Chapter 11 Geology, Peat, Hydrology and Hydrogeology

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11 Geology, Peat, Hydrology and Hydrogeology

11.1 Executive Summary

11.1.1 This chapter considers the potential effects of the Proposed Development on hydrological, hydrogeological, and geological resources.

11.1.2 A combination of desk study and field survey work was undertaken to identify and characterise the geological, hydrological, and hydrogeological receptors which could be subject to impacts from construction, operation, and decommissioning of the Proposed Development.

11.1.3 The Site is located within the Shetland Coastal catchment, with on-site and adjacent watercourses and waterbodies including the Burn of Kebister, Loch of Kebister and its tributaries and drains in the surrounding area. The nearest watercourse classified by the Scottish Environment Protection Agency (SEPA) is Burn of Dale which is considered to be of 'Good' quality, therefore surface water receptors are considered to have a precautionary value of 'Good' quality.

11.1.4 The bedrock beneath the Site is metamorphic beneath the majority of the Site, with sedimentary bedrock in the south-east. Superficial deposits comprise peat, which is typically low permeability. The peat is identified as a Class 1 peatland according to the Scottish Natural Heritage (SNH) (now NatureScot) Carbon and Peatlands Map 2016.

11.1.5 Extensive peat surveys were undertaken and identified that approx. 73% of probes recorded peat exceeding 1 m, otherwise known as deep peat. Several design iteration works were undertaken to avoid siting turbines or other infrastructure on deep peat. The proposed turbine is sited on peat no deeper than the permitted turbine locations.

11.1.6 A peat slide risk assessment has identified that there is a low likelihood of a peat landslide at the proposed turbine, associated infrastructure and battery storage location.

11.1.7 Potential construction and operational effects arising from the Proposed Development (in the absence of mitigation) include changes to surface water and groundwater flow and quality, excavation of peat, peat slide risk and effects to water abstractions, designated sites or Groundwater Dependent Terrestrial Ecosystems (GWDTE).

11.1.8 The mitigation measures set out in this chapter will be included within a Construction Environmental Management Plan (CEMP), prior to the commencement of construction activities. An outline CEMP is presented as **Appendix 4.1** to this EIA Report. Measures include pre-construction site investigations to inform Micrositing, water quality monitoring where required and implementation of a Peat Management Plan to restore peatland habitat. An outline Drainage Strategy and water crossing designs will be developed to ensure appropriate control of run-off. Detailed designs will be agreed with SEPA and SIC prior to construction.

11.1.9 These mitigation measures are considered to be robust and implementable and will reduce the potential impacts on peat resources and watercourses. The significance of residual effects on geology, peat, hydrology and hydrogeology receptors following the implementation of these mitigation measures are considered to be Minor to Negligible and therefore not significant. No cumulative effects are predicted. Potential effects, mitigation measures and residual effects are summarised in **Table 11.8.**

11.2 Introduction

11.2.1 This chapter considers the potential effects of the Proposed Development on geology, peat hydrology and hydrogeology. This includes detailed consideration of potential impacts on surface watercourses, groundwater and the local geology in and around the Site and any potential impacts on flood risk of the local area. Potential impacts on peat deposits, and risks associated with peat landslide, are also assessed.

11.2.2 This chapter presents the current environmental setting (baseline) for the related environmental topics. A desk study and site-based surveys, including peat depth surveys, have been carried out to inspect and identify potentially sensitive hydrogeological, hydrological and geological receptors. Review of the 2011 Environmental Statement (ES) has also been carried out to inform the assessment.

11.2.3 Joanna Cassidy (BSc (Hons) has undertaken this chapter assessment, MCIWEM). Joanna has 5 years' experience in undertaking geological, hydrological and hydrogeological assessments, including EIA chapters and relevant technical appendices, on a variety of renewable developments. Technical appendices have been undertaken by David Nisbet (BSc (Hons)) who leads the Geology, Peat and Hydrology team. A full QA of all hydrology, geology and hydrogeology deliverables has been undertaken by Jenny Hazzard (MSc Engineering Geology, BSc, MIEMA). Jenny is Head of Environmental Planning at ITPEnergised with 21 years of experience in environmental consultancy.

11.2.4 This Chapter is supported by the following Figures and Appendices:

- **Figure 11.1**: Hydrological Features.
- **Figure 11.2**: Superficial Geology.
- **Figure 11.3**: Peat Depth.
- **Figure 11.4**: Bedrock Geology.
- **Figure 11.5**: Hydrogeology.
- **Figure 11.6**: Groundwater Dependent Terrestrial Ecosystems.
- **Appendix 11.1**: Peat Landslide and Hazard Risk Assessment.
- **Appendix 11.2**: Outline Peat Management Plan.

11.2.5 A list of abbreviations used throughout this chapter is provided in **section 11.15** reference.

11.3 Legislation, Policy and Guidelines

11.3.1 Relevant legislation, policy and guidance documents have been reviewed and taken into account as part of this assessment.

Legislation

11.3.2 The European Union (EU) Water Framework Directive (WFD) has been implemented in Scotland through the Water Environment and Water Services (Scotland) Act 2003. The act introduced a regulatory system with SEPA as the lead authority, to establish a framework for co-ordinated controls on activities with the potential to negatively impact the water environment. Water monitoring and classification systems are maintained by SEPA to provide the data to support the aim of the WFD.

11.3.3 The European Parliament and of the Council (EC) Groundwater Directive (GWD) is implemented in Scotland through the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR) (as amended).

11.3.4 Other relevant legislation includes:

- The Town & Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017;
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended);
- The Water Resources (Scotland) Act 2013;
- The Private Water Supplies (Scotland) Regulations 2006;
- The Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017;

- Flood Risk Management (Scotland) Act 2009;
- Environmental Protection Act 1990;
- Environment Act 1995; and
- The Contaminated Land (Scotland) Regulations 2000 (as amended).

11.3.5 The relevant legislation relating to flood prevention is the Flood Risk Management (Scotland) Act 2009. Scotland is separated into fourteen Local Plan Districts for flood risk management purposes. SEPA, working with others, has produced a Flood Risk Management Strategy for each Local Plan District which describes the ambition for managing flooding and priority actions to deliver this. The Proposed Development site sits within the Shetland Local Plan District.

Policy

11.3.6 The policies set out below include those from the Shetland Local Development Plan (2014). This section also considered the relevant aspects of the Scottish National Planning Framework 4 (NPF4) revised draft, Planning Advice Notes (PAN) and other relevant guidance. Of relevance to the hydrological, hydrogeological, geological and soils assessment presented within this chapter are the following policies and advice notes:

- LDP NH1 International and National Designations;
- LDP NH5: Soils;
- LDP NH6: Geodiversity;
- LDP NH7: Water Environment;
- LDP RE1 Renewable Energy;
- LDP W4: Contaminated Land;
- LDP WD1: Flooding Avoidance;
- LDP WD2: Waste Water;
- LDP WD3: SuDs;
- NPF4 Policy 5 Soils;
- NPF4 Policy 22 Flood Risk;
- PAN 51: Planning, Environmental Protection and Regulation (Scottish Executive, 2006);
- PAN 61: Planning and Sustainable Urban Drainage Systems (Scottish Executive, 2001);
- PAN 69: Planning and Building Standards Advice on Flooding;
- PAN 79: Water and Drainage (Scottish Executive, 2006); and
- Scottish Planning Policy (Scottish Government, 2014).

Guidance

Pollution Prevention Guidelines (PPGs) and Guidance for Pollution Prevention (GPPs)

11.3.7 Pollution Prevention Guidelines (PPGs) provide guidance on responsibilities and good practice to prevent pollution from a range of development activities. These are currently in the process of being replaced by the Guidance for Pollution Prevention (GPPs) series. SEPA's environmental regulatory guidance applies to Scotland.

- GPP1: Understanding your environmental responsibilities – good environmental practices (2020);
- GPP2: Above ground oil storage tanks (2018);
- GPP4: Treatment and disposal of wastewater where there is no connection to the public foul sewer (2017);
- GPP5: Works and maintenance in or near water (2018);
- PPG6: Working at construction and demolition sites (2012);
- GPP8: Safe storage and disposal of used oils (2017);
- GPP13: Vehicle washing and cleaning (2017);
- GPP21: Pollution incident response planning (2021); and
- GPP22: Dealing with spills (2018).

