2.5.6 Other Indicators

Herbivores were observed to be present and grazing within the site during site surveys.

Photo 8: Sheep grazing to the east of Turbine 5. Taken from NN 88956 01829 facing east.

2.5.7 Assessment Summary

The overall condition of the site is described as modified condition class within the **NVC report**[16]. The presence of active grazing, ATV tracks, active erosional and drainage features over large areas of the proposed development provide further evidence of modified to actively eroding peat condition.

3.0 Fieldwork

3.1 Peat Surveys

Peat surveys were carried out in accordance with best practice guidance for developments on peatland[20,21]. Phase 1 peat probing was conducted on a 100m grid to allow for initial assessment of the site which was used in preliminary site layout designs. Phase 2 probing saw detailed probing undertaken across the proposed development layout, focussing on access tracks, turbines, hardstandings and other site infrastructure. Phase 2 probing was typically undertaken on linear infrastructure (permanent / temporary tracks) at 25m to 50m spacings with offset probing locations either side (approximately 10m to 25m). Infrastructure (turbines, hardstandings, compounds, etc.) was typically probed at 10m grid spacings.

SLR assessed the thickness of the peat using a graduated peat probe, approximately 6mm diameter and capable of probing depths of up to 10m. This was pushed vertically into the peat to refusal and the depth recorded, together with a unique location number and the co-ordinates from a handheld Global Positioning System instrument (GPS). The accuracy of the GPS was quoted as ±2m, which was considered sufficiently accurate for this survey. All data was uploaded into a GIS database for incorporation into various drawings and analysis assessments.

Where the peat probing met refusal on a hard substrate, the 'feel' of the refusal can provide an insight into the nature of the substrate. The following criteria were used to assess material:

- Solid and abrupt refusal – rock;
- Solid but less abrupt refusal with grinding or crunching sound – sand or gravel or weathered rock;
- Rapid and firm refusal – clay; or
- Gradual refusal – dense peat or soft clay.

The relative stiffness of the peat was also assessed from the resistance to penetration of the probe and from the effort required to extract the probes (retrieval of the probe was often impossible for one person). In all instances refusal was met on obstructions allowing identification of subsurface geology.

3.2 Peat Depth

Peat is generally defined as a soil with a surface organic layer in excess of 0.5m[20]. Where the probing recorded less than 0.5m thick, it is considered to be a peaty soil (or organo-mineral soil). Soils with a peaty organic horizon over mineral soil are often referred to as 'peaty soils'. These organo-mineral soils are extensive across the UK uplands, but do not meet recognised definitions of peat as they are either shallower than true peat or have a lower carbon density.

A total of 7,299 peat probes were undertaken across all survey phases, with the results summarised in **Table 3-1** and detailed within the peat depth interpolation figures provided in **Figure 10.2.3** and **Figure 10.2.4**. The interpolation was undertaken using the Spline with Barriers tool in ArcGIS Pro methodology. The average thickness of peat recorded across the proposed development was 0.7m and the maximum depth of recorded peat was 4.0mbgl.

[20] Scottish Renewables & SEPA (2012) 'Developments on Peatland Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste'.

[21] Scottish Natural Heritage (SNH), SEPA, Scottish Government & James Hutton Institute. (2014)' Peat Survey Guidance; Developments on Peatland: Site Surveys'.

Table 3-1: Peat Probing Results

Peat Thickness (m)	No. of Probes	Percentage (of total probes undertaken on-site)
0 (no peat)	32	0.4
0.01 – 0.49 (peaty soil)	3490	47.8
0.50 – 0.99	1679	23.0
1.00 – 1.49	1019	14.0
1.50 – 1.99	640	8.8
2.00 – 2.49	318	4.4
2.50 – 2.99	89	1.2
3.00 – 3.49	26	0.4
3.50 – 3.99	5	0.1
> 4.0	1	0.0

3.3 Physical Peat Condition

Peat is described using BS5930[22] and the Von Post classification[23]. Six peat cores and samples were collected by SLR during Phase 2, using a peat auger and used to inform interpretations of the underlying physical peat condition and underlying substrate (see **Table 3-2**). Peat samples were undertaken to depths of between 1.0 and 2.8 mbgl. The peat cores recorded fibrous to pseudo-fibrous condition.

