SSE Renewables

Cloiche Wind Farm Additional Information

Technical Appendix 4.5 - Outline Habitat Management Plan

Wood Group UK Limited – June 2022

Report for

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Contents

1. Introduction

1.1.1 This outline Habitat Management Plan (oHMP) has been prepared as part of a package of Additional Information (AI) to support the 29 Turbine Proposed Development at Cloiche Wind Farm. This report, is therefore, provided as a technical appendix to **Chapter 4 - Ecology (Volume 1)**.

1.1.2 The oHMP provides a summary of the rationale, objectives, baseline conditions, restoration opportunities and scope of habitat management works in relation to the delivery of both on- and off-site habitat restoration within the Glendoe and Garrogie Estates, providing a substantial package of restoration opportunities, that not only offset predicted loss of blanket bog habitat from within the proposed wind farm, but provides enhancement measures or Biodiversity Net Gains for the development.

1.1.3 A final Habitat Management Plan (HMP), which would include specific prescriptions and confirmation of the peatland restoration locations, would be agreed with relevant statutory agencies including NatureScot, SEPA, The Highland Council (THC) and discussed with relevant interested organisations such as RSPB, prior to the commencement of construction of the Proposed Development.

1.2 Background

1.2.1 SSE Renewables (SSE) submitted an application for a 36 turbine wind farm at Cloiche south east of Fort Augustus in May 2020. NatureScot objected to the proposal on 24 September 2020 on the basis of "*significant adverse impacts on the nationally important carbon-rich soils, deep peat and priority peatland habitat which are present on the site*".

1.2.2 In the Annex to the letter of the 24 September 2020 one of the issues raised in relation to peatlands was "*…the compensatory restoration proposed is of an insufficient scale to offset the anticipated loss and damage to high quality priority peatland habitat. We consider that restoration on a sufficiently large scale is unlikely to be feasible at this site.*"

1.2.3 Peatland restoration proposals previously identified in the Environmental Impact Assessment Report (EIAR) were for the restoration and enhancement of a minimum of 13.92 ha of blanket bog within the proposed Cloiche Wind Farm Site (hereafter Cloiche Site). However, in light of NatureScot's comments, it was considered that a more substantial and ambitious package of peatland restoration and habitat management proposals would be required in order to provide sufficient assurance that adverse construction impacts could be adequately offset and biodiversity enhancement measured offered.

1.2.4 On this basis, a package of AI has been prepared, comprising updated vegetation surveys and condition assessment; a suite of baseline condition data and supporting evidence base outlined in Section 2.1; revisions to the site layout of the Proposed Development, associated habitat loss calculations based on robust updated survey

data; and a revised Deer Management Plan have helped inform the production of this plan.

1.3 Revised Cloiche Wind Farm Layout

1.3.1 The original application was submitted for a 36-turbine scheme (the 36 Turbine Scheme) the minimum total installed capacity of which would have been 150 MW. The 29 Turbine Proposed Development covered by the Additional Information would comprise 29 turbines with a tip height of up to 149.9 metres (m). It would see the removal of Turbines 20, 21, 22, 23, 27 and 28 from the western cluster and Turbine 29 from the eastern cluster of the original scheme.

1.4 Rationale

1.4.1 During the development phase of the 29 Turbine Proposed Development, the Applicant has minimised any potential ecological impacts; firstly, by designing the wind farm to avoid or limit ecological impacts wherever practicable (see **AI Chapter 2: Site Selection and Design Evolution**), and secondly, by undertaking to employ industry best environmental-practice during wind farm construction and operation (see **AI Chapter 4: Ecology**; and the **Construction and Environmental Management Plan (CEMP))**.

1.4.2 Within the **AI Chapter 4: Ecology**, the following habitat loss is predicted:

- Direct loss of 19.2 hectares (Ha) of blanket bog habitats due to infrastructure including borrow pits;
- Indirect modification of 23.84 Ha of blanket bog due to indirect effects during the lifespan of the Proposed Development

1.4.3 The following document outlines criteria for identifying and delivering ecological enhancement in the form of blanket bog habitat restoration measures both on and off-site in order to deliver net positive effects. The aim would be to contribute a greater area than that which is predicted to be affected by the Proposed Development, providing additional enhancement to the surrounding landscape including improved connectivity and restoration within the Monadhliath Special Area of Conservation (SAC).

1.4.4 Peat management and reinstatement during and following construction are detailed separately in the outline CEMP and Peat Management Plan (PMP) (**Technical Appendix 7.1**).

1.5 Aims and Objectives of the oHMP

1.5.1 This oHMP has been completed following best practice guidance from NatureScot (SNH, 2016). The purpose of the plan is:

- At the earliest opportunity following commissioning of the windfarm, to restore and enhance **c.150 ha** of blanket bog habitat including habitats within the Monadhliath SAC. Proposals will help encourage vegetation cover of the peatland and limit peat erosion and carbon loss. The peatland restoration may also allow areas of the peatland to become actively peat forming. Proposals will improve the quality and extent of blanket bog and offset habitat loss incurred as a result of the Proposed Development, as well as well as providing additional enhancement through improvements to the condition of blanket bog habitat within the SAC;
- Work in conjunction with the Deer Management Plan (DMP) to manage grazing/trampling pressures to ensure that blanket bog vegetation can re-establish on areas of bare peat through reduction of deer grazing pressure and improve the quality of blanket bog within the candidate HMUs and the wider area.

1.5.2 Similar to the Strategic peatland restoration works within the wider Monadhliath, proposals within the Cloiche Wind Farm HMUs will also:

- Slow down or halt the loss of particulate organic carbon in the near-term, by re-vegetating actively eroding bare peat and blocking sediment flow pathways down gullies;
- help reduce downstream flooding (with restored bogs holding back more water in the upper catchment for longer than would otherwise be the case in a degraded bog system);
- Help to re-wet eroding gully bases and peat pan bases in the near-term, to allow secondary bog vegetation to develop in the medium-term. This could lead to the sequestration of new carbon in the longer-term;
- Expand the number and size of seasonal and permanent bog pools present on the wider site in the near-term, which should deliver biodiversity benefits such as increased insect life in the medium-term and increased habitat suitability for upland waders such as snipe, golden plover, greenshank and dunlin; and
- Reduce direct losses of CO_2 to the atmosphere from peat oxidation in the long-term, by re-wetting parts of the wider eroding peat mass (e.g. lower gully walls, peat pan bases etc).

1.5.1 Peatland restoration of the scale proposed would likely make a substantial contribution to improving the overall ecology of the area, reducing carbon emissions, stabilising bare peat surfaces and potentially re-establishing active blanket bog.

2. Existing Conditions

2.1 Evidence Base

2.1.1 A Search Area within which peatland restoration opportunities have been considered is presented in Figure 4.5.1; and a Baseline Conditions and Constraints Overview Plan is presented in Figure 4.5.2.

2.1.2 Detailed consideration of the Search Area allowed identification of candidate HMUs that were considered suitable for restoration. This process has been informed by the following:

- A ground-truthing site visit, where peatland condition[1] features (including historical drainage, peat hags and identification of 'Modified/Drained/Actively Eroding' habitat have been considered (**AI Technical Appendix 4.4 - Habitat Restoration Opportunities – Site Visit Report**);
- Land-ownership boundaries;
- Aerial imagery and Ordnance survey (OS);
- Presence of designated sites;
- Remote-sensed high-resolution habitat/landcover maps[2];
- Carbon and Peatland Map (2016); and Peat depth data (Tony Gee, 2020);
- The Proposed Cloiche Wind Farm Development layout;
- Cloiche Wind Farm Habitat and vegetation survey and condition assessment of blanket bog and montane heath habitats (**AI Technical Appendix 4.2 - Habitat & Vegetation Surveys Report**);
- Review of hydrological catchments and topographic data within Search Areas;
- Detailed discussions with Glendoe Estate and Garrogie Estate regarding the presence of deer and degraded/modified habitats on the wider landholdings;
- Monadhliath Deer Management Group (DMG) Strategic Deer Management Plan (SDMP) deer count data[3]; and

[1] Consideration was given to the condition of the peatland habitat based on the Peatland Condition Assessment (PCA) guide (Peatland Action, 2016).
[2] https://data.gov.uk/dataset/911c87c4-a0d3-4bb8-9089-f7657980113e/scotland-habitat-and-land-cover-map-2020
[3] Monadhliath DMG: Strategic Deer Management Plan for 2015 – 2024 (Strath Caulaidh, 2015); and Annual Deer Management Report (Strath Caulaidh, 2021).