SEPA Guidance

11.3.8 The following relevant guidance from SEPA has been considered as part of the assessment of geology, peat, hydrology and hydrogeology:

- Land Use Planning System Guidance Note 4 (LUPS GU4) Planning Guidance on On-shore Windfarm Developments (SEPA, 2017);
- Land Use Planning System Guidance Note 31 (LUPS GU31) Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems (SEPA, 2017);
- Supporting Guidance (WAT-SG-75) Sector Specific Guidance: Water Run-Off from Construction Sites (SEPA, 2021);
- Technical Flood Risk Guidance for Stakeholders, Version 12 (SEPA, 2019);
- Developments on Peat and Off-Site Uses of Waste Peat (SEPA, 2017);
- Guidance on Developments on Peatland (Scottish Government, SNH and SEPA, 2017);
- Developments on Peatland: Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste (Scottish Renewables and SEPA, 2012); and
- Groundwater Protection Policy for Scotland, Version 3 (SEPA, 2009).

Other Relevant Guidance

11.3.9 The following relevant guidance has also been considered.

- CIRIA C532: 'Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors' (CIRIA, 2001);
- CIRIA C741: 'Environmental Good Practice on Site' (CIRIA, 2015);
- Good practice during wind farm construction, 4th edition (NatureScot, 2019);
- The Conservation (Natural Habitats, & c.) Regulations (1994, as amended in Scotland);
- Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments (ECU Scottish Government, 2017);
- The Scottish Soil Framework (Scottish Government, 2009); and
- BS5930:2015 - Code of Practice for Site Investigation (British Standards Institute, 2015).

11.4 Consultation

11.4.1 **Table 11-1** provides details of consultations undertaken with relevant regulatory bodies, together with action undertaken by the Applicant in response to consultation feedback.

Table 11-1 – Consultation Responses

Consultee	Consultation Response	Applicant Action
Shetland Islands Council (SIC) (3 March 2021) Scoping Response	The applicant should ensure that the surveys include an assessment of peatland habitat quality and condition (as set out in my response to the EIA screening application) and that should important /valuable habitat be identified the EIA Report clearly shows how impacts have been avoided or mitigated as far as possible.	Stage 1 and Stage 2 peat surveys has been undertaken in line with the relevant SEPA guidance. The results from the peat surveys are included in **Section 11.6** have been considered during the design iteration process.
NatureScot (11 February 2021) Scoping Response	An assessment of peatland habitat quality should also be carried out, given the greater emphasis on peatland in National Planning Framework 3 to protecting areas of high-quality peatland. Information on peatland assessment can be found in the Peatland Survey Guidance.	Stage 1 and Stage 2 peat surveys have been undertaken following review of relevant guidance. The results and following assessment of peatland habitat, including potential impacts from the Proposed Development is outlined in **Section 11.6**.
Shetland Amenity Trust (3 March 2021) Scoping Response	It appears that most civil engineering projects in Shetland substantially under-estimate the volumes of peat that are removed when development occurs, so a robust Peat Management Plan should be in place along with appropriate contingency plans should predicted volumes be under-estimated.	A Stage 1 and Stage 2 peat depth survey has been undertaken, which will inform the peat removal volume. A Peat Management Plan (PMP) is included as **Appendix 11.2**. The PMP will provide contingency plans should predicted volume be underestimated.
Scottish Water (1 February 2021) Scoping response	Raised no objections but does not confirm that the proposed development can currently be serviced.	Noted, no permanent substation or control station is proposed. As such no wastewater servicing requirements are set out.
Scottish Water (19	Response to request for information regarding DWPAs submitted by ITPEnergised (22 September 2022).	Noted that no public water catchments, abstractions, or

Consultee	Consultation Response	Applicant Action
October 2022) Drinking Water Protection Area (DWPA) information request response	Confirmed no Scottish Water drinking water catchments or water abstraction sources may be affected by proposed activity. Records found no Scottish Water assets in the area.	assets are present in the surrounding area.
Scottish Water Asset Impact Assessment response	Asset Impact Assessment application submitted by ITPEnergised (22 September 2022). Case Officer assigned but no response to application received. FOI request found no Scottish water assets in the area.	Noted, no Scottish Water assets in area.
SEPA (22 October 2020) FOI data request response	Response to a Freedom of Information (FOI) data request from ITPEnergised (email dated 14 September 2021) requesting data relating to CAR authorisations, surface water and groundwater levels, quality and quantity, and rainfall data. SEPA provided relevant CAR authorisation information, available surface water and rainfall data.	This data has been used to inform the baseline conditions at the Proposed Development.
SIC (21 September 2020) FOI data request response	Response to a FOI data request from ITPEnergised (email dated 14 September 2021) requesting data relating to flood risk, Private Water Supplies (PWS), surface water quality/ quantity and historic landfills within 2 km of the Site centre. SIC provided the details for the only recorded flooding incident in the search area and confirmed they hold no information relating to PWS, surface water quality / quantity or historic landfills.	This data has been used to inform the baseline conditions at the Proposed Development.

Consultee	Consultation Response	Applicant Action
SIC (18 October 2022) FOI data request response	Response to a FOI data request from ITPEnergised (email dated 14 September 2022) requesting data relating to PWS within 2 km of the Site centre.	Confirmed that there were no additional PWS identified within the 2 km of the Site centre.

11.5 Assessment Methods and Significance Criteria

Study Area

11.5.1 The study area will primarily be based upon the land within the red line boundary, within a wider study area of 500 m for hydrological, geological and hydrogeological receptors near the Site (refer to **Figure 1.1**). The criteria for defining the study area have been based on professional judgement with regard to likely access and working areas, the nature and size of the Proposed Development and with due consideration to the relevant guidance on hydrological and geological assessment.

11.5.2 A PWS search has been carried out by SIC within 2 km from the centre point of the Site as part of the Freedom of Information request, which gives a minimum search distance of 1.2 km from the Site boundary. This distance is considered appropriate based on the local terrain, environmental constraints, and proximity to the coastline.

Desk Study

11.5.3 Baseline conditions have been established primarily through desk-based assessment which has included:

- Consultation with relevant bodies and collation of data;
- Review of previous reporting;
- Identification of surface watercourses and waterbodies, including WFD classifications;
- Identification of hydrogeology, including Principal and Secondary aquifers;
- Identification of underlying bedrock and superficial geology, including assessment of peat depth contours;
- Assessment of topography, land use and climate conditions to inform drainage patterns;
- Assessment of any identified PWS;
- Assessment of potential GWDTEs; and
- Assessment of flood risk.

11.5.4 The following information sources have been reviewed to inform the desk study:

- 2011 Environmental Statement (ES);
- The Ordnance Survey (OS) Mapping (1:50,000 and 1:25,000);
- British Geological Survey (BGS) GeoIndex Online Mapper;
- National Soils Map of Scotland;
- Carbon and Peatland 2016 Map;
- SEPA Flood Map;
- Scotland's Environment Map; and
- NatureScot SiteLink Map Search.

Field Surveys

Peat

11.5.5 Stage 1 peat depth probing was undertaken in October 2020 by a team of suitably qualified and experienced surveyors, in respect of relevant guidance. Peat depths were measured on an approximate 100 m grid across the developable area. In addition to the 100 m grid supplementary peat depth measurements were taken in locations that were being considered in early design iterations for track routing and turbine placement.

11.5.6 Data obtained from the peat depth surveys were used to plot the presence and distribution of peat across the Site and feed into the detailed design process. Following the design process, a proposed design was agreed, considered by the project team to represent the optimal turbine and infrastructure siting to deliver viable renewable energy generation whilst minimising environmental effects, including effects on geology, peat, hydrology, and hydrogeology.

11.5.7 A Stage 2 peat depth survey was undertaken in September to October 2021 with additional probing in March 2023 to address additions to the design. The surveys recorded peat depths along proposed access tracks, turbine, hardstanding, and battery storage locations in the following probing pattern:

- Probe turbine centre and every 10 m to the north, east, south and west, out to 50 m from the centre;
- Probe points every 50 m along the proposed new access tracks, with offset probes 10 m either side of the track centre line;
- Approximately 10 to 15 points at each proposed turbine hardstanding or turning head; and
- Probe a 10 m grid across the proposed battery storage boundary.

11.5.8 As a result of the findings of the Stage 2 survey at the layout proposed at that time, and due to ongoing design iteration work in response to other identified constraints, additional peat depth points were measured at other potential turbine siting areas. This additional detailed surveying informed the final design and ensured coverage of peat depth measurements extended to the final layout. This data also informed **Appendix 11.1**: Peat Landslide and Hazard Risk Assessment and **Appendix 11.2**: Peat Management Plan.

Hydrological Walkover

11.5.9 The hydrological walkover of the Site was undertaken in conjunction with the peat depth surveys. site observations included topography, habitats, ground conditions and features of watercourses ad waterbodies. The walkover also allowed ground-truth of receptors identified during the desk study and identification of further hydrological receptors.

11.5.10 During the Stage 1 Survey, two minor channels were identified underlying the Proposed Development layout. Following the Stage 2 survey and further engineering survey by an experienced Principal Engineer, it was determined no additional watercourse crossings were required.

