institute, 2017);
- Developments on Peatland: Guidance on the assessment of peat volumes, reuse of excavated peat and the minimisation of waste (Scottish Renewables and SEPA, 2012);
- Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments (Second Edition) (Scottish Government, 2017); and
- Developments on Peat and Off-Site Uses of Waste Peat (SEPA, 2017).

9.4 Consultation

9.4.1 The following consultation responses have been received for the Proposed Development.

Table 9.1 – Consultation in Relation to Geology, Hydrology and Hydrogeology

Consultee	Consultation Response	Key Actions
The Highland Council (THC) (2018 Scoping Response)	The EIA Report should cover effects from borrow pits, earthworks and site restoration. It must include risks of engineering instability from peat and carbon balance.	Proposed temporary borrow pit search areas are located in the north-west and central areas of the site, as shown on Figure 9.1. Borrow pits are discussed in Section 3.4 of this EIA Report. This is summarised paragraphs 9.8.10 to 9.8.11 of this chapter. An assessment of engineering instability from peat is provided in detail in Appendix 9.1. Estimated volumes of peat to be extracted, and measures for re-use of peat on-site and suitable handling and management of peat extraction and storage, are set out in Appendix 9.2. An assessment of carbon balance is provided in Appendix 3.3.

Consultee	Consultation Response	Key Actions
	EIA report should assess impacts on watercourses, private water supplies and aquatic interests.	Effects on watercourses, private water supplies and aquatic interests have been assessed as reported in Sections 9.9 and 9.11 of this chapter.
	A flood risk assessment needs to be undertaken for the site covering both fluvial and pluvial flood risk.	Flood risk has been taken into account in developing a suitable site design, and a high level assessment of flood risk has been undertaken as reported in paragraphs 9.6.16 to 9.6.26 of this chapter.
	A drainage impact assessment should be provided.	Outline drainage arrangements are discussed in Chapter 3 and Appendix 3.1 and summarised in paragraph 9.8.26 of this chapter. This would be developed further as part of a detailed Drainage Strategy to be agreed prior to commencement of construction.
The Highland Council (02/10/2020)	The Highland Council provided information on known private water supplies.	The Highland Council provided information on known private water supplies across the region. This was reviewed to identify any supplies that may be located within the study area (within 1 km of the site boundary). None were identified.
SEPA (2018 Scoping Response)	Provide a map and assessment of impacts upon Groundwater Dependent Terrestrial Ecosystems (GWDTE).	A map showing identified areas of potential GWDTE is provided as Figure 9.5. The potential occurrence and distribution of GWDTE is discussed in paragraphs 9.6.43 to 9.6.48, and likely effects on groundwater are assessed in Sections 9.9 and 9.11.
	Provide a peat depth survey and table detailing re-use proposals.	Details of peat depth survey work undertaken at the site are provided in Appendix 9.1, and summarised in paragraphs 9.6.32 to 9.6.35 of this chapter. Peat re-use proposals are set out in Appendix 9.2.
	Provide a map and site layout of borrow pits.	Proposed temporary borrow pit search areas are located in the north-west and central areas of the site, as shown on Figures 9.1 to 9.6. Borrow pits are discussed in Section 3.4 of this EIA Report. This is summarised in paragraphs 9.8.10 to 9.8.11 of this chapter.
	Provide a schedule of mitigation, including	Mitigation relevant to geology, peat, hydrology and hydrogeology is set out in Sections 9.7 and 9.10, and summarised in

Consultee	Consultation Response	Key Actions
	pollution prevention measures.	Table 9.2. Chapter 17 of the EIA Report provides a Draft Scheme of Mitigation covering all committed mitigation measures for the Proposed Development. A Construction Environmental Management Plan (CEMP) will be developed, outlining pollution prevention measures (an outline CEMP can be found in Appendix 3.2).
	Provide a decommissioning statement.	Information on decommissioning is provided in Section 3.7 of Chapter 3. Also, as noted in paragraph 9.9.31, discussions will be held with THC and the appropriate Regulatory Authorities prior to decommissioning to agree an appropriate Decommissioning Strategy.
	A flood risk assessment should be carried out to inform the design of the watercourse crossings, with crossings demonstrated to be able to convey 1:200 year flood event.	Flood risk has been taken into account in developing a suitable site design, and a high level assessment of flood risk has been undertaken as reported in paragraphs 9.6.16 to 9.6.26 of this chapter. Appendix 9.3 provides a water crossing schedule. All water crossings will be designed to convey the 1:200 year flood event. Detailed final designs would be developed and agreed with SEPA and THC prior to commencement of construction.
	With the exception of watercourse crossings, infrastructure should be located at least 50 m from the top of the bank of the watercourse.	All permanent infrastructure is located at least 50 m from the Feith Osdail watercourse (the only substantial watercourse on-site), with the exception of one proposed water crossing. A proposed temporary access and short stretch of temporary access road in the south of the site is proposed for the construction phase only. This will be within the 50 m watercourse buffer but will be subject to rigorous environmental controls to protect the watercourse during its brief temporary use, and it will be removed and restored following completion of construction. Further information is given in paragraphs 9.6.16 to 9.6.26, 9.7.5 to 9.7.8, and in Chapter 2.

Consultee	Consultation Response	Key Actions
SEPA (July 2020)	SEPA was consulted with respect to the proposed Stage 2 peat survey approach and methodology. SEPA confirmed agreement with the survey methodology.	No further action. Additional information is given in paragraphs 9.6.32 to 9.6.35 and Appendix 9.1.
SEPA (September 2020)	SEPA was further consulted to confirm suitability of the Stage 2 peat survey data gathered, given some design changes following completion of the survey. SEPA confirmed that the surveys undertaken were considered to be suitable and sufficient for the EIA.	No further action. Additional information is given in paragraphs 9.6.32 to 9.6.35 and in Appendix 9.1.
SEPA (October/ November 2020)	As part of consultation feedback on peat surveys (see above), SEPA had noted concerns regarding the proposed construction of a new stretch of access track in the south of the site, running parallel to the existing private Dalnessie access track which is adjacent to (outside) the southern site boundary. SEPA expressed a strong preference for using existing infrastructure wherever possible, i.e. the existing Dalnessie track. Further dialogue was therefore held with SEPA, including a meeting on 27 October 2020, to discuss the design iteration, clarify that land owner permission for use of the Dalnessie track was not achievable, and discuss options for	Full details of the design iteration process, including design of the southern access point and temporary track in the southern part of the site, are provided in Chapter 2. Summary information in terms of flood risk and mitigation to control and minimise potential effects on the Feith Osdail watercourse are set out in paragraphs 9.6.16 to 9.6.26 and 9.7.4 to 9.7.8.

Consultee	Consultation Response	Key Actions
	optimising the proposed infrastructure to minimise impacts. This included discussion of the southern track being temporary, to be restored following the construction phase.	
SNH (2018 Scoping Response)	The Scoping Report incorrectly states that the site does not contain any nationally important mapped environmental interest. The proposal lies entirely within a Class 1 Area of Carbon Rich Soils, Deep Peat and Priority Peatland Habitat. The EIA will need to address how a windfarm can be constructed without compromising this national interest, and mitigation opportunities should be fully considered.	The reference in the Scoping Report was in relation to statutory national designations. It is recognised that the SNH Carbon and Peatlands Map (2016) identifies the site as being within an area of Class 1 Peat. Detailed peat surveys have been undertaken to provide a more detailed, site-specific understanding of the distribution, depth and nature of peat deposits at the site and to inform the assessment of impacts on peat and carbon rich soils. Please refer to paragraphs 9.6.31 to 9.6.38 of this chapter, Appendix 9.1 and Appendix 9.2.
SNH (2018 Scoping Response)	A peat management plan will be required	An outline Peat Management Plan is provided as Appendix 9.2.
SNH (2018 Scoping Response)	A Peat Slide Risk Assessment will be required for this proposal	An assessment of peat slide hazard and risk is provided as Appendix 9.1.

9.5 Assessment Methodology and Significance Criteria

9.5.1 The following section sets out the approach that was followed to collect relevant baseline information and the methodology for assessing impacts and the significance of effects.

Study Area

9.5.2 The study area has largely incorporated the area within the site boundary but has also included consideration of hydrological effects up to 1 km away from the site. Any Private Water Supplies within 1 km of the site have been considered.

9.5.3 The criteria for defining the study area with regard to hydrological resources have been established based on professional judgement and experience with regard to likely access and working areas, reference to SEPA guidance, and with due consideration to other relevant guidance on hydrological assessment.

Desk Study

9.5.4 Baseline conditions have been established primarily via desk-based research and has included the following:

- consultation with relevant regulatory authorities as described in Table 9.1 above;
- identification of the locations and characteristics of catchments and principal watercourses and waterbodies as shown on 1:50,000 scale OS mapping which may be affected by construction activities;
- identification of SEPA/WFD watercourse and waterbody classifications;
- review of online SEPA flood mapping;
- review and collation of pertinent information on surface hydrology, flooding, climate etc.;
- review of geological mapping of the area, British Geological Survey (BGS), Geology of Britain Viewer, 1:50,000 scale;
- review of hydrogeological characteristics and groundwater resource, including the BGS digital hydrogeological map of the UK, 1:625,000 scale; and
- review of Private Water Supply records held by held by the Drinking Water Quality Regulator for Scotland (DWQR) and The Highland Council.

Site Visit

9.5.5 The findings of the desk study have been supported by a site reconnaissance survey of surface watercourses, proposed water crossing locations and ground conditions, which was undertaken on 16 July 2020. This included a visual inspection of watercourses where works are likely to occur within or in the close vicinity of the Proposed Development, visual assessment of gradients and drainage pathways across the site and an inspection of the ground conditions.