Table 3-2: Peat Coring Results

Location	Von Post Degree of Decomposition	Description
PC01:	GL-1.20 1.20-2.50	H2, B2 H4, B2
PC02:	GL-0.70 0.70-1.90	H2, B2 H4, B3
PC03:	GL-0.50 0.50-2.50	H2, B2 H4, B2
PC04:	GL-0.50 0.50-1.00	H2, B2 H3, B2
PC05:	GL-0.50 0.50-2.75 2.75-2.80	H2, B2 H4, B2
PC06:	GL-0.70 0.70-1.50	H2, B2 H4, B2

Peat core logs and photographs are presented within **Annex B**.

[22] BS 5930:2015+A1:2020, Code of practice for ground investigations

[23] Von Post, L. and Grunland, E., (1926), 'Sodra Sveriges torvillganger 1' Sverges Geol. Unders. Avh., C335, 1-127.

4.0 Potential Impacts on Peat During Construction

The initial construction phase for the proposed development will include soil and peat stripping and excavation activities associated with construction of the proposed development.

There are four main types of impact on peat which can occur during construction. These are:

- Loss of structural integrity and peat strength, due to stripping off or damaging the surface vegetation turf, excavation, handling and transporting peat (particularly wet, subsurface peat);
- Erosion and gullying, caused by exposure and desiccation of bare peat surfaces primarily caused by water erosion, due to surface runoff after rainfall;
- Contamination, caused by leaks, spillages or inappropriate laydown of materials; and
- Peat slide, caused by laying wet peat on top of wet peat, laying other heavy materials (including excavated mineral soil or other construction materials) on top of wet peat or by inappropriate stockpiling, such as attempting to create stockpiles of peat that are too high, without bunding, engineering or geotechnical support.

A range of methods and control measures are described below which are designed to prevent these impacts from occurring.

5.0 Peat Management and Mitigation

The proposed development design took account of a number of environmental and technical constraints. The design sought to avoid areas of thick peat where technically feasible, whilst taking into account other environmental factors such as ecology, ornithology, archaeology, hydrology and topography. The proposed development design evolution has largely avoided extensive areas where peat is >1m.

There are areas of both permanent and temporary infrastructure within the proposed development which are on areas of deep peat >1m and it is acknowledged that the main mitigation will be further micro-siting of turbines and infrastructure, adoption of sections of floating road where technically feasible and use of temporary hardstands to minimise excavation of peat during the construction phase.

Further details on mitigation through design included within the proposed development design evolution are provided in **Chapter 2: Site Description and Design Evolution** of the EIA Report.

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Where peat and peaty soils are to be excavated, re-used or reinstated, the following good practice applies to protect carbon rich soils and mitigate impacts to peat.

5.2 Excavation

Excavated peat should be excavated as turves, including the acrotelm (surface vegetation) and a layer of adjoining catotelm (more humified peat) typically up to 0.5m thick in total, or as blocks of catotelm; the acrotelm should not be separated from its underlying peat;

- the turves should be as large as possible to minimise desiccation during storage, though the practicalities of handling should be considered;
- the mixing of excavated peat with substrate materials to be avoided at all times; and
- consider timing of excavation activities to avoid very wet weather and avoid multiple handling to minimise the likelihood of excavated peat losing structural integrity.

If possible, extract intact full depth acrotelm layers from the top surface of the peat deposit. This technique will maintain connectivity between the surface vegetation and the partially decomposed upper layers of the catotelm.

