CHAPTER 10: HYDROLOGY AND HYDROGEOLOGY

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10. Hydrology and Hydrogeology

10.1 Executive Summary

10.1.1 The Proposed Development is located within the River Cassley hydrological catchment which forms part of the River Oykel Special Area of Conservation (SAC). Several smaller named and unnamed watercourses flow directly from the Site to the River Cassley.

10.1.2 Following the implementation of appropriate mitigation measures managed through the Construction Environmental Management Plan (CEMP), Pollution Prevention Plan (PPP) and adherence to regulatory guidance, there would be **no significant effects** on the hydrology or hydrogeology of the Site associated with the construction, operation and decommissioning of the Proposed Development.

10.1.3 The Scottish Environment Protection Agency (SEPA) River Basin Management Plan (RBMP) classifies the River Cassley as being in overall 'Good' condition. There are also a number of ephemeral streams or areas of saturated ground within the Site which are not considered to represent formal watercourses.

10.1.4 There are no Private Water Supplies (PWS) within 250m of the Site, however the catchment area of one PWS extends into the Site and this has been used to inform the sensitivity of surface watercourses.

10.1.5 The layout of the Proposed Development has been designed to ensure infrastructure is located outwith the indicative flood extent of 'natural watercourses' and their 50m watercourse buffer. The layout has also been designed to avoid habitats identified as potentially groundwater dependent where possible. A total of 32 locations were surveyed in order to assess the potential for watercourse presence and 25 of the surveyed points were identified to be unnamed ephemeral streams. Seven watercourse crossings over 'natural watercourses' have been identified as required, of which 5 will likely to be in the form of circular culverts and 2 single-span bridges. Following the application of proposed mitigation measures and best practice methods during the construction phase, residual adverse effects associated with sedimentation and erosion on controlled waters of high sensitivity would be **not significant**.

10.1.6 All surface watercourses are considered to be of High Sensitivity due to their hydrological connectivity with the River Oykel SAC and PWS.

10.1.7 The Site is underlain by a low productivity aquifer which is considered to be of low sensitivity**.**

10.1.8 An ecological survey by Alba Ecology identified National Vegetation Classification (NVC) habitats with the potential to be groundwater dependent. A hydrological review of potentially Groundwater Dependent Terrestrial Ecosystems (GWDTE) indicates these habitats are primarily linked to surface water features and areas of ombrotrophic bog and are, therefore, not likely to be groundwater dependent. GWDTEs are therefore considered to be of low sensitivity.

10.2 Introduction

10.2.1 This Chapter considers the likely significant effects on Hydrology and Hydrogeology associated with the construction, operation and decommissioning of the Proposed Development. The specific objectives of the Chapter are to:

- describe the hydrology and hydrogeology baseline;
- describe the assessment methodology and significance criteria used in completing the impact assessment;
- describe the potential effects, including direct, indirect and cumulative effects;
- describe the mitigation measures proposed to address likely significant effects; and
- assess the residual effects following the implementation of mitigation.

10.2.2 The assessment has been carried out and reviewed by Ramboll UK Limited (Ramboll) hydrologists with over ten years' experience of specialist hydrology, hydrogeology and geology EIA.

10.2.3 This Chapter is supported by the following Figures and Technical Appendices:

- Volume 3: Figures
  - Figure 10.1: Surface Water Features;
  - Figure 10.2: Private Water Supplies;
  - Figure 10.3: Hydrogeology;
  - Figure 10.4: High GWDTEs based on NVC survey; and
  - Figure 10.5: GWDTE classification based on hydrological analysis.
- Volume 4: Technical Appendices
  - Technical Appendix 10.1: Groundwater Dependent Terrestrial Ecosystem (GWDTE) Assessment; and
  - Technical Appendix 10.2: Watercourse Crossing Assessment.

10.2.4 Figures and Technical Appendices are referenced in the text where relevant. Reference is made to Technical Appendix 10.1 to support the assessment of impacts on GWDTEs.

10.3 Scope of Assessment

10.3.1 This Chapter considers the likely significant effects on the water environment, taking account of the hydrological and hydrogeological characteristics of the Site.

10.3.2 This Chapter considers effects on:

- Water quality (including both surface water and groundwater bodies) and assessment of the impacts from pollution;
- Flood risk, and the potential for direct and indirect impacts of the Proposed Development on the flood risk status of the Site or downstream areas;
- Water resources, impacts on hydrological flow regimes and the geomorphological characteristic of watercourses as a result of proposed watercourse crossings;
- Any alterations to the zones of contribution and therefore the regimes of water supplying Private Water Supplies (PWS) in the locale of the Proposed Development or within potential hydrological connection to the Site; and
- The potential for the Proposed Development to impact hydrology or hydrogeology with secondary effects on GWDTEs.

10.3.3 This Chapter considers the potential for changes to the hydrological and hydrogeological regimes to impact upon GWDTE. The ecology or biodiversity effects on GWDTE are captured in Chapter 8: Ecology of this EIA Report.

10.3.4 This Chapter considers cumulative effects as arising from the addition of the Proposed Development to other cumulative developments, which are the subject of a valid consent application. Operational, under construction and consented developments are considered as part of the baseline. Developments close to the end of their operational life will be included as part of the baseline to present 'worst case scenario'.

10.3.5 The assessment is based on the Proposed Development as described in Chapter 3: Description of Development of this EIA Report and takes in to account the Outline Construction Environmental Management Plan (CEMP) (Technical Appendix 3.1).

Issue Scoped Out

10.3.6 The following effects have been scoped out of further assessment:

- SEPA Flood Maps indicate the Site intersects sections of the High (1 in 10 years or 10% Annual Exceedance Probability) and Medium (0.5% Annual Exceedance Probability) likelihood fluvial floodplain of the Allt Bad an t-Sagairt and Allt an Ràsail (SEPA, 2021, Flood Maps). The Proposed Development infrastructure (with the exception of sections of access track leading to watercourse crossings, the locations of which are discussed in further detail in Technical Appendix 10.2, and summarised in Section 10.7.16 of this chapter) has deliberately been located outwith the indicative flood extent of these watercourses and their 50m watercourse buffer. Therefore, further detailed assessment of potential vulnerability to flood risk has been scoped-out of this assessment.
- Detailed assessment of potential flow rates at proposed watercourse crossing locations would be carried out by a contractor at the detailed design stage such that all of the watercourse crossings identified for the Proposed Development would be designed in compliance with requirements of The Water Environment (Controlled Activities) (Scotland) Regulations 2011, as amended. The design of watercourse crossings would also take account of the future 'with climate change' baseline and to avoid altering the flow regime, would be sized for a 1:200 year plus climate change flood event. Detailed flow rate calculations are not required to inform the EIA.
- No PWS are located within 250m of the Site and proposed infrastructure and excavations. Infrastructure is proposed near watercourses within the upper catchment area of the Badintagairt PWS (Figure 10.2). This has been used to inform the sensitivity of watercourses in the study area. However, as no construction is proposed within 250m of a PWS there will be no requirement for a separate detailed risk assessment for PWS abstractions (in line with SEPA LUPS guidance 4 and 31[1]) as water quality is considered separately (SEPA, September 2017).

10.3.7 Potential effects during decommissioning are considered to be the same as those during construction, so these are not repeated within the Chapter.

Study Area

10.3.8 Hydrological issues are typically considered at a catchment scale and therefore the study area includes all water resources within the Site (see Figure 10.1: Surface Water Features), as well as watercourses with downstream hydraulic connectivity with the Site.

Consultation Responses

10.3.9 Table 10.1 summarises the consultation responses received regarding hydrology and hydrogeology and provides information on where / or how they have been addressed in this assessment.

10.3.10 Further details on the consultation responses can be reviewed in Technical Appendices 5.2: 2019 Scoping Matrix and 5.4: 2020 Scoping Matrix and Chapter 5: Scoping and Consultation of this EIA Report.