9.5.6 Habitat and botanical surveys were undertaken in June and July 2020, supplementing previous surveys undertaken in 2014 and 2017 and providing information relevant to the identification of habitats which could represent groundwater dependent terrestrial ecosystems (GWDTE) (refer to Chapter 8 for further details).

Peat Depth Survey

9.5.7 The presence of peat at the site was identified based on a desk study review of published geological mapping and the SNH Carbon and Peatland Map 2016, and confirmed during peat depth survey work undertaken in 2015 as part of earlier studies relating to potential development at the site. A programme of updated peat depth survey work was therefore devised, in line with Guidance on Developments on Peatland - Site Surveys (SNH, SEPA and The James Hutton Institute, 2017).

9.5.8 Stage 1 peat depth probing was undertaken by ITPE in 2015 as part of earlier work relating to a proposed development at the site. The surveys were undertaken by a team of suitably qualified and experienced surveyors, and provided a 100 m spaced grid, as per the above-noted guidance.

9.5.9 Following re-start of the project in 2020, including review and revision of the previously considered layout (refer to Chapter 2 of the EIA Report), a 'design chill' was agreed. This was considered to represent the best possible turbine and infrastructure layout to optimise yield whilst minimising environmental effects, including effects on geology, hydrogeology and peat but also taking account of other environmental constraints.

9.5.10 The Stage 1 survey had identified relatively shallow peat across the site, with the deepest peat located in the north-east site area, as well as along the A836 in the western site area. Stage 2 peat

surveys were required to confirm and expand on Stage 1 findings, targeting the proposed infrastructure locations.

9.5.11 The Stage 2 peat depth probing exercise was undertaken by a suitably qualified team of ITPE surveyors, during the week of the 20 July and on 3 August 2020. The surveys involved recording peat depth at each proposed turbine and hardstanding location, along the route of proposed temporary and permanent access roads, and at proposed infrastructure locations including the temporary construction compound, the switching station and energy storage system, the permanent met mast, and borrow pit search areas. Peat samples were extracted using a hand auger at seven locations, and were subject to laboratory testing for moisture content, carbon content, and bulk density to help characterise the nature of the peat and/or peaty soil.

9.5.12 Following this Stage 2 survey work, some changes were made to the "design chill" layout, reducing the extent of infrastructure sited on areas of deeper peat. An area of track which would have crossed an area of peat with depths locally >1 m was removed from the design and another section of road was realigned to avoid deep peat. Other road alignments were slightly amended for design reasons unrelated to peat, but within areas where minimal peat depths had been recorded. An ongoing dialogue with SEPA was maintained to confirm suitability of the survey programme in response to design proposals.

9.5.13 Data obtained from the peat depth surveys were used to inform a Peat Slide Risk Assessment (PSRA) and development of an outline Peat Management Plan (PMP); refer to Appendices 9.1 and 9.2. As set out in Section 9.8, the Applicant has committed to detailed pre-construction site investigation works to further inform appropriate micro-siting and/or other geotechnical or engineering controls that may be considered necessary during construction.

Assessment of Potential Effect Significance

9.5.14 The characterisation of geological, hydrological and hydrogeological sensitivities has been guided by the matrix presented in Table 9.2 which lists the characterisation criteria.

Table 9.2 – Geological, Hydrological and Hydrogeological Sensitivity

Sensitivity	Description
High	Areas containing geological, geomorphological or hydrological features considered to be of international or national interest, for example Aquatic Natura 2000 sites, Special Areas of Conservation (SAC), Sites of Special Scientific Interest (SSSI). Highly permeable superficial deposits allowing free transport of contaminants to groundwater and surrounding surface waters. Wetland/watercourse of High or Good Ecological Potential. Raised or blanket bog. High risk of flooding.
Medium	Areas containing features of designated regional importance, for example Regionally Important Geological and Geomorphological Sites (RIGS), considered worthy of protection for their educational, research, historic or aesthetic importance. Moderately permeable superficial deposits allowing some limited transport of contaminants to groundwater and surrounding surface waters. Wetland/watercourse of Moderate Ecological Potential. Significant peat deposits.

Sensitivity	Description
	Moderate risk of flooding.
Low	Geological features not currently protected and not considered worthy of protection. Low permeability superficial deposits likely to inhibit the transport of contaminants. Wetland/watercourse of Poor or Bad Ecological Potential or no WFD classification. Thin superficial peat deposits. Low risk of flooding.

9.5.15 The criteria for sensitivity have been developed based on a hierarchy of factors relating to quality of the aquatic and geological environment including international and national designations, water and soil quality information, watercourse status from the WFD review work undertaken to date by SEPA, consultations, site reconnaissance and the professional judgement of the assessment team.

9.5.16 The prediction and assessment of effects on hydrology, hydrogeology and geology has been undertaken using a series of tables to document the various potential impacts from aspects of the construction works and operations. Effects have been predicted for the Proposed Development based on the guidance criterial for impact magnitudes set out in Table 9.3.

Table 9.3 – Impact Magnitude

Impact Magnitude	Guideline Criteria
High	Total loss of, or alteration to, key features of the baseline resource such that post development characteristics or quality would be fundamentally and irreversibly changed e.g. extensive excavation of peatland or watercourse realignment
Medium	Loss of, or alteration to, key features of the baseline resource such that post development characteristics or quality would be partially changed e.g. instream permanent bridge supports or partial excavation of peatland
Low	Small changes to the baseline resource, which are detectable, but the underlying characteristics or quality of the baseline situation would be similar to pre-development conditions e.g. culverting of very small watercourses/drains
Negligible	A very slight change from baseline conditions, which is barely distinguishable, and approximates to the 'no-change' situation e.g. short-term compaction from machinery movements

9.5.17 The significance of the predicted effects has been assessed in relation to the sensitivities of the baseline resource and magnitude of predicted impacts. A matrix of significance was developed to provide a consistent framework for evaluation and is presented in Table 9.4. Guideline criteria for the various categories of effect are included in Table 9.5

Table 9.4 - Effect Significance Matrix

	Sensitivity			
Magnitude	**High**	**Moderate**	**Low**	**Not Sensitive**
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Minor
Low	Moderate	Minor	Minor	Negligible
Negligible	Minor	Minor	Negligible	Negligible

Table 9.5 - Effect Significance Categories

Significance	Definition	Guideline Criteria
Major	A fundamental change to the environment	Changes in water quality or quantity affecting widespread catchments or groundwater reserves of strategic significance, or changes resulting in substantial loss of conservation value to geological or aquatic habitats and designations
Moderate	A larger, but non-fundamental change to the environment	Changes in water quality or quantity affecting part of a catchment or groundwaters of moderate vulnerability, or changes resulting in loss of conservation value to geological or aquatic habitats or designated areas
Minor	A small but detectable change to the environment	Localised changes resulting in minor and reversible effects on soils, surface and groundwater quality or habitats
Negligible	No detectable change to the environment	No effects on geological resources, drainage patterns, surface and groundwater quality or aquatic habitat

9.5.18 In the above classification, fundamental changes are those which are permanent, either adverse or beneficial, and would result in widespread change to the baseline environment. For the purposes of this assessment, those effects identified as being major or moderate have been evaluated as significant environmental effects.

9.5.19 These matrices have been used to guide the assessment, although they have been applied with a degree of flexibility, since the evaluation of effects will always be subject to location-specific characteristics which must be taken into account. For this reason, the evaluation of the significance of effects in particular will not always correlate exactly with the cells in the relevant matrix, especially where professional judgement and knowledge of local conditions may result in a slightly different interpretation of the impact concerned.

9.5.20 Cumulative effects have been accounted for through the prediction and evaluation of effects cumulatively with those which could arise as a result of the construction and operation of other developments (operational, consented or in planning) within the study area.

Requirements for Mitigation

9.5.21 Proposed mitigation measures are presented within this chapter (Sections 9.8 and 9.10) where the potential to affect sensitive geological, hydrological or hydrogeological receptors has been predicted. These may include temporary effects from construction or decommissioning, or permanent/longer-term effects associated with the operational phase of the Proposed Development and its associated infrastructure.

Assessment of Residual Effect Significance

9.5.22 An assessment of any predicted significant residual effects on sensitive geological, hydrological or hydrogeological receptors, taking account of committed mitigation measures, is presented within this chapter (Section 9.11).

Limitations to Assessment

9.5.23 No water quality monitoring has been undertaken, although this is not considered warranted at this stage and would not materially affect the impact assessment.

9.5.24 Due to some iteration of the site infrastructure design following completion of Stage 2 peat survey work, there are some proposed infrastructure elements for which survey spacing/intensity does not fully accord with the relevant peat survey guidance. However, in all these cases, the available peat survey data indicates very limited peat depth across the location in question. The addition of further peat survey data points at the specific final infrastructure locations would therefore not materially add to the understanding of peat distribution and depth, peat slide risk, or the assessment of peat volumes requiring excavation. The sufficiency of the peat survey data was discussed and agreed with SEPA (refer to Table 9.1).

9.6 Baseline Conditions

Geography, Topography and Geomorphology

9.6.1 The Proposed Development site lies approximately 8 km to the north of Lairg and 4 km to the east of Loch Shin and covers an area of approximately 79 hectares. The site lies within a gently sloping landscape, sloping down towards the south-west and ranging in elevation from approximately 155 m AOD in the north-east site area to approximately 130 m AOD in the south-west. The landform across the site comprises a relatively uniform slope, steepening only along the banks of Feith Osdail which flows from the central part of the eastern site boundary, to its south-west corner.

Land Use, Historical Developments and Man-Made Features

9.6.2 The site comprises mainly plantation forestry and scrub birch interspersed with areas of open moorland. Areas of potentially regenerating woodland are observed on the banks of Feith Osdail. The site is currently used primarily by the landholder for deer stalking.