- Monadhliath Deer Management Group (DMG) Peatland Restoration Project (2021 – 2025)[4].

2.1 Current and Historic Land Uses

2.1.1 A summary of the current and historic land uses within the Garrogie and Glendoe Estates and the two peatland restoration search areas within the two estates is provided in Table 2.1.

Table 2.1 Current and historic land uses

Land use	Garrogie Estate	Glendoe Estate	Garrogie Estate Search area	Glendoe Estate Search area
Deer stalking	Deer are actively managed across both estate (mainly red deer; with occasional other species, mainly on low ground).		Deer use the search areas within both estates. Use of peatlands, due to their altitude (>600m), is more common in the summer on most estates. According to the SDMP, deer preferentially use heather moorland / grassland / summit communities locally in preference to adjacent peatland at most times of the year (due to better quality forage).	
Domestic stock farming	Sheep farming occurs on lower ground.		Both estates report that there are no sheep on the estate within the search areas.	
Grouse	Management for grouse is undertaken. Low intensity local muirburn is practiced on both estates, in the few areas where heather is dominant (i.e. in better drained areas where mineral soils or shallow peat are present).			
Conservation open habitats	Peatland restoration projects have been ongoing across the Estate for a number of years.	Peatland restoration opportunities are being explored by the Estate.	No peatland restoration has been undertaken within the search areas of either Estate.	
Conservation native woodlands	There are extensive remnant woodlands particularly along the Garrogie/Killin Glen. Additional fenced enclosures have been installed within the past 10 years to expand native woodland (c. 200 acres).		None present, or planned, in the vicinity.	None present, or planned, in the vicinity.
Forestry & timber production	N/A	N/A	N/A	N/A
River fishing	Fishing is undertaken in the lower glens of both Estates.		N/A	N/A

[4] Available Peatland Restoration Plans prepared as part of the Peatland Restoration Project for high altitude sites within the Monadhliath (including Braeroy Estate, Dunmaglass Estate, Glenshero Estate, Cullachy Estate and Kinrara Estate) have been reviewed and have helped inform the scope of management prescriptions.

Land use	Garrogie Estate	Glendoe Estate	Garrogie Estate Search area	Glendoe Estate Search area
Hydro scheme	The Estate has four hydroelectric schemes.	Glendoe Hydroelectric Power Scheme.	N/A	N/A
Wind farm	The existing Stronelairg Wind Farm and Proposed Cloiche Wind Farm Development sits within the land ownership of Garrogie Estate.	Access to the Cloiche Proposed Wind Farm Development is also taken through Glendoe Estate.	N/A	The proposed Cloiche Wind Farm is located within the on-site search area.

Monadhliath Special Area of Conservation (SAC)/SSSI

2.1.1 The qualifying interest of the Monadhliath SAC and SSSI is blanket bog and the site supports one of the most extensive areas of high-altitude blanket bog in the UK.

NatureScot – Monadhliath Conservation Advice Package[5]

"The key issue for this site is to restore eroding peat. The blanket bog is eroding in many places, and the erosion is greater at higher altitudes on the site, until the conditions become too severe for peat formation and the blanket bog is replaced by alpine heath or grasslands. The causes of the erosion are not known for certain and are likely to be a mixture of historic high stocking levels, past burning, high red deer numbers, and natural erosion processes.

The predominant requirement for blanket bog is to be actively forming peat, a process that relies on peat-forming species having suitable conditions to maintain growth including a high water table. Blanket bog that is degraded through damage or drying is likely to resume active peat-forming function following suitable restoration. A covering of 'active' peat-forming vegetation will protect the peat surface and will be more resilient to climate change.

Maintaining appropriate hydrology for blanket bog is critical. Most of the drainage gullies at Monadhliath are due to erosion and gully blocking would be beneficial. There are very few man-made drains on this site, but where they exist, blocking drains is also beneficial for raising the water table.

This site is grazed by red deer and in places, with domestic stock. Deer and stock can impact blanket bog via grazing or trampling, by removing vegetation, by breaking up the surface of the peat or helping to prevent bare peat from re-vegetating. There has been a concentrated effort to reduce red deer numbers via the Monadhliath Deer Management Group and this effort needs to be maintained to keep deer numbers at a level where they do not damage the blanket bog. The site is also grazed by sheep but the numbers have significantly reduced from the 1970s and 1980s, and some parts of the site are not stocked with sheep at the current time. This grazing level will benefit the species composition as well as peat erosion over the long term."

However, the blanket bog is considered to be in an unfavourable condition based on monitoring completed by Scottish Natural Heritage (SNH) in 2004[5].

2.1.2 The SAC/SSSI follows the same boundary, which runs close to the site boundary of the Proposed Development (See Figure 2.2). At the closest point, it occurs ~50m to the south-east from a proposed LiDAR unit and associated access track. The northern section of SAC/SSSI also lies within the proposed off-site candidate HMU.

Monadhliath Deer Management Group

2.1.3 The Monadhliath Deer Management Group (MDMG) consists mainly of deer stalking and grouse shooting estates and covers 175,733ha, between Spean Bridge, Aviemore, Loch Ness and Inverness. The MDMG's Strategic Deer Management Plan (SDMP) was adopted in 2015 with delivery overseen by an Executive Committee.

2.1.4 Red deer are by far the most abundant of the species present on the open range within both Garrogie and Glendoe Estates and the wider MDMG, with roe and sika deer mainly found in the lower reaches of these estates particularly in and near woodland.

2.1.5 Red deer across the MDMG are mobile, with the herds mainly using the high ground (>600m) in the middle of summer but mostly using the lower ground (<600m) from autumn through to late spring. There is also regular movement within and between estates due to the weather (e.g. wind direction) and disturbance (e.g. culling, recreation etc).

2.1.6 Further detail is provided in the revised Cloiche Wind Farm Deer Management Plan (**AI Technical Appendix 4.6**).

Monadhliath Landscape Scale Peatland Restoration

2.1.7 A landscape scale peatland restoration project is being delivered across thirteen estates in the Monadhliath Deer Management Group (MDMG) area (which do not include the Garrogie Estate and Glendoe Estate). The group began this collaborative landscape-scale project in 2017-18. The project covers generally remote high-altitude sites (similar in conditions to the areas considered within this plan) experiencing severe winter weather, with extensive drainage and gullying.

2.1.8 The MDMG has completed over 3,500ha of peatland restoration on the estates taking part in Phase 1 of the project (6 estates in total). Around 1,000ha of eroding peatland has been treated, with two main forms of work undertaken: drain-blocking and erosion restoration. A wide range of novel techniques have been developed as part of the MDMG project, to ensure that the methods used on each site are appropriate in

[5] https://sitelink.nature.scot/site/8324 - NatureScot (2020). Monadhliath SAC – Conservation Advice Package.

an eco-hydrological sense as well as cost-effective to deliver. A total of 13 estates have been asked to be part of the Phase 2 project, which will run from 2021-2024.

