Figures

13. Geology, Hydrology and Hydrogeology

13.1 Summary

13.1.1 This chapter considers the potential effects of the proposed Limekiln Wind Farm Section 36C Variation Application (hereafter referred to as the 'Revised Consented Development') on geology, hydrology and hydrogeology.

13.1.2 The scope of the assessment was determined through a combination of a desk study to identify the baseline water environment setting relating to the site and surrounding area and consultation with relevant stakeholders.

13.1.3 The assessment has highlighted several potential effects on site hydrology and hydrogeology, primarily during wind farm construction, but potentially also during site operation. These effects are associated with a range of activities, most notably access track construction. The most serious potential effects are associated with sediment-laden runoff from exposed ground entering watercourses.

13.1.4 Mitigation measures incorporated into the scheme's design would reduce the likelihood and magnitude of a pollution event or other impact resulting from the Revised Consented Development'. These mitigation measures have been defined for each element of the on-site development. The measures would be undertaken in accordance with current best practice and would ensure that there are no significant effects on hydrological or hydrogeological receptors as a result of the Rpevised Consented Development.

13.1.5 Also, no significant operational, decommissioning or cumulative effects are predicted as a result of the Revised Consented Development.

13.2 Introduction

13.2.1 This chapter considers the potential effects of the Revised Consented Development on geology, hydrology and hydrogeology during its construction, operation and decommissioning phases.

Background

13.2.2 An assessment of the potential hydrological and hydrogeological effects of the proposed Limekiln Wind Farm was undertaken for the Environmental Statement (ES) submitted in 2012. The assessment was based on the collection of a wide range of data and information from published material, plus consultations with statutory bodies, principally the Scottish Environment Protection Agency (SEPA) and The Highland Council (THC), and other stakeholders relating to the local and wider hydrological environment. In addition, a site visit by a Wood hydrologist was undertaken on 03 November 2011, which permitted an inspection of water features and an assessment of the existing land use within the site.

13.2.3 The original proposal was the subject of a Public Local Inquiry (PLI). The overall conclusions in the Report to Scottish Ministers in 2015 stated that 'Other than the potential impact on wild land, we conclude that the proposal would not give rise to any detrimental impacts, either singly or cumulatively, sufficient to outweigh the benefits of the proposal.'

13.2.4 In 2016 the Applicant submitted a Section 36 Application with the same proposed infrastructure and layout as the first Section 36 Application submitted

in 2012. The Application, ES and other documents that were submitted in support took account of relevant changes in policy or guidance that had occurred in the intervening period since the first Application and was supported by additional information regarding wild land and updated information on cumulative impacts.

13.2.5 In February 2017 the planning committee of THC voted to object to the Section 36 Application on the grounds of a loss of recreational amenity close to the village of Reay and an unacceptable impact on Wild Land Area 39 - East Halladale Flows. The Scottish Ministers therefore referred the Section 36 Application to the Directorate for Planning and Environmental Appeals (DPEA) to be examined at PLI.

13.2.6 In response to this, the Applicant removed three turbines (T19, T20 and T21) and the associated access tracks from the proposed wind farm. Supplementary Information (SI) to support this layout was submitted in September 2017 and it was consented by the Scottish Ministers in June 2019 (hereafter it is referred to as the 'Consented Development'). The Applicant has subsequently satisfied the planning conditions required for construction to commence and has commenced construction.

13.2.7 **Table 13.1** presents a summary of the conclusions from the previous applications highlighted above, and from the Revised Consented Scheme.

Table 13.1 Summary of conclusions for geology, hydrology and hydrogeology from previous applications

2012 ES (24 Turbine Layout)	2016 ES (24 Turbine Layout)	2017 SI (21 turbine layout - Consented Development)	2021 Section 36C Application (21 Turbine Layout with amended access tracks – Revised Consented Development)
The assessment highlighted several potential effects, primarily during wind farm construction (though potentially also during site operation and decommissioning). These effects were associated with a range of activities, most notably access track construction and the resulting potential of sediment-laden runoff from exposed ground entering watercourses. Specific mitigation measures were	As outlined above, the Applicant submitted this Application with the same proposed infrastructure and layout as the that submitted in 2012. This ES took account of relevant changes in policy or guidance that had occurred in the intervening period since the first Application and was supported by additional information regarding wild land and updated	No supplementary information was required to be submitted for geology, hydrology and hydrogeology.	This EIA Report takes account of relevant changes in policy or guidance since the previous Application and up-to-date data sources. With the removal of proposed works within the Sandside Burn catchment and with a Water Quality Monitoring Plan already being implemented, this EIA concludes that the potential effects upon the water environment were

2012 ES (24 Turbine Layout)	2016 ES (24 Turbine Layout)	2017 SI (21 turbine layout - Consented Development)	2021 Section 36C Application (21 Turbine Layout with amended access tracks – Revised Consented Development)
identified to reduce the likelihood and magnitude of a pollution event or other impact resulting from the development on the water environment, namely implementation of a Drainage Management Plan; implementation of a Pollution Prevention Plan; and adequate pollution control measures throughout the site. All mitigation would be included within the Construction Method Statements (CMS) for the site, and specific CMS would be produced for the most sensitive construction operations. All activities would adhere to best practice guidance and follow appropriate requirements and conditions associated with Controlled Activities Regulations (CAR) licensing. With the application of the specific mitigation measures and best practice that was identified in the assessment, the overall potential effects upon the water environment, predicted to result from the proposed development, were assessed as not significant for all potential receptors and for all proposed activities.	information on cumulative impacts. This Application included a requirement for PWS and surface water quality monitoring (secured by condition to the grant of any consent). As with the previous Application, the potential effects upon the water environment were assessed as not significant for all potential receptors and for all proposed activities.		the same as previously i.e. not significant for all potential receptors and for all proposed activities.

13.2.8 A detailed description of the Revised Consented Development and an overview of the construction methodology is provided within **Chapter 4: Description of Revised Consented Development**; the planning context for the Revised Consented Development is provided within **Chapter 5: Policy Context**.

13.2.9 Groundwater Dependent Terrestrial Ecosystems (GWDTEs) are discussed in this chapter but are also identified in the ecology assessment in **Chapter 11: Ecology**.

13.2.10 This chapter is supported by the following Technical Appendices:

- Technical Appendix 13.A Peat Management Plan (PMP); and
- Technical Appendix 13.B Peat Slide Risk Assessment (PSRA).

13.2.11 This chapter is supported by **Figures 13.1** to **13.6**.

13.3 Legislation, Policy Context and Technical Guidance

Legislation and Policy

13.3.1 This Section provides the key legislation and planning context for the Project, together with a listing of relevant key technical guidance.

Legislation

13.3.2 The key legislative drivers relating to the water environment that have been considered in this assessment include the following (in chronological order, oldest first):

- Control of Pollution Act 1974 (as amended);
- Agriculture Act 1986;
- Environment Protection Act 1990;
- Land Drainage Act 1991 and 1994;
- Water Resources Act 1991 and 1994;
- Environment Act 1995;
- Pollution Prevention and Control Act 1999;
- Control of Substances Hazardous to Health Regulations 2002 (COSHH);
- Water Environment and Water Services (Scotland) Act 2003 (WEWS), as amended by the Environment (EU Exit) (Scotland) (Amendment etc.) Regulations 2019;
- Landfill (Scotland) Regulations 2003;
- Water Environment (Register of Protected Areas) (Scotland) Regulations 2004;
- Nature Conservation (Scotland) Act 2004;

- Private Water Supplies (Scotland) Regulations 2006;
- Water Environment (Oil Storage) (Scotland) Regulations 2006;
- Environmental Liability (Scotland) Regulations 2009, as amended by the Environment (EU Exit) (Scotland) (Amendment etc.) Regulations 2019;
- Flood Risk Management (Scotland) Act 2009;
- Flood Risk Regulations 2009;
- Water Environment (Groundwater and Priority Substances) (Scotland) Regulations 2009;
- Flood and Water Management Act 2010;
- Water Quality (Scotland) Regulations 2010;
- Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) (CAR);
- Waste Management Licensing (Scotland) Regulations 2011;
- Water Environment (Controlled Activities) (Scotland) Amendment Regulations 2013 (CAR);
- Water Environment (Drinking Water Protected Areas) (Scotland) Order 2013;
- Water Act 2014;
- Construction Design and Management Regulations 2015;
- Water Environment (Miscellaneous) (Scotland) Regulations 2017;
- Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017; and
- Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017, as amended.

13.3.3 The requirements of various EU directives such as the Water Framework Directive (WFD, 2000/60/EC), the European Liability Directive (2004/35/EEC) and the Groundwater Daughter Directive (2006/118/EEC) have been transposed into domestic legislation as indicated by the Environment (EU Exit) (Scotland) (Amendment etc.) Regulations 2019. Previously the WFD and now the Environment Regulations 2019 and supporting domestic legislation establish a legal framework for the protection, improvement and sustainable use of surface waters, transitional waters, coastal waters and groundwater resources.

13.3.4 The regulation of activities relating to the water environment is implemented through CAR. This covers activities including abstraction, discharges, impoundments and engineering works that could impact on a watercourse.

Depending on the size and nature of the activity, General Binding Rules (GBRs) need to be followed, the activity registered, or a full licence obtained.

Planning Policy Context

13.3.5 The National Planning Framework (NPF) 3 was published in June 2014 (and revised in December 2020) and sets the long-term context for development planning in Scotland. However, it does not contain any specific policies regarding geology, hydrology and hydrogeology, and onshore wind energy developments.

13.3.6 The Scottish Government (SGt) Scottish Planning Policy (SPP) was published in June 2014 (and revised in December 2020) and sets out national planning policies that reflect the priorities of the Scottish Ministers for the operation of the planning system and the development and use of land through sustainable economic growth. SPP paragraphs 161 -166 relate to onshore wind farms in general, whilst SPP 254 - 268 specifically cover flooding and drainage, and so both sets of policies are summarised at the head of **Table 13.2**.

13.3.7 National planning policy is supported by Planning Circulars, Planning Advice Notes (PANs), and Specific Advice Sheets (SASs), as well as Ministerial/Chief Planning Letters to Planning Authorities, which set out detailed advice from the SGt in relation to planning issues. The PANS and SASs considered most relevant to the Project are also summarised in **Table 13.2** (in chronological order, oldest first).

13.3.8 There have been no other changes to the key national planning policy documents since their publication. However, the following relevant changes to national guidance and advice publications have occurred:

- the SGt's Chief Planner issued a letter regarding renewable energy targets and the consideration of socio-economic impacts (dated 11th November 2015) and Draft Advice on Net Economic Benefit and Planning (March 2016);

- the Carbon and Peatland Map 2016, published by Scottish Natural Heritage (SNH, now NatureScot (NS)) on 29th June 2016, identifies areas considered likely to host Scotland's nationally important resource of deep peat, carbon rich soils and priority peatlands habitats. Under Table 1 of the SPP these are to be identified on wind energy spatial frameworks as "Group 2 – Areas of Significant Protection"; and

- in June 2016, the SGt published its draft Peatland and Energy Policy Statement, which provides the basis from which the SGt and its agencies will act in developing and implementing policies in relation to peatland and energy. This policy is a material consideration for new energy developments and the impact they may have on peatland habitats.

Development Plan Policies

13.3.9 The statutory development plan applicable to the Revised Consented Development comprise the Highland-wide Local Development Plan (HwLDP, adopted 5th April 2012) together with statutory Supplementary Planning Guidance (SPG), including that for Wind Energy Development (adopted December 2017). The Development Plan policies particularly relevant to water

are also listed in **Table 13.2**. The Wind Energy Development SPG requires such development proposals to demonstrate that they have been designed to minimise any detrimental impact on the water environment.

Table 13.2 Planning policy issues relevant to geology, hydrology and hydrogeology

Policy reference	Policy issue	Considered in Section
National planning policies		
SGt SPP 2014, paragraphs 161 - 166	These policies provide guidance to planning authorities on setting out of a spatial framework for identifying areas that are likely to be most appropriate for onshore wind farms. The framework aims to deliver consistency nationally. It is also complemented by a more detailed and exacting development management process where the merits of an individual proposal will be carefully considered against the full range of environmental, community and cumulative impacts.	13.7
SGt SPP 2014, paragraphs 254 - 268	The SPP provides guidance to planners and developers on how to approach the issues of flood risk and drainage. It establishes that a precautionary approach to flood risk from all sources should be taken, alongside ensuring development proposals would increase the flood resilience of their surroundings. Development proposals that would have a significant probability of being affected by flooding or increase the probability of flooding occurring elsewhere are not permitted by the SPP.	13.6 (paragraph 13.6.35-36) 13.8 (paragraph 13.8.7)
SGt Controlling the Environmental Effects of Surface Mineral Workings (PAN 50), October 1996	This PAN gives good practice advice for planners and developers on the more significant environmental effects arising from mineral working operations, including borrow pits.	13.8 (paragraph 13.8.37)
SGt Planning and Sustainable Urban Drainage Systems (PAN 61), July 2001	This PAN gives good practice advice for planners and developers on the use of sustainable drainage systems (SuDS) and complements the Sustainable Urban Drainage Systems Design Manual for Scotland and Northern Ireland.	13.8 (paragraph 13.8.35)
SGt Water and Drainage (PAN 79), September 2006	This PAN clarifies the role of the planning authority in setting the direction of development to inform the planning and delivery of new water infrastructure in a coordinated way. It explains the role of Scottish Water (SW) and SEPA and encourages joint working to ensure a common understanding of capacity constraints and agreement on the means of their removal. It advises on the appropriateness of private schemes and the handling of SW developments.	N/A

Policy reference	Policy issue	Considered in Section
SGt Wind Farm Developments on Peat Land, May 2013	The SGt has supported the development of the carbon calculator for use in the consideration of carbon savings from wind farm developments on peatlands. Originally published in 2008, a revised version launched in June 2011 refined the calculator following feedback and further research and is an even more effective tool.	**Chapter 8: Climate Change and Carbon Balance**
SAS (updated 28 May 2014): Onshore Wind Turbines	This provides advice for planning authorities on planning issues to be considered in relation to onshore wind farms, including water.	**Chapter 5: Policy Context**
SAS: Peatland Survey 2017: Guidance on Developments on Peat Land	This guidance defines a consistent sampling methodology to quantify and qualify the peat material on-site and provides advice as to how to publish peat surveys as part of a developer's wider site investigations.	Technical **Appendix 13.A**: PMP
Development plan policies		
Highland Wide Local Development Plan 2012 (HwLDP 2012)		
Policy 28: Sustainable Design	This policy sets out the requirement for all development to be designed in the context of sustainable development and climate change. Proposed developments will be assessed in various ways including on the extent to which they: • demonstrate that they have sought to minimise the generation of waste during the construction and operational phases; and • impact on the following resources, including pollution and discharges: habitats, freshwater systems, species, marine systems, landscape etc., particularly within designated areas. Where environmental and/or socio-economic impacts of a proposed development are likely to be significant by virtue of nature, size or location, THC will require the preparation by developers of appropriate impact assessments. Developments that will have significant adverse effects will only be supported if no reasonable alternatives exist, if there is demonstrable over-riding strategic benefit or if satisfactory overall mitigating measures are incorporated.	**Chapter 13: Geology, Hydrology and Hydrogeology**
Policy 36: Development in the Wider Countryside	Renewable energy development proposals will be assessed against the Renewable Energy Policies, the non-statutory Highland Renewable Energy Strategy and where appropriate, Onshore Wind Energy: Supplementary Guidance.	N/A

Policy reference	Policy issue	Considered in Section
Policy 53: Minerals	THC will support the following areas for mineral extraction: • Extension of an existing operation/site; • Re-opening of a dormant quarry; • A reserve underlying a proposed development where it would be desirable to extract prior to development. Before a new site for minerals development will be given permission, it must be shown that other existing reserves have been exhausted or are no longer viable or, for construction aggregates, amount to less than a ten-year supply of permitted reserves. All minerals developments will have to provide information on pollution prevention, restoration and mitigation proposals. Restoration should be carried out in parallel with excavation where possible. Otherwise it should be completed in the shortest time practicable. Planning conditions will be applied to ensure that adequate provision is made for the restoration of workings. THC will expect all minerals developments to avoid or satisfactorily mitigate any impacts on residential amenity, the natural, built and cultural heritage, and infrastructure capacities. After uses should result in environmental improvement rather than just restoring a site to its original state. After uses should add to the cultural, recreational or environmental assets of an area. A financial guarantee may be sought.	4.4 (paragraphs 4.4.44-47) 13.8 (paragraph 13.8.37)
Policy 55: Peat and Soils	Development proposals should demonstrate how they have avoided unnecessary disturbance, degradation or erosion of peat and soils. Unacceptable disturbance of peat will not be permitted unless it is shown that the adverse effects of such disturbance are clearly outweighed by social, environmental or economic benefits arising from the development proposal. Where development on peat is clearly demonstrated to be unavoidable then THC may ask for a peatland management plan to be submitted which clearly demonstrates how impacts have been minimised and mitigated. Proposals must also demonstrate to THC's satisfaction that extraction would not adversely	13.6 (paragraph 13.6.14) 13.8 (paragraphs 13.8.38-43)

Policy reference	Policy issue	Considered in Section
	affect the integrity of nearby Natura sites containing areas of peatland.	
Policy 63: Water Environment	This policy states that THC will support proposals for developments that do not compromise the objectives of the Water Framework Directive (2000/60/EC), which is aimed at the protection and improvement of Scotland's water environment. In assessing proposals, THC will consider the River Basin Management Plan for the Scotland River Basin District and associated Area Management Plans and supporting information for opportunities for improvements and constraints.	13.6 (paragraph 13.6.23) 13.8 (paragraph 13.8.7) **Figure 13.6**
Policy 64: Flooding	Development proposals should avoid areas susceptible to flooding and promote sustainable flood management. Development proposals within or bordering medium to high flood risk areas, will need to demonstrate compliance with SPP through the submission of suitable information which may take the form of a Flood Risk Assessment (FRA). Development proposals outwith indicative medium to high flood risk areas may be acceptable. However, where: • better local flood risk information is available and suggests a higher risk; • a sensitive land use (as specified in the risk framework of SPP) is proposed; • the development borders the coast and therefore may be at risk from climate change; and/or • the development borders the coast and therefore may be at risk from climate change; a Flood Risk Assessment or other suitable information which demonstrates compliance with SPP will be required. Developments may also be possible where they are in accord with the flood prevention or management measures as specified within a local (development) plan allocation or a development brief. Any developments, particularly those on the flood plain, should not compromise the objectives of the EU WFD. Where flood management measures are required, natural methods such as restoration of floodplains, wetlands and water bodies should be incorporated, or adequate justification should be provided as to why they are impracticable.	13.6 (paragraphs 13.6.27-28) 13.8 (paragraph 13.8.7)