Groundwater Dependent Terrestrial Ecosystems

11.5.11 A National Vegetation Classification (NVC) Survey was undertaken by Firth Ecology and included the identification of habitats which had the potential to be GWDTE. Further details of this are provided in **Chapter 6**.

Assessment of Likely Effect Significance

11.5.12 The sensitivity characteristics of geological, peat, hydrological and hydrogeological resources have been guided by the matrix presented in **Table 11-2** below.

Table 11-2 – Sensitivity Criteria for Receptors

Sensitivity	Description
High	Highly sensitive land use including raised or blanket bog, carbon-rich or peat soils (Class 1 or 2 priority peatland). Highly permeable superficial deposits, allowing storage and transport of contaminants. Designated receptor present protected under national or international legislation, including SSSIs, SACs and SPA. A waterbody with a SEPA WFD Overall or Ecological classification of 'High' or 'Good'. An aquifer classified by BGS as a 'highly productive aquifer' or 'moderately productive aquifer', or that is of regional importance. Extensive areas of 'High Likelihood' or 'Moderate Likelihood' of river, surface water or coastal flooding which acts as an active floodplain. Public Water Supplies or Private Water Supplies that abstract from a hydrological receptor underlying or connected to the Site. Potential GWDTE identified through NVC survey classified by SEPA to be 'highly groundwater dependent' with minimal degradation, which are found to have site-specific groundwater dependency and are not ombrotrophic.
Medium	Moderately sensitive land use including carbon-rich or peat soils (Class 3 or 4 priority peatland). Moderately permeable superficial deposits, allowing limited storage and transport of contaminants. Designated Receptors of regional importance, including Regionally Important Geological and Geomorphological Sites (RIGS), or receptors of local importance. A waterbody with a SEPA WFD Overall or Ecological classification of 'Moderate'. An aquifer classified by BGS as a 'low productivity aquifer' that does not support abstractions. Isolated areas of 'High Likelihood' or 'Moderate Likelihood' of surface water flooding or river or coastal flooding that is confined to waterbody extents and is not an active floodplain. Potential GWDTE identified through NVC survey classified by SEPA to be 'highly groundwater dependent' with extensive degradation, which are found to have site specific groundwater dependency and are not ombrotrophic. Potential GWDTE identified through NVC survey classified by SEPA to be 'moderately groundwater dependent', that are found to have site specific groundwater dependency and are not ombrotrophic.

Sensitivity	Description
Low	Low sensitive land use that do not include carbon-rich or peat soils (Class 5 or 0). Geological or hydrological features not currently protected and not considered worthy of protection. Low permeability superficial deposits likely to inhibit the transport of contaminants. A waterbody with a SEPA WFD Overall or Ecological classification of 'Poor' or 'Bad', or no classification. A non-aquifer, classified by BGS as a 'Rocks with essentially no groundwater'. Areas of 'Low Likelihood' of surface water, river or coastal flooding. Public Water Supplies or Private Water Supplies are not supported by hydrological receptor underlying or connected to the Site. Potential GWDTE identified through NVC survey classified by SEPA to be 'highly groundwater dependent' or 'moderately groundwater dependent', that are not found to be groundwater dependent and are instead ombrotrophic.

11.5.13 The criteria for sensitivity have been developed based on a hierarchy of factors has been assessed following experience and professional judgement following extensive assessment and work undertaken to date, in line with appropriate guidance, legislation and best practice.

11.5.14 The magnitude of change criteria that will apply to the baseline sensitivities of the identified receptors are set out in **Table 11-3**. Similar to criteria for sensitivity, these have been developed based professional judgement and appropriate guidance, legislation and best practice.

Table 11-3 – Magnitude of Change Criteria

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

11.5.15 Using these criteria, potential effects resulting from the Proposed Development have been assessed. Details of embedded mitigation measures and additional mitigation measures are outlined in **Section 11.7** and **Section 11.9** respectively.

11.5.16 The significance of the predicted effects has been assessed in relation to the sensitivities of the baseline resource. A matrix of significance, based on the combination of magnitude of change and sensitivity of the receptor, was developed to provide a consistent framework for evaluation, shown in **Table 11-4** below.

Table 11-4 – Significance of Effect Matrix

		Magnitude of Impact			
		High	Medium	Low	Negligible
Sensitivity of Receptor	High	Major	Major	Moderate	Minor
	Medium	Major	Moderate	Minor	Negligible
	Low	Moderate	Minor	Negligible	Negligible
	Negligible	Minor	Negligible	Negligible	Negligible

11.5.17 The guideline criteria for the various categories of effect are provided in **Table 11-5** below.

Table 11-5 – Significance Criteria

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

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

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

Requirements for Mitigation

11.5.20 Depending on the potential impact predicted to sensitive receptors, committed embedded and additional mitigation measure are presented within this chapter. Wherever possible, mitigation has been embedded and incorporated into the design. Additional mitigation has been outlined in this chapter and those to be implemented during the construction phase will be included within the CEMP.

Assessment of Residual Effect Significance

11.5.21 An assessment of any predicted significant residual effects on sensitive geological, hydrological or hydrogeological receptors is presented within this chapter (**Section 11.10**).

11.5.22 This includes effects from other developments and proposed developments in the surrounding area, within the cumulative effects assessment, as shown in **Section 11.12**.

Limitations to Assessment

11.5.23 No water quality monitoring or intrusive investigations, other than the peat depth survey work detailed above, have been undertaken. This is not considered to represent a significant limitation to the assessment of effects, as detailed intrusive site investigation works, and water quality monitoring would be undertaken prior to and during construction to inform detailed engineering design, micro-siting and environmental protection and control measures to be implemented.

11.6 Baseline Conditions

Hydrology

11.6.1 Upon review of OS mapping there were no identified watercourses present within the Site boundary, however, the Burn of Kebister does rise immediately to the east of the Site. There are unnamed minor lochans present to the south-west of the Site at the low-lying Hill of Gremista, associated with the Loch of Kebister, located approx. 20 m west of the Site. A tributary drains from the Loch of Kebister and it confluences with the Burn of Tagdale prior to discharge to Dales Voe.

11.6.2 No watercourses classified under the WFD are located within the Site. The nearest waterbody classified under the WFD is the Burn of Dale (ID: 20674) which had an overall status of 'Good' in 2020. The Burn of Dale discharges into the Dales Voe approx., 2.4km from the Site.

11.6.3 There is artificial drainage present in the surrounding area, identified to be associated with nearby waste management and recycling site to the east and Dale Voe South Quay to the west. Drainage channels immediately east of the Site, and an on-site water management pond is understood to be associated with the nearby waste management and recycling centre. A series of drains are present surrounding Dale Voe South Quay.

11.6.4 As a result of its coastal setting, the Site is located within the larger Shetland Coastal catchment. Following a review of named watercourses, waterbodies and underlying topography for local catchments, site discharge is likely to the following:

- Burn of Kebister;
- Loch of Kebister and associated watercourses in the south-west;
- Drains to the west; and
- Drains and water management pond to the east.

11.6.5 The identified waterbodies discharge to the following coastal water bodies surrounding the peninsula. These are classified under WFD as being of 'Good' condition in 2020.

- Dales Voe (South Mainland) (ID: 200250);
- The Keen to Isle of Noss (ID: 200263); and
- Bressay Sound (ID: 200246).

11.6.6 A review of SEPA's online maps found that the Site is not located within a surface Drinking Water Protected Area (DWPA).

11.6.7 A watercourse crossing survey was carried out in October 2020 where two minor watercourses were recorded adjacent to the proposed infrastructure at the time of survey. These were observed to be low flowing, boggy channels draining runoff. One of these minor channels is also recorded as a "bog pools & related pools & runnels" by NVC surveys (further details relating to NVC surveys are provided in **Chapter 6**).

Geology

Superficial Geology

11.6.8 The 1:50,000 BGS Superficial Geology Map from the BGS Onshore GeoIndex Viewer indicates that the superficial geology underlying the Site comprises entirely peat shown in **Figure 11.2**.

11.6.9 Upon review of the National Soils Map of Scotland, the centre and east of the Site was found to be underlain by blanket peat and the west of the Site by peaty podzols. The blanket peat is described to be 'dystrophic', meaning it is likely nutrient poor and rain-fed. The peaty gleyed podzols are drifts derived from schists of the underlying Dalradian Supergroup.