Table 10.1: Consultation Responses

Consultee and Date	Scoping / Other Consultation	Issue Raised	Response / Action Taken
Scottish Government Energy Consents Unit (ECU)	Scoping	Scottish Ministers request that the Company contacts Scottish Water and makes further enquires and includes details in the EIA report of any relevant mitigation measures provided.	Scottish Water was contacted as part of the scoping opinion and noted that there are no Scottish Water drinking water catchments or water abstraction sources, which are designated as Drinking Water Protected Areas (DWPA) under the Water Framework Directive, in the area that may be affected by the proposed activity. This is noted in section 10.6 of this chapter. Water quality mitigation measures are considered in section 10.8 of this chapter.
Scottish Government Energy Consents Unit (ECU)	Scoping	Scottish Ministers request that the Company investigate private water supplies within close proximity to the proposed development, which may be impacted by the development. The EIA report should include details of these supplies identified by this investigation, the Company should provide an assessment of the potential impact, risks, and any mitigation which would be provided.	Highland Council records and the Site survey confirmed there are no PWS within 250 m of the Site (see section 10.3.6 of this chapter). Infrastructure within the upper catchment area of the Badintagairt PWS has been used to inform the sensitivity of watercourses in the study area but a separate detailed risk assessment for PWS is not required as water quality mitigation measures are considered in section 10.8 of this chapter.
The Highland Council	Scoping / Scoping Refresh	The EIA Report needs to address the nature of the hydrology and hydrogeology of the Site, and of the potential impacts on	Baseline characterisation of the hydrology and hydrogeology of the Site are covered in section 10.6 of this chapter. Potential impacts are discussed in section

Consultee and Date	Scoping / Other Consultation	Issue Raised	Response / Action Taken
		watercourses, water supplies including private supplies, water quality, water quantity and on aquatic flora and fauna.	10.7. Details of PWS located within the vicinity of the Site have been reviewed, but PWS were scoped out of further assessment, as stated in section 10.3.6 of this chapter. Potential impacts on flora and fauna are covered in Volume 2: Chapter 8: Ecology.
The Highland Council	Scoping / Scoping Refresh	Measures to prevent erosion, sedimentation or discolouration will be required, along with monitoring proposals and contingency plans.	Mitigation to prevent sedimentation and erosion impacts are covered in section 10.8 of this chapter. Specific measures and monitoring plans will be detailed in the final CEMP. An Outline CEMP is provided in Technical Appendix 3.1.
The Highland Council	Scoping / Scoping Refresh	Assessment will need to recognise periods of high rainfall which will impact on any calculations of run-off, high flow in watercourses and hydrogeological matters.	Detailed assessment of flow rates would be carried out by the Principal Contractor and are not required to inform the EIA assessment (section 10.3.6 of this chapter).
The Highland Council	Scoping / Scoping Refresh	The council advises the Applicant to consult with SEPA to identify if a Controlled Activities Regulations (CAR) licence is necessary and the extent of information required by SEPA to access any licence application.	SEPA were consulted during scoping and their responses are detailed in this table. The Proposed Development would be subject to a licence (under CAR regulations). Appropriate CAR licences would be applied for, in consultation with SEPA, by the appointed contractor.
The Highland Council	Scoping / Scoping Refresh	Schemes should be designed to avoid crossing watercourses, and to bridge watercourses where this cannot be avoided. The EIA Report will be expected to identify all water crossings and include a systematic table of watercourse crossings or channelising, with detailed justification for any such elements and design to minimise impact. The table should be accompanied by photography of each watercourse affected and include dimensions of the watercourse.	The design process has sought to minimise the number of watercourse crossings. A summary of the proposed crossing points are provided in Section 10.7.16 of this chapter. Technical Appendix 10.2: Watercourse Crossing Assessment identifies all surveyed hydrology points of interest, including details of ephemeral steams, or areas of surface water accumulation not considered formal watercourses for the purposes of the EIA. It also gives details of the 'natural watercourse' proposed crossing points, including watercourse dimensions and bed substate, and proposed means of

Consultee and Date	Scoping / Other Consultation	Issue Raised	Response / Action Taken
			crossing. It is accompanied by a watercourse crossing photo record (Annex 2).
The Highland Council	Scoping / Scoping Refresh	The need for, and information on, abstractions of water supplies for concrete works or other operations should also be identified. The EIA Report should identify whether a public or private source is to be utilised.	A requirement for potential abstractions for water supplies has not, at this stage, been identified. Were a requirement for abstraction of water supplies identified at the detailed design stage, application for appropriate siting and permitting would be prepared by the appointed contractor in consultation with SEPA.
The Highland Council	Scoping / Scoping Refresh	The assessment should identify private water supplies, including pipework, which may be adversely affected by the development and should include details of the measures proposed to prevent contamination or physical disruption.	Highland Council records and the Site survey confirmed there are no PWS within 250m of the Site (see section 10.3.6 of this chapter). Infrastructure within the upper catchment area of the Badintagairt PWS has been used to inform the sensitivity of watercourses in the study area but a separate detailed risk assessment for PWS is not required as water quality mitigation measures are considered in section 10.8 of this chapter.
NatureScot	Scoping	The River Oykel SAC is a very sensitive receptor, and it is hydrologically connected through multiple watercourses throughout the Site. Therefore, it will be important to show how effective pollution (including silt) control measures will be to ensure that good water quality conditions can be maintained during construction in all weather conditions.	The River Oykel has been identified as a sensitive receptor (Table 10.5 of this chapter). Pollution control mitigation measures (including silt) are considered in section 10.8 of this chapter. The final CEMP would detail the specific measures. An Outline CEMP is provided in Technical Appendix 3.1.
NatureScot	Scoping / Scoping Refresh	The EIA Report should consider both on-site and off-site impacts, particularly any potential effects on the adjacent Caithness and Sutherland Peatlands SAC and the downstream River Oykel SAC. This should include consideration of	The hydrological connectivity of the Proposed Development to the off-site SACs have informed the sensitivity of hydrological receptors as discussed in section 10.6 of this chapter, with potential impacts considered in section 10.7.

Consultee and Date	Scoping / Other Consultation	Issue Raised	Response / Action Taken
		areas of hydrological connectivity between the development area and protected areas.	
SEPA	Scoping	The EIA must include a map and assessment of all engineering activities in or impacting on the water environment including proposed buffers.	All proposed infrastructure superimposed over watercourse mapping and a 50m 'natural watercourse' surface water buffer is provided in Figure 10.1: Surface water Features. Technical Appendix 10.2: Watercourse Crossing Assessment provides outline details of typical watercourse crossing design. The detailed design of watercourse crossings will include a consideration of flood conveyance to accommodate a 1 in 200 (0.5%) AEP plus climate change design standard.
SEPA	Scoping	The EIA must include a map and assessment of impacts upon Groundwater Dependent Terrestrial Ecosystems and buffers.	Provided in Technical Appendix 10.1: Groundwater Dependent Terrestrial Ecosystem Assessment, Figure 10.1.7.
SEPA	Scoping	The EIA must include a schedule of mitigation including pollution prevention measures.	Mitigation measures are provided in section 10.8 and summarised in section 10.2 of this chapter, with potential residual impacts identified.
SEPA	Scoping	There is a clear pinch-point in the vicinity of the Allt an Rasail. The layout in this area needs to include the standard 50 m buffer to the watercourse and minimise the number of watercourse crossings required.	The standard 50m buffer to watercourses was applied to all 'natural watercourses' and design iterations for the layout of the Proposed Development have taken in to account the sensitivity of surface water resources. Turbine / infrastructure layout has been configured such that the number of crossings required has been minimised, while taking into account further environmental and physical constraints identified. A Watercourse Crossing Assessment is provided in Technical Appendix 10.2.
SEPA	Scoping	The Site layout must be designed to avoid impacts	All proposed infrastructure has been superimposed over

