Forestry Commission Scotland
Coimisean na Coilltearachd Alba

Practice Guide

Deciding future management options for afforested deep peatland

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Forestry Commission Scotland: Edinburgh

This publication is also available on our website at: www.forestry.gov.uk/publications

First published by the Forestry Commission Scotland in 2015.

ISBN 978-0-85538-927-7

Forestry Commission Scotland (2015).
Deciding future management options for afforested deep peatland.
Forestry Commission Scotland Practice Guide.
Forestry Commission, Edinburgh. i–iv + 1–20 pp.

Keywords: future management, afforested, deep peatland

FCPG104/FCS(AC)/PDF/JUN15

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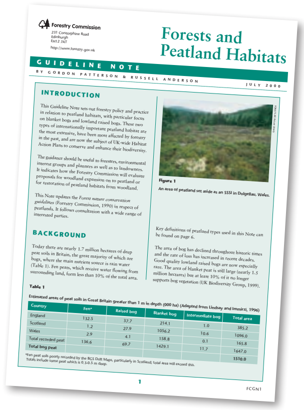
Introduction

The Scottish Government has an ambitious climate change programme which recognises that peatlands and forests are key elements in both minimising further greenhouse gas emissions and absorbing carbon dioxide from the atmosphere. Fast-growing woodland, or undamaged or well-restored peatland, can act as a carbon sink, but if peatlands altered by tree planting are not managed appropriately then they can release greenhouse gases.

Whenever trees are felled there is a presumption, supported by legislation, in favour of restocking. However, for woodland on deep peats, the greenhouse gas and wider environmental implications of future management are more significant than on other sites. For this reason, we (Forestry Commission Scotland) are likely to support applications for felling without conventional restocking on peatland sites that are less suitable for second rotation forestry or where there is a clear benefit of restoration.


Forestry Commission
Forests and Peatland Habitats
GUIDELINE NOTE
BY GORDON PATTERSON & RUSSELL ANDERSON
JULY 2000
INTRODUCTION
BACKGROUND

This guide explains the factors to consider when seeking felling approval from us for forestry on a peatland habitat. It explains how to undertake the decisions required by our 2014 supplementary guidance called *Forestry on peatland habitats*, which was written to update the *Forests and Peatland Habitats* guideline note published by the Forestry Commission in 2000 and which is still in operation.

We will review the guide when there is significant development of scientific work by Forest Research and other researchers. The carbon science of trees and peatland is a rapidly developing area, and it is important we keep abreast of latest findings. As well as informing forestry practice, this guide will help implement the new *National Peatland Plan for Scotland*.

This document focuses on future management options based on potential greenhouse gas benefits. These benefits need to be considered alongside other priorities such as timber production, biodiversity, environmental protection of water and hydrological impacts, and landscape. Decisions should be based on an assessment of the overall benefits of different management options and outcomes, and at a scale appropriate to the landscape.

Figure 1 Woodland can be an appropriate land use for peatland habitats.

Summary of evidence used

The Scottish Government wants to ensure that Scotland's forests are managed to make a positive contribution to mitigating climate change. Although the contribution of trees to help mitigate climate change is now widely known[1], in some circumstances establishing second rotation productive forestry on deep peats may cause a net loss of greenhouse gases (carbon dioxide, methane and in some conditions nitrous oxide). This is because disturbing the peat during cultivation and exposing it to oxygen will cause it to break down, and stored carbon to be released back to the atmosphere. Dissolved Organic Carbon can also be lost through peat drainage, with additional consequences for water quality (especially drinking water). Where this loss of carbon is likely to be significant, removing the woodland and restoring the site back to peatland habitat is supported by the Scottish Government's Control of Woodland Removal Policy.

To help you decide future management options, we have developed a method to estimate whether a second rotation on deep peat is likely to generate a positive or negative net greenhouse gas balance. This will help identify whether a second rotation, or deforestation followed by restoration, will bring the most benefit to the site from a carbon management perspective. However, the decision based on this method will be just one part of a broader consideration of opportunities and constraints affecting the site, so greenhouse gas balance should be considered alongside other environmental values of the land such as biodiversity, landscape and water. Guidance on this is given in the Forestry Commission Guideline Note *Forests and Peatland Habitats* (2000).

