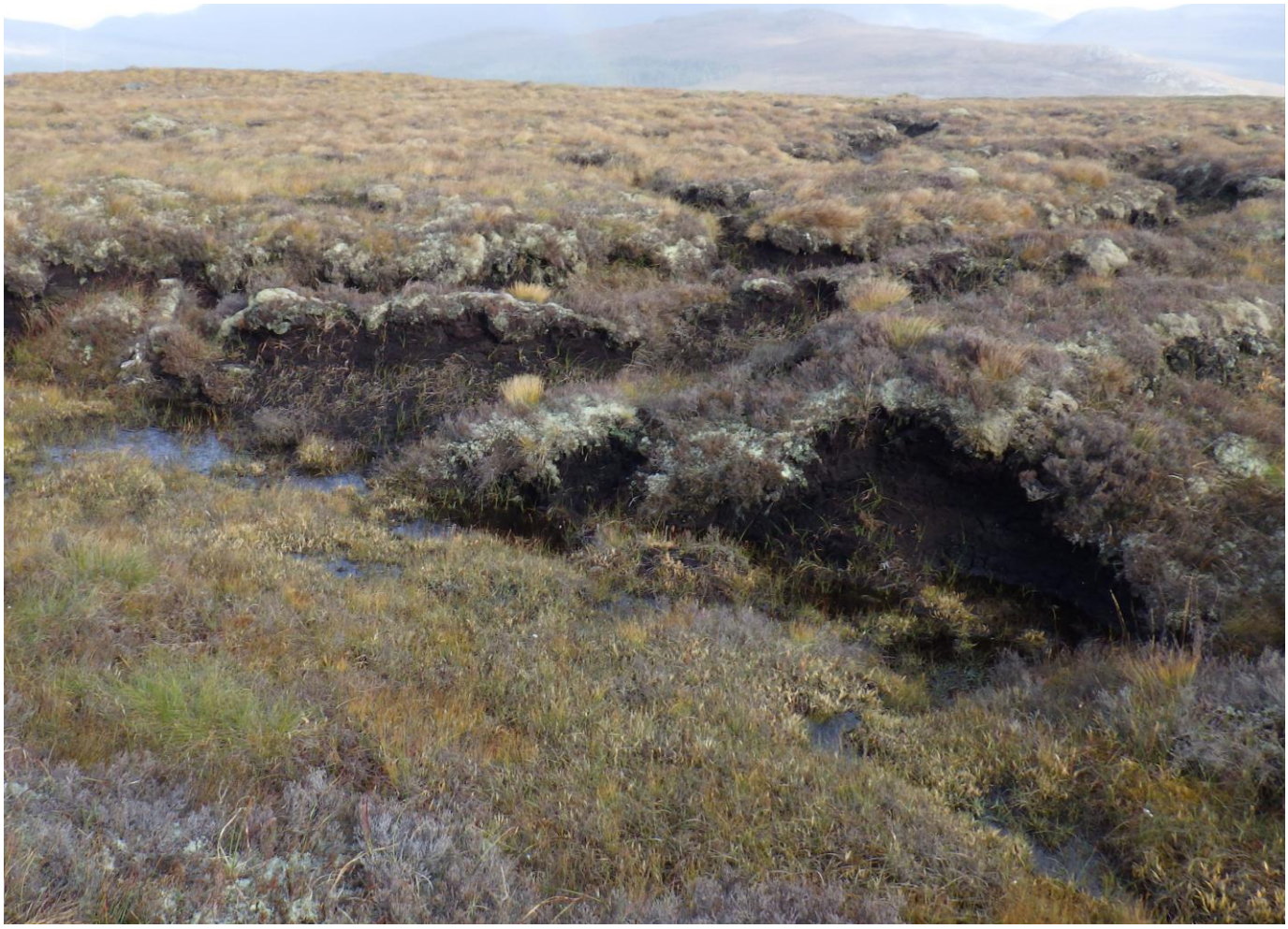

Renantis UK Limited

The Repowered and Extended Ben Aketil Wind Farm: Peat Slide Risk Assessment

Technical Appendix 9.1

663617-P9.1 (00)

MAY 2023

RSK GENERAL NOTES

Project No.: 663617-P9.1 (00)

Title: The Repowered and Extended Ben Aketil Wind Farm: Peat Slide Risk Assessment, Technical Appendix 9.1

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1 INTRODUCTION

1.1 This report provides a Peat Slide Risk Assessment (PSRA) for The Repowered and Extended Ben Aketil Wind Farm (hereafter referred to as the Proposed Development) and associated infrastructure.

1.2 The report forms a Technical Appendix to the Environmental Impact Assessment Report (EIAR) for the Proposed Development and should be read in conjunction with this document. It has been produced in response to concerns over development in areas of peatland relating specifically to the risk of induced instability within peat caused by the Proposed Development.

1.3 This report describes the existing peatland conditions within the application boundary (hereafter 'the Site') and identifies and assesses the potential impacts that may be caused by the proposed development. This includes potential risks from induced peat instability. Design and mitigation methods to avoid or minimise these risks are set out, along with a number of good construction practices that would be employed during all project works.

1.4 Within this report, the Study Area is considered to include the planning application boundary and an area up to 2 km from this boundary.

Site location

1.5 The Proposed Development is located on the Isle of Skye, the largest island of Scotland's Inner Hebrides, and part of the Highland Council area. The Site is situated approximately 15 km west of Portree, the Island's main settlement. The Site, within which the Proposed Development would be located, incorporates the existing Ben Aketil Wind Farm comprising twelve operational wind turbines and the associated infrastructure. Currently, access to the existing Wind Farm is gained from a track leading southwards from the A850, 2 km west of Edinbane.

1.6 The land within the Site slopes down from north-east to south-west, generally consisting of upland moorland habitat, rough grazing and watercourses, most notably the Caroy River in the western part of the Site. There is an area of commercial forestry to the north of the Site boundary through which the Northern Site Access track runs.

Development proposals

1.7 The Proposed Development infrastructure would include:

- decommissioning and removal of the twelve existing turbines and related infrastructure including hardstandings and the existing operational control building;
- erection of nine new turbines of approximately 5.6 to 6.6 MW each, with a maximum tip height of 200 m, a rotor diameter of approximately 140 m to 155 m and hub height of 115 to 122.5 m;
- hardstanding areas at the base of each turbine, each 3,820 m^2, with a maximum total area of 34,380 m^2;
- approximately 9 km of new track, of which 1.5 km will consist of floating track;

- approximately 2.3 km of upgraded track;
- two substations and associated compounds including parking and welfare facilities;
- an energy storage facility;
- up to six construction compounds;
- a storage bund area;
- two potential borrow pits, to provide suitable rock for access tracks, turbine bases and hardstandings; and
- underground cabling linking the turbines with substations.

1.8 Full details of the Proposed Development design are provided in **Chapter 2** of the EIAR.

Aims

1.9 This report aims to undertake a review of available relevant Site information, including all peat depth and peat condition records, in order to provide an assessment of the risk of peat instability within the Site. Recommendations will be made for mitigation measures and specific construction methods that should be implemented in order to minimise the risk of inducing instability in the peat during construction works and the process of decommissioning and removal of the existing infrastructure.

Assessment Method

1.10 The assessment has involved the following stages:

- desk study;
- site reconnaissance;
- peat condition assessment;
- hazard and risk assessment;
- detailed assessment; and
- mitigation identification.

2 DESK STUDY

Information Sources

2.1 The desk study involved a review of available information sources on the ground conditions at the Proposed Development. Information sources included:

- Ordnance Survey mapping at 1:50,000, 1:25,000 and VectorMap and Local raster mapping, Terrain 5 digital terrain model, and OpenData mapping;
- Historical OS mapping as available to view online;
- High-resolution orthorectified aerial imagery;
- British Geological Survey online geological mapping, 1:50,000 scale;
- Scotland's Soils digital mapping, 1:250,000 scale;
- Data provided by land owners and adjacent landowners;
- Data provided by the Client relating to wind farm and renewable energy development nearby;
- Archive data from local newspapers, as available online;
- Peat depth data collected by RSK;
- Archive and extensive site data held by RSK Group.

Historical Information

2.2 There are no available records that indicate any historical peat slides in and around the development area.

2.3 A detailed inspection of available current and historical satellite and aerial photography has been undertaken to identify any signs of recent or former peat or slope instabilities within the development area and its surroundings.

2.4 No indications of historical slope instabilities have been identified within the development area or immediate neighbourhood. Historical landslides are recorded along the A87 in September 2022 (ref) and near Kylerhea in December 2019 (ref); these were not peat slides, but were rather debris slides in response to significant wet weather.

2.5 In addition, the Quiraing and Storr area on the Trotternish peninsula, near Staffin, is known to consist of a series of landslides. These events have given rise to the spectacular landforms in this area. The landslide complex is no longer active and dates to the period after the last glaciation, approximately 13,000 to 5,000 years ago, although smaller-scale slope movements continue to occur, causing ongoing problems with subsidence in roads and other local infrastructure. This area is approximately 20 km north-east of the Site.

Climate

2.6 The Proposed Development is located adjacent to the existing Ben Aketil Wind Farm on the Isle of Skye, an island located off the west coast of Scotland. The Isle of Skye is part of the Highland Council area and is situated within the UK Meteorological (Met) Office's Northern Scotland climatic region (Met Office, 2023). Much of Northern Scotland is exposed to the rain-bearing westerly winds associated with Atlantic depressions which

pass close to, or across the UK, particularly the Western Isles and the west coast. The western part of Northern Scotland has an average annual rainfall of at least 1,700 mm.

2.7 The Proposed Development is approximately 10 km south-west of the Skye Prabost climate monitoring station. Average annual rainfall from 1991-2020 for the Prabost monitoring station is 1769.05 mm compared with 1702.52 mm for the Northern Scotland climatic region (Met Office, 2016; Met Office, 2023). The Prabost monitoring station is located at an altitude of 67 m above Ordnance Datum (AOD).

Topography and Geomorphology

2.8 Slope and geomorphology mapping are provided in **Figures 9.1.1** and **9.1.2.**

2.9 The Proposed Development lies on relatively low undulating ground which slopes gently from north-east to south-west. Elevations range from <5 m AOD in the southernmost part of the Site, to 268 m AOD near the eastern margin.

2.10 The highest point within the Site is the peak of Ben Aketil on the eastern margin of the Site at 268 m AOD. From Ben Aketil, the ground slopes down to the north, west and south. The westernmost part of the site begins to rise again on the western side of the Caroy River. The southernmost part of the site is just above sea level, near where the Caroy River flows into the sea loch Loch Caroy.

2.11 The Northern Site Access slopes down from the existing Ben Aketil Wind Farm and joins the A850 at approximately 50 m AOD.

2.12 Within the main part of the Site, the existing Ben Aketil Wind Farm lies along a shallow ridge that runs from Ben Aketil and Ben Sca (283 m AOD), north-westwards towards Ben Horneval (264 m AOD) and Strone Geers (185 m AOD). This ridge forms a watershed between the Caroy River, draining southwards, and the Red Burn, draining northwards.

Geology

2.13 Geological information is derived from the British Geological Survey (BGS) GeoIndex online geological mapping at 1:50,000 scale and the BGS Lexicon of Named Rock Units (BGS, 2023a & b). Geological mapping is shown in **Figures 9.1a** and **9.1b** of the EIAR.

Bedrock geology

2.14 The Site is underlain by basalt lavas from the Skye Lava Group varying in composition from alkali basalt to hawaiite and mugearite, all of Palaeogene age. Some lavas include larger crystals of feldspar and are described as feldspar-phyric. The majority of the bedrock has a finely crystalline and relatively uniform texture and dark grey to brown colour.

2.15 A series of dykes is present across the Site. These form part of the North Britain Palaeogene Dyke Suite and consist of basalt and microgabbro. The dykes all trend in a north-west to south-east direction and are associated with the Skye Central Complex that forms the Cuillin hills.

2.16 The area is cut by a series of north-west to south-east trending extensional faults cross-cut by later north-south or north-east to south-west trending faults, relating to a period of

folding and basin formation. The faults are not geologically active and recent seismic activity in the area is very limited.

Superficial geology

2.17 Superficial deposits are dominated by peat, which is mapped as a blanket over the majority of the site. Some areas are indicated to have diamicton till, of Devensian age. Till is a very variable glacial sediment consisting of unsorted material ranging in size from clay to boulders, with a matrix of clay to sand. It is usually overconsolidated and has limited or no re-working by water from the glacier or other sources.

2.18 Alluvial deposits are present along the main watercourse valleys, notably the Caroy River, and consist of clay, silt, sand and gravel. Small alluvial fan deposits are present in locations where alluvium has been reworked by tributary streams.

2.19 The lower part of the Caroy River, near the coast, includes raised marine beach deposits and marine beach deposits, mainly gravel and sand and may contain shelly fragments.

Soils and peat

2.20 The Soil Survey of Scotland digital soils mapping indicates that soil coverage within the Proposed Development predominantly consists of peaty gleys with some blanket peat and brown earth soils (Soil Survey of Scotland, 1981).

2.21 The peaty gleys, from the Darleith Association, are described as peaty gleys and peat with some peaty podzols. These are wet soils with an organic (peaty) surface layer and impeded drainage.

2.22 Two areas of blanket peat are indicated, one in the northern part of the Site around the headwaters of the Caroy River and across the watershed into the Red Burn catchment, including much of the Northern Site Access route, and the second on the southern slopes of Ben Aketil in a col around Cnoc a' Chrochaire. Blanket peat is poorly drained, acidic and nutrient poor upland peat soil which contains no mineral layer within 0.5 m of the surface.

2.23 Brown earth soils of the Darleith Association are focused in and around the main Caroy River valley, with one area in Gleann Eoghainn near the Caroy River headwaters and the second in Glen Heysdal extending south to the coast.

2.24 Further details on soils found within the Proposed Development are provided in **Table 9.1.1**.

Table 9.1.1: Soil Types within the Proposed Development

Soil Assoc.	Parent Material	Component Soils	Landforms	Vegetation	Area %
Darleith	Drifts derived from basaltic rocks	Peaty gleys with dystrophic blanket peat	Terraced hills with gentle and strong slopes: slightly to moderately rocky	Wet heathland and rough grassland communities	80
	Drifts derived from basaltic rocks	Brown earths	Hills/valley sides, frequently terraced, gentle and strong slopes: slightly rocky	Supports better quality grassland	10

Soil Assoc.	Parent Material	Component Soils	Landforms	Vegetation	Area %
Organic Soils	Organic deposits	Dystrophic blanket peat	Uplands and northern lowlands with gentle and strong slopes	Mire and blanket bog plant communities/ low quality grazing	10

2.25 NatureScot's Carbon and Peatland map (Scotland's Soils, 2016) has been consulted to understand the carbon-rich soils, deep peat and priority peatland habitat within the Application Boundary. The map classifies soils into five carbon classes, as well as three for mineral soils, non-soil or unknown. Classes 1 and 2 are considered to be nationally important carbon-rich soils.

2.26 The majority of the Site has been assigned Class 1 soil, with small pockets of Classes 2, 3, 5 and 0. Class 1 indicates that the majority of the Site is likely to be of high conservation value.

2.27 Details of each soil and peatland class and the associated area are provided in **Table 9.1.2**. Soils and peatland are shown on **Figure 9.2** of the EIAR.

Table 9.1.2: Carbon and Peatland Classes Present Within the Proposed Development (Scotland's Soils, 2016)

Peatland class	Description	Area %
Class 1	Nationally important carbon-rich soils, deep peat and priority peatland habitat. Areas likely to be of high conservation value.	86.8
Class 2	Nationally important carbon-rich soils, deep peat and priority peatland habitat. Areas of potentially high conservation value and restoration potential.	0.6
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.	1.4
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.	1.3
Class 0	Mineral soil - Peatland habitats are not typically found on such soils.	9.8

2.28 There is evidence of modification to peatland areas within the Site, particularly in areas associated with the existing wind farm and associated infrastructure. Commercial forestry and cutting of channels to improve drainage provide further evidence of modification to the peatland areas in and around the Site.

2.29 A Phase 1 peat depth survey of the Site was undertaken in June 2022. A Phase 2 peat depth and condition survey was undertaken in August and November 2022 for areas of proposed infrastructure and access tracks.

2.30 The combined peat depth surveys include a total of 1,331 individual peat depth records. The surveys indicate that peat depth is variable across the Site. One extended area of deep peat is found in the north-west near the new Turbine 2. Other areas of deep peat (2.0 m or deeper), appear to be associated with watercourses or areas with shallow gradient within the Site but are not typically extensive.

2.31 Peat is largely absent from the southern access route, although some pockets of peat are present. Peat is present along the Northern Site Access although is mainly <1.0 m in thickness.

2.32 Further details of peat depth and peat depth variation are provided in **Technical Appendix 9.2**. Maps of the peat depth distribution within the Proposed Development are provided in **Figures 9.1.3a-b**.

Hydrogeology

2.33 The Site is underlain by bedrock forming part of the Skye North groundwater body. This is classed as a low productivity aquifer with small amounts of groundwater in the near-surface weathered zone and secondary fractures. Flow is virtually all through fractures and discontinuities (Scottish Government, 2023).

2.34 The Skye North groundwater body is considered to have good water quality and is in good overall status (Scottish Government, 2023).

2.35 Regional groundwater flow will tend to mimic the natural topography, predominantly flowing south and west from the slopes of Ben Aketil toward the Caroy River and Loch Caroy. In the area around the Northern Site Access, groundwater flow would mainly be towards the north-west and the Red Burn.

2.36 The superficial deposits within the Site are predominantly peat. Peat bodies will hold some groundwater but drainage is impeded and poor. Flow within peat is known to be extremely slow, although it can contribute some limited baseflow to local streams and burns. The diamicton till, alluvium and alluvial fan deposits may hold groundwater but their restricted area indicates that they would not be able to hold significant volumes.