5.3 Re-use

It is anticipated that the volume of material excavated for the construction of the proposed development can be entirely reused for a variety of re-use, re-instatement and restoration purposes, including around constructed structures, restoration of temporary hardstanding areas, borrow pits and road verges. There is also potential for excavated peat to be used for habitat and peat restoration on or locally to the proposed development. This potential re-use option has not been quantified but will provide an additional method to retain and beneficially re-use material. Further details are provided in Section 6.0.

5.4 Temporary Peat Storage

The following good practice applies to the storage of peaty soils/peat:

- stripped materials should be carefully separated to keep peat and other type of soils apart;
- to minimise handling and haulage distances, excavated material should be stored local to the site of excavation or end point of restoration;
- peat turves would be stored in wet conditions or irrigated in order to prevent desiccation (once dried, peat will not rewet);
- stockpiling of peat would be in large volumes to minimise exposure to wind and sun (and desiccation), but with due consideration for slope stability, but should not exceed 1m in height to maintain stability of stockpile;
- stockpiles would be isolated from watercourses or drains with appropriate bunding to minimise pollution risks;
- to be stored a minimum of 10m from any watercourse.
- stores of non-turf (catotelm) peat should be bladed off to reduce the surface area and desiccation of the stored peat; and
- peat storage areas would be monitored during periods of very wet weather, or during snowmelt, to identify early signs of peat instability.

Any peaty soils/peat to be removed during construction would require a temporary storage area near to the construction works/area of re-use. Where peat cannot be transferred immediately to an appropriate restoration area, short term storage will be required. In this case, the following good practice applies:

- peat would be stored around the excavation perimeter at sufficient distance from the cut face to prevent overburden induced failure;
- local gullies, diffuse drainage lines (or very wet ground) and locally steep slopes should be avoided for peat storage;
- drying of stored peat should be avoided by irrigation or by seeding (although this is unlikely to be significant for peat materials stored for less than 2 months);
- peat generated from permanent excavations should be transported directly to its allocated restoration location, to minimise the volume being stockpiled with the possibility of drying out;
- stores of catotelm peat should be bladed off to reduce their surface area and minimise desiccation;
- where transport cannot be undertaken immediately, stored peat should be irrigated to limit drying and stored on a geotextile mat to promote stability; and

- monitoring of large areas of peat storage during wet weather or snowmelt should be undertaken to identify any early signs of peat instability.

5.5 Transport

The following good practice applies to transport:

- movement of turves should be kept to a minimum once excavated, and therefore it is preferable to transport peat planned for translocation and reinstatement to its destination at the time of excavation; and
- if heavy goods vehicles (HGVs)/dump trucks that are used for transporting non-peat material are also to be used for peat materials, measures should be taken to minimise cross-contamination of peat soils with other materials.

5.6 Handling

Following refinement of the excavated peat volumes, a detailed storage and handling plan would be prepared forming part of the detailed CEMP, including details of:

- best estimate excavation volume at each infrastructure location (including peat volumes split into area/volume of 'acrotelm' or 'turf', and volume of catotelm) which would be achieved by undertaking additional probing in line with current guidance;
- volume to be stored locally and volume to be transferred directly on excavation to restoration areas elsewhere (e.g. peat storage areas) in order to minimise handling;
- location and size of storage area relative to turbine foundations and infrastructure locations and natural peat morphology / drainage features; and
- irrigation requirements and methods to minimise desiccation of excavated peat during short term storage.

These parameters are best determined post-consent, informed by detailed ground investigation with the micro-siting areas for each element of infrastructure.

5.7 Restoration

There may be scope for re-use of peat within peatland restoration as detailed within **Technical Appendix 8. Outline Habitat Management Plan.** The methodologies detailed in any future restoration scheme should be followed as well as the following best practice:

- carefully evaluate potential restoration sites, such as peat storage areas for their suitability, and agree that these sites are appropriate with the EnvCoW, landowners and relevant consultees;
- undertake restoration and revegetation or reseeding work as soon as practically possible;
- where required, consider exclusion of livestock from areas of the proposed development undergoing restoration, to minimise impacts on revegetation; and
- as far as reasonably practicable, restoration would be carried out concurrently with construction rather than at its conclusion.