9.6.3 Historical maps from the late 1800s and early- to mid-1900s show the site as comprising undeveloped moorland, with a track running approximately north-south across it. No historical built development has been identified at the site.

Designated Sites

9.6.4 There are no statutorily designated sites relevant to geology, hydrology or hydrogeology within the site or study area.

9.6.5 The nearest internationally designated site is the Caithness and Sutherland Peatlands SAC, a very large designation with component areas within approximately 5.9 km of the Proposed Development site at their nearest. This SAC is designated for bog, mire and heathland habitats, freshwater habitats, otter, and marsh saxifrage. Given the distance between the nearest parts of the SAC to the site, there is considered to be very low potential for the Proposed Development to affect the qualifying features of this designation.

9.6.6 The nearest nationally important designated site is the Lairg and Strath Brora Lochs SSSI approximately 1.7 km to the south-east. This SSSI is designated for breeding black-throated diver and is therefore not directly relevant to the assessment of effects on hydrological, hydrogeological and geological receptors. Given the SSSI's distance from the Proposed Development site, there is limited potential for the Proposed Development to have any indirect effects, for example as a result of impacts on groundwater or surface water resources which may be important to black throated diver habitat.

9.6.7 The nearest Geological Conservation Review (GCR) site lies approximately 4.5 km to the west of the Proposed Development and is designated due to well preserved outcropping Moine Schist. Given the distance from the site, there is no potential for this feature of geological interest to be affected by the Proposed Development.

Surface Water

9.6.8 Feith Osdail is the only watercourse within the site, flowing westward from the centre of the eastern site boundary, downslope to the south-west corner of the site. The watercourse ranges between 5 m and 8 m in width and is turbulent and meandering in nature. The banks of Feith Osdail are characterised by vegetated gravel bars, composed of coarse alluvial cobbles as well as mixed sand and steep vegetated outer banks.

Photograph 1: Feith Osdail towards east end of site

9.6.9 Feith Osdail is classified by SEPA (2018) as having an overall status of Poor. Overall ecology is classified as Poor, although fish ecology is Moderate, and hydromorphology is Good.

9.6.10 Feith Osdail flows directly into the River Tirry, approximately 140 m west of the site. The River Tirry has an overall status (2018) of Poor, also with Poor overall ecology but Moderate fish ecology.

9.6.11 The Proposed Development lies within the River Shin Catchment. All areas of the site are anticipated to drain directly to Feith Osdail, which joins the River Tirry just off-site as noted above, itself flowing southward into Loch Shin, some 4 km south of the site.

9.6.12 There will be one watercourse crossing over Feith Osdail, towards the east end of the site at Grid Reference 258028, 914408.

Photograph 2: Approximate crossing location of Feith Osdail, looking downstream

9.6.13 Additional minor field drains and possible spring features were identified on the site during site reconnaissance and survey work. These all ultimately drain to Feith Osdail.

Photograph 3: Example of a minor, possibly ephemeral drainage feature in the north of the site

9.6.14 The proposed site temporary and permanent access roads will need to cross these minor drains at several locations, as identified on Figure 9.1. A water crossing schedule, providing further information and indicative crossing designs, is provided as Appendix 9.3.

9.6.15 Overall, the sensitivity of the baseline surface water resources at this site are considered to be **low**.

Flood Risk

9.6.16 The online SEPA Indicative River & Coastal Flood Map, illustrating the areas in the vicinity of the site where there is a 0.5 % or greater probability of being flooded in any given year, i.e. the 1:200-year flooding event, has been reviewed.

9.6.17 This map indicates that areas of fluvial flood risk (flooding from rivers) are directly adjacent to Feith Osdail. The fluvial flood risk areas are limited to the immediate vicinities of the river, within abandoned channels and meanders.

9.6.18 The large majority of proposed infrastructure is sited well outside the fluvial flood plain and is considered to not be at risk from fluvial flooding. However, the proposed temporary (construction phase) site access at the south-west corner of the site, and a short stretch (730 m) of proposed temporary access road leading into the site from there, is necessarily in close proximity to Feith Osdail and requires further consideration.

9.6.19 The rationale for, and design iteration process that has resulted in the proposed access arrangements for the site are discussed in detail in Chapter 2 and illustrated in Figures 2.3 to 2.7. In summary, the private Dalnessie track that runs parallel but outwith the site's southern boundary is not available as an access option, as it is within land not in the control of the Applicant. A site access point is therefore proposed further north, entering the site from the A836 towards the northern end of the western site boundary. However, it is not feasible to transport abnormal loads across the bridge on the A836 at the south-west corner of the site.

9.6.20 Therefore, it was considered that an access point would be required on the south side of the bridge (in the small gap between the bridge and the southern site boundary), to allow abnormal loads to be brought into the site. The access point is in close proximity to the top of the east bank of the Feith Osdail watercourse (approximately 7.5 m), but is elevated approximately 4 m to 5 m above the level of the watercourse, and is not considered to be at risk of flooding.

Photograph 4: Existing bridge over Feith Osdail, showing elevated bank at location of proposed access point

9.6.21 With respect to the track orientation leading into the site from this access point, consideration was given to crossing Feith Osdail very close to the site access near the western edge of the site, with the track then leading north-east towards turbine T3. However, peat depth surveys indicated the presence of deep peat in the west/south-west of the site, which would need to be crossed by this route. Furthermore, a second crossing of Feith Osdail further east would be required in order to access the proposed turbine T4 and the switching station/energy storage system compound. Due to anticipated impacts on deep peat and the requirement for additional infrastructure (water crossing and track), this option was considered to be unsuitable.

9.6.22 It was then considered that the access route could run east along the south side of the river, providing access to the proposed substation/energy storage compound and turbine T4 beyond. This would involve a single crossing of Feith Osdail towards the east, providing access to the northern site area while avoiding deep peat. The western-most stretch of this route would be within the 50 m watercourse buffer around Feith Osdail, with one section particularly close to a meander in the

watercourse (approximately 13 m from the river's edge but within approximately 2.3 m of the southern 'floodplain' bank of the watercourse, at its closest point). The track is considered to be within the flood plain at this location, and likely to be impacted by flooding on a fairly regular basis. Due to the limited distance between this southern meander of the river, and the site's southern boundary, it was not possible to re-route the track further south and out of the interpreted flood plain.

Photograph 5: Area south of Feith Osdail meander where access is to be routed

9.6.23 It is therefore proposed that the access point and access road at the south of the site are temporary, and used only for the construction phase. Depending on conditions and access agreements at the time of decommissioning, this temporary track may need to be reinstated for a further short-term period during decommissioning. A second, permanent access point further north would provide operational access. This would allow the southern access to be used for the critical but short-term purpose of delivering abnormal loads and allowing access for incoming construction traffic to avoid the heaviest loads crossing the listed bridge over Feith Osdail, without introducing a permanent access road that would be susceptible to regular flooding.

9.6.24 Based on this design option, there is not considered to be a requirement for detailed flood modelling, given that the proposed temporary access road would not be particularly sensitive to flooding. During design rainfall events, the flood response of the Feith Osdail catchment would be 'short and sharp' and thus any flooding of the temporary track would likely be limited to hours and not days. Provided good construction practices are adhered to, including regular review of weather and flood risk forecasts, and employment of a bespoke flood warning system for the site, there would be little risk associated with this short-term activity.

9.6.25 Due to the lack of proposed permanent infrastructure within any flood risk areas, the sensitivity of the site to flooding is considered to be **low**.

Geology

Geological and Soils Mapping

9.6.26 Based on BGS digital mapping, the bedrock geology underlying the site comprises mainly Morar Group Psammite (Altnaharra Psammite Formation), which is a low grade metamorphic rock. Bedrock geology is shown on Figure 9.2.

9.6.27 BGS digital mapping indicates that the superficial deposits overlying bedrock across the site predominantly comprise peat. Further detail on the distribution of peat deposits at the site has been obtained by site survey, described in the section below.

9.6.28 Geological mapping identifies till and morainic deposits, with no peat cover, in the south of the site and across a central swathe from the north-west corner to the Feith Osdail watercourse. These deposits are anticipated to comprise poorly sorted sand, gravel, cobbles, boulders, silt and clay. Alluvial clays, silts, sands and gravels are indicated to be present on the banks of Feith Osdail.

9.6.29 Superficial geology is shown on Figure 9.3.

Peat

9.6.30 Most of the site area is shown on the SNH Carbon and Peatlands Map (2016) as being within an area of Class 1 Peat, defined as "*nationally important carbon-rich soils, deep peat and priority peatland habitat; areas likely to be of high conservation value*." The very southern area of the site is shown as Class 2 Peat, defined as "areas *dominated by peat soil and peatland habitats*". Areas of Class 1 and Class 2 peat are shown on Figure 9.3.

9.6.31 Peat surveys were undertaken as described in Section 9.5, to identify the extent, depth and nature of peat across the site. Peat depths across much of the site area were recorded as being less than 0.5 m, however localised pockets of deeper peat were identified, with depths over 2 m recorded.

9.6.32 The Guidance on Developments on Peatland - Site Surveys (Scottish Government, SNH and SEPA 2017) uses the definition of peat, deep peat and organo-mineral (peaty) soils which is presented in the Joint Nature Conservation Committee (JNCC) report 445 *Towards an Assessment of the State of UK Peatlands* (2011). This definition, which has been used within this chapter, is summarised below:

- **Peaty (or organo-mineral) soil:** a soil with a surface organic layer less than 0.5 m deep;
- **Peat:** a soil with a surface organic layer greater than 0.5 m deep which has an organic matter content of more than 60 %;
- **Deep peat:** a peat soil with a surface organic layer greater than 1.0 m deep.