2.37 There are no superficial aquifers within the application boundary.

Hydrology

2.38 The Site lies between two main catchment areas: the Caroy River and the Red Burn. The catchment areas are shown in **Figure 9.4**.

2.39 The majority of the Site lies within the Caroy River catchment. The north-west of the Site lies within the Red Burn catchment.

2.40 The catchment wetness index (PROPWET) for both Caroy River and Red Burn is 0.73, indicating soils in the Site are wet for 73% of the time. The area has a baseflow index (BFI HOST19) of between 0.258 and 0.259, indicating a low input of groundwater baseflow to surface watercourses. The standard percentage runoff (SPR HOST) is 55-57%, indicating that this percentage of rainfall on site is converted into surface runoff from rainfall events; this represents a high runoff where soils have a limited capacity to store rainfall and/or a slow infiltration rate and will quickly saturate, leading to rapid runoff.

2.41 Catchment statistics derived from the Flood Estimation Handbook Web Service are provided in **Table 9.1.3**. Catchment statistics have only been provided for the main catchments within the site.

Table 9.1.3: Proposed Development catchment statistics (CEH, 2023)

Catchment Name	Catchment Wetness Index (PROPWET)	Base Flow Index (BFI HOST19)	Standard Percentage Runoff (SPR HOST)	Site Area %
Caroy River	0.73	0.259	55.45 %	86.6
Red Burn	0.73	0.258	57.07 %	10.0
Allt nan Cat	Not available			3.4

Aerial Photography

2.42 The high-resolution orthorectified colour aerial imagery from ESRI has been used for this assessment (ESRI 2023) with additional information from Google maps and Bing maps.

2.43 The Site is dominated by dark and mid-brown areas, with some patches of light brown or tan, areas of pale to mid-green and some very dark green sections.

2.44 The very dark green sections are around the Northern Site Access and indicate areas of conifer forestry plantation.

2.45 The pale and mid-green areas are mainly sinuous in the northern part of the Site, becoming more dominant as rectangular areas in the southern section. These green areas are mainly associated with watercourses and drainage channels, indicating flush zones and areas with good natural drainage, with the brighter green areas in the south identifying enclosed fields and improved pasture. Some of the green areas are native woodland associated with watercourse valleys.

2.46 The varying shades of brown are indicative of the dominant blanket bog vegetation that characterises the main part of the Site. The darker brown areas identify thick heather growth. Areas of mid-brown represent mixed heather, sedge and grass vegetation. Light brown or tan areas are dominated by sedges and grasses with limited or no heather. These colours often form a mosaic with a highly variable pattern of vegetation that changes frequently.

2.47 Some patches of irregular very dark brown indicate areas of peat hagging. These patches look to be naturally occurring and are not extensive. The hagged areas tend to be irregular in shape with the erosion channels appearing strongly sinuous and narrow.

Vegetation

2.48 Most of the Site is dominated by blanket bog habitats, characterised on the ground by grass-dominated vegetation in better-drained areas and heather moorland with interspersed *Sphagnum* mosses in areas where conditions are wetter.

2.49 The Southern Site Access is a mixture of improved grassland, semi-improved grassland and marshy grassland, with improved grassland habitats in the lowest lying areas near the proposed Site entrance and marshy grassland becoming more dominant upslope nearer the Developable Area. The existing Northern Site Access Track runs through an area of commercial forestry.

3 SITE RECONNAISSANCE

3.1 A walkover survey was undertaken by RSK in November 2022. The scope of the survey included a reconnaissance survey of the Site and its immediate surroundings, plus mapping of the geomorphology and local-scale hydrology of the Site. The survey covered the entire Site, with a particular focus on the Developable Area, where infrastructure is planned, and potential access routes into and across the Site. The weather during the survey was variable, with clear sunny but windy weather with excellent visibility on the first day and heavy rain and strong winds with poor visibility on the second day.

3.2 The areas described below provide good coverage of the Site, detailing the range of landforms, vegetation and erosion patterns encountered.

3.3 Reference is made to peat hagging, a form of erosion specific to peat. The peat develops channels which form breaks in the surface vegetation, exposing bare peat surfaces which are then more susceptible to erosion. Over time, this can lead to the development of a network of complex and sinuous channels through the peat and can lead to the formation of isolated peat 'islands'. In extreme situations, the peat body can be completely removed to leave bare mineral soil. Peat hagging is a natural process but can be exacerbated by poor land management practices including overgrazing and trampling from deer, sheep and cattle, extensive muirburn from grouse moor management, and uncontrolled off-road vehicle activity.

3.4 There is relatively limited peat hagging at the Site, with some patches occurring in the developable area due south of Turbine T3 and west of Turbine T4. The majority of the Site shows limited or no peat hagging.

A) View along existing wind farm looking NW, NGR NG 3243 4708

Photograph shows a typical view of the northern part of the Site looking along the line of the current Ben Aketil Wind Farm. Vegetation is a mix of heather, sedges, grasses and *Sphagnum* moss.

Peat depths in this area vary from <0.5 to >3.0 m. Most peat is less than 1.5 m, although deeper peat around 2.0-2.5 m is present in the flat area immediately right of the turbines.

	**B) View SW across the Developable Area, NGR NG 3167 4811** Photograph shows a view across the Caroy River valley from the existing wind farm substation. The existing export power line is visible across the photograph. Vegetation here is dominated by heather in the mid-ground, becoming more grassy and sedge-rich on the lower slopes. Pale areas in the distance identify drainage channels. Peat in this area is very variable. The foreground has no peat, although peat up to 4.3 m has been recorded on the flatter ground in the middle distance.
	**C) View along Northern Site Access from the Site entry, NGR NG 3175 4819** Photograph shows the existing access track leading away from the Site, and the area of commercial forestry plantation. Peat in this area is mostly shallow (<1.0 m) although a pocket of peat up to 2.2 m has been identified in the mid-ground area, before the forestry margin.
	**D) View SE along the existing wind farm to Ben Aketil, NGR NG 3052 4881** Photograph across the headwaters area of the Caroy River, showing the forestry plantation to the north and the northern part of the Developable Area. Peat in this area is deep, notably in the flatter ground around the Caroy River headwaters, with records up to 5.4 m.

	**E) View E across the Developable Area to Ben Aketil, NGR NG 3030 4805** Photograph showing most of the Developable Area and the existing Ben Aketil Wind Farm. Paler green channels mark principal drainage paths. Much of the vegetation is characterised by heather moorland. Peat in this area is very variable. The foreground area has no peat, but pockets of peat >3.0 m are present across the area.
	**F) View NW across the Developable Area, NGR NG 3185 4665** Photograph showing the southern part of the Developable Area, plus one of the drainage ditches within the peat. Vegetation is characterised by sedges, grass, *Sphagnum* mosses and some heather. Peat in this area is variable. Much of the area has no peat, or peat <1.0 m. Pockets of deeper peat, up to 2.0 m, are present in the mid-view area.
	**G) View S along the Caroy River, NGR NG 3069 4698** Photograph looking south along the Caroy River channel. The channel has been modified and straightened in this area. Riverside vegetation is characteristic of the rocky channel, with grass and rushes dominating. Peat in this area is typically absent or shallow (<1.0 m) in the areas adjacent to the river, with some records >1.0 m set back from the main channel.

	**H) View S along the Aketil Burn to the Caroy River and the coast, NGR NG 3029 4493** Photograph across the confluence of the Aketil Burn and Caroy River, showing the rough grazing and improved pasture in this area. This part of the Site is largely without peat. Some small pockets of peat <1.0 m have been identified but are typically small and isolated.
	**I) View NE along the existing Northern Site Access, NGR NG 3189 4826** Photograph along the existing access track into the Site, showing the forestry plantation and track margins. A crossing of the Allt a Choire is visible in the foreground. Peat in this area variable, mainly <1.0 m but with some records up to 2.0 m. It is possible that the deeper areas reflect peat relocated to permit construction of the access track.
	**J) View W along the A850 showing the existing track entrance splay, NGR NG 3241 5116** Photograph showing the entry to the Ben Aketil Wind Farm track from the A850. The forestry plantation is visible at the left side of the photograph. Peat in this area is mainly <1.0 m with occasional deeper pockets up to 1.8 m. Some of the deeper peat records may reflect relocated as part of the track construction process.

4 MAPPING

Peat Depth Survey

4.1 Some peat survey information was already available for the Site, collected prior to RSK's commission and provided by the Developer. This information covered approximately 50% of the Developable Area, excluding the existing Ben Aketil Wind Farm, and a corridor for a proposed southern access.

4.2 Additional Phase 1 peat depth surveying was undertaken by RSK in June 2022. This was required to cover the remaining part of the Developable Area, including the area around the existing Ben Aketil Wind Farm. These datasets were combined to develop a picture of the overall pattern of peat development across the Developable Area. The survey results were used to inform the infrastructure design through minimising incursion into areas of deeper peat.

4.3 A subsequent phase of peat depth surveying was undertaken by RSK in August 2022, with a supplementary survey taking place in November 2022. For this Phase 2 survey, peat depths were recorded at 50 m intervals along the proposed tracks, crosshair probing at turbine base locations and in grids across hardstanding areas, site compounds, substations and borrow pit areas. Offset records were made alongside existing tracks that may require widening as part of the Proposed Development and in some areas alongside proposed new tracks.

4.4 Peat probing point locations were recorded using a handheld GPS or GPS-enabled tablet with typical accuracy of ±5 m and peat depths were measured to an accuracy of ±0.05 m. All measurements were recorded to full depth/depth of refusal.

4.5 The peat survey results are summarised in **Table 9.1.4**.

Table 9.1.4: Summary of Peat Depth Probing Results

Peat Depth Range (m)	No. of Points	Percentage of Points
0.00	23	1.7%
0.01 – 0.50	428	32.2%
0.51 – 1.00	429	32.2%
1.01 – 1.50	207	15.6%
1.51 – 2.00	115	8.6%
2.01 – 2.50	66	5.0%
2.51 – 3.00	30	2.3%
3.01 – 3.50	19	1.4%
3.51 – 4.00	9	0.7%
4.01 +	5	0.4%
Total:	**1331**	**100%**

4.6 The peat depth survey indicates that approximately a third of the site has no peat, with 33.9% of the measured locations having topsoil or peaty soil cover up to 0.5 m deep.

81.7% of the area has peat depths of 1.5 m or shallower. 9.7% of the site has very deep peat (>2 m) and the deepest recorded depth was 5.4 m.

4.7 The peat depth surveys and reconnaissance survey all confirm that peat is present in the area but much of the peat present is shallow (between 0.5 and 1 m) in depth. The Southern Site Access track is almost entirely without peat except for a few isolated patches. A larger concentrated area of deep peat is found in and around the proposed Turbine T2 and the existing wind farm tracks to either side of it. There are isolated patches of deep peat found near Turbines T9 and T7. Further pockets of deep peat are found along areas of proposed new and existing tracks, but these are not extensive. Much of the remaining infrastructure is proposed in areas where peat depths are less than 2 m deep.

Indicative Peat Depth Mapping

4.8 Indicative peat depth maps for the study area are provided in **Figures 9.1.3a and 9.1.3b.**.

4.9 The combined peat depth survey results were used to produce an extrapolated indicative peat depth map for the study area. The extrapolated peat depth map was produced using a Gravity interpolation across the survey area with a 10 m cell size.

4.10 The advantage of using digital interpolation is that the process is fully objective and there can be no subjective influence. However, the process is not able to allow for known variation in peat development in varying topographical settings. As a result, there may be over-estimation of peat development in areas of steep or well drained ground, and potential under-estimation of peat development in the flatter or poorly drained areas. Owing to good resolution of the underlying data, the interpolation appears largely to give a representative indication of peat depth across the study area.

Peat Sampling and Analysis

4.11 Peat core samples were taken at three locations and the peat cores were logged using the modified Von Post humification and wetness scale. Core logs and photographs are provided in Annex 1.

4.12 Three peat core samples were sent for analysis by Envirolab. Analysis results are provided in **Table 9.1.5** and sampling locations are shown on **Figure 9.1.3a.**

Table 9.1.5: Peat Sample Analysis Results

Client Sample ID	Units	Limit of Detection	Method	C1	C2	C3
Depth to Top				1.60	1.15	1.00
Depth to Bottom				1.90	1.35	1.20
Date Sampled				01-Nov-2022	01-Nov-2022	02-Nov-2022
Sample Type				Soil	Soil	Soil
% Moisture at 105°C	% w/w	0.1	A-T-044	71.3	71.8	68.3
% Stones >10mm	% w/w	0.1	A-T-044	<0.1	<0.1	<0.1
Total Carbon	% w/w	0.1	A-T-032s	50.9	51.1	28.2
Wet weight of soil	g			221.1	140.6	197.4
Dry weight of soil	g	0.1		23.4	21.7	15.1
Bulk density	g cm^{-3}			0.69	0.66	0.93

5 PEAT CONDITION

Developments on Peat

Definition of Peat

5.1 Scotland's Soils (2018a) classifies peat as:

> *An accumulation of partially decomposed organic material, usually formed in waterlogged conditions. Peat soils have an organic layer more than 50 cm deep from the soil surface which as an organic matter content of more than 60%.*

5.2 Organic soils which are 50 cm or thinner can also support peatland vegetation and as a result are also considered within Scotland's broader peatland system in Scotland's national Peatland Plan (NatureScot, 2015). These are often described as 'peaty gleys' or 'peaty podzols', reflecting key aspects of the underlying soil. Peaty soils have a higher plant fibre content and are less decomposed than peat.

5.3 Active peatland typically consists of two layers; the surface layer or *acrotelm* and the deeper layer or *catotelm*. The acrotelm contains the living vegetation and consists of living and partially decayed plant material. It typically has a low but variable hydraulic conductivity and allows some through-flow of water within the plant material. The underlying catotelm is denser, with a very low hydraulic conductivity, and is formed from older decayed plant material. The catotelm varies in structure, in some areas retaining a proportion of fibrous material and in other areas being more humified and amorphous. The degree of humification typically increases with depth.

5.4 Underneath the peat-forming layers, the basal substrate can be a mineral soil, a superficial deposit such as glacial material, or bedrock. There may be a transition zone through a mineral-rich peaty layer at the base of the peat, although this is usually no more than 5 cm in thickness.

Importance of Peat

5.5 Peatland forms a key part of the Scottish landscape, covering more than 20% of the country's land area, and forming a significant carbon store (Scotland's Soils, 2018b). In addition, peatland is an internationally important habitat.

5.6 Active and healthy peatlands develop continuously, removing carbon dioxide from the atmosphere and storing it within the peat soil. Peatland protection and restoration form key parts of the Scottish Government's Climate Change Plan, which targets restoration of 250,000 ha by 2030 (Scottish Government, 2018). As of March 2020, over 25,000 hectares of peatland had begun restoration, and in 2020 the government announced a £250 million ten-year funding package to support the restoration of degraded peat (Scottish Government, 2020). Restoration will need to be conducted at a faster pace to reach targets.

5.7 It is therefore important that developments in peatland areas take recognition of the importance of peatland as a habitat and carbon store. Careful planning of developments, and careful infrastructure design, can remove or minimise the disturbance of peat that would be needed to allow the development to proceed.

Peat Condition Survey

5.8 As part of the peat depth surveys, information was collected concerning the condition of the peat present within the Site. NatureScot recognises five categories of peatland condition: (1) Near-natural; (2) Modified; (3) Drained; (4) Actively eroding; and (5) Forested/Previously Afforested (NatureScot, 2018).

5.9 As the Proposed Development is principally within near-natural upland moorland, the majority of the area falls into categories 1 and 2. There are some areas where attempts at drainage have been made (category 3; **Photograph 9.1.1**) and others where active peat erosion is ongoing (category 4; **Photograph 9.1.2**).

5.10 The area including the existing Ben Aketil Wind Farm would mostly be classed as a mix of categories 2 and 3 (**Photograph 9.1.3; Photograph 9.1.4**).

5.11 The forestry plantation around the Northern Site Access would fall into category 5. This category would also include areas of woodland within the southern part of the Site.

Photograph 9.1.1: Drainage ditch on the lower slopes of Ben Aketil, looking SE from NGR NG 3182 4666.

Photograph 9.1.2: Area of bare peat showing signs of active erosion, NGR NG 3222 4752.

Photograph 9.1.3: Modification and drainage associated with the existing Ben Aketil Wind Farm. View shows access and part of the crane pad for one of the operational turbines. View NW from NGR NG 3168 4815.

Photograph 9.1.4: Modification and drainage associated with the existing Ben Aketil Wind Farm. View shows access tracks with associated drainage and modified verges. View NW from NGR NG 3142 4819.

Peatland Restoration

5.12 An area of the Site south of the Rageary Burn has been identified as potentially suitable for peatland and habitat restoration. This area includes some drainage ditches, areas of burned heather (muir burn) and some actively eroding peat. Restoration work would aim to bring more of the peat bodies into near-natural condition and to prevent further erosion.

5.13 This may include blocking of natural or artificial drainage channels to encourage re-wetting and regrowth of *Sphagnum* species, the use of geotextile and/or mulches to prevent erosion and encourage natural regrowth of vegetation, and/or the exclusion of grazers through fencing.

5.14 Peatland restoration proposals for the Proposed Development are discussed in **Technical Appendices 9.2 (Peat Management Plan)** and **Technical Appendix 7.6 (Outline Habitat Management Plan)**.

6 HAZARD AND RISK ASSESSMENT

6.1 For the purposes of this peat slide risk assessment, the following definition of risk has been adopted:

Risk = Probability of a Peat Landslide x Adverse Consequence

6.2 Probability, or likelihood, can be estimated in a number of ways and should take account of both natural factors and man-made or man-imposed factors that could influence slope stability. Man-made or man-imposed factors can include overgrazing from over-stocking, excavation of drainage ditches or grips, or heather burning for land management purposes. Natural factors can include extreme weather events such as very high intensity rainfall, or prolonged dry periods followed by storms.