5.8 Access Tracks

There is guidance[5,9] available to support access track design in peatlands. Guidance is generally focused on floating tracks and excavated tracks and is summarised below.

Based on the avoidance of significant areas of thick peat with tracks all typically present on peat <1m and only limited sections of track on localised areas of peat >1m then the use of excavated tracks is proposed for the majority of the track. Floating tracks would be implemented where considered technically feasible following ground investigation and detailed design on suitable length sections (>30m) of access track where peat depths are >0.5m.

Excavated tracks require complete excavation of soil/peat to a competent substrate. Excavated tracks will generally be undertaken where peat depths are less than 0.5m. This peat/soil would require storage ahead of re-use elsewhere within proposed development. Good practice guidance relates mainly to drainage in association with excavated tracks:

- trackside ditches should capture surface water (within the acrotelm) before it reaches the road;
- interceptor drains should be shallow and flat bottomed (and preferably entirely within the acrotelm to limit drawdown of the water table);
- any stripped peat turves should be placed back in the invert and sides of the ditch to assist regeneration and prevent erosion to the peat and wash out that could occur; and
- culverts and cross drains should be installed under excavated tracks to maintain subsurface drainage pathways (such as natural soil pipes or flushes). Discharge from constructed drainage should allow for as much diffuse dispersion of clean (silt free) water as possible while minimising disturbance to existing peatland as far as possible. Silt mitigation measures will be incorporated into all constructed drainage as per the requirements of the CEMP.

Although excavation is normally undertaken in peat of minor thickness (< 1.0m), there is a possibility of minor slippage from the cut face of the peat mass. Accordingly:

- free faces should be inspected for evidence of instability (cracking, bulging, excessive discharge of water or sudden cessation in discharge); and
- where significant depths of peat are to be stored adjacent to an excavation, stability analysis should be conducted to determine Factor of Safety (FoS) and an acceptable FoS adopted for loaded areas.

Regular routine monitoring should be scheduled post-construction to ensure that hydrological pathways and track integrity have been suitably maintained.

5.9 Monitoring and Inspection

There would be frequent, routine and regular inspections of peat in all stockpiles and temporary storage areas as part of the PMP audit process. Inspections would assess in situ peat physical conditions, integrity of containment and temporary drainage conditions, and they would seek to confirm that stockpile design and management was adequate to prevent erosion and peat slide. These inspections would take place weekly during stockpile creation and storage.

Should any problems be observed during regular visual inspections of peat stockpiles, this would invoke implementation of an appropriate corrective action which would be recorded and monitored for effectiveness. Types of corrective actions would include, but would not necessarily be limited to; modification of temporary drainage, additional or modified bunding, incorporating of sediment fencing if required, light re-grading to correct any areas of surface erosion, etc.

Regular, frequent inspections of peat conditions during construction and restoration phases of work would be carried out by the Engineer and EnvCoW as follows:

- peat surface, peat profile and peat consistency conditions would be carried out as part of ground investigations prior to the start of construction. This information would provide detailed information on the baseline conditions for each part of the infrastructure footprint;
- restored peat conditions would be inspected immediately after restoration to ensure that the methods detailed in the PMP had been correctly implemented and to inform any corrective actions should they be required;
- further monitoring to be undertaken where required to ensure restoration works have been correctly implemented; and
- the physical condition of peat would be retained as carefully as possible both at the peat storage and the peat restoration stages. This is particularly important for vegetation establishment.

6.0 Peat Balance Assessment

The volumetric analysis of excavated peat volumes incorporates the mean peat depths recorded across each infrastructure location, based on the interpolation of the survey data. Average peat depths have been assessed based on relevant interpolated data points using the GIS package ArcGIS.