Recent research indicates that a negative net greenhouse gas balance may occur from restocking on deep peats where tree growth is poor, even if there is no significant soil disturbance from cultivation[2]. The research concluded that to generate a positive greenhouse gas balance on restock sites there should be a good rate of tree growth achieved without significant cultivation. Where this isn't possible, the site should not have a conventional (like-for-like) second rotation. The assessment method in the guide is based on these parameters.

For conventional restocking with conifers, extensive modelling work showed us that for Sitka spruce (SS), general yield class (GYC) 8 is likely to produce enough growth that the second rotation will create a positive greenhouse gas balance, sufficient to offset what would be lost from cultivation. The modelling work is explained further at Appendix 1. Note, though, that this threshold of SS GYC8 can't be used in isolation – a site's soil and climate factors must also be considered before approval is given for restocking a deep peat site. This is why the assessment method in this guide also refers to the edaphic (soil) and climate potential for restocking.

For conventional restocking with native woodland, modelling work showed us that for the W4 woodland type (Downy Birch), GYC 4 is an appropriate threshold. This assumes felling at 90 years and under conditions where woodland establishment can be successfully achieved (for example effective tree protection and an absence of browsing damage etc).

In practical terms this means that the greatest potential for a positive greenhouse gas balance to result from a second rotation is on relatively dry and fertile sites where a good rate of growth is likely. Equally, the greatest potential for successful and early restoration of peatland

1. For example, see Read, D. J. et al. (2009). Combating climate change – a role for UK forests. TSO, Edinburgh.
2. This guidance is based on the review and modelling work in Morison, J. et al (2010). Understanding the GHG implications of forestry on peat soils in Scotland. Forest Research, Farnham.

Figure 2 This Lowland Raised Bog has a high water level and poor growing trees indicating good restoration prospects.

Figure 3 Productive timber can grow well on deep peat.

into a net carbon sink is generally on the wettest sites which have yielded very poor tree growth. For sites that are neither a good candidate for conventional restocking (because they offer little chance of generating a positive greenhouse gas balance) nor for restoration (because the peat is significantly damaged by the first rotation), we have identified a low-density, low-intensity 'peatland edge woodland' type that may offer the best benefits in these circumstances.

Carbon science is evolving, so we will review this guidance and assessment method if new research reveals significantly different conclusions. We'll also work with other stakeholders through the National Peatland Plan to initiate research and make sure that sustainable, proportionate monitoring programmes are in place for forestry and other land uses on peat.

Method for assessing future options for deep peat sites

The assessment method is designed to identify the most appropriate future management option for an afforested peatland habitat that is not already classed as a presumption to restore. Site types for which there is a presumption to restore are listed in the section below. These sites do not need to be assessed using this method – their future is already decided.

Afforested deep peat sites with a presumption to restore

On some afforested deep peat sites there is a presumption to restore to bog habitat. On these sites – listed below – restocking should not take place, but restoration started as soon as possible. This list reflects the potential indicators of acceptability given in the Scottish Government's Control of Woodland Removal policy for when deforestation would contribute to enhancing priority habitats and their connectivity. These sites may include areas with peat less than 50 cm deep.

- Habitats designated as qualifying features in the UK Biodiversity Action Plan, or on Natura sites, Ramsar sites, Sites of Special Scientific Interest (SSSIs) or National Nature Reserves (NNRs);
- Sites or parts of sites where restocking is likely to adversely affect the functional connectivity (hydrology) of an adjacent Annex 1 peatland habitat (as defined in the EU Habitats Directive), or a habitat associated with one;
- Sites where deforestation would prevent the significant net release of greenhouse gases.

Note that all proposals for deforestation need to meet the requirements of the Environmental Impact Assessment (Forestry) (Scotland) Regulations, which includes an assessment of the impact that the deforestation may have on the environment.

Restoration that is already earmarked in an approved 10-year forest plan at the time of this guidance being published should go ahead.

Figure 4 Restoration of a lowland raised bog.

Box 1 Understanding the functional connectivity (hydrology) of It adjacent peatland.