2.1.9 Practical work is mostly focused on drain-blocking, however gully and peat pan work is also being carried out, to explore the most effective restoration methods. Where gullies and peat hags are being restored eroding edges are re-profiled and bunding installed in gully bases. Cell-bunding and sphagnum mulching are being used in areas of bare exposed peat pans. Lessons learnt from these sites across the Monadhliath will be adopted as part of the implementation of the detailed HMP in order to ensure the most effective (and least disruptive) approaches are employed.

2.1.10 Strath Caulaidh (who are funded by Peatland ACTION, are responsible for implementing the programme of peatland restoration across the area) have so far found very few locations where deer impacts seem likely to lead to a failure of long-term restoration outcomes, however impacts have still found to be evident across most sites (e.g. heather browsing, hoof marks etc), but damaging impacts have found to be highly localised. More detailed interrogation of deer impacts (based on available annual monitoring reports) across the Moandhliath peatland restoration sites will be used to inform the final HMP.

Hydrology

2.1.11 The on-site and off-site Search Areas intersect a number of hydrological catchments which are displayed within Figure 4.5.2.

2.1.12 As presented in Figure 4.5.2 the onsite Search Area intersects the catchments of two unnamed tributaries of the River Taff (Ai – Aii). The first larger unnamed tributary (Ai) has a dendritic drainage pattern, flowing in a westerly direction and draining into a concrete-lined aqueduct which discharges into the eastern end of Glendoe Reservoir (OS Grid Reference NH 47126 03569) used for a hydroelectric scheme. The second (Aii) tributary catchment comprises two smaller isolated channels, flowing in a southerly direction into the north eastern part of the reservoir (OS Grid Reference NH 46575 03951 and NH 46129 03862).

2.1.13 The other on-site river is the Allt na Feithe Gobhlaich (Aiii) which flows in a north westerly direction and discharges into the Allt Breineag approximately 500m to the west of the site (OS Grid Reference NH 46716 05013). An aqueduct also carries surface waters from a small sluiced reservoir (OS Grid Reference NH 47118 04613) on the course of Allt na Feithe Gobhlaich in a south westerly direction to the Glendoe Reservoir.

2.1.14 Each of these catchments is situated within low-lying relief within the red line boundary of the Search Area. Extensive parts of the catchments within the Search Area are less than 5 degrees in slope, therefore this low-lying ground offers good opportunities for peat restoration. The larger catchments (Ai, Aiii) do have minor areas with steeper gradients up to 25 – 45 degrees, but these slopes are confined to the small mountain peaks of Meall Caca at 761m AOD (Above Ordnance Datum) (OS Grid Reference NH 48687 02533) and Carn Easgann Bana at 779mAOD (OS Grid Reference NH 48566 06312).

2.1.15 There are a variety of examples of peat erosion discussed in further detail in the following peatland/bog restoration section of this plan (see Section 3). Within the on-site Search Area there are numerous eroding gullies which have been identified within the unnamed catchment of River Taff (Ai) and the Allt na Feithe Gobhlaich (Aiii) catchments.

2.1.16 UK-wide studies have indicated that at heavily eroded peat gully locations rainfall runoff behaviour is very different to that experienced by undisturbed, intact peatlands (Allott *et al*. 2009). At undisturbed, intact peatlands, water levels are predominantly close to the ground surface except during prolonged periods of dry weather when a gradual water table drawdown occurs. Eroded gullies are characterised by predominantly low water table conditions with very rapid 'wet-up' responses to rainfall followed immediately by rapid drain-down after the cessation of rainfall. These patterns demonstrate very different hydrological behaviours of eroded and intact peats, with clear implications for the hydrological functioning of the peatland.

2.1.17 Other studies (Halcrow, 2001 and Evans and Warburton, 2007) have also indicated that gullying will typically lead to more rapid runoff and has a positive feedback loop leading to increased erosion, sedimentation and the export of particulate and dissolved organic carbon. These issues are of particular relevance for the on-site catchments which, as noted earlier, drain into the Glendoe Reservoir and dam used for hydroelectric energy generation.

2.1.18 There is also evidence of continued peat erosion in the form of bare peat pans eroding down to mineral soil in the Allt na Feithe Gobhlaich (Aiii) catchment. Publications indicate that areas of vegetated peat surrounding peat pans are often found to be permanently dry, causing peat collapse and the expansion of dendritic pan/gully areas. This suggests that areas of bare peat pans are active systems that may continue to expand (without intervention via peat restoration) (Brazier *et al*. 2020).

2.1.19 As presented in Figure 4.5.2 the off-site Search Area intersects ten catchments. The majority of these are tributaries of the Allt Cam Bàn that flows in a north westerly direction and subsequently discharges into the River Killin, approximately 6.2km to the west of the Search Area (OS Grid Reference 53594 07072). The tributaries include Allt Cam nan Cròc (1), the lower section of Allt Cam Bàn (2), Allt Cleith nam Fiadh (3), Allt Garbh (4), the upper section of Allt Cam Bàn (5) and three unnamed tributaries (7, 9 and 10). The other two tributaries are the upper reaches of the Allt Coire na Saobhaidhe (6) and Allt Mor (8) that flow in a westerly direction and later join downstream (OS Grid Reference NH 56846 03708) before discharging into the Crom Allt (OS Grid Reference NH 55872 03200) and then the River Killin (OS Grid Reference NH 53585 07065).

2.1.20 Each of these catchments is predominantly gently sloping (<7 degrees in slope), apart from in a few exceptions where the ground rises up more steeply to 12 – 18 degrees towards small mountain peaks e.g Carn Odhar na Criche (895mAOD) (OS Grid Reference NH 60205 03249) and Carn Donnachaidh Beag (873mAOD) (OS Grid Reference NH 58682 03872). There are numerous flatter areas between 0 – 3 degrees, for instance there are topographic hollows within the lower section of Allt Cam Bàn

(2) and plateaus between mountain ridges within the upper sections of Allt Cam Bàn (5) and Allt Coire na Saobhaidhe (6).

2.1.21 Within the off-site Search Area the lower sub-catchment of Allt Cam Bàn (2) shows evidence of micro-erosion in between tussocks and more expansive bare areas of peat pan features. The upper sub-catchments of Allt Cam Bàn (5) and Allt Coire na Saobhaidhe (6) have also experienced the development of extensive peat pans, some of which show evidence of slippage and the generation of silty runoff in close proximity to burns. The upper sub-catchments (5, 6) also constitute part of the Monadhliath SAC which is designated for blanket bog habitat. As such there are valuable opportunities to restore peat within this designated area, whilst promoting the re-wetting of the water table, the attenuation of surface water runoff and the reduction of sediment mobilisation and entrainment of particulate and dissolved carbon into downstream watercourses. Peatland and bog restoration opportunities are considered and further investigated within the following section.

3. Peatland/Bog Restoration

3.1 Restoration opportunities

3.1.1 Based on a site visit undertake in September 2021 (**AI Technical Appendix 4.4 – Habitat Restoration Opportunities Site Visit Report**), there is extensive peatland restoration potential and opportunity within both the on-site and off-site Search Areas.

3.1.2 Suitable areas for peatland restoration were found to comprise of drained peatland with large networks of gulley-systems or extensive areas of actively eroding deep peat with only limited vegetation cover. The peatland habitat within the Search Areas and a range of erosion features and contributing factors are summarised below.

Bare peat pans

3.1.1 Bare peat pans covered large expanses particularly within the off-site Search Area. The pans varied in size from 10's of meters to 100's of meters and were often linked with less degraded areas. Many of the bare peat pans appeared to have deep peat (>1m) remaining below the surface demonstrating a large resource of carbon that was exposed, eroding and being lost.