Peat

11.6.10 The majority of the peat across the Site is recorded as Class 1 on NatureScot's Carbon and Peatland Map (SNH, 2016), which is the highest importance. Class 1 peat is defined as nationally important carbon rich-soils, deep peat, and priority peatland habitat. Class 1 areas are likely to be of high conservation value. At the northern boundary of the Site, the peat is recorded as Class 3 and Class 5 importance. A small area of Class 5 is also located to the south of the Site. In Class 3 peat, the dominant vegetation cover is not priority peatland habitat but is associated with wet and acidic type. Occasional peatland habitats can be found, and most solids are carbon-rich solids with some areas of deep peat. In Class 5 peat, soil information takes precedence over vegetation data, and no peatland habitat is recorded. This may also include areas of bare soil and soils are carbon-rich and deep peat.

11.6.11 The findings of the desk study are supported by the peat surveys carried out as described in **Section 11.5**, during which varying depths of peat were recorded. The probe locations and the peat depth contour plot interpolated from the survey data are provided in **Figure 11.3**.

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

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

11.6.13 A total of 629 peat depth measurements were made across the Stage 1 and Stage 2 surveys. **Table 11-6** provides an overview of the range of depths recorded. At approximately 8% of probes, depths were recorded to be below 0.5 m, defined as peaty organic soil. At approximately 22% of probes, depths were recorded to be equal to or greater than 0.5 m and less than or equal to 1 m. At approximately 72% of probes, depths were recorded to be equal to or greater than 1 m, defined as deep peat. Generally, recorded peat is thinner on steeper sloping areas of the Site, with thicker peat recorded in flatter areas.

Table 11-6 – Peat Survey Depths Across the Surveyed Area

Depth (cm)	Number of Probes	Percentage of total probes (%)
Nil	1	<1
0.01 – 0.49	51	8.1
0.50 – 1.00	126	20
1.01 – 1.50	159	25.3
1.51 – 2.0	173	27.5
2.01 – 3.0	111	17.6
3.01 – 4.0	7	1.1
>4.0	1	<1

11.6.14 During site walkovers, three sinkholes were identified. These are located to the west of the Site.

11.6.15 Peat depth and distribution has been carefully considered in the design iteration process for the Proposed Development, aiming to site turbines, hardstanding and other infrastructure outside areas of deep peat wherever possible (noting that the initial proposed layout included two turbines). This is to minimise disturbance and peat slide risk and the requirement for peat to be excavated.

11.6.16 Following design iterations and accounting for other constraints such as ecological sensitivities and operational efficiency, the following peat depths were recorded at the 'design freeze' infrastructure locations.

- The proposed turbine is located on an area generally recorded as having peat depths less than 1 m, with an average peat depth of 0.6 m.
- The proposed crane hardstanding is located in an area where average peat depths is 1.1 m.
- The proposed new access track traverses peat depths that average 1.49 m. Where deep peat was recorded, it is proposed to construct floating tracks to reduce the volume of peat to be excavated.
- The proposed battery storage is located on an area where average peat depth is 1.2 m.

11.6.17 Full details of the peat depth survey, Peat Landslide and Hazard Risk Assessment and Peat Management Plan are provided in **Appendix 11.1** and **Appendix 11.2,** respectively.

Bedrock Geology

11.6.18 The 1:50,000 BGS Bedrock Geology Map shows that the Site is largely underlain by metamorphic semipelite of the Cliff Hills Phyllitic Formation, also shown in **Figure 11.4**. To the north-west of the Site, Quartzite of the Dales Voe Grit Member is present. The Site is bisected from the south-west to north-east by a thrust fault, separating the Cliff Hills Phyllitic Formation to the north-west from the Quarff Succession and Melange to the south-east. The Quarff Succession and Melange are described as 'shear-bonded metamorphic rock slices forming tectonic melange'. The rock units described are metasediments of the Dalradian Supergroup.

11.6.19 A secondary inferred fault is present to the south-east of the Site, separating the Quarff Succession and Melange to the north-west from the Rova Head Conglomerate to the south-east. The Rova Head Conglomerate is of the Lerwick Sandstone Formation unit and underlies the south-east of the Site.

Hydrogeology

11.6.20 The bedrock aquifers that underlie the majority of the Site of quartzite and semipelite are of the Southern Highland Group, part of the Dalradian Supergroup and are recorded to be 'low productivity' aquifers of Class 2C. These are described as having flow 'virtually all through fractures and other discontinuities' where there are 'small yields where fractured near surface and from springs locally'. The tectonic melange of the Appin Group and Argyll Group, also part of the Dalradian Supergroup, are also 'low productivity' aquifers of Class 2C, as shown in **Figure 11.5**.

11.6.21 The bedrock aquifer associated with the conglomerate present within a small area to the south-east of the Site, is found to be Middle Old Red Sandstone (undifferentiated). It is a 'moderately productive' aquifer of Class 2B. It is described as 'locally yields small amounts of groundwater'.

11.6.22 The underlying groundwater body is classified under the WFD as to be the Shetland groundwater body (ID: 150687), which includes all of mainland Shetland, had an overall classification of 'Good' in 2020.

11.6.23 As outlined, the majority of the Site is underlain by peat, with most depths to be greater than 1 m (77% of probes).Peat would be expected to have low permeability and be likely to inhibit groundwater flow. It is considered that while the superficial deposits are not considered to be a significant aquifer, there is likely groundwater present. This groundwater is considered to be perched, present locally within the peat across the Site.

11.6.24 Due to the aquifer underlying the Site being 'low productivity' and the impermeable nature of the peat deposits, a hydrological connection between perched groundwater with deeper groundwater is considered unlikely.

Potential Groundwater Dependent Habitats

11.6.25 Habitats indicative of GWDTE were identified within and adjacent to the main site area, during NVC survey work, as summarised in **Chapter 6** and **Drawing 6.3**, **Drawing 6.4**, and **Drawing 6.5**. The NVC report includes an assessment of the occurrence of potential GWDTE at the Site in the context of hydrogeological setting (**Appendix 6.2**).

11.6.26 The majority of potential GWDTE at the Proposed Development are considered to be ombrogenous. As the peat is considered to have low permeability, it is likely that rainwater will collect at the surface of these deposits and movement through the peat will likely be slow and limited.

11.6.27 Two areas of habitat, as shown in **Figure 11.6**, are considered to be groundwater dependent:

- MCx - non-NVC neutral small-sedge mire. One flush emerging mid-way down the north-west slope where it is surrounded by acidic vegetation; its neutral status implies that at least part of its water source is from the underlying rock, offsetting the surface acidity. It is classified as 'highly groundwater dependent'.

- M15a, Carex panicea sub-community. The flushed heath area at the bottom of the eastern slope contains several species indicative of calcareous influence. It is surrounded by acidic vegetation, implying that at least part of its water source is from the underlying rock, offsetting the surface acidity. It is classified as 'moderately groundwater dependent'.

Private Water Supplies

11.6.28 Based on information from the 2011 ES and the absence of residential properties in the close vicinity, it is considered that there are unlikely to be any PWS within influencing distance. In response to a Freedom of Information request in September 2020, SIC confirmed that there are no PWS within 2 km of the Site centre and 1.2 km of the Site boundary. An updated FOI request was issued to SIC in October 2022 who confirmed that no additional PWS had been registered in this search area.

Public Water Supplies and Abstractions

11.6.29 In response to the Freedom of Information request in September 2020, SEPA provided details on CAR authorisations within 2 km from the Site centre. An abstraction identified in this study area is the 'abstraction of water from spring' at Shetland Islands Council Energy Recovery Plant (Licence CAR/R/1009160). The water is used as process water for industrial or commercial purposes at the plant. The abstraction point is located 283 m east of the Site, surrounded by surface water drains and water management pond.

11.6.30 Scottish Water were consulted in September 2022 for the presence of public water supplies and abstractions within 2 km from the Site centre. This included Drinking Water Protected Areas (DWPAs), public supply water abstractions or Scottish Water assets. Scottish Water confirmed that there were no records of public supplies or abstractions within the surrounding area.

Flood Risk

11.6.31 A review of the SEPA Flood Maps online indicates no areas at high or medium risk of river, surface water or coastal flooding are present at the Site. An area of low risk surface water flooding is shown located immediately to the south-west of the Site boundary, which is present within the constraints of the Loch of Kebister.

11.6.32 As the Site is located on a peninsula, there are coastal waters present in the surrounding area. There is a high risk of coastal flooding at the shoreline, however, this risk is highlighted at all coastal shorelines. There are no extensive areas at high risk of coastal flooding in the surrounding area of the Site. The minimum distance from the Site to an area of coastal flooding is 70 m.

11.6.33 In response to a Freedom of Information request in September 2020, SIC provided details of a flooding incident at a landfill site in August 2005 at North Gremista Industrial Estate located approximately 660 m east of the Site at Wester Rova Head. SIC also confirmed that there are no existing or proposed flood defences within 2 km from the Site centre.