Consultee and Date	Scoping / Other Consultation	Issue Raised	Response / Action Taken
		upon the water environment. Where activities such as watercourse crossings, watercourse diversions or other engineering activities in or impacting on the water environment cannot be avoided then the submission must include justification of this and a map showing: - All proposed temporary or permanent infrastructure overlain with all lochs and watercourses. - A minimum buffer of 50 m around each loch or watercourse. If this minimum buffer cannot be achieved each breach must be numbered on a plan with an associated photograph of the location, dimensions of the loch or watercourse and drawings of what is proposed in terms of engineering works. - Detailed layout of all proposed mitigation including all cut off drains, location, number and size of settlement ponds.	watercourse mapping and a 50 m 'natural watercourse' surface water buffer is provided in Figure 10.1. Volume 4: Technical Appendix 10.2: Watercourse Crossing Assessment provides a plan (Annex 1: Figure 10.2.1) of all proposed watercourse crossings; photographs of watercourse survey locations (Annex 2) and watercourse dimensions and proposed crossing design. Detailed layout of all proposed mitigation would be developed by the contractor in consultation with SEPA.
SEPA	Scoping / Scoping Refresh	Watercourse crossings must be designed to accommodate the 0.5% Annual Exceedance Probability (AEP) flows, or information provided to justify smaller structures. If it is thought that the development could result in an increased risk of flooding to a nearby receptor then a Flood Risk Assessment must be submitted in support of the planning application.	Watercourse crossings are considered in Technical Appendix 10.2. Watercourse crossings would be designed to accommodate a 1 in 200 (0.5%) AEP plus climate change event. Detailed flow calculations would be carried out by a contractor at the detailed design stage.
SEPA	Scoping Scoping Refresh	GWDTE are protected under the Water Framework Directive and therefore the layout and design of the development must avoid impact on such areas. The	A map of all GWDTE in relation to proposed infrastructure is provided in Volume 4: Technical Appendix 10.1: Groundwater Dependent Terrestrial Ecosystem (GWDTE)

Consultee and Date	Scoping / Other Consultation	Issue Raised	Response / Action Taken
		following information must be included in the submission: - A map demonstrating that all GWDTE are outwith a 100 m radius of all excavations shallower than 1 m and outwith 250 m of all excavations deeper than 1 m and proposed groundwater abstractions. If micro-siting is to be considered as a mitigation measure the distance of survey needs to be extended by the proposed maximum extent of micro-siting. The survey needs to extend beyond the Site boundary where the distances require it. - If the minimum buffers above cannot be achieved, a detailed site specific qualitative and/or quantitative risk assessment will be required. We are likely to seek conditions securing appropriate mitigation for all GWDTE affected.	Assessment (Figure 10.1.7). The layout of the Proposed Development has been designed to avoid interaction with GWDTE. One section of track (leading to T08) crosses through a habitat identified as potentially groundwater dependent through NVC survey. The habitat is directly connected to a stream located in a deep peat hag and was, therefore, assessed by Ramboll not to be a groundwater dependent habitat. It is considered that the maintenance of quality and quantity in surface water distribution across this area will be important such that the condition of habitat which is not directly affected by the proposed track is maintained.
SEPA	Scoping	A schedule of mitigation supported by site specific maps and plans must be submitted. These must include reference to best practice pollution prevention and construction techniques (for example, limiting the maximum area to be stripped of soils at any one time) and regulatory requirements. They should set out the daily responsibilities of Ecological Clerk of Works (ECoW)s, how site inspections will be recorded and acted upon and proposals for a planning monitoring enforcement officer	Mitigation measures are provided in section 10.8 and summarised in section 10.2 of this chapter, with potential residual impacts identified. Specific mitigation measures, responsibilities, inspections and monitoring will be detailed in the final CEMP. An Outline CEMP is provided in Technical Appendix 3.1. A Pollution Prevention Plan (PPP) would also be compiled in accordance with SEPA guidance.

Consultee and Date	Scoping / Other Consultation	Issue Raised	Response / Action Taken
SEPA	Scoping Refresh	Prior to the formal submission of the application SEPA encouraged the developer to consult with SEPA on the project.	Whilst information was provided to SEPA (via the ECU) in March 2021, it was not possible to engage with SEPA at this time due to the cyber-attack that SEPA were victim to in December 2020. SEPA made contact with the Applicant during April 2021, following the submission of the Gate Check Report, to confirm they were now operating in a limited capacity and to request the information to be resent. The Applicant resent the information on 04 May 2021. Further discussions were held with SEPA prior to submission, although due to the late stage of the project it was agreed that discussions between the Applicant and SEPA will continue post submission, once SEPA are in receipt of the EIA Report.
Scottish Water	Scoping	A review of our records indicates that there are no Scottish Water drinking water catchments or water abstraction sources, which are designated as Drinking Water Protected Areas under the Water Framework Directive, in the area that may be affected by the proposed activity.	Noted in section 10.6 of this chapter.
Kyle of Sutherland District Salmon Fishery Board	Scoping	The environmental assessment should include hydrology data, including artificial drainage watercourses.	The surface water hydrology of the Site, including artificial drainage, is outlined in section 10.6 of this chapter and shown in Figure 10.1.
Kyle of Sutherland District Salmon Fishery Board	Scoping	The environmental assessment should include water quality data (i.e. turbidity, pH, dissolved organic carbon, acid-neutralising capacity etc.) in all potentially affected watercourses.	Baseline water quality monitoring would be carried out pre-construction and subsequent monitoring during construction and operation in line with the CEMP adopted by the Applicant's appointed Principal Contractor. An outline CEMP is included in the EIA Report (Technical Appendix 3.1).

Consultee and Date	Scoping / Other Consultation	Issue Raised	Response / Action Taken
Kyle of Sutherland District Salmon Fishery Board	Scoping	The Kyle of Sutherland District Salmon Fishery Board has become increasingly aware of the extent of land drainage within the district. These artificial drainage features have the potential to act as vectors for the transfer of silt, pollutants etc. to larger watercourses. We would therefore ask that, if present within the proposed development site, all drainage features are fully taken into account when undertaking any environmental impact assessment.	The surface water hydrology of the Site, including artificial drainage, has been considered and is outlined in section 10.6 of this chapter (and shown in Volume 2: Figure 10.1). Mitigation to prevent sedimentation and pollutants impacting watercourses and surface water drainage features has been set out in section 10.8 of this chapter.
Marine Scotland	Scoping	The proposed development is drained by watercourses within the River Cassley which forms part of the River Oykel SAC; salmon is a qualifying feature for this designation status.	Section 10.6 of this chapter outlines the baseline surface water characteristics of the Site. It is noted the River Cassley is part of the River Oykel SAC. This has informed the sensitivity of the watercourses in this assessment. Aquatic biology is considered within Chapter 8: Ecology.
Marine Scotland	Scoping	MSS advises that the developer carries out the following in the EIA: - Consults the MSS generic scoping guidelines; - Site characterisation surveys of water quality and fish populations within the watercourses which could potentially be impacted as a result of this development. Surveys should follow MSS guidelines on survey/monitoring programmes as outlines in point 1 above. The results from the site characterisation surveys should be presented in the EIAR along with a detailed description of proposed mitigation measures and	The guidelines have been consulted and this chapter presents the baseline water quality with respect to water quality classification within the SEAP River Basin Management Plan (RBMP) in section 10.6. Baseline water quality monitoring would be carried out pre-construction and subsequent monitoring during construction and operation in line with the CEMP adopted by the Applicant's appointed Principal Contractor. An outline CEMP is included in the EIA Report (Technical Appendix 3.1). Cumulative impacts on water quality has been considered in section 10.7 of this chapter. Fish populations and aquatic biology are covered in Chapter 8: Ecology of this EIA Report.

Consultee and Date	Scoping / Other Consultation	Issue Raised	Response / Action Taken
		monitoring programmes; and - Considers the potential cumulative impacts on water quality and fish populations associated with adjacent (operational and consented) wind farms and hydro schemes, particularly in the selection of control sites in the monitoring programmes.	

10.4 Legislation, Policy and Guidance

10.4.1 The following legislation, guidance and advice has been taken into consideration in the preparation of this Chapter and shall be considered to provide the basis for the implementation of good environmental practice at the Site, with regard to water resources:

National Legislation and Policy

- Water Environment and Water Services (Scotland) Act 2003;
- Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) (CAR);
- The Water Environment (Miscellaneous) (Scotland) Regulations 2017;
- Flood Risk Management (Scotland) Act 2009;
- The Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017;
- The Public and Private Water Supplies (Miscellaneous Amendments) (Scotland) Regulations 2015;
- The Public Water Supplies (Scotland) Regulations 2014 (as amended 2017); and
- The Water Environment (Drinking Water Protected Areas) (Scotland) Order 2013.