Policy reference	Policy issue	Considered in Section
Policy 66: Surface Water Drainage	All proposed developments must be drained by SuDS designed in accordance with The SuDS Manual (CIRIA C753) and, where appropriate, the Sewers for Scotland Manual 2nd Edition. Planning applications should be submitted with information in accordance with Planning Advice Note 69: Planning and Building Standards Advice on Flooding paragraphs 23 and 24. Each drainage scheme design must be accompanied by particulars of proposals for ensuring long-term maintenance of the scheme.	13.8 (paragraphs 13.8.16-23 & 13.8.35)
Policy 67: Renewable Energy Developments	The Council will consider: • the contribution of the proposed development towards meeting renewable energy generation targets; and • any positive or negative effects it is likely to have on the local and national economy. Subject to balancing with these considerations and considering any mitigation measures to be included, THC will support proposals where it is satisfied that they are located, sited and designed such that they will not be significantly detrimental overall, either individually or cumulatively with other developments, having regard in particular to any significant effects on, for example, groundwater, surface water (including water supply), aquatic ecosystems and fisheries.	13.9, 13.10 & 13.12

Technical Guidance

13.3.10 Relevant policy and general guidance utilised includes the following (in alphabetical order, by lead author organisation and then by report number or date of publication, oldest first):

- British Standards (BS):
  - BS6031: 2009 Code of Practice for Earth Works (2009);
  - BS5930:2015+A1:2020 Code of Practice for Site Investigations (2015); and
  - BVS10175:2011 Code of Practice for Investigation of Potentially Contaminated Sites (2011).
- Construction Industry Research and Information Association (CIRIA) reports:
  - Report C515: Groundwater Control - Design and Practice, second edition (2016);
  - Report C521: Sustainable Urban Drainage Systems - Design Manual for Scotland and Northern Ireland (2000);
  - Report C532: Control of Water Pollution from Construction Sites (2001);
  - Report C624: Development and Flood Risk - Guidance for the Construction Industry (2004);

  - Report C648: Control of Water Pollution from Linear Construction Projects (2006);
  - Report C649: Control of Water Pollution from Linear Construction Projects - Site Guidance (2006);
  - Report C650: Environmental Good Practice on Site, second edition (2005);
  - Report C651: Environmental Good Practice - Pocket Book (2005);
  - Report C689: Culvert Design and Operation Guide (2010);
  - Report C692: Environmental Good Practice on Site (2010);
  - Report C698: Site Handbook for the Construction of SUDS (2007); and
  - Report C753: The SUDS Manual (2015).

- Department for Food, Environment and Rural Affairs (Defra) Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (2009);

- Forestry Commission (FC), Forestry Commission Scotland (FCS) and co-authored reports:
  - FC Forestry Practice Guide: Whole-Tree Harvesting: A Guide to Good Practice (1997);
  - FCS and SNH Floating Roads on Peat (2010);
  - FC Forests and Water Guidelines, 5th Edition (2011);
  - FC Forests and Soil Guidelines (2011); and
  - FC The UK Forestry Standard (2017).

- Ministry of Agriculture, Forestry and Food (MAFF) Good Practice Guide for Handling Soils (2000);

- Scotland and Northern Ireland Forum for Environmental Research (SNIFFER) A Functional Wetland Typography for Scotland (2009);

- SEPA lead author publications:
  - Engineering in the Water Environment: Good Practice Guide – Temporary Construction Methods (2009);
  - Regulatory Position Statement - Developments on Peat (February 2010);
  - Guidance on Developments on Peatland – Site Surveys, SEPA and Scottish Renewables (2014);
  - CAR: A Practical Guide (2015);
  - Guidance: Life Extension and Decommissioning of Onshore Wind Farms (2016);
  - Guidance WST-G-052: Development on Peat and Off-site Uses of Waste Peat (2017);
  - Planning Information Note 3: Flood Risk Advice for Planning Authorities (August 2017);
  - Technical Flood Risk Guidance for Stakeholders (July 2018);

- SEPA Flood Risk Standing Advice for Planning Authorities and Developers (November 2020); and
- CAR Flood Risk Standing Advice for Engineering, Discharge and Impoundment Activities (undated).

- SEPA Land Use Planning System Guidance Notes (LUPS-GU):
  - No. 4: Planning Guidance on On-shore Windfarm Developments (2017);
  - No. 8: SEPA Standing Advice for Planning Authorities and Developers on Development Management Consultations (2016);
  - No. 27: Use of Trees Cleared to Facilitate Development on Afforested Land (2014);
  - No. 31: Guidance on Assessing the Impacts of Windfarm Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems (2017); and
  - No. 50 - Controlling the Environmental Effects of Surface Mineral Workings.

- SEPA Policies:
  - No. 19: Groundwater Protection Policy for Scotland (2009); and
  - No. 41: Development at Risk of Flooding: Advice and Consultation (Oct 2016).

- SEPA Guidance for Pollution Prevention (GPP) Notes and former (now discontinued) Pollution Prevention Guidance (PPG) Notes:
  - GPP 1 Understanding your Environmental Responsibilities – Good Environmental Practices (October 2020);
  - GPP 2: Above Ground Oil Storage Tanks (January 2018);
  - PPG 3: Use and Design of Oil Separators in Surface Water Drainage Systems (April 2006);
  - GPP 4: Treatment and Disposal of Wastewater where there is no Connection to the Public Foul Sewer (November 2017);
  - GPP 5: Works and Maintenance in or near Water (February 2018);
  - PPG 6: Working at Construction and Demolition Sites (2012);
  - GPP 8: Safe Storage and Disposal of Used Oils (July 2017);
  - GPP 13: Vehicle Washing and Cleaning (April 2017);
  - PPG 18: Managing Fire Water and Major Spillages (June 2000);
  - GPP 20: Dewatering of Underground Ducts and Chambers (January 2018);
  - GPP 21: Pollution Incident Response Planning (July 2017); and
  - GPP 26: Safe storage of Drums and Intermediate Bulk Containers (February 2019).

- SEPA Position Statements (PS) and Supporting Guidance (SG), namely:
  - WAT-PS-06-02 Culverting of Watercourses (June 2015);
  - WAT-PS-07-02 Bank Protection (April 2012);
  - WAT-PS-10-01 Assigning Groundwater Assessment Criteria for Pollutant Inputs (August 2014);

- WAT-SG-21: Bank Protection Environmental Standards for River Morphology (July 2012);
- WAT-SG-23: Engineering in the Water Environment, Good Practice Guide, Bank Protection Rivers and Lochs, First edition (April 2008);
- WAT-SG-25: Engineering in the Water Environment, Good Practice Guide, River Crossings, Second edition (November 2010);
- WAT-SG-26: Engineering in the Water Environment, Good Practice Guide, Sediment Management, First edition (June 2010);
- WAT-SG-29: Engineering in the Water Environment, Good Practice Guide, Temporary Construction Methods, First edition (March 2009);
- WAT-SG-31: Prevention of Pollution from Civil Engineering Contracts: Special Requirements, Version 2 (June 2006);
- WAT-SG-75: Sector Specific Guidance: Construction Sites (February 2018); and
- WAT-SG-78: Sediment Management Authorisation (December 2012).

- SGt publications:
  - River Crossings and Migratory Fish: Design Guidance (2000);
  - Scotland's Zero Waste Plan (June 2010);
  - PAN 1/2013 - Environmental Impact Assessment (August 2013);
  - Planning Advice on Flood Risk (June 2015); and
  - Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments, second edition (April 2017)

- SNH lead author publications:
  - Guidelines on the Environmental Impacts of Wind Farms and Small Scale Hydroelectric Schemes (2001);
  - Constructed Tracks in the Scottish Uplands, Second edition (Updated September 2015);
  - Siting and Designing Wind Farms in the Landscape (2014); and
  - Environmental Impact Assessment Handbook V5 (2018).

- Scottish Renewables (SR) lead publications:
  - SR and SEPA Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste (January 2012); and
  - SR, SNH, SEPA, FCS, Historic Environment Scotland (HES), Marine Scotland Science (MSS) and Association of Environmental and Ecological Clerks of Works (AEECoW), Good Practice During Wind Farm Construction, Fourth edition (2019).

- Local and Regional Land Drainage Byelaws.

13.4 Stakeholder Consultation

13.4.1 In undertaking the assessment, consideration has been given to the scoping responses and other consultation undertaken with relevant organisations as detailed in **Table 13.3**.

13.4.2 **Table 13.3** summarises the consultation responses and provides information on where and how they have been addressed in the assessment, where relevant.

Table 13.3 Consultation responses relevant to geology, hydrology and hydrogeology

Consultee and Date	Scoping/Other Consultation	Issue Raised	Response/Action Taken
THC – 23 April 2021	Scoping	The EIAR should include a full assessment on the impact of the development on peat. The assessment of the impact on peat must include peat probing for all areas where development is proposed. THC is of the view this should include probing not just at the point of infrastructure as proposed by the scheme but also covering the areas of ground which would be subject to micro-siting limits.	Refer to **Appendices 13.A** and **13.B**
		Where borrow pits are proposed the EIAR should include information regarding the location, size and nature of these borrow pits including information on the depth of the borrow pit floor and the borrow pit final reinstated profile. This can avoid the need for further applications.	Refer to **Chapter 4: Description of Revised Consented Development**
		Impacts on watercourses, lochs, groundwater, other water features and sensitive receptors, such as water supplies, need to be assessed.	Refer to Section 13.9
		Measures to prevent erosion, sedimentation or discolouration will be required, along with monitoring proposals and contingency plans.	Refer to Section 13.8
		The Applicant is strongly advised at an early stage to consult SEPA as the regulatory body responsible for the implementation of the CAR, to identify if a CAR license is	Outline of requirement for a Construction Site Licence (CSL, paragraph 13.8.12), CAR licence for dewatering (13.8.37) and authorisation under CAR

Consultee and Date	Scoping/Other Consultation	Issue Raised	Response/Action Taken
		necessary and the extent of the information required by SEPA to assess any license application.	for culverting of watercourses (13.8.29)
		The applicant will be required to carry out an investigation to identify any private water Supplies (PWSs), including pipework, which may be adversely affected by the development and to submit details of the measures proposed to prevent contamination or physical disruption.	PWSs identified in Section 13.6 (paragraphs 13.6.34-35). Mitigation proposed to protect PWSs includes 250 m groundwater abstraction buffer (13.8.9)
		The EIAR should include an assessment of the effects on GWDTEs.	GWDTEs identified (paragraphs 13.6.40-43) and effects evaluated in Section 13.7
NatureScot (NS) – 8 April 2021	Scoping	NS welcomes the proposals to undertake peat depth surveys for the new infrastructure locations. A PSRA should also be undertaken.	Appendices 13.A and 13.B
		The application site borders the Caithness and Sutherland Peatlands SAC. In its response to the S36 Application for the consented proposal, dated 31 August 2016, NS was satisfied that there would be no adverse effects on the integrity of the SAC providing the prescribed mitigation was adhered to.	Caithness and Sutherland Peatlands SAC is scoped out of the assessment (Section 13.7)

13.5 Assessment Methodology and Significance Criteria

13.5.1 The generic project-wide approach to the assessment methodology is set out in **Chapter 3: Approach to Preparing the Environmental Impact Assessment Report**. This section here describes how the methodology is applied and adapted as appropriate to address the specific needs of the water environment assessment.

13.5.2 The current and future baseline presented in Section 13.6 provide the benchmark against which the potential impact of the Revised Consented Development, alone and cumulatively with other wind farm developments is assessed.

13.5.3 The significance of the effects resulting from the Revised Consented Development is primarily determined by reference to the value (importance) of a given water feature and the magnitude of change. In terms of hydrology and hydrogeology, the key types of effects relate to water quantity (level and flow)

and quality. However, depending on the effects on surface water flows, there may also be effects on immediate and downstream morphology and sediment dynamics and flood risk.

13.5.4 Therefore, the assessment presented in Section 13.9 is based on both receptor value and the nature and magnitude of the effect as a result of the Revised Consented Development. All mitigation considered necessary is identified and residual effects with this mitigation in place determined. It is intended that no residual significant effects remain following adoption of the proposed mitigation.

13.5.5 **Table 13.4** provides a summary of the criteria that are used in the assessment of the water feature value and introduces the concept of receptor type (groups of receptors whose value is assessed using the same criteria). The criteria are semi-quantitative and therefore professional judgement is required in the assessment.

13.5.6 The magnitude of change on water receptors is independent of the value of the receptor, and its assessment is semi-quantitative and again reliant in part on professional judgement. **Table 13.5** provides examples of how various levels of change have been determined with respect to water features.

13.5.7 The EIA Regulations require that a final judgement is made about whether the effects are likely to be significant. The significance of water-related effects is derived by considering both the value of the feature and the magnitude of change. In this assessment, effects are significant or not significant according to the matrix in **Table 13.6**, with 'Major' and 'Moderate' effects taken to be 'Significant'. Significance can be 'Beneficial', 'Adverse' or 'Neutral'.

13.5.8 It is important to recognise that 'significant' effects on geology, hydrology and hydrogeology receptors do not necessarily mean that the same outcomes would occur in respect of the same receptors that may also be ecology receptors. Indeed, because of the different value and magnitude criteria used by the two assessments, it is possible that effects assessed as 'Not significant' in one environmental topic assessment, e.g. geology, hydrology and hydrogeology, can still sit alongside effects assessed as 'Significant' in another environmental topic assessment, e.g. ecology, and vice-versa.

Table 13.4 Summary of value of geology, hydrology and hydrogeology receptors

Value	Criteria	Receptor type*	Examples
High	Features with a high yield, quality or rarity with little potential for substitution.	Aquatic environment	Conditions supporting a site with an international conservation designation (Special Area of Conservation (SAC), Special Protection Area (SPA), Ramsar), where the designation is based specifically on aquatic features. WFD surface water body (or part thereof) with overall High status, also any associated upstream non-reportable WFD surface water body or non-WFD surface water body. WFD surface water body (or part thereof) with High status for morphology.
	Water use supporting human health and economic activity at a regional scale.	Water use	CAR-licensed public surface water or groundwater supply (and associated catchment) or permitted discharge.
	Features with a high vulnerability to flooding.	Flood risk	Land use type defined as 'Essential Infrastructure' (i.e. critical national infrastructure, such as essential transport and utility infrastructure) and 'Most Vulnerable Use' (e.g. police/ambulance stations that are required to operate during flooding, mobile homes intended for permanent residential use) in the SPP flood risk land use vulnerability classification.
Medium	Features with a medium yield, quality or rarity, with a limited potential for substitution.	Aquatic environment	Conditions supporting a site with a national conservation designation (e.g. Site of Special Scientific Interest (SSSI), National Nature Reserve (NNR)), where the designation is based specifically on aquatic features. WFD surface water body (or part thereof) with overall Good status/potential, also any associated upstream non-reportable WFD surface water body or non-WFD surface water body. WFD groundwater body (or part thereof) with overall Good status.
	Water use supporting human health and economic activity at a local scale.	Water use	Local public surface water and groundwater supply (and associated catchment) or permitted discharge. CAR-licensed non-public surface water and groundwater supply abstraction (and associated groundwater catchment) which is relatively large relative to available resource, or where raw water quality is a critical issue e.g. industrial process water or permitted discharge.
	Features with a medium vulnerability to flooding.	Flood risk	Land use type defined as 'Highly Vulnerable Use' in the SPP flood risk land use vulnerability classification e.g. most types of residential development, hostels and hotels, landfill and waste management facilities.

Value	Criteria	Receptor type*	Examples
Low	Features with a low yield, quality or rarity, with some potential for substitution.	Aquatic environment	Conditions supporting a site with a local conservation designation (e.g. Local Nature Reserve (LNR)), where the designation is based specifically on aquatic features, or an undesignated but highly/moderately water-dependent ecosystem, including a Listed Wildlife Site (LWS) and a GWDTE. WFD surface water body (or part thereof) with overall Moderate or lower status/potential, also any associated upstream non-reportable WFD surface water body or non-WFD surface water body. Groundwater body (or part thereof) with overall Poor status.
	Water use supporting human health and economic activity at household/individual business scale.	Water use	CAR-registered non-public surface water and groundwater supply abstraction (and associated catchment), which is relatively small relative to available resource, or where raw water quality is not critical, e.g. cooling water, spray irrigation, mineral washing or permitted discharge. Unregistered potable surface water and groundwater abstraction (and associated catchment) e.g. private domestic water supply, well, spring or permitted discharge.
	Features with a low vulnerability to flooding.	Flood risk	Land use type defined as 'Least Vulnerable' in the SPP flood risk land use vulnerability classification e.g. most types of business premises.
Very Low	Commonplace features with very low yield or quality with good potential for substitution.	Aquatic environment	Conditions supporting an undesignated and low water-dependent ecosystem, including a LWS, GWDTE and pond. Non-reportable WFD surface water body (or part thereof), or non-WFD surface water body, not associated with any downstream WFD surface water body. Non-reportable WFD groundwater body (or part thereof), or non-WFD groundwater body including non-abstraction springs.
	Water use does not support human health, and of only limited economic benefit.	Water use	Unregistered non-potable surface water and groundwater abstraction (and associated catchment) e.g. livestock supply.
	Features that are resilient to flooding.	Flood risk	Land use type defined as 'Water-compatible use' in the SPP flood risk land use vulnerability classification and undeveloped land e.g. flood control infrastructure; water transmission infrastructure.

*Receptor types map onto the Table receptor lists as follows:

- Aquatic environment – aquifers and WFD groundwater bodies, watercourses and WFD surface water bodies, conditions supporting GWDTEs and conservation sites
- Water use – springs, abstractions
- Flood risk – humans, properties and infrastructure.