Designated Sites

11.6.34 Within the wider study area of 500 m around the Site, the following designated receptor has been identified: the East Mainland Coast, Shetland, Special Protection Area (SPA). The protected features of the SPA include the Red-throated Diver (breeding) and Great Northern Diver (non-breeding), with a latest assessed condition of 'Favourably Maintained'. The SPA is present along the coastline of the peninsula, located 70 m from the Site, where surface waters from the Site discharge to the surrounding coastal waters.

Contaminated Land

11.6.35 Within the Site, there is no historical land use noted and therefore a low potential contamination risk. BGS data and mapping indicate that there is no artificial ground present within the Site.

11.6.36 Gremista Waste Management Facility is located to the east of the Site, however, there is not considered to be a risk from the waste management facility to the Proposed Development. This is due to the low permeability of the surrounding deep peat and bedrock, low productivity bedrock aquifer, combined with engineering controls at the waste management facility.

Changes in Baseline since the 2011 Environmental Statement

11.6.37 It is considered that there have been no significant changes relevant to this chapter and within the Study Area in the baseline from the 2011 Previously Permitted Development.

11.6.38 The Dale Voe Base appears to have undergone extension of its open storage area. Review of documents on the planning portal indicates the application included surface water drainage to French drains at the outer edges of the storage area.

11.6.39 The proposed SPA East Mainland Coast at the time of the 2011 ES, was designated in December 2020.

Receptor Sensitivity

11.6.40 A summary of potential receptor sensitivity is outlined in **Table 11.7**. Those with a high or medium sensitivity have been brought forward for assessment. Those with a low sensitivity will not require further assessment following the application of standard mitigation unless there is an established potential for impacts of high magnitude.

Table 11-7 Sensitivity of Receptors

Receptor	Description	Sensitivity
Peat	The superficial geology is dominated by blanket peat and peaty podzols. The underlying peat is largely Class 1.	High
Groundwater	Largely underlain by 'low productivity' aquifer, however, small area of site underlain by 'moderately productive' aquifer.	High and Medium
Surface Water	Nearest WFD watercourse Burn of Dale with 'Good' classification. Dales Voe, The Keen to Isle of Noss and Bressay hydrologically connected to Site, with 'Good' classification.	High
Private Water Supply (PWS)	No PWS are registered within 2 km of the Site centre.	Low

Receptor	Description	Sensitivity
Public Water Supply and Abstractions	CAR licenced surface water abstraction 280 m from the Site. No DWPA, Scottish Water assets or abstractions are recorded.	High and Low
GWDTE	'Highly groundwater dependent' community and 'Moderately groundwater dependent' community present on Site.	High
Designated Sites	Site hydrologically connected to East Mainland Coast, Shetland SPA.	High

Receptors Scoped Out of Assessment

11.6.41 The following receptors have been scoped out for further assessment;

- Based on information from previous EIA work, the absence of residential properties in the surrounding area and no PWS being identified within a 2 km from the Site centre by SIC, PWS have been scoped out for further assessment.
- Scottish Water abstractions and assets are not present in the surrounding area and therefore there will be no direct or indirect impacts. Further assessment is therefore not required, and these assets are scoped out.
- Due to areas of high or medium risk of flooding are not present on site, the risk of significant impacts from flooding is considered very unlikely. It is therefore considered that a separate Flood Risk Assessment is not required, and flood risk is scoped out of further assessment. Best practice measures to prevent increase of flood risk are included within the Standard Mitigation, **Section 11.7**.

11.7 Standard Mitigation

Embedded Mitigation

11.7.1 The following considerations have been taken into account in the iterative design of the Proposed Development, considered as embedded mitigation:

- A 50 m buffer has been maintained around all surface watercourses identified in OS 1:25k mapping.
- It would be usual to locate infrastructure outwith deep peat, however, due to the depth and extent of peat at the Site, this is unavoidable. However, deepest areas of peat have been avoided and the proposed turbine is located in areas of peat no deeper than the permitted turbines.
- Floating tracks have been used where topography will allow to reduce the amount of peat excavation required.
- Infrastructure has been sited outwith areas identified as high risk within the PLHRA.

- Infrastructure has also been sited outwith areas assessed to be GWDTE.
- Existing infrastructure has been reused as far as practicable.

Good Practice Measures

11.7.2 In undertaking the assessment of potential effects from the Proposed Development, good practice measures are assumed to be embedded mitigation. As appropriate, these mitigation measures would be outlined within the CEMP.

Pre-Construction

11.7.3 Prior to construction being undertaken, relevant detailed site investigations would be conducted. This could include of underlying deposits, in particular where proposed infrastructure is sited and informing suitable micro-siting of the turbines and associated infrastructure.

11.7.4 If there are assessed to be potential effects to surface watercourses or groundwater, baseline water quality monitoring will be undertaken as required. This may also include groundwater level and flow monitoring.

11.7.5 Prior to construction, a detailed Drainage Strategy (DS) would be developed and agreed with SEPA and SIC. The DS would detail the Site drainage design, including the type of surface to be used for the access track, the soft engineering and habitat enhancement measures proposed to slow surface water flows and any necessary ponds, swales, cross drains and bunds, to ensure that runoff from hard surfaces would be controlled.

Construction

11.7.6 Following review of best practice outlined in relevant guidance and legislation, including SEPA guidance 'Prevention of Pollution from Civil Engineering Contracts: Special Requirements' (SEPA, 2006), a CEMP would be compiled. The Principal Contractor would implement measures outlined with the CEMP, as agreed with relevant consultees, including SEPA, NatureScot and SIC. This would also include a construction method statement, which would account for:

- Pollution Risk Assessment;
- Identification of Controlled Waters and temporary discharge points to these watercourses;
- Planning and design of dewatering activities to minimise the local drawdown;
- Planning and design of pollution control measures, in particular during earthworks;
- Storage of fuel and chemicals in a designated area in accordance with best practice procedures, out with 50 m buffers of watercourses and waterbodies;
- Designated area for concrete batching (if applicable), away from watercourses;
- Pollution control system management, including dewatering of excavations;
- Contingency planning and emergency procedures; and
- On-going monitoring of construction procedures.

11.7.7 Embedded measures within the CEMP to prevent sedimentation pollution and erosion include the following:

- All earthworks would be carried out in accordance with BSI Code of Practice for Earth Works BS6031:2009.

- Stockpiles will be placed at least 50 m from watercourses. The height and maximum slope angle will be in accordance with BSI guidance. Where there are stockpiles of peat, re-wetting will occur to prevent peat drying out. Sediment pollution mitigation measures, including drains will be implemented at the base of stockpiles.
- Sediment pollution mitigation measures will be emplaced across the Proposed Development, this may include: drainage; silt fencing; settlement lagoons; and check dams.
- Plant movements will be minimised through management measures. Measures to prevent sediment on public roads may include wheel washing or road sweeping at the Site entrance.
- Any CAR licences required for site discharges will be applied to from SEPA prior to construction.
- A 'wet weather policy' will be in place, given that there are likely to be periods of significant rainfall at the Site in Shetland. The policy will include that site management checks local weather forecast daily, regularly checks and maintains pollution control system, and suspends work during adverse conditions.
- Where topography dictates that working platforms are needed, these would be formed to ensure that surface water drains away from watercourses.
- To avoid unnecessary compaction and disturbance to site soils, working areas and corridors would be established and demarcated, with construction operatives appropriately inducted and trained to avoid work outside the designated work areas.

11.7.8 Embedded measures within the CEMP to prevent chemical pollution include:

- Dewatering at the turbine will be minimised through careful management and reducing the time the excavation is open, including concrete pouring.
- A method statement to address the transport, transfer, handling and pouring of liquid concrete at foundations will be undertaken by the Principal Contractor.
- Cement, grout and unset concrete will not be allowed to enter the water environment. No operations involving concrete transfer will take place within 50 m of watercourses.
- There will be no washing out of vehicles used for concrete delivery or washing of vehicles within 50 m of watercourses.
- Chemicals will be stored in impermeable bunded containers at least 110% of the volume stored. No refuelling will take place onsite.
- Spill kits will be stored across the Site and within all vehicles and plant. Onsite toolbox talks with construction staff will include to report all onsite spills and the correct implementation of spill kits.
- All vehicles and plant will be checked regularly with regular maintenance undertaken as required.

11.8 Potential Effects

Construction

Impact on Surface Water Quality

11.8.1 Surface water runoff containing silt and other sediments, particularly during and after rainfall events, has the potential to enter the watercourses and field drains on and adjacent to the Site. Silt and sediment laden surface water runoff is predicted to arise from excavations, exposed ground

and any temporary stockpiles. This has the potential to temporarily impact on the water quality and hydrological and ecological function of the receiving watercourse at and downstream of the works in the absence of any mitigation. Additionally, pollutants such as oils, fuel and cement may be mobilised through mechanical leaks or spillage and carried in surface drainage.