Guidance and Advice

10.4.2 The following guidelines and good practice guides are published by SEPA and other regulatory bodies:

- Planning Advice Note (PAN) 79: Water and Drainage (September 2006);
- LUPS-GU4: Planning guidance on on-shore windfarm developments (2017);
- LUPS-DP-GU2a: Development Plan Guidance on Flood Risk (2018);
- LUPS-GU19: Planning advice on wastewater drainage (2011);
- LUPS-GU31: Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems, Version 3 (September 2017);

- WAT-SG-25: Good Practice Guide - River Crossings (November 2010);
- WAT-SG-26: Good Practice Guide - Sediment Management (September 2010);
- WAT-SG-29: Good Practice Guide - Temporary Construction Methods (March 2009);
- WAT-SG-75: Sector Specific Guidance: Construction Sites;
- WAT-PS-06-02: Culverting of Watercourses (June 2015);
- SEPA (2015), CAR - A Practical Guide, Version 8.4 (October 2019);
- Scottish Renewables, Scottish Natural Heritage (SNH), SEPA, Forestry Commission Scotland, Historic Environment Scotland, Marine Scotland Science and AEECoW (2019), Good Practice During Wind Farm Construction (4th Edition).

10.5 Methodology

Desk Study

10.5.1 The methodology for baseline characterisation is set out as follows:

- describe surface water hydrology, including watercourses, springs and ponds;
- identify existing catchment pressures;
- identify private drinking water abstractions and public water supplies within the study area;
- identify any flood risks;
- describe the hydromorphological conditions of watercourses; and
- describe hydrogeological information.

10.5.2 Published information consulted to determine the baseline condition include:

- Ordnance Survey 1:25,000 and 1:50,000 mapping;
- 5 m Digital Terrain Model (DTM) data;
- Aerial and LiDAR imagery (ESRI world imagery);
- British Geological Society (BGS) Hydrogeological and Groundwater Vulnerability Maps of Scotland (1:625,000);
- SEPA Flood Risk Management Maps web mapping (SEPA, 2021, Flood Maps);
- SEPA Water Classification Hub (SEPA, 2021, River Basin Management Plan Water Environment Hub);
- The 2012 Glencassley Wind Farm Environmental Statement (ES) and associated GIS data; and
- Drinking Water Protected Areas - Surface, Scottish Government (Scottish Government, 2021).

Field Survey

10.5.3 A site walkover was conducted by Ramboll on the 2nd – 5th November 2020. Conditions on the date of the survey were showery and cold. The site visit was preceded by a period of wet weather. The purpose of the site walkover was to (i) assess the general hydrological condition of the Site; (ii) characterise watercourses at the Site such that proposed watercourse crossing points may be addressed, and (iii) assess hydrological conditions at potential GWDTE sites. The survey consisted of visual inspection and geolocated surveying of watercourses across the Site.

Criteria for the Assessment of Effects

Criteria for Assessing the Sensitivity of Receptors

10.5.4 Effects on water resources are described as beneficial, neutral or adverse and are considered with reference to the value or sensitivity of the receptor, as described in Table 10.2.

Table 10.2: Sensitivity of Environmental Resource

Sensitivity of Receptor	Definition	Typical Criteria
High	International or national level importance. Receptor with a high quality and rarity, regional or national scale and limited potential for substitution/ replacement.	• High likelihood of fluvial/ tidal flooding in the sub catchment - defined as 1:10 probability in a year. • EC Designated Salmonid/ Cyprinid fishery. • Surface Water Framework Directive (WFD) class 'High'. • Scottish Government Drinking Water Protected Areas. • Aquifer providing regionally important resource such as abstraction for public water supply, abstraction for PWS. • Supporting a site protected under EC or UK habitat legislation/ species protected by EC legislation. • Protected Bathing Water Area. • Active floodplain. • Highly GWDTE.
Medium	Regional, county and district level importance. Receptor with a medium quality and rarity, regional scale and limited potential for substitution/ replacement.	• Medium likelihood of fluvial/ tidal flooding in the sub-catchment - defined as a 1:200 probability in a year. • Surface water WFD class 'Good' or 'Moderate'. • Aquifer providing water for agricultural or industrial use. • Local or regional ecological status / locally important fishery. • Contains some flood alleviation features. • Moderately GWDTE.
Low	Local importance. Receptor is on-site or on a neighbouring site with a low quality and rarity, local scale. Environmental equilibrium is stable and is resilient to changes that are greater than natural fluctuations, without detriment to its present character.	• Surface water WFD class 'Poor'. • Unproductive strata/ no abstractions for water supply. • Sporadic fish present. • No flood alleviation features. • Sewer. • Potential GWDTE confirmed to be of low sensitivity to change due to heavily modified underlying groundwater bodies.

Criteria for Assessing the Magnitude of Change

10.5.5 The size or magnitude of each impact is determined as a predicted deviation from the baseline conditions during construction, operation and decommissioning, as described in Table 10.3.

Table 10.3: Magnitude of Impact in a Receptor

Magnitude of Impact	Criteria
High	Large alteration/ change in the quality or quantity of and/ or to the physical or biological characteristics of environmental resource.
Medium	Medium alteration/ change in the quality or quantity of and/ or to the physical or biological characteristics of environmental resource.
Low	Small alteration/ change in the quality or quantity of and/ or to the physical or biological characteristics of environmental resource.
Negligible	No alteration/ change detectable in the quality or quantity of and/ or to the physical or biological characteristics of environmental resource.

Criteria for Assessing Cumulative Effects

10.5.6 Potential cumulative environmental impacts to water resources have been assessed where concurrent proposed wind farm sites or construction activity may be in hydrological connection with the Proposed Development, or water resource receptors.

10.5.7 Where potential cumulative impacts are identified, the same criteria as used for assessment of the Proposed Development shall be employed.

Criteria for Assessing Significance

10.5.8 Table 10.4 illustrates how residual effects are determined by comparison of the sensitivity of receptors with the magnitude of predicted change. For the purposes of this assessment significant effects are those that are major or major/ moderate.

Table 10.4: Residual Effects

	Magnitude of Change			
Sensitivity	**High**	**Medium**	**Low**	**Negligible**
High	Major	Major/ moderate	Moderate	Moderate/ minor
Medium	Major/ moderate	Moderate	Moderate/ minor	Minor
Low	Moderate	Moderate/ minor	Minor	Minor/ none

Limitations and Assumptions

10.5.9 This assessment refers to and uses publicly available data sources and site-specific survey to the Proposed Development, which is considered robust and sufficient to enable this assessment to be completed.

10.6 Baseline

Current Baseline

Surface Hydrology

10.6.1 The Proposed Development is located within the River Cassley catchment. The site is located at a raised elevation above the base of the river valley, through which the River Cassley runs in a southerly direction, on an undulating plateau. Several small named and unnamed watercourses drain south-west from within the site, down the steep hillside to the River Cassley in the valley bottom. These include the Allt an Leacach; Allt Bad an t-Sagairt and Allt an Ràsail. Numerous artificial drains were identified in the vicinity of T20. There are also a number of ephemeral streams and artificial drainage assets, which were identified on-site as part of the previous 2012 Glencassley ES.

10.6.2 A site survey of the ephemeral streams and artificial drainage assets identified in the previous ES was conducted in November 2020. These features were found to be predominantly areas of saturated ground formed by surface water runoff accumulation and were not observed to support distinctly aquatic habitats or hydromorphological characteristics. They are not therefore considered representative of formal watercourses. These features are therefore considered less sensitive for the purposes of this assessment. Of the 32 surveyed points, only 7 were identified at 'natural watercourses' which were considered of higher sensitivity and crossings will be required. Further details are provided in section 10.7.16 of this chapter, and Technical Appendix 10.2: Watercourse Crossing Assessment.

10.6.3 A hydrology survey was conducted in November 2020. The upper reaches of the Allt Bad an t-Sagairt is approximately 3m wide with a peaty bed substrate. The Allt an Ràsail is approximately 5m in width. The bed substrate varied, with bedrock and cobbles present in its upper reaches but a peaty substrate dominated in its lower reaches. Tributaries of the Allt an Ràsail in the vicinity of T16 varied in width between 0.3 – 1.5m with a peat bed substrate. A full assessment of watercourses to be crossed is presented in Technical Appendix 10.2. No springs or wells were identified during the site visit.

10.6.4 Surface water features are shown in Figure 10.1.

Water Quality

10.6.5 The River Cassley is part of the River Oykel Special Area of Conservation (SAC), designated for the presence of Atlantic salmon *Salmo salar* and Freshwater pearl mussel *Margaritifera margaritifera.*

10.6.6 The site also borders the Caithness and Sutherland Peatlands SAC and Grudie Peatlands Site of Special Scientific Interest (SSSI). However, the Proposed Development is not considered to be hydrologically linked to these sites, with the Allt an Ràsail and its associated tributaries following south and west away from the Caithness and Sutherland Peatlands SAC and SSSI which fringes the eastern margin of the Site.