9.6.33 Of the 605 probes undertaken during the peat depth surveys, the peat depth was zero at 58 probes (9.6%) and less than 0.5 m at 363 further probes (60.0%), the latter defined as peaty or organo-mineral soil. At 130 probes (21.5%), peat depth between 0.5 m and 1.0 m was recorded, and at the remainder of the probes (54, or 8.9%), the peat depth was recorded to be equal to or greater than 1.0 m, defined as deep peat. The occurrence of deep peat is mainly located to the north-east and the west/south-west of the site. These areas exhibit peat depths of generally 1.0 m to 2.0 m depth, but with ten probe points recording peat equal to or over 2.0 m deep. A map of all probing locations and associated peat depths s presented in Figure 9.4.

9.6.34 Laboratory testing results from samples of peat taken during peat depth surveys identified moisture contents generally within or slightly below the typical values for peat of 85% to 95%. Carbon contents were recorded as being well below the typical value of 55% for peat in all samples, ranging from 15.9% to 34.8% Total Organic Carbon (18.0% to 44.8% Total Carbon). This suggests that the material may be considered peaty or organo-mineral soils, rather than peat. Refer to Appendix 9.1 for further detail.

9.6.35 This corresponds with ecology survey findings, which recorded evidence of peatland habitats on the site having been affected over time by drainage and forestry, with blanket bog habitats transitioning to marshy grassland since earlier surveys in 2014 and 2017, likely due to lowering of the water table (refer to Chapter 8).

9.6.36 Full details of the peat depth survey, risk assessment and peat management proposals are provided in Appendix 9.1 and Appendix 9.2.

9.6.37 Overall, the sensitivity of the baseline geological resources at this site are considered to be **medium**, based on the presence of peat and organic soils at the site, but noting that surveys identified peat to be much thinner in most areas than would be suggested by the Class 1 Peat definition (and in fact absent in some parts of the site), and having been degraded by drainage and forestry activities at the site.

Hydrogeology

9.6.38 The groundwater body beneath the site is the Northern Highlands (ID 150701), classified by SEPA (2018) as having an overall status of Good, with quantitative and chemical status both also noted as Good.

9.6.39 The Hydrogeology Map of Scotland identifies the bedrock beneath the site as being a low productivity aquifer, with virtually all flow being through fractures or other discontinuities. Small amounts of groundwater may be present in the near-surface weathered zone and secondary fractures.

9.6.40 Peat and peaty soils would be expected to contain perched groundwater, but would also be expected to inhibit groundwater flow. Till and alluvial deposits, where present, are anticipated to be of variable permeability, depending on the proportion of clays and silts relative to coarser components (sand, gravel, cobbles and boulders).

Private Water Supplies

9.6.41 There are no Private Water Supplies (PWS) identified within a 1 km radius of the site boundary, based on a review of the Drinking Water Quality Regulator (DWQR) for Scotland database (DWQR, 2019). The DWQR data has been supplemented by a review of information provided by THC on known private water supplies across the Highland region, and a review of OS mapping to identify any wells or springs marked at or near properties in the close vicinity of the site. None have been identified.

Groundwater Dependent Terrestrial Ecosystems (GWDTEs)

9.6.42 Habitats indicative of GWDTE were identified during NVC survey work (see Figure 9.5 for a summary of potential GWDTE within the site area and see Chapter 8 and Figure 8.3 for further detail).

9.6.43 Within the site, habitats indicative of potentially high or moderate groundwater dependency were identified at several locations, shown on Figure 9.5 and discussed in turn below.

- Rush pasture and mire habitats in the north-west corner of the site.
- Mire and wet heath habitats along forestry rides and the north and west site perimeters.
- Heath habitats near the central part of the western site boundary, and in the south-west.
- Rush pasture and mire habitats in the central part of the site, south-west of T3.
- Largely mire and heath habitats with some fen and rush pasture, along the watercourse in the south of the site.
- Rush pasture habitat along the southern site boundary and in the south-east.

9.6.44 As noted in paragraphs 9.6.28 and 9.6.29, the bedrock underlying the site is low permeability, with very little groundwater anticipated to be present at shallow depths, except potentially within localised fractures. Perched groundwater is expected to be present within the superficial geological deposits, however this is interpreted as being localised and discontinuous.

9.6.45 The pattern of occurrence of the above-noted habitats, which are indicative of potential groundwater dependence, is focused around forestry breaks, roads/tracks, and surface water features. These are areas of preferential surface water flow, where run-off from the surrounding areas will naturally be directed. Based on the low permeability of the underlying geology, and this distribution of habitats, it is considered likely that most of the observed habitats are in fact fed by surface water/rainwater/localised perched groundwater within superficial soils, rather than being supported by any more extensive groundwater body.

9.6.46 However, site observations in the southern part of the site did identify potential spring features, suggesting potential for localised emergence of groundwater via fractures. The potential for habitats

in localised areas south of Feith Osdail to be fed by groundwater via localised fracture flow cannot be ruled out.

9.6.47 On this basis, it is considered that true GWDTE are not present across most of the Proposed Development site, but may be present in the south-central part of the site, south of Feith Osdail.

Summary of Hydrogeological Sensitivity

9.6.48 Given the low productivity bedrock aquifer beneath the site, the potentially variable but generally low permeability of overlying superficial deposits, the absence of private water supplies in the study area, and the potential presence of localised GWDTE, the sensitivity of groundwater as a receptor is assessed as **medium**.

9.7 Standard Mitigation

9.7.1 The following paragraphs set out the standard mitigation measures that are embedded in the Proposed Development design and proposed construction methods. It is considered that these measures can be secured by appropriately worded planning conditions.

Project Design

9.7.2 A summary of the hydrological influences on the Proposed Development layout are given below with full details of the Proposed Development design provided in Chapter 2. Due to the nature of the environment occupied by the Proposed Development, it is imperative that the design of the infrastructure helps to maintain or even improve the local hydrology. Poor design of wind farm infrastructure can result in significant implications for the hydrological environment.

Use of Existing Infrastructure

9.7.3 Although it has not been possible to make use of the private Dalnessie access track to the south of the Proposed Development site (outside the site boundary and not in the control of the Applicant), the access track design makes use of existing forestry rides wherever possible, in order to minimise the requirement for felling and to make use of routes which have already been subject to heavy plant usage and associated disturbance.

Minimising New Watercourse Crossings

9.7.4 As described in paragraph 9.6.21, the Proposed Development has been designed such that only one crossing of Feith Osdail is required, rather than an alternative design which included two crossings.

Watercourses and Temporary Track Design

9.7.5 A 50 m buffer was implemented for all watercourses located on-site as far as has been possible, taking account of other constraints. This is illustrated on Figure 9.6. With the exception of the south western part of the temporary southern access track into the site, and the single crossing of Feith Osdail, all infrastructure has been designed to be located outwith the watercourses buffer.

9.7.6 As described in paragraphs 9.6.18 to 9.6.24, the design of the site access (temporary for abnormal load delivery and construction traffic, and permanent for operational traffic) has been carefully considered to minimise potential impacts on deep peat, to exclude the requirement for two crossings of the Feith Osdail watercourse and additional associated track, and to respond to the potential for flooding to affect the southern access by designing it as a temporary access for the construction phase only, potentially needing temporarily reinstated for decommissioning.

9.7.7 Given the close proximity of a short stretch of temporary access track to the Feith Osdail watercourse, and its susceptibility to flooding, there is potential for flood washout to impact on the quality and geomorphology of the watercourse, even taking account of the temporary nature of the track. Detailed flood modelling will therefore be undertaken to inform the detailed design of the track at the post planning stage, potentially involving raising the level of the track to be above an agreed flood level, with provision of suitable drainage under the track, and erosion protection on

the banks. The potential for short-term, temporary and localised loss of floodplain storage that may result from this solution would be carefully considered in the detailed design process. It is noted however that the impact of this will be indiscernible given the receiving catchment (River Shin) is ultimately attenuated and outflow controlled by Loch Shin Dam immediately downstream of Lairg and the relative floodplain volume loss at the track location compared to the River Shin Catchment.

9.7.8 Other suitable design solutions for the temporary track which may be considered, subject to detailed flood modelling and ongoing liaison with SEPA, include employing a geo-grid solution for track construction, a concrete or tarmac surface to reduce washout potential (likely be less preferable given the temporary nature of the track), or a cut-off ditch along the riverside, to direct flood washout to a local settlement pond.

9.7.9 The final detailed design of the temporary track, including level, surfacing, drainage and other protective measures to ensure the watercourse is suitably protected from pollution associated with flood washout and construction phase activities, will be agreed with SEPA and THC prior to commencement of construction.

Water Crossings

9.7.10 There will be one watercourse crossing over Feith Osdail located towards the east end of the site at British National Grid (BNG) 258028, 914408. This will provide access to the northern part of the site without requiring new track to traverse an identified area of deep peat. The crossing is likely to be a single span structure due to the crossing width and likely design flood envelope at the crossing location (refer to Figure 3.5c). The crossing will be designed to accommodate the 1:200 years flood event.

9.7.11 Additional crossings of drains and drainage ditches (several likely to be ephemeral) are proposed, and these will be appropriately sized to mimic greenfield flow conditions. In some cases where minor/potentially ephemeral land drainage features are present at proposed hardstanding locations, it may be preferable to divert drainage around the hardstandings rather than providing crossings in the form of piped culverts. The locations of all proposed water crossings are shown on Figure 9.6 and further detail is provided in Appendix 9.3.

