13 GEOLOGY AND PEAT

13.1 INTRODUCTION

This chapter of the Environmental Impact Assessment (EIA) Report provides an appraisal of the consequence of Ackron Wind Farm (the Development) on Geology, Soils and Peat and provides a preliminary geological assessment on the existing ground conditions while considering peat instability and management. This assessment was undertaken by David Ballentyne at Arcus Consultancy Services Limited (Arcus) who is an Environmental Civil Engineer with for over 15 years of experience in ground condition assessment. This chapter has been technically reviewed by Heather Kwiatkowski, Principal EIA Consultant at Arcus, and Tomos ap Tomos, Associate Director of Engineering at Arcus.

This geological assessment identifies areas of geological interest and features of note. The information and data collated from the peat and geological assessments have informed the site layout to minimise the potential impacts on peat and geology as a result of the Development.

This Chapter is supported by the following Figures provided in Volume 2a: Figures excluding Landscape and Visual:

- Figure 13.1: Superficial Soils;
- Figure 13.2: Bedrock Geology;
- Figure 13.3: National Soils of Scotland;
- Figure 13.4: Extract from Carbon and Peatland 2016; and
- Figure 13.5: Interpolated Peat Depths.

This chapter of the EIA Report is also supported by the following Technical Appendix documents provided in Volume 3 Technical appendices:

- Appendix A13.1: Peat Slide Risk Assessment (PSRA);
- Appendix A13.2: Outline Peat Management Plan (oPMP); and
- Appendix A13.3: Borrow Pit Assessment (BPA).

This Chapter is structured as follows:

- Legislation, Policy and Guidance;
- Scoping Responses and Consultations;
- Assessment Methodology and Significance Criteria;
- Baseline Conditions;
- Assessment of Potential Effects;
- Residual Effects; and
- Summary.

The following terms are used within this Chapter to describe the Development and various associated study areas:

- The Development: the whole physical process involved in the development of Ackron Wind Farm, including wind farm construction, operation and decommissioning (i.e. not a piece of land or an area); and
- The Study Area: the entire area within the redline boundary.

13.2 LEGISLATION, POLICY AND GUIDANCE

The Scottish Planning Policy (SPP)[1] was published in 2014 and sets out the Scottish Government's policy on how nationally important land use planning matters should be addressed.

In relation to peat and organic soils, paragraph 205 from SPP states that "*where peat and other carbon rich soils are present, applicants should assess the likely effects of development on carbon dioxide (CO2) emissions. Where peatland is drained or otherwise disturbed, there is liable to be a release of CO2 to the atmosphere. Developments should aim to minimise this release*".

In relation to minerals, Section 8 of SPP4[2] 'Planning for Minerals' states that a "*sustainable approach to mineral extraction should reconcile the need for minerals with concern for the natural and built environment and communities in a manner that safeguards minerals as far as possible for future use, ensures a steady and adequate supply is maintained to meet the needs of society and the economy, encourages sensitive working practices during mineral extraction that minimise the environmental and transport impacts and once extraction has ceased, ensure sites are reclaimed to a high standard or enhance the value of the wider environment, promotes the use and recycling of secondary materials in development plan policies in addition to those for the release of sites for extraction of primary materials, protects international, national and locally designated areas of acknowledged natural or built heritage importance from adverse impacts, and minimises the potential adverse impact of minerals extraction on communities*".

In addition to the SPP, guidance of relevance to this chapter includes:

- Scottish Natural Heritage (SNH[3]) (2019) 4th Edition, Good Practice During Wind Farm Construction[4];
- The Scottish Government (2017), Peat Landslide Hazard and Risk Assessments – Best Practice Guide for Proposed Electricity Generation Developments[5];
- Scottish Government, SNH, SEPA (2017) Peatland. Guidance on Development on Peatland, on-line-version-only[6];
- The Scottish Government (2009), The Scottish Soil Framework[7];
- The Construction Industry Research and Information Association (CIRIA) (2015), Environmental Good Practice on Site (C741)[8]; and
- Planning Advice Note PAN 50 Controlling the Environmental Effects of Surface Mineral Workings[9].

[1] The Scottish Government (2014) Scottish Planning Policy [Online] Available at: http://www.gov.scot/Publications/2014/06/5823 (Accessed 08/08/2020)
[2] The Scottish Government Scottish Planning Policy 4 'Planning For Minerals' (2014) [online] available at: https://www2.gov.scot/resource/doc/146319/0038293.pdf
[3] Scottish Natural Heritage (SNH) rebranded in August 2020 as NatureScot. Where relevant reference is still made to SNH within this chapter in respect of guidance which remains valid and is yet to be republished etc.
[4] SNH (2019) Good practice during windfarm construction, 4th Edition [Online] Available at: https://www.nature.scot/guidance-good-practice-during-wind-farm-construction (Accessed 03/08/2020)
[5] The Scottish Government (2017) Peat Landslide Hazard and Risk Assessments - Best Practice Guide for Proposed Electricity Generation Developments Guidance [Online] Available at: http://www.gov.scot/Resource/0051/00517176.pdf (Accessed 08/01/2020)
[6] Scottish Government, Scottish Natural Heritage, SEPA (2017) Peatland Survey. Guidance on Developments on Peatland, on-line version only Available at: https://www.gov.scot/Resource/0051/00517174.pdf (Accessed 08/01/2020)
[7] The Scottish Government (2009) The Scottish Soil Framework [Online] Available at: http://www.gov.scot/Publications/2009/05/20145602/0 (Accessed 08/01/2020)
[8] The Construction Industry Research and Information Association (CIRIA) (2015) Environmental Good Practice on Site Guide (C741), CIRIA: London. (Accessed 08/01/2020)
[9] Scottish Government (2017) Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments. Available at: http://www.gov.scot/Publications/2017/04/8868/0 (Accessed 08/01/2020)

13.3 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

13.3.1 Scoping Responses and Consultation

Throughout the scoping phase, and subsequently during the ongoing EIA process, relevant organisations were contacted with regards to the Developments. Table 13.1 outlines the consultation responses received in relation to Peat and Geology.