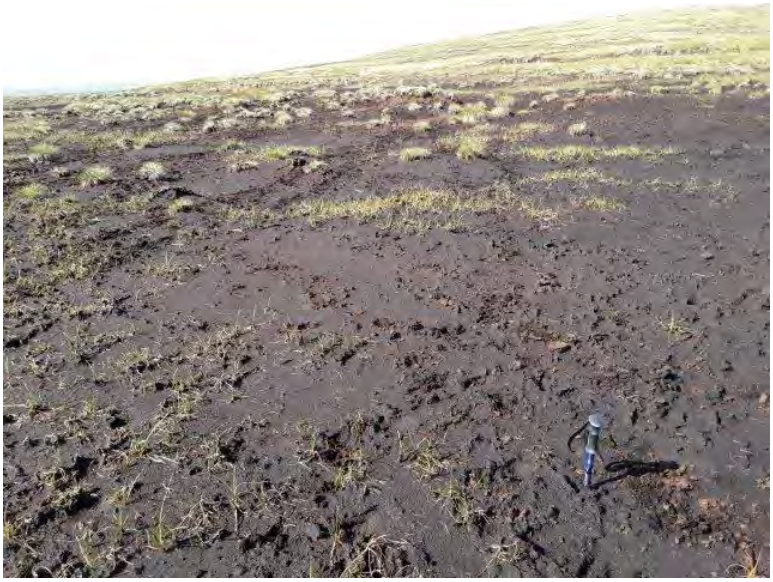

Photo 3.1: An area of bare peat which was likely >1m in depth with a little common cotton-grass colonisation but active erosion clearly evident.

Types of erosion at the edge of bare peat pans

3.1.2 Around the edges of the bare peat pans there were two main types of erosion: erosion hagg faces and tussocks of remaining bog vegetation surrounded by bare peat.

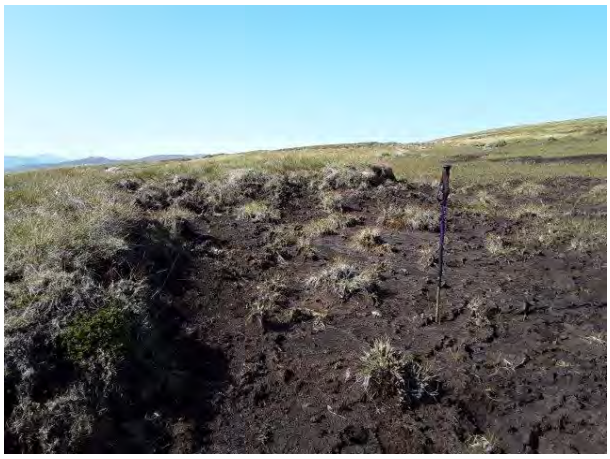


Photo 3.2 and 3.3: Examples of erosion at the edge of the bare peat pans. Photo on the left is an example of an erosion faces around the edge of bare peat pan. The photo on the right is an example of tussocks of hare's-tail cotton-grass with bare peat surrounding them. This was on a gentle slope on the edge of a peat pan.

3.1.3 Erosion faces at the edge of bare peat pans were generally between c. 0.5m and 1.5m high with little vegetation cover and appeared to be actively eroding, causing the bare peat pans to expand. On gentler slopes, often at the transition to fragments of blanket bog habitat, there were tussocks, appearing to be held in places by the roots of either hare's-tail cotton-grass or deergrass, surrounded by bare peat that was eroding. These areas were clearly actively eroding and expanding into the fragments of remnant blanket bog.

Fragments of remaining blanket bog habitat

3.1.4 Between the bare peat pans there were fragments of remnant blanket bog habitat. Occasionally these areas were of high-quality blanket bog, with hummocks and hollows present and carpets of bog-mosses, with occasional bog pools with feathery bog-moss. However, the scale of this high-quality blanket bog was very small in comparison to the scale of bare peat pans. Nevertheless, such remnant patches likely indicate what was once probably widespread and also what restoration could aspire to reach in terms of blanket bog habitat condition in some areas.


Photo 3.4 and 3.5: A fragment of blanket bog vegetation with bog pools and hummocks of rusty bog-moss.

3.1.5 Several examples were identified in the centre and north of the off-site Search Area where the fragments of remnant bog were very small (e.g. 10m x 30m) (NVC communities M19 and M20). In these fragments there were hummocks of rusty bog-moss very close to bare peat pans.

Photo 3.6 and 3.7: Rusty bog-moss hummocks within a few meters of extensive bare peat pans.

Gully systems

3.1.6 There were numerous erosion gullies through fairly dry blanket bog habitat within on-site Search Area. These erosion gullies were c.1m deep and 1-2m wide and formed a network of actively eroding peat.

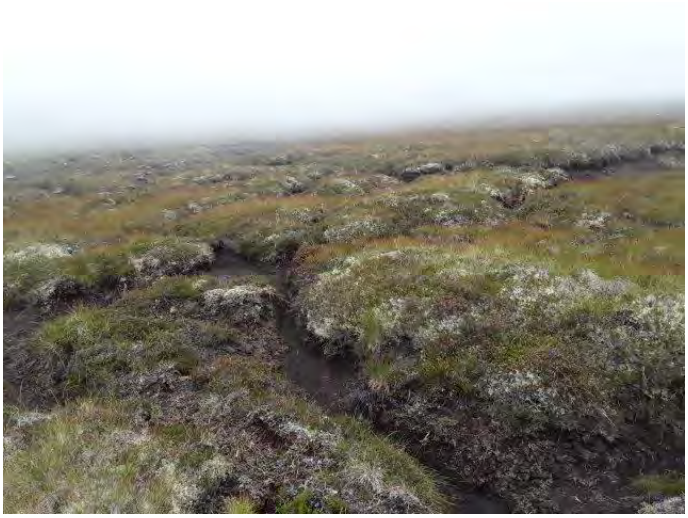

Photo 3.8: A network of erosion gullies within the blanket bog habitat.

Drained lochans

3.1.7 Drained lochans were identified within the on-site Search Area where lochan walls were found to have eroded at a breach-points and the water had drained away. Blocking and securing the breach point would likely result in the lochan re-wetting. Several other smaller lochans within the immediate vicinity were also identified at risk of being lost through erosion of lochan walls. Peatland restoration around these lochans would ensure they remained.

Photo 3.9: A former lochan with a breach in the lochan wall.

Monadhliath SAC

3.1.8 Within the internationally important blanket bog of the Monadhliath SAC, there were large expanses of bare peat that were clearly actively eroding. In some areas there was deep peat, demonstrating a large carbon store which is currently being eroded away.

Photo 3.9: A bare peat pan suitable for peatland restoration which forms part of the Monadhliath SAC internationally important blanket bog.

Deer presence

3.1.9 There was widespread evidence of deer across the Search Areas. This included hoof marks and deer trails clearly visible in the bare peat. Deer were regularly seen during the site visit including a large, dispersed herd of up to 350 head of red deer seen on the lower slopes of Carn Odhar na Criche within the off-site Search Area. It was considered highly likely that impacts from deer were a significant causal factor of the widespread erosion, particularly within the off-site Search Area. Combined with the cold climate and short growing season associated with the high altitude within the search areas, natural re-colonisation and the ability of the blanket bog to recover from the impacts of deer at these densities is likely to be severely limited.

Photo 3.10: c.350 deer on the slopes of Carn Odhar na Criche.

Photo 3.11: A recent deer trail in bare peat between tussocks of hare's-tail cotton-grass.

Photo 3.12: Hoof prints clearly visible on bare peat – common across the off-site Search Area.

3.2 Candidate Habitat Management Units

3.2.1 Informed by evidence outlined in **Section 2.1**, three candidate HMUs have been identified as suitable for peatland restoration as illustrated in Figure 4.5.3.