For this purpose, relevant hydrological impacts on an adjacent peatland are:

- a reduction in the amount of water – or changes to the chemistry of water – reaching a priority habitat downslope from, or on a level with, the potential restock site; or
- an increase in the rate and/or amount of water leaving a priority habitat upslope from, or on a level with, the potential restock site.

As a general rule, significant hydrological impacts are unlikely to happen where the coupe is separated from adjacent peatland habitats by non-peat soil, a watercourse with a non-peaty base or a watershed. On the other hand, significant hydrological impacts are likely to happen where the coupe is connected to adjacent peatland habitats by a continuous link of coplanar peat soil or a watercourse with a peat base and it lies in the same watershed.

If you think that slope topography may exacerbate the hydrological impact of restocking, seek expert advice.

In cases where restocking a site, or part of site, is likely to adversely affect the hydrology of an adjacent Annex 1 peatland habitat or a habitat associated with one, then the restored area might appear as a buffer zone between the open ground peatland and a productive coupe on the remainder of the landholding (which is not hydrologically connected).

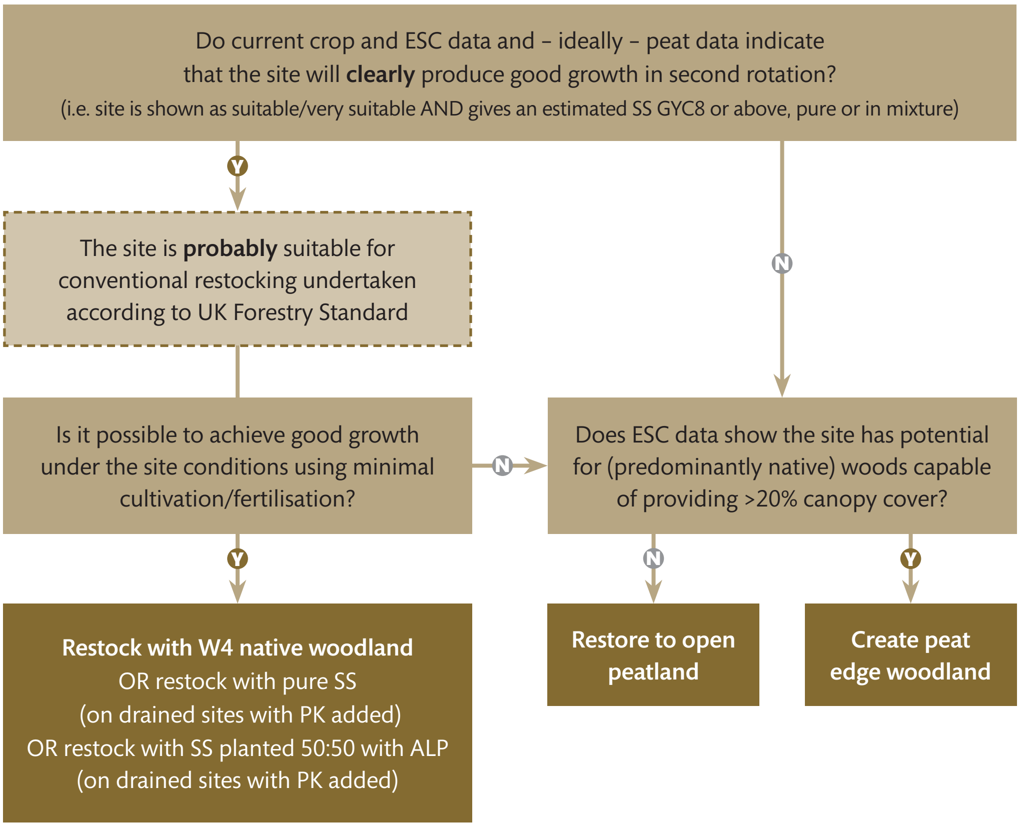
The assessment method explained in the section below does not apply to habitats listed as a presumption to restore. Other circumstances where restoration is the best option will emerge from undertaking the assessment. Note that this guide does not offer detailed advice about the process of undertaking a restoration project on previously afforested land. Our latest guidance on this is in the Forestry Commission Practice Guide *Managing open habitats in upland forests*.