Table 13.1: Consultation Summary

Consultee	Details	Where Addressed in EIA Report
The Highland Council Scoping 06/06/2019	The ES must consider the risks of engineering instability relating to presence to peat on the site. A comprehensive peat slide risk assessment in accordance with the Scottish Government Best Practice Guide for Developers will be expected. Assessment should also address pollution risk and environmental sensitivities of the water environment. It should include a detailed map of peat depth and evidence that the scheme minimises impact on areas of deep peat. The ES should include site-specific principles on which construction method statements would be developed for engineering works in peat land areas, including access roads, turbine bases and hard standing areas, and these should include particular reference to drainage impacts, dewatering and disposal of excavated peat. Consideration should be given to the disturbance and re-use of peat generally as highlighted by SEPA. Carbon balance calculations should also be undertaken.	A Peat Slide Risk Assessment and an Outline Peat Management Plan are included as Technical Appendices A13.1 and A13.2 to this EIA Report. All technical appendices have been prepared in accordance with Scottish Government guidelines and best practice guidance as listed in Section 13.2 of this chapter. Furthermore, a Carbon Calculator, which takes into account loss of carbon through peat excavation is included in Chapter 15.
The Highland Council Scoping 06/06/2019	The ES should fully describe the likely significant effects of the development on the local geology including aspects such as earthworks, site restoration and the soil generally including direct effects and any indirect. Proposals should demonstrate construction practices that help to minimise the use of raw materials and maximise the use of secondary aggregates and recycled or renewable materials.	Details of sustainable construction techniques, covering all relevant issues raised are covered in the Construction Environmental Management Plan (CEMP) in Appendix A4.1 and a Preliminary Borrow Pit Assessment is included as Appendix A4.2.

Consultee	Details	Where Addressed in EIA Report
The Highland Council Scoping 06/06/2019	The ES should include outline construction method statements or the site-specific principles on which such construction method statements would be based for engineering works in peat land areas, including access roads, turbine bases and hard standing areas, and these should include particular reference to drainage impacts, dewatering and disposal and reuse of excavated peat.	Mitigation of potential impacts on peatlands and water environments are included in this chapter and further details are included in TA4.1: CEMP and TA13.2: Outline Peat Management Plan (oPMP).
SEPA Scoping 17/04/2019	We welcome the inclusion of the phase 1 peat probing information within the scoping report. This suggests that the current turbine layout avoids deep peat, which is welcomed. Careful consideration will need to be given to track layout to ensure that the areas of deepest peat are avoided and we are unlikely to accept a design which results in lots of watercourse crossings or loops.	During preparation of the EIA Report, consultation was undertaken following the design evolution and detailed peat probing to illustrate the avoidance of deep peat where possible with reference to other environmental and buildability constraints.
SEPA Scoping 17/04/2019	The application will need to be supported by further peat probing work. This should generally meet the requirements of the recognised best practice guidance however in this case, where the initial probing suggests much of the site is on shallow peat, we would be happy to agree a more proportionate approach.	Detailed Phase 2 peat probing was undertaken across the infrastructure to allow micrositing outwith deep peat where possible. The detailed peat probing is presented in Figure 2 in TA13.2: oPMP.
SEPA Scoping 17/04/2019	In relation to our specific interest in peatland (and GWDTE, covered below) then we welcome the principle of proposals for peatland restoration of degraded bog as mitigation for impacts on bog habitats (and carbon storage). This is as long as the first principle of design is still avoidance of best quality habitat and deep peat in the first instance. We would welcome an approach which demonstrated an overall net benefit to peatland. We note that much of the site has man-made drains and a programme of ditch blocking may bring significant benefits. Proposals should be outlined in a draft Habitat Management Plan.	Where possible, deep peat has been avoided as illustrated in the consultation details. A Habitat Management Plan should be secured through planning condition if required.

Consultee	Details	Where Addressed in EIA Report
SEPA Scoping 17/04/2019	The planning submission must a) demonstrate how the layout has been designed to minimise disturbance of peat and consequential release of CO2 and b) outline the preventative/mitigation measures to avoid significant drying or oxidation of peat through, for example, the construction of access tracks, drainage channels, cable trenches, or the storage and re-use of excavated peat. There is often less environmental impact from localised temporary storage and reuse rather than movement to large central peat storage areas.	The design evolution is driven by avoidance of environmental constraints including deep peat. During preparation of the EIA Report, consultation has taken place to illustrate how site design has changed to avoid the deepest peat areas. TA 4.1: CEMP, TA 13.2: oPMP, and mitigation in section 13.8 of this chapter outlines the preventative measures and mitigation for avoiding the drying out or oxidisation of peat during construction.
SEPA Scoping 17/04/2019	The submission must include: a) A detailed map of peat depths (this must be to full depth and follow the survey requirement of the Scottish Government's Guidance on Developments on Peatland - Peatland Survey (2017)) with all the built elements (including peat storage areas) overlain to demonstrate how the development avoids areas of deep peat and other sensitive receptors such as Groundwater Dependent Terrestrial Ecosystems. b) A table which details the quantities of acrotelmic, catotelmic and amorphous peat which will be excavated for each element and where it will be re-used during reinstatement. Details of the proposed widths and depths of peat to be re-used and how it will be kept wet permanently must be included.	TA 13.2: oPMP details peat depth mapping, peat excavation and re-use volumes (including the acrotelmic and catotelmic split), and details measures of reuse.
SEPA Scoping 17/04/2019	Dependent upon the volumes of peat likely to be encountered and the scale of the development, applicants must consider whether a full Peat Management Plan (as detailed in the above guidance) is required or whether the above information would be best submitted as part of the schedule of mitigation.	TA13.2 provides an oPMP. The details of mitigation required are included in the Schedule of Mitigation.