Table 13.5 Summary of geology, hydrology and hydrogeology magnitude of change

Magnitude	Criteria	Receptor type	Example*
High	Results in major change to feature, of sufficient magnitude to affect its use/integrity.	Aquatic environment	Deterioration in river flow regime, morphology or water quality, leading to sustained, permanent or long-term breach of relevant conservation objectives (COs) or non-temporary downgrading (deterioration) of WFD surface water body status (including downgrading of individual WFD elements) or dependent receptors, or resulting in the inability of the surface water body to attain Good status in line with the measures identified in the RBMP. Deterioration in groundwater levels, flows or water quality, leading to non-temporary downgrading of status of WFD groundwater body or dependent receptors, or the inability of the groundwater body to attain Good status in line with the measures identified in the RBMP.
		Water use	Complete or severely reduced water availability and/or quality, compromising the ability of water users to abstract.
		Flood risk	Change in flood risk resulting in potential loss of life or major damage to the property or infrastructure.
Medium	Results in noticeable change to feature, of sufficient magnitude to affect its use/integrity in some circumstances.	Aquatic environment	Deterioration in river flow regime, morphology or water quality, leading to periodic, short-term and reversible breaches of relevant COs, or potential temporary downgrading of surface water body status (including potential temporary downgrading of individual WFD elements), or dependent receptors, although not affecting the ability of the surface water body to achieve future WFD objectives. Deterioration in groundwater levels, flows or water quality, leading to potential temporary downgrading of status of WFD groundwater body or dependent receptors, although not affecting the ability of the groundwater body to achieve future WFD objectives.
		Water use	Moderate reduction in water availability and/or quality, which may compromise the ability of the water user to abstract on a temporary basis or for limited periods, with no longer-term impact on the purpose for which the water is used.
		Flood risk	Change in flood risk resulting in potential for moderate damage to the property or infrastructure.
Low	Results in minor change to feature, with insufficient	Aquatic environment	Slight change in river flow regime or water quality, but remaining generally

Magnitude	Criteria	Receptor type	Example*
	magnitude to affect its use/integrity in most circumstances.		within COs, and with no short-term or permanent change to WFD surface water body status (of overall status or element status) or dependent receptors. Slight deterioration in groundwater levels, flows or water quality, but with no short-term or permanent downgrading of status of WFD groundwater body or dependent receptors.
		Water use	Minor reduction in water availability and/or quality, but unlikely to affect the ability of a water user to abstract.
		Flood risk	Change in flood risk resulting in potential for minor damage to property or infrastructure.
Very Low	Results in little or no change to feature, with insufficient magnitude to affect its use/integrity	Aquatic environment	None or very slight change in river flow regime or water quality, and no consequences in terms of COs or surface water body status or dependent receptors. No or very slight change in groundwater levels or quality, and no consequences in terms of status of WFD groundwater body or dependent receptors.
		Water use	No or very slight change in water availability or quality and no change in ability of the water user to exercise licensed rights or continue with small private abstraction.
		Flood risk	Increased frequency of flood flows, but which does not pose an increased risk to property or infrastructure.

*For the purposes of this assessment of change, relevant WFD elements for surface water body classification include:

- all biological quality elements e.g. fish, macrophytes, invertebrates;
- all physico-chemical quality elements e.g. dissolved oxygen, phosphate;
- hydromorphological supporting elements;
- Priority Hazardous Substances;
- Priority Substances;
- Specific Pollutants; and, for Artificial and Heavily Modified Water Bodies; and
- the mitigation measures assessment.

For the purposes of this assessment of change, relevant WFD characteristics for groundwater body classification are quantity (groundwater level regime) and chemistry (conductivity and source of pollutants), as determined by the following tests:

- Water balance (quantitative);
- DWPAs (chemical);
- General Quality Assessment (GQA, chemical);
- Saline and other intrusions (quantitative and chemical);
- Surface water (quantitative and chemical); and
- GWDTEs (quantitative and chemical).

Table 13.6 Significance evaluation matrix relating to geology, hydrology and hydrogeology

		Magnitude of change			
Sensitivity/ Importance/ Value		**High**	**Medium**	**Low**	**Very Low**
	High	Major (Significant)	Major (Significant)	Moderate (Probably Significant)	Minor (Not significant)
	Medium	Major (Significant)	Moderate (Probably Significant)	Minor (Not Significant)	Negligible (Not significant)
	Low	Moderate (Probably Significant)	Minor (Not Significant)	Negligible (Not significant)	Negligible (Not significant)
	Very Low	Minor (Not significant)	Negligible (Not significant)	Negligible (Not significant)	Negligible (Not significant)

Note: 'Significant' effects are those identified as 'Major'. 'Moderate' effects would normally be deemed to be 'significant'. However, there may be some exceptions, depending on the environmental topic and the application of professional judgement.

13.6 Baseline Conditions

13.6.1 This section characterises the local geology, hydrology and hydrogeology environment so that the potential effects of the Revised Consented Development can be determined and appropriate additional mitigation identified.

Data Gathering Methodology

Study Area

13.6.2 Both desk study and survey data for this chapter of the EIA report have been gathered with respect to a defined study area. The study area is focussed on the Revised Consented Development and a 2 km buffer area immediately beyond the Revised Consented Development (**Figure 13.1**). This buffer has been considered as the usual realistic maximum extent for impacts from wind farm-related construction activities on the water environment. However, data for beyond the study area are also collected whenever catchment areas for distant water features could potentially intersect the study area, such as for abstractions and conservation sites. It should be noted that the study area sits entirely within the THC Local Authority area.

Data Sources

13.6.3 The appraisal of existing (baseline) conditions for the purposes of this assessment has involved the collection and interpretation of a wide range of data and information from published material, plus consultations relating to the

local and wider hydrological environment with statutory bodies, principally SEPA and THC. The data collected, and other sources of information, are listed in **Table 13.7**. The assessment also draws on information presented for the site from a review of existing ES and SI reports. It is also inter-related with, and uses information from, other chapters of this EIA report, such as **Chapter 11: Ecology**.

Table 13.7 Sources of desk study information

Source	Data
Ordnance Survey (OS) 1:50,000 Landranger Sheet 11 Thurso and Dunbeath OS 1:25,000, Explorer Sheet 449: Strath Halladale and Strathy Point OS 1;10,000 Raster map	Topography and features
Centre for Ecology and Hydrology (CEH) National River Flow Archive (NRFA) www.ceh.ac.uk/data/nrfa/index.html CEH Flood Estimation Handbook (FEH) CD-ROM https://fehweb.ceh.ac.uk/ CEH-GEAR data https://nrfa.ceh.ac.uk/catchment-rainfall Rainfall data https ://www.metoffice.gov.uk/ Meteorological Office (Met. Office) climate station data (Strathy East) https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gfmjjhy0r SEPA rainfall data (Halladale gauging station) https://www2.sepa.org.uk/rainfall	Climate
British Geological Survey (BGS) 1:625000 Hydrogeological Map of Scotland (1988) BGS Scotland Sheet 115E (Reay) 1:50,000, Solid and Drift edition (2003) BGS 1:50000 scale geological mapping (emapsite) BGS online mapping https://mapapps2.bgs.ac.uk/geoindex/home.html BGS Borehole data http://mapapps2.bgs.ac.uk/geoindex/home.html?layer=BGSBoreholes BGS GeoSure and EnviroSure reports Geological Conservation Review (GCR) sites https://sitelink.nature.scot/home BGS/Natural Environment Research Council (NERC). A GIS of Aquifer Productivity in Scotland. Explanatory Notes. Commissioned Report CR/04/047N http://nora.nerc.ac.uk/504764/1/CR-04-047N_SEPA%20Aq%20productivity.pdf BGS/SEPA. The superficial deposits aquifer productivity (Scotland) map BGS Aquifer Classification (Scotland's Environment) https://map.environment.gov.scot/sewebmap/	Geology, ground conditions and hydrogeology

Source	Data
SEPA/BGS/Scotland and Northern Ireland Forum for Environmental Research (SNIFFER) Vulnerability of Groundwater in the Uppermost Aquifer (Scotland) BGS Groundwater Vulnerability (Scotland) http://www.bgs.ac.uk/discoverymetadata/13603084.html	
National Soil Map of Scotland (Macaulay Institute for Soil Research) http://soils.environment.gov.scot/ Soil Survey of Scotland 1:250 000 Map Sheet 3 (Northern) The Carbon and Peatland 2016 Map for Scotland https://soils.environment.gov.scot/maps/thematic-maps/carbon-and-peatland-2016-map/	Soils and peat
CEH NRFA www.ceh.ac.uk/data/nrfa/index.html FEHCEH FEH CD ROM	Hydrology and flows
SEPA Flood Map http://map.sepa.org.uk/floodmap/map.htm CEH FEH CD ROM	Flood risk
SGt The River Basin Management Plan for Scotland River Basin District 2015-2027 (RBMP) SGt interactive mapping https://map.environment.gov.scot/sewebmap/?layers=riverClass SEPA interactive mapping facility for the Scotland RBMP https://www.sepa.org.uk/data-visualisation/water-classification-hub/ Water Body data sheets https://www2.sepa.org.uk/WaterBodyDataSheets	RBMP and water quality
CAR Licenced Sites data http://map.sepa.org.uk/atom/SEPA_Licensed_sites.atom SEPA interactive mapping facility for licenced sites https://map.environment.gov.scot/sewebmap/?layers=licensedSites SEPA data request: information on locations of CAR licences PWSs data request directly to THC[1] SGt. Drinking Water Protected Areas (DWPAs) https://www.gov.scot/publications/drinking-water-protected-areas-scotland-river-basin-district-maps/	Abstractions and discharges
NS information on protected areas https://sitelink.nature.scot/ Ecology surveys - as per **Chapter 11: Ecology**	Wetlands and peatlands

13.6.4 A request for CAR Licenced activities within 2 km of the Revised Consented Development boundary was submitted to SEPA on 29 April 2021. SEPA replied to this request, stating that due to a cyber-attack on 24 December 2020

[1] The Drinking Water Quality Regulator (DWQR) no longer displays a map of PWSs on its site. Under legislation it is the responsibility of the local authority to maintain a register of PWSs.

affecting internal systems etc it was unable to provide a response to this data request. Therefore, this assessment has utilised SEPA's online data facilities, as well as information provided in previous ESs. The main limitation of the online data facility is that information provided on CAR registrations is more limited, with specific licence details, for example licence type and reason, not provided.

Current Baseline

13.6.5 This sub-section characterises the local geological, hydrological and hydrogeological environment so that the most likely effects of the wind farm can be determined, and appropriate mitigation identified. It also provides the point of reference against which the success of the adopted mitigation measures can be assessed.

13.6.6 The following description is based upon data obtained from the sources listed in **Table 13.7** and Section 13.6.3. **Figures 13.1** to **13.5** accompany this section of the report. **Figure 13.1** locates the site in a local context and illustrates the locations of watercourses and other hydrological features of interest within the site. **Figures 13.2** and **13.3** illustrate the drift and solid geology of the site and its surroundings, respectively. Key water features are summarised in **Figure 13.4**. Finally, **Figure 13.5** presents the elevational detail of the site.

Topography

13.6.7 The Revised Consented site covers an area of approximately 1,139 ha and is located approximately 2 km south south-east of the village of Reay, Caithness (**Figure 13.1**). Ground elevations in the application site range from ~25 metres Above Ordnance Datum (mAOD) at the northernmost tip of the application site, near Bridge of Isauld (National Grid Reference (NGR) NC 976 649) to ~170 mAOD at the southernmost tip (NC 995 578) (**Figure 13.1** and **13.5**). Between the valleys of the Reay and Achvarasdal Burns, the topography rises gently, with a ridge of higher ground from Creag Leathan (NC 983 631) in the north through Claperon (NC 974 627), Cnocan Dubh nan Eun (NC 980 617), Cnocan nan Eun (NC 982 614), Cnoc nan Airigh (NC 986 605) to Cnoc an Fhraoich (NC 986 591) in the south.

Rainfall

13.6.8 The closest rain gauge operated by SEPA, with data also available through the CEH NRFA, is a gauge at Halladale, on the Halladale River (NC 891 561) located approximately 9 km south-west of the site. The average annual rainfall for period 1976-2017 was 1121 mm (**Table 13.8**). The average annual rainfall depth based on the meteorological data for the Strathy East climate station (1981-2010) is, slightly drier, at 1003 mm. Strathy East is 12.5 km to the northwest of the Development Site, near the coast and at 68 mAOD.

Table 13.8 Average Monthly Rainfall (Calculated from CEH NRFA Data for 1961 – 2017)

Month	Rainfall depth (mm)
January	116.26
February	88.05
March	89.22
April	69.27
May	66.14
June	69.46
July	67.72
August	88.03
September	95.36
October	118.59
November	132.78
December	120.01
Total	1,120.89

Geology

13.6.9 The superficial geology of the application site is presented in **Figure 13.2**. This indicates that the superficial geology underlying the site comprises predominantly peat deposits in the south of the site on higher ground, with glacial till on the lower ground in the north, north-east and east (Aryleive Moss) of the site. Alluvium comprising clay, silt, sand and gravel is mapped along the Achvarasdal Burn, which forms the eastern site boundary, and along the unnamed tributary of the Achvarasdal Burn draining Milton Moss (NC 983 624).

13.6.10 Small pockets of hummocky (moundy) glacial deposits occur throughout the site. These are described as lithologically diverse and complex glacial deposits that have a characteristic moundy topographic form. They comprise rock debris, clayey till and poorly to well-stratified sand and gravel. The most extensive of these deposits occur to the east of Creag Bheag (NC 989 630), west of Bruach Bhreac (NC 971 623) and at Crochan Geal (NC 980 597).

13.6.11 No drift deposits are indicated on the high ground of Creag Leathan (NC 983 631), Creag Bheag (NC 987 629) and Cnocan Dubh nan Eun (NC 980 617), south to Leathad Breac (NC 982 604) and south-east to Esvarasdal (NC 994 598). This would suggest that superficial deposits are thin or absent in these areas.

13.6.12 The solid geology of the application site is presented in **Figure 13.3**. This indicates that the site is dominantly underlain by a late Silurian felsic igneous intrusion known as the Strath Halladale Granite (biotite-granite). Devonian Conglomorate, known as the Tobaireach Conglomorate, is also present, in the north of the site underlying Milton Moss and in the south of the site.

13.6.13 The Rubha Sandstone Member, a sandstone with subordinate conglomerate and siltstone, is shown underlying the eastern flank of the application site. It

should be noted that older printed BGS mapping (BGS, 2003) refers to this solid geology as the Lybster subgroup (Wick Beds) which are part of the Lower Caithness Flagstone Group. The Lybster subgroup tends to be drab or dark grey in colour and contain relatively thin sandstone members. This includes the Luachair Sandstone Member which outcrops in the south of the site and comprises interbedded sandstone and conglomerate.

13.6.14 Rocks of the Portskerra Formation are present along the northern site boundary. These are psammite, migmatitic, with migmatitic semipelite. A small outcrop of Silurian age quartz-diorite is also present in the north-west of the application site, at Torran Dubh (NC 965 624), known as the Reay Diorite. A small outcrop of Badanloch Granite Sheets occurs just to the east of this (NC 973 622). These are described as a locally, highly foliated sodic, plagioclase granite with biotite schlieren. Finally, in the east of the site two minor outcrops of limestone occur, namely the Gunnscroft limestone (NC 989 608) and Rubha Sandstone Member – limestone (NC 991 596).

13.6.15 An extensive local fault intersects the southern part of the site, named the Bridge of Forss Fault. The fault downthrows in a north north-east to south south-westerly direction. Across most of the site the strata are highly inclined in a south-easterly direction at angles of about 25-40°. Additional faulting is also present in the north and the east of the site at the geological boundaries between the Tobaireach Conglomorate and Strath Halladale Granite and between the Rubha Sandstone and Tobaireach Conglomorate.

13.6.16 There are no Geological Conservation Review (GCR) sites, i.e. sites of geological and geomorphological features of national and international importance, within the study area.

Soils and land use

13.6.17 The Revised Consented Development site predominantly comprises coniferous woodland plantation used for commercial forestry.

13.6.18 The Soil Survey of Scotland map for this area indicates that the soil type present on the site is predominantly blanket peat. Also, in the north and west of the site, the soils comprise peaty podzols, peat and peaty gleys. In the north these drifts are derived from sandstones and conglomerates, whilst in the west they are derived from granites and granitic rock.

13.6.19 Peat depth surveys have been undertaken, and the areas of peat are highlighted on Figures 5-7 of **Appendix 13.A**. These indicate that approximately one third of the Revised Consented Development site contains peat depths <0.5 m. In the west of the site between proposed turbines T26 and T43 the proposed access passes through a large area of peat with thicknesses in excess of 2.0 m, ranging up to approximately 4.5 m. In addition, further pockets of peat with thicknesses >2.0 m were identified throughout the site in or near the proposed locations of T25, T54, T55, T30 and T57.

13.6.20 The FEH CD-ROM has been used to calculate the standard percentage runoff (SPR), an indication of soil permeability. Based on a 5.8 km^2 catchment at NC 970 632 (Reay Burn at the northern site boundary) and a 15.8 km^2 catchment at NC 986 640 (Achvarasdal Burn at the northern site boundary), the average SPR is 58.0%. This indicates that surface runoff is a more significant

component of watercourse flow than baseflow, suggesting that the soils are weakly permeable.

Hydrogeology

13.6.21 The superficial deposits aquifer productivity (Scotland) map (BGS/SEPA, 2004) indicates that for most of the site where peat and till are mapped the site is underlain by a superficial aquifer of low productivity (receptor GW01 on **Figure 13.4**, for the purposes of the later assessment). Areas where more permeable drift deposits are mapped, for example the alluvium associated with the narrow watercourse channel of the Achvarasdal Burn and its tributary draining Milton Moss, may offer enhanced aquifer productivity. However, these areas are isolated and limited in extent.

13.6.22 The BGS aquifer classification mapping indicates that a moderately productive bedrock aquifer, classed 2B, is present in the east of the site, co-incident with the Rubha Sandstone Member. Flow is virtually all through fractures and other discontinuities and the groundwater body is described as a locally important, multi-layered aquifer.

13.6.23 However, the BGS aquifer mapping indicates that most of the site is located on a low productivity (class 2C) aquifer. Within the Strath Halladale Granite formation flow is virtually all through fractures and other discontinuities. Small amounts of groundwater may be present in the near-surface weathered zone and in secondary fractures.