6.3 The methods of assessment of likelihood and adverse consequence used here are described below.

Assessing Likelihood

6.4 As peat slope failures are mainly considered to resemble planar translational slides, the assessment of likelihood of a peat landslide makes use of the Infinite Slope Model (Boylan & Long, 2014) to assess stability of the peat across the slopes in the Site, in line with the Scottish Government guidance (Scottish Government, 2017). The Infinite Slope Model assesses slope stability by calculating the forces resisting failure (shear strength or cohesion) and the forces inducing failure (shear stress) and taking a ratio of these, known as the Factor of Safety. The modified Infinite Slope Model equation is as follows:

$$F = \frac{c'}{\gamma\, z \sin\beta \cos\beta}$$

where
- F = Factor of Safety, the ratio of forces resisting a slide to forces causing a slide
- c' = undrained shear strength of the material; kPa
- γ = specific weight of peat, undrained in situ; kN/m^3
- z = peat depth; m
- β = slope of ground surface, assumed to be parallel to the slope of the failure plane; degrees

6.5 If F > 1, the slope is stable; if F < 1 the slope is unstable; if F = 1 the forces are exactly balanced. It is possible to state with some confidence, therefore, that if F > 1.3 the slope is stable and would have some resistance to change.

6.6 Values assigned to the parameters are provided in **Table 9.1.6**, along with an explanation for their election.

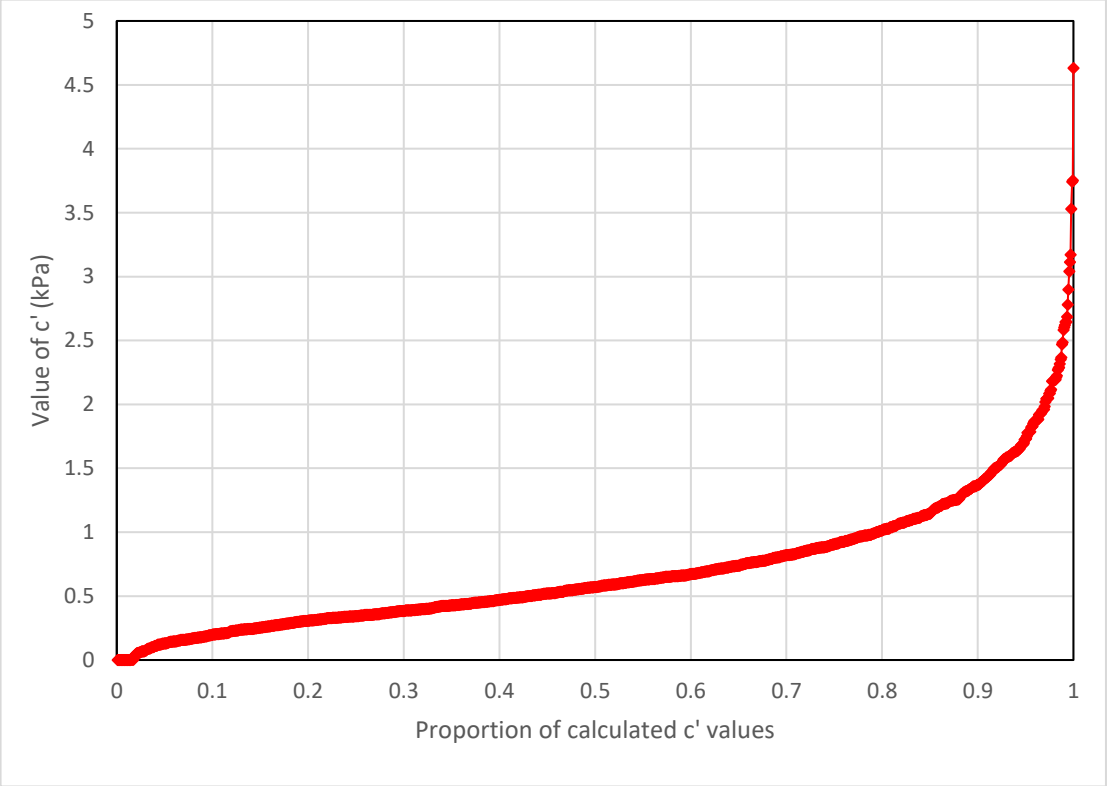
Table 9.1.6: Parameters for the Infinite Slope Model

Parameter	Value and Derivation
F	Calculated value
c'	4.6 kPa Published shear strength values for peat vary from 4.5 to 60 kPa or more (e.g. Long, 2004). Published values from recent field tests tend to cluster between 10 and 20 kPa with some higher and lower values recorded. The selected value represents the maximum of a black-calculated minimum c' (see explanation below).
γ	9.12 kN/m^3 Derived from density of peat multiplied by acceleration due to gravity (9.81 m/s^2). Density of peat varies depending on degree of decomposition and water content; published values range from 500 to 1,400 kg/m^3. This value is derived from peat core samples collected from the Development which provided a value of 930 kg/m^3.
z	Where available, measured peat depths have been used. For grid analysis, the maximum interpolated depth within the grid has been taken to provide a conservative estimate.
β	Slope angles have been derived from the DTM for the Site. Grid cell slopes were all derived from the Site DTM. The DTM used for slope angle generation has a resolution of 5 m. The slope raster map was generated within the GIS software used for the analysis. Average (mean) slope angles were used for each cell.

6.7 The shear strength *c'*, has been estimated from the study area data. This is undertaken by assuming that the slope is just marginally stable at each point where peat depth has been measured, i.e. the slope has *F* = 1. The Infinite Slope Model equation can be rearranged to derive a value for *c'*, using the other parameters as described in **Table 9.1.6**.

6.8 It is important to note that the calculated values for *c'* for each location represent the *minimum* shear strength needed for the peat to be stable. In fact, the shear strength may be, and in most cases probably is, considerably higher. For example, on very shallow slopes the peat needs only a very low shear strength to remain stable, whereas on steeper slopes a much higher shear strength is required to hold the peat on the slope. For this reason, the higher estimated values of *c'* are of more relevance as they are more likely to be representative of the actual shear strength of the peat on the study area. For this assessment, the maximum value of the calculated shear strengths has been used in the stability analysis. This gives a value of 4.6, as stated in **Table 9.1.6.**

6.9 For the Proposed Development, 1,331 locations have been probed during the phases of fieldwork. *c'* values have been calculated for each of these and the distribution is provided in **Graph 9.1.1.**



Graph 9.1.1: Estimate of minimum shear strength, *c'*

6.10 In order to produce a Site-wide dataset for Factor of Safety, a grid of 50 x 50 m cells was overlain across the Site and a Factor of Safety calculated for each cell. It is a standard and widely recognised GIS technique to use a regular grid for terrain analyses of this kind. It allows a systematic process across the landscape and minimises the subjectivity of the analysis. The 50 x 50 m cells are referred to as 'grid cells' throughout the analysis.

6.11 The Factor of Safety, *F*, has been calculated for each peat probing location within the Site, and for each grid cell within the survey area. Areas not considered for development were excluded from surveying and, as a result, some areas within the application boundary have not been included in the analysis as local peat depth records are not available for these areas. The Factors of Safety have been divided into classes, which have been used to map the likelihood of a peat landslide occurring at each point and for each grid cell across the study area.

6.12 The calculated Factor of Safety results have been considered together with field observations and geomorphological assessment to take into account additional risk factors including breaks in slope, or risk reduction factors such as areas of bedrock exposure. These factors have been applied to the calculated Factor of Safety results and the grid cell classes have been changed as appropriate based on the geomorphological mapping. For cells where additional risk factors and risk reduction factors are both present, no change has been made to the calculated results.

6.13 The results of the modified classification are presented in **Table 9.1.7**. Please note that the modification to calculated FoS to generate an estimate of Likelihood applies only to grid cells and the point data retain the calculated FoS value.

6.14 The likelihood map is provided in **Figure 9.1.4**.

Table 9.1.7: Summary of Likelihood Ratings

Likelihood	Initial FoS Band	No. of Points	% of Points	No. of Cells (FoS)	% of Cells (FoS)
Nil	No peat	451	33.9%	861 (861)	17.64% (17.64%)
Negligible	2.5+	824	61.9%	3,451 (3,783)	70.70% (77.50%)
Unlikely	1.3-2.499	53	4.0%	504 (233)	10.33% (4.77%)
Likely	1.1-1.299	2	0.2%	63 (3)	1.29 % (0.07%)
Probable	1.0-1.099	1	0.1%	1 (0)	0.02% (0.00%)
Almost certain	<1.0	0	0.0%	1 (1)	0.02% (0.02%)
Totals		1,331	100.0%	4,881	100.0%
N.B. Numbers in brackets for the grid cells are the original results from the Infinite Slope Model analysis, to provide a comparison with the Likelihood Rating results					

Assessing adverse consequence

6.15 Potential adverse consequences resulting from a peat landslide cover a wide range, from environmental through to economic and, potentially, harm to life. Scottish Government (2017) gives five examples, as follows:

- Potential for harm to life during construction;
- Potential economic costs associated with lost infrastructure or delays in the construction programme;
- Potential for reputational damage associated with the occurrence of a peat landslide in association with construction activities;
- Potential for permanent, irreparable damage to the peat, in terms of both carbon store and habitat, through mobilisation and loss of peat in a landslide;
- Potential for ecological damage to watercourses and waterbodies subject to inundation by peat debris.

6.16 Adverse consequence has been assessed taking account of environmental sensitivity, including potential consequences to water quality from peaty debris, habitat loss by peat removal and by blanketing of sensitive areas with peat debris, and economic significance, including damage to infrastructure and construction delays resulting from a peat landslide, in line with current guidance (Scottish Government, 2017).

6.17 Adverse consequence has been assigned as follows:

- **Very high consequence:** public roads, all buildings, wind turbine foundations (including Ben Aketil Wind Farm turbines), substation, sites designated as SAC or Ramsar, private water supply sources;
- **High consequence:** watercourses and waterbodies, areas of sensitive habitat, turbine hardstandings, substation or construction compounds, sites designated as SSSI, meteorological mast;
- **Moderate consequence:** areas of moderately sensitive habitat, access tracks, GCR sites;
- **Low consequence:** areas of low sensitivity habitat, borrow pits; and

- **Very low consequence:** damaged or degraded habitats.

6.18 **Table 9.1.8** below provides a summary of the grid cells in the study area assigned the various consequence ratings. The adverse consequence map is provided in **Figure 9.1.5**.

Table 9.1.8: Summary of Adverse Consequence Ratings

Adverse Consequence	No. of Cells	% of Cells
Very high consequence	151	3.1%
High consequence	1,082	22.3%
Moderate consequence	331	6.8%
Low consequence	3,145	64.7%
Very low consequence	152	3.1%

Risk Assessment

6.19 The Likelihood and Adverse Consequence are combined to produce an estimate of risk for each grid cell within the Site. The risk assessment matrix used to combine these two parameters is provided in **Table 9.1.9** below.

Table 9.1.9: Risk Assessment Matrix

		Adverse Consequence				
		Extremely High	High	Moderate	Low	Very Low
Peat Landslide likelihood	Almost Certain	High	High	Moderate	Moderate	Low
	Probable	High	Moderate	Moderate	Low	Negligible
	Likely	Moderate	Moderate	Low	Low	Negligible
	Unlikely	Low	Low	Low	Negligible	Negligible
	Negligible	Low	Negligible	Negligible	Negligible	Negligible

6.20 **Table 9.1.10** below provides a summary of the risk ranking for the grid cells across the Site, together with an indication of appropriate mitigation from Scottish Government (2017). The risk ranking map is provided in **Figure 9.1.6**.

Table 9.1.10: Summary of Risk Ranking and Appropriate Mitigation

Risk Ranking	No. of Grid Cells	% of Grid Cells	Appropriate Mitigation
High	0	0.0%	Avoid project development at these locations
Moderate	46	0.9%	Project should not proceed unless risk can be avoided or mitigated at these locations, without significant environmental impact, in order to reduce risk ranking to low or negligible
Low	330	6.8%	Project may proceed pending further investigation to refine assessment, and mitigate hazard through relocation or re-design at these locations
Negligible	3644	74.7%	Project should proceed with monitoring and mitigation of peat landslide hazards at these locations as appropriate
No peat	861	17.6%	No peat landslide hazard

6.21 Most of the Site has been assessed as having a negligible risk of peat landslide, or of having no peat (92.3%). Forty-six grid cells have been assessed as having a moderate risk of peat landslide, and none with a high risk.

6.22 Of the 46 grid cells assessed as having a moderate risk, nine are located near Proposed Development infrastructure. These cells and their immediate surroundings have been the subject of further investigation in order to refine the assessment in these areas. This is detailed in **Section 7**.

6.23 The remaining moderate-risk cells have been considered in relation to natural peat slide and the risk this may cause to the Proposed Development infrastructure and nearby protected areas or sensitive receptors. This is also discussed in **Section 7**.

Peat Slide Risk Associated with Blasting for Aggregate

6.24 As with many renewable energy developments, rock extraction for the Proposed Development is proposed to be achieved by blasting. It is recognised that shock waves from blasting have the potential to travel through the bedrock and could, potentially, be associated with triggering instability in peat areas at some distance from the borrow pit sites. Both borrow pit sites have been located within areas of limited peat, to restrict the potential for induced peat slide adjacent to the borrow pit areas.

All blasting will be under the supervision of a qualified and experienced blast engineer. The smallest practicable amount of explosive would be used in order to minimise shock waves resulting from the blast. Additional pre-drilling of the blast face may be appropriate to provide a higher level of control of the blast, particularly if this allowed use of smaller amounts of explosive; this would be undertaken on the advice of the blast engineer on the site.

6.25 Significant excavation works would be restricted when blasting for aggregate is planned at any of the borrow pit locations. Restrictions would be imposed as follows:

- Borrow Pit 1: restrictions affecting works at Turbines 7 and 8;
- Borrow Pit 2: restrictions affecting works at Turbine 3 and substations.

6.26 Works would only continue after appropriate inspections have determined that ground instability has not arisen as a result of the blast.

6.27 Visual peat monitoring would be undertaken by the Environmental Manager or alternative nominated site staff following periods of blasting, to inspect nearby infrastructure locations for any signs of potential instability. This would include recording any signs of cracking or mounding of peat, which can be the early signs of slippage. It is recommended that infrastructure and peat areas within 500 m of the blasting location are visited, with additional locations if relevant as recommended by the Environmental Manager.

6.28 Blasting may be restricted in periods of significant wet weather, upon the advice of the blast engineer. Wet weather definitions are provided in **Technical Appendix 9.2** of the EIA Report.

6.29 Blasting has been undertaken previously within the Site by local landowners in order to extract aggregate for track construction and maintenance, and for construction of other existing infrastructure. No induced instabilities have been reported as a result of this activity, and no signs of induced ground instability were observed during any of the site surveys.

7 DETAILED ASSESSMENT AND MITIGATION

Detailed Assessment

7.1 Nine grid cells located near Proposed Infrastructure have been identified as having a moderate risk of peat landslide. In addition, eight main clusters of cells within or just outwith the Site have been identified as having a moderate risk of peat landslide. The areas identified for detailed assessment are indicated on **Figure 9.1.6.**

7.2 These cells have been considered in greater detail, as 12 groups. Areas 1-4 consider the ten cells or groups of cells within or near the Proposed Infrastructure footprint. Areas 5-12 consider the eight wider cell clusters that are located some distance from Proposed Development infrastructure. Relevant photographs of the areas are included to provide additional context.

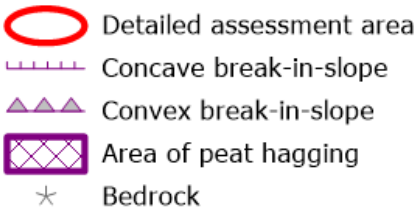
7.3 The inspection for Areas 1-4 includes a detailed inspection of the highlighted cells, the cells immediately around and downslope of them, the measured peat depths and slope angles present, drainage features and the nature of proposed and existing nearby infrastructure. Mitigation measures are recommended to reduce or control the risk for the areas.

7.4 The inspection for the clusters of cells in Areas 5-12 have been further appraised to determine if there is any risk to downslope receptors including existing infrastructure and property, environmentally sensitive receptors and Proposed Development infrastructure.