10.6.7 The River Cassley (Dornoch Firth to Glenmuick, ID 20110) is classified within the SEPA River Basin Management Plan (RBMP) as being in 'Good' overall condition, downgraded from 'High' on the basis of physical alterations as a result of hydroelectricity generation.

10.6.8 Other watercourses within the site are not classified within the RBMP.

10.6.9 As all watercourses within the Site feed into the River Oykel SAC and the River Cassley is classified as being in 'Good' overall condition all surface watercourses are considered to be of High Sensitivity.

10.6.10 There are no Drinking Water Protected Areas (DWPA) within or in hydrological connectivity to the Proposed Development.

Groundwater Bodies

10.6.11 The BGS 1:625,000 scale hydrogeological mapping indicates the Site is underlain by a low productivity aquifer. Such aquifers are characterised as having limited groundwater potential, with small amounts of groundwater limited to near surface weathered zones and secondary fractures (e.g. rare springs). Low productivity aquifers do not widely contain groundwater in exploitable quantities; however, some bedrock formations can locally yield water supplies in sufficient quantities for private/ domestic use. The overlying superficial deposits are considered to be generally of low permeability; however, groundwater may be present in sand and gravel lenses, hence locally important aquifers or perched groundwater bodies may be present, although are unlikely to be continuous over a wide area. No springs or wells were identified within the Site.

10.6.12 The Site is underlain by the Northern Highlands groundwater body (RBMP ID 150701) which is 9,382km^2 and the Scottish Environment Protection Agency (SEPA) River Basin Management Plan (RBMP) classifies the River Cassley as being in overall 'Good' condition.

10.6.13 Due to the groundwater body's limited hydrological potential and productivity, as well as the low permeability nature of the superficial geology, the groundwater body is considered to be of Low Sensitivity.

Groundwater Dependent Terrestrial Ecosystems

10.6.14 According to the ecological surveying carried out at the site by Alba Ecology and reported in Chapter 8: Ecology, potentially groundwater dependent vegetation communities are recorded predominantly in areas closely associated with a surface water feature. Detailed description of GWDTE areas is provided in Chapter 8: Ecology and Technical Appendix 10.1 (Groundwater Dependent Terrestrial Ecosystem Assessment). Figure 10.4 shows the location of habitats initially identified to have a potential to be groundwater dependent vegetation based on the National Vegetation Classification (NVC) survey only.

10.6.15 Due to the underlying hydrogeological conditions (as specified in SNIFFER (2007) guidance), topography and land use, all of the potential GWDTE areas have been subsequently identified as not likely to be groundwater dependent (SNIFFER, 2007). This is because the NVC communities identified are in connectivity with surface water drainage either through:

- Direct connectivity with a surface water feature e.g. a watercourse or ephemeral stream;
- Located on a hillslope where a number of surface water drains originate, indicating habitat dependency on overland surface water flows; or
- Are located in peatland habitats likely influenced by ombrotrophic bog and surface water.

10.6.16 Additionally, the underlying bedrock geology is considered to be a low productivity aquifer, and the superficial geology considered poorly draining therefore also indicating habitats are unlikely to be groundwater dependent.

10.6.17 However, the potential for a degree of groundwater contribution is not ruled out. Figure 10.5 shows the likelihood of groundwater dependence of the NVC habitats following the hydrological GWDTE evaluation set out in Technical Appendix 10.1.

10.6.18 As the likelihood of groundwater dependency across the site is assessed to be Low, all potential GWDTE areas identified through NVC surveying are assessed to be of Low Sensitivity with regards to the disruption of groundwater supply.

Future Baseline

10.6.19 There is potential for climate change to impact on future baseline conditions. Climate change studies predict a decrease in summer precipitation and an increase in winter precipitation alongside slightly higher average temperatures. This suggests that there may be greater pressures on PWS in summer months in the future. However, summer storms are predicted to be of greater intensity. Therefore, peak fluvial flows associated with extreme storm events may also increase in volume and velocity. These climate change factors have been taken into account when considering the potential for likely significant effects.

Summary of Sensitive Receptors

10.6.20 Table 10.5 provides a summary of the baseline receptor sensitivity.

Table 10.5: Summary of Receptor Sensitivity

Receptor	Sensitivity	Justification
Surface Water	High	All watercourses within the Site flow into the River Cassley, which forms part of the River Oykel SAC, designated for Atlantic salmon and Freshwater pearl mussel. The River Cassley is classified as being in 'Good' overall condition by SEPA in the RBMP. The Proposed Development is within the catchment area of the Badintagairt PWS (Figure 10.2).
Groundwater	Low	The Site is underlain by a low productivity aquifer, according to the BGS.
GWDTEs	Low	Hydrological assessment of potential GWDTE communities within the vicinity of the Proposed Development, as identified through the NVC survey (Technical Appendix 10.1), has shown these habitats are unlikely to be groundwater dependent. The NVC communities are closely linked to surface water features and ombrotrophic bog, as such the sensitivity of these areas will be primarily to alterations in surface water and near surface water flows. On this basis, the habitats themselves are considered to be of low sensitivity with regard to groundwater dependency although, where associated with watercourses, the presence of the habitats would inform the sensitivity of the watercourses although, as set out above, the watercourses are already considered to be of high

Receptor	Sensitivity	Justification
		sensitivity due to the connectivity with the River Oykel SAC.

10.7 Potential Effects

10.7.1 The following section provides the assessment of likely effects in the absence of mitigation, as summarised in Table 10.6.

Potential Construction Impacts

Chemical Pollution

10.7.2 There is the potential for the accidental release of stored fuels, oils and materials (e.g. cement and grout) used on-site during construction works to negatively impact surface waters on the site and downstream from the Site, and the underlying groundwater. Potential effects include degradation of water quality and indirect effects on aquatic habitats and species.

10.7.3 Borrow pits are proposed across the Site. Such locations may represent areas where the unsaturated zone of the bedrock would be exposed and therefore of a relatively higher vulnerability with regard to groundwater contamination. These areas are located outwith the 50m buffer of watercourses identified on the 1:10,000 OS mapping within the Site.

10.7.4 Were such a release to occur, there is the potential for a negative impact to surface water resources and to shallow groundwater (if present) in near-surface peat and superficial deposits, with a subsequent impact on biodiversity. Potential effects include degradation of water quality, direct effects on aquatic ecology and indirect effects on the ecology of downstream receptors.

Sedimentation and Increased Erosion Rates

10.7.5 There is the potential for the discharge of increased sediment loads due to construction activity and erosion, to negatively impact on aquatic ecology or fluvial morphology of receptors downstream from the Proposed Development. There is also potential for surface water runoff with relatively high sediment loads to be discharged over or into soil, which may in turn impact on local infiltration capacity. Increased sediment loads may be the result of excavation and surface disturbance, excavation and dewatering of foundation excavations or the mobilisation of stockpiled material.

10.7.6 Surface water channels across the Site have been denoted as 'natural watercourses', those identified on the OS 1:10,000 scale mapping, or 'ephemeral watercourses' (Figure 10.1). When designing the Proposed Development layout, initially a 50m buffer was applied around all natural watercourses and waterbodies across the Site. The site visit in November 2020 assessed the ephemeral nature of the smaller watercourses in vicinity of the proposed turbine locations. These 'ephemeral watercourses' were found to be areas of relatively stagnant surface water accumulation, and not flowing watercourses. On this basis, these are not considered to represent watercourses for the purposes of this assessment. The same is also true of artificial drainage channels. There are turbines located in proximity to the ephemeral streams and artificial drainage channels, but no turbines are located within the 50m buffer of a 'natural watercourse'.

10.7.7 Where proposed access tracks are required to cross a watercourse, there is a requirement for infrastructure to be included within the 50m 'natural watercourse' buffer. All surface water features which proposed infrastructure crosses have been

considered within a Watercourse Crossing Assessment (Technical Appendix 10.2). A total of 7 watercourse crossings over 'natural watercourses' were identified and are detailed in section 10.7.16 of this chapter as well as in Technical Appendix 10.2. As such, the design of the Proposed Development has sought to reduce the potential for the release of sediments to the water environment and it would be anticipated that sediment in distributed overland flows would be entrained in areas of vegetation or smaller surface water channels. However, there remains the potential that sediment mobilised via surface water runoff could reach surface water receptors via overland flow or flow through the extensive network of 'ephemeral streams' and any artificial drains.