SEPA Scoping 17/04/2019	In accordance with Paragraphs 52 to 57 of Planning Advice Note 50 Controlling the Environmental Effects of Surface Mineral Workings (PAN 50) a Site Management Plan should be submitted in support of any application. The following information should also be submitted for each borrow pit: a) A map showing the location, size, depths and dimensions. b) A map showing any stocks of rock, overburden, soils and temporary and permanent infrastructure including tracks, buildings, oil storage, pipes and drainage, overlain with all lochs and watercourses to a distance of 250 metres. You need to demonstrate that a site-specific proportionate buffer can be achieved. On this map, a site-specific buffer must be drawn around each loch or watercourse proportionate to the depth of excavations and at least 10m from access tracks. If this minimum buffer cannot be achieved each breach must be numbered on a plan with an associated photograph of the location, dimensions of the loch or watercourse, drawings of what is proposed in terms of engineering works. c) You need to provide a justification for the proposed location of borrow pits and evidence of the suitability of the material to be excavated for the proposed use, including any risk of pollution caused by degradation of the rock. d) A ground investigation report giving existing seasonally highest water table including sections showing the maximum area, depth and profile of working in relation to the water table. e) A site map showing cut-off drains, silt management devices and settlement lagoons to manage surface water and dewatering discharge. Cut-off drains must be installed to maximise diversion of water from entering quarry works. f) A site map showing proposed water abstractions with details of the volumes and timings of abstractions. g) A site map showing the location of pollution prevention measures such as spill kits, oil interceptors, drainage associated with welfare facilities, recycling and bin storage and vehicle washing areas. The drawing notes	A Preliminary Borrow Pit Assessment is included as part of the EIA Report as TA13.3.

Consultee	Details	Where Addressed in EIA Report
	should include a commitment to check these daily. h) A site map showing where soils and overburden will be stored including details of the heights and dimensions of each store, how long the material will be stored for and how soils will be kept fit for restoration purposes. Where the development will result in the disturbance of peat or other carbon rich soils then the submission must also include a detailed map of peat depths (this must be to full depth and follow the survey requirement of the Scottish Government's Guidance on Developments on Peatland - Peatland Survey (2017)) with all the built elements and excavation areas overlain so it can clearly be seen how the development minimises disturbance of peat and the consequential release of CO2. i) Sections and plans detailing how restoration will be progressed including the phasing, profiles, depths and types of material to be used. j) Details of how the rock will be processed in order to produce a grade of rock that will not cause siltation problems during its end use on tracks, trenches and other hardstanding.	
NatureScot Scoping 06/09/2019	We advise that hydrological effects on the peatland habitats of this SAC should be scoped in. Due to the apparent continuity of blanket bog habitat between Turbines 13 & 14, it is likely there is also hydrological continuity with this protected area	Site layout is up to 12 turbines (see Figure 4.1). However, the hydrological impacts, in relation to blanket bog continuity, is addressed in **Chapter 12: Hydrology and Hydrogeology** of this EIA Report.
NatureScot Scoping 06/09/2019	We note that there is no reference to the National Importance afforded to Carbon-rich Soils, Deep Peat and Priority Peatland Habitat. This is a significant omission which needs to be rectified within the EIA Report (see Annex A for background).	The impact on Carbon rich soils and deep peat is addressed in this Chapter while peatland habitat is discussed in detail in **Chapter 7: Ecology**.

Consultee	Details	Where Addressed in EIA Report
NatureScot Scoping 06/09/2019	Scottish Planning Policy (SPP) identifies "carbon rich soils, deep peat and priority peatland habitat" as nationally important. Also, that "Further consideration will be required to demonstrate that any significant effects on the qualities of these areas can be substantially overcome by siting, design or other mitigation." To ensure that a wind farm can be built on this site without significant loss and damage to these nationally important interests, the applicant needs to demonstrate this fully within the EIA Report and the outline Construction Environmental Management Plan. See our preapplication comments for more detail on this.	EIA consultation and post site layout design consultation illustrated the avoidance of deep peat and sensitive habitat where possible. Further details on mitigation and best practices during construction are outlined in TA4.1: CEMP and TA13.2 oPMP.
NatureScot Scoping 06/09/2019	We advise that a Habitat Management Plan should be developed to reflect the importance of peat and peatland habitats. Any wind farm built on this site is likely to result in loss and damage to peatland habitats, therefore it is important to know what measures will be taken to mitigate and compensate for these.	An outline Habitat Management Plan HMP is detailed in **Chapter 7: Ecology**.
SEPA Updated Scoping 11/11/19 SEPA Updated Scoping 11/11/19	We welcome the inclusion of the phase 1 peat probing information within the scoping report and note that it has been updated to cover the change in layout. It suggests that the current turbine layout avoids the deepest peat, which is welcomed. Further turbine relocation should be made so that all the deep peat (>0.5 m) is avoided. Careful consideration will need to be given to track layout to ensure that the areas of deepest peat are avoided and we are unlikely to accept a design which results in lots of watercourse crossings or loops. The application will need to be supported by further peat probing work. This should generally meet the requirements of the recognised best practice guidance however in this case, where the initial probing suggests much of the site is on shallow peat, we would be happy to agree a more proportionate approach.	The site layout was subject to detailed probing as illustrated on the figures included in Appendix A13.2: Outline Peat Management Plan and the site layout design sought to avoid any areas of dep peat where possible. Further consultation on site layout and peat took place following the detailed peat probing and is included in this section of the Chapter.