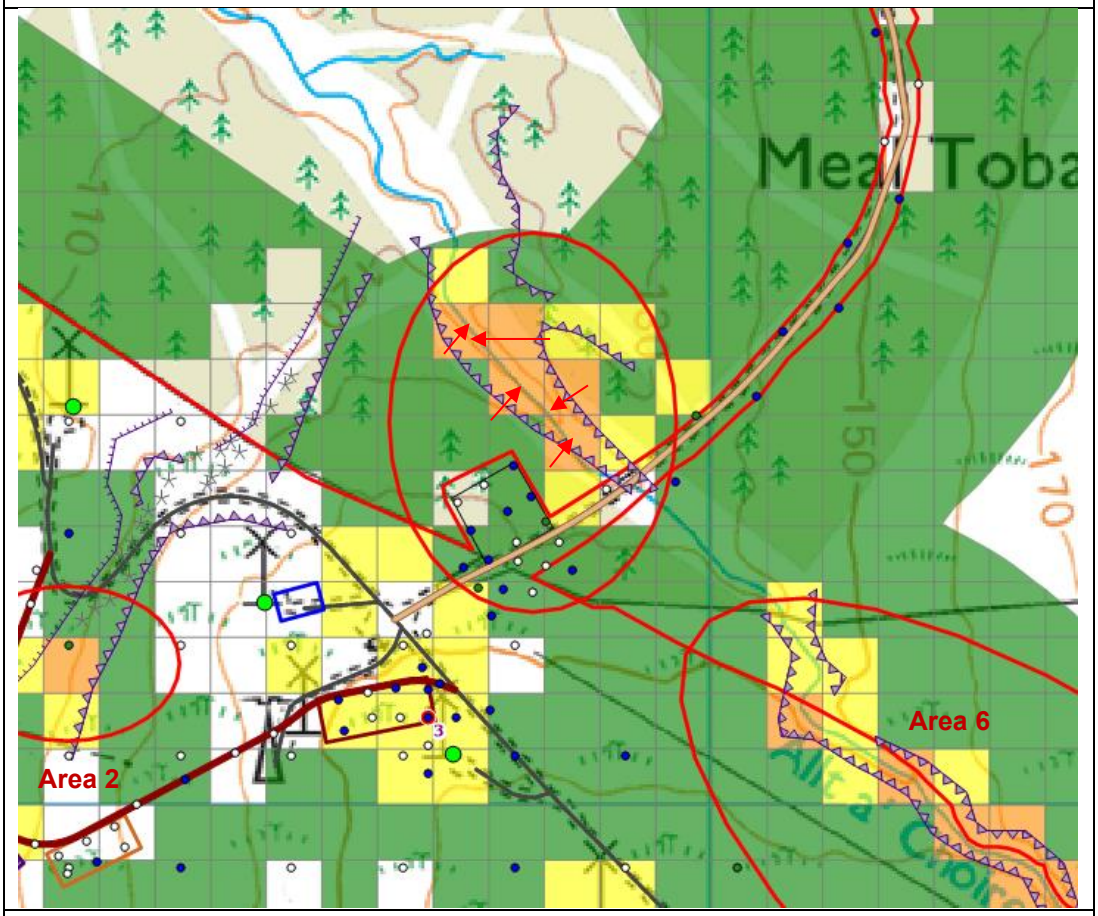
7.5 Following detailed consideration, the risk ranking has been re-appraised in the light of the presented information and proposed mitigation. Each description is accompanied by a map of the cells and their immediate surroundings. The grid cells in each map are 50 x 50 m, to give an indication of scale. Green cells have negligible risk; yellow cells have low risk, orange cells have moderate risk; red cells have high risk. Blank cells have no peat as defined in the PLHRA Guidelines (Scottish Government, 2017).

7.6 The points on the maps show the calculated Likelihood rating for all locations with directly measured peat depth, where blue is negligible; green is unlikely; yellow is likely; orange is probable; and red is almost certain. Points in white have no peat.

7.7 Other symbols used on the maps are described below:



Detailed Assessment: Area 1



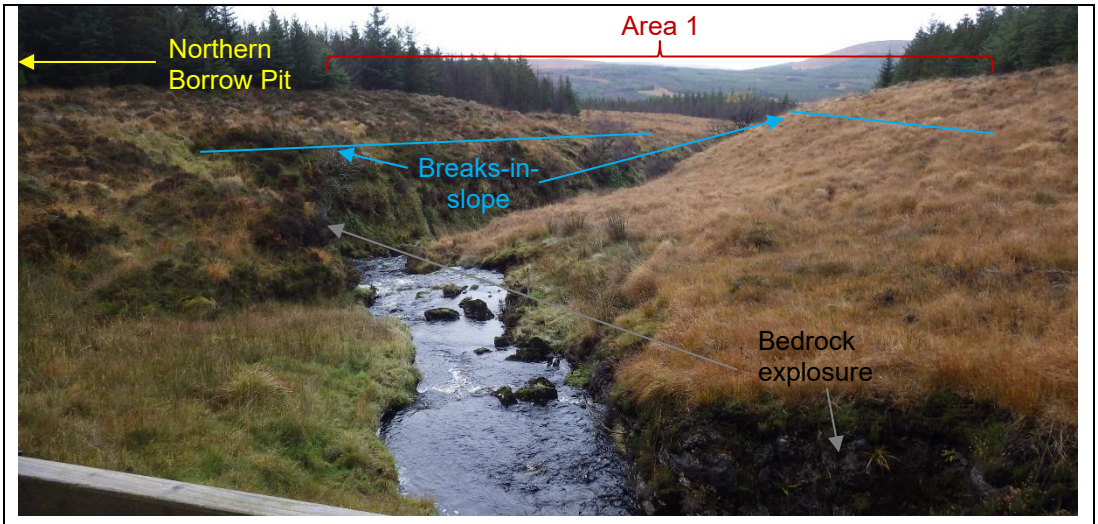
Five cells north of the Northern Borrow Pit area and north-west of the existing Northern Site Access have been assigned Moderate Risk. The cells are all intersected by a watercourse. The assigned risk level relates to the sensitivity of the receptor the Allt a' Choire, and its associated High consequence rating.

Calculated likelihood for the cells is Likely, reflecting the combination of interpolated peat depth, slope present within the cells and the presence of convex breaks-in-slope associated with the watercourse channel, which is quite deeply incised in this area. The existing access track and proposed Northern Borrow Pit are both upslope of the area, although no activity is planned to take place in any of the highlighted cells. The nearest construction activity would be potential upgrading of the watercourse crossing, approximately 30 m from the area. The principal risk arises from the proximity of the Northern Borrow Pit, and the likelihood of blasting associated with rock extraction.

The interpolated peat depths are 1.0-1.3 m within the five cells. The cells have average slope angles between 11.4 and 16.8°.

Potential runout from any failure: Any failure in these or adjacent cells would travel north-east, west or south-west down the slope to terminate in the watercourse channel. A failure could affect the integrity of the channel, may cause temporary damming of the watercourse and would be likely to cause a reduction in water quality downstream. Runout paths are indicated by arrows.

It is possible that peat upslope of the identified cells, particularly on the south-west side, could be destabilised in the event of a failure as peat measurements indicate there is an area of deep peat between the borrow pit and the river. This may be in the form of a peat pocket rather than a more substantial area, and may therefore be less likely to fail. A failure here has potential to affect the borrow pit, but would be unlikely to extend far enough to affect any adjacent infrastructure.



Photograph looking NW from the existing track crossing of the Allt a' Choire towards Area 1, showing bedrock exposure in the burn banks and prominent breaks-in-slope.

Photographs from the area indicate that the burn channel is cut into bedrock and would not therefore be at any direct risk of peat instability. The ground has been significantly disturbed in the past to allow forestry planting and this has not resulted in any induced peat instability.

Calculated likelihood for the peat depth records within the area are Unlikely or Negligible in areas with peat, including for the area of deep peat just at the margin of the borrow pit area, reflecting the gentle slope angles in this area. Peat depths for all the highlighted cells are derived from the GIS interpolation.

Mitigation

Closer inspection of the highlighted cells indicates that interpolated peat depths are likely to be deeper than actual peat depths, as nearby records adjacent to the watercourse are <1.0 m and photographs and survey notes from the area indicate that the channel is within bedrock through this section. The elevated risk ranking is largely a result of the coincidence of the High consequence status of the watercourse and the increased likelihood based on the breaks-in-slope. As the breaks-in-slope correspond with bedrock exposure, it is considered that the assessment does not accurately reflect the risk status at this location.

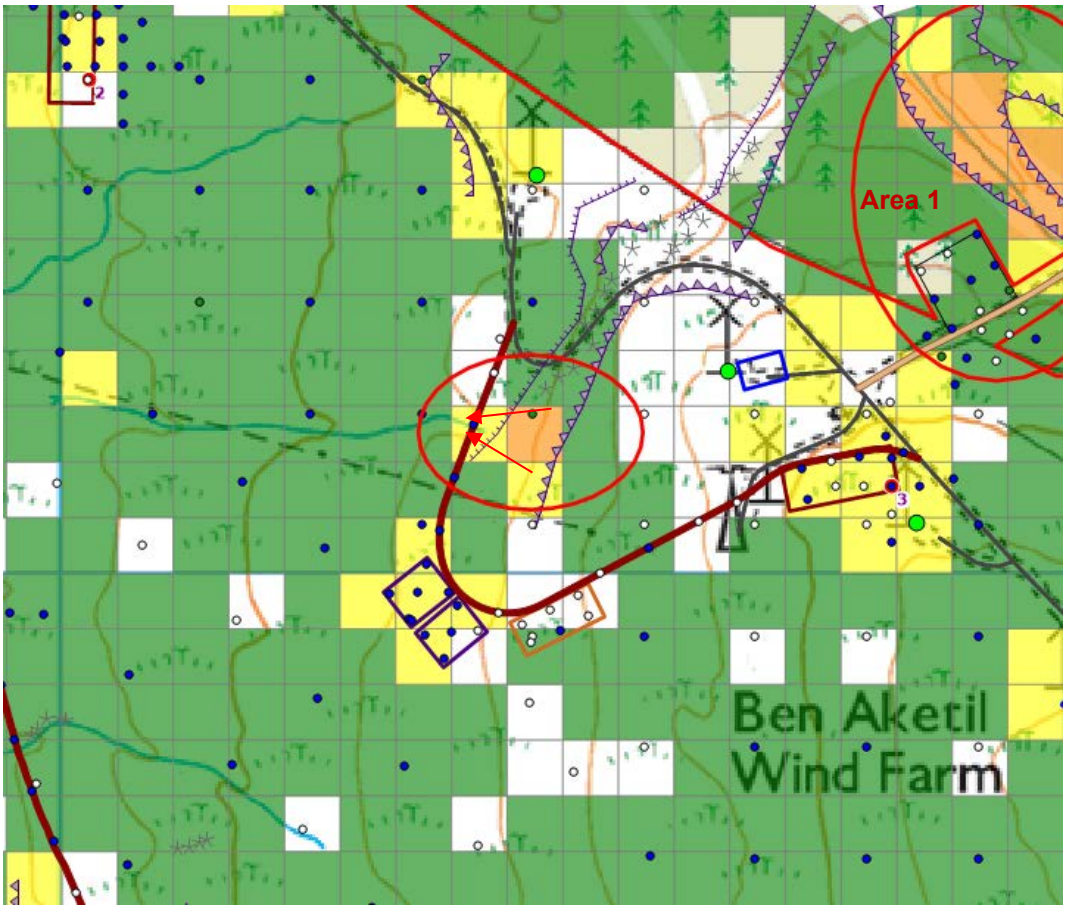
The proximity of the Northern Borrow Pit remains a concern. The Northern Borrow Pit is included in the design as a contingency, with the expectation that it would not be required for construction. In the event of extraction, the appointed blast engineer must be made aware of the risk status at this location to allow appropriate charges to be applied. The Environmental Manager or appointed deputy must make stability checks within Area 1, upstream and downstream along the watercourse and in the area between the borrow pit and the watercourse before and after any blasting takes place. No construction activity may be permitted until stability checks following blasting have been completed and confirm that no signs of instability are present. All such stability checks must be fully documented and accompanied by photographs of the areas inspected. Should any signs of instability be identified, all future blasting at the borrow pit would be cancelled and the borrow pit restored.

Micrositing of the borrow pit to avoid incursion into the area of deeper peat at the eastern margin would be undertaken; this would also help to maximise the separation between the highlighted risk area and the proposed works. Any required upgrades to the access track and watercourse crossing would be targeted on the upstream (south-east) side where peat is not recorded.

Revised risk ranking

Low

Detailed Assessment: Area 2



One cell west of Turbine 3 and north of the proposed new and repower substations has been assigned Moderate Risk. The assigned risk level relates to the sensitivity of the receptor, the M6 habitat within and downslope of the cell, and its associated High consequence rating.

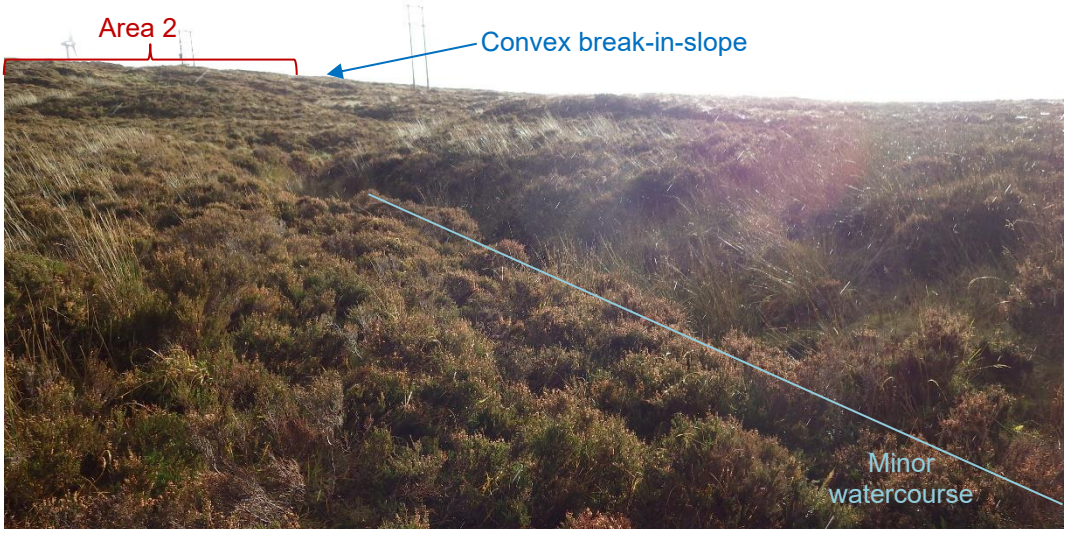
Calculated likelihood for the cell is Likely, reflecting the combination of peat depth, slope present within the cell and the presence of paired convex and concave breaks-in-slope.Turbine 3 and its associated hardstanding plus part of the new access track are located upslope of this cell, at a distance of 100 m to the track and 195 m to the turbine hardstanding. Part of the new access track also crosses 20 m downslope of this cell.

The peat depth record for this cell is 1.25 m, with an average slope angle for the cell of 12.7°.

Potential runout from any failure: Any failure in this or adjacent cells would travel roughly westwards down the slope and would terminate either in the minor watercourse or on the flatter ground downslope. A failure could affect the integrity of the watercourse channel, may cause temporary damming of the watercourse and would be likely to cause a reduction in water quality downsteram. It would also be likely to cause damage to the M6 habitat and nearby habitat areas. Runout paths are indicated by arrows.

It is possible that peat upslope of the identified cell could be destabilised in the event of a failure.

The nearest infrastructure, the access track below the cell, would be directly affected by a failure. The access track upslope may also be affected if upslope destabilisation were to occur. Turbine 3 is unlikely to be affected as there is an area with no peat between the highlighted cell and the turbine.



Photograph looking SE from the proposed watercourse crossing showing the slope up to Area 2 and the convex break-in-slope.

Photographs from the area indicates that the ground is quite variable in character, and that peat depths and slope angles have more variation on a local scale than is suggested by the GIS model. A short distance north of the cell, bedrock is present at surface and a number of cells in this area have no peat recorded. The concave break-in-slope is not particularly pronounced although the upper convex break-in-slope is quite distinct. The areas with deeper peat records are present on the more gentle slopes near the concave break-in-slope and do not coincide with the steeper slopes further up the hill.

Calculated likelihood for the peat depth records within this area are Negligible in the areas with peat, with one record of Unlikely coinciding with the peat depth of 1.25 m within the highlighted cell.

Mitigation

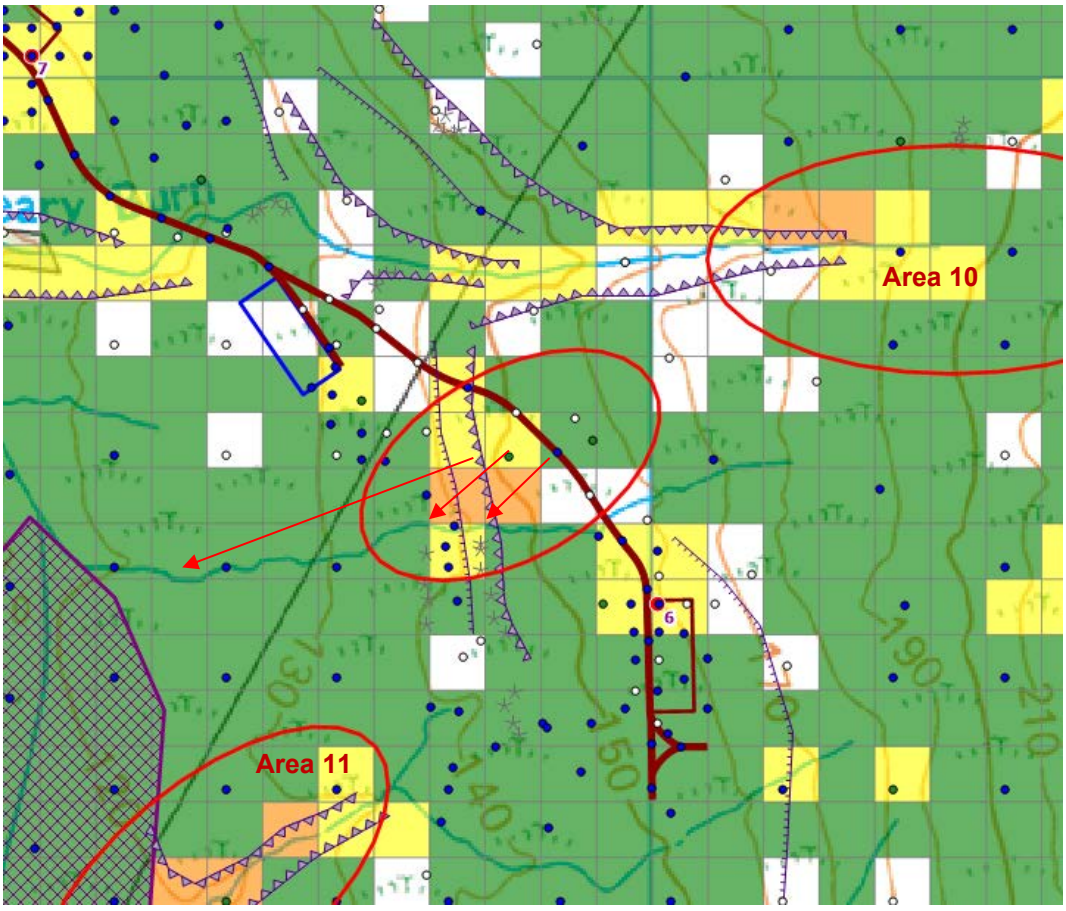
Closer inspection of the highlighted cell indicates that the deeper peat records and steep slopes are not coincident. The elevated risk ranking is a result of the High consequence status of the M6 habitat and the increased likelihood based on the breaks-in-slope. It is considered that the assessment does not accurately reflect the risk status at this location as the deep peat and steep slopes do not coincide.