Using the method to guide decisions for all other sites

The assessment method, summarised in Figure 5, is primarily desk-based and takes a step-by-step approach to decide the future for afforested deep peat sites that do not carry a presumption to restore. It uses current crop data and the Ecological Site Classification (ESC) tool to assess the site's potential for tree growth. ESC is free to use via the Forestry Commission website. If your experience of the site suggests that crop records or ESC results may be inaccurate or over-simplified, undertake a site survey. Conservancies also have the discretion to request a site survey if the data supporting your decision is inconclusive.

Since none of the steps give entirely accurate results, the checks and balances of the forest plan process are also important in guiding the future of these sites. In other words, the decision based on this assessment is unlikely to stand alone – there are likely to be other opportunities and constraints affecting the site. Appendix 2 outlines the regulatory framework that you need to work within and the grant aid regime that may be available to you.

Figure 5 Flowchart to decide future options on deep peat sites that are not already classed as a presumption to restore for biodiversity or other reasons.



Our Conservancy offices will offer advice on how to present supporting information, e.g. print outs of the ESC results or tariff details from the site's first rotation. This data will be part of submitting a Forest Plan or amendment for approval, so close liaison with your local Conservancy is advised.

The assessment method offers a number of alternatives: conventional restock with conifers, conventional restock with W4 native woodland, restock with low-density/low-intensity woodland (a new model called 'peatland edge woodland'), or restore to peatland habitat. We recognise the difficulty of planning appropriate management on these challenging and complex sites, especially where multiple management options are suggested on one site. Therefore, if less than 20% of a site is suited for a particular management option then it need not be undertaken (see examples in Table 1).

Table 1 Examples of different scenarios for afforested peatland after first rotation.

Scenario	Option
<20% is suitable for restoration; remainder is suitable for conventional restocking	Conventional restock
<20% is suitable for peatland edge woodland; remainder is suitable for conventional restocking	Conventional restock
<20% is suitable for conventional restocking; remainder is suitable for peatland edge woodland and/or restoration	Conditional felling licence will require peatland edge woodland and/or restoration
<20% is suitable for peatland edge woodland; remainder is suitable for restoration	Restore to peatland

This 20% threshold is based on other existing criteria: that woodland is defined as stands of trees with a canopy cover of at least 20%; and that designed open ground within a standing forest is expected to constitute up to 20% of a forest.

Note that all proposals for deforestation need to meet the requirements of the Environmental Impact Assessment (Forestry) (Scotland) Regulations, which includes an assessment of the impact that the deforestation may have on the environment.

Assess the potential for restocking

Identify an initial GYC estimate for the site

Crop records might be sufficiently accurate to give confidence that the site is capable of producing a second rotation crop that is clearly SS GYC8 or above. The Conservancy may ask for a site assessment to confirm this, which could include a site walk-over to see the size of remaining stumps. For these sites, conventional restocking is likely to be the best option, provided that there is no significant hydrological impact on adjacent priority peatland (see page 4).

Where crop records do not suffice, the next best technique is to use ESC. This uses climate and soil data to predict the suitability of the site for growing trees.

Figure 6 Crop data from harvester heads can be used to estimate the GYC of a second rotation.

Use ESC – to establish the climate potential for restocking

For soil types that may be suitable for restocking, you should establish the climate potential for restocking by using ESC to generate climate data for specific locations on the site. Sites that ESC classifies as sub-alpine and with a DAMS score of 18 and AT5<775 should not be considered as suitable for conventional restocking. Instead they should be considered for either converting to peatland edge woodland or restoring to peatland habitat.

Figure 7 ESC version 3 provides an invaluable tool to help you make your decision.

Again, use caution with this broad-brush approach and be aware of the limitations of using ESC. Some sites that do not pass the AT5 and DAMS thresholds may still be suitable for growing SS, or those identified as suitable may not be, if sub-optimal local site conditions prevail. **This is why we urge you to use a combination of ESC results, crop records and site-specific peat data.** An on-line video offering advice on using the latest version of ESC is available online.

Identify peat depth and type – to establish the edaphic potential for restocking

This data is not compulsory but it will improve the reliability of the information on which your decision is made. The soil data gained from a site survey will also identify which peat types **might** be sufficiently dry or fertile to produce good growth rates without significant disturbance.