11.8.2 As noted previously, a minimum buffer of 50 m around all watercourses has been maintained in siting all infrastructure except where watercourses need to be crossed. Furthermore, good construction practice measures would be set out in a CEMP and fully implemented to minimise the risk of pollution to surface watercourses.

11.8.3 The magnitude of change, prior to any additional mitigation, is considered to be Negligible, on a High sensitivity receptor. Therefore, there is potential for an effect of Minor significance, prior to additional mitigation this is considered to be significant.

Impact on Surface Water Flow

11.8.4 The access tracks and turbine hardstanding could result in an increased rate of surface water run-off from the Site. This could potentially increase sedimentation and erosion in watercourses and risk of flooding downstream. It can also result in the diversion of surface water flows.

11.8.5 As outlined in embedded mitigation, a detailed Drainage Strategy will be developed and agreed with SEPA and SIC to ensure runoff from infrastructure is controlled. Hydrological connectivity and maintenance of existing drainage pathways will be undertaken through installation of trackside and cross drainage.

11.8.6 The magnitude of change, prior to any additional mitigation, is therefore Negligible, on a High sensitivity receptor. Therefore, there is potential for an effect of Minor significance, this is considered to be not significant.

Impact on Groundwater Flow

11.8.7 The installation of turbine foundations, BESS, and permanent access tracks can result in the diversion of groundwater flows within underlying geology by creating a barrier. If dewatering occurs at turbine foundations during construction, this could locally reduce groundwater quantity.

11.8.8 The superficial geology underlying the Proposed Development is characterised by low permeability peat with localised perched groundwater. Deeper, catotelmic peat deposits typically exhibit very low permeability, with extremely slow transmission of groundwater. This is considered to have minimal connectivity to the underlying 'low productivity' bedrock aquifer where flow is largely in fractures and discontinuities. An inferred thrust fault is located 180 m south-east of the turbine.

11.8.9 As the groundwater is considered to be of relatively slow transmission, the spatial impacts of drawdown from dewatering will be a localised area at the turbine foundation. It is also considered to be a short-term impact with localised groundwater levels anticipated to recover when completed. Embedded measures will be implemented to prevent impacts to groundwater, which will include completing excavation and dewatering as quickly as practicable.

11.8.10 Diversion of groundwater flows by turbine hardstanding, BESS, and permanent access tracks is a potential impact. Drainage will be utilised to maintain hydrologically connectivity upslope and downslope of access tracks. On areas of permanent tracks this will be maintained though cross-track drainage. Sections of track are also proposed to be floated, which will maintain hydrological connectivity and prevent disturbance to groundwater flow.

11.8.11 Impact on groundwater flow within superficial peat is assessed to be of Negligible magnitude of impact on a High sensitivity receptor. This is assessed to be an effect of Minor significance, which prior to additional mitigation is considered to be significant.

11.8.12 Impact on groundwater flow within bedrock is assessed to be of Negligible magnitude of impact on a Medium sensitivity receptor. This is assessed to be an effect of Negligible significance (not significant).

Impact on Groundwater Quality

11.8.13 As outlined above, the geology underlying the Site is characterised by low permeability peat and low permeability metamorphic semipelite of the Cliff Hills Phyllitic Formation. There is therefore likely to be slow flow of groundwater and limited potential for transmission of contaminants.

11.8.14 The installation of the turbine foundation has the potential to impact groundwater quality as a result of alkaline leachate from concrete foundations. Due to the characteristics of the underlying geology, the spatial impact of any alkaline leachate is therefore likely to be limited to the localised area at the turbine foundation. Other forms of chemical pollution that may occur include spills of fuels and chemicals stored onsite or from vehicle and plant spills, or from BESS.

11.8.15 Embedded mitigation measures include sufficient and continued dewatering at the turbine foundation excavation until the concrete is cured, to prevent leaching. To prevent pollution to groundwater other mitigation includes appropriate management measures for transfer of concrete and minimising the duration of concrete pouring. Other measures will include appropriate storage of fuels and chemicals, refuelling of plant and vehicles at designated locations and distributing spill kits throughout the Site and within all plant and vehicles.

11.8.16 Impact on groundwater quality within superficial peat is assessed to be of Negligible magnitude of impact on a High sensitivity receptor. This is assessed to be an effect of Minor significance and is considered to be not significant.

11.8.17 Impact on groundwater quality within bedrock is assessed to be of Negligible magnitude of impact on a Medium sensitivity receptor. This is assessed to be an effect of Negligible significance and is considered to be not significant.

Removal and Impact on Peat

11.8.18 The proposed turbine, associated hardstanding, and battery storage would be constructed by excavating peat within their footprints to allow construction on a suitable founding stratum (i.e., bedrock). As outlined in embedded mitigation measures, the proposed turbine and infrastructure have been sited to minimise the excavation of peat as far as practicable, taking account of other constraints. Siting infrastructure within the area of deepest peat has been avoided, located in the south of the Site. The identified sinkholes located to the west of the Site have also been avoided. Proposed track sections traversing deep peat are proposed to be floated where topography allows.

11.8.19 Detail on the estimated volume of peat to be excavated, and the management of excavated peat, is given in **Appendix 11.2**: Outline Peat Management Plan (PMP).

11.8.20 Embedded mitigation measures outlined will be implemented by the Principal Contractor, to reduce the potential effects on peat during construction. This includes measures to prevent drying out of peat in stockpiles, to enable the peat to be successfully restored, where practicable, as outlined in the PMP.

11.8.21 Following implementation of mitigation, the excavation of peat is assessed to be a Low magnitude of impact on a High sensitivity receptor. This will result in an effect of Moderate significance and prior to additional mitigation this is considered to be significant.

Peat Landslide Impact on Watercourses

11.8.22 Construction on peat soils can result in destabilisation of peat deposits on slopes and lead to slope failure. This can result in the peat slides to reach downslope watercourses, potentially resulting in sedimentation and changes to flow and fluvial geomorphology.

11.8.23 A detailed assessment of peat landslide risk has been undertaken as presented in **Appendix 11.1**: Peat Landslide Hazard and Risk Assessment. This has identified the risk of peat landslides at the proposed turbine, hardstanding, and battery storage to downslope receptors.

11.8.24 The potential magnitude of impact from peat landslides is assessed to be Negligible, on a High sensitivity receptor, resulting in a Minor effect. This is not considered to be significant.

Compaction of Soils

11.8.25 As part of the Proposed Development there will be a requirement for construction of permanent access tracks and hardstanding. During construction there will also be movement of vehicles and plant. There is therefore potential for this to result in soil compaction, leading to reduced soil permeability, increasing the potential for surface water runoff. Reduced soil permeability could also reduce the flood storage capacity within the Site and could potentially lead to localised flooding incidents.

11.8.26 As discussed previously, the Site is largely underlain by peat of varying depths, but largely categorised as deep peat. It is inferred that the peat is of low or variable permeability. There is therefore unlikely to be a significant reduction in flood storage capacity between low permeability peat to low permeability hardstanding. In addition, the area of hardstanding of the Proposed Development has been minimised as far as practicable. Also, the existing access track will be utilised as far as practicable, as part of the embedded design measures.

11.8.27 Following the implementation of these embedded measures, the potential effect on a receptor of High sensitivity, is considered to be of Negligible magnitude. This will result in an indirect effect of Minor and is considered to be not significant.

Impacts to GWDTE

11.8.28 As outlined previously, identified GWDTE communities that were found to have a site-specific groundwater dependency are MCx and M15a. In line with SEPA's LUPS-GU31, buffers have been applied to infrastructure to determine if GWDTE are likely to suffer direct or indirect effects from the Proposed Development. Buffers are applied to the following infrastructure depths:

- 100 m for excavations/intrusions less than 1 m depth; and
- 250 m for excavations/intrusions more than 1 m depth.

11.8.29 As shown in **Figure 11.6**, the highly dependent MCx community is located outwith both 250 m and 100 m buffers from the Proposed Development. Therefore, there are considered to be no likely direct or indirect impacts to highly dependent GWDTE.

11.8.30 The moderately dependent M15a community is located 22 m within the 250 m buffer of the turbine. It was noted to be groundwater dependent by the surveyor due to its calcareous influence surrounded by acidic vegetation.

11.8.31 The surrounding area is likely to be fed by runoff from the peatland, which will also likely partly feed the M15a community. The community is noted to be located between two aquifers separated by a thrust fault. The bedrock is described to be low productivity where groundwater flow is through fractures and yields where fractured at the surface. The groundwater feeding the M15a community is likely produced due to the fault modifying groundwater flow. The potential impacts to the M15a community is therefore from changes to groundwater from installation of the turbine foundations, which are within 250 m.