The presence of M6 habitat indicates that care would be required in design and installation of the watercourse crossing required immediately downslope from the highlighted cell. An oversized crossing would be recommended. All construction works in this area would be under the supervision of the Environmental Manager at all times. Regular monitoring of the slope between the highlighted cell and nearby sections of new track would be required to check for warning signs of developing instability. Micrositing of the track and watercourse crossing location to increase their separation from the breaks-in-slope and to protect the M6 habitat would be considered if practical in relation to other environmental and engineering constraints.

Revised risk ranking

Low

Detailed Assessment: Area 3



Two cells south-west of the access track to Turbine 6 have been assigned Moderate Risk. A watercourse crosses immediately south of the cells. The assigned risk level relates to the sensitivity of the receptor, the unnamed watercourse, and its associated High consequence rating.

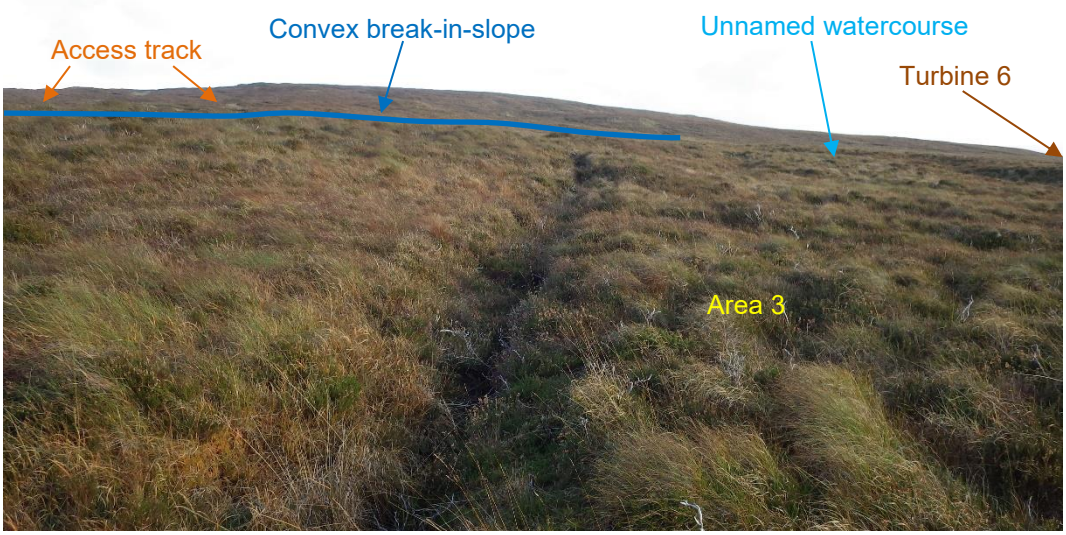
Calculated likelihood for the cells is Likely, reflecting the combination of interpolated peat depths, slope present within the cells and the presence of paired convex and concave breaks-in-slope. The access track is located between 20 and 120 m upslope of the highlighted cells. Turbine 6 is located across the watercourse, and is not at risk.

The interpolated peat depths are 1.5-1.8 m, with average slope angles of 8.9° and 9.7°.

Potential runout from any failure: Any failure in this or adjacent cells would travel west-south-west down the slope and terminate in the watercourse channel. A failure could affect the integrity of the channel, may cause temporary damming of the watercourse and would be likely to cause a reduction in water quality downstream. Runout paths are indicated by arrows.

It is possible that peat upslope of the identified cell could be destabilised in the event of a failure, although much of the slope above the proposed access track is indicated to have no peat present.

The nearest infrastructure, the access track to Turbine 6, is located directly upslope of the highlighted cells.



Photograph looking SE across Area 3 towards Turbine 6 and the watercourse crossing

There is a distinct convex break-in-slope within Area 3, with the access track to Turbine 6 located above and behind this break-in-slope. The track is set back from the break-in-slope, on flatter ground. Although a ditch is clear in the photograph, no signs of instability associated with the ditch were apparent and the ground was firm in this area. The ditch was excavated to base of soil, a depth of approximately 0.4 m. Peat depth records from this area are variable, with depths between 0.2 and 2.1 m recorded in cells adjacent to the highlighted risk cells. Neither highlighted cell has a direct peat depth record owing to the Phase 1 survey spacing and the Phase 2 focus on infrastructure. The proposed track above the highlighted risk cells is mainly located in areas with no peat, helping to minimise the risk in this area.

Calculated likelihood for the peat depth records in this area are all Negligible or No Peat, with one Low likelihood immediately north of the eastern cell.

Mitigation

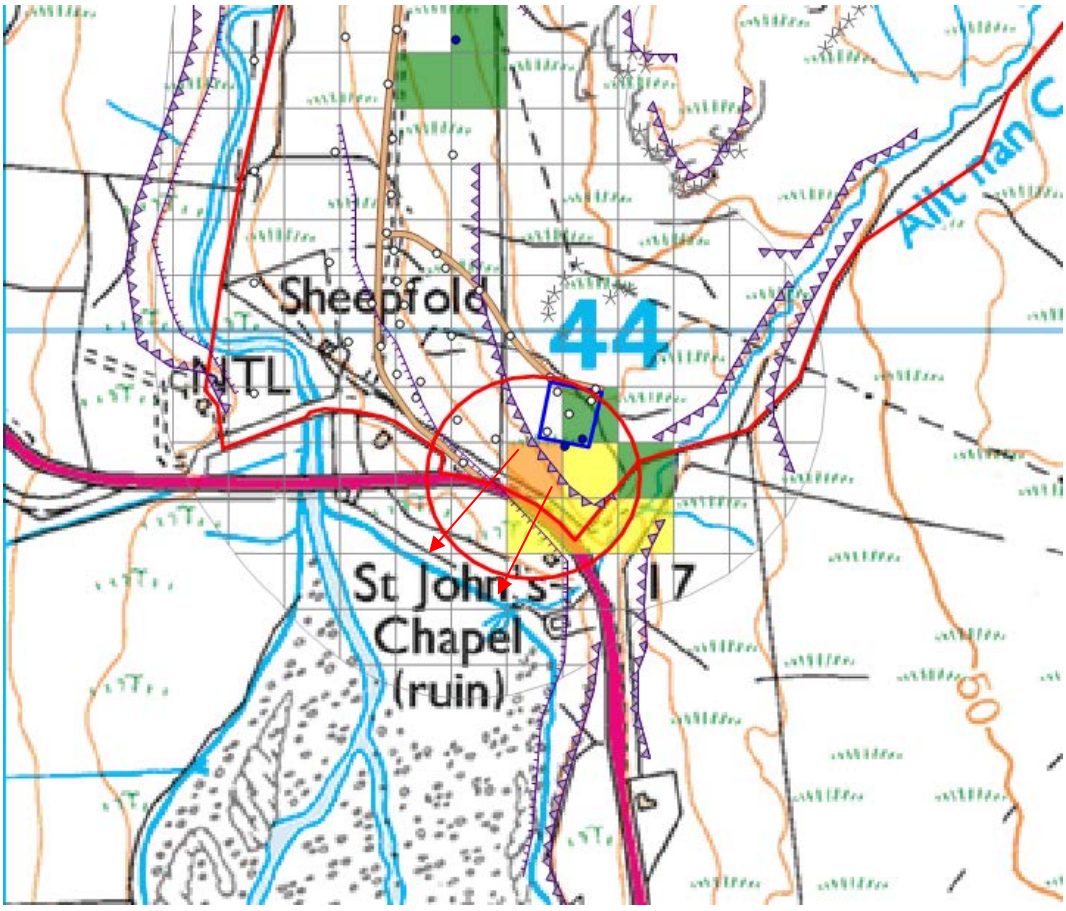
Closer inspection of the highlighted cells indicates that the interpolated peat depths are likely to be deeper than actual peat depths, reinforced by the depth of the ditch across the area with a depth to hard ground of 0.4 m. The elevated risk ranking is largely a result of the coincidence of the High consequence status of the watercourse and the increased likelihood based on the breaks-in-slope. Although the presence of a ditch may provide a risk factor, no signs of current or past instability were apparent in the area despite evidence of vehicle movements in the immediate area. It is considered that the assessment does not accurately reflect the risk status at this location as a result of the over-estimation of peat depth arising from the interpolation.

Work in the area is not proposed within the highlighted cells. All construction works in this area would be under supervision of the Environmental Manager at all times. Additional care would be taken at this location, owing to the track's location upslope from the highlighted risk cells, with regular monitoring of the slope between the track and the breaks-in-slope to check for warning signs of developing instability. Micrositing of the track to increase the separation distance from the breaks-in-slope would be advisable if practical in relation to other environmental and engineering constraints.

Revised risk ranking:

Low

Detailed Assessment: Area 4



One cell located between the proposed access track and proposed temporary construction compound at the site entrance has been assigned Moderate Risk. The cell lies adjacent to the existing A863 public road. The assigned risk level relates to the sensitivity rating of the receptor, the A863, and its associated Very High consequence rating.

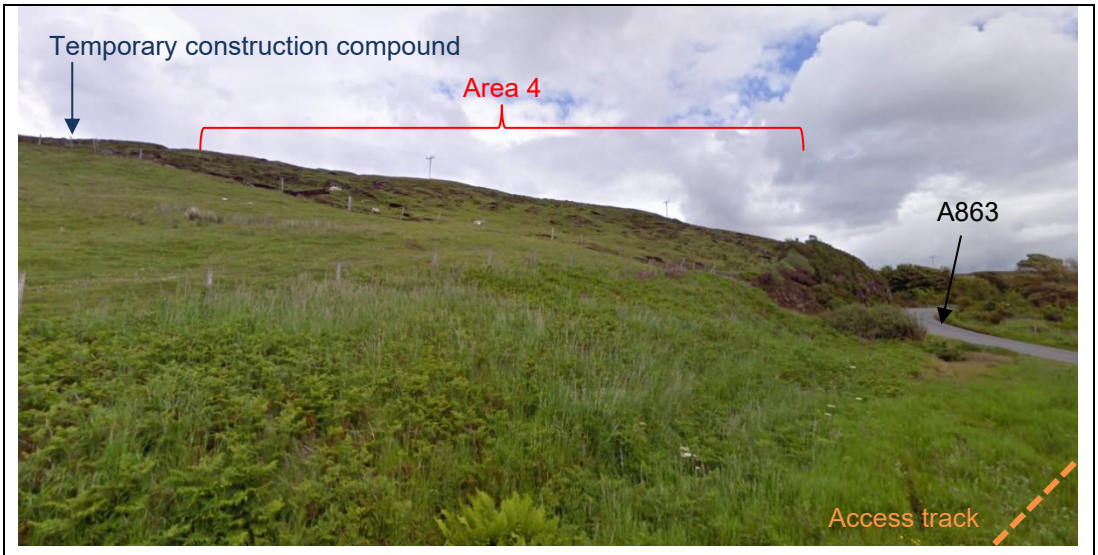
Calculated likelihood for the cell is Likely, reflecting the combination of interpolated peat depth, slope present within the cell and the presence of paired convex and concave breaks-in-slope. The proposed temporary construction compound lies immediately upslope of the highlighted cell, with the A863 immediately downslope.

The interpolated peat depth is 0.88 m in the cell, with an average slope angle of 21.4°.

Potential runout from any failure: Any failure in this or adjacent cells would travel south-west down the slope to the A863 and would be likely to terminate on the sea shore. A failure could block or damage the road and would be likely to have a blanketing effect on the foreshore area, causing ecological damage. Runout paths are indicated by arrows.

It is possible that peat upslope of the identified cell could be destabilised in the event of a failure, although peat upslope is limited in area coverage.

While the end of the access track is unlikely to be affected, it is possible that a failure could affect the integrity of the construction compound area.



Photograph looking SE from near the site access off the A863 showing Area 4

Although the slope within Area 4 is distinct and the convex break-in-slope is clear, closer inspection of photographs from the area indicates that bedrock is very shallow below the ground surface, mainly 0.3 m or less. The cutting on the A863 has a rock face on the NE side, as apparent in the photograph above.

Peat depth records within the proposed temporary construction compound indicate that the majority of the footprint is without peat, with only one record of peat present in the south-eastern corner. A second record of peat is present just outwith the construction compound footprint.

Calculated likelihood for the peat depth records in this area are all Negligible or No Peat. No direct peat depth records are available for the highlighted cell, meaning that peat depth is derived from the GIS interpolation.

Mitigation

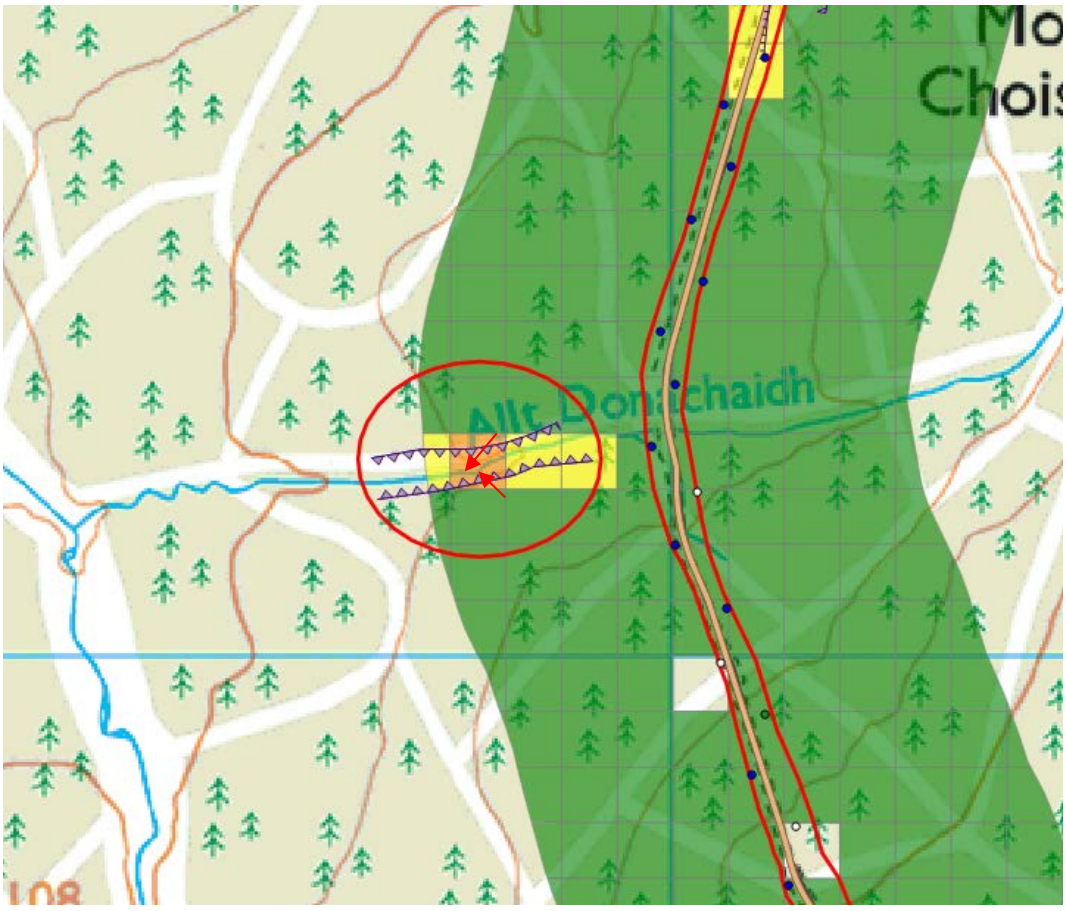
Area 4 is largely without peat, and the area identified with some peat is likely to be a discrete and contained peat pocket. Closer inspection of the area indicates that the interpolated peat depth is likely to be an over-estimation of peat/soil coverage, as demonstrated by bedrock at surface and vegetation patterns within the highlighted area. The elevated risk taking is largely a result of the Very High consequence status of the public road and the increased likelihood based on the breaks-in-slope. It is considered that the assessment does not accurately reflect the risk status at this location as a result of the over-estimation of peat depth arising from the interpolation.

It may be possible to microsite the temporary construction compound entirely outwith the identified area of peat. This would be managed on site by the Environmental Manager during establishment of the construction compound. Visual monitoring of the ground slope in this area would be recommended as a result of the Very High sensitivity status of the public road.

Revised risk ranking

Negligible

Detailed Assessment: Area 5



A Moderate Risk cell is apparent along the channel of the Allt Donachaidh downslope of the existing access track into the site from the north. The cell is 140 m west of the existing track, within a gorge-like section of the watercourse channel where convex breaks-in-slope are apparent on either side of the watercourse. Peat depth in this area is an estimate from the interpolation, with a maximum depth of 1.45 m, and a slope angle of 11.1°.