10.7.8 There is the potential for hardstanding and compacted surfaces to increase rates of surface runoff on the Proposed Development and for infrastructure to create preferential drainage pathways. Increases in surface runoff may in turn lead to higher risks of erosion and sedimentation and also have the potential to increase flood risk downstream.

Alteration to Surface Water Flows and Runoff

10.7.9 The construction of access tracks could lead to the restriction of surface water flows and alterations to near-surface flows downslope across the Site. This leads to the potential for a reduction in the water supply to down slope mire habitats and the risk of peat soils becoming dry or eventually desiccated due to a lowering of the water table and alterations to the drainage pattern.

10.7.10 There is the potential, if unmitigated or inappropriately constructed, for the Proposed Development to increase rates of runoff, leading to a temporary increase in flood risk and indirect effects on aquatic ecology, fluvial morphology downstream of the Site. Areas of potentially reduced permeability include proposed hardstanding areas, tracks and areas of compacted hardcore.

Impact on GWDTE

10.7.11 An assessment of potential effects to GWDTE areas is provided in Technical Appendix 10.1. The introduction of new areas of hardstanding has the potential for alteration in the quality or quantity of groundwater supplies to downgradient habitats which could lead to drying out or an alteration in water chemistry, and therefore the composition of vegetation communities. However, no GWDTE (areas with a dependency on groundwater supply) have been identified.

10.7.12 The ecological assessment of the recorded potentially groundwater dependent NVC communities within the Site determined them to be either of no groundwater dependency or moderate groundwater dependency (see Technical Appendix 8.2A, Table 8.2.6). In line with underlying hydrogeological conditions (as specified in SNIFFER (2007) guidance), all potential GWDTE areas are identified in the site-specific assessment of NVC communities (Technical Appendix 10.1) as not likely to be groundwater dependent. Therefore, the habitats initially identify as having a potential to be GWDTE areas are considered not to be groundwater dependent and therefore not sensitive. Best practice measures to ensure that there are no adverse effects on surface water supplies to such habitats would be implemented as outlined in section 10.8 of this chapter.

Watercourse Crossings

10.7.13 During the construction of watercourse crossings there is potential for activities to negatively impact both water quality and the natural morphology. SEPA's good practice guide (Engineering in the water environment: River crossings (Natural Scotland and SEPA, 2010)) identifies that where proper care is not taken during the construction phase,

disturbance of river bed and banks can lead to the direct loss of aquatic flora and fauna, and the release of fine sediments and other pollutants that may lead to the smothering of plants and animals or the habitats they depend on (SEPA, November 2010).

10.7.14 Crossings (and culverts) will be designed to ensure protection of the existing channel and substrate, allow free passage of fish and include provision of suitable ledges or mammal crossings to ensure free passage to otters during periods of high water flow.

10.7.15 An assessment of the proposed locations of watercourse crossings, and the likely licensing requirements for crossings are set out in Technical Appendix 10.2.

10.7.16 A total of 32 locations were surveyed in order to assess the potential for watercourse presence and 25 of the surveyed points were identified to be unnamed ephemeral streams, or areas of saturated ground formed by surface water runoff accumulation, which are not considered formal watercourses for the purposes of this assessment. Cross drains beneath tracks are likely to be used to manage drainage from these saturated areas.

10.7.17 Seven watercourse crossings over 'natural watercourses' have been identified. The characteristics of the crossing points, and anticipated crossing type are summarised in Table 10.6. The locations of the crossings are shown in Technical Appendix 10.2, Annex 1 and photographs of the watercourses in Technical Appendix 10.2, Annex 2.

Table 10.6: Watercourse Crossings Summary

Survey Location Reference (see Technical Appendix 10.2)	Name	Width (m)	Depth (m)	Bed Substrate	Likely crossing method
2	Unnamed	0.30	0.05	peat	Circular culvert
4	Allt Bad an t-Sagairt	3.00	0.40	boulder	Single-span (bridge)
27	Unnamed 'natural watercourse'	0.30	0.50	peat	Circular culvert
28	Unnamed 'natural watercourse'	1.50	0.80	peat	Circular culvert
29	Unnamed 'natural watercourse'	0.80	0.50	peat	Circular culvert
30	Unnamed 'natural watercourse', potentially cut / straightened	0.50	1.00	peat	Circular culvert
32	Allt an Ràsail	5.00	1.00	peat	Single-span (bridge)

Summary of Likely Construction Effects

10.7.18 Table 10.7 provides a summary of the likely construction effects on the identified sensitive receptors, in the absence of mitigation.

Table 10.7: Potential Construction Effects

Receptor / Sensitivity	Summary of Assessment	Magnitude of Impact Prior to Mitigation	Effect
Surface water / High	• There is the potential to impact on surface water quality through the release of contaminated water, stored chemicals or nutrient enrichment through on-site construction works. • There is the potential to impact on flow rate / volume resulting in impacts on aquatic ecology or fluvial morphology during construction.	High	**Significant**
GWDTE / Low - Moderate	• There is potential to alter and disrupt local groundwater flow during construction, in particular through temporary excavations for tracks and foundation works. • Potential effects include temporary direct effects of local dewatering and alterations to downstream flow regimes and indirect effects on habitats/ ecosystems dependent on groundwater. • The baseline analysis confirms that the potential GWDTE are not likely to be groundwater dependent and are mostly associated with surface water features or ombrotrophic bog.	Low	**Not Significant**
Groundwater / Low	• There is the potential for the release of deleterious materials (such as oils and fuels) to lead to a reduction in groundwater quality. • The installation of turbine foundations, the sourcing of construction materials from borrow pits and the presence of tracks and cable trenches could lead to alteration in groundwater flows. • Dewatering and temporary abstraction operations could lead to localised lowering in groundwater levels.	Low	**Not Significant**

Potential Operational Effects

10.7.19 The potential risk of the release of pollutants or sediment from the activities relating to the operational phase of the Proposed Development is substantially lower than during construction because of the decreased levels of ground disturbance. Additionally, the operation or refuelling of plant machinery shall not take place on the Proposed Development area during the operational phase.

10.7.20 There is the potential for hardstanding surfaces and compacted tracks and infrastructure to lead to increased rates of surface runoff, in turn leading to the potential for increased risk of surface erosion and downstream flood risk; however as described in Chapter 3:

Description of Development, the Proposed Development will incorporate a drainage design using Sustainable Drainage Systems (SuDS) principles in accordance with The SuDS Manual (C753) 2015 (Susdrain, 2015).

10.7.21 There is the potential for infrastructure installed as part of the Proposed Development to present a barrier to near surface flows across the Site during the operational phase. Were cross drainage measures not appropriately installed, there is the potential for tracks to impede the movement of surface waters across blanket bog leading to the drying out or desiccation of areas dependent on water supply or retention.

10.7.22 Table 10.8 summarises the likely operational effects.

Table 10.8: Potential Operational Effects

Receptor / Sensitivity	Summary of Assessment	Magnitude of Impact Prior to Mitigation	Effect
Surface water / High	• There is limited potential to impact on surface water quality during operation as there would be no source for release of contaminated water or chemicals. • The Proposed Development would be designed in accordance with SUDS principles and therefore would not impact flow rate/ volume.	Low / None	**Not Significant**
GWDTE / Low - Moderate	• The baseline analysis confirms that the potential GWDTE are not likely to be groundwater dependent and are mostly associated natural or artificial surface water features. There are not anticipated to be any additional adverse effects on GWDTE further to those identified during the construction phase. • The proposed infrastructure is unlikely to create a barrier to groundwater flow or result in dewatering of any sensitive habitats.	None	**Not Significant**
Groundwater	• The Site according to the BGS is underlain by a low productivity aquifer.	Low / None	**Not Significant**

Potential Cumulative Construction Effects

10.7.23 In the absence of mitigation, the construction of other wind farm sites at the same time as the Proposed Development could lead to the cumulative denudation of water quality in the downgradient water receptors including the River Oykel SAC, in line with the potential construction effects identified in paragraphs 10.7.2 to 10.7.10 with regard to chemical pollution, sedimentation, increased erosion and alteration to surface water flows and runoff.

Potential Cumulative Operational Effects

10.7.24 Operational sites are considered highly unlikely to impact surface waters in connection to the Proposed Development.