9.7.12 The detailed design of all water crossings will be confirmed following ground investigations and addressed through an appropriately worded condition in order to ensure that the works comply with the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (also known as the Controlled Activities Regulations (CAR)). Where necessary CAR licence for work affecting watercourses will be applied for post-consent, prior to construction commencing once final design has been reached.

Peat

9.7.13 The findings from the desk study work, site reconnaissance, and peat depth surveys were carefully considered in the design iteration process. As a result, none of the proposed turbines or other infrastructure are sited on deep peat (>1 m). Most of the proposed infrastructure elements are sited on areas where peat depth has been recorded at less than 0.5 m, therefore defined as peaty soil rather than peat.

Borrow Pit

9.7.14 Three temporary on-site borrow pit search areas have been identified, based on interpreted suitability of geology for winning stone, proximity to proposed track infrastructure, and incorporating a suitable buffer distance from surface watercourses. Winning stone from an on-site borrow pit will minimise the volume of imported material brought onto the site and any associated environmental impact.

9.7.15 Detailed site investigations will be carried out prior to construction to confirm the rock type, rock characteristics and suitability, as well potential volumes to be extracted from the search area. The

final borrow pit identified during the geotechnical evaluation, and pollution control measures to be implemented during usage and reinstatement of the borrow pit, will be set out within the CEMP.

Construction

Construction Environmental Management Plan

9.7.16 With specific reference to the SEPA 'Guidelines for Water Pollution Prevention from Civil Engineering Contracts' and 'Special Requirements', the contractor will produce a CEMP which contains a construction method statement that includes:

- a detailed breakdown of the phasing of construction activities;
- a pollution risk assessment of the site and the proposed activities;
- identification of all Controlled Waters that may be affected by the works and temporary discharge points to these drainage ditches and the marine environment;
- planning and design of appropriate pollution control measures during earthworks and construction;
- management of the pollution control system, including dewatering of excavations away from drainage ditches and the marine environment;
- contingency planning and emergency procedures; and
- on-going monitoring of construction procedures to ensure management of risk is maintained.

9.7.17 An outline CEMP is provided as Appendix 3.2 to this EIA Report, and this will be expanded upon and finalised when the Principal Contractor is appointed, and agreed with SEPA and THC prior to commencement of construction.

9.7.18 While it is acknowledged that best practice to minimise run-off would be to undertake construction and dismantling during the driest period of the year, given the location of the Proposed Development in northern Scotland, there are likely to be significant periods of rainfall throughout the year. Therefore, site management will check the local weather forecast daily and prime all site staff to ensure that everyone is aware of their responsibilities to maintain the pollution control system during wet weather.

Pre-Construction Site Investigations

9.7.19 Detailed pre-construction site investigations would be conducted, focusing on areas where construction is proposed to be undertaken to inform suitable micro-siting of the turbines and associated infrastructure. Findings from these detailed investigations will also inform detailed water crossing designs.

9.7.20 Targeted monitoring and assessment of the groundwater levels and flows beneath the site would also be carried out to inform micro-siting and to assist in the detailed design of infrastructure, the selection of appropriate materials for use during the construction process, and the requirement for any additional measures required to ensure protection of groundwater during construction. This will help to clarify whether identified areas of potential GWDTE in the south of the site are in fact groundwater fed and if any micro-siting or additional protective measures are required to minimise impacts to groundwater quality and flow in these areas.

9.7.21 Pre-construction baseline water quality sampling and analysis would be undertaken at Feith Osdail, upstream and downstream of the development site. A programme of regular monitoring and analysis of the Feith Osdail water quality would be implemented throughout the construction period.

Control of Pollution from Chemical Contaminated Run-off

9.7.22 All fuel and other chemicals will be stored in accordance with best practice procedures, including in a designated fuelling site within the construction compound, located at a safe distance from watercourses and in appropriate impermeable bunded containers/areas which will be defined within the CEMP. These will be designed to capture any leakage, whether from a tank or from associated equipment such as filling and off-take points, sighting gauges etc., all of which will be located within the bund.

9.7.23 Oil booms and soakage pads will be maintained in all work areas and spill kits kept in all vehicles to enable a rapid and effective response to any accidental spillage or discharge. All construction staff will be trained in the effective use of this equipment.

9.7.24 Construction vehicles and plant will be regularly maintained and all maintenance, fuelling and vehicle washing will be undertaken on appropriate impermeable surfaces away from watercourses in order to minimise risks of leaks to soil and surface waters.

9.7.25 The contractor will develop a method statement to address the transport, transfer, handling and pouring of liquid concrete at foundations.

9.7.26 Cement, grout and unset concrete will not be allowed to enter the water environment. No operations involving concrete transfer between vehicles or into vehicles will take place within 50 m of the Feith Osdail watercourse.

9.7.27 All vehicles used for delivery of concrete will only be washed out at locations to be agreed with SEPA. Excess concrete or wash-out liquid will not be discharged to watercourses on-site or at compounds. Drainage from washout facilities will be collected and treated or removed to an appropriate treatment point/licensed disposal site.

9.7.28 The requirement for dewatering will be minimised in all locations by timely and efficient excavation of the foundation void and subsequent concrete pouring and backfilling.

Forestry Felling

9.7.29 The design of the Proposed Development has aimed to minimise the felling required, and has used existing forest rides as access routes for construction and operation, wherever possible. Felling works will be undertaken in accordance with good practice set out in the Forestry Commission's UK Forestry Standard (Forestry Commission, 2017). This includes protection and enhancement of the water environment during felling and construction, and implementation of tree harvesting and extraction methods to ensure minimisation of soil disturbance and compaction during felling and construction. Watercourses/drains will be kept clear of brash as far as practicable, with any accidental blockages removed. Further information on forestry management is provided in Chapter 16.

Operation

Surface Water Drainage Strategy

9.7.30 An outline Drainage Strategy (DS) is presented as Appendix 3.1 to this EIA Report, setting out measures to manage site drainage based on a Sustainable Drainage Systems (SuDS) design. This aims to replicate natural drainage patters, attenuating and treating run-off in order to reduce peak flow and the potential for sedimentation and pollution of watercourses. The outline DS broadly sets out the site drainage design, including methods proposed to slow surface water flows and treat run-off using swales, cross drains, silt traps and settlement lagoons. Prior to construction, a detailed DS would be developed and agreed with SEPA and THC, providing confirmed design of all such measures. The DS would also detail the dimensions and final design of the watercourse crossings as noted above.

9.8 Receptors Brought Forwards for Assessment

9.8.1 The following receptors have been scoped out of further assessment:

- designated sites;
- bedrock geology; and
- flood risk.

9.8.2 Therefore, the following receptors have been taken forward for assessment

- surface water (given potential for significant effects resulting from high magnitude impacts, even taking account of the low sensitivity);
- groundwater resource, including consideration of GWDTEs; and
- superficial geology, namely peat.

9.9 Potential Effects

Construction

9.9.1 The construction phase includes all activities prior to the operation of the Proposed Development, i.e. up to the point at which the turbines begin generating electricity. The following outlines the likely effects identified, with respect to geology, peat, hydrology and hydrogeology.

Pollution Impact from Sediment-laden and/or Chemical Contaminated Run-off

9.9.2 Surface run-off containing silt and sediment, particularly during and after rainfall events, has the potential to enter the watercourses located on-site. Sediment-laden surface water run-off is predicted to arise from excavations, exposed ground and any temporary stockpiles, and potential flood washout from the temporary track south of Feith Osdail. This has the potential to temporarily impact on the water quality and hydrological and ecological function of the receiving watercourses.

9.9.3 Additionally, pollutants such as oils, fuel and cement may be mobilised through mechanical leaks or spillage and carried in surface drainage. Unless managed appropriately, the pollutants could be washed into watercourses, impacting on freshwater quality and ecological value.

9.9.4 With the exception of minor land drainage features, there is only one on-site watercourse, Feith Osdail. No permanent infrastructure has been sited within 50 m of this watercourse, with the exception of one water crossing, the design of which will be determined at the detailed design stage in accordance with SEPA Good Practice Guidance (2010) as described in paragraph 9.8.4 and in Appendix 9.3.

9.9.5 A temporary site access and 730 m stretch of access road is proposed to be constructed immediately south of Feith Osdail, within the 50 m watercourse buffer. As set out in paragraphs 9.6.18 to 9.6.24, this design solution was considered to be preferable to other options such as a permanent track creating a second crossing of Feith Osdail and traversing an area of deep peat, or construction of a permanent track where the temporary track is proposed. However, given the close proximity of a short stretch of proposed temporary access road to the watercourse, the potential for impact via sediment-laden run-off generated by associated construction activities is considered to be higher than would be the case if a 50 m buffer could be achieved. Detailed design measures to minimise this potential will be undertaken and agreed with SEPA and THC as part of the standard mitigation described in paragraphs 9.7.5 to 9.7.9.

9.9.6 The sensitivity of the surface water receptors is low and the magnitude of impact is medium with the implementation of the standard mitigation described above, resulting in an adverse, direct, temporary, short-term effect of **minor** significance (not significant).

Impact on Groundwater Quality and Flow Regime

9.9.7 The introduction of turbine foundations has the potential to divert groundwater flows within superficial geology, and to impact groundwater quality as a result of alkaline leachate from concrete foundations. The potential requirement for dewatering of excavations during construction could locally reduce groundwater quality.

9.9.8 There is anticipated to be perched groundwater within superficial deposits at the site, with near-surface deposits likely to allow at least some transmission of groundwater, therefore dewatering of excavations would likely result in localised drawdown of the water table and resultant dewatering of peat/organic soils in the vicinity. The potential for groundwater within the bedrock to be near the surface in localised areas also cannot be ruled out, particularly in the south of the site where possible spring features and habitats indicative of potential groundwater dependence were observed. However, it is noted that the bedrock beneath the site is low permeability and groundwater is likely to be limited to fissure flow.