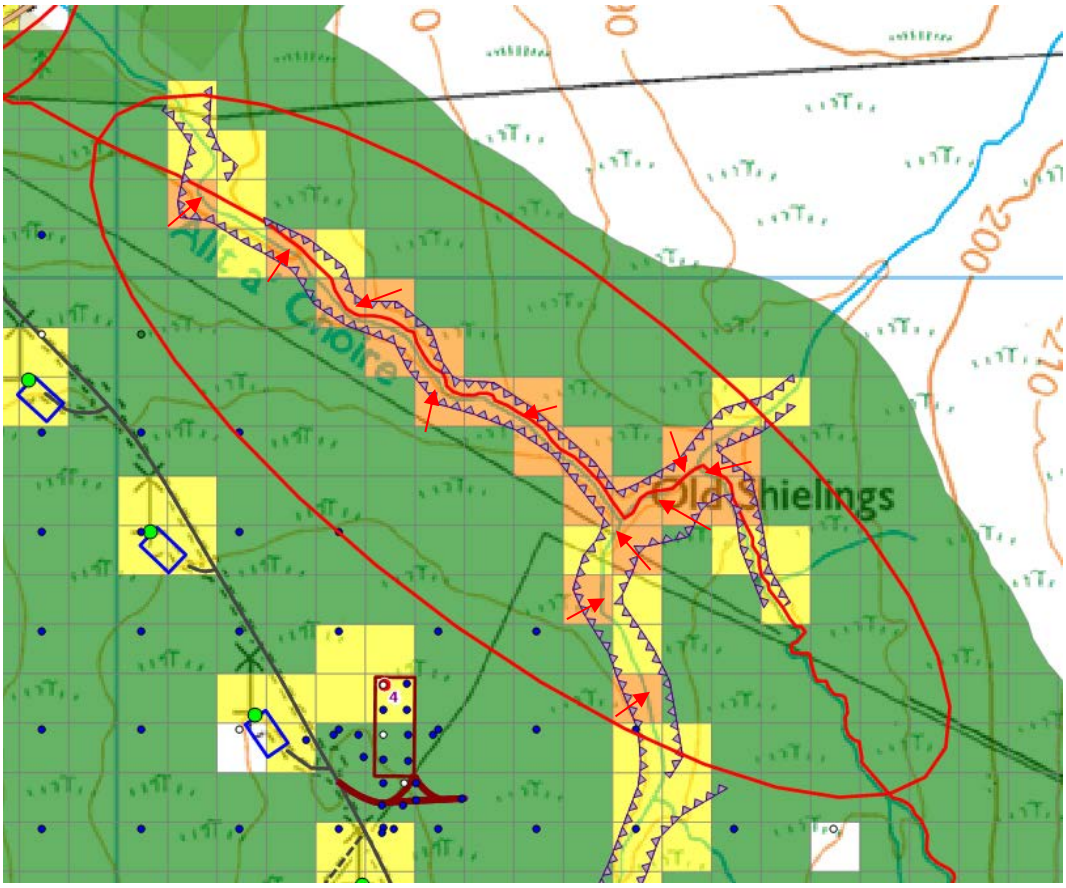
Potential runout areas: A failure in this area would have an effect on the watercourse, as failures would be most likely to occur on the watercourse banks into the channel. Any failure would terminate within the watercourse channel. Runout paths are indicated by arrows.

No indications of peat instability were recorded in nearby areas. It is likely that there is limited peat in this area, and peat that is present would be affected by the existing forestry plantation and would already be disturbed as a result of trenching for tree planting.

Mitigation

There are no plans for any Development activity to take place within this cell. Any required widening of the existing access track, and associated tree felling works, would be targeted on the eastern side of the track, to maximise the separation of construction works from the highlighted area.

Detailed Assessment: Area 6



A number of Moderate Risk cells are apparent along the northern Application Boundary to the north and east of Turbine 4 and the southern half of the existing turbine array. The cells are all over 160 m from the nearest proposed infrastructure, Turbine 4 and sections of access track. The cells are all located along a watercourse channel where the channel is incised and has convex breaks-in-slope along both sides for much of its length. All peat depths in this area are estimates from interpolation, as a result of the distance between the highlighted cells and all proposed infrastructure. Depths vary between 1.3 and 1.7 m.

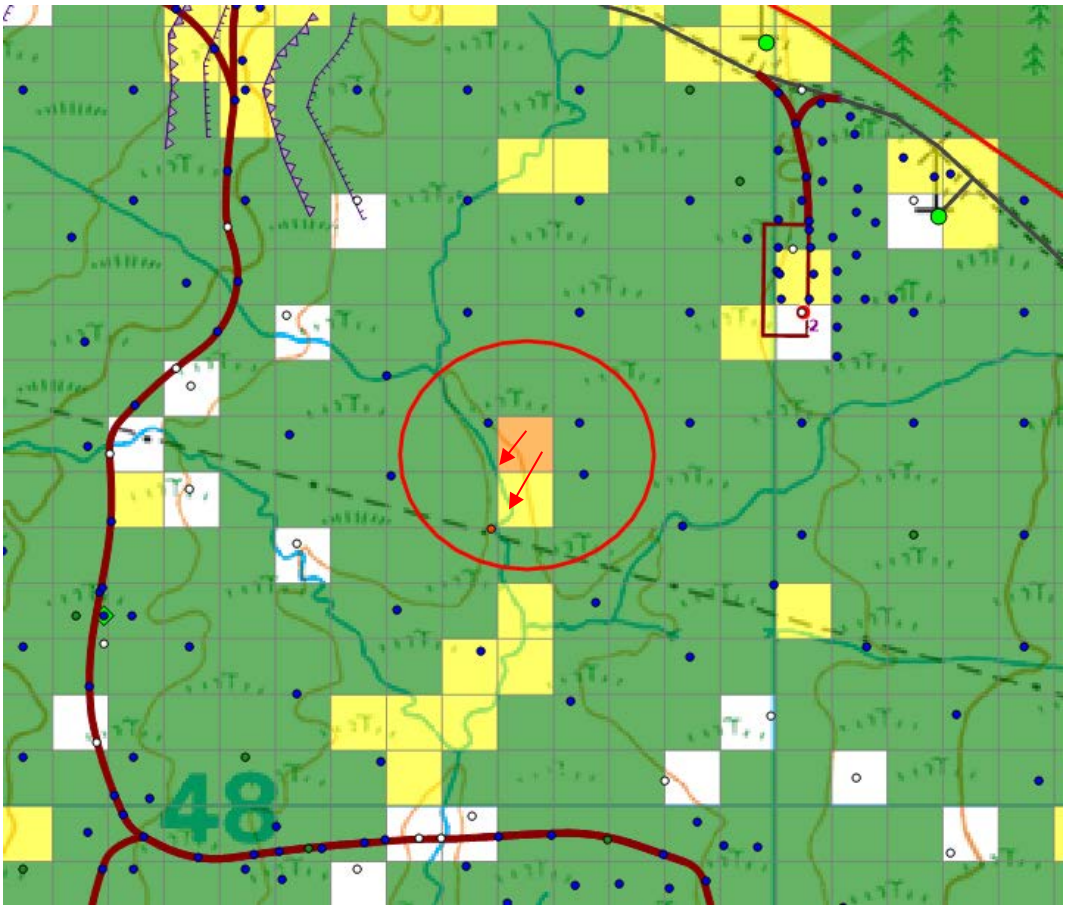
Potential runout areas: Failures in this area would have an effect on the watercourse as failures would be most likely to occur on the watercourse banks into the channel. Any failure would terminate within the watercourse channel. Runout paths are indicated by arrows. Given the slope angles in the area, it is unlikely that significant volumes of peat upslope of the highlighted cells would be destabilised by any failure, although some localised destabilisation may occur.

No indications of peat instability were recorded in nearby areas despite the steep peat banks to either side of the watercourse channels in this area. Any instability would mostly likely be the result of watercourse movement and natural meandering rather than being a peat slide in the strictest sense of the term.

Mitigation

There are no plans for any Development activity to take place within 160 m of these cells. Three watercourse crossings are proposed upstream of this area, and care would be required as part of their design and installation to ensure that no constriction of the watercourse channel arises as a result of their construction. The nearest crossing is 240 m upstream of the highlighted area. The Environmental Manager would be responsible for management of construction works in areas upslope of the highlighted risk zone.

Detailed Assessment: Area 7



One Moderate Risk cell has been highlighted within the northern part of the Proposed Development. The cell is over 200 m from the nearest proposed infrastructure, Turbine 2 hardstanding, and over 250 m from the nearest section of access track. The cell is located immediately adjacent to a watercourse channel and includes an area of sensitive habitat, both of which give a consequence rating of High. Although there are peat depth records in this area, none are present within the highlighted cell and estimated peat depth is 3.7 m mainly as a result of very deep peat present immediately to the east of the highlighted cell (4.3 m). The average slope angle is 6.1°. The higher Risk ranking is a result of the high consequence rating assigned to the watercourse combined with a deep interpolated peat depth and moderate slope angle within the cell.

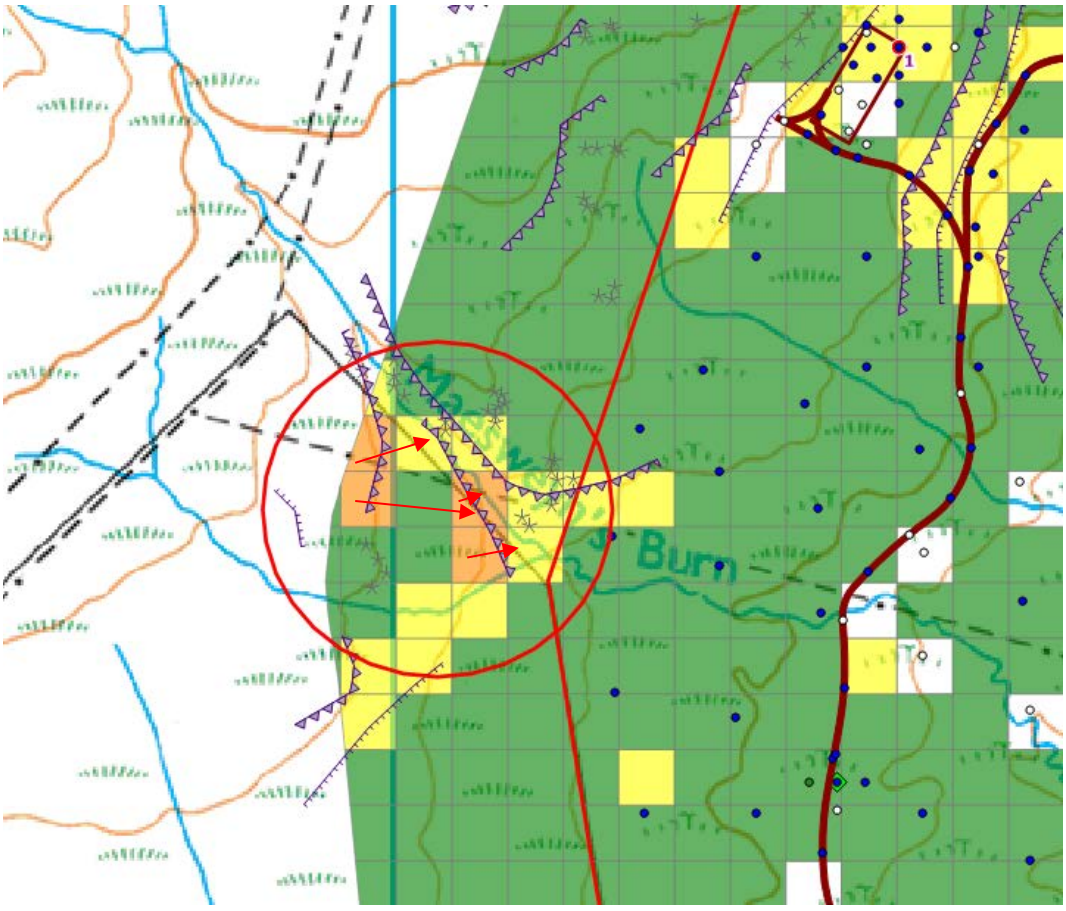
Potential runout areas: Any failure within the highlighted cell would terminate within the watercourse channel, a tributary to the Caroy River. Debris may travel down the watercourse for some distance. It is possible that a failure at this location could destabilise peat in areas upslope of the highlighted risk area. Runout paths are indicated by arrows.

No indications of peat instability or developing instability were recorded in nearby areas during the peat depth and reconnaissance surveys.

Mitigation

There are no plans for any development activity to take place within 200 m of this cell and it is unlikely that any construction activity would have any influence over its stability. Two watercourse crossings are proposed upstream of this area, and care would be required as part of their design and installation to ensure that no constriction of the watercourse channel arises as a result of their construction. The nearest crossing is 265 m upstream of the highlighted area. The Environmental Manager would be responsible for management of construction works in areas upslope of the highlighted risk zone.

Detailed Assessment: Area 8



Four Moderate Risk cells have been identified adjacent to and outwith the Application Boundary to the west of the access track linking Turbines 1 and 9. The cells are over 300 m distant from this section of access track. Two cells are associated with a watercourse channel and sensitive habitat, and three cells are crossed by the existing overhead power export cable from the site. All four cells are associated with convex breaks-in-slope. All peat depths in this area are estimates from interpolation, with depths varying between 1.5 and 1.7 m. The higher Risk ranking is mainly a result of the high consequence rating assigned to the watercourse, sensitive habitat and overhead line.

Potential runout areas: All highlighted cells would have potential runout zones into the channel of the Maesweyn's Burn or one of its tributaries. Debris may travel down the watercourse for some distance. Runout paths would be expected to pass into the Application Boundary area. Runout paths are indicated by arrows.

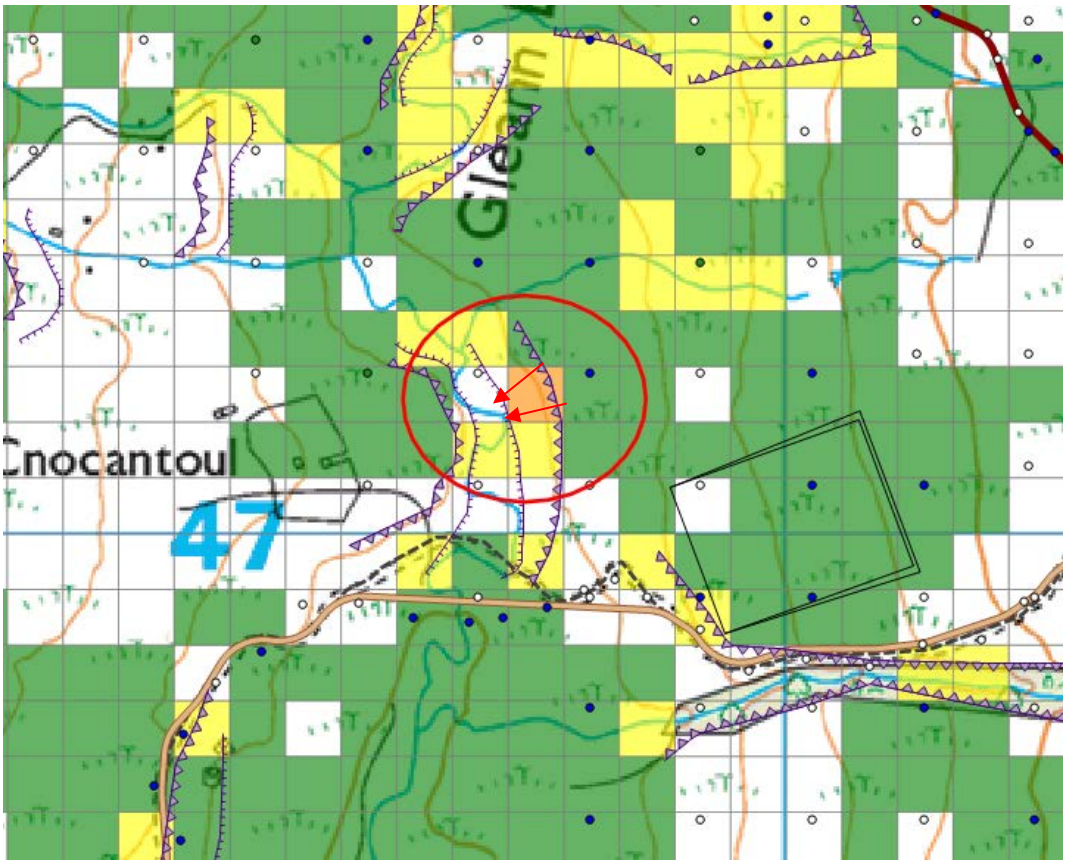
No indications of peat instability or developing instability were recorded in nearby areas during the peat depth and reconnaissance surveys.

Mitigation

There are no plans for any development activity to take place within 300 m of the highlighted cells, and no development is proposed upslope of these cells. As a result, it is unlikely that construction activity would have any influence on their stability. The nearest activity would be in relation to construction of the access track between Turbines 1 and 9.

The nearest peat depth records indicate that peat is variable, and aerial photography identifies bedrock at surface in parts of the watercourse channel adjacent to the identified cells. It is likely that bedrock at surface and shallow bedrock are relatively extensive in this area, and that peat depths have been over-estimated as part of the interpolation process.

Detailed Assessment: Area 9



One Moderate Risk cell has been identified north of the southern access route into the Proposed Development. The cell is over 110 m north-west of Borrow Pit 2 and over 160 m north of the proposed access track. The cell is near a watercourse and is associated with paired convex and concave breaks-in-slope. Peat depths within the cell are derived from the interpolation, and no direct records are available. Estimated depth is 1.4 m. The higher Risk ranking is mainly a result of the high consequence rating assigned to the watercourse.

Potential runout areas: The potential runout zone would be west and south-west into the Caroy River channel. Debris may travel down the watercourse for some distance and there would be a possibility of interaction with the access track where it crosses the river. Runout paths are indicated by arrows.