Consultee	Details	Where Addressed in EIA Report
SEPA Updated Scoping 11/11/19	In relation to our specific interest in peatland (and GWDTE, covered below) then we welcome the principle of proposals for peatland restoration of degraded bog as mitigation for impacts on bog habitats (and carbon storage). This is as long as the first principle of design is still avoidance of best quality habitat and deep peat in the first instance. We would welcome an approach which demonstrated an overall net benefit to peatland. We note that much of the site has man-made drains and a programme of ditch blocking may bring significant benefits. Proposals should be outlined in a draft Habitat Management Plan.	Details of the proposed peatland restoration considers the potential for ditch blocking will be included in a Habitat Management secured through planning condition if required.
SEPA Pre-application submission consultation 26/07/2020	SEPA email response PCS/165025 Further consultation with SEPA took place on site layout, peat and GWDTE's.	Comments from SEPA were considered when finalising the site layout. The Interpolated Peat depths are presented in Figure 13.5 of this chapter and details included in Appendix A13.1: Outline Peat Management Plan.

13.3.2 Scope of Assessment

The following effects on peat and geology resources related to the Development will be considered within the EIA due to the potential for significant effects as agreed during consultation, as summarised in Section 13.3.1.

- Potential for peat destabilisation and peat slide risk;
- Potential effects relating to peat disturbance and the subsequent effects from excavated peat and management of peat and peaty soils;
- Potential for compaction of superficial soils; and
- Potential for loss of important geological minerals.

This is assessed through technical assessment in the form of:

- Peat Slide Risk Assessment;
- Outline Peat Management Plan; and
- Outline engineering design of site layout and borrow pits.

The key sensitive receptors in the assessment are considered to be:

- Existing infrastructure in the form of tracks and footpaths and dwellings;
- Proposed infrastructure in the form of turbine foundation, crane hardstandings, tracks and other infrastructure;
- Sensitive areas of GWDTE's, blanket bog and other sensitive habitats; and
- Major and minor watercourses.

13.3.3 Elements Scoped Out of Assessment

Desk studies have not identified any areas of contaminated land within the Core Study Area. Should potentially contaminated land be encountered during excavations, appropriate action would be taken in accordance with The Environmental Protection Act 1990. As a result, potential effects arising from contaminated land have been scoped out of this assessment.

13.3.4 Study Area

The Study Area is the Site which is located approximately 18 kilometres (km) west of Thurso and approximately 2 km south-east of Melvich in Sutherland, Highland Council. The Site extents and location are shown on Figure 1.1 and 1.2. The Site ranges from approximately 186 metre (m) Above Ordnance Datum (AOD) in the east of the Site at Beinn Ruadh, generally sloping westward to 30 m AOD along the A897. The Site predominately comprises of open moorland used for rough grazing; there is a small area of improved pasture in the north-west and pockets of land grant woodland.

13.3.5 Design Parameters

The parameters of the design that will influence the Geology, Soils and Peat assessment in relation to physical effects has been based on the turbine layout and associated infrastructure. No additional design parameters, other than those set out in **Chapter 4: Development Description** of this EIA Report, are required for the assessment presented in this Chapter.

As set out in **Chapter 4: Development Description**, the turbines and associated infrastructure may be microsited up to 50 m, where constraints allow. Such relocations have been considered when undertaking the assessment, and mitigation recommended, where appropriate.

13.3.6 Baseline Survey Methodology

The assessment of peat and geology has included the review of publicly available information in relation to the current condition of the soils at the Site and the information is detailed in the baseline description. This was supported by detailed site walkover surveys. The information has been reviewed in the context of the Development to evaluate both short and long-term impacts.

The assessment has involved a review of the following data sources detailed below:

- National Soils Map of Scotland;
- Carbon and Peatland 2016 Map;
- British Geological Survey (BGS) Geoindex – Superficial Soils; and
- BGS Geoindex – Solid Geology.

Soil types are considered to be of high sensitivity where they are categorised as peat soils of high moisture content, such as those found in blanket bog.

The methodology employed for the Peat Slide Risk Assessment (PSRA) is in accordance with Energy Consents Unit (ECU) Scottish Government guidance. Using experience from other wind farm projects, the assessment endeavours to assess the effects on geology and soils either affected directly or indirectly by construction or operation of the Development.

13.3.6.1 Stage One Peat Probing

Initial phase one peat probing was carried out in 2019 in accordance with Scottish Government guidance with a 100 m grid carried out across the developable Site area and the information gathered to inform the preliminary site layout design.