9.9.9 The till and peaty soils at the site are interpreted as having relatively low permeability, limiting the transmission of groundwater. Water table drawdown is therefore likely to be localised to the area of excavations, recovering following completion of construction. Similarly, the spatial impact of any alkaline leachate is likely to be limited to the localised area around turbine bases. The potential magnitude of impact is therefore assessed as low.

9.9.10 The sensitivity of groundwater resource at the site is moderate. Therefore, with the implementation of the standard mitigation described in Section 9.7, the potential for construction-phase changes to the groundwater flow regime and quality could result in a direct adverse, temporary, short-term effect of **minor** significance (not significant).

Removal of and Impact on Peat

9.9.11 The proposed turbine and infrastructure layout has been specifically designed to minimise the need for extensive peat excavation, resulting in all infrastructure being sited outside areas of deep peat. There remains a requirement for some excavation of peat or peaty soil, although this is limited and there is ample opportunity for reuse of excavated peat on-site for restoration and landscaping. Further detail on the estimated volume of peat to be excavated, and the management of excavated peat, is given in Appendix 9.2.

9.9.12 Taking account of the standard mitigation set out in Section 9.7, the excavation of peat deposits to allow construction of the Proposed Development is assessed as an impact of low magnitude, on a moderate sensitivity receptor, resulting in a direct, permanent effect of **minor** significance (not significant).

Peat Slide Impact on Watercourses

9.9.13 Construction on peat soils can result in destabilisation of peat deposits on slopes and lead to slope failure, with subsequent potential for peat and soils to reach watercourses downslope and cause pollution/sedimentation and changes to fluvial geomorphology. A detailed assessment of peat landslide risk has been undertaken as presented in Appendix 9.1. This has identified negligible or low peat landslide risk at all proposed turbine, hardstanding and other infrastructure locations.

9.9.14 As noted in Section 9.8, detailed site investigations would be undertaken prior to commencement of construction, to further inform the assessment of and, if necessary, protection against peat slide risks. Any site-specific geotechnical mitigation measures, or micro-siting to reduce risks, would be stipulated based on the findings of these further investigations.

9.9.15 Taking account of this standard mitigation, the overall potential magnitude of impact from peat landslide resulting from construction activities at the site is assessed as negligible, on a low sensitivity receptor, resulting in a direct, temporary, short-term effect of **negligible** significance (not significant).

Impact from Soil Compaction

9.9.16 Soil compaction can occur as a result of construction of permanent roads and by movement of construction vehicles and plant. Soil compaction can cause a reduction in water permeating to the ground, resulting in an increase in potentially contaminated surface run-off. Reduced permeability in soils also reduces the site's flood storage capacity which may result in localised flooding incidents.

9.9.17 Taking account of standard mitigation set out in Section 9.7, the magnitude of change prior to any additional, specific mitigation is negligible to low. The sensitivity of the surface water receptors is low, therefore there is potential for an adverse, indirect, temporary, short-term effect of **negligible to minor** significance (not significant).

Pollution Impact from Forestry Felling

9.9.18 Removal of mature trees may lead to direct impacts on the water environment through forestry material and brash entering local watercourses, and loss of structure of the underlying soils, with increased risk of erosion.

9.9.19 Taking account of the standard mitigation set out in Section 9.7, the magnitude of impact is low, on a low sensitivity receptor. Therefore, there is potential for an adverse, direct, temporary, medium-term effect of **minor** significance (not significant).

Impact on the Integrity of Banking

9.9.20 Construction activities on or close to the sides of watercourses can detrimentally affect the structural integrity of burn banks, either through direct damage to bankside material or indirect loosening of soil structure thus impacting on the localised morphology and water quality of the watercourse through erosion or even collapse of the banking.

9.9.21 A permanent new watercourse crossing will be required at one location over Feith Osdail, with other crossings comprising culverting of minor land drainage features. The Feith Osdail crossing will is likely to be a single span structure due to the crossing width and likely design flood envelope at the crossing location (refer to Figure 3.5c). The crossing will be designed to minimise floodplain restriction and ensure no adverse impacts on river morphology and geomorphology.

9.9.22 Detailed design of the temporary access track south of Feith Osdail, to minimise the potential impact on the integrity of banking at this location, will be undertaken and agreed with SEPA and THC as part of the standard mitigation described in paragraphs 9.7.5 to 9.7.9.

9.9.23 Taking account of the proposed water crossing design in line with relevant guidance, and the standard mitigation set out in Section 9.7, there is potential for a low to medium magnitude impact on a low sensitivity receptor, therefore, there is potential for an adverse, direct, permanent effect of **minor** significance (not significant).

Operation

Surface Water Drainage

9.9.24 The permanent access roads and crane hardstandings for the wind turbines could result in additional surface water flows, potentially resulting in soil erosion and sediment-laden run-off, which could pollute downstream watercourses.

9.9.25 Taking account of the standard mitigation described in Section 9.8 (in particular the detailed DS to be developed and agreed with SEPA and THC to ensure appropriate control of run-off from hard surfaces), there is potential for a negligible magnitude impact, on low sensitivity surface water receptors. Therefore, there is potential for an adverse, indirect, long-term effect of **negligible** significance (not significant).

Fluvial Geomorphology

9.9.26 If watercourse crossings do not ensure continuous flows, this can adversely affect the geomorphology of streams by reducing heterogeneity.

9.9.27 Taking account of the standard mitigation set out in Section 9.7, in particular the suitable design of watercourse crossings in line with relevant guidance, and detailed designs to be agreed with SEPA and THC and regulated under CAR, the magnitude of change is negligible, on a low sensitivity receptor. Therefore, there is potential for an adverse, direct, permanent effect of **negligible** significance (not significant).

Long-Term Changes to Groundwater Flow Regime

9.9.28 The presence of turbine foundations, access roads and other infrastructure has the potential to interrupt groundwater flow; for example impermeable concrete foundations can act as barriers to flow. This could result in drying of peat deposits/organic soils. However, given the nature of the superficial geology at the site, groundwater is anticipated to be limited to perched water in near-surface deposits, with flow likely to be limited and slow. Groundwater flow within bedrock is indicated to be minimal, and restricted to fissures and other discontinuities. This flow is very unlikely to be impacted by foundations, which would be within superficial deposits.

9.9.29 Taking account of standard mitigation measures set out in Section 9.7, the magnitude of impact is assessed as low, on a moderate sensitivity receptor. There is therefore potential for an adverse, indirect, long-term effect of **minor** significance (not significant).

Decommissioning

9.9.30 Potential effects of decommissioning the Proposed Development are similar to those encountered in the construction phase, however, generally with less magnitude as the level of site activity is lower.

9.9.31 Discussions will be held with THC and the appropriate Regulatory Authorities prior to decommissioning to agree an appropriate Decommissioning Strategy.

9.10 Mitigation and Enhancement

9.10.1 No significant environmental effects have been identified following the implementation of the standard mitigation outlined in Section 9.7. Therefore, no further mitigation is required. However, the following additional mitigation and enhancement measures are proposed by the Applicant to further minimise potential effects and provide environmental benefit where possible.

- Excavated peat would be re-used on-site as far as reasonably practicable and to provide suitable restoration and landscaping (refer to Appendix 9.2). Habitat enhancement measures will also be undertaken, to raise the water table in an identified area of the site post-felling, encouraging regeneration of modified peatland (refer to Appendix 8.)7). A monitoring programme will be agreed to review the effectiveness of the Habitat Management Plan (HMP) and agree any further work or modification. The HMP will be agreed with NS, SEPA and THC prior to construction, and will be implemented during the operation of the Proposed Development.
- Through the on-site and off-site re-use and restoration, all excavated peat will be used without the requirement for any disposal of excavated peat. This therefore mitigates the effect of the minimal peat excavation required to construct the development (although recognising the that habitat restoration will take time and will require monitoring as noted above).
- The above-noted habitat restoration works will also likely result in beneficial, though not material, hydrological effects on watercourses local to the agreed HMP area.

- The requirement for dewatering of excavations during construction would be minimised in all locations by timely and efficient excavation of the foundation void and subsequent concrete pouring and backfilling.
- Where topography dictates that working platforms are needed, these would be formed to ensure that surface water drains away from watercourses/drains.
- To avoid unnecessary compaction and disturbance to site soils, working areas and corridors would be established and demarcated, with construction operatives appropriately inducted and trained to avoid work outside the designated work areas. Further detail is provided in the Appendix 9.2.

9.11 Residual Effects

Construction

Pollution Impact from Sediment-laden and/or Chemical Contaminated Run-off

9.11.1 The additional mitigation measures would not materially affect the likely effect, and the residual effect significance is assessed as **minor** (not significant).

Impact on Groundwater Quality and Flow Regime

9.11.2 The additional mitigation measures would not materially affect the likely effect, and the residual effect significance is assessed as **minor** (not significant).

Removal of and Impact on Peat

9.11.3 The additional mitigation measures (on-site re-use of peat for landscaping and restoration, and HMP implementation) are considered to reduce the magnitude of impact to no impact, with restoration anticipated to provide a beneficial impact at least as great as any adverse impact. The residual effect is therefore assessed as **no effect**.

Peat Slide Impact on Watercourses

9.11.4 The additional mitigation measures would not materially affect the likely effect, and the residual effect significance is assessed as **negligible** (not significant).

Impact from Soil Compaction

9.11.5 The additional mitigation measures would slightly reduce the impact magnitude to negligible, and the residual effect significance is assessed as **negligible** (not significant).

Pollution Impact from Forestry Felling

9.11.6 The additional mitigation measures would not materially affect the likely effect, and the residual effect significance is assessed as **minor** (not significant).