10.7.25 Were accidental spills or leaks of potentially polluting substances (for example fuels or oils) to occur on separate sites at the same time, there is the potential for cumulative impacts to occur to surface waters. It should be noted that no bulk storage of such materials would be anticipated, and that such incidents would be limited to accidental release from service vehicles, equipment, or the failure of wind turbine gear boxes due to poor maintenance.

10.7.26 Were measures designed to prevent increased runoff rates on wind farm sites poorly maintained or damaged, there is the potential for altered drainage patterns to lead to increased runoff rates, which could lead to erosion of soils and increased downstream flood risk.

10.8 Mitigation

Mitigation Through Design

10.8.1 The layout of the Proposed Development has been designed to ensure infrastructure is located outwith the indicative flood extent of 'natural watercourses' and their 50m watercourse buffer (with the exception of sections of access track leading to watercourse crossings, the locations of which are discussed further in Technical Appendix 10.2, in this chapter, paragraphs 10.7.13 to 10.7.17 and summarised in Table 10.6). The layout has also been designed to avoid habitats identified as potentially groundwater dependent where possible. The track to T8 crosses through a habitat identified as potentially groundwater dependent through the NVC survey. This comprises an area of M6c - *Carex echinata-Sphagnum fallax/denticulatum mire* habitat but which is directly connected to a stream located in a deep peat hag and was therefore, not considered as a groundwater dependent habitat.

10.8.2 Design iterations to inform the layout of the Proposed Development have taken in to account the sensitivity of surface water resources, and the turbine / infrastructure layout has been configured such that the number of crossings required has been minimised, while taking in to account further environmental and physical constraints identified.

Mitigation During Construction

10.8.3 The mitigation schedule set out below identifies measures that shall be implemented through the final CEMP and detailed assessment of further measures that shall be implemented at hydrologically sensitive locations.

<u>Chemical Pollution</u>

10.8.4 The potential for impacts on the water environment through the release of pollutants or sediments during the construction phase shall be managed through the implementation of a final CEMP (as outlined in Technical Appendix 3.1: Outline Construction Environmental Management Plan). The final CEMP shall incorporate measures to ensure that the release of sediments or pollutants to the surrounding environment is avoided.

10.8.5 The storage of potentially contaminative materials (oils, cements/ grouts) shall be carried out at least 50m from watercourses. Fuels, oils or chemicals stored on-site shall be sited over an impervious base and according with the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended).

Sedimentation and Erosion

10.8.6 The final CEMP (as outlined in Technical Appendix 3.1: Outline CEMP) would include measures to minimise potential adverse effects related to surface water and groundwater discharge, including impacts associated with dewatering which may arise from the excavation of borrow pits and turbine foundations. Therefore, the contractor shall be required to meet regulatory requirements and implement best practice measures as set out in SEPA planning guidance.

10.8.7 Construction works would be regulated under the CAR licensing regime and all necessary licences will be sought from SEPA prior to the commencement of any operations on-site.

10.8.8 Where required, interceptor ditches shall divert water to locations downstream of proposed excavation or soil disturbance works associated with the installation of turbine foundations, the development of construction compounds and batching plants, groundworks during the installation of the substation and the excavation of borrow pits. These would be specified in a Pollution Prevention Plan (PPP) that would be compiled by the contractor in accordance with SEPA guidance (SEPA, February 2018).

10.8.9 Sediment capture methods to be implemented at the Site would be detailed in the final CEMP. Such measures shall ensure that sediment laden runoff shall be directed to settlement ponds suitable for the containment of volumes of water and sediment as appropriate to the area of disturbed or excavated ground (taking in to account the potential for rainfall events). Water discharged from settlement ponds shall be directed to vegetated areas and measures such as silt fences shall ensure sediment loads are fully entrained.

10.8.10 The Outline CEMP (see Technical Appendix 3.1) includes proposed drainage layout for borrow pits and methods by which stockpiled materials would be separated from surface runoff as far as practicably possible. The CEMP would be finalised prior to commencement.

10.8.11 Where drains are installed, either temporarily during the construction phase, or in association with the installation of site infrastructure, check dams would be installed at suitable intervals (as defined by the gradient of the drain) to reduce flow velocity and allow the settlement of sediment loads prior to discharge to watercourses. These would be detailed in the PPP.

Alteration to Surface Water Flows and Runoff

10.8.12 Details of construction phase SuDS would be included in the PPP and the final CEMP, as required, to provide a surface water management and treatment train that would mitigate potential adverse impacts on the hydrology of the Site and surrounding areas during the construction phase of the Proposed Development. Measures would be included to ensure that pre-development runoff rates are maintained and that rates of runoff to watercourses are not increased. Construction Site plans and proposed drainage measures shall form a PPP.

10.8.13 Where a track is required to enter the 50m buffer around a 'natural watercourse' in order to cross a watercourse, as described in Technical Appendix 10.2, the installation of SuDS measures shall be supervised by the Ecological Clerk of Works (ECoW) during the construction phase of works. The requirement for monitoring of water quality within watercourses upstream and downstream of the Proposed Development would be agreed with SEPA and Marine Scotland. Prior to works, baseline water quality monitoring shall be carried out. Subsequent monitoring during construction (and operation) in line with

the final CEMP would be adopted by the Applicant's appointed Principal Contractor. An outline CEMP is included in the EIA Report (Technical Appendix 3.1)

10.8.14 Any requirement for surface water or groundwater abstraction will be completed in accordance with the CAR.

GWDTE

10.8.15 As the potential GWDTE areas assessed are not considered likely to be groundwater dependent, specific mitigation with respect to groundwater supplies are not considered to be applicable.

10.8.16 It is considered that the maintenance of quality and quantity in surface water distribution across habitats identified as potentially groundwater dependent will be important, as these areas are assessed to be predominantly supported by surface water supply. Suitable drainage and surface water measures would be used to maintain hydrological connectivity in peatland and wetland habitats and prevent deleterious impacts on surface water distribution, which would be addressed in the final CEMP.

Watercourse Crossings

10.8.17 Construction shall be carried out in accordance with best SEPA practice and SEPA Guidance for Pollution Prevention (SEPA, 2010)(SEPA, 2018). Splash boards and runoff diversion measures, including silt fencing adjacent and parallel to watercourses beneath bridges and at culvert crossings, will be used at all crossings during construction to prevent direct siltation of watercourses.

10.8.18 To ensure that all drainage measures employed during the construction phase of the Proposed Development are maintained appropriately and remain effective, the performance of the drainage measures will be monitored. The drainage management works will, therefore, be supervised by the ECoW and shall be in accordance with the final CEMP.

10.8.19 The detailed design of each watercourse crossing would seek to ensure hydraulic conveyance is maintained to prevent any restriction of flows, as well as allowing the free passage of mammals and aquatic ecology. Therefore, each watercourse crossing would have sufficient capacity to pass the climate change-adjusted 1:200-year flood including an allowance for partial blockage.

10.8.20 Two watercourse crossings will span relatively large watercourses. These are WC4 across the Allt Bad an t-Sagairt, and WC32 across the Allt an Ràsail (see Technical Appendix 10.2). SEPA guidance typically requires that single span structures be designed where feasible, especially for larger watercourse crossing widths where a bridge design would typically be considered more appropriate.

10.8.21 At the remaining five watercourse crossing locations, it has been assumed that the proposed watercourse crossings could constitute culverts with construction on the bed or banks of the watercourses only. Where feasible, bottomless arched culverts may be installed. However, it is noted that closed culverts are likely to be appropriate at most locations due to the small size of watercourses, artificial morphology or intermittent flow.

Mitigation During Operation

10.8.22 A site maintenance programme with regard to site plant and infrastructure would be implemented.

10.8.23 A maintenance schedule would be developed for all SuDS and drainage assets installed at construction stage to ensure that the function and benefit provided, remains for the lifetime of the Proposed Development.

10.8.24 Water quality monitoring would be carried out during operation in line with the CEMP adopted by the Applicant's appointed Principal Contractor. An outline CEMP is included in the EIA Report (Technical Appendix 3.1).