The degree of information required will depend on the complexity of the site and the availability of silvicultural records. Widely available soil maps are of too low resolution to be useful for this exercise, though, so a site visit is the best way to determine accurately where deep peat lies on a site and (if used) the Forestry Commission (FC) soil types. Guidance for good practice in undertaking a peat survey is given at Appendix 3.

Figure 8 Digging a deep peat soil profile.

Using the identification criteria set out in Kennedy (2002)[3], peat types can be categorised as:

Scenario A

Peat types that are edaphically unsuited for woodland and so are more suitable for restoring or converting to peat edge woodland.

- **Peat types:** 8a, 8d, 9a, 10a, 10b, 14, 14h, 14w.
- **Characteristic habitat:** wet flushes, hagged peat, degraded bog habitat.
- **Characteristic vegetation:** *Sphagnum*, *Juncus*, willow.

Scenario B

Peat types that should grow pure SS on maintained drained sites, with PK added, in order to achieve a growth rate that allows a positive greenhouse gas balance.

- **Peat types:** 8b, 8c, 9b, 9c, 9d.
- **Characteristic habitat:** fertile wet peats.
- **Characteristic vegetation:** *Molinia*, *Calluna*, Downy birch.

Scenario C

Peat types that should grow SS if planted 50:50 with ALP on maintained drained sites, with PK added, in order to achieve a growth rate of the SS that allows a positive greenhouse gas balance. Note, though, that these peat types may face climatic constraints if the site is not AT5>1000.

- **Peat types:** 9e, 11a, 11b, 11c, 11d.
- **Characteristic habitat:** infertile but drier peats.
- **Characteristic vegetation:** *Erica*, Scots pine.

Caution is needed for this broad-brush approach, however, as site potential will also be affected by climate, so soil type data must only be used alongside ESC data.

Consider the potential for restoration

If you decide that the most appropriate future option for your site is to restore it to an open ground peatland habitat, you must also consider carefully the feasibility of restoration. Restoration projects on clearfell sites can be difficult and expensive because of the fragility of the original peatland habitat. The most cost-effective restoration projects are likely to be where drainage, fertilising and tree growth had the least impact at the first rotation.

3. Kennedy, F. (2002). FC Field Guide: The identification of soils for forest management. Forestry Commission, Edinburgh.

Figure 9 Colonisation by sphagnum is a good indicator that the site is too wet for restocking and should be restored.

In other words, the greatest potential for successful and early restoration of peatland into a net carbon sink is generally on the wettest sites which have yielded very poor tree growth. You must also consider how the site will be monitored over the long term, so that all restoration actions are successful.

Appendix 4 makes an indicative match between peat soil groups, FC soil codes, peat type and vegetation – this drawing together of different ways to assess the peat's condition may help you make the case for a site being a good candidate for restoration. We recommend that you work with a suitably-qualified ecologist to follow the advice on restoring afforested peat bogs available from Forestry Commission Scotland.

Figure 10 Innovative methods of restoration include spreading moss 'brash' to encourage re-vegetation.

Figure 11 Diggers preparing to block ditches as part of restoration work.

Images courtesy of Stephen Corcoran.

Consider the potential for peatland edge woodland

What is peatland edge woodland?

Peatland edge woodland is low density woodland which avoids the net carbon loss that would result from conventional restocking on unsuitable land, and combines some of the biodiversity and visual benefits of woodland and peatland. It is designed for afforested land after first rotation which is not a presumption to restore and is considered, following this assessment process, to be neither suitable for conventional restocking nor a good candidate for restoration.

The objective is to achieve at least 20% canopy cover. It can be secured through a conditional felling licence or a management plan.

Figure 12 How peatland edge woodland might look on site.

Where is peatland edge woodland the appropriate option?

It is the appropriate option on sites where this guide's assessment method indicates a potential general yield class (GYC) of below 8 (Sitka spruce), i.e. SS GYC8 – unless a case can be made for restoration to open ground peatland or native woodland habitat.

Creating and managing a peatland edge woodland

A typical specification for peatland edge woodland would be low density planting comprising 50% planted, 50% open ground. It would be restocked with native species within their natural range, in groups and with no less than 500 planted stems per gross hectare. Creating a priority native woodland habitat as per Annex 1 of the Habitats Directive is desirable, but this new type is not specifically designed for that purpose. We will review this specification as appropriate to reflect practitioner experience in how successful it is in meeting its objectives. Any updates or further advice will be published on our website.