13.6.24 SEPA water classification data within its interactive mapping facility indicates that the WFD groundwater body underlying the majority of the site is that of the Northern Highlands (ID 150701) (receptor GW02), whilst that beneath Milton Moss and to the east of the site is the Dounreay groundwater body (150487) (receptor GW03). Both are classified as of Good overall, quantitative and chemical status in 2018. In addition, the site lies within the Thurso bedrock and localised sand and gravel aquifers DWPA (groundwater).

13.6.25 Several springs are present within the site boundary and the study area, although none appear to be used for abstraction purposes. These potential spring receptors are numbered and located in **Table 13.9** and on **Figure 13.4**.

Table 13.9 Springs

Receptor no.	Location	NGR
Springs – On-site		
S01	Achvarasdal Leans	NC 99020 61664
S02	Aryleive	NC 98901 60647
Springs – Off-site		
S03	Chalybeate Spring (near Milton)	NC 97544 64015
S04 - 08	Springs associated with Allt Forsiescye	ND 00574 56354 ND 00486 56249 ND 00463 56189 ND 00415 56189 ND 00299 55939

Hydrology

13.6.26 The Revised Consented Development site lies within the surface water catchments of the Reay Burn to the west and the Achvarasdal Burn to the east (**Figures 13.1** and **13.4**).

13.6.27 The Reay Burn drains the western side of the site and discharges to the sea through the Sandside Bay SSSI at Sandside Bay (NC 966 652). The headwaters of this watercourse lie just south of the site boundary. The gradient of the watercourse in the vicinity of the site ranges from 0.07 in the upper, southern part of the site (NC 981 587) to 0.01 in the lower, northern part of the site (NC 971 631). Named tributaries of the Reay Burn include Meur an Fhuarain Ghil (NC 978 606), Meur an Fhaoich (NC 978 603), Meur a' Chrochain Ghil (NC 977 602) and Meur Gadach (NC 975 602).

13.6.28 The Achvarasdal Burn, which drains the eastern side of the site, and forms the eastern site boundary, is confluent with the Burn of Isauld, south of Achvarasdal House (NC 983 645), 800 m south-east of the Bridge of Isauld (NC 976 650), near the site entrance. The Burn of Isauld also discharges to sea at Sandside Bay (NC 969 656). The headwaters of the Achvarasdal Burn lie south of the site on the slopes of Beinn nam Bad Mòr (NC 994 552). Gradients are similar to those of Reay Burn, although the headwaters themselves lie on steeper ground. The valley sides are also steep in the north of the site, to the east of Creag Leathan.

13.6.29 The Sandside Burn is located to the west of the site. It too flows in a northerly direction, through designated land (Caithness and Sutherland Peatlands and East Halladale SSSI), from its headwaters at Cnoc Maol Donn (NC 968 566) to Sandside Bay (NC 961 655). Sandside Burn receives the majority of its water from headwater tributaries ~1.2 km south-west of the site and also from the numerous feeder tributaries from Clachgeal Hill (NC 959 575), Sean Airigh (NC 947 587) and Beinn Ratha (NC 953 609), to the west. Although the Sandside Burn intersects the site boundary at Hellshetter (NC 963 628), no Revised Consented Development site infrastructure is proposed to be located within its catchment.

13.6.30 Lochan nan Eun (NC 981 613) is located close to the centre of the site. It is situated on a high ridge within an area of particularly wet, boggy ground, to the south of a large rock outcrop. With no discernible flow into or out of the lochan, it is likely that the majority of the water within this water body originates from rainfall.

13.6.31 An unnamed burn rises from ~1.3 km south-east of the site and flows from Clais Luachair (ND 007 586) and feeds into Loch Thormaid (ND 010 603). This, in turn, feeds into Loch Saorach (ND 014 605) via a small tributary. The release of water into the Achaveilan Burn is then controlled via a sluice on the northern end of the Loch (ND 013 609). The Achaveilan Burn flows northwards and is eventually confluent with the Dounreay Burn at Beul an Lochan (NC 992 639), approximately 600 m north-east of the site. The Dounreay Burn discharges to sea near the remains of Dounreay Castle (NC 982 669), approximately 2 km north-east of the site.

13.6.32 The Allt Forsiescye (ND 010 570) drains the south-east of the study area. The burn is fed by overspill from Loch Scye (ND 005 553) and Lochan Dubh nan Clachan Geala (NC 998 563) as well as a number of springs located between

these two lochs. The Allt Forsiescye is confluent with the Forss Water (ND 037 590), ~4 km south-east of the site. This flows northwards and discharges to sea at Crosskirk Bay (ND 028 699), approximately 7.3 km north-east of the site.

13.6.33 The WFD Achvarasdal Burn (ID 20623), Sandside Burn (ID 20622), Dounreay (including Achaveilan) Burn (ID 20624) and Allt Forsiescye (ID 20636) surface water bodies are all classified by SEPA as having Good overall status. Reay Burn and Lochan nan Eun are not classified by SEPA but are likely to have similar characteristics to the Achvarasdal and Sandside Burns and so are assumed to be equivalent to WFD Good overall status.

13.6.34 The nearest surface water gauging station to the site is operated by SEPA on the Halladale River (Gauge 96001 at Halladale NC 891 561)[2]. Flow data for this gauge is available from 1976-2019, and the mean flow over this period is 5.01 m^3/s, with a Q95 flow (i.e. the flow exceeded 95% of the time) of 0.30m^3/s.

13.6.35 The baseflow index (BFI) is a measure of the proportion of river flow that is derived from storage near the surface. The BFI given for the SEPA gauge at Halladale has a value of 0.27, suggesting that baseflow is not a significant component of flow. For the catchments located within the site for the Reay and Achvarasdal Burns, the FEH estimates similar BFI values of 0.265 and 0.239 respectively.

13.6.36 The potential surface water receptors are numbered and approximately located in **Table 13.10** and **Figure 13.4**.

Table 13.10 Surface water bodies and watercourses

Receptor No.	Location	NGR
W01	Achvarasdal Burn (and associated tributaries) and WFD surface water body	NC 994 610
W02	Reay Burn (and associated tributaries)	NC 973 612
W03	Sandside Burn (and associated tributaries) and WFD surface water body	NC 968 606
W04	Lochan nan Eun	NC 981 613
W05	Dounreay Burn (including Achaveilan Burn, Loch Thormaid and Loch Saorach and associated tributaries) and WFD surface water body	NC 992 639
W06	Allt Forsiescye (and associated tributaries) and WFD surface water body	ND 010 570

Flood Risk

13.6.37 The SEPA Flood Map indicates high (1 in 10 year return period) flood extents for the Reay Burn and Achvarasdal Burn (10% annual exceedance probability (AEP) of occurrence), confined to a well-defined floodplain of up to a maximum

[2] https://nrfa.ceh.ac.uk/data/station/meanflow/96001

150 m in width. It also indicates that there is a high risk of out-of-channel flooding from watercourses downstream of the site, associated with the Achvarasdal Burn. The site access track intersects a small section of this flood risk area. The fields that lie between Loancorrisbest and Milton (NC 980 641) are the epicentre of this possible flooding (receptor F01 on **Figure 13.4**), where a flood event is predicted to occur on average once in every ten years (1:10), or, in other words, has a 10% chance of happening in any given year.

13.6.38 Tributaries and channels which have a catchment area of less than 3 km^2 are not shown on the SEPA Flood Map, though it is likely that flooding from the more minor watercourses that drain the site is limited to a narrow floodplain adjacent to the channels.

Abstractions and discharges

13.6.39 Information regarding licenced abstractions and discharges has been obtained from the SEPA website and corroborated, where possible, with information obtained for the 2012 ES. The data are summarised in **Table 13.11** and shown on **Figure 13.4**.

Table 13.11 SEPA CAR licences

Receptor No.	Licence No.	Site Name	Description	NGR
A01	CAR/L/1187662	Limekiln Wind Farm	Discharge of site run-off to the water environment	NC 97170 63290
A02	CAR/R/1026447	Loanscorribest, Reay, Thurso	Sewage treatment effluent (STE) to Achvarasdal Burn	NC 97165 64140
A03	CAR/R/1078005	Creag Leathan, Milton Reay, Thurso	STE to soakaway	NC 98559 64006
A04	CAR/R/1020397	Borlum House, Reay, Caithness	STE to soakaway	NC 97685 64249
A05	CAR/R/1078134	Achvarasdal Cottage, Reay	Unknown	NC 98130 64986
A06	CAR/R/1078668	Charene Cottage, Achvarasdal	Unknown	NC 98339 64965
A07	CAR/R/1078067	Milton Farm, Reay	Unknown	NC 97792 64507
A08	CAR/R/1108620	Reay Golf Club	Unknown	NC 96590 64928
A09	CAR/R/1153447	Birchwood, Achiegullen	Unknown	NC 98555 64883
A10	CAR/R/1162042	Achvarasdal Farm, Reay	Unknown	NC 98133 64774
A11	CAR/R/1183092	Achvarasdal House, Reay	Unknown	NC 98287 64621
A12	CAR/R/1188340	Isauld Farm Butchery Unit, Reay	Unknown	NC 97469 65754
A13	CAR/L/1001963	Naval Reactor Test Establishment (NRTE) Vulcan, Dounreay	Unknown	NC 98011 66717
A14	CAR/L/1008805	Reay Sewage Treatment Works (STW), Reay	Unknown	NC 96000 64900
A15	CAR/R/1017785	Glen Cottage, Reay	Unknown	NC 95774 64711
A16	CAR/R/1018422	1 Water Plant Houses, Shebster	Unknown	ND 00560 64263
A17	CAR/R/1022260	Craigmore and Mo Dachaidh, Reay	Unknown	NC 98815 64928
A18	CAR/R/1030499	New house south of Rehovot, Reay	Unknown	NC 98740 65210
A19	CAR/R/1043050	Briarlea, Achunabest	Unknown	NC 99011 64916
A20	CAR/R/1066053	Shebster View, Blackhills, Caithness	Unknown	NC 98645 65200
A21	CAR/R/1105837	Porters Lodge, Sandside	Unknown	NC 95083 64626
A22	CAR/R/1120593	Vulcan NRTE, Dounreay	Unknown	NC 97841 66719
A23	CAR/R/1139962	Dounreay - Mybster Overhead Line (OHL)	Unknown	NC 98870 65700

Receptor No.	Licence No.	Site Name	Description	NGR
A24	CAR/R/1139963	Dounreay - Mybster OHL	Unknown	NC 98870 65700
A25	CAR/R/1138580	Dounreay - Mybster OHL	Unknown	NC 98870 65700
A26	CAR/R/1144909	Strathnaver, The Terrace, Reay	Unknown	NC 95888 64417
A27	CAR/R/1166691	Rathlin, Shebster	Unknown	ND 01020 64025
A28	CAR/S/1186549	Vulcan NRTE, Dounreay	Unknown	NC 97841 66719
A29	RSA/N/1035280	Vulcan NRTE. Dounreay	Unknown	NC 97841 66719
A30	WMX/N/0034757	Brackside, Reay	Unknown	NC 95615 64395

13.6.40 The licence owned by Limekiln Wind Farm (No. A01) is for the discharge of water run-off from the site to the water environment. Information obtained for the 2012 ES indicates that three of the licences (Nos. A02-04) within the study area are for Sewage treatment effluent (STE), but no further details regarding the other CAR registrations are available from SEPA's online platform. However, it is considered likely that the other licences are also for discharges, rather than abstractions, given that they are generally located close to the town of Reay, where mains water is understood to be available.

Private Water Supplies

13.6.41 THC has provided details of three PWSs within the study area. These are listed in **Table 13.12** and presented on **Figure 13.4**. The THC database lists the Loanscorribest and Craigielea PWSs as springs and the Achins PWS as a well. However, according the 2012 ES, the PWS at Loanscorribest was visited by a Wood representative on 7 February 2012, and information provided by the owner suggested that this PWS was not a spring but a shallow well, approximately 1 m deep. All of the PWSs are used for domestic water supply and are therefore classified as Type B[3] PWSs.

13.6.42 With regards to Loanscorribest, it is understood that the Applicant is currently engaged with Scottish Water with the aim to have the property connected to the Scottish Water mains pipe. This however does not preclude a PWS being retained at the site for other purposes e.g. livestock.

[3] PWS Type B = supplies which are non-commercial and supply less than 50 persons.

Table 13.12 PWSs

Receptor No.	Site Name	Source Type	NGR (NC)	Distance from site
P01	Loanscorribest	Well	986 640	160 m
P02	Achins	Well	959 641	1 km
P03	Craigielea	Spring	951 646	1.85 km

Conservation Sites

13.6.43 The following conservation interests lie within the study area:

- East Halladale SSSI and the Caithness and Sutherland Peatlands SAC, SPA and Ramsar (receptor C01). The East Halladale and Caithness and Sutherland designated sites (all NC 945 555) cover much of the same, relatively large area, lying to the west, south-west and south of the site and straddling the Caithness-Sutherland border. Situated adjacent to the south-western site boundary, at its closest point, and up gradient of the site activities, the East Halladale and Caithness and Sutherland SAC and Ramsar are designated for their blanket bog as well as other ornithological interests. The Caithness and Sutherland SPA is designated for its breeding bird interests;
- Sandside Bay (NC 965 655) SSSI (receptor C02) includes the bay itself, located ~0.9 km north-west of the site, a small pocket of land (NC 965 651) located within Reay Golf Course ~1.1 km north-west of the site, and the banks of the Burn of Isauld (NC 973 653) stretching from its confluence with the Achvarasdal Burn at the northern tip of the site to the Bay. It is designated for its dune habitat and associated plant species; and
- Loch Caluim Flows (ND 010 564) SSSI (receptor C03) is located 1.5 km south-east of the site. This is a large area of blanket bog centred on Loch Caluim and is important for its blanket bog habitat and breeding birds that it supports.

GWDTEs

13.6.44 GWDTEs exist across the Revised Consented Development site area. The GWDTEs are identified in the National Vegetation Classification (NVC) map (**Figure 11.3**).

13.6.45 Potentially highly groundwater dependent mire habitat (M6) has been identified in the vegetation survey (**Appendix 11.A**) within the floodplain of the Reay Burn and upstream of its confluence with the Meur an Fhuarain Ghil and Meur Gadach (receptor C04). However, its location would suggest that water supply to the habitat is mostly from surface runoff from the watercourse with groundwater support not a significant component of supply, except for that part of the habitat east of Meur an Fhuarain Ghil, which could potentially be receiving some groundwater input from the rising higher ground to the east.

13.6.46 Potentially moderately groundwater dependent M25 mire vegetation is also present along the main watercourses of the site and along forest rides, with M15 (wet heath) on the higher forested slopes through the central area of the

site (together comprising receptor C05). The majority of these habitats are fed, almost entirely, by surface runoff in watercourses, precipitation or very near-surface groundwater within shallow drift deposits and soils. It is considered that the groundwater component supporting these habitats more resembles a surface (or near-surface) water regime, with localised and shallow rain-fed or surface runoff-fed catchments for each GWDTE. This is certainly the case for the majority of those GWDTEs that have been mapped along the floodplains of the Achvarasdal and Reay Burns (including their respective head waters), and for those centred on rides and cleared areas within the commercial woodland.

Future Baseline

13.6.47 Changes could potentially occur to the study area in the future in relation to climate change and land use. Section 13.7 below defines the years for which the assessment needs to be carried out and the developments/changes that need to be considered within the assessment.

13.6.48 Climate change could affect the amount and intensity of rainfall, and temperature and evapotranspiration. The UK Climate Projections 2018 (UKCP18) include predictions for Scotland. The high emissions scenario for this north coast area predicts an increase in summer temperatures by 0.6-4.8°C and an increase in winter temperatures by 0.6-4.5°C by the 2070s. This would be accompanied by wide range of rainfall patterns, from 40% drier to 8% wetter in the summer and 3% drier to 9% wetter in the winter, by the 2070s. These changes could alter the hydrological characteristics of the Revised Consented Development and wider catchment areas over time.

13.6.49 Given the nature of the terrain and distance from any major urban areas, any future land use change in the area from its current rural nature is unlikely over the lifespan of the Revised Consented Development. The HwLDP (2012) gives no indication of future major land use changes in the area.

13.7 Identification and Evaluation of Effects

Scope of the Assessment

Spatial Scope

13.7.1 The spatial scope of the assessment of geology, hydrology and hydrogeology covers the study area (including 2 km buffer area) described in Section 13.6, on the basis that the effects on the water environment due to the Revised Consented Development are considered unlikely to extend beyond this area.

Temporal Scope

13.7.2 The temporal scope of the assessment of geology, hydrology and hydrogeology covers the construction, operational and decommissioning periods for the Revised Consented Development.

13.7.3 The construction period for the Revised Consented Development would be approximately 22 months in duration and would comprise the activities listed in **Chapter 4 Description of Revised Consented Development, Section 4.5**. The EIA assumes decommissioning would occur at the end of the 40 years operational phase.

Receptors

13.7.4 The receptors that are considered as requiring impact assessment (i.e. 'scoped in') are listed in **Table 13.13** and presented in **Figure 13.6**, ordered broadly in accordance with their first appearance in the Section 13.6 baseline i.e. groundwater, surface water and then composite receptors. The features are referred to by means of the one or two-letter category character and two-digit sequential number codes used in the baseline.

13.7.5 It is important to note that this chapter examines potential changes of the Revised Consented Development on the water environment supporting potential GWDTEs and conservation sites, not the habitats themselves, which are instead a matter for **Chapter 11: Ecology**.

Table 13.13 Geology, hydrology and hydrogeology receptors requiring assessment

Reference No.	Receptor	Location
Aquifers and associated WFD groundwater bodies		
GW02	Bedrock aquifer and North Highlands WFD groundwater body	Beneath and beyond the Revised Consented Development
GW03	Bedrock aquifer and Dounreay WFD groundwater body	Beneath and beyond the Revised Consented Development
Springs		
S01	Achvarasdal Leans	Within the Revised Consented Development
S02	Aryleive	Within the Revised Consented Development
Watercourses, lochan and associated WFD surface water bodies		
W01	Achvarasdal Burn (and associated tributaries) and WFD surface water body	Within the Revised Consented Development
W02	Reay Burn (and associated tributaries)	Within the Revised Consented Development
W03	Sandside Burn (and associated tributaries) and WFD surface water body	Within Study Area
W04	Lochan nan Eun	Within the Revised Consented Development
Flood Risk		
F01	Area of flood risk between Loanscorrisbest and Milton	Within and downstream of the Revised Consented Development
PWS		
P01	Loanscorribest	Downgradient of the Revised Consented Development

Reference No.	Receptor	Location
Conditions supporting conservation site and GWDTEs		
C02	Sandside Bay SSSI	Downstream of the Revised Consented Development
C04	GWDTEs (high groundwater dependency)	Within the Revised Consented Development
C05	GWDTEs (moderate groundwater dependency)	Within the Revised Consented Development

13.7.6 Given the nature of the Revised Consented Development, it is the watercourse receptors that have been identified as likely to be most significantly affected. This is due to both the proximity of the proposed construction to the site watercourses and the access track route intersecting tributaries of the two main watercourses draining the site, namely the Achvarasdal Burn and the Reay Burn.