3.2.2 A total of 150 ha of peatland restoration would be delivered, comprising:

- c. 65 ha of peatland restoration within the HMU A (Glendoe Estate);
- c. 45 ha of peatland restoration within HMU B (Garrogie Estate);
- c. 40 ha of peatland restoration within HMU C (Garrogie Estate);

3.2.3 The location of these areas would be subject to refinement prior to completion of a detailed HMP, but restoration would aim to restore the peatland/blanket bog habitat within the following HMUs.

On-site HMUs (Ai-iii)

3.2.1 The proposed on-site HMU (See Figure 4.5.4) is situated within Glendoe Estate, on lower lying ground at c. 650m above sea level (asl) surrounded by a ring of hills at higher altitude. The HMU covers an area of deeper peat than is found elsewhere across the Search Area and was an important aspect in its site selection:

- Within **HMU A**, there were numerous erosion gullies through fairly dry blanket bog habitat. These erosion gullies were c. 1m deep and 1-2m wide and formed a network of actively eroding peat on gently sloping ground. The blanket bog was largely made up of heather, deergrass, common cotton-grass and hare's-tail cotton-grass with conspicuous and abundant lichens and woolly fringe moss. The detrimental impacts of deer were evident in the form of hoof prints and deer tracks, including within the bare peat at the base of erosion gullies. These erosion gullies and several identified drained lochans appeared to be highly suitable for peatland restoration. The erosion gullies and lochans could be blocked with peat or wood dams, which would prevent further erosion and raise the water table re-wetting the surrounding blanket bog.
- This type of eroded habitat was characteristic of much of the habitat within and around the Proposed Development and the adjacent Stronelairg Wind Farm and so it is considered likely that large areas could be suitable for peatland restoration.

Off-site HMUs (B and C)

3.2.2 The two proposed off-site HMUs (See Figure 4.5.5 and Figure 4.5.6) are situated within the Garrogie Estate, within a large, high-altitude plateau at c. 800m asl with a network of streams.

3.2.3 The habitats and vegetation were broadly similar to that of the Proposed Development site (Headley, 2021). The habitats were made up of fragments of blanket bog, wet and dry modified bog, montane heath and montane grassland, and included a similar array of NVC communities (e.g. M2, M3, M15, M17, M19, U5, U7). However,

the scale and type of erosion features present within these HMUs was different to that of the Proposed Development site.

3.2.4 Across the two HMUs vast expanses of exposed bare peat pans were identified which were considered to be largely actively eroding. Common cotton-grass was colonising across many of the pans but it was not providing complete cover, and often there was little to no colonisation. Many of the edges of the pans were expanding, evidenced by eroding hagg faces or tussocks of remnant bog habitats surrounded by bare peat. Deer hoof prints were also common across the bare peat areas and were demonstrably causing and exacerbating erosion.

- **HMU B** is placed between two hill summits - Sgaraman nam Fiadh (856m asl) to the south east and an un-named hill (831m asl) to the north east and is situated in the upper catchment of the Allt Cam nan Croc where there was considered great potential to revert the eroded areas back to wet and potentially active blanket bog.

  The unit has many small (ca. 10x 30m) fragments of bog habitat with bog-mosses present, including hummocks of rusty bog-moss, within a wide expanse of bare peat (ca. 500m x 500m) which appeared deep. The vegetation between bare peat pans included montane heath, montane grassland and blanket bog vegetation in various stages of degradation. The topography was generally flat with slopes rising around it. Given the existing suitable seed source, by blocking drainage routes it is considered that this area would likely re-wet and support high quality blanket bog, probably with little other intervention beyond the potential requirement for deer control measures.

- **HMU C** is placed between Carn Odhar na Criche (895m asl) to the south east and an un-named hill (846m asl) to the west; and the unit drains into the Allt Cam Ban; and an adjoining sub-unit to the south of Carn Donnachaidh Beag (873m asl) and north of Cairn Ewen (875m asl) that drains entirely into the Allt Coire na Saobhaidhe.

  The aim of any peatland restoration in HMU C would be likely to comprise stabilisation of exposed peat in the upper catchments of the central watercourse the Allt Cam Ban and the Allt Coire na Saobhaidhe to prevent further erosion and ongoing run off. The northern extent of the SAC/SSSI also sits within proposed HMUs, where large expanses of deep, bare peat are clearly actively eroding. The Monadhliath SAC blanket bog is of international importance and restoration of these bare peat areas in the upper catchment of the Allt Mór and Allt Cam Ban would reduce the erosion of the internationally important peatland, prevent the expansion of eroded areas within the internationally important blanket bog, reduce particulate matter entering these watercourses and slow the movement of water into the lower catchments.

3.3 Management Prescriptions

3.3.1 A suite of management measures would be undertaken to halt the rate of peatland erosion and encourage the regeneration of blanket bog habitat using best practice

techniques (NatureScot, 2020) within three identified candidate HMUs within the Garrogie Estate and Glendoe Estates.

3.3.2 Prescriptions would be based on strategic restoration proposals currently being delivered across the Monadhliath (funded by Peatland Action and implemented by Stath Caulaidth), where a suite of techniques (See **Appendix A**) are being used to help mitigate the impacts arising from each type of peatland erosion.

3.3.1 Interlinking the restoration programme with the construction of the scheme will help to maximise the reuse of vegetated turves and excess peat as soon as possible with only limited storage would significantly increase the chance of restoration success. This would need to be integrated with the PMP.

3.3.2 There are four main types of erosion present within the candidate HMUs: micro-erosion, linear gullies, peat haggs and peat pans. However, much of the erosion found across the candidate HMUs is intermediate in form between types (e.g. peat pans have peat haggs in their midst, linear gullies are fringed by micro-erosion etc).

3.3.1 Restoration would focus on halting or reducing peatland erosion and re-wetting modified or degraded blanket bog, which would be likely to include the following:

- Gully and lochan wall-blocking;
- Reprofiling gully edges and peat haggs; and
- Peat pan restoration;
  - Peat-cored contour bunds;
  - Spot turfing; and
  - Bare peat mulching with bog moss.

3.3.2 Success of any peatland restoration is considered likely to be heavily reliant on the close monitoring of deer numbers (which is discussed further within the Deer Management Plan (**AI Technical Appendix 4.6**). Currently the pressure on the peatland from deer in particular, within the off-site HMUs B and C is such that they are likely to be a contributing factor towards the continued widespread peat erosion. Without deer control peatland restoration will likely fail and the current situation will continue and so deteriorate further with exposed peat eroding and the bare peat areas expanding into the small remaining fragments of blanket bog habitat that remain.

3.3.3 Deer will therefore continue to be culled annually on the two estates in line with the regional cull plan put in place by the MDMG. Some of that cull will inevitably be taken from land in and around the HMUs.

3.3.4 Should deer be clearly implicated in the failure of restoration work at a significant scale on these sites (based on annual monitoring – See Section 4), then the estates will consider taking a more targeted cull from in and around these restoration sites. In the first instance this should simply involve taking more of the planned cull from this area. In due course, should this not have the desired effect, the estate should consider culling additional animals from these areas, or if appropriate consider the

installation of fencing around HMUs (subject to their considered effectiveness, given the exposure to heavy snow, damage and necessary maintenance required).

Deer Monitoring

3.3.5 A clear picture of the density and distribution of deer across the two estates during the summer months is not fully understood. It is recognised that the distribution of deer in the summer is likely to be somewhat uneven and localised densities would be expected to range from being low to being very high depending on the location. A summer count is therefore considered necessary prior to commencement of the peatland restoration works to help establish a summer baseline and determine better resolution deer densities within and around proposed HMUs, which will inform requirements for any additional targeted measures which may be required above and beyond the regional cull plan.

Partnership Working

3.3.1 Peatland restoration techniques (particularly at altitude, have been developing rapidly) and as such discussions with experienced peatland restoration teams (e.g. Peatland Action and Strath Caulaidh) is recommended. Monitoring of restoration techniques, successes and lessons learned across the Monadhliath through the ongoing work of the Monadhliath Peatland Restoration Programme will be of importance in informing peatland restoration work outlined in this plan.