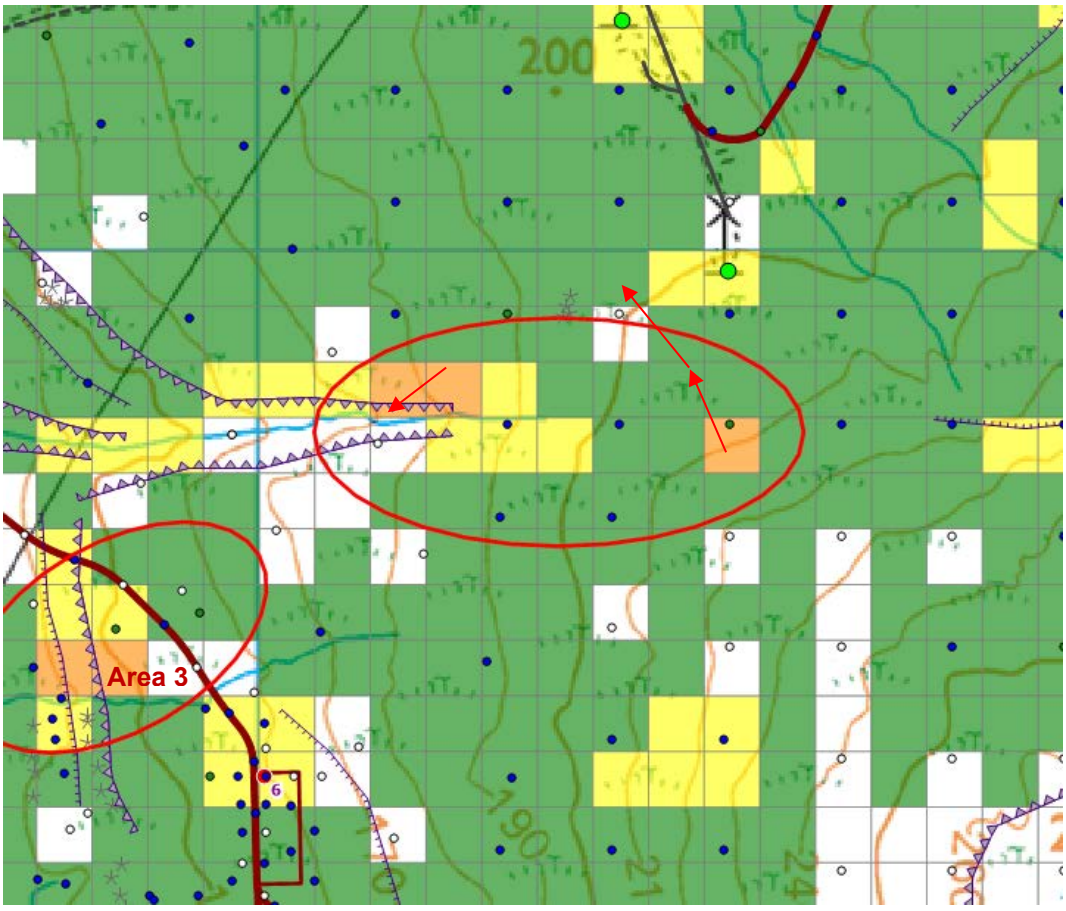
Some indications of bank instability were apparent on Caroy River meanders, arising from water undercutting the banks and leading to localised bank failure. None of these had triggered any larger-scale slides and would not be classed as peat slides as they are natural events arising from channel movement.

Mitigation

There are no plans for development activity to take place within 110 m of the highlighted cell. Construction activity associated with the access track is unlikely to have any influence on the stability in this area. It is possible that blasting activity within BP2 may have an effect, although blasting should be managed to be as low-risk as practicable and would be supervised at all times by a qualified blast engineer.

Checks for any indications of developing instability should be undertaken by the Environmental Manager following any activity at BP2 and, if required, all rock extraction and processing should be suspended until further stability checks can be undertaken. Blasting should not take place during or immediately following periods of wet weather.

Detailed Assessment: Area 10



Three Moderate Risk cells are apparent within the Application Boundary between Turbines 5 and 6. The cells are over 240 m distant from the nearest proposed infrastructure, sections of access track to Turbines 5 and 6, and 130 m from the nearest existing turbine. The two western cells are associated with a watercourse and a break-in-slope. No direct peat depth records are present in either cell. The higher Risk ranking is mainly a result of the high consequence rating assigned to the watercourse.

The eastern cell has a Likelihood rating of Almost Certain, based on the calculated Factor of Safety. This is a result of a very deep peat record (3.9 m) on the northern margin of the cell and a moderate average slope angle of 7.9° for the cell.

Potential runout areas: Runout from the western cells would be directed into the neighbouring watercourse channel. Debris may travel down the channel for some distance and full or partial blockage of the channel may occur. It is possible that some debris may reach the access track to Turbine 6, located 520 m downstream of the highlighted cells.

Runout from the eastern cell would be directed north-west down the slope, and would be likely to terminate on the flatter ground west of the existing turbine.

Runout paths are indicated by arrows.

No indications of peat instability or developing instability were recorded in nearby areas during the peat depth and reconnaissance surveys.

Mitigation

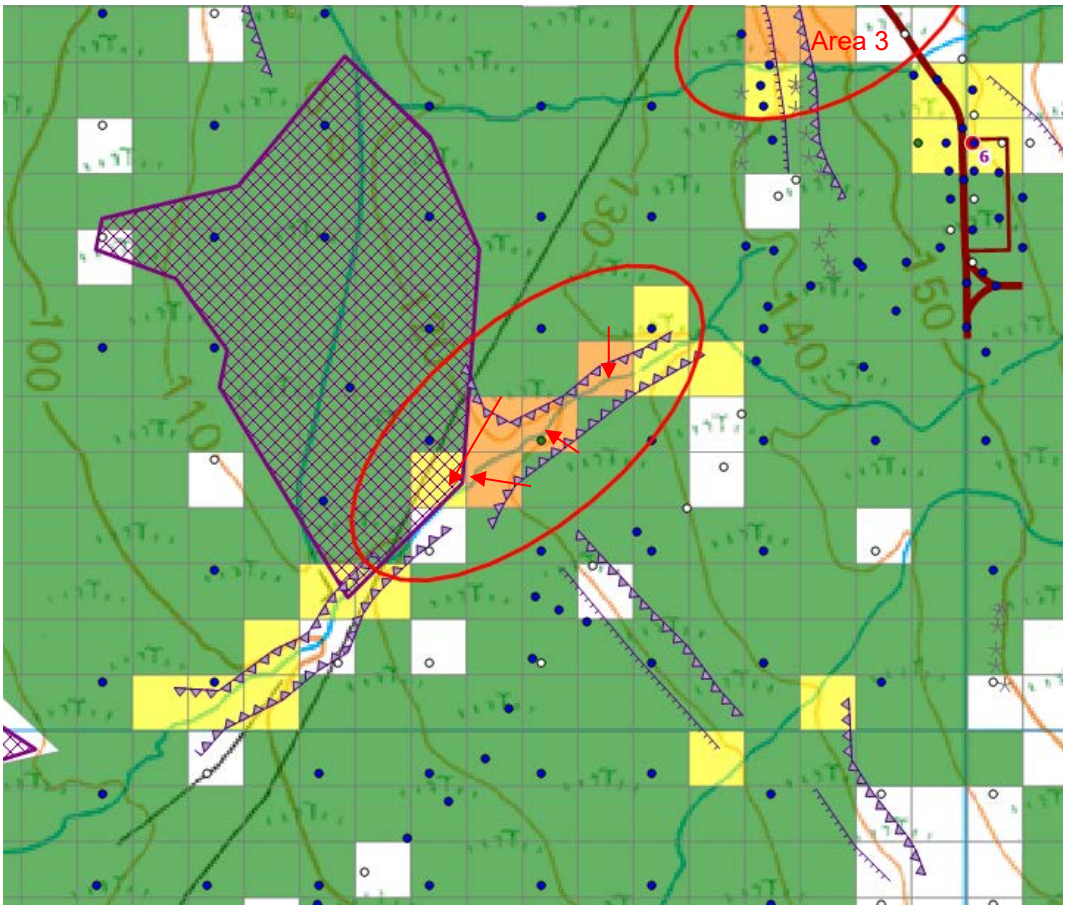
There are no plans for construction activity to take place within 240 m of the highlighted cells, although decommissioning activity would be required approximately 130 m from the eastern cell.

It is unlikely that any construction or decommissioning activity would have any influence on the stability of the two western cells. The nearest peat depth records to these cells indicate that this area is largely without peat, and may include bedrock at surface. It is likely that the peat depth has been over-estimated as part of the interpolation and that the highlighted cells have no peat presence.

Closer inspection of the eastern cell indicates that the deep peat record and the steeper slopes are not coincident. The steeper slope angles are present in the south-eastern part of the cell, with the deep peat present in the northern part. The higher Risk ranking is considered to be an artefact of the model used to assess Likelihood, including the use of a minimally stable c' value for calculating Factors of Safety. The point Likelihood for the peat depth record within the cell has an Unlikely rating.

It is recommended that the Environmental Manager undertakes regular (daily) checks of the area around the eastern highlighted cell during construction activity on the access track to Turbine 5 and during the decommissioning works associated with removal of the nearest existing turbine and associated infrastructure, to look for signs of developing instability. Works in this area should not be undertaken during or immediately following periods of wet weather.

Detailed Assessment: Area 11



Four Moderate Risk cells are highlighted in the area south-west of Turbine 6. The cells are over 300 m from the nearest proposed infrastructure, the turning head and crane hardstanding for Turbine 6, and are over 350 m from Turbine 6 itself. All the cells are intersected by a watercourse with associated breaks-in-slope. One peat depth measurement is present within these cells, with other records located nearby; depth records are mainly over 1.0 m with some in excess of 2.0 m. The depth record within the highlighted cells is 2.4 m. The higher Risk ranking is largely a result of the High consequence rating assigned to the watercourse.

Potential runout areas: All the highlighted cells would have potential runout zones into the watercourse channel, an unnamed tributary to the Caroy River. Debris may travel down the watercourse for some distance. There is no existing or proposed infrastructure downstream for a distance of 2 km. Runout paths are indicated by arrows.

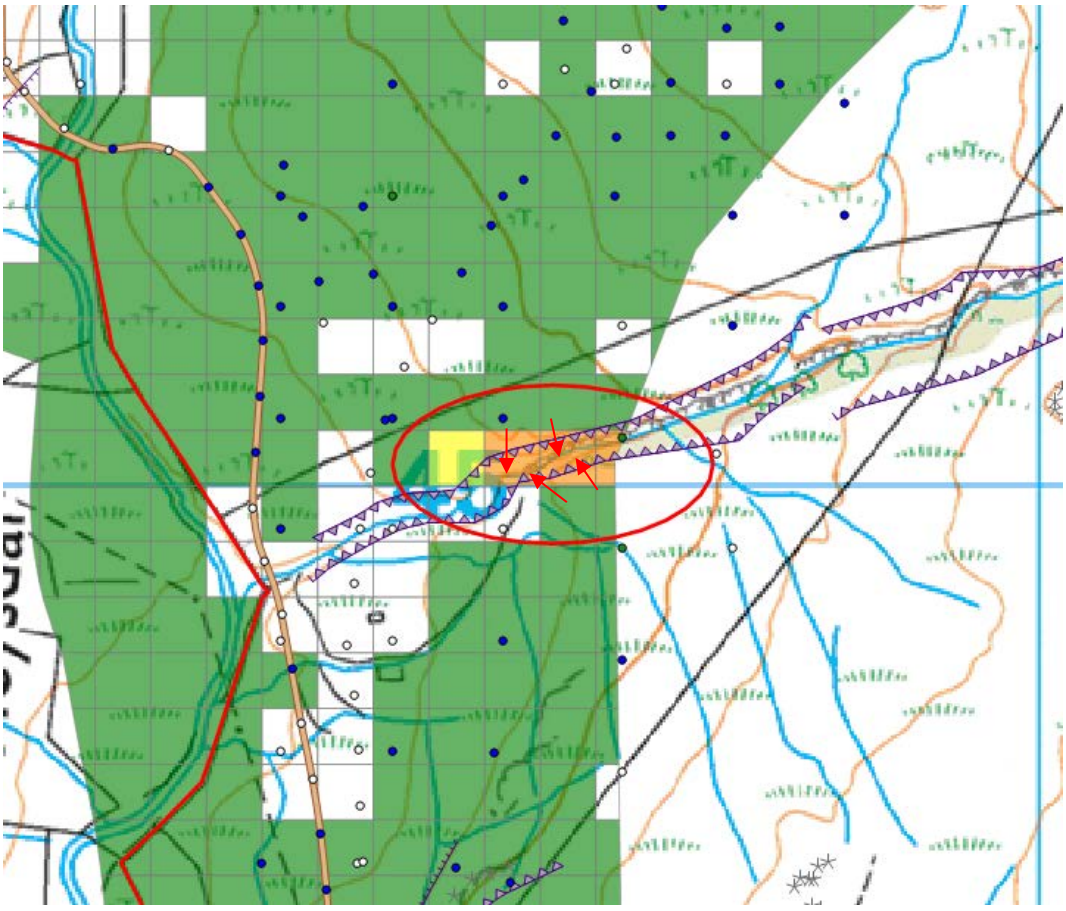
No indications of peat instability or developing instability were recorded in nearby areas during the peat depth and reconnaissance surveys.

Mitigation

There are no plans for any development activity to take place within 300 m of these cells and it is unlikely that any construction activity would have any influence on their stability. The nearest activity would be in relation to construction of Turbine 6 and its associated hardstanding and turning head.

Nearby peat depth records indicate that peat in this area is relatively deep, varying between 0.8 and 2.7 m. However, the steeper slopes and breaks-in-slope that have raised the Likelihood rating are all associated with the incised watercourse channel where it is likely that the peat depths have been over-estimated as a result of the interpolation.

Detailed Assessment: Area 12



Three Moderate Risk cells are highlighted in the area west of the southern access to the Proposed Development, within the channel of the Aketil Burn. The cells are over 200 m from the nearest proposed infrastructure, the new access track. All the cells are intersected by a watercourse with associated breaks-in-slope. There are no direct peat depth records within these cells and nearby peat depth records within the watercourse channel indicate either no peat or peat <1.0 m. The higher Risk ranking is largely a result of the High consequence rating assigned to the watercourse.

Potential runout areas: All the highlighted cells would have potential runout zones into the watercourse channel, the Aketil Burn. Debris may travel down the watercourse for some distance and may pass beyond the Application Boundary. Runout paths are indicated by arrows.

No indications of peat instability or developing instability were recorded in nearby areas during the peat depth and reconnaissance surveys.

Mitigation

There are no plans for any development activity to take place within 200 m of these cells and it is unlikely that any construction activity would have any influence on their stability as all proposed works are located downslope of the highlighted cells. The nearest activity would be in relation to construction of the southern access route.

Nearby peat depth records indicate that peat in this area is either relatively shallow (0.7 m or less) or absent. Some localised areas of deeper peat are present set back from the watercourse channel, but the channel itself is quite rocky and it is likely that the peat depths have been over-estimated by the interpolation.

Mitigation

7.8 The following mitigation measures would be implemented to ensure that slope stability is maintained across the Site and to minimise the risk of inducing a peat slide.

7.9 Construction work would make use of current best practice guidance relating to developments in peatland areas. A risk management system, such as a geotechnical risk register, would be developed as part of the post-consent detailed design works. This would be maintained through all subsequent stages of the project and updated as necessary whenever new information becomes available. During construction, members of project staff would undertake advance inspections and carry out regular monitoring for signs of peat landslide indicators. A geotechnical specialist would be on call to provide advice, if required by Site conditions.

7.10 Micrositing would be used to avoid possible problem areas. This would be assisted by additional verification of peat depths, to full depth, in any highlighted areas where construction work is required. Track drainage would be installed in accordance with published good practice documentation and would be minimised in terms of length and depth in order to minimise concentration of flows.

7.11 Construction activities would be restricted during periods of wet weather, particularly for any work occurring within 20 m of a watercourse or within areas of identified deeper peat (>1.0 m). Careful track design would ensure that the volume and storage timescale for excavated materials would be minimised as far as practicable during construction works.

7.12 Monitoring checks would be undertaken along identified higher-risk watercourse channels following periods of heavy rain and/or high flow. These would look for any recent signs of bank instability that may affect the flow or lead to a larger destabilisation of the nearby bank area. Any identified instabilities would be brought to the attention of the Environmental Manager as soon as possible.

7.13 Vegetation cover would be re-established as quickly as possible on track and infrastructure verges and cut slopes, by re-laying of excavated peat acrotelm, to improve slope stability and provide erosion protection. Additional methods, including hydroseeding and/or use of a biodegradable geotextile, would be considered if necessary in specific areas.

7.14 Construction staff would be made aware of peat slide indicators and emergency procedures. Emergency procedures would include measures to be taken in the event that an incipient peat slide is detected.

7.15 Key early indicators of peat instability are:

- Tension cracks in the upper layers or to full depth of peat may indicate an accumulation of stress in peat soils. In addition, cracking can provide a route for surface water to infiltrate rapidly through the peat body, contributing to elevated pore water pressure and lubrication along lines of weakness.
- Compression ridges, usually indicative of displacement upslope which has led to formation of ridges within the peat body.
- Peat creep, usually visible as tilting of fence posts or young trees. This may be accompanied by tension cracking and/or compression ridges.

Infrastructure Design

7.16 Careful and informed infrastructure design forms a key measure for prevention of induced instability in peat. The collated peat depth information has been used to inform the proposed infrastructure layout throughout the design process. Incursion into areas of deeper peat has been kept to a practical minimum by careful design and will be reinforced by careful micrositing, in order to minimise disruption to peatland ecosystems and hydrology, and to avoid the risk of induced peat instability.

7.17 Access tracks are anticipated to be constructed using established cut-and-fill construction methods for peat of 1.0 m deep or less, with floating construction intended for the small areas where peat deeper than 1.0 m needs to be crossed. Any peat present along the cut-and-fill track routes would be excavated and stored for use in reinstatement of trackside verges and other elements of project infrastructure where appropriate.