13.7.7 SEPA flood risk mapping indicates that there is currently no risk of flood risk issues potentially affecting the Revised Consented Development's infrastructure and watercourse crossing locations. Provided watercourse crossings are designed to accommodate the 1 in 200 year event and other infrastructure is located well away from watercourses, SEPA does not foresee from current information a need for detailed information on flood risk. However, the access track intersects an extensive area of flood risk between Loanscorribest and Milton (F01) where the risk of flooding associated with the Achvarasdal Burn is estimated as 1:10 i.e. 10% chance of occurring in any given year. Therefore, flood risk is retained in the assessment.

13.7.8 The following receptors have been 'scoped out' from further assessment because the potential effects are not considered likely to be significant or because the effects remain unchanged for those already established for the Consented Development:

- The underlying solid geology comprises both igneous and sedimentary lithologies, overlain by peat, till, alluvium and hummocky glacial deposits. Geology, however, is not considered to be of local or regional importance and no features of geological interest have been designated, e.g. GCRs. Furthermore, disturbance of the geology during project construction would be limited to shallow excavation to establish buildings, tracks and turbine foundations, and excavation of rock from a single borrow pit to provide road stone for site tracks. On this basis, any geological effect would be insignificant, and it is proposed that geology is scoped out as a receptor;
- The superficial aquifer for the majority of the site is classified as a low productivity aquifer (GW01). Areas of increased productivity exist, for example, the alluvium along the Achvarasdal Burn and its tributary draining Milton Moss. However, these areas are isolated and limited in extent and do not alter the overall superficial aquifer classification for the Revised Consented Development site. On this basis the superficial aquifer is scoped out as a receptor. Nevertheless, shallow groundwater is still taken account of in the assessment in terms of its role in supporting the GWDTEs;

- Springs S03 - 08 are located either outwith the SEPA LUPS-GU31 100 m and 250 m buffers for wind farm infrastructure for excavations less than 1 m and greater than 1 m depth respectively, up gradient of Revised Consented Development infrastructure and/or in separate surface water catchments from development activities. Therefore, with no obvious hydrological or hydrogeological connections, effects on spring flows or quality are not considered likely, and these springs are 'scoped out' from further assessment;
- Surface watercourses located either outwith a 250 m buffer of wind farm infrastructure, up gradient of proposed infrastructure and/or in separate surface water catchments from development activities include the Dounreay Burn (W05) and the Allt Forsiescye (W06). Therefore, with no obvious hydrological or hydrogeological connections, effects on these watercourse flows or quality are not considered likely, and the features are 'scoped out' from further assessment;
- The closest SEPA licensed activities to the Revised Consented Development (A01 - 04) have been confirmed as discharges. In addition, it is considered likely that the other licences identified from the SEPA website are also for discharges, rather than abstractions, given that they are generally located close to the town of Reay, where mains water is understood to be available. Therefore, as impacts on soakaways and other types of discharge are not considered likely, SEPA licenced activities have been 'scoped out' from further assessment;
- Private water supplies at Achins (P02) and Craigielea (P03) are outwith the catchment of the Revised Consented Development and are located a significant distance from the nearest proposed infrastructure (at least ~1.9 km). Therefore, effects on these PWSs are considered unlikely and as such these potential receptors are 'scoped out' from further assessment; and
- The East Halladale SSSI and the Caithness and Sutherland Peatlands SAC, SPA and Ramsar (C01) and Loch Caluim Flows SSSI (C03) are located upgradient of the proposed wind farm infrastructure and within a separate surface water catchment. With no obvious hydrological connection, effects on the status of these designated sites are not considered likely, and the features are 'scoped out' of further assessment.

Likely significant environmental effects

13.7.9 The likely significant hydrological and hydrogeological effects that are to be taken forward for assessment are summarised in **Table 13.14**.

Table 13.14 Likely significant hydrology and hydrogeology effects

Activity	Effects	Receptors
Land preparation (earthworks and excavation of the turbine foundations and borrow pits)	Ground disturbance leads to sediment loading and/ or the remobilisation of existing contamination resulting in the pollution of watercourses. Contamination of soils, surface waters and groundwater due to accidental release of pollutants during works. Excavation and fill leads to disruption of surface and near-surface flow paths and changes to the drainage regime, most typically increased runoff. Dewatering interception of groundwater leading to a loss of water resource and disruption of groundwater support (baseflow) to watercourses.	Aquifers and associated WFD groundwater bodies (GW02 and GW03) Springs (S01 and 02) Watercourses, lochans and associated WFD surface water bodies (W01, 02, 03 and 04) Flood risk (F01) PWS (P01) Conditions supporting conservation site and GWDTEs (C02, 04 and 05)
Soil compaction and temporary hardstanding	Contamination of soils, surface waters and groundwater due to accidental release of pollutants during works. Reduced infiltration capacity results in increased runoff, and reduced recharge to groundwater, leading to loss of water resource and disruption of baseflow to watercourses.	Aquifers and associated WFD groundwater bodies (GW02 and GW03) Springs (S01 and 02) Watercourses, lochans and associated WFD surface water bodies (W01, 02, 03 and 04) Flood risk (F01) PWS (P01) Conditions supporting conservation site and GWDTEs (C02, 04 and 05)
Land clearance and deforestation.	Land clearance and ground disturbance leads to sediment loading and/or the remobilisation of existing contamination resulting in the pollution of watercourses. Contamination of soils, surface waters and groundwater due to accidental release of pollutants during works. Land clearance leads to disruption of surface and near-surface flow paths and changes to the drainage regime, most typically increased runoff. Land clearance leads to breakdown of peat structure and disturbance of peat hydrology.	Aquifers and associated WFD groundwater bodies (GW02 and GW03) Springs (S01 and 02) Watercourses, lochans and associated WFD surface water bodies (W01, 02, 03 and 04) Flood risk (F01) PWS (P01) Conditions supporting conservation site and GWDTEs (C02, 04 and 05)
Peat working	Ground disturbance leads to sediment loading and/or the remobilisation of existing contamination resulting in the pollution of watercourses. Contamination of soils, surface waters and groundwater due to accidental release of pollutants during works.	Aquifers and associated WFD groundwater bodies (GW02 and GW03) Springs (S01 and 02) Watercourses, lochans and associated WFD surface water bodies (W01, 02, 03 and 04)

Activity	Effects	Receptors
	Peat disturbance leads to disruption of surface and near-surface flow paths and changes to the drainage regime, most typically increased runoff. Peat disturbance leads to breakdown of peat structure and disturbance of peat hydrology.	Flood risk (F01) PWS (P01) Conditions supporting conservation site and GWDTEs (C02, 04 and 05)
Material stockpiling/removal (including quarrying)	Ground disturbance leads to sediment loading and/or the remobilisation of existing contamination resulting in the pollution of watercourses. Contamination of soils, surface waters and groundwater due to accidental release of pollutants during works. Excavation and fill leads to disruption of surface and near-surface flow paths and changes to the drainage regime, most typically increased runoff. Dewatering interception of groundwater leading to a loss of water resource and disruption of groundwater support (baseflow) to watercourses.	Aquifers and associated WFD groundwater bodies (GW02 and GW03) Springs (S01 and 02) Watercourses, lochans and associated WFD surface water bodies (W01, 02, 03 and 04) Flood risk (F01) PWS (P01) Conditions supporting conservation site and GWDTEs (C02, 04 and 05)
Watercourse crossings	Bank and bed disturbance lead to sediment loading, changes in morphology and pollution of watercourses. Contamination of watercourses due to accidental release of pollutants during works.	Watercourses, lochan and associated WFD surface water bodies (W01, 02, 03 and 04) Flood risk (F01) PWS (P01) Conditions supporting conservation site and GWDTEs (C02, 04 and 05)
Track and crane pad placement	Ground disturbance leads to sediment loading and/or the remobilisation of existing contamination resulting in the pollution of watercourses. Contamination of soils, surface waters and groundwater due to accidental release of pollutants during works. Track and crane pad placement lead to disruption of surface and near-surface flow paths and changes to the drainage regime, most typically increased runoff.	Aquifers and associated WFD groundwater bodies (GW02 and GW03) Springs (S01 and 02) Watercourses, lochans and associated WFD surface water bodies (W01, 02, 03 and 04) Flood risk (F01) PWS (P01) Condition supporting conservation site and GWDTEs (C02, 04 and 05)
Control building and potential substation placement	Ground disturbance leads to sediment loading and/or the remobilisation of existing contamination resulting in the pollution of watercourses. Contamination of soils, surface waters and groundwater due to accidental release of pollutants during works.	Aquifers and associated WFD groundwater bodies (GW02 and GW03) Springs (S01 and 02)

Activity	Effects	Receptors
	Control building and potential substation placement leads to disruption of surface and near-surface flow paths and changes to the drainage regime, most typically increased runoff.	Watercourses, lochans and associated WFD surface water bodies (W01, 02, 03 and 04) Flood risk (F01) PWS (P01) Conditions supporting conservation site and GWDTEs (C02, 04 and 05)
Operational facilities and activities	Exposed ground leads to continued sediment loading and/or the remobilisation of existing contamination resulting in the pollution of watercourses. Contamination of soils, surface waters and groundwater due to accidental release of pollutants during maintenance activities. Contamination of soils, surface waters and groundwater due to control building and substation chemical leaks and concrete leaching. Continuation of flow disruption, reduced infiltration capacity and peat disruption effects.	Aquifers and associated WFD groundwater bodies (GW02 and GW03) Springs (S01 and 02) Watercourses, lochans and associated WFD surface water bodies (W01, 02, 03 and 04) Flood risk (F01) PWS (P01) Conditions supporting conservation site and GWDTEs (C02, 04 and 05)

Note: For each activity an effect will often impact many different types of receptors. Effects and receptors have only been listed above due to the large number possible linkages involved.

13.7.10 The main potential hydrological/hydrogeological impacts associated with the Revised Consented Development relate to the construction phase, in particular from tracks and watercourse crossings. The assessment presented later identifies the location and the nature of the effects from these construction and upgrading activities, in particular the potential for the generation of silt-laden runoff. It then prescribes measures to be adopted during construction to mitigate against negative impacts on the water environment.

13.7.11 Other activities of relevance include the construction of wind turbine foundations and crane pads, the control building and substation. The impacts from these activities, such as the leaching of concrete residues to the water environment and changes in the runoff/recharge characteristics, are also addressed in the assessment. Again, mitigation measures are outlined that would reduce negative impacts.

13.7.12 The construction compound is to be located approximately 180 m south-west of the nearest watercourse (tributary of the Achvarasdal Burn), on gently sloping ground towards the Achvarasdal Burn. The control building is located on flatter topography, approximately 175 m south of a tributary of the Reay Burn. Mitigation would be required during construction to protect these watercourses.

13.7.13 The possibility of stockpiling is being explored, and the potential impacts of this activity has therefore also been assessed. Appropriate mitigation measures are prescribed to reduce any negative impacts on the water environment from any deeper excavations such as the proposed borrow pit.

13.7.14 Due to the shorter duration of this phase of works and because some of infrastructure, e.g. turbine foundations, would be left in place, impacts during decommissioning would likely be less than those during the construction phase. Mitigation similar to that implemented during the construction and operational phases (updated to reflect changes in legislation/guidance) would also help ensure that the significance of such impacts is minimised, and it is therefore proposed that consideration of decommissioning effects is 'scoped out' of the assessment.

13.8 Environmental Measures Embedded into the Development Proposals

13.8.1 Embedded mitigation proposals are those mitigation measures that are inherent to the Revised Consented Development. Embedded mitigation includes all mitigation usually assumed to be in place during construction, operation and decommissioning, and is generally regarded as industry standard or Best Practice. A Construction and Environmental Management Plan (CEMP) is introduced in **Chapter 4: Description of Revised Consented Development**, whilst an overview of some of the general (not project specific) environmental management considerations is also included in **Chapter 4**. Water-specific embedded mitigation measures are presented below.

Introduction

13.8.2 A qualitative, preliminary screening assessment for the potential location of the Revised Consented Development's wind turbines and infrastructure was undertaken as part of a desk-based study. The purpose of this study was to identify potential significant constraints which may be posed by the baseline conditions of the Revised Consented Development, so that the construction plan and layout of the Development (as described in **Chapter 4: Description of Revised Consented Development**) could be developed/refined to account for these constraints, and so minimise the potential risks and impacts to certain receptors during construction and operation.

13.8.3 A review of the baseline information for the study area (Section 13.6) identified potential development constraints associated with the original Consented Development. This led to areas being discounted for the siting of turbines and access tracks and other areas being considered for development only if appropriate mitigation could be provided. For example, as described in Section 13.2, and in response to THC who objected on the grounds of a loss of recreational amenity close to the village of Reay and an unacceptable impact on Wild Land Area 39 - East Halladale Flows, three turbines were removed and sections of access track and a borrow pit relocated from the north-western corner of the site, removing any Revised Consented Development infrastructure from the surface water catchment of the Sandside Burn.

13.8.4 The preliminary constraints map generated as part of the screening process was used to 'scope out' potential locations for the wind turbines and site infrastructure. To establish an indicative wind farm layout, buffer zones were placed around specific areas of the Revised Consented Development where significant constraints were identified to exclude these from the possible areas of the Revised Consented Development. A map of hydrological constraints showing the Revised Consented Development layout is presented in **Figure 13.6**.

Avoidance of steep gradients

13.8.5 Parts of the study area where steep slopes are mapped were identified as a significant constraint due to potential peat slide risks and enhanced runoff. These are indicated in Figure 7 of the PSRA (**Appendix 13.B**). Except where existing tracks are being utilised and at watercourse crossing areas where steeper gradients are present, these areas have generally been avoided for construction of turbines and other infrastructure, including new access tracks.

Avoidance of deep peat deposits

13.8.6 Potential significant constraints were identified in areas of the Revised Consented Development where peat was shown to be deeper than 3 m (see Technical **Appendix 13.A**). Avoiding such areas serves to minimise the volume of peat needing to be excavated, but excavation of this depth of peat could also have significant local influences on hydrology and associated habitats. As such, every effort was made to avoid siting turbines in areas of relatively deep peat deposits. Micro-siting during construction would aim to focus development on areas of shallower peat. Further information on the mitigation measures relevant to the peat and be found in the PMP (Technical **Appendix 13.A**), and the PSRA (Technical **Appendix 13.B**).

Avoidance of flood zones

13.8.7 The study identified potential fluvial flood constraints downstream of the Revised Consented Development. As a precaution, all areas identified as being located within a 1 in 10 year fluvial flooding zone were considered to be unsuitable for development. SPP (2020) states that developments should promote flood avoidance by safeguarding flood storage and conveying capacity and locating development away from functional flood plains and medium (1 in 200 year flood zone) and high (1 in 10 year flood zone) risk areas. The 1 in 200 year flood zones throughout and downstream of the Revised Consented Development are virtually identical to the 1 in 10 year flood zones.

Watercourse buffer zones

13.8.8 Additionally, a 50 m buffer zone was applied to the entire watercourse network including the lochan and springs not used for abstraction purposes. As well as providing further reassurance regarding flood risk, this considers the risk of pollution to these water features and provides a buffer to reduce the risk of uncontrolled run-off to them. The buffer zone is unsuitable for development, with the exception of watercourse crossings and where existing site tracks are utilised to preclude extra ground disturbance effects in the construction of new tracks. The buffer zone was defined based on the watercourse network/water features included on the OS mapping.

Groundwater abstraction buffer zone

13.8.9 The study has identified one abstraction close to the site boundary. As discussed earlier (Section 13.6), information from the 2012 ES identified the PWS at Loanscorribest (P01) as a shallow well. New infrastructure has been kept >250 m away from this location, with the access track passing approximately 750 m away.

Conservation site and GWDTE buffer zones

13.8.10 No significant constraints are required regarding risks to designated conservation sites. However, the proposed site layout aimed to minimise incursions of 100 m (shallow excavation, <1 m deep) and 250 m (deep excavation, >1 m deep) buffer areas around the potential GWDTEs identified earlier[4]. Due to the mosaic nature of the potential GWDTE habitat across the site it is not possible to avoid these buffers completely.

Micro-siting

13.8.11 High-level micro-siting of proposed turbine locations has been carried out to ensure that ecological, hydrological, hydrogeological and geotechnical aspects were optimised. The final turbine locations are shown in **Figure 13.1**. In addition, there is the potential for further micro-siting (Section 13.11) as a result of further on-site surveys and further baseline data collection prior to construction.

Construction Site Licence

13.8.12 Under CAR, a proposed construction site in Scotland may need to obtain a CSL[5], prior to commencing work. A CSL for the Revised Consented Development is likely to be required since the construction site is greater than 4 hectares in area and includes trackways of greater than 5 km in length. This licence application requires the holder to adhere to a Pollution Prevention Plan (PPP) that SEPA has reviewed and must consider the potential impacts of construction on the water environment. Further details of SEPA's requirements for a PPP to accompany a CSL is provided in guidance document WAT-SG-75[6].

Track design

13.8.13 On areas of peat depths greater than 1 m, floating roads are proposed. In these circumstances, the weight of the road is supported by the peat beneath, thereby avoiding the need to construct foundations extending through to the underlying solid stratum. The floating roads would be constructed in line with the good practice guidance produced by FCS and SNH (2010) and SR et al (2019) and would include the use of geogrids and geotextiles. The geotextile used would be selected to maintain load distribution, ensure separation of aggregate and peat, and prevent peat rutting, erosion and drainage. Aggregate choice would be sensitive to peat geochemistry and would be of sufficient grade to allow infiltration through to the geotextile.