Figure 13 Drain blocking is likely to be needed to create peatland edge woodland.

This model of woodland might be achieved by, for example:

- taking advantage of natural regeneration whenever acceptable results (in terms of stocking and species mix) are likely to be achieved within a reasonable timescale.
- matching locally native tree and shrub species to site conditions, where planting is necessary. Mimicking natural patterns of plant spacing and distribution will encourage these native stands to become semi-natural in the long-term.
- allowing an element of non-native natural regeneration on sites with an internal forest boundary to help secure a positive carbon balance, provided this regeneration does not compromise the growth of native planting on the site.
- confining non-native regeneration to coupes within remaining forest areas to reduce the threat of invasive spread onto adjacent open peatland habitat or native woodland. External boundaries should have only native scrub/woodland and/or open peatland.
- using the minimum cultivation needed to ensure satisfactory establishment, and little or no artificial drainage.
- being located where it will provide a gradation from high forest to areas of existing or restored peatland, but without transgressing onto associated buffer zones (particularly for designated or high value peatland sites, e.g. those used for wading birds).
- maintaining deer populations at less than five per square kilometre.
- removing invasive or non-native shrub species e.g. *Rhododendron ponticum*.

Site preparation and cultivation

All soil disturbance leads to a loss of soil carbon, so the aim is to reduce disturbance as much as possible. A restocking proposal on deep peat will need to demonstrate that it will use the **least intensive** cultivation regime possible for the woodland type.

To assess what significant cultivation means for a second rotation on deep peat we took a precautionary approach and looked to identify techniques that would mean SS GYC8 is still achieved under a modelled maximum disturbance threshold of up to 30% loss of total carbon of peat to a depth of 1 m (see Appendix 1). We then drew on work undertaken to support the Woodland Carbon Code in order to devise a list of techniques relevant to restocking on deep peats (rather than woodland creation).

We concluded that the site preparation methods appropriate for conventional restocking on deep peats are, in order of increasing disturbance:

- Hand turfing / drains
- Hinge mounding with no drains
- Drains at 250 m/ha – 360° excavator with a draining bucket
- Drain mounding – 360° excavator with a drainage bucket, maximum mound size of 50 x 50 x 30 cm
- Trench mounding + drains @ 250 m/ha – 360° excavator, maximum mound size of 50 x 50 x 30 cm.

Other cultivation methods for conventional restocking on deep peats will not be acceptable.

Restocking a deep peat site with peatland edge woodland should be done using minimal cultivation (usually hand turfing or hinge mounding with no drains) and with little or no artificial drainage.

Figure 14 Signs of extensive cracking on peat.

We recommend that you minimise the fallow period to reduce nutritional losses and encourage vigorous growth. Keep fertiliser use within the standard prescription for unimproved deep peat soils[4] and do not use nitrogen. If your site assessment was over-optimistic and the crop is not growing well or canopy closure is not being achieved, then later applications of PK at 650 kg/ha are permitted if it is believed they will result in the forecasted growth (and therefore carbon sequestration) rates.

However, in line with the principles behind this guidance, be aware of when a second rotation crop is failing and would be better converted to peatland edge woodland or open ground habitat. Equally, if the second rotation trees are growing poorly and the peat on which it is being grown shows signs of extensive cracking, then seek advice from your local Conservancy office about whether it should be converted to peatland edge woodland or open ground habitat, to avoid increasing the rate of peat decomposition and greenhouse gas emissions.

Beyond the second rotation

With the data and models currently available, researchers can't determine the conditions under which a positive greenhouse gas balance could be maintained on deep peat beyond the second rotation. Therefore this methodology – or one that improves it – should be repeated as the second rotation comes to maturity and before a third rotation is considered.