10.9 Residual Effects

Residual Construction Effects

10.9.1 Pollution prevention measures specified within the Outline CEMP (Technical Appendix 3.1) would ensure compliance with SEPA's guidelines and good practice guides listed in paragraph 10.4.2. Measures such as the use of spill kits, placement of impermeable geotextile membranes and the suitable storage, maintenance and handling of equipment and materials would effectively limit the release of contaminants to the environment and the associated potential significant effects. Through the implementation of mitigation, the residual adverse effects on surface waters or groundwater have the potential to be of a negligible magnitude on receptors of high sensitivity, and are therefore **not significant**.

10.9.2 Provided mitigation measures and best practice methods are adhered to during the construction phase (as outlined in Technical Appendix 3.1: Outline CEMP), and specific guidance related to watercourse crossings referenced in Technical Appendix 10.2 are adhered to, residual adverse effects associated with sedimentation and erosion on controlled waters of high sensitivity would be of a negligible magnitude and therefore **not significant**.

Residual Operational Effects

10.9.3 Appropriate design and construction, and suitable maintenance schedules would be developed and adhered to. As a result, residual adverse effects on surface waters or groundwater receptors, and on water resources during the operational phase would be **not significant**.

10.10 Cumulative Effects

10.10.1 It is reasonable to assume that any cumulative development within catchments in potential hydrological connection to the Proposed Development would incorporate good practice drainage management measures into their respective designs, including temporary construction stage and permanent SuDS to manage the rate, quantity and quality of surface water runoff to a level where effects on the water environment would be negligible. It is considered that the addition of the Proposed Development (with negligible effects as assessed above) would not give rise to significant cumulative effects during the construction or operational phase, when considered in-combination with those developments.

10.11 Monitoring

10.11.1 Taking the sensitivity of the downstream River Oykel SAC, baseline water quality monitoring would be carried out prior to construction activity such that a baseline of water quality may be established. Subsequent regular monitoring during construction would be carried out during the construction and operation phase in line with the CEMP adopted by the Applicant's appointed Principal Contractor. Such water quality monitoring

would be supervised by the ECoW and the location and frequency of water quality monitoring shall be agreed with SEPA.

10.11.2 The ECoW would also undertake visual inspections of the watercourse crossings and SuDS measures within the Site throughout construction to ensure that there are no accidental disruptions to flow rates and to ensure that the SuDS measures are functioning correctly in terms of managing any silt laden runoff.

10.11.3 The drainage management works will, therefore, be supervised by the ECoW. All monitoring and supervision of the drainage works will be recorded.

10.12 Conclusion

10.12.1 This Chapter considers the likely significant effects on hydrology and hydrogeology associated with the construction, operation and decommissioning of the Proposed Development.

10.12.2 Following the application of mitigation measures, it is assessed that the residual effects on hydrology and hydrogeology are not considered to be significant in the context of the EIA Regulations. Table 10.9 provides a summary of the likely significant effects considered, proposed mitigation commitments and the residual effects.

Table 10.9: Summary of Potential Significant Effects of the Proposed Development

Likely Significant Effect Without Mitigation	Mitigation Proposed	Means of Implementation	Outcome / Residual Effect
Construction			
Release of chemical pollutants Major (**significant**) potential impact on surface waters (including the River Oykel SAC) within and downstream of the Site, due to release of chemical pollutants.	Storage, containment and operational best practice shall be implemented. Suitable emergency spill or leak response kits and procedures shall be in place.	Detailed through the final CEMP (as detailed in Technical Appendix 3.1: Outline CEMP) and associated Pollution Prevention Plan.	**Not Significant**
Increased sediment loads Major (**significant**) potential impact on surface waters within and downstream of the Site, due to effects on water quality due to increased sediment loads.	Implementation of 50m buffers to watercourses. Implementation of best practice with regards to construction methods in close proximity to watercourses. To include diversion ditches around excavation works. Implementation of best practice with regards to construction of watercourse crossings.	Detailed through the final CEMP (as detailed in Technical Appendix 3.1: Outline CEMP) and associated Pollution Prevention Plan. Monitoring of works by the ECoW, inspection of watercourses during the construction phase.	**Not Significant**

Likely Significant Effect Without Mitigation	Mitigation Proposed	Means of Implementation	Outcome / Residual Effect
	Baseline and subsequent water quality monitoring.		
Creation preferential drainage pathways Major (**significant**) potential impact on surface waters within and downstream of the Site, due to hardstanding and compacted surfaces leading to increased rates of surface runoff on the area of the Proposed Development and for infrastructure to create preferential drainage pathways.	Drainage management proposals to ensure pre-construction rates/ volumes of runoff maintained. The drainage management works would be supervised by the ECoW.	Detailed drainage calculations to be submitted by the contractor to quantify potential increases in surface runoff and define operational parameters for SuDS measures.	**Not Significant**
Reduction in the water supply to downslope mire habitats Major (**significant**) potential impact on surface waters within and downstream of the Site, due to restriction of surface water flows and near-surface flows downslope across the Site. This leads to the potential for a reduction in the water supply to downslope mire habitats.	Track design in accordance to best practice measures for the construction of tracks on peat. Maintenance of 'clean' water flows around construction locations. Suitable distribution of surface waters from SUDS measures.	Detailed design of tracks and infrastructure. Detailed through the final CEMP (as detailed in Technical Appendix 3.1: Outline CEMP).	**Not Significant**
Alteration of sub-surface flows Minor (**non-significant**) effects on groundwater, associated with	None required. Good practice drainage management proposals to ensure groundwater flow and hydraulic continuity is maintained.	Condition of Consent requiring scope of final CEMP to be agreed.	**Not Significant**

Likely Significant Effect Without Mitigation	Mitigation Proposed	Means of Implementation	Outcome / Residual Effect
chemical pollution, alteration of sub-surface flows and lowering groundwater table.			
Effects on GWDTE Moderate/ minor (**non-significant**) effects on GWDTE	None required. Good practice drainage management proposals to ensure groundwater flow and hydraulic continuity is maintained.	Condition of Consent requiring scope of final CEMP to be agreed.	**Not Significant**
Operation			
Sediment related pollution and chemical contamination None – Minor (**non-significant**) effects associated with alterations to runoff volumes and rates and fluvial morphology through the alteration of drainage patterns. Groundwater recharge through impermeable surfaces. Sediment related pollution and chemical contamination of surface or groundwater.	None required. Ongoing maintenance for all proposed drainage measures on the Site, particularly including water crossings and sustainable drainage features designed to manage water quality and runoff rate. Maintenance schedule for site operation to follow good practice for managing hazardous chemicals.	Relevant legislation and good practice measures for site operation to be followed.	**Not significant**
GWDTE No impact (**non-significant**) for GWDTE during operation further to those identified for the construction phase.	None required.	N/A	**Not significant**
Cumulative Construction			
No additional effects anticipated			
Cumulative Operation			

Likely Significant Effect Without Mitigation	Mitigation Proposed	Means of Implementation	Outcome / Residual Effect
No additional effects anticipated			

10.13 References

Scottish Government (2021): *Drinking water protected areas – Scotland river basin district: maps*, available online at: https://www.gov.scot/publications/drinking-water-protected-areas-scotland-river-basin-district-maps/, [last accessed on 06 April 2021].

SEPA, (November 2010) *Engineering in the water environment: good practice guide – River crossings*, Second edition, available online at: https://www.sepa.org.uk/media/151036/wat-sg-25.pdf, [last accessed on 06 April 2021].

SEPA (September 2017): GPP 4: Treatment and disposal of wastewater where there is no connection to the public foul sewer, in: *LUPS-GU31: Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems*, Version 3.

SEPA (2018): *Works and Maintenance in or Near water: GPP5.*

SEPA (February 2018): *Supporting Guidance (WAT-SG-75), Sector Specific Guidance: Construction Sites,* available online at: https://www.sepa.org.uk/media/340359/wat-sg-75.pdf, [last accessed on 06 April 2021].

SEPA (2021): *Flood Maps*, available online at: https://map.sepa.org.uk/floodmap/map.htm, [last accessed on 06 April 2021].

SEPA (2021): *River Basin Management Plan: Water Environment Hub*, available online at: https://www.sepa.org.uk/data-visualisation/water-environment-hub/, [last accessed on 06 April 2021].

SNIFFER (2007): *WFD66 – Wetland Hydrogeomorphic Classification for Scotland*.

Susdrain (2015): *The SUDS Manual (C753) 2015*, available online at: https://www.susdrain.org/resources/SuDS_Manual.html, [last accessed on 06 April 2021].