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

[4] SEPA (LUPS-GU31)

[5] https://www.sepa.org.uk/regulations/water/pollution-control/construction-site-licences/

[6] SEPA, 2018. Sector Specific Guidance: Construction Sites, Version 1, Feb 2018. https://www.sepa.org.uk/media/340359/wat-sg-75.pdf

13.8.15 On areas of steeper gradient or where there are concerns about slope stability, the use of floating roads may not be appropriate and cut tracks would be considered. These would need to be cut all the way through the peat, thereby potentially increasing disturbance of the local hydrology. The extent of these access tracks would be minimised.

Drainage design

13.8.16 The need for drainage on the access track network would be considered for all parts of the track network separately, since slope and wetness vary considerably across the Revised Consented Development. In flat areas, drainage of floating roads is not required as it can be assumed that rainfall on to the access track would infiltrate to the ground beneath the access track or along the verges. Track-side drainage would be avoided where possible, to prevent any local reductions in the water table or influences on the access track structure and compression (the latter can occur where a lower water table reduces the ability of the peat to bear weight, increasing compression).

13.8.17 Where access tracks are to be placed on slopes, lateral drainage would be required on the upslope side of the access track. The length of drains would be minimised, to prevent either pooling on the upslope side or, at the other extreme, creating long flow paths along which rapid run-off could occur. Regular cross-drains would be required to allow flow to pass across the access track as recommended in SR et al (2019), with a preference for subsequent re-infiltration on the downslope side, rather than direct discharge to the drainage network.

13.8.18 Check dams may be implemented in drainage ditches where necessary to reduce flow velocities to aid in the sedimentation of silt from suspension and to also direct water into the cross drains so that natural flow paths are maintained as far as possible.

13.8.19 The ditch design would be considered in line with the recommendations of the FCS and SNH (2010) guidance, including the use of flat-bottomed ditches to reduce the depth of disturbance.

13.8.20 Cross-drainage may be by culverts or pipes beneath the access track, again in line with the FCS and SNH (2010) guidance. Drainage would be installed before or during access track construction, rather than afterwards, to ensure that the access track design is not compromised. The cross drainage would flow out into shallow drainage, which would allow diffuse re-infiltration to the peat on the downslope side. The cross drains would flow out at ground level and not be hanging culverts. The avoidance of steep gradients for the access tracks would also reduce the risk of erosion occurring at cross-drain outflows.

13.8.21 In instances of drainage close to surface watercourses, discharge from the drainage may be to surface water rather than re-infiltration. In these situations, best practice control measures including sediment settlement would be undertaken before the water is discharged into surface water systems. The discharges would be small and collected from only a limited area, rather than draining a large area to the same location. Sufficient attenuation storage would also be incorporated into site drainage systems to ensure that discharge rates to watercourses do not exceed pre-development rates.

13.8.22 Although drainage would be provided in areas of disturbance as required, areas of hardstanding would be minimised so that this need is reduced. This includes careful design of construction compounds and minimising the size of crane pads at each turbine location.

13.8.23 The details of proposed site drainage measures would be set out in the Water Management Plan (WMP) for the site, which would accompany the CEMP. In addition, a Water Quality Monitoring Plan (WQMP) has already been approved and is being implemented for the Consented Development. The monitoring aims to provide reassurance as to the overall effectiveness of the mitigation measures designed to protect the water environment.

Cable trench design

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

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

Watercourse crossings design

13.8.26 The number of watercourse crossings has been minimised, but due to the number of watercourses and preferential flow pathways on the Revised Consented Development, and limitations regarding access locations, it is not possible for the Revised Consented Development to take place without some crossings. The types of watercourse crossing available typically comprise bridges, culverts and causeways. Bridges in general are the preferred solution due to their lesser hydrological and ecological effects, but where there are small or indistinct channels with little topographic variability culverts are generally accepted to be more appropriate.

13.8.27 Adherence to WAT-SG-25 (SEPA, 2010), River Crossings and Migratory Fish: Design Guidance (SGt, 2000) and CIRIA Culvert Design and Operation Guide (C689) helps to minimise potential hydrological (including morphological) effects. All watercourse crossings would be designed to convey a 1 in 200-year return period flood event with an allowance for climate change, and each watercourse/flow pathway crossing has been considered individually with respect to topography and hydrology. The proposed locations and types of watercourse and flow path crossings are shown in **Figure 13.6** and summarised in Error! Reference source not found.**13.15**.

Table 13.15 Types of watercourse and flow path crossings

Crossing number	Watercourse	Feature code	NGR	Type	Comments
RX01	Reay Burn	WC01	297165 961557	Culvert	Simple culvert type
RX02	Unnamed tributary of Reay Burn	WC02	297577 961341	Culvert	Simple culvert type
RX03	Meur an Fhuarain Ghil	WC03	297758 960796	Culvert	Simple culvert type
RX04	Unnamed tributary of Achvarasdal Burn	WC04	299280 960626	Culvert	Simple culvert type
RX05	Meur Gadach	WC05	297509 960279	Culvert	Simple culvert type
RX06	Meur a' Chrochain Ghil	WC06	297784 960236	Culvert	Simple culvert type
RX07	Meur an Fhraoich	WC07	298186 959646	Culvert	Simple culvert type

13.8.28 Seven new simple culvert type constructions are proposed using a cross sectional area that would not impede flow of water, wherever the trackway crosses a watercourse within the Revised Consented Development. The design of culverts would be to at least CIRIA Culvert Design and Operation Guide (C689) standard and the culvert structure would not affect either the channel or banks. The existing alignment of the watercourses would remain unchanged.

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

13.8.30 All turbine cables need eventually to lead to the substation that is proposed to be located at NC 976 627. This means that the cables from turbines to west of the Reay Burn (and unnamed tributaries) would need to cross this watercourse at some point. WAT-SG-25 (SEPA, 2010) discusses cable crossings and identifies boring beneath the channel as having the least impact on watercourses. Directional drilling would therefore possibly be required to pass the cable beneath the site watercourses and ensure that there is no influence on the watercourse. GBR7 would be adhered to in laying the cable beneath the watercourse. A full geotechnical assessment would be undertaken at the detailed design stage following consent.

Excavations and associated drainage

13.8.31 Where possible, excavations required to facilitate the construction of foundations for the wind turbines, service trenches and each crane base would be designed so that they can freely drain by gravity. Cut-off drains would be installed around the excavation areas to prevent surface run-off entering the excavations.

13.8.32 Measures based on Best Practice guidelines from SEPA would be adopted during construction to prevent pollution, with all contractors aware of a pre-planned pollution incident response procedure, as detailed in PPG21. The turbine

foundation design minimises excavation requirements in accordance with BS6031: 2009 Code of Practice for Earth Works.

13.8.33 Turbine construction would need to adopt mitigation measures to prevent contaminants entering the shallow groundwater system. The main potential groundwater effect arising from the construction of the wind turbine foundations and adjacent crane pads is the risk of leaching concrete residues into the water environment. Given the dominant soil type and areas of peat distribution, the near-surface groundwater at the Revised Consented Development is likely to be acidic. Therefore, to minimise the potential of concrete leaching and alkaline pollution of groundwater, suitable sulphate-resistant concrete would be used. The foundation design would be checked with SEPA, and if necessary the foundation excavations would incorporate an adequate barrier to prevent the migration of any on-site pollutants to the underlying groundwater.

13.8.34 Should ground conditions occur during excavation where gravity drainage is not possible (i.e. where low permeability rock or superficial deposits are present), the excavations would be dammed and drained by pumping. These dewatering activities would be undertaken in accordance with Best Practice (including WAT-SG-29 on Temporary Construction Methods), which would be detailed in the CEMP to be agreed by SEPA and the Ecological Clark of Works (ECoW).

13.8.35 The design for the dewatering would ensure collection and settling of suspended sediment i.e. use of silt traps, fences, straw bales or lagoons. Any water removed from the excavation would be treated and pumped to a bunded and vegetated settlement and infiltration swale, downgradient of the excavation and away from watercourses, and there would be no discharge of water directly into a watercourse. The potential for infiltration would need to be carefully assessed due to the presence of saturated/peaty soils across the Revised Consented Development. Should this be an issue, a number of these swales could be used with a wide spatial distribution to prevent oversaturation. If large volumes of water are expected from dewatering, other SUDS elements such as french drains could also be utilised (subject to ground conditions). Should local topography or ground conditions prove unsuitable for construction of either infiltration swales or settlement lagoons, the use of portable silt trap devices such as 'Siltbuster' type tanks could be considered for removal of elevated suspended solids from water pumped from excavations. These activities would be designed and implemented in consultation with SEPA on a foundation-specific basis following completion of detailed ground investigations and micro-siting prior to construction.

13.8.36 The locations of swales or settlement lagoons, where required, would be on stable areas of shallow slope, to reduce the risk of failure. The size of the settlement lagoons would be appropriate to the amount of dewatering, but if large quantities of dewatering are anticipated, the potential for more than one lagoon or the use of portable silt trap devices would be considered on a foundation-by-foundation basis. If any discharge to surface watercourses is required, the water would be treated beforehand and the need for any consent from SEPA agreed (it is expected that in most cases the activities would be covered by CAR GBR3 and/or GBR15).

13.8.37 A single borrow pit has been proposed within the Revised Consented Development, located at Bruach Bhreac/Cnoc an t'Samhraidh (NC 975 622), in the north of the site. It is anticipated that the excavation of this pit may involve a small amount of dewatering during rock removal. This assumption is based on the status of the local aquifer (low productivity) and, as such, impacts on groundwater resources would be limited. Similar controls to those detailed above would be employed to prevent contamination of surface waters with suspended sediment. Based on the nature of the underlying geology it is assumed that groundwater flow in the solid geology is limited and so, as no abstraction points have been identified in proximity to any excavation locations, dewatering would not have any impact on existing abstractions. However, the dewatering of excavations at greater than 10 m^3/day would require CAR Registration, while over 50 m^3/day would require a CAR licence. Abstractions smaller than 10 m^3/d would comply with GBR3.

Peat excavations and storage

13.8.38 Policy 55 of HwLDP 2012 (**Table 13.2**) states that for development proposals affecting peat deposits applications should demonstrate how they have avoided unnecessary disturbance, degradation or erosion of peat and soils. Measures that would be employed to minimise impacts on peat are outlined below.

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

13.8.40 During the design phase of the Revised Consented Development the selection of appropriate turbine sites has avoided areas, wherever possible, where substantial peat thicknesses have been identified. This helps to reduce the volumes of peat that are required to be excavated for the construction of concrete foundation slabs and therefore the need to manage materials. However, it has not been possible to avoid all areas where peat overlies the solid geology. Consequently, mitigation measures would be adopted to prevent changes which have the potential to influence water quality.

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

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

13.8.43 The upper levels of the peat and turf excavated for the turbine bases can be used for resurfacing following construction (in non-hardstanding areas), thus

maintaining the hydrological and biological characteristics of the location. This resurfacing would aim to restore a flat surface around the turbine, preventing mounding. This would help to re-establish hydraulic continuity of the replaced peat and turf with surrounding saturation levels, thereby reducing the possibility of peat drainage and desiccation.

Site working practices

13.8.44 Site activities during construction and operation have been identified to have potential effects. These can be controlled by the implementation of pollution prevention and control measures and Best Practice, based on the guidance outlined earlier.

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

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

13.8.47 In areas where there is a potential for hydrocarbon residues from run-off/isolated leakages, such as in plant storage areas and around fuel storage tanks and in refuelling zones in the proposed temporary site compound, surface water drainage would be directed to a hydrocarbon interceptor prior to discharge. The interceptor would filter out hydrocarbon residues from drainage water and retain hydrocarbon product in the event of a spillage to prevent release into surface waters at the discharge point and deterioration of downstream water quality.

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

13.8.49 The main potential hydrological effects during the operational phase of the Revised Consented Development relate to the servicing of the turbines and storage of oils and lubricants involved in the process which may be accidentally released into the water environment. This includes during the turbine gearbox oil changes, which are proposed to be undertaken every 18 months during the lifetime of the Revised Consented Development.

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

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

CEMP

13.8.52 In accordance with SR et al (2019), engineering activities that involve the construction of river crossings or drainage systems would be avoided where possible to ensure that the Revised Consented Development and surface water system remain in a near as natural a state as possible. However, there are circumstances where this is not achievable due to the nature of the Revised Consented Development and restrictions on the number of options for access. Prior to the commencement of construction activities, a CEMP would therefore be produced that would follow Best Practice guidance, as well as incorporating specific recommendations made in this EIAR, and would therefore account for potential risks and ensure minimal effects on the site hydrology and hydrogeology during construction. No works would be undertaken unless agreed in the CEMP.

13.8.53 The CEMP would include or be accompanied by a WMP, a PPP and a PIRP for construction activities at the site. The WMP would set out the specific details of surface water drainage, management of dewatered groundwater from excavations and watercourse crossings. The PPP would set out specific measures to protect hydrology and hydrogeology receptors from pollution arising from construction activities and a programme for inspection and monitoring to ensure the effectiveness of these measures. The PIRP would describe the response plan for pollution incidents, should accidental spillages occur despite the control measures in place.

Summary

13.8.54 A range of environmental measures have been embedded into the development proposals as outlined above. A summary of how these embedded measures relate to each of the receptor groups in the assessment is presented in **Table 13.16**.

Table 13.16 Summary of embedded environmental measures

Receptor	Changes and effects	Embedded measures
Aquifers and associated WFD groundwater bodies	Soil compaction and the introduction of areas of hardstanding during construction and throughout operation reducing recharge and groundwater levels, leading to a loss of water resource	CEMP
	Dewatering during construction associated with the excavation of the turbine foundations and borrow pit reducing groundwater levels, leading to a loss of water resource	CEMP Dewatering of excavations and associated drainage consistent with requirements of GBRs 3 and 15.
	Site activities during construction and operation resulting in the release of pollutants and the subsequent contamination of groundwater, leading to a loss of water resource	CEMP Site working practices
Springs	Soil compaction and the introduction of areas of hardstanding during construction and throughout operation reducing recharge and groundwater levels, leading to spring flow derogation	Watercourse buffer zones CEMP
	Dewatering during construction associated with the excavation of the turbine foundations and borrow pit reducing groundwater levels, leading to spring flow derogation	Watercourse buffer zones CEMP
	Site activities during construction and operation resulting in the release of pollutants and the subsequent contamination of groundwater, leading to pollution of springs	Watercourse buffer zones CEMP Site working practices
Watercourses, lochans and associated WFD surface water bodies	Soil compaction and the introduction of areas of hardstanding during construction and throughout operation increasing runoff and sediment loading, leading to changes in watercourse flow, quality and morphology	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients Micro-siting CEMP Track design Drainage design Cable trench design Watercourse crossings design
	Disruption of flow paths and changes to drainage regime during construction and throughout operation can be associated with increases in runoff and less on-site water retention, leading to changes in watercourse flow and morphology	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients Micro-siting CEMP Track design Drainage design Cable trench design Watercourse crossings design

Receptor	Changes and effects	Embedded measures
		Peat excavation and storage
	Disruption of ground during construction resulting in increased sediment loading, leading to changes in watercourse quality and morphology	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients Micro-siting CEMP Track design Drainage design Cable trench design Watercourse crossings design Peat excavation and storage
	Dewatering and/or drainage during construction disrupting groundwater support (baseflow), leading to changes in watercourse flow	Avoidance of flood zones Watercourse buffer zones Micro-siting CEMP Excavations and associated drainage
	Discharge to surface water of groundwater intercepted during construction associated with the excavation of the turbine foundations and borrow pit, leading to changes in watercourse flow, quality and morphology	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients Micro-siting of turbines and tracks CEMP Excavations and associated drainage
	Site activities during construction and operation resulting in the release of pollutants and the subsequent contamination of surface waters, leading to changes in watercourse quality and morphology	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients Micro-siting CEMP Watercourse crossings design Site working practices
Flood risk	Soil compaction and the introduction of areas of hardstanding and changes of land use (e.g. deforestation) during construction and throughout operation increasing runoff, leading to increased flood risk	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients Micro-siting CEMP Track design Drainage design Cable trench design Watercourse crossings design
	Disruption of flow paths and changes to drainage regime during construction and throughout operation can be associated with increases in runoff and less on-site water retention, leading to increased flood risk	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients Micro-siting CEMP Track design Drainage design Cable trench design Watercourse crossings design Peat excavation and storage
	Discharge to surface water of groundwater intercepted during construction associated with the excavation of the turbine foundations and borrow pit, leading to increased flood risk	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients Micro-siting of turbines and tracks CEMP Excavations and associated drainage

Receptor	Changes and effects	Embedded measures
PWS	Soil compaction and the introduction of areas of hardstanding during construction and throughout operation reducing recharge and groundwater levels, leading to abstraction derogation	Groundwater abstraction buffer zones CEMP
	Dewatering during construction associated with the excavation of the turbine foundations and borrow pit lowering groundwater levels, leading to abstraction derogation	Groundwater abstraction buffer zones CEMP
	Site activities during construction and operation resulting in the release of pollutants and the subsequent contamination of groundwater, leading to abstraction pollution	Groundwater abstraction buffer zones CEMP Site working practices
Conditions supporting conservation site and GWDTEs (groundwater)	Soil compaction and the introduction of areas of hardstanding during construction and throughout operation reducing recharge and groundwater levels, leading to reduced groundwater support	Avoidance of deep peat deposits Conservation site buffer zones CEMP
	Dewatering during construction associated with the excavation of the turbine foundations and borrow pit lowering groundwater levels, leading to reduced groundwater support	Avoidance of deep peat deposits Conservation site buffer zones CEMP Excavations and associated drainage
	Site activities during construction and operation resulting in the release of pollutants and the subsequent contamination of groundwater, leading to polluted groundwater support	Avoidance of deep peat deposits Conservation site buffer zones CEMP Site working practices
	Physical disturbance of the peat and groundwater throughflow could occur as a result of excavation works and peat stockpiling/removal, leading to reduced groundwater support for peatlands	Avoidance of deep peat deposits Conservation site buffer zones CEMP Peat excavation and storage
Conditions supporting conservation site and GWDTEs (surface water)	Soil compaction and the introduction of areas of hardstanding during construction and throughout operation increasing runoff and sediment loading, leading to changed/polluted surface water support	Avoidance of steep gradients Avoidance of deep peat deposits Conservation site buffer zones Micro-siting CEMP Track design Drainage design Cable trench design Watercourse crossings design
	Disruption of flow paths and changes to drainage regime	Avoidance of steep gradients Avoidance of deep peat deposits

Receptor	Changes and effects	Embedded measures
	during construction and throughout operation can be associated with increases in runoff and less on-site water retention, leading to altered surface water support	Conservation site buffer zones Micro-siting CEMP Track design Drainage design Cable trench design Watercourse crossings design Peat excavation and storage
	Disruption of ground during construction resulting in increased sediment loading, leading to polluted surface water support	Avoidance of steep gradients Avoidance of deep peat deposits Conservation site buffer zones Micro-siting CEMP Track design Drainage design Cable trench design Watercourse crossings design Peat excavation and storage
	Dewatering and/or drainage during construction disrupting groundwater support (baseflow) to watercourses, leading to reduced surface water support	Avoidance of deep peat deposits Conservation site buffer zones Micro-siting CEMP Excavations and associated drainage
	Discharge to surface water of groundwater intercepted during construction associated with the excavation of the turbine foundations increasing flows and sediment loading, leading to changed and polluted surface water support	Avoidance of steep gradients Avoidance of deep peat deposits Conservation site buffer zones Micro-siting CEMP Excavations and associated drainage
	Site activities during construction and operation resulting in the release of pollutants and the subsequent contamination of surface waters, leading to polluted surface water support	Avoidance of steep gradients Avoidance of deep peat deposits Conservation site buffer zones Micro-siting CEMP Watercourse crossings design Site working practices

13.9 Assessment of Hydrology and Hydrogeology Effects

Aquifers and associated WFD groundwater bodies (GW02 and GW03)

13.9.1 Based on the water environment baseline presented in Section 13.6, Section 13.7 identified that the potential effects due to the Revised Consented Development on the bedrock aquifers and associated Northern Highlands WFD and Dounreay groundwater bodies (GW02 and GW03 respectively) required consideration as part of the assessment (**Table 13.13**).