Work Programme

3.3.2 A detailed work programme would be developed and agreed with THC, in consultation with the landowners and NatureScot, as part of the development of the final HMP.

Funding and Duration

3.3.3 The HMP and implementation would be funded in full by the Applicant and would continue for the lifetime of the Proposed Development.

4. Monitoring and Review

4.1.1 Monitoring will be required to establish the trajectory of change following gully-blocking and erosion control within the HMUs.

4.1.2 The methodology for all monitoring surveys will be informed by evolving survey techniques and future guidance and would be agreed with THC and NatureScot; however, it is anticipated that monitoring approaches will broadly align with approaches adopted by the Monadhliath Peatland Restoration Project.

4.1.3 Vegetation monitoring will be undertaken by suitably qualified ecological professionals who would monitor the success of peatland/bog restoration and highlight the need for any further management measures. The main way in which change would be assessed is by visiting fixed points set up pre-treatment.

4.1.4 A selection of previously established points would be visited (the number of points per HMU would be agreed with NatureScot), each would have been located during a baseline visit on a feature due for treatment (e.g. artificial drain, hagg/gully feature, peat pan feature). At each point geo-rectified photographs would be taken along the main axis of the feature (e.g. along the drain, along the gully, across the pan). These photographs would then be repeated to show the extent of visible change on the ground.

- Within HMU A where gulley blocking is the key focus, the frequency of functioning versus non-functioning dams would be assessed.
- Within HMUs B and C where erosion is the key focus would be to assess the % of land treated on which bare peat is still 'extensive and continuous' in comparison with the % of land treated on which bare peat is no longer the case.

4.1.1 This approach would comprise a series of monitoring visits with a focus on determining change in peatland condition (e.g. from the 'Actively Eroding/Gully' category to the 'Drained: Re-Vegetated' category) following the Peatland code protocol[6]. Surveys would collect data on the structure and composition of the vegetation, and plant species abundance and diversity from permanent quadrats in the restored areas.

4.1.2 Supplementary information would also be obtained, including:

- Functioning of restored features;
- Signs of large mammals causing significant damage to restoration outcomes; and

[6] https://www.iucn-uk-peatlandprogramme.org/sites/default/files/2019-07/PC_Field_Protocol_v1.1.pdf

- Signs of muirburn.

4.1.3 Fixed point vegetation monitoring would commence during the first summer after completion of restoration works in each HMU and would be repeated at appropriate frequency during the operational life of the Proposed Development i.e. at least years 1, 3, 5, and 10 following restoration works. The high altitude of the candidate HMUs is likely to result in the timeframe for success to be longer than that of more lowland sites; therefore, the requirement for longer-term monitoring would be subject to ongoing review of the results and agreement with statutory consultees.

4.1.4 Monitoring (visual inspections) of restoration activities would also be undertaken in order to record progress in completion of the physical works to install, maintain and, where necessary, repair those features. This monitoring would be completed by windfarm operations staff over the course of the first five years following completion of the restoration works. Any faults or issues identified during this monitoring would be addressed as soon as possible.

4.1.5 The methodology for all monitoring surveys will be informed by evolving survey techniques and future guidance and would be agreed with THC and NatureScot. Reports would be submitted to THC and NatureScot following surveys in each monitoring year. The reports would highlight the management measures completed to date, the results of the surveys and any measures proposed for the next reporting period. The results would be regularly reviewed, in consultation with THC and NatureScot, to ensure the HMP objectives are being met and to determine any appropriate amendments, where practicable.

4.2 Amendments

4.2.1 This oHMP will be a live document that will be further modified during pre- and post-construction, taking account of any design changes and priorities within the Site, in response to monitoring outcomes within the Study Area, or changes in guidance. New opportunities for habitat management and enhancement may become apparent during this pre- and post-construction period and indeed during the lifetime of the Proposed Development. Approval by THC and NatureScot should be sought for any amendments before revised measures are implemented.

References

IUCN (2017). Field Protocol: Assessing Eligibility, Determining Baseline Condition Category and Monitoring Change - https://www.iucn-uk-peatlandprogramme.org/sites/default/files/2019-07/PC_Field_Protocol_v1.1.pdf

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Peatland Action (2019). Guidance for land managers – Dam installation and techniques – Peat and plastic dams. https://www.nature.scot/sites/default/files/2019-03/Guidance-Peatland-Actioninstalling-peat-dams.pdf

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Appendix A Peatland Restoration Techniques

The following is based on restoration techniques detailed in the Restoration & Monitoring Plans as part of Phase 2 Restoration works prepared on behalf of Monadhliath DMG: Peatland Restoration Project 2021-25. The tables below describe each erosion type (micro-erosion, linear gullies, peat haggs and peat pans), the impacts the erosion causes on the peatland and the techniques used to undertake treatment work.

Feature	Description	Impact(s) arising pre-treatment	Restoration feature target	Restoration aim(s)	Restoration techniuque	Equip.	Materials	Basics of the technique	Key limitations OR mitigation needed
Micro-erosion	Peatland with minor / early-stage erosion (< 50cm feature depth)	Surface continues to break up -> channels continue to deepen and join together -> sediment is released during storms -> peatland surface experiences drought stress and can release CO2 to atmosphere -> faster runoff via channels can exacerbate erosion of downstream features (e.g. gullies, pans) -> reducing extent of active bog vegetation	Un-eroded peatland surface	Flatten high points in the landscape and displace peat into juvenile channels to promote more diffuse flow pathways and help slow down runoff rates during storms / encourage ponding of runoff in low points in landscape / encourage specialist bog species to expand onto previously drier areas and bare	Cross-tracking	Excavator	None	Track across the area with the machine moving perpendicular to slope. Work from upslope to downslope, overlapping tracks (where possible) and use machine weight to depress high points / squeeze material into shallow depressions	The ground may not respond to this treatment (e.g too dry) or machines may risk getting bogged locally. Try some test areas to see how they work. Do the work before any re-profiling or gully blocking ideally (as surface will become wetter afterwards).
					Topographic smoothing	Excavator	Peat and turf	Work across the site in a similar pattern to cross tracking but use the machine bucket to borrow material from local high points and deposit as micro blockages at key points to block flow, or otherwise displace locally from high to low points (e.g. sides of pools can be stretched in to close over channels). Any borrow pits should have vegetation stretched and 'toothed' back over using the digger bucket	This approach can cause a lot of surface disturbance, if used extensively, which could conceivably lead to the risk of mass movement (if entire surace is 'moved) or excessive sediment discharge in the short term. Consider using locally, and sparingly, if at all
			Gully bases	Slow down runoff / reduce sediment loss / re-wet gully side walls / promote re-colonisation of active bog vegetation in channel and adjacent land	Micro-gully blocks	Excavator	Peat and turf	Cubes of peat, with or without turf, to be won locally using excavator bucket; cubes placed into channel onto bare peat base then compressed; turf won and laid on top as req'd to cap then compress structure to seal; build at max 5m intervals; tooth in all 'borrow holes' as work progresses. Look to win turf with a bog moss and cotton grass component ideally, to speed up active gully re-colonisation in the wetter conditions which will arise after blocking.	If parts of the micro-eroded area have a high proportion of bare peat present then turf will be hard to come by - it may be that turf can be imported from adjacent areas, otherwise some dams may need to be formed only from peat and/or dam spacing may need to be wider than ideal

Micro-erosion			
			
Cross-tracking	Topographic smoothing	Micro-gully blocks	Micro-gully blocks
			

wood.