Impact on the Integrity of Banking

9.11.7 The additional mitigation measures would not materially affect the likely effect, and the residual effect significance is assessed as **minor** (not significant).

Operation

Surface Water Drainage

9.11.8 The additional mitigation measures would not materially affect the likely effect, and the residual effect significance is assessed as **negligible** (not significant).

Fluvial Geomorphology

9.11.9 The additional mitigation measures would not materially affect the likely effect, and the residual effect significance is assessed as **negligible** (not significant).

Long-Term Changes to Groundwater Flow Regime

9.11.10 The additional mitigation measures would not materially affect the likely effect, and the residual effect significance is assessed as **minor** (not significant).

Decommissioning

9.11.11 Residual effects of decommissioning the Proposed Development are similar to those encountered in the construction phase, however, generally with less magnitude as the level of site activity is lower. No significant residual effects have been identified.

9.12 Cumulative Assessment

9.12.1 No operational, proposed or consented developments have been identified within the study area. With no significant effects on geological, hydrological and hydrogeological receptors assessed as arising from the construction, operation or decommissioning of the Proposed Development itself, there is not considered to be any potential for significant cumulative effects to arise in relation to other developments further afield, which may be within the River Shin Catchment.

9.13 Summary

9.13.1 The Proposed Development is an area largely occupied by plantation forestry, with fairly flat topography falling very gently towards the south-west. The Feith Osdail watercourse flows north-east to south-west across the southern site area, joining the River Tirry just off-site. Minor land drainage features are present across the site, all flowing into Feith Osdail. The site is within the River Shin Catchment.

9.13.2 Site geology comprises relatively impermeable psammite bedrock (low productivity aquifer), overlain by till, morainic deposits and peat, with alluvium along the banks of Feith Osdail.

9.13.3 The SNH Carbon and Peatlands Map (2016) identifies Class 1 Peat across much of the site. However, peat depth surveys have identified peat to be much thinner in most areas than would be suggested by the Class 1 Peat definition (absent or less than 0.5 m at nearly 70% of probes) and having been degraded by drainage and forestry activities at the site.

9.13.4 The site design avoids any infrastructure being sited on deep peat, with almost all infrastructure elements sited on areas with peat depth less than 0.5 m and therefore defined as peaty soil rather than peat. A peat slide risk assessment has identified negligible to low risks at all proposed turbine and infrastructure locations across the site.

9.13.5 There are no private water supplies located within 1 km of the site.

9.13.6 Habitats indicative of potential groundwater dependency have been identified locally across the site, although based on the site geology and pattern of habitat occurrence, the habitats are interpreted as mostly being surface water or rainwater fed. Localised areas of potentially groundwater dependent habitats have been identified in the south of the site, however the significance of effects on the groundwater resource are assessed as non-significant given the low productivity aquifer status, minimal groundwater anticipated to be present within bedrock at shallow depth, and absence of private water supplies in the vicinity.

9.13.7 Likely construction and operational effects include sedimentation or pollution of the water environment from surface run-off and forestry felling, compaction of soils, effects on the integrity of watercourse banks and fluvial geomorphology, the removal of peat/peaty soils, peat landslide hazard, and effects on groundwater quality and flow regime.

9.13.8 Standard/embedded mitigation measures include design and layout decisions taken through the design iteration process, including appropriate buffering of watercourses wherever possible, designating a site access and stretch of road within the watercourse buffer as temporary for use in the construction phase only, using forestry rides for access road routes, and avoiding areas of deep peat in siting turbines and other infrastructure. Standard good construction and design practice has also been considered as standard mitigation, including detailed pre-construction site investigations, agreement and implementation of a CEMP, appropriate design of the proposed watercourse crossings regulated under the CAR licensing regime, and development of a detailed Drainage Strategy for the site.

9.13.9 The likely effects on hydrological, geological and hydrogeological receptors, taking account of the standard mitigation measures, have been assessed as negligible to minor (not significant). However, some additional specific mitigation measures have been proposed to further reduce effects. These include appropriate peat management and re-use on-site, additional dewatering and construction-phase surface run-off control, and establishing and demarcating working areas and corridors. Additionally, a Habitat Management Plan would be implemented, to restore degraded peatland in a specified area of the site post-felling.

9.13.10 The significance of residual effects on hydrological, geological and hydrogeological receptors is considered to be negligible to minor (not significant).

9.13.11 No cumulative effects on hydrology, hydrogeology and geology are predicted.

Table 9.6 – Summary of Effects

Description of Effect	Significance of Potential Effect		Mitigation Measure	Significance of Residual Effect	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Construction					
Sedimentation/ chemical contamination of watercourses	Minor	Adverse	Standard mitigation: suitable design, implementation of CEMP.	Minor	Adverse
Effects on groundwater quality and flow	Minor	Adverse	Standard mitigation: suitable design, implementation of CEMP.	Minor	Adverse
Removal of peat	Minor	Adverse	Standard mitigation: suitable design and implementation of CEMP. Additional mitigation: implementation of PMP and peatland restoration via HMP.	No effect	N/A
Peat slide effects on watercourses	Negligible	Adverse	Standard mitigation: suitable design, implementation of CEMP, pre-construction site investigations.	Negligible	Adverse
Soil compaction	Negligible to Minor	Adverse	Standard mitigation: suitable design, implementation of CEMP. Additional mitigation: use of designated working corridors.	Negligible	Adverse

Description of Effect	Significance of Potential Effect		Mitigation Measure	Significance of Residual Effect	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Pollution of watercourses from forestry felling	Minor	Adverse	Standard mitigation: suitable design, implementation of CEMP, good practice felling practices.	Minor	Adverse
Effects on the integrity of banking	Minor	Adverse	Standard mitigation: suitable design, implementation of CEMP.	Minor	Adverse
Operation					
Effects on surface water drainage regime	Negligible	Adverse	Standard mitigation: suitable design, implementation of DS and HMP	Negligible	Adverse
Effects on fluvial geomorphology	Negligible	Adverse	Standard mitigation: suitable design, implementation of DS	Negligible	Adverse
Long-term effects on groundwater quality and flow	Minor	Adverse	Standard mitigation: suitable design, implementation of HMP	Minor	Adverse
Decommissioning					
Decommissioning effects will be similar to those encountered during construction, however generally with lower magnitude of impact as the intensity of site activity will be lower (for example new borrow pits will not be excavated). No significant residual effects have been identified.					

9.14 References

BGS. (2019). The BGS Lexicon of Named Rock Units — Result Details. Available at: *https://www.bgs.ac.uk/lexicon/lexicon.cfm?pub=TILLD*

CIRIA (2001). Control of water pollution from constructions sites. Guidance for consultants and contractors C532. Available at: *https://www.ciria.org/*

CIRIA (2006). Control of water pollution from linear construction projects: technical guidance C648. Available at: *https://www.ciria.org/*

CIRIA (2015). SUDS Manual C753. Available at: *https://www.ciria.org/*

CIRIA (2010). Environmental good practice on site C650. Available at: *https://www.ciria.org/*

CIRIA (2016). Groundwater Control – design and practice C515. Available at: *https://www.ciria.org/*

DEFRA (2011). Code of Practice for the sustainable use of soils on construction sites. Available at: *https://www.gov.uk/government/publications/code-of-practice-for-the-sustainable-use-of-soils-on-construction-sites*

DWQR. (2019). Private Water Supply map. Available at: *https://dwqr.scot/private-supply/pws-location-map/*

EA, SEPA & EHSNI (2011): PPG26: Storage and handling of drums and intermediate bulk containers. Available at: *https://www.gov.uk/government/publications/storing-and-handling-drums-and-intermediate-bulk-containers-ppg26*

EA, SEPA & EHSNI (2012). PPG6: Working at construction and demolition sites. Available at: *https://www.gov.uk/government/publications/construction-and-demolition-sites-ppg6-prevent-pollution*

EA, SEPA & EHSNI (2013). PPG1: General guide to the prevention of pollution. Available at: *https://www.gov.uk/government/publications/basic-good-environmental-practices-ppg1-prevent-pollution*

EA, SEPA & EHSNI (2017). GPP21: Pollution incidence response planning. Available at: *http://www.netregs.org.uk/environmental-topics/pollution-prevention-guidelines-ppgs-and-replacement-series/guidance-for-pollution-prevention-gpps-full-list/*

EA, SEPA & EHSNI (January 2017). GPP5: Works and maintenance in or near water. Available at: *http://www.netregs.org.uk/environmental-topics/pollution-prevention-guidelines-ppgs-and-replacement-series/guidance-for-pollution-prevention-gpps-full-list/*

EA, SEPA & EHSNI (January 2018). GPP2: Above ground oil storage tanks. Available at: *http://www.netregs.org.uk/environmental-topics/pollution-prevention-guidelines-ppgs-and-replacement-series/guidance-for-pollution-prevention-gpps-full-list/*

EC (1979). Groundwater Directive 80/68/EEC. Available at: *https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31980L0068*

EC (2000). Water Framework Directive 2000/60/EC (WFD) 2000. Available at: *http://ec.europa.eu/environment/water/water-framework/index_en.html*

EC (2006). Groundwater Daughter Directive 2006/118/EC. Available at: *https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32006L0118*

Forestry Commission (2011). Guidance on Road Construction and Maintenance Forests and Water Guidelines Fifth Edition. Available at: https://www.confor.org.uk/media/246145/forest-and-water-guidelines.pdf

Joint Nature Conservation Committee. (2011). Towards an Assessment of the State of UK Peatlands. JNCC, Peterborough. Available at: http://data.jncc.gov.uk/data/f944af76-ec1b-4c7f-9f62-e47f68cb1050/JNCC-Report-445-FINAL-WEB.pdf