11.8.32 Implementation of mitigation will include measures to prevent changes to groundwater quantity or quality. This will include best practice measures for the foundation installation, dewatering at the foundation as short a time as practicable, monitoring of works and any potential contamination by the Environmental Clerk of Works (ECoW).

11.8.33 There will be no direct impacts from the Proposed Development to the community. Indirect impacts to the M15a community are considered to be of Negligible magnitude of impact. This is due to the community being just within 250 m of the turbine, the impermeable nature and low productivity of the bedrock aquifer and the implementation of embedded mitigation, including short dewatering periods.

11.8.34 The potential effect on the moderately groundwater dependent (M15a) receptor of High sensitivity, is considered to be of Negligible magnitude. This will be of Minor effect and is considered not significant.

Impacts to CAR Abstractions

11.8.35 The water abstraction at the Energy Recovery Plant is registered to be abstracting from a spring, therefore possible impacts to groundwater are considered. As described previously, groundwater can potentially be impacted from the Proposed Development through chemical pollution, sedimentation, dewatering and diverting groundwater flow.

11.8.36 The abstraction point is located 619 m from the proposed turbine and 649 m from the nearest proposed track. In line with SEPA's LUPS-GU31, as the abstraction is located out with 100 m from excavations less than 1 m and 250 m from excavations greater than 1 m, the groundwater supply is not considered to be affected. In addition, groundwater flow within the area is considered to be slow and localised within the peat and similarly within the bedrock. The drainage and water management pond of the Energy Recovery Plant is also located between the Site and the abstraction.

11.8.37 With implementation of embedded mitigation, the potential effect on a receptor of High sensitivity, is considered to be of Negligible magnitude. This will be of Minor effect and is considered not significant.

Impacts to Designated Sites

11.8.38 The East Mainland Coast, Shetland SPA is hydrologically connected to the Site through surface water runoff to the coastal waters surrounding the peninsula. The habitat for the SPA identified features may be affected by changes to surface water quality.

11.8.39 As discussed above, sediment pollution mitigation measures and chemical pollution mitigation measures are embedded and will prevent contaminated runoff to the surrounding coastal waters. There will be regular verification of the correct implementation and maintenance of these measures. Following the implementation of these embedded measures, the potential effect on a receptor of High sensitivity, is considered to be of Negligible magnitude. This will result in an indirect Minor effect and is considered not significant.

Operation

Impact on Surface Water Flow

11.8.40 The access tracks, BESS, and turbine hardstanding could result in an increased rate of surface water run-off from the Site. This could potentially increase sedimentation and erosion in watercourses and risk of flooding downstream. Permanent hardstanding can also alter natural drainage pathways.

11.8.41 There will be a reduction in exposed ground and hardstanding areas during the operational phase as compared to the construction phase. Any changes to drainage of surface water will be altered from the construction phase and continue during the operational phase.

11.8.42 As outlined in embedded mitigation, a detailed Drainage Strategy will be developed and agreed with SEPA and SIC to ensure runoff from infrastructure is controlled.

11.8.43 The magnitude of change, prior to any additional mitigation, is therefore Negligible, on a High sensitivity receptor. Therefore, there is potential for an effect of Minor significance (not significant).

Impact on Groundwater Flow and Drying Out of Peat

11.8.44 The presence of turbine foundations, BESS, and hardstanding have the potential to interrupt groundwater flow by acting as barriers to flow. This could result in drying out of surrounding peat deposits. As outlined previously, the groundwater flow is considered to be limited in both the perched superficial aquifer and in the bedrock aquifer, where flow is restricted to fractures and discontinuities. It is considered that any impacts to groundwater flow are therefore considered to be localised.

11.8.45 There may be effects to peat immediately surrounding areas excavated during construction for hardstanding and foundations, however, it is considered that these are unlikely to produce long-term effects and are likely to rebound during the operational phase.

11.8.46 Taking account of embedded mitigation measures, the magnitude of impact is assessed as Negligible, on a High sensitivity receptor (peat deposits). There is therefore potential for an effect of Minor significance (not significant).

11.8.47 The magnitude of impact on groundwater flow within bedrock is assessed to be of Negligible magnitude on a Medium sensitivity receptor. This is assessed to be of Negligible significance and considered to be not significant.

Impacts on Fluvial Geomorphology

11.8.48 If new watercourse crossings are not designed properly to ensure continuous flows, this could potentially adversely affect the geomorphology of watercourses by reducing heterogeneity. While the Proposed Development does not cross any mapped watercourses, two minor channels at the proposed track were identified, considered likely to be ephemeral channels. The Watercourse Crossing Schedule (**Appendix 11.1**) details the two new watercourse crossings required and suggested crossing types to ensure heterogeneity. Following further design of these watercourse crossings, CAR licences may be applicable, and all necessary licences would be sought prior to the commencement of any operations on-site, if required.

11.8.49 The magnitude of impact on a High sensitivity receptor is assessed to be Negligible. This is considered to be an effect of Minor significance and is considered to be not significant.

Impact on Surface Water and Groundwater Quality from Chemical Pollution and Sedimentation

11.8.50 As outlined during the Construction phase, surface water and groundwater quality can be impacted by polluted run-off from the Site, including the BESS. Following the construction phase, there will also be less disturbance to sediments during the operational phase. Many of the activities that may have resulted in chemical pollution including refuelling and cement pouring, will not occur during the operational phase. Embedded measures to mitigate potential chemical pollution including spill kits to be present within each vehicle will continue within the operational phase.

11.8.51 Impact on surface water quality is assessed to be of Negligible magnitude of impact on a High sensitivity receptor. This is assessed to be of Minor significance and considered to be not significant.

11.8.52 Impact on groundwater quality within superficial peat is assessed to be of Negligible magnitude on a High sensitivity receptor. This is assessed to be of Minor significance and considered to be not significant.

11.8.53 Impact on groundwater quality within bedrock is assessed to be of Negligible magnitude on a Medium sensitivity receptor. This is assessed to be of Negligible significance and considered to be not significant.

Decommissioning

11.8.54 Decommissioning effects would be expected to be no greater than those associated with construction. This is based on the access tracks and hardstanding remaining in situ so there will be no impacts associated with removal. No significant effects are expected at the decommissioning stage. A Decommissioning Environmental Management Plan will be in place and agreed with the relevant consultees prior to decommission.

11.9 Additional Mitigation

11.9.1 With the exception of removal and impact of peat, no significant environmental effects have been identified following the implementation of the embedded mitigation outlined in **Section 11.7.** Therefore, the further mitigation measures set out below focus on reducing the significance of effects resulting from peat excavation and associated impacts and providing environmental benefit where possible.

11.9.2 Excavated peat would be re-used on-site as far as reasonably practicable and to provide suitable restoration, landscaping, and repair/reprofiling of local hag features to improve peatland habitat and hydrological function, as set out in **Appendix 11.2**.

11.9.3 The proposed peatland restoration measures are in line with standard, established practice and have been shown to be successful in similar habitats and settings. Appropriate peat handling and storage measures as set out in **Appendix 11.2** will be implemented to enhance the potential for successful habitat restoration. A monitoring programme will be agreed to review the effectiveness of the restoration works and agree any further work or modification. The works will be agreed with NatureScot, SEPA and SIC prior to construction and will be implemented during construction works.

Through the on-site re-use and restoration, *all excavated peat will be used without the requirement for any disposal of excavated peat.* This therefore mitigates the effect of peat excavation (although recognising that habitat restoration will take time and will require monitoring as noted above). Repair of hagging/erosion features in the vicinity of new infrastructure will provide benefits through reduction of ongoing erosion risks and increased water retention.

11.10 Residual Effects

Construction

Impacts on Surface Water Quality

11.10.1 The embedded measures, including silt mitigation measures, correct storage of fuels and chemicals and management of any spills, are considered to result in an effect of Minor significance on surface water.

Impacts on Surface Water Flow

11.10.2 The embedded measures, including trackside and cross drainage and implementation of a Drainage Strategy, are considered to result in an effect of Minor significance on surface water.

Impacts on Groundwater Quality

11.10.3 The embedded measures, including correct storage of fuels, management plans in the event of spills and implementation of measures to prevent leaching, are considered to result in an effect of Minor significance on groundwater in peat, and an effect of Negligible significance on groundwater in bedrock.

Impacts on Groundwater Flow

11.10.4 The embedded measures, including trackside and cross drainage, dewatering for as short a time as practicable and implementation of a Drainage Strategy, are considered to result in an effect of Minor significance on peat and its groundwater, and an effect of Negligible significance on groundwater flow in bedrock.

Removal and Impact on Peat

11.10.5 Implementation of embedded measures, such as reusing existing infrastructure, and additional measures, including implementation of the PMP for the restoration of peat, are considered to result in an effect of Minor significance.