13.9.2 **Table 13.16** indicates that loss or contamination of the groundwater resources could occur as a result of soil compaction and the introduction of areas of hardstanding during construction and throughout operation reducing recharge and groundwater levels; dewatering during construction associated with the excavation of the turbine foundations and borrow pit reducing groundwater levels; and site activities during construction and operation resulting in the release of pollutants and the subsequent contamination of groundwater.

13.9.3 The aquifers are of moderate to low productivity and the associated WFD groundwater bodies are classified as of Good overall status. They are therefore both considered to be of medium value (Error! Reference source not found.).

13.9.4 Mitigation that looks to protect the aquifers and WFD groundwater bodies includes adherence to the CEMP, BS6031: 2009 Code of Practice for Earth Works, WAT-SG-29 on Temporary Construction Methods and any dewatering CAR registration or licence requirements (Section 13.8 and Error! Reference source not found.**13.16**). The limited extent of the proposed works compared to the areas of the Revised Consented Development and the aquifers and WFD groundwater bodies, and the anticipated effectiveness of the embedded environmental measures combine to limit the magnitude of change to the aquifers and WFD groundwater bodies baseline condition.

13.9.5 The magnitude of change to the aquifers and WFD groundwater bodies with respect to the soil compaction and hardstanding (groundwater levels), turbine foundation and borrow pit dewatering works (groundwater levels), and site activities (groundwater quality) is therefore very low (Error! Reference source not found.).

13.9.6 On this basis, the level of effect on the aquifers and WFD groundwater bodies is negligible adverse and not significant (Error! Reference source not found.).

Springs (S01 and S02)

13.9.7 Based on the water environment baseline presented in Section 13.6, Section 13.7 identified that the potential effects due to the Revised Consented Development on two springs (Achvarasdal Leans and Aryleive, S01 and S02 respectively) required consideration as part of the assessment (**Table 13.13**).

13.9.8 **Table 13.16** indicates that derogation or contamination of the springs could occur as a result of soil compaction and the introduction of areas of hardstanding during construction and throughout operation reducing recharge and groundwater levels; dewatering during construction associated with the excavation of the turbine foundations and borrow pit reducing groundwater levels; and site activities during construction and operation resulting in the release of pollutants and the subsequent contamination of groundwater.

13.9.9 Given that neither of the springs are used for abstraction purposes and Aryleive (S02) does not appear to be linked to a watercourse and therefore not important as a source of baseflow, the springs are both considered to be of very low value (**Table 13.4**).

13.9.10 Mitigation that would serve to help protect the springs is extensive (Section 13.8 and **Table 13.16**). This includes limiting new wind farm development in their vicinity by way of a 50 m buffer zone, and adherence to the CEMP, BS6031: 2009 Code of Practice for Earth Works, WAT-SG-29 on Temporary Construction Methods and any dewatering CAR registration or licence requirements. For example, Achvarasdal Leans (S01) is approximately 225 m downgradient from Turbine 23 and its access track, whilst previously consented tracks in the vicinity of Aryleive (S02) are no longer proposed (although Turbine 51 is some 140 m away).

13.9.11 The anticipated effectiveness of embedded mitigation measures means that the magnitude of change to the springs with respect to the soil compaction and the introduction of areas of hardstanding (groundwater levels), any dewatering

works (groundwater levels), and site activities (groundwater quality) is low (**Table 13.5**).

13.9.12 On this basis, the level of effect on the springs is negligible adverse and not significant (**Table 13.6**).

Watercourses, lochans and associated WFD surface water bodies (W01, W02, W03 and W04)

13.9.13 Based on the water environment baseline presented in Section 13.6, Section 13.7 identified that potential effects of the Revised Consented Development on the Achvarasdal Burn and WFD surface water body (W01), the Reay Burn (W02), the Sandside Burn and WFD surface water body (W03) and Lochan nan Eun (W04) required consideration as part of the assessment (**Table 13.13**).

13.9.14 **Table 13.16** indicates that changes in flow and morphology and also sediment loading and pollution of watercourses and WFD surface water bodies could occur as a result of soil compaction and the introduction of areas of hardstanding during construction and throughout operation increasing runoff and sediment loading; disruption of flow paths and changes to drainage regime during construction and throughout operation can be associated with increases in runoff and less on-site water retention; disruption of ground during construction leading to increased sediment loading; dewatering and/or drainage during construction disrupting groundwater support (baseflow) to watercourses; discharge to surface water of groundwater intercepted during construction associated with the excavation of the turbine foundations and borrow pit increasing flows and sediment loading; and site activities during construction and operation resulting in the release of pollutants and the subsequent contamination of surface waters.

13.9.15 The Achvarasdal and Sandside Burns and WFD surface water bodies are classified as being at Good overall status. The Reay Burn and Lochan nan Eun are not classified by SEPA but are likely to have similar characteristics to the Achvarasdal and Sandside Burns and so are assumed to be equivalent to WFD Good overall status. All four receptors are therefore considered to be of medium value (**Table 13.4**).

13.9.16 No works are proposed in the Sandside Burn catchment, but there is a series of works proposed in the other two surface water catchments, including six watercourse crossings, a control building, turbines and access tracks in the Reay Burn catchment and a borrow pit, construction compound, turbines and access tracks in the Achvarasdal Burn catchment.

13.9.17 However, the mitigation that looks to protect surface watercourses is extensive (Section 13.8 and **Table 13.16**). It includes a 50 m buffer zone applied to the entire river network and Lochan nan Eun, micro-siting of turbines, tracks and other infrastructure, careful access track drainage and watercourse crossing design and adherence to numerous relevant protocols, including the CEMP, SR et al (2019) Good Practice During Wind Farm Construction guidance, the WAT-SG-25 (SEPA, 2010) River Crossings Good Practice Guide, the WAT-SG-29 on Temporary Construction Methods and any dewatering CAR registration or licence requirements. Any dewatering would necessitate the use of silt traps, fences, straw bales, settlement lagoons, swales and SUDS, and any discharge to surface water would be subject to conditions attached to the deemed

planning permission. Other pollution prevention and emergency response planning are also relevant.

13.9.18 It is considered that these mitigation measures are sufficient to ensure that change to the surface waters with respect to soil compaction and hardstanding (surface water quantity and quality), disruption of flow paths (surface water quantity), disruption of ground (surface water quality), dewatering and/or drainage (surface water quantity), discharge to surface water (surface water quantity and quality), and site activities (surface water quality) to be of low to very low magnitude (**Table 13.5**). However, this magnitude assignment recognises that there is the potential for some very localised short-term effects on water quality, and which generate the need for further mitigation actions in the form of a water quality monitoring programme (see Section 13.11).

13.9.19 On this basis, the level of effect on the surface waters is minor to negligible adverse and not significant (**Table 13.5**).

Flood Risk (F01)

13.9.20 Based on the water environment baseline presented in Section 13.6, Section 13.7 identified that the potential effects due to the Revised Consented Development on flood risk within an area to the north and east of the site between Loanscorribest and Milton (F01) required consideration as part of the assessment (**Table 13.13**).

13.9.21 **Table 13.16** indicates that changes in flood risk could be as a result of soil compaction and the introduction of areas of hardstanding and changes of land use (e.g. deforestation) during construction and throughout operation increasing runoff; disruption of flow paths and changes to drainage regime during construction and throughout operation can be associated with increases in runoff and less on-site water retention; and discharge to surface water of groundwater intercepted during construction associated with the excavation of the turbine foundations and borrow pit.

13.9.22 The only human properties or infrastructure located within and immediately downstream of the flood risk area is the Loanscorribest area, which is considered as of medium value (**Table 13.4**). No receptors exist upstream of the 1 in 10 year high risk flood zone.

13.9.23 The Loanscorribest area has a high likelihood (10% AEP) of out-of-channel flooding associated with the Achvarasdal Burn, downstream of the site. The main concern is related to the proposed access track that extends from an existing track, between Little and Big Keoltag (NC 976 646), south to Milton (NC 978 637). The new proposed trackway skirts around the edge of the indicative 1 in 10 year high risk flood zone. OS mapping shows the area of the new trackway to be fairly flat, over agricultural land that is well drained as a result of the extensive drain network to the east and west of the track.

13.9.24 Mitigation that looks to minimise flood risk is extensive (Section 13.8 and **Table 13.16**). In particular, the design of the trackway and watercourse crossing in the Achvarasdal Burn flood risk area, in consultation with SEPA, would be such that the ability of the floodplain to store and convey water would not be compromised. The anticipated effectiveness of design and embedded environmental measures means that the magnitude of change on the watercourse and surface flow with respect to flood risk is therefore low (

13.9.25 **Table 13.5**).

13.9.26 On this basis, the level of effect on the flood risk is minor adverse and not significant (**Table 13.6**).

PWS (P01)

13.9.27 Based on the water environment baseline presented in Section 13.6, Section 13.7 identified that the potential effects due to the Revised Consented Development on a PWS required consideration as part of the assessment. This is the Loanscorribest PWS, which is understood to be a shallow (1 m deep) well located near the Achvarasdal Burn, approximately 160 m north of the site.

13.9.28 **Table 13.16** indicates that derogation or contamination of this abstraction could occur as a result of soil compaction and the introduction of areas of hardstanding during construction and throughout operation reducing recharge and groundwater levels; dewatering during construction associated with the excavation of the turbine foundations and borrow pit lowering groundwater levels; and site activities resulting in the release of pollutants and the subsequent contamination of groundwater.

13.9.29 Like all PWSs, the Loanscorribest PWS is considered to be of low value (**Table 13.4**).

13.9.30 Given the shallow nature of the PWS and its proximity to the Achvarasdal Burn, any, for example, silt-laden runoff as a result of the Revised Consented Development could potentially impact this receptor. It is noted that a borrow pit, construction compound, turbines and access tracks are all proposed to be located within the Achvarasdal Burn catchment.

13.9.31 Mitigation that would serve to help protect the abstraction is extensive (Section 13.8 and **Table 13.16**). With respect to a groundwater abstraction such as Loanscorribest, mitigation includes restricting new wind farm development in its vicinity by way of the 250 m LUPS-GU31 buffer zone, and adherence to the CEMP/OEMP, BS6031: 2009 Code of Practice for Earth Works, WAT-SG-29 on Temporary Construction Methods and any dewatering CAR registration or licence requirements. Furthermore, the mitigation described earlier that looks to protect surface watercourses could also have some relevance to the nearby shallow Loanscorribest PWS.

13.9.32 Distance, the low permeability of the superficial aquifer and the anticipated effectiveness of embedded mitigation measures means that the magnitude of change to the Loanscorribest PWS with respect to the soil compaction and the introduction of areas of hardstanding (groundwater levels), any dewatering works (groundwater levels), and site activities (groundwater quality) is very low (Error! Reference source not found.**13.5**).

13.9.33 On this basis, the level of effect on the Loanscorribest PWS is negligible adverse and not significant **(**Error! Reference source not found.).

Conditions Supporting Conservation Site (C02) and GWDTEs (C04 and 05)

13.9.34 Based on the water environment baseline presented in Section 13.6, Section 13.7 identified that the potential effects due to the Revised Consented Development on a conservation site required consideration as part of the

assessment, namely the Sandside Bay SSSI (C02), together with two potentially high and moderate GWDTEs (C04 and C05 respectively).

13.9.35 **Table 13.16** indicates that derogation or contamination of these sites could occur as a result of soil compaction and the introduction of areas of hardstanding during construction and throughout operation reducing recharge and groundwater levels and increasing runoff and sediment loading; disruption of flow paths and changes to drainage regime during construction and throughout operation can be associated with increases in runoff and less on-site water retention; disruption of ground during construction resulting in increased sediment loading; dewatering and/or drainage during construction lowering groundwater levels and disrupting groundwater support (baseflow) to watercourses; discharge to surface water of groundwater intercepted during construction associated with the excavation of the turbine foundations increasing flows and sediment loading; site activities during construction and operation resulting in the release of pollutants and the subsequent contamination of groundwater and surface waters; and physical disturbance of any peat and groundwater throughflow as a result of excavation works and peat stockpiling/removal.

13.9.36 The Sandside Bay SSSI (C02) is located downstream of the site along the Achvarasdal Burn/Burn of Isauld. Whilst its designation is not based on specific aquatic features, it is nevertheless considered of medium value (**Table 13.4**). The GWDTEs (C04 and 05) are of high and moderate potential groundwater dependence respectively, and of low value (**Table 13.4**).

13.9.37 The Sandside Bay SSSI is located to the north of the Revised Consented Development, separated from the site by the A836 carriageway. Both the Reay Burn and the Achvarasdal Burn (via the Burn of Isauld) connect the site to Sandside Bay and therefore all of the infrastructure is regarded to be located upgradient of the SSSI.

13.9.38 That the proposed infrastructure is > 1 km up stream of the SSSI, together with the anticipated effectiveness of the up-catchment embedded environmental measures discussed earlier with respect to the watercourses, means that the magnitude of change on the upgradient watercourse with respect to soil compaction and hardstanding (surface water quantity and quality), disruption of flow paths (surface water quantity), disruption of ground (surface water quality), dewatering and/or drainage (surface water quantity), discharge to surface water (surface water quantity and quality) and site activities (surface water quality) is very low (**Table 13.5**).

13.9.39 On this basis, the level of effect on the SSSI is negligible adverse and not significant (**Table 13.6**).

13.9.40 The limited area of GWDTE with high potential groundwater dependence (M6 mire habitat, C04) in the west of the site within the floodplain of the Reay Burn and upstream of its confluence with the Meur an Fhuarain Ghil and Meur Gadach is likely to be largely surface water dependent given its location along these watercourses. However, a small portion of this habitat, east of Meur an Fhuarain Ghil could potentially be receiving some groundwater input from the rising higher ground to the east. The watercourse crossing RX01 (**Table 13.15**), and associated trackway infrastructure lies within this GWDTE. Turbines T26 and 32 also lie within the same surface water catchment as the habitat.

13.9.41 The more widespread moderately groundwater dependent GWDTEs (C05), comprising predominantly M25 and M15 present along the main watercourses of the site and along forest rides and on the higher forested slopes through the central area of the site, are more likely to be surface water-fed. This is suggested by their location in areas typified by surface water input. Given their widespread distribution, they are located within the same surface catchments as all the proposed infrastructure, so could potentially be impacted by for example silt laden runoff from the construction of access tracks.

13.9.42 Mitigation that serves to protect the GWDTEs includes the minimising of incursions of 100 m (shallow excavation, <1 m deep) and 250 m (deep excavation, >1 m deep) buffer areas around the potential GWDTEs[7] (Section 13.8 and **Table 13.16**). Some parts of the GWDTEs sit within the SEPA LUPS-GU31 infrastructure buffers, but most of the other mitigation presented in Section 13.8 is relevant to the protection of the quantity and quality of the surface and groundwater support and maintaining the peat structure. This includes the avoidance of development, where possible, on steep gradients and within deep peat deposits, adherence to the CEMP and careful infrastructure design. The up-catchment embedded environmental measures discussed earlier with respect to the watercourses are also relevant.

13.9.43 The magnitude of change to the GWDTEs with respect to soil compaction and hardstanding (groundwater levels, surface water quantity and quality), disruption of flow paths and changes to drainage regime (surface water quantity), disruption to ground (surface water quality), dewatering and/or drainage (groundwater levels and surface water quantity), discharge to surface water of groundwater intercepted during construction (surface water quantity and quality), site activities (groundwater and surface water quality) and disturbance of any associated peat is therefore considered to be low (**Table 13.5**).