13.3.6.2 Stage Two Peat Probing

Following design freeze, targeted peat probing was carried out across proposed infrastructure. This probing was generally at 50 m intervals along the centre line of the tracks with probes at 10 - 25 m on either side of the tracks to provide a corridor for micro-siting. In addition, probing at turbine locations were recorded at 10 m intervals.

It should be noted that the PSRA was undertaken on the findings of all phases of probing with focus on the Phase two peat probe data, as this was within the proposed infrastructure envelope. Details of the assessment are included in Appendix A13.1: Peat Slide Risk Assessment

13.3.7 Methodology for the Assessment of Effects

The assessment of effects is based on the final design of the Development detailed in **Chapter 4: Development Description** of this EIA Report. The assessment considers the sensitivity of the receptor and the magnitude of any potential change, to conclude whether the effect is significant.

13.3.7.1 Sensitivity of Receptors

The sensitivity of the receiving environment is defined as its ability to absorb an effect without perceptible change and can be classified as high, medium or low. These classifications are dependent on factors such as the nature and extent of peat, associated habitats, and soil characteristics as well as the Site geology and their purpose and existing influences, such as land-use.

Table 3.2 provides an overview of the different categories of sensitivity that are used within this chapter to inform the assessment of effects on existing geology and peat, identifying whether the effects would be significant under EIA Regulations.

Table 3.2: Receptor Sensitivity Criteria

Receptor Sensitivity	Sensitivity Description
High	• Soil type and associated land use are highly sensitive (e.g. peat/blanket bog); • Class 1 or 2 priority peatland, carbon-rich and peaty soils cover >20% of the Development Area; and • Receptor contains areas of regionally important economic mineral deposits.
Medium	• Soil type and associated land use are moderately sensitive; • Class 1 or 2 priority peatland, carbon-rich and peaty soils cover <20% of the Development Area, or Class 3 and 5 peatland areas, carbon rich and peaty soils; and • Receptor contains areas of locally important economic mineral deposits.
Low	• Soil type and associated land use not sensitive to change in hydrological regime (e.g. intensive grazing); and • Receptor contains Class -2, -1, 0, and 4 non-peatland areas, with no carbon-rich and/or peaty soils.

13.3.7.2 Magnitude of Change

The magnitude is determined by the timing, scale, size and duration of the potential effect resulting from the Development. The magnitude of potential effects can be classified as major, moderate, minor or negligible as outlined in Table 13.3.

Table 13.3: Impact Magnitude Criteria

Impact Magnitude	Description
Major	• Major or total loss of or alteration to peatland resource such that post development characteristics or quality will be fundamentally or irreversibly changed; • Long term /permanent change to baseline resource; and • Major or total loss of a geological site or mineral deposit, where the value of the site would be severely affected.
Moderate	• Loss of, or alteration to the baseline resource such that post development characteristics or quality will be partially changed; • Mid-term /permanent change to baseline resource; and • Partial loss of a geological site or mineral deposit, with major effects to the settings, or where the value of the site would be affected.
Minor	• Small loss of soils or peatland, or where soils will be disturbed but the value not impacted; • Short-term change to baseline resource; and • Small effect on a geological site or mineral deposit, such that the value of the site would not be affected.
Negligible	• Minimal or no change to soils or peatland deposits; • A very slight change from the baseline conditions. The change is barely distinguishable, and approximates to the 'no-change' situation; and • Minimal or no change to a geological site or mineral deposit.

13.3.7.3 Significance of Effect

The significance of the potential effect is broadly determined by correlating the sensitivity of the asset against the magnitude of the expected change as shown in Table 13.4 with the final conclusion of the significance of the effect informed by professional judgement.

Table 13.4: Matrix for Defining Significant Effects*

Magnitude of Effect	Sensitivity of Resource or Receptor				
	Very High	**High**	**Medium**	**Low**	**Negligible**
High	Major	Major	Moderate	Moderate	Minor
Medium	Major	Moderate	Moderate	Minor	Negligible
Low	Moderate	Moderate	Minor	Negligible	Negligible
Negligible	Minor	Minor	Negligible	Negligible	Negligible

*light grey shaded areas denote "significant" effects as per the EIA Regulations

13.3.8 Assessment Limitations

With exception of ornithological and ecological survey times, there were no assessment limitations in relation to the peat and geology.

13.3.9 Embedded Mitigation

Embedded mitigation measures are set out within the CEMP (provided as Appendix A4.1) which sets out specific mitigation which relates to this Development. They comprise good practice methods and works that are established and effective measures to which the Applicant will be committed through the planning consent.

Mitigation also takes place through embedded design of the site layout avoiding key environmental constraints including avoidance of deepest peat (i.e. no turbines sited in

peat > 1 m) or limiting the impacts on deep peat where possible, as well as taking cognisance of hydrological and ecological features and associated buffers.

The site layout design was presented through pre-application consultation to SEPA to illustrate how the site layout had considered the avoidance of deep peat where possible and how infrastructure sited in peat greater than 1.0 m where generally located within the shallowest peat possible. This consultation also illustrated the key constraints, such as watercourse buffers and GWDTE's.

13.4 BASELINE CONDITIONS

13.4.1 Published Geology

The baseline condition has involved a review of the following data sources detailed below:

- National Soils Map of Scotland;
- Carbon and Peatland 2016 Map;
- British Geological Survey (BGS) Geoindex – Superficial Soils; and
- BGS Geoindex – Solid Geology.