7.18 Trackside ditches would be constructed as required. For tracks parallel or sub-parallel to contours, best practice recommendations are for a ditch along the uphill side only, with cross-drains installed at regular intervals below the track to minimise flow concentration. Cross-drains would discharge onto vegetated ground where possible, to encourage spread of surface flow rather than focused flow and the consequent development of new drainage channels. Tracks crossing contours may require ditches or swales on both sides. In all cases, lengths and depths of trackside drainage would be minimised, particularly in areas where peat deeper than 1.0 m is present. There would be a requirement for some trackside drainage to minimise track surface erosion and damage.

8 CONCLUSIONS

8.1 A detailed assessment of peat slide risk has been carried out for the Proposed Development. All proposed new and upgraded infrastructure, plus existing infrastructure proposed for decommissioning, has been covered by the assessment.

8.2 The assessment found that the majority of the Site has a negligible or low risk of peat landslide.

8.3 Nine grid cells forming four groups, located close to proposed infrastructure, have been identified as having a Moderate risk of peat instability. These have been individually appraised in greater detail taking into account location-specific details. In most cases, the apparent risk is an artefact of the assessment mechanism, which uses maximum peat depth and average slope for each grid cell. In the highlighted cells, the areas of interpolated deep peat were found to over-estimate the likely peat depth in these areas. The highlighted cells were also located in areas with distinct breaks-in-slope, associated with watercourse channels, which gave them a higher likelihood rating as a result of the changing slope angles. The reassessed risk of instability is Negligible or Low rather than the initial assessment of Moderate.

8.4 Eight additional areas of apparent Moderate risk have been identified. These are mainly associated with incised watercourse channels or changes in slope angle in other parts of the Site. In most of these areas, the peat depths used in the assessment have been determined through interpolation and are likely to over-estimate, in some cases considerably, the actual peat depths on the ground. In locations where direct peat depth records are available, the deeper peat and steeper slopes have been found not to be coincident and the apparent risk is an artefact of the assessment mechanism. These areas are all distant from proposed infrastructure or decommissioning works and there would be no requirement for construction or decommissioning activity to approach these areas. It is recommended that construction areas are demarcated and all site staff are made aware of the requirement to stay within the marked construction or decommissioning corridor at all times.

8.5 For all eight areas, mitigation measures have been recommended to control the peat landslide hazard. For all areas, the peat landslide hazard can be controlled by use of good construction practice and micrositing. Revised risk rankings taking into account location-specific details and mitigation measures are Negligible or Low across the Site.

8.6 Good construction methods and appropriate micrositing would also be effective at controlling residual peat landslide risk for lower-risk locations at the Site. Providing that the recommended mitigation measures are put in place and adhered to, the risk of peat landslide hazard as a result of the Proposed Development is not significant.

9 REFERENCES

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10 ANNEX 1: PEAT CORE LOGS

Notes to Accompany Peat Coring Results
Peat coring was undertaken by WRc on 1-2 November 2022, during Phase 2 peat depth surveying. Three locations were identified by WRc to be targeted, prior to the works.

Main Findings
Coring locations C1, C2 and C3 were located within areas of identified peat located near turbines T4, T7 and T2, respectively. Ground conditions at C1 were boggy, at C2 were slightly boggy and C3 were well-drained. Vegetation at all locations included grass and heather.

Generally, peat was more decomposed at depth. At depth there was fluctuation in decomposition between moderately highly decomposed peat and practically fully decomposed peat. Moisture content of cores ranged from low to high.

Cores recovered from C1 returned peat to a depth of 1.9 m bgl. This consisted of a surface layer (0.30 m) of moderately highly decomposed peat, underlain by slightly to moderately decomposed peat. Between 1.00 – 1.40 m bgl was a layer of very highly to practically fully decomposed peat, and below this was very highly decomposed peat. Moisture content of cores ranged from moderate to high.

Cores recovered from C2 returned peat to a depth of 1.5 m bgl. This core recovered a layer (0.25 m bgl) of very slightly decomposed peat which was underlain by peat ranging from highly decomposed to practically fully decomposed. Moisture content of cores ranged from low to moderate.

Cores recovered from C3 returned peat to depth of 1.5 m bgl. The top layer of peat (0.30 m bgl) was very slightly decomposed and underlain by layers of moderately to highly decomposed peat. The basal 0.10 m of the core returned very highly decomposed peat. Moisture content of cores ranged from low to high.

Photographs of all recovered cores are included at the end of this document.

Peat Core Logs

ID	X	Y	Peat Depth (m)	Notes
C1	132268	847445	2.1	Sampled 1.60 – 1.90 m. 0.00 – 0.30 m bgl: H6 B3, moderately highly decomposed peat with a very indistinct plant structure. When squeezed, about one-third of peat escapes between fingers. The residue is pasty but shows the plant structure more distinctly than before squeezing. Moderate moisture content. Dark brown. 0.30 – 0.50 m bgl: H4/5 B3, slightly to moderately decomposed peat which, when squeezed, releases very muddy brown water with very small amounts of granular amorphous peat escaping between fingers. Plant remains are pasty and have lost most identifiable features. Moderate moisture content. Lighter brown towards the base. 0.50 – 1.00 m bgl: H4/5 B4, slightly to moderately decomposed peat which, when squeezed, releases very muddy brown water with very small amounts of granular amorphous peat escaping between fingers. Plant remains are pasty and have lost most identifiable features. High moisture content. Amorphous with root material. 1.00 – 1.40 m bgl: H8/9 B4, very highly to practically fully decomposed peat with large quantities of amorphous material and very indistinct to hardly any recognisable plant structure. When squeezed, it is a fairly uniform paste with small quantities of pasty water and some plant material. High moisture content. Uniform brown in colour. 1.40 – 1.70 m bgl: H8 B3, very highly decomposed peat with a large quantity of amorphous material and very indistinct plant structure. When squeezed, about two-thirds of the peat escapes between the fingers. The plant material remaining in the hand consists of residues such as roots and fibres that resist decomposition. Moderate moisture content and drier at base. 1.70 - 1.90 m bgl: H8 B3, very highly decomposed peat with a large quantity of amorphous material and very indistinct plant structure. When squeezed, about two-thirds of the peat escapes between the fingers. The plant material remaining in the hand consists of residues such as roots and fibres that resist decomposition. Moderate moisture content. Darker in colour for the basal 0.20 m.

ID	X	Y	Peat Depth (m)	Notes
C2	131421	847093	1.5	Sampled 1.15 – 1.35 m. 0.00 – 0.25 m bgl: H3 B3, very slightly decomposed peat which, when squeezed, releases muddy brown water, but from which no peat passes between fingers. Plant remains are still identifiable with no amorphous material present. Moderate moisture content. Some roots present and mid-brown in colour. 0.25 – 0.50 m bgl: H7 B2/3, highly decomposed peat which contains a lot of amorphous material with very faintly recognisable plant structure. When squeezed, about one-half of the peat escapes fingers. Very little water released which is very dark and almost pasty. Low to moderate moisture content. Dark brown with less roots than above. 0.50 – 0.65 m bgl: H8 B2, very highly decomposed peat with a large quantity of amorphous material and very indistinct plant structure. When squeezed, about two-thirds of the peat escapes between the fingers. The plant material remaining in the hand consists of residues such as roots and fibres that resist decomposition. Low moisture content. Dark brown with some roots. 0.65 – 1.00 m bgl: H9 B2, practically fully decomposed peat in which there is hardly any recognisable plant structure. When squeezed, it is a fairly uniform paste. Low moisture content. 1.00 – 1.20 m bgl: H8 B2/3, very highly decomposed peat with a large quantity of amorphous material and very indistinct plant structure. When squeezed, about two-thirds of the peat escapes between the fingers. The plant material remaining in the hand consists of residues such as roots and fibres that resist decomposition. Low to moderate moisture content. Dark brown. 1.20 – 1.50 m bgl: H8 B2/3, very highly decomposed peat with a large quantity of amorphous material and very indistinct plant structure. When squeezed, about two-thirds of the peat escapes between the fingers. The plant material remaining in the hand consists of residues such as roots and fibres that resist decomposition. Low to moderate moisture content. Brown with very dark banding and some roots.

ID	X	Y	Peat Depth (m)	Notes
C3	131142	848565	1.6	Sampled 1.00 – 1.20 m. 0.00 – 0.30 m bgl: H3 B4, very slightly decomposed peat which, when squeezed, releases muddy brown water, but from which no peat passes between fingers. Plant remains still identifiable and no amorphous peat present. High moisture content. Light brown with roots. 0.30 – 0.50 m bgl: H5/6 B4, moderately to moderately highly decomposed peat which, when squeezed, releases muddy brown water and some peat between fingers. The plant structure is quite indistinct with some fibrous roots. High moisture content. Brown grading to dark brown at 0.40 m. 0.50 – 0.75 H6 B3/4, moderately highly decomposed peat with an indistinct plant structure. When squeezed, about one-third of the peat escapes between the fingers. The residue is very pasty but shows the plant structure more distinctly than before squeezing. Decomposed but rooty/fibrous. Moderate to high moisture content. Slightly paler than above except top 5 cm. 0.75 – 1.00 H7 B3/4, highly decomposed peat. Contains a lot of amorphous material with very faintly recognisable plant structure. The water, if any is released, is very dark and almost pasty. Base is less rooty and fairly amorphous. Moderate to high moisture content. 1.00 – 1.20 H6 B3/4, moderately highly decomposed peat with an indistinct plant structure. When squeezed, about one-third of the peat escapes between the fingers. The residue is very pasty but shows the plant structure more distinctly than before squeezing. The top is still fibrous but fairly amorphous. Moderate to high moisture content. 1.20 – 1.40 H6 B3/4, moderately highly decomposed peat with an indistinct plant structure. When squeezed, about one-third of the peat escapes between the fingers. The residue is very pasty but shows the plant structure more distinctly than before squeezing. The lower 20 cm of peat is darker in colour with no roots. Moderate to high moisture content. 1.40 – 1.50 H8 B2, very highly decomposed peat with a large quantity of amorphous material and very indistinct plant structure. When squeezed, about two-thirds of the peat escapes between the fingers. The plant material remaining in the hand consists of residues such as roots and fibres that resist decomposition. Grey silty mineral soil which is very firm with gravel & gritty content which grades into peat. Low moisture content.

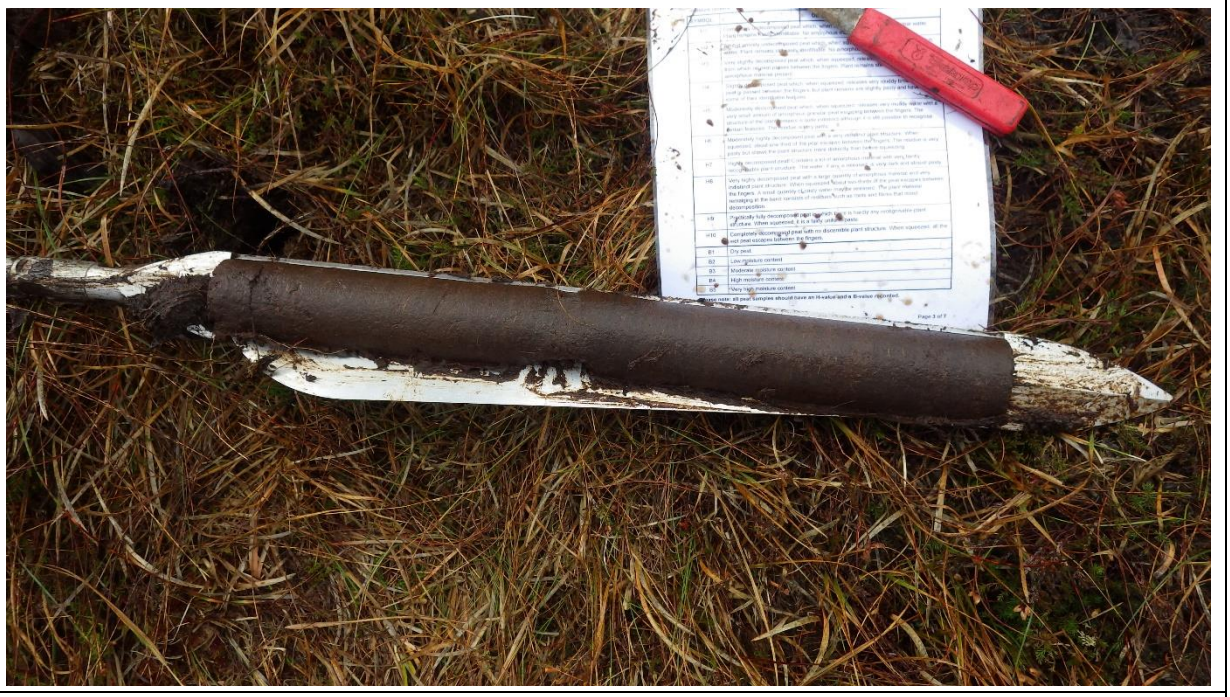
Location: C1	Depth: 0.00 – 0.50 m bgl	Date: 01/11/2022

Notes: Core interior of moderately highly decomposed peat with indistinct plant structure and dark brown in colour, overlying slightly to moderately decomposed peat which is lighter in colour and of moderate moisture content.

Location: C1	Depth: 0.50 – 1.00 m bgl	Date: 01/11/2022

Notes: Core interior of slightly to moderately decomposed peat which is generally amorphous with some root material and high moisture content. Brown to dark brown in colour.

Location: C1	Depth: 1.00 – 1.50 m bgl	Date: 01/11/2022



Notes: Core interior of very highly to practically fully decomposed peat with large quantities of amorphous material, little recognisable plant structure and uniform colour until the basal 0.10 m which is darker brown.

Location: C1	Depth: 1.50 – 2.00 m bgl	Date: 01/11/2022

Notes: Core interior of very highly decomposed peat with lots of amorphous material and limited indistinct plant structure. Dark brown in colour with the basal 0.20 m grading into very dark brown.

Location: C2	Depth: 0.00 – 0.50 m bgl	Date: 01/11/2022

Notes: Core interior of very slightly decomposed peat with identifiable plant remains and no amorphous material, underlain by highly decomposed peat with faintly recognisable plant structure and darker brown in colour than above.

Location: C2	Depth: 0.50 – 1.00 m bgl	Date: 01/11/2022

Notes: Core interior of very highly to practically fully decomposed peat with lots of amorphous material and indistinct plant structure. Dark brown with some root fibres present towards the top of the core and more uniform below.

Location: C2	Depth: 1.00 – 1.50 m bgl	Date: 01/11/2022

Notes: Core interior of very highly decomposed peat comprising amorphous material and indistinct plant structure. Brown with very dark brown banding throughout.

Location: C3	Depth: 0.00 – 0.50 m bgl	Date: 02/11/2022

Notes: Core interior of very slightly decomposed peat with identifiable plant remains and light brown in colour, overlying moderately to moderately highly decomposed peat with some fibrous roots which is darker in colour.

Location: C3	Depth: 0.50 – 1.00 m bgl	Date: 02/11/2022

Notes: Core interior of moderately highly to highly decomposed peat with faintly recognisable plant structure. The top of the core is slightly darker in colour compared to below which is mid-brown.

Location: C3	Depth: 1.00 – 1.50 m bgl	Date: 02/11/2022

Notes: Core interior of moderately highly decomposed peat which at the top is slightly fibrous. This overlies very highly decomposed peat which has bands of grey silty mineral soil and grit.

11 ANNEX 2: AUTHOR EXPERIENCE

This report was produced by Lucy McCulloch and Emma Barrie, under the supervision of Catherine Isherwood.

Field surveys were undertaken by Emma Barrie and Lucy McCulloch, supported by Spyridonas Angeli and Callum Strachan. All are members of professional institutions and are working towards chartership. Emma and Lucy have significant experience of peat surveying and classification from wind farm developments, peatland restoration surveys, overhead line route studies and ground investigation works, and other infrastructure projects including substation development and major road alignments.

Catherine Isherwood is a Chartered Geologist with an MA and PhD in Geological Sciences from the University of Cambridge and an MSc in Hydrogeology from Newcastle University. She has over 17 years' experience in environmental impact assessment and the assessment of peat and slope stability.

The report has been reviewed and authorised by Catherine Isherwood.

The assessment method was developed with input from a Chartered Engineer and a Chartered Environmentalist with a combined experience of more than 35 years.

FIGURES

127000 128000 129000 130000 131000 132000 133000 134000 135000 136000

851000 850000 849000 848000 847000 846000 845000 844000

1 2 3 4 5 6 7 8 9

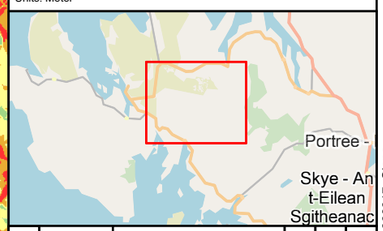
Legend:

- The Site
- Proposed New Turbine Locations
- Existing Turbine Layout
- Hardstanding
- Existing Access Track
- Existing Crofters' Track
- Bell mouth junction modification
- Floating Access Track
- Wind Farm Access Track
- Northern Access Track
- Southern Access Track
- Construction Compound
- Substation and Compound Area (Repower)
- Substation and Compound Area (Extension)
- Borrow Pit
- Storage Bund
- Battery Storage

Slope angle

- Less than 4 degrees
- 4 - 8 degrees
- 8 - 12 degrees
- Greater than 12 degrees

Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter



Rev	Date	Description	Drn	Chk	App
00	18/04/2023	Slope	DL	SA	DB

Ben Aketil Wind Farm

RSK Renantis Rock Renewables

TITLE: Figure 9.1.1:
Slope mapping

ID:P663617_PSRA_663617_Slope

0 0.5 1
Kilometres

Scale: 1:28,000 @ A3

N W E S

REV 00

Path: P:\660000 - EPD Projects\663617 - Ben Aketil\01 - GIS\P663617_PSRA.aprx\663617_Slope