13.9.44 On this basis the level of effect is negligible adverse and not significant (**Table 13.6**).

Summary

13.9.45 A summary of the results of the assessment of the hydrology and hydrogeology is provided in **Table 13.17**.

[7] SEPA (LUPS-GU31)

Table 13.17 Summary of significance of adverse effects from Revised Consented Development

Receptor and summary of predicted effects	Sensitivity/ importance/ value of receptor[1]	Magnitude of change[2]	Significance[3]	Summary rationale
Aquifers and WFD groundwater bodies (GW02 and GW03)				
Soil compaction and introduction of areas of hardstanding during construction and throughout operation reducing recharge and groundwater levels, leading to loss of water resource	Medium	Very low	Negligible (NS)	Limited extent of proposed works compared to area of both the Revised Consented Development and aquifers and WFD groundwater bodies, and anticipated effectiveness of embedded environmental measures combine to limit magnitude of change to the aquifer and WFD groundwater body baseline conditions
Dewatering during construction associated with excavation of turbine foundations and borrow pit resulting in a decline in groundwater levels, leading to loss of water resource	Medium	Very low	Negligible (NS)	Limited extent of proposed works compared to area of both the Revised Consented Development and aquifers and WFD groundwater bodies, and anticipated effectiveness of embedded environmental measures combine to limit magnitude of change to aquifer and WFD groundwater body baseline conditions
Site activities during construction and operation resulting in release of pollutants and subsequent contamination of groundwater, leading to loss of water resource	Medium	Very low	Negligible (NS)	Limited extent of proposed works compared to area of both the Revised Consented Development and aquifers and WFD groundwater bodies, and anticipated effectiveness of embedded environmental measures combine to limit magnitude of change to aquifer and WFD groundwater body baseline conditions
Springs (S01 and S02)				
Soil compaction and the introduction of areas of hardstanding during construction and throughout operation reducing recharge and groundwater levels, leading to springflow derogation	Very Low	Low	Negligible (NS)	Anticipated effectiveness of embedded environmental measures combine to limit magnitude of change to spring baseline conditions
Dewatering during construction associated with the excavation of the turbine foundations and	Very Low	Low	Negligible (NS)	Anticipated effectiveness of embedded environmental measures combine to limit magnitude of change to spring baseline conditions

Receptor and summary of predicted effects	Sensitivity/ importance/ value of receptor[1]	Magnitude of change[2]	Significance[3]	Summary rationale
borrow pit reducing groundwater levels, leading to springflow derogation				
Site activities during construction and operation resulting in the release of pollutants and the subsequent contamination of groundwater, leading to pollution of springs	Very Low	Low	Negligible (NS)	Anticipated effectiveness of embedded environmental measures combine to limit magnitude of change to spring baseline conditions
Watercourses, lochan and associated WFD surface water bodies (W01, W02, W03 and W04)				
Soil compaction and introduction of areas of hardstanding during construction and throughout operation increasing runoff and sediment loading, leading to changes in watercourse flow, quality and morphology	Medium	Low	Minor (NS)	Some proposed works in catchments but anticipated effectiveness of embedded environmental measures and dilution combine to limit magnitude of change to watercourses, lochan and WFD surface water body baseline conditions
Disruption of flow paths and changes to drainage regime during construction and throughout operation can be associated with increases in runoff and less on-site water retention, leading to changes in watercourse flow and morphology	Medium	Low	Minor (NS)	Some proposed works in catchments but anticipated effectiveness of embedded environmental measures and dilution combine to limit magnitude of change to watercourses, lochan and WFD surface water body baseline conditions
Disruption of ground during construction resulting in increased sediment loading, leading to changes in watercourse quality and morphology	Medium	Low	Minor (NS)	Some proposed works in catchments but anticipated effectiveness of embedded environmental measures and dilution combine to limit magnitude of change to watercourses, lochan and WFD surface water body baseline conditions
Dewatering and/or drainage during construction disrupting groundwater support (baseflow) to watercourses, leading to changes in watercourse flow	Medium	Very low	Negligible (NS)	Some proposed works in catchments but anticipated effectiveness of embedded environmental measures and dilution combine to limit magnitude of change to watercourses, lochan and WFD surface water body baseline conditions

Receptor and summary of predicted effects	Sensitivity/ importance/ value of receptor[1]	Magnitude of change[2]	Significance[3]	Summary rationale
Discharge to surface water of groundwater intercepted during construction associated with excavation of the turbine foundations and borrow pit, leading to changes in watercourse flow, quality and morphology	Medium	Very low	Negligible (NS)	Some proposed works in catchments but anticipated effectiveness of embedded environmental measures and dilution combine to limit magnitude of change to watercourses, lochan and WFD surface water body baseline conditions
Site activities during construction and operation resulting in release of pollutants and the subsequent contamination of surface waters, leading to changes in watercourse quality and morphology	Medium	Low	Minor (NS)	Some proposed works in catchments but anticipated effectiveness of embedded environmental measures and dilution combine to limit magnitude of change to watercourses, lochan and WFD surface water body baseline conditions
Flood risk (F01)				
Soil compaction, the introduction of areas of hardstanding and changes of land use during construction and throughout operation increasing runoff, leading to increased flood risk	Medium	Low	Minor (NS)	Some proposed works in catchment but anticipated effectiveness of embedded environmental measures limit magnitude of change to flood risk baseline condition
Disruption of flow paths and changes to drainage regime during construction and throughout operation can be associated with increases in runoff and less on-site water retention, leading to increased flood risk	Medium	Low	Minor (NS)	Some proposed works in catchment but anticipated effectiveness of embedded environmental measures limit magnitude of change to flood risk baseline condition
Discharge to surface water of groundwater intercepted during construction associated with the excavation of the turbine foundations and borrow pit, leading to increased flood risk	Medium	Low	Minor (NS)	Some proposed works in catchment but anticipated effectiveness of embedded environmental measures limit magnitude of change to flood risk baseline condition
PWS (P01)				

Receptor and summary of predicted effects	Sensitivity/ importance/ value of receptor[1]	Magnitude of change[2]	Significance[3]	Summary rationale
Soil compaction and the introduction of areas of hardstanding during construction and throughout operation reducing recharge and groundwater levels, leading to abstraction derogation	Low	Very Low	Negligible (NS)	Distance, the low permeability of the superficial aquifer and anticipated effectiveness of embedded environmental measures combine to limit magnitude of change to groundwater PWS baseline condition
Dewatering during construction associated with the excavation of the turbine foundations and borrow pit lowering groundwater levels, leading to abstraction derogation	Low	Very Low	Negligible (NS)	Distance, the low permeability of the superficial aquifer and anticipated effectiveness of embedded environmental measures combine to limit magnitude of change to groundwater PWS baseline condition
Site activities during construction and operation resulting in the release of pollutants and the subsequent contamination groundwater, leading to abstraction pollution	Low	Very Low	Negligible (NS)	Distance, the low permeability of the superficial aquifer and anticipated effectiveness of embedded environmental measures combine to limit magnitude of change to groundwater PWS baseline condition
Conditions supporting conservation site (C02)				
Soil compaction and the introduction of areas of hardstanding during construction and throughout operation increasing runoff and sediment loading, leading to changed/polluted surface water support	Medium	Very low	Negligible (NS)	Distance, intervening dilution and anticipated effectiveness of embedded environmental measures combine to limit magnitude of change to the conservation site baseline condition
Disruption of flow paths and changes to drainage regime during construction and throughout operation can be associated with increases in runoff and less on-site water retention, leading to altered surface water support	Medium	Very low	Negligible (NS)	Distance, intervening dilution and anticipated effectiveness of embedded environmental measures combine to limit magnitude of change to the conservation site baseline condition
Disruption of ground during construction resulting in increased sediment loading, leading to polluted surface water support	Medium	Very low	Negligible (NS)	Distance, intervening dilution and anticipated effectiveness of embedded environmental measures combine to limit magnitude of change to the conservation site baseline condition

Receptor and summary of predicted effects	Sensitivity/ importance/ value of receptor[1]	Magnitude of change[2]	Significance[3]	Summary rationale
Dewatering and/or drainage during construction disrupting groundwater support (baseflow) to watercourses, leading to reduced surface water support	Medium	Very low	Negligible (NS)	Distance, intervening dilution and anticipated effectiveness of embedded environmental measures combine to limit magnitude of change to the conservation site baseline condition
Discharge to surface water of groundwater intercepted during construction associated with the excavation of the turbine foundations increasing flows and sediment loading, leading to changed and polluted surface water support	Medium	Very low	Negligible (NS)	Distance, intervening dilution and anticipated effectiveness of embedded environmental measures combine to limit magnitude of change to the conservation site baseline condition
Site activities during construction and operation resulting in the release of pollutants and the subsequent contamination of surface waters, leading to polluted surface water support	Medium	Very low	Negligible (NS)	Distance, intervening dilution and anticipated effectiveness of embedded environmental measures combine to limit magnitude of change to the conservation site baseline condition
Conditions supporting GWDTEs (C04 and 05)				
Soil compaction and the introduction of areas of hardstanding during construction and throughout operation reducing recharge and groundwater levels and increasing runoff and sediment loading, leading to leading to reduced groundwater support and changed/polluted surface water support	Low	Low	Negligible (NS)	Some proposed works in catchment but anticipated effectiveness of embedded environmental measures limit magnitude of change to GWDTE baseline condition
Disruption of flow paths and changes to drainage regime during construction and throughout operation can be associated with increases in runoff and less on-site water retention, leading to altered surface water support	Low	Low	Negligible (NS)	Some proposed works in catchment but anticipated effectiveness of embedded environmental measures limit magnitude of change to GWDTE baseline condition

Receptor and summary of predicted effects	Sensitivity/ importance/ value of receptor[1]	Magnitude of change[2]	Significance[3]	Summary rationale
Disruption of ground during construction resulting in increased sediment loading, leading to polluted surface water support	Low	Low	Negligible (NS)	Some proposed works in catchment but anticipated effectiveness of embedded environmental measures limit magnitude of change to GWDTE baseline condition
Dewatering and/or drainage during construction lowering groundwater levels and disrupting groundwater support (baseflow) to watercourses, leading to reduced groundwater and surface water support	Low	Low	Negligible (NS)	Some proposed works in catchment but anticipated effectiveness of embedded environmental measures limit magnitude of change to GWDTE baseline condition
Discharge to surface water of groundwater intercepted during construction associated with the excavation of the turbine foundations increasing flows and sediment loading, leading to changed and polluted surface water support	Low	Low	Negligible (NS)	Some proposed works in catchment but anticipated effectiveness of embedded environmental measures limit magnitude of change to GWDTE baseline condition
Site activities during construction and operation resulting in the release of pollutants and the subsequent contamination of groundwater and surface waters, leading to polluted groundwater and surface water support	Low	Low	Negligible (NS)	Some proposed works in catchment but anticipated effectiveness of embedded environmental measures limit magnitude of change to GWDTE baseline condition
Physical disturbance of the peat and groundwater throughflow could occur as a result of excavation works and peat stockpiling/removal, leading to reduced groundwater support for peatlands	Low	Low	Negligible (NS)	Some proposed works in catchment but anticipated effectiveness of embedded environmental measures limit magnitude of change to GWDTE baseline condition

1. The value of a receptor is defined using the criteria set out in **Table 13.4** and is defined as very low, low, medium and high.
2. The magnitude of change on a receptor resulting from activities relating to the development is defined using the criteria set out in **Table 13.5** and is defined as very low, low, medium and high.
3. The significance of the environmental effects is based on the combination of the sensitivity/importance/value of a receptor and the magnitude of change and is expressed as major (significant), moderate (probably significant) or minor/negligible (not significant), subject to the evaluation methodology outlined in **Table 13.6**.

13.10 Cumulative Effects and Interaction of Effects

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

13.10.2 In terms of cumulative residual effects on the water environment, consideration has been given to developments that would impact upon the areas immediately downstream of the watercourses that drain the Revised Consented Development. The assessment presented here therefore assesses a zone of influence comprising a 10 km radius of the Revised Consented Development (**Table 13.18**).

Table 13.18 Wind Developments within 10 km of Limekiln Wind Farm

Name	Status	Location
Ackron	Application	4.9 km west, within a separate surface water catchment (Halladale River)
Drum Hollistan 2	Application	3.5 km west north-west, within a separate surface water catchment (Allt Clais Coille/Allt Achadh na Gaodha)
Limekiln Extension	Application	Adjacent to the east, sharing the same access track from the north, but turbines are also proposed to be located within the Achvarasdal Burn catchment
Baillie Hill	Operational	3.6 km north-east, within a separate surface water catchment (Forss Water)
Hill of Lybster	Consented	6 km north-east, within a separate surface water catchment (Forss Water)
Forss	Operational	6.3 km north-east, within a separate surface water catchment (Forss Water)
Forss III	Application	7 km north-east, within a separate surface water catchment (Forss Water)

13.10.3 Given the near-coast location of the Revised Consented Development and lack of other developments downstream of the site, the likelihood of a cumulative effect is naturally restricted. Indeed, only one wind farm proposal is located within the same river catchment as the Revised Consented Development, and within 10 km of it, and this is the adjacent Limekiln Extension Wind Farm, which is currently going through the determination process.

13.10.4 It is reasonable to assume that good practice mitigation of the type outlined in this EIAR will also be applied to the Limekiln Extension Wind Farm, ensuring no significant effects downstream. Whilst the construction phase for the Extension could overlap with that of the Revised Consented Development, then a downstream monitoring programme could be conditioned to ensure that it is possible to identify any construction phase changes in water quality from either site or both sites and to apply appropriate mitigation measures quickly to

prevent any effects. Section 13.11 contains further information on water quality monitoring proposals.

13.10.5 Each of the other sites are located within separate surface water catchments from the Revised Consented Development, such that no other cumulative effects are possible.

13.11 Consideration of Optional Additional Mitigation or Compensation

13.11.1 It would be precautionary to implement some further mitigation measures. These have been identified through the iterative process of scheme design and would be in addition to those outlined in Section 13.8. The additional measures outlined below have not been included in the significance assessment presented earlier (Section 13.9 and **Table 13.17**).

13.11.2 A WQMP (Nevis, 2020) has already been developed for the Consented Development and is currently being implemented to obtain the baseline water environment condition. This would also be used to establish whether there are any effects on surface water quality both in the immediate vicinity of the control building and compound and elsewhere on the Revised Consented Development and further downstream. The water quality monitoring scheme includes the following:

- Water quality monitoring of the Achvarasdal, Reay, and Sandside Burns (W01, W02 and W03 respectively);
- Identification of additional water quality monitoring upstream and downstream of watercourse crossings to be supervised by the ECoW during the construction phase;
- Biological monitoring in the form of macroinvertebrate sampling and electrofishing surveys on the Achvarasdal, Reay and Sandside Burns; and
- Water quality monitoring of the Loanscorribest PWS (P01, from the holding tank and at the kitchen tap).

13.12 Conclusions of Significance Evaluation

13.12.1 The summary of the significance of predicted hydrological and hydrogeological effects presented in **Table 13.17** indicates that, based on the environmental baseline and embedded mitigation described in Sections 13.6 and 13.8 respectively, there are no likely significant adverse effects related to the Revised Consented Development in isolation. Section 13.10 indicates that there are also no cumulative water effects with consented developments within a 10 km radius of the Revised Consented Development.

13.12.2 On this basis, with both embedded and additional mitigation in place, standalone and cumulative effects of the Revised Consented Development on all water receptors are not significant.

13.13 Comparison of Significance Outcomes between Revised Consented and Consented Development

13.13.1 As described in Section 13.2, the Consented Development obtained consent and deemed planning permission in 2019. **Table 13.19** presents a comparison of the outcomes of the geology, hydrology and hydrogeology EIA of the proposed Revised Consented Development and the Consented Development.

Table 13.19 Comparison of significance of adverse effects from Revised Consented Development versus Consented Development

Receptor	Significance (Revised Consented Development)	Significance (Consented Development)	Comment
Aquifers and WFD groundwater bodies (GW02 and GW03)	Negligible (NS)	Scoped Out	Despite originally being scoped out, the assessment for the Revised Consented Development established that effects on the aquifers and WFD groundwater bodies are not significant.
Springs (S01 and S02)	Negligible (NS)	Not assessed	Assessment of potential effects on springs was not undertaken for the Consented Development, therefore no comparison is possible.
Watercourses, lochan and associated WFD surface water bodies (W01, W02 W03 and W04)	Minor to Negligible (NS)	Minor to Negligible (NS)	Level of effects and significance are generally equivalent for the Revised Consented Development and the Consented Development and not significant. However, the removal of wind farm infrastructure from the Sandside Burn surface water catchment under the revised layout has resulted in a lesser significance evaluation, still not significant.
Flood risk (F01)	Minor (NS)	Scoped Out	Updated flood risk mapping indicated an area at risk of flooding downstream of the site, near Loanscorribest/Milton which required assessment for the Revised Consented Development.
PWS (P01)	Negligible (NS)	Minor (NS)	The assessed level of effects was virtually the same, with the difference (Minor vs Negligible)
Conditions supporting East Halladale SSSI and Caithness and Sutherland Peatlands SAC, SPA and Ramsar (C01)	Scoped Out	Minor (NS)	The Consented Development included these potential receptors. However, they were scoped out of this assessment due to the removal of wind farm infrastructure from the Sandside Burn catchment under the revised layout, thus removing any

Receptor	Significance (Revised Consented Development)	Significance (Consented Development)	Comment
			potential risk to these designated sites.
Conditions supporting Sandside Bay SSSI (C02)	Negligible (NS)	Minor (NS)	With the removal of wind farm infrastructure from the Sandside Burn catchment, the magnitude of change is assessed to be slightly lower for the Revised Consented Development with the resulting level of effect also lower. The significance of effects remains unchanged however (not significant).
Conditions supporting GWDTEs (C04 and C05)	Negligible (NS)	Minor (NS)	Although the details of the assessment have changed slightly, the significance of effects remains unchanged (not significant).

13.13.2 The comparison of significance, above, indicates that, for all potential receptors of the Revised Consented Development, potential effects remain largely unchanged from those assessed for the Consented Development and not significant.

13.14 Implementation of Environmental Measures

13.14.1 **Table 13.20** describes the environmental measures embedded within the Revised Consented Development and the means by which they would be implemented i.e. they would be secured through the CAR authorisation process and deemed planning conditions.

Table 13.20 Summary of environmental measures to be implemented relating to hydrology and hydrogeology

Environmental measure	Responsibility for implementation	Compliance mechanism	EIA Report section reference
Pre-construction works: detailed design of watercourse crossings and cable trenching	Geotechnical and design teams	Approval of watercourse crossing design through CAR authorisation process.	13.8
Construction and maintenance of bunding and other works	Site management	Agreed construction method statements followed on-site, secured by planning condition.	13.8
Construction and maintenance of watercourse crossings	Site management	Agreed construction method statements followed on-site, secured by planning condition.	13.8
Micro-siting of tracks, turbines and other infrastructure during construction	ECoW	Agreed construction method statements followed on-site, secured by planning condition.	13.8
Implementation of best practice in construction in relation to drainage, soil handling and other potential sources of pollution (e.g. oil)	Site management	Agreed construction method statements and best practice guidance followed on-site, secured by planning condition and CAR authorisation process.	13.8
Implementation of best practice in operation, including preventing spills and maintenance of infrastructure	Site management	Ongoing monitoring.	13.8
Continued implementation of water quality monitoring plan to establish baseline conditions and measure the effectiveness of mitigation measures throughout construction and operational phases.	EcoW	Already secured by planning condition.	13.11

13.15 References

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