This published data is based on large scale mapping which does not necessarily consider the localised environment. Further works is detailed in Section 13.4.2 which documents the field survey and peat probing which provides a more detailed geological context of the local environs within the Site. Further details of baseline peatland habitats are also included in **Chapter 7: Ecology**.

13.4.1.1 Superficial Soils

Published geological mapping[10] of superficial soils indicates the majority of the Site by Glacial deposits, comprising of sand, gravel and boulders. Localised pockets of Peat were noted across the Site. Figure 13.1 illustrates the 'Superficial Soils'.

13.4.1.2 Bedrock Geology

Published bedrock geology mapping indicates the Site to be underlain by Migmatitic Psammite with Migmatitic Semipelite of Portskerra Psammite formation. Figure 13.2 illustrates the 'Bedrock Geology.

13.4.1.3 National Soils of Scotland

The following information is a summary of the information on soil units within Scotland's Soils, Scotland's Environment Website[11]. The majority of the Site is class 2 peatland with pockets of class 1 in the east and pockets of class 5 in the south-west. Figure 13.3 illustrates an extract from the 'National Soils of Scotland' map.

National Soils Map of Scotland mapping indicates peaty gleys with dystrophic blanket peat with peaty gleyed podzols.

A brief description of the characteristics and formation of component soil groupings is detailed below, described by Scotland's Soils Map, although these do not include information on depths or engineering properties:

- Blanket Peat: Poorly drained upland soil with an organic surface layer generally greater than 50 centimetre (cm) thick, unconfined 'blankets' the landscape;
- Podzols: Podzols are acid soils with a grey leached layer just below the surface and bright orangey-brown coloured subsoils and/or dark brown to black, organic rich subsoils;
- Gleys: Gleys are soils that are periodically or permanently waterlogged: and

[10] British Geological Survey Mapping Website http://mapapps.bgs.ac.uk/geologyofbritain/home.html Accessed 10/06/20)
[11] Scotland's Environmental Website: http://soils.environment.gov.scot/ (Accessed 10/06/2020)

- Brown Soils: Brown Soils are moderately acid soils with brown mineral topsoils and brown or yellowish subsoils.

13.4.1.4 Carbon-rich Soils, Deep Peat and Priority Peatland Habitats

The Carbon and Peatland Map (SNH, 2016) indicates the Carbon-rich soils and peatland importance categories to be:

- Class 1 - Nationally important carbon-rich soils, deep peat and priority peatland habitat. Areas likely to be of high conservation value;
- Class 2 - Nationally important carbon-rich soils, deep peat and priority peatland habitat. Areas of potentially high conservation value and restoration potential;
- Class 3 - Dominant vegetation cover is not priority peatland habitat but is associated with wet and acidic type. Occasional peatland habitats can be found. Most soils are carbon-rich soils, with some areas of deep peat;
- Class 4 - Area unlikely to be associated with peatland habitats or wet and acidic type. Area unlikely to include carbon-rich soils; and
- Class 5 - Soil information takes precedence over vegetation data. No peatland habitat recorded. May also include areas of bare soil. Soils are carbon-rich and deep peat.

Figure 13.4 provides the Carbon and Peatland 2016 Map extract which indicates at the macro level that the Site is identified as containing Class 1, Class 2 and Class 5 soils. Further peat survey was undertaken to better inform the localised geological and soil context of the Site. A summary of the peat survey is summarised in Section 13.4.2 and the details are included in Appendix A13.2: Outline Peat Management Plan. The appendix provides site-specific peat depth information which informed the design of the layout of the Development and the subsequent assessment of effects.

13.4.2 Peat (Site Specific Environs)

Peat is a sedimentary material, which is dark brown or black in colour, and comprises partially decomposed remains of plants and organic materials preserved in anaerobic conditions, essentially within a waterlogged environment. There are two principal types of peat:

- Acrotelm is the upper layer, quite fibrous and contains plant roots. Acrotelmic peat is relatively dry, generally lying above the groundwater table and has some tensile strength; and
- Catotelm is the lower layer of peat which is highly amorphous and has a very high water content. Catotelm generally lies below the ground water table and has a very low tensile strength.

Interpolation of these principle types are discussed further in the Appendix A13.2: outline Peat Management Plan.

13.4.2.1 Field Surveys

The desk-based assessment recorded the potential presence of peat and peaty soils in line with NatureScot data described above. The results of the peat probing indicated that peat was generally shallow across the Site, varying only with depth according to local topographical conditions, with pockets of deep peat situated in topographically flat areas or in the vicinity of bodies of water.

During the course of the works, a total of 2,684 probes were sunk within the study area. The peat probe locations and peat depth interpolation are shown in Figure 13.4 and further details on the peat probing included in Appendix A13.2: Outline Peat Management Plan Table 13.5 summarises the peat depth findings.

Table 13.1: Peat Depth Summary

Peat Depth Range (m)	No of peat probes	Percentage of Total (%)
0 – 0.50	1379	51.0
0.51 – 1.00	679	25.0
1.01 – 1.50	299	11.0
1.51 – 2.00	146	5.5
2.01 – 2.50	93	3.5
2.51 – 3.00	33	1.5
3.01 – 3.50	18	<1.0
3.51 – 4.00	7	<1.0
4.01 – 4.50	6	<1.0
4.51 – 5.00	3	<1.0
5.01 – 5.50	2	<1.0

Recorded peat depths averaged just over 0.75 m, with 51% less than 0.5 m and 76% less than 1.0 m. Peat greater than 1.0 m was localised, generally found in topographically low lying, flat areas.