Feature	Description	Impact(s) arising pre-treatment	Restoration feature target	Restoration aim(s)	Restoration technique	Rapid	Materials	Basics of the technique	Key limitations OR mitigation needed
Linear gullies	Small linear channels caused by severe erosion	Channels continue to deepen and widen, and may join together -> mineral base may start to erode -> side walls will continue to migrate laterally and collapse inwards -> sediment is released during storms -> adjacent peatland surface experiences drought stress and can release CO2 to atmosphere -> runoff down the channels can exacerbate erosion of downstream features (e.g.peat pans) -> reducing extent of active bog vegetation in between gullies	Gully walls	Re-grade banks (as part of gully blocking process) to prevent further gully widening / to reduce sediment supply during storms / to help maintain the integrity of installed peat dams	Undermining re-profiling	Excavator	None	Working from above excavate cubes of peat from the base of the bare gully wall. Work along a short section of wall, then carefully depress the upper gully edge (turf, with peat still attached below it) to achieve a c.45 degree finished slope. Peat won from the excavation to be re-used to form gully blocks, or lift the base of the gully (if there is spare) in between blockages	Peat may be too dry, and bank may collapse when undermining to win peat - if this is the case, revert to standard re-profiling by stripping turf then re-grading bank to win peat for the dams
	Medium-large linear channels caused by severe erosion		Gully walls	Re-grade banks to prevent further gully widening and reduce level of collapse (e.g. due to frost heave) / to reduce the mobilisation of sediment from gully walls during storms / to slow rate of runoff into channels during storms / to slow down oxidative losses from bare peat collapse of side walls	Carpet re-profiling	Excavator	Peat and turf	Remove 'nose' of dry turf from gully edge, and place behind machine -> scrape dry bare peat on gully wall off to create a 'bed' to key in donor turves (re-working the peat bank more generally only if needed to reduce its angle (minimise this form of disturbance as far as possible) -> create flat 'bench' at toe of slope in the peat (and otherwise pull up peat/soil from gully base) -> reach behind and strip a large thick turf (e.g. 1.8m by 0.9m; 0.3m+ deep) from the un-eroded surface between gullies -> lay this up and down the prepared slope (lay turves from bottom to top; bottom turf should abut the benching; use gentle compression to seat) -> ideal is to carpet the whole slope (1 - 3 turfs depending on length of angled slope -> use wetter turves at base of slope moving to drier types towards top -> use grassier turves in general if available, and avoid heather-lichen dominant turves (higher chance of vegetation die-back) -> ensure installed donor torves are pushed together to minimise open joints -> any surplus peat from the next section down can be deposited in turf borrow holes, capped with the dry 'nose turf' if not used in re-profiling -> tooth over / smooth over borrowed areas to aid their re-colonisation	Large, thick grass-dominated turves are most resistant to being damaged during translocation, and to drought after placement. Heather turves can die back after placement (bucket damage during compression) and often seem to suffer more during droughts. If gullies are close by, there may be too little turf available to carpet slopes and/or the process may leave too much bare peat after the operation. If gully networks are very complex machines may not be able to access all parts of the system. Machine tracks on land in between gullies (especially when coupled to borrowed areas) can initiate new erosion on the land between the gullies.
			Gully bases	To centralise storm runoff within the channel, and thus keep it away from restored gully walls / to slow down further losses of peat directly from gully bases	Gully channel management	Excavator	Peat and turf	Where the channel is narrow excavate mineral from the centre (if peat on base is shallow) to form the bench for re-profiling -> this will help armour the toe of the re-profiling. This also helps keep flow in the middle away from the re-worked edge. Occasionally form a deeper hollow in the centre of the channel to act as a sediment trap.	There is a risk that if the channel is re-worked into the mineral soil / too intensively that runoff may erode this layer over a period (due to storm flow) and later undermine the gully walls. Operators need to be careful not to make channel to deep or wide, just sufficient to carry flows.
			Gully bases	To capture sediment during storms and allow it to settle	Chequerboard or turf -strip sediment traps	Excavator	Turf	In wider gullies with well vegetated bases a square (chequerboard) or strip of turf can be taken from across the base every 5m or so to use in carpet re-profiling - these stripped zones can be left to pick up sediment.	It is not appropriate to strip the entire gully base (ideally no more than 25% or so, maximum 50%)
	All sizes of linear channel caused by severe erosion		Gully walls	To slow down runoff from intervening land into gully channels during storms, where gully walls cannot be re-profiled / to stop side wall gullies deepening and extending	Gully side wall 'nick-point' blocks	Excavator	Peat and turf	Use 'micro gully blocks' (as per micro-eroding gullies) along with re-grading of the banks of the channels (machine bucket compression +/- limited use of 'undermining re-profiling' as required locally to achieve the desired effect (banks of no more than 45 degrees angle, with vegetation capping where possible)	Try to limit the amount of undermining done on banks. Try to bring material for blocks from adjacent land (tooth over where borrow pits created, to avoid new erosion arising). Care needed not to create more problems i.e machine disturbance may lead to long term problems arising from new erosion in track lines
			Gully bases	To slow runoff during storms / to reduce rate of sediment discharge / to help trap sediment and create 'peat dead flats' in void behind each blockage so that specialist plants have better chance to re-colonise	Gully blocking (full or partial height)	Excavator	Peat and turf	Use peat won from undermining re-profiling of banks, or otherwise from nearby small borrow pits on land adjacent to gullies, to form peat dams. These to span the gully, keying in to bare peat banks on either side if possible. Dams should ideally be at least 1.5m thick from their upslope to downslope side, with a steep upstream face and shallow-angled face downstream face. A central depression should be created so overtopping flow has free passage downstream. The dam top including the depression (spillway) should be turved with the best turf available locally (ideally large single turfs with a good bulk of peat on the base; grass or bog moss dominated is ideal). Finished structure not more than 0.9m tall in upper reaches of gullies but as low as 0.3m tall towards bottom end of gullies to ensure runoff does not build up too much pressure behind the dams. Frequency = 5-10m spacing between dam edges, depending on channel gradient and volume of flow it carries.	Work from upstream to downstream; avoid doing this work when the gullies have running water during storm events; try to ensure dams are well packed down, and well turved, to stop chances of them failing by being super-saturated; consider diverting some of the flow out of the gully (if opportunities are available) to reduce pressure on the structures themselves; if grazing intensity is high, animals may damage the dam tops during the first 1-2 years after treatment; ensure spillways are present on each block; leave gully un-blocked if there are concerns about storm flow blowing out too many blockages (e.g. if there is a large catchment above the gully)

Gully erosion			
			
Carpet re-profiling	Gully channel management	Chequerboard or turf -strip sediment traps	Gully blocking (full or partial height)
			