The estimation of peat extraction and re-use volumes relies on a series of design assumptions that may vary on a small scale according to discrete changes in ground conditions. Therefore, it should be highlighted that the peat volume estimates stated in this report are a preliminary indication only. Volumetric calculations should be re-evaluated if more detailed intrusive site investigation data becomes available. Design assumptions with regard to the likely access track construction methods have also been taken. SLR does not warrant these assumptions as a final engineering design for the Proposed Development. The design of the detailed site layout should be confirmed with a comprehensive site investigation.

Table C provides an estimate of peat and peaty soil volumes to be excavated and re-used during the construction of the Proposed Development. The peat and peaty soil excavation and re-use volumes are detailed for each infrastructure element in **Annex A**.

No allowance has been made for potential re-use of peat and peat soils within peatland restoration at this stage of the assessment and further re-use of excavated peat may be possible within bunding to support re-wetting as detailed within the areas detailed in **Technical Appendix 8.4: Outline Habitat Management Plan**.

The peat and peaty soil excavation and re-use volumes are detailed for each infrastructure element in **Annex A**.

6.1 Excavated Volumes

Peat excavation volumes associated with the construction of the proposed development have been calculated using the results from the peat depth surveys and interpolation using the GIS package ArcGIS. Peat excavation volumes are detailed in **Table 6-1** and **Annex A** and based on the following assumptions:

- Interpolation of peat depth was undertaken using the Spline interpolation method.
- An estimated acrotelm depth of 0.5m across all infrastructure based on onsite peat depth survey results.
- The acrotelm volumes have been calculated based on the average peat depth across each item of infrastructure and linear infrastructure based on peat depth survey results.
- An assumption that the peat probe depths are representative of the actual depth of peat (validated by the peat coring).
- The excavated volumes will comprise primarily acrotelmic peat and soils.

6.2 Reuse Volumes

The volume of peat to be reused around the proposed development is detailed in **Table 6-1** and **Annex A** and based on the following assumptions:

- Reuse would be undertaken in appropriate locations around the infrastructure perimeter such as track verges, the edges of permanent structures within a 3m wide strip either side of the track at a thickness of about 1m (turves and acrotelmic peat).
- Reuse would be undertaken in appropriate locations around the perimeter of turbine and hardstandings within a 2m wide strip and with an average peat depth of 1m.

- Reuse would be undertaken in such a manner as to ensure integration with the adjacent habitat areas where possible which comprise blanket bog.
- For temporary infrastructure including temporary hardstandings and compounds – full re-instatement of excavated peat would be undertaken at each location back to original depth.
- Borrow pits to reuse peat with an average peat depth of 0.5m to ensure integration with the adjacent habitat areas where possible.

6.3 Net Peat Balance

Table 6-1 provides an estimate of peat volumes to be excavated and reused during the construction of the infrastructure.

Table 6-1: Peat Balance Assessment

Infrastructure	Volume of Peat Excavated (m^3)	Volume of Peat Reused and Reinstated (m^3)
New Excavated Track	60,067	89,652
Existing Upgraded Track	1,702	1,702
Proposed Turning Head T05	328	300
Proposed Turning Head T09	661	300
Proposed Turning Head T10	980	360
Proposed Turning Head T11	490	300
Proposed Turning Head T13	319	150
Turbine Bases	5,511	1,560
Permanent Hardstandings - Turbine	14,797	6,760
Temporary Hardstandings - Turbine	17,867	17,867
Proposed Substation Compound	1,200	350
Proposed TCC 1	931	2,738
Proposed TCC 2	1,947	3,356
Proposed TCC 3	4,340	5,636
Borrow Pit 1	1,510	2,551
Borrow Pit 2	1,660	1,875
Total	**114,307**	**135,457**

The total volume of peat predicted to be excavated of **114,307m^3**, does not exceed the intended total peat reuse volume of **135,457m^3**, therefore no excess peat is required to be disposed off-site as a consequence of the proposed development.