The deepest pockets of peat were naturally encountered in the shallow/flatter topographical areas. The deepest depth was recorded as 5.3 m in one of the isolated hot spots in the southern site area, likely a result of a natural basin created by slopes. Deep peat was also recorded south and north-east in proximity to water bodies.

A more detailed representation of peat within the Site is available in Appendix A13.1: Peat Slide Risk Assessment and Appendix A13.2: Outline Peat Management Plan.

Table 13.6: Peat Depths Recorded at Turbines

Proposed Turbine No.	Average Peat Depths at 50 m Radius (m)
T1	0.44
T2	0.99
T3	0.43
T4	0.49
T5	0.61
T6	0.42
T7	0.62
T8	0.94
T9	0.45
T10	0.71
T11	0.4
T12	0.52

13.4.2.2 Peat Stability and Peat Management

The recorded peat depths, existing slope information and receptor data has been utilised to identify hazard areas in relation to peat slide risk. The assessment found that the majority of the Site lies within areas of Negligible or Low slide risk potential with localised areas of medium risk recorded 150 m south of the permanent met-mast, on the northern side of the Ackran Burn, and two separate localised areas in close proximity to each other 20 m and 350 m north-east of T10.

The peat depth data is utilised to calculate estimated peat excavation and re-use volumes based on an outline 3-D civil Site layout design. In this, rational options for reuse of excavated material and provides guidance on good practice storage and management of excavated material, including peat. Further details are provided in Appendix A13.2: Outline Peat Management Plan.

13.5 ASSESSMENT OF POTENTIAL EFFECTS

The effect of the Development on soils and geological receptors has been considered for the consideration of the construction and operation phases. Effects occurring during construction are considered to be short term effects, with those occurring as a result of the operational development being considered as long-term.

13.5.1 Potential Construction Effects

13.5.1.1 Disturbance of Deep Peat

Construction activities including excavation of tracks, turbine foundations and crane hardstanding and other infrastructure can lead to disturbance of peat. Beyond the main construction activities, other considerations include the formation of borrow pits and temporary storage of soils and peat on Site. The details of peat disturbance through excavations and subsequent re-use methods are included in Appendix A13.2: Outline Peat Management Plan**.** Figure 13.5 Interpolated Peat Depths illustrates the areas of deep peat.

All turbines have been sited in peat depths less than 1.0m as detailed in Table 13.6. Infrastructure associated with T2, T7, and T12 and tracks sections between T1 and T3, and T4 and T7 are impacting areas where peat depths were recorded up to 2.0 m at associated crane hardstands and up to 2.50 m across the track sections. It should be noted that the crane hardstands only encroach marginally in to the deeper peat areas identified. The Development has largely avoided areas of deep peat and track sections situated in areas of deep peat will be constructed using 'floating track' techniques.

The assessment of peat disturbance has highlighted only localised areas of deep peat at risk from the Development, with the deepest peat recorded outwith the footprint of the Development.

On this basis and in the absence of mitigation, the Development is considered to result in a potential minor effect that would be **not significant**, in accordance with the EIA Regulations.

<u>Peat Stability</u>

Peat instability is generally the result of a combination of causative factors. Several construction activities have the potential to increase the likelihood of peat slides in areas where peat is present at a sufficient depth and where gradients are sufficiently steep to result in a peat slide event.

Construction activities have the potential to increase the likelihood of peat slides by way of locating proposed infrastructure including track networks on sloping ground where peat is present. All construction activities involve the removal of surface vegetation and

excavation of peat and other near surface soils from the bedding surface of the underlying rock which naturally increases potential for slide.

Peat slides can affect soils, local sensitive habitats and have the potential to affect surface water systems from soil inundation, leading to sedimentation. This can have an effect by slip materials sliding onto areas of sensitive habitat, or causing damage to local surrounding surface soils and can also reduce water quality and/or modify drainage patterns. Receptors identified across the Development area are:

- Existing major and minor watercourses;
- Important Habitat (Blanket Sphagnum Bog (as identified in the **Chapter 7: Ecology**); and
- Proposed Wind Farm Infrastructure.

Peat depths are generally shallow, with depths less than 1.0 m recorded across most of the proposed Development. Localised deep pockets were recorded in areas of proposed tracks and on the periphery of the T2, T7 and T12 infrastructure. The peat slide risk assessment analysis has highlighted the Site to be of low or negligible hazard rank in terms of slide risk.

Since there are only localised areas of medium risk identified during risk assessment which are located outwith the main Development areas and the areas proposed for the Development itself were indicated to be of low or negligible risk from peat slide, in the absence of mitigation, the Development is considered to result in a potential effect of minor and would therefore not be significant, in accordance with the EIA regulations.

Good practice measures are embedded in the design principles and adoption of further best practices, as detailed in Appendix A4.1: Construction Environmental Management Plan (CEMP). By adopting the measures set out in the CEMP, the risk of peat instability will be further reduced.

Loss of Soils

In its regulatory position statement, SEPA states that:

"Developments on peat should seek to minimise peat excavation and disturbance to prevent unnecessary production of waste soils and peat".

The key items of infrastructure which influence this effect are the dimensions, location and type of new access tracks, turbine base foundations and crane hardstanding. Other features which should be considered for excavation requirements include borrow pits, substation and temporary construction compound facilities.