Peat Landslide Impact on Watercourses

11.10.6 Following implementation of embedded measures including design of the proposed layout, the effect on peat landslide impact is considered to be of Minor significance.

Compaction of Soils

11.10.7 Following the implementation of embedded measures including design of the proposed layout, the effect on soils from compaction is considered to be of Minor significance.

Impacts to CAR Abstractions

11.10.8 The embedded measures, including correct fuel storage, management of spills, dewatering for as short a time as practicable and implementation of a Drainage Strategy, are considered to result in an effect of Minor significance.

Impacts to GWDTE

11.10.9 Following the implementation of embedded mitigation measures, including best practice methods for installation of foundations and dewatering for as short a time as practicable, the effects on GWDTE from changes to groundwater quantity or quality are considered to be of Minor significance.

Impacts to Designated Sites

11.10.10 The embedded measures to prevent chemical pollution and sedimentation to surface watercourses, are considered to result in an effect of Minor significance on designated sites.

Operation

Impacts on Surface Water Flow

11.10.11 The embedded measures, including trackside and cross drainage and implementation of a Drainage Strategy, are considered to result in an effect of Minor significance on surface water.

Impacts on Groundwater Flow and Drying Out of Peat

11.10.12 The embedded measures, including trackside and cross drainage, installation of floated tracks and implementation of a Drainage Strategy, are considered to result in an effect of Minor significance on peat and its groundwater, and an effect of Negligible significance on groundwater flow in bedrock.

Impacts on Fluvial Geomorphology

11.10.13 The embedded mitigation measures, including assessment and further design of watercourse crossings prior to construction regulated by CAR and agreed with SEPA and SIC, are considered to result in an effect of Minor significance.

Impacts on Surface Water and Groundwater Quality from Chemical Pollution and Sedimentation

11.10.14 The embedded measures, including correct storage of fuels, management plans in the event of spills and implementation of silt mitigation measures, are considered to result in an effect of Minor significance on surface water and groundwater in peat, and an effect of Negligible significance on groundwater in bedrock.

Decommissioning

11.10.15 The residual effects of the decommissioning phase will be similar to during construction, however, due to reduced site activity, these will be of lesser magnitude.

11.11 Comparison of Effects

11.11.1 The Proposed Development has been revised since the 2011 Previously Permitted Development. The layout revision includes the removal of a turbine (T3) and its associated hardstanding, and removal of the track required to access T3. As a result, there will have been a reduction in the following effects to receptors:

- Removal and impacts to peat;
- Impacts to groundwater flow and quality;
- Impacts to surface water flow and quality;
- Risk of peat landslides; and
- Compaction of soils.

11.12 Assessment of Cumulative Effects

11.12.1 Cumulative developments have been considered where they are located within the same catchment areas as the Proposed Development. The permitted Mossy Hill scheme lies within the Shetland Coastal Catchment between Stromfirth Burn and the Burn of Dale, the catchment that the Proposed Development lies within. However, the nearest permitted turbine is located over 1.2 km from the Proposed Development and surface water and runoff pathways do not overlap with the Proposed Development. As such, it is considered that Mossy Hill and the Proposed Development are not hydrologically connected. Although runoff from both schemes discharges to the coastal waters surrounding the peninsula, considering the embedded mitigation set out in this assessment and the outline CEMP set out in the Mossy Hill application, no significant effect on coastal waters is anticipated.

Comparison of Cumulative Effects

11.12.2 No cumulative effects as a result of the 2011 Previously Permitted Development were anticipated. This was primarily because the watercourses draining the Site are small and discharge directly to coastal waters surrounding the Site. The permitted Mossy Hill scheme did not consider the 2011 Previously Permitted Development within its cumulative assessment in the geological, hydrological and hydrogeological ES chapter.

11.12.3 There have been no cumulative effects anticipated related to the Proposed Development. Similarly, no cumulative effects were identified from the 2011 Previously Permitted Development.

11.13 Conclusion

11.13.1 The Site is located within the Shetland Coastal catchment, with on-site and adjacent watercourses and waterbodies including the Burn of Kebister, Loch of Kebister and its tributaries and drains in the surrounding area. The nearest watercourse classified by SEPA is Burn of Dale which is considered to be of 'Good' quality, therefore surface water receptors are considered to have a precautionary value of 'Good' quality.

11.13.2 The bedrock beneath the Site is metamorphic beneath the majority of the Site, with sedimentary bedrock to the south-east. Superficial deposits comprise peat, which is typically low permeability. The peat is identified as a Class 1 peatland according to the SNH Carbon and Peatlands Map 2016.

11.13.3 Extensive peat surveys were undertaken and identified that approx. 73% of probes recorded peat exceeding 1 m, otherwise known as deep peat. Several design iteration works were undertaken to avoid siting turbines or other infrastructure on deep peat. The proposed turbine is sited in areas of peat no deeper than the permitted turbines.

11.13.4 A Peat Landslide and Hazard Risk Assessment has identified low risks at the turbine and along proposed access tracks.

11.13.5 Potential construction and operational effects include changes to surface water and groundwater flow and quality, excavation of peat, peat slide risk and effects to water abstractions, designated sites or Groundwater Dependent Terrestrial Ecosystems.

11.13.6 The mitigation measures set out in this chapter will be included within a Construction Environmental Management Plan prior to the commencement of construction activities. These mitigation measures are considered to be robust and implementable and will reduce the potential impacts on peat resources and watercourses. The significance of residual effects on geology, peat, hydrology and hydrogeology receptors following the implementation of these mitigation measures are considered to be Minor to Negligible and therefore not significant. Potential effects, mitigation measures and residual effects are summarised in **Table 11-8** with cumulative effects summaries in **Table 11-9**.

Table 11-8 – Summary of Effects

Description of Effect	Significance of Potential Effect		Mitigation Measure	Significance of Residual Effect		Comparison in Residual Effect Significance from 2011 Previously Permitted Development
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse	
Impact on Surface Water Quality	Minor	Adverse	50 m buffer from watercourses. Implementation of mitigation measures in CEMP. Drainage Strategy to be implemented.	Minor	Adverse	No change in significance
Impact on Surface Water Flow	Minor	Adverse	50 m buffer from watercourses. Implementation of mitigation measures in CEMP, including cross drainage. Drainage Strategy to be implemented.	Minor	Adverse	No change in significance
Impact on Groundwater Quality	Minor / Negligible	Adverse	Implementation of mitigation measures in CEMP. Drainage Strategy to be implemented.	Minor / Negligible	Adverse	No change in significance
Impact on Groundwater Flow	Minor / Negligible	Adverse	Implementation of mitigation measures in CEMP, including cross drainage. Drainage Strategy to be implemented. Dewatering undertaken as short a time as practicable. Floated tracks to be installed.	Minor / Negligible	Adverse	No change in significance
Removal and Impact on Peat	Moderate	Adverse	Pre-construction surveys to be undertaken. Avoidance of deepest areas of peat in design.	Minor	Adverse	No change in significance

Description of Effect	Significance of Potential Effect		Mitigation Measure	Significance of Residual Effect		Comparison in Residual Effect Significance from 2011 Previously Permitted Development
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse	
			Management, storage and restoration in line with PMP.			
Peat Landslide Impact on Watercourses	Minor	Adverse	Embedded design measures, including utilising existing infrastructure.	Minor	Adverse	Not noted in the 2011 Previously Permitted Development ES.
Compaction of Soils	Minor	Adverse	Embedded design measures, utilising existing infrastructure and floated tracks.	Minor	Adverse	No change in significance
Impacts to CAR Abstraction	Minor	Adverse	Installation of mitigation measures in CEMP. Drainage Strategy to be implemented.	Minor	Adverse	Not noted in the 2011 Previously Permitted Development ES.
Impacts to GWDTE	Minor	Adverse	Embedded mitigation measures including dewatering at turbine foundations for as short a time as practicable.	Minor	Adverse	Not noted in the 2011 Previously Permitted Development ES.
Impacts to Designated Sites	Minor	Adverse	50 m buffer from watercourses. Installation of mitigation measures in CEMP. Drainage Strategy to be implemented.	Minor	Adverse	Not noted in the 2011 Previously Permitted Development ES.
Impacts on Fluvial Geomorphology	Minor	Adverse	Further design of drainage and watercourse crossings. CAR registration where required.	Minor	Adverse	Not noted in the 2011 Previously Permitted Development ES.

Table 11-9 – Summary of Cumulative Effects

Receptor	Effect	Cumulative Developments	Significance of Cumulative Effect		Comparison in Residual Effect Significance from 2011 Previously Permitted Development
			Significance	Beneficial/ Adverse	
Surface Water	Chemical pollution or sedimentation	Mossy Hill	Minor	Adverse	Not noted in the 2011 Previously Permitted Development ES.

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