Feature	Description	Impact(s) arising pre-treatment	Restoration feature target	Restoration aim(s)	Restoration techniuque	Equip'	Materials	Basics of the technique	Key limitations OR mitigation needed
Peat haggs	Isolated peat masses left after severe erosion	Haggs continue to shrink vertically and horizontally due to de-watering / oxidation and from wind/water erosion -> sediment is released during storms -> hagg experiences drought stress and can release CO2 to atmosphere -> runoff down hagg side walls can exacerbate erosion of adjacent features (e.g.associated gullies) -> reducing extent of active bog vegetation in centre of larger haggs if the hagg shrinks	Walls	To slow down runoff from adjacent land into pan / to slow down rate of oxidation from side walls by turfing over / to reduce the sediment supply into pan	Re-profiling of hagg walls	Excavator	Peat and turf	Use carpet re-profiling approach, or bare peat turfing approach, if sufficient material is available nearby. Otherwise, consider use of the range of measure detailed for peat haggs below.	Care is needed to decide which haggs need to be left and which are to be re-worked (for materials needed for bunds and gully blocks locally). Discussions always needed on site to get this balance right
			Top layer of hagg OR entire structure	As above; also to provide material to build bunds (see below); also, to re-locate dry peat into wetter zone in between bunds (if otherwise it will oxidise over time)	Hagg harvesting	Excavator	Peat and turf	Remove capping vegetation (with good depth of peat attached) and set aside for re-use. Clip off the upper driest zone of peat (upper 1/3 to 1/2) and re-distribute into peat pan 'low points' nearby, or deposit in other nearby excavation zones created when forming bunds (with wetter peat). Replace the vegetation removed earlier to cap the lowered hagg surface. All of the hagg can however be harvested if of use in creating contour bunds in peat pans, with its capping vegetation used to top the bunds for protection	Tends to be used most often if lots of 'dry' haggs present, and lots of bunding needs installed. Careful thought needs to be applied in a pan to which haggs are 'used' and which are 're-profiled' only. Marking should be used to help machine operators know what to do, especially with intermediate forms (i.e. in between wet and dry)
			Walls	To slow down runoff from adjacent land into pan / to reduce the sediment supply into pan / to act as receptor & armouring for any bog moss mulch applied to base of slope	Bog pine armouring	Excavator or Labour	Bog pine	Rake up fragments of woody material (or entire root plates if available) from the base of gullies in hagg complexes and spread evenly on the lower slopes of profiled banks or existing banks if angles are shallow. Gently seat this by walking over it or packing with a rake, or using machine bukcet pressure.	Care is needed to ensure that any damage done when stumps are removed is made good; stumps should only be removed if they are already well exposed (i.e. don't dig them up) as disturance to the un-eroded peat mass needs to be minimised
			Gully bases (within hagg complexes)	To slow runoff during storms / to reduce rate of sediment discharge / to help trap sediment and create 'peat dead flats' in void behind each blockage so that specialist plants have better chance to re-colonise	Leaky dams (peat blocks / bog pine stumps	Excavator or Labour	Peat and turf	Gather up bog pine root plates either by hand or machine as appropriate. Form these into a linear structure across the gully, interlocking these and anchoring them into the peat beneath. Loosely place large turves (with peat attached where possible, for anchoring) on the upstream side of the pine and in spaces between interlocked root plates to form a leaky dam. If no wood is available try to use large cube-shaped turves with a heavy bulk of peat attached and place these in clusters at choke points in the gully. Finished structure typically no more than 0.5m tall and often closer to 0.3m	Seek permission from the land owner that they are happy to use the bog pine available. Be careful not to make the dams overly well-sealed otherwise they will hold a lot of water behind them (if this is an express requirement, there are better structures - see below) to achieve this effect
			Gully bases (within hagg complexes)	As above	Leaky dams (stone)	Excavator	Mineral material and stone	Gather up boulders by machine from suitable donor sites or by excavating out from beneath the peat. Form these into a linear structure across the gully, ensuring the material has voids that water can pass through slowly - don't pack these down. Finished structure to be not more than 0.9m but ideally 0.3m-0.5m tall max. Useful in particular on steeper gullies and outflows.	In taking rock from below the peat, you may 'break the seal' (e.g. if ironpans or induration present). This may allow runoff to escape vertically downwards hence meaning bunds may not hold water except in a storm (may not therefore trap sediment). Useful to run some initial trials to test this.

Peat haggs			
			
Re-profiling of hagg walls	Leaky dams (stone)	Leaky dams (peat blocks / bog pine stumps)	Leaky dams (peat blocks / bog pine stumps)
			

Feature	Description	Impact(s) arising pre-treatment	Restoration feature target	Restoration aim(s)	Restoration techniuque	Equip'	Materials	Basics of the technique	Key limitations OR mitigation needed
Peat pans	Severely eroded flat areas with +/- extensive bare peat	Pan continues to deepen due to erosion action -> sediment is released during storms -> peat surface may fail to re-colonise naturally in near term due to sediment swamping / direct weathering effects -> surface experiences drought stress and can release CO2 to atmosphere -> runoff out of its downslope outlet can exacerbate erosion of downstream features (e.g. gullies)	Pan bases	To slow runoff during storms / to reduce rate of sediment discharge / to help trap sediment and create 'peat dead flats' in void behind each blockage so that specialist plants have better chance to re-colonise	Peat-cored contour and cell bunds (+/- turf capping)	Excavator	Peat and turf	Strip off any plant or woody material from the base of the pan, plus any cracked peat, leaving a smooth peat surface to key into; carefully lay aside stripped surface veg (e.g. cotton grass) even if sparse (i.e. dont bury under the new bund). Then, using good wet peat, either from the base of the gully upslope (borrow hole), or harvested from the lower part of a hagg, or from undermining-reprofiling, form up low bund using the same process as peat damming described for 1.3. Finished feature should be no more than c.0.6m high. Re-distribute any vegetation harvested initially onto suitable bare areas. Bund shape can be tailored to the situation (short and linear, or more curved and natural looking if longer). Can be formed linear or in honeycomb structure (cell).	Machinery is likely to cause a lot of temporary mess in such areas, as the peat is deeper. Decisions need to be made about the pros and cons of working such areas, and loosening a lot of peat which could wash out if structures fail. That said, after a few large rain events the worked areas do tend to become much smoother, and signs of the re-working often quickly disappear.
				As above	Mineral-cored contour and cell bunds (+/- turf capping)	Excavator	Sub-soil, stone, peat and turf	As above, but sub-soil and rock can be used to form the 'core' of the bund either if (i) peat is shallow or absent in the pan base or otherwise (ii) there are concerns about the rate of runoff flowing into the pan breaching the structure during storms	As above
				As above (if large supply of donor turf available)	Re-turfing of bare peat	Excavator	Turves	Import turves from nearby areas outwith the pan in order either to (i) completely re-turf or (ii) if there is insufficient donor material then create islands of turf to promote vegetative re-colonisation locally (and potentially help with reducing wind erosion / sediment trapping)	A balance needs to be achieved if importing turves, as too much removal from donor sites may lead to new erosion problems arising therein. Aim to strip no more than 20% of the turf from a donor site, and in a patchwork pattern to help promote recovery.
				As above (if limited supply of donor turf available)	Spot turfing of bare peat	Excavator	Turves	If turf is in short supply, cut and space turves evenly across the zone between bunds. Try to put drier grassier turves towards the top of the zone and wetter sphagnum rich turves lower down in the zone, as water will pool downslope first behind bunds. It may be necessary to cast turves in from better ground nearby first. Turves can be broken up into small pieces (0.3m x 0.3m) to facilitate better spread if in very short supply	As for other techniques, if using turf donor sites be careful to minimise problems on these sites post-stripping
				To prevent further erosion / to help re-colonise bare peat with specialist plants / to help reduce future rate of sediment discharge and slow runoff	Bare peat mulching with bog moss	Labour	Harvested bog moss	Using machinery or raking (by hand) into 1-tonne bags (or similar) gather bog mosses (and associated other plant fragments) from areas nearby then distribute this as required on the bases of pans (behind bunds; at the foot of treated haggs, if water is likely to hold). Can be used in association with bog pine armouring at the base of hagg slopes. Can also be used to 'seed' the pools lying behind dams in hagg complexes treated with gully blocking	Max of 20% of bog moss cover to be harvested locally, and in a patchwork so no one area is overly-depleted. Pros and cons to doing this in summer or winter weather, so seek advice and agreement on best time of year and conditions to do this work
				To prevent deepening of peat-bottomed out flow channel -> helps to protect installed blockages further upstream	Rock-armoured outflow	Excavator or Labour	Mineral material and stone	At key pressure points (e.g. gully outflows etc) armour the central section of peat dams using stone excavated from beneath the peat or from a nearby donor site to form a carefully constructed stone pitched spillway on the feature	Needs suitable material for construcion and machine operators may have to work closely with hand labourers to ensure a good outcome

Peat pans			
			
Peat-cored contour bunds (+/- turf capping)	Spot turfing of bare peat	Bare peat mulching with bog moss	Rock-armoured outflow