While the layout design process has sought to avoid most areas where deep peat is recorded, crane hardstand infrastructure associated with 3 turbines are located in deep peat as are localised tracks sections as detailed previously. Outwith areas of deep peat, the remainder of the soils are considered to be thin, in the region of 0.5 m to 1.0 m. See Figure 13.5 which illustrates the Interpolated Peat Depth. Further information on peat excavation is also included in Appendix A13.2: Outline Peat Management Plan which details the volumes estimated for excavated materials and re-use possibilities.

Given the majority of soils being affected by the Site are thin deposits, generally classified as either peaty or mineral soils, and soils would be reinstated fully within the areas of origination, the significance of effects associated with the loss of soils is considered to be minor and not significant, in accordance with the EIA regulations.

Loss and Compaction of Peat and Soils

In relation to compaction of soils, investigations at the Site have recorded generally thin soil cover across the majority of the proposed Development, and construction of access tracks and movement of construction traffic, in the absence of construction good practice,

could lead to the compaction of soil. This can reduce soil permeability, potentially leading to increased run-off and increased erosion. The superficial soils underlying the Development are of a varying permeability, so the effects of compaction could result in a significant increase in a runoff from existing conditions. The total surface area affected by the footprint of the proposed layout equates to approximately 157,500 m^2, just under 2.5% of the total Site area.

Therefore, in the absence of mitigation, the significance of effects associated with the compaction of peat and soils is considered to be Negligible and **not significant**, in accordance with the EIA Regulations.

13.5.2 Operational Phase

There would be minimal or no impacts upon peat and soils during the operational phase, and significant effects are not anticipated.

13.5.3 Decommissioning Phase

During decommissioning, the turbine foundation bases would be broken out to below ground level. All cables would be cut off below ground level, de-energised, and left in the ground. Access tracks would be left for use by the landowner. No stone would be removed from the Site. The decommissioning works are estimated to take six months. This approach is considered to be less environmentally damaging than seeking to remove foundations, cables and roads entirely.

Therefore, it is considered that decommissioning activities would be less intrusive with infrastructure in place for access meaning no or little requirement for further disturbance of peat, therefore no significant effects are anticipated.

13.6 ASSESSMENT OF CUMULATIVE EFFECTS

A cumulative effect is considered to be an additional effect on peat and geology resources arising from the Development in addition to the combination of other developments likely to impact the peat and geological environment.

However, peat depths across the Site were generally thin with only localised areas of deep peat (>1.0 m) affected by the Development infrastructure, and all peat excavated during construction will be suitably re-used in reinstatement and restoration as detailed in Appendix A13.2: Outline Peat Management Plan. In addition, it is considered that the borrow pits proposed will not impact any regionally important or economically important resources.

Therefore, for the purposes of the assessment of potential cumulative effects Geology and Peat is considered as a site-specific consideration, and there will be no cumulative effects.

13.7 MITIGATION MEASURES

Mitigation in relation to peat disturbance is initiated through embedded mitigation in design and adopting best practices during construction.

Mitigation proposed states that infrastructure associated with turbines which encroaches deep peat will be microsited (if possible) outwith these areas in order to reduce the overall effect on peat disturbance, stability and loss of soils. Micrositing limits are discussed in **Chapter 4: Project Description** Maintenance of existing drainage is critical to avoid compaction of soils, therefore, all existing drainage network channels would be maintained and, where necessary, channelled below the access track construction drainage ditches on the upslope of the track. Further details are provided in **Chapter 12: Hydrology and Hydrogeology** and in Appendix A4.1: CEMP.

Intrusive site investigations will take place will be undertaken following forestry clearance at turbine locations located within areas of peat.

Slope stability monitoring will occur during pre-construction and construction phases of work, including for both peat stability and non-peat related stability. These would focus on locations highlighted as being of risk in Appendix A13.1: Peat Slide Risk Assessment.

Best practice measures for managing excavated peat and peaty soils are detailed in Appendix A13.2: Outline Peat Management Plan.

13.8 RESIDUAL EFFECTS

Following the incorporation of mitigation measures as detailed on Table 13.6, residual effect associated with peat disturbance, peat stability and peat and soil losses will all be negligible.

With the mitigation proposed, the magnitude of effects on peat disturbance can be reduced from moderate to minor, and are therefore not significant in accordance with the EIA Regulations.

13.9 SUMMARY OF EFFECTS

This Chapter identified no likely residual significant effects, through inclusion of the measures as outlined in Table 13.7.

Table 13.7: Summary of Effects

Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Significance
Peat	Disturbance	Minor	Where possible micro-siting of turbines where associated infrastructure encroaches deep to reduce peat disturbance. Floating tracks in areas where peat is consistently 1.0m or greater. Best Practice Measures for avoiding peat and the management of peat and peaty soils. Additionally, peatland restoration is proposed in the Habitat Management Plan.	Negligible

Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Significance
Peat	Peat Stability	Minor	Where possible, micro-siting of turbines where associated infrastructure encroaches deep peat within micro-siting buffer to further reduce peat disturbance and in turn lessen any risk of peat instability. Floating tracks in areas where peat is consistently 1.0m or greater. Best Practice Measures for avoiding peat and the management of peat and peaty soils.	Negligible
Soils	Compaction of Peat and Soils	Negligible	None.	Negligible

13.9.1 Statement of Significance

This chapter has assessed the likely significance of effects relating to the Development on Geology, Soils and Peat. Given that only effects of moderate significance or greater are considered significant in terms of the EIA Regulations, the potential effects on Geology, Soils and Peat are considered not to be significant.