7.0 Waste Classification

This section of the Stage 1 PMP includes the method for dealing with peat which could potentially be classified as waste (only if the above volumes estimate significant quantities of catotelm peat, which cannot be re-used).

Table 7-1 outlines where those materials that are likely to be generated on-site, fall within the Waste Management Licensing (Scotland) Regulations 2011.

Based on the results presented in this document, it has been concluded that all of the materials to be excavated on-site would fall within the non-waste classification and would be re-used on-site. Based on a detailed probing exercise and visual inspection of the peat, it is predominantly fibrous peat which would be suitable to be re-used on-site. Typically, the peat was found to be fibrous and fairly dry within the top metre before becoming slightly more pseudo-fibrous with depth.

Table 7-1: Excavated Materials – Assessment of Suitability

Excavated Material	Indicative Volume % of total excavated soils	Is there a suitable use for material	Is the Material required for use on Site	Material Classified as Waste	Re-use Potential	Re-use on Site
Turf and Acrotelmic Peat	75	Yes	Yes	Not classified as waste	Yes	Will be re-used in reinstatement of access track verges, cut and fill verges, road verges, side slopes and check drains. Peripheral embankments of turbine bases, crane hardstandings and reinstatement of borrow pits.
Upper Catotelmic peat	25	Yes	Yes	Not classified as waste	Yes	Will be re-used in reinstatement of floated access track verges, cut and fill verges, road verges, side slopes and check drains. Peripheral embankments of turbine bases, crane hardstandings and reinstatement of borrow pits.
Amorphous Catotelm Peat (amorphous material unable to stand unsupported when stockpiled >1m)	0	Potentially	Potentially*	Potentially if not required as justifiable restoration of habitat management works	Limited	If peat does not require treatment prior to re-use it can be used on-site providing adequate justification and method statements are provided and approved by SEPA. If it is unsuitable for use without treatment then it may be regarded as a waste. However every attempt to avoid this type of peat has been incorporated into the design.

*Such uses for this type of material are limited, however there may be justification for use in the base of peat restoration areas to maintain waterlogged conditions and prevent desiccation of restored area and in some habitat management works such as gully or ditch blocking where saturated peat is required to mimic mire type habitats and encourage establishment of sphagnum.

8.0 Conclusion

This Stage 1 Outline PMP presents a pre-construction assessment of the expected peat extraction and reuse volumes associated with the works phase of the construction of the proposed development.

Through a process of continued design refinement (focused on minimising peat excavation volumes) and adoption of best practice working method, the proposed development is expected to achieve an overall peat balance, i.e. the volume (and character) of excavated peat compliments requirements for re-use and reinstatement. Thus, all excavated material will be required for reuse as part of the works and no surplus peat is anticipated.

A detailed geotechnical probing exercise at 7,299 locations in areas of identified peaty soil/peat was undertaken to determine the thickness thereof. The peat was found to vary across the site in terms of thickness and coverage. Peat deposits are most frequent across the central and eastern parts of the site. Deposits are typically localised and associated with topographic hollows, gentle slopes and flatter expanses that allow for the formation of peat. The main access track and areas of forestry plantation are largely absent of significant peat deposits.

The site supports moderately decomposed peat with a very distinct plant structure that is considered suitable for re-use during reinstatement work, e.g. dressing of infrastructure edges, restoration and borrow pit restoration. Good practice standards, which will be outlined in the updated CEMP, relating to excavation, handling and storage of peat, shall ensure against any compromise to the structural integrity of the peat and its associated suitability for reuse.

Avoidance of localised pockets of deep peat that would otherwise require excavation will continue to be a key design refinement objective. Furthermore, it is expected that such micro-siting onto land supporting shallower peat deposits shall be possible during the construction of the proposed development.