MAFF (2000). Good practice guide for handling soil. Available at: *https://webarchive.nationalarchives.gov.uk/20090317221756/http://www.defra.gov.uk/farm/environment/land-use/soilguid/index.htm*

NERC. (2012). Geology of Britain. Available at: http://mapapps.bgs.ac.uk/geologyofbritain/home.html

Ordnance survey (2019) OS Open Data Supply: Available at: *https://www.ordnancesurvey.co.uk/opendatadownload/products.html*

Scottish Executive (2006). Private Water Supplies: Technical Manual. Available at: *http://www.privatewatersupplies.gov.uk/private_water/files/Full%20Doc.pdf*

Scottish Executive (2007). Flood Prevention and Land Drainage (Scotland) Act 1997. Available at: *http://www.legislation.gov.uk/ukpga/1997/36/section/3/enacted*

Scottish Executive (1996). Planning Advice Note 50: Controlling the Environmental Effects of Surface Mineral Workings, 1996. Available at: https://www.gov.scot/publications/planning-advice-note-pan-50-controlling-environmental-effects-surface-mineral/pages/0/

Scottish Government (2001). Planning Advice Note 61: Planning and SUDS, 2001. Available at: *https://www.gov.scot/publications/pan-61-sustainable-urban-drainage-systems/*

Scottish Government (2003). Water Environment and Water Services (Scotland) Act (WEWS Act) 2003. Available at: *http://www.legislation.gov.uk/asp/2003/3/contents*

Scottish Government (2006). Planning Advice Note 79: Water and Drainage, 2006. Available at: *https://www.gov.scot/publications/planning-advice-note-pan-79-water-drainage/*

Scottish Government (2009). The Flood Risk Management (Scotland) Act 2009. Available at: *http://www.legislation.gov.uk/asp/2009/6/contents*

Scottish Government (2011). The Waste Management Licensing (Scotland) Regulations 2011. Available at: *http://www.legislation.gov.uk/ssi/2011/228/contents*

Scottish Government (2011). Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended in 2018 (CAR). Available at: *http://www.legislation.gov.uk/ssi/2011/209/contents/made*

Scottish Government (2014). Scottish Planning Policy (SPP) June 2014. Available at: *https://www.gov.scot/publications/scottish-planning-policy/*

Scottish Government (2015). The Environmental Liability (Scotland) Regulations 2015. Available at: http://www.legislation.gov.uk/ssi/2015/214/contents/made

Scottish Government (2017). The Public Water Supplies (Miscellaneous Amendments) (Scotland) Regulations 2017. Available at: *http://www.legislation.gov.uk/ssi/2017/321/contents/made*

Scottish Government (2017). The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017. Available at: *http://www.legislation.gov.uk/ssi/2017/102/contents/made*

Scottish Government (2017). The Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017. Available at: *http://www.legislation.gov.uk/ssi/2017/282/contents/made*

Scottish Government (Second Edition, 2017). Peat Landslide Hazard and Risk Assessments: Good practice Guide for Proposed Electricity Generation Developments. Available at: *https://www.gov.scot/publications/peat-landslide-hazard-risk-assessments-best-practice-guide-proposed-electricity/*

Scottish Government, SNH and SEPA. (2017). Guidance on Developments on Peatland - Site Surveys. Available at: https://www.gov.scot/binaries/content/documents/govscot/publications/advice-and-guidance/2018/12/peatland-survey-guidance/documents/peatland-survey-guidance-2017/peatland-survey-guidance-2017/govscot%3Adocument/Guidance%2Bon%2Bdevelopments%2Bon%2Bpeatland%2B-%2Bpeatland%2Bsurvey%2B-%2B2017.pdf

Scottish Natural Heritage (SNH) (2016). Carbon and Peatland Map. SNH, Scotland.

Scottish Renewables and SEPA. (2014). Developments on Peatland: Guidance on the assessment of peat volumes, reuse of excavated peat and the minimisation of waste. Available at: https://www.gov.scot/Topics/Business-Industry/Energy/Energy-sources/19185/17852-1/CSavings/guidancepeatwaste

Scottish Renewables, SNH, SEPA & Forestry Commission Scotland (4th Edition 2019). Good practice during windfarm construction 3rd Edition. Available at: *https://www.nature.scot/guidance-good-practice-during-wind-farm-construction*

SEPA (2002). Managing River Habitats for Fisheries. Available at: *https://www2.gov.scot/Publications/2002/04/14606/3644*

SEPA (2004). Methodology for the Water Framework Directive, Scotland and Northern Ireland Forum for Environmental Research, Project WFD 28 Final Report. Available at:

https://lwecext.rl.ac.uk/PDF/SNIFFER_WFD28.pdf

SEPA (2006). Special Requirements for Civil Engineering Contracts for the Prevention of Pollution, Version 2. Available at: *https://www.sepa.org.uk/media/152220/wat_sg_31.pdf*

SEPA (2008). Regulatory Position Statement: Waste Water Drainage. (CANT FIND CORRECT ONE)?

SEPA (2009/2015). The River Basin Planning Strategy for the Scotland River Basin District. Available at: *https://www.sepa.org.uk/media/37453/rbmp_planning-strategy_scotland.pdf*

SEPA (2010). River Crossings, Engineering in the water environment: good practice guide. Available at: https://www.sepa.org.uk/regulations/water/engineering/engineering-guidance/

SEPA (2010): Regulatory Position Statement – Developments on peat. Available at: *https://www.sepa.org.uk/media/143822/peat_position_statement.pdf*

SEPA (2011 as amended in 2018). The Water Environment (Controlled Activities) (Scotland) Regulations 2011 as amended in 2018 - A practical guide. Available at: *https://www.sepa.org.uk/media/34761/car_a_practical_guide.pdf*

SEPA (2014). Flood Risk and Planning Briefing Note. Available at: *https://www.sepa.org.uk/media/143403/sepa-briefing-note-to-planning-authorities-on-the-flood-risk-management-scotland-act-2009.pdf*

SEPA (2014). Land Use Planning System Guidance Note 31 (LUPS-GU31)- Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems. Available at: *https://www.sepa.org.uk/media/144266/lups-gu31-guidance-on-assessing-the-impacts-of-development-proposals-on-groundwater-abstractions-and-groundwater-dependent-terrestrial-ecosystems.pdf*

SEPA (Feb 2012). Position Statement: The role of SEPA in natural flood management. Available at: *https://www.sepa.org.uk/media/42133/sepa-04-12-position_statement_the_role_of_sepa_in_natural_flood_management.pdf*

SEPA (January 2014, updated April 2018). Indicative River & Coastal Flood Map (Scotland). Available at: *http://map.sepa.org.uk/floodmap/map.htm*

SEPA (July 2012). Environmental Standards for River Morphology, WAT-SG-21. Available at: *https://www.sepa.org.uk/regulations/water/engineering/engineering-guidance/*

SEPA (July 2019). Technical flood risk guidance for stakeholders, version 12. Available at: *https://www.sepa.org.uk/media/162602/ss-nfr-p-002-technical-flood-risk-guidance-for-stakeholders.pdf*

SEPA (2017). Developments on Peat and Off-Site Uses of Waste Peat. Available at: https://www.sepa.org.uk/media/287064/wst-g-052-developments-on-peat-and-off-site-uses-of-waste-peat.pdf

SEPA (September 2017). Land Use Planning System Guidance Note 4 (LUPS GU4) - Planning guidance on on-shore windfarm developments. Available at: *https://www.sepa.org.uk/media/136117/planning-guidance-on-on-shore-windfarms-developments.pdf*

SEPA (2018). Supporting Guidance (WAT-SG-75) – Sector Specific Guidance: Construction Sites. Available at: https://www.sepa.org.uk/media/340359/wat-sg-75.pdf

SNH (2018). A Handbook of Environmental Impact Assessment, 5th Edition. Available at: *https://www.nature.scot/handbook-environmental-impact-assessment-guidance-competent-authorities-consultees-and-others*

The Highland Council (2012). Highland-Wide Local Development Plan. Available at: https://www.highland.gov.uk/info/178/local_and_statutory_development_plans/199/highland-wide_local_development_plan

The Highland Council (2016 and 2017). Onshore Wind Energy Supplementary Guidance. Available at: https://www.highland.gov.uk/directory_record/712079/onshore_wind_energy

The Highland Council (2013): Flood Risk and Drainage Impact Assessment Supplementary Guidance. Available at: https://www.highland.gov.uk/downloads/file/2954/flood_risk_and_drainage_impact_assessment_supplementary_guidance

The Highland Council (2018): Caithness and Sutherland Local Development Plan. Available at: https://www.highland.gov.uk/info/178/local_and_statutory_development_plans/283/caithness_and_sutherland_local_development_plan

UK Government (1974). Control of Pollution Act 1974. Available at: *https://www.legislation.gov.uk/ukpga/1974/40*

UK Government (1990). Environmental Protection Act 1990. Available at: *https://www.legislation.gov.uk/ukpga/1990/43/contents*

UK Government (1994). Waste Management Licensing Regulations 1994. Available at: *http://www.legislation.gov.uk/uksi/1994/1056/contents/made*

UK Government (1995). Environment Act 1995. Available at: *https://www.legislation.gov.uk/ukpga/1995/25/contents*

UK Government (1998). Groundwater Regulations 1998. Available at: *http://www.legislation.gov.uk/uksi/1998/2746/contents/made*

UK Technical Advisory Group on the WFD (2013). UK Environmental Standards and Conditions Final Report, November 2013.

http://www.wfduk.org/sites/default/files/Media/Environmental%20standards/UKTAG%20Environmental%20Standards%20Phase%203%20Final%20Report%2004112013.pdf