4. Taylor, C. M. A. (1991). Forest Fertilisation in Britain. FC Bulletin 95. Forestry Commission, Edinburgh.

Appendix 1: Estimating the potential for a positive carbon balance by restocking with productive conifer

Reasoning behind the threshold of SS GYC8/ALP GYC6

In forming the assessment method for this guide, we made the assumption that until there is evidence to support otherwise, Sitka spruce (SS) and Alaskan Lodgepole pine (ALP) will remain the most suitable species mixture for production forestry under deep peat site conditions in Scotland. ALP is included in the calculations **only as a nurse mix** and its yield class is referred to in this context –in other words the ALP yield class is not measured in terms of it being the crop species. Climate change may present opportunities to use alternative species for restocking in the future, but this needs testing on a plantation scale.

Although other greenhouse gases are considered in this guide, the scientific modelling that lies behind it is based only on carbon balance because that is the best that can be derived from current data. It means that carbon (C) is used as a proxy for other greenhouse gases. When deciding whether a site is capable of supporting good growth without significant cultivation in a second rotation, optimising carbon accumulation and sequestration rates is taken as the aim.

The amount of carbon lost from a second rotation is relative to the level of soil and hydrological disturbance (for example by drainage). Higher levels of disturbance will require more tree growth to ensure a net fixation of carbon. Modelled scenarios[5] suggest that a positive greenhouse gas balance can arise from growth rates as low as SS GYC6/ALP GYC4 with minimal or medium levels of peat disturbance, and from a growth rate of SS GYC8/ALP GYC6 with higher levels of disturbance.

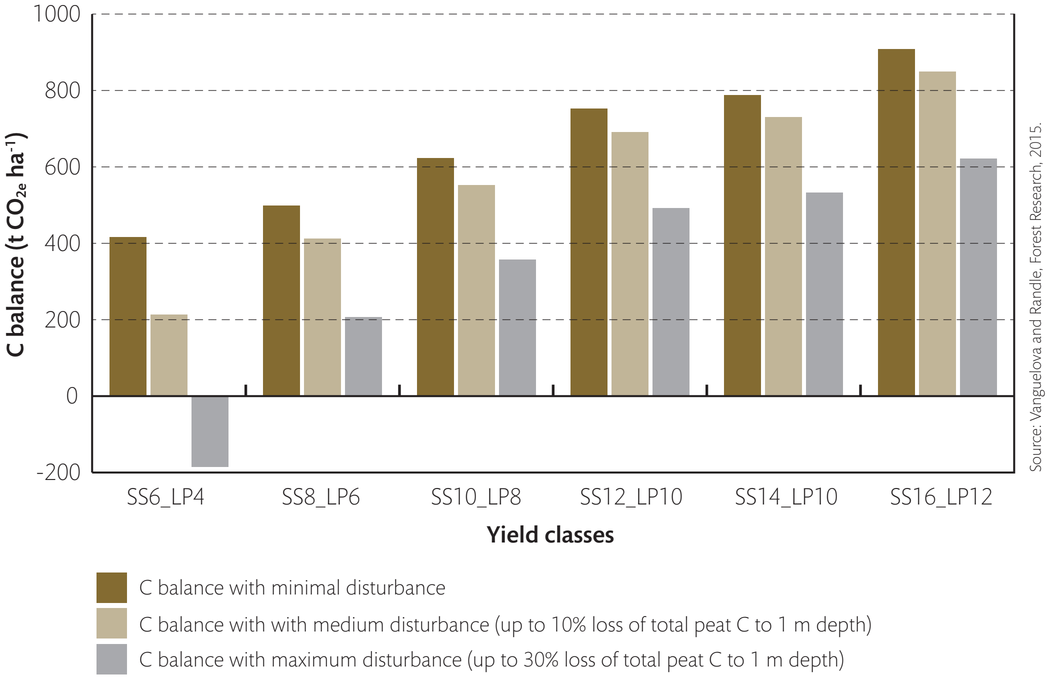
Modelled scenarios of carbon balance

Environmental conditions in Scotland mean that some cultivation and fertilisation is usually required to achieve good growth for second rotations on deep peats so it was felt that appropriate techniques should be based on the upper threshold (maximum 30% total peat loss to a 1 m depth). Using this threshold in the modelled scenarios leads to the recommendation that if greenhouse gas balance is to be considered, SS GYC8 is the minimum for productive restocking on deep peats. However, this must account for cultivation in the second rotation being the least intensive possible for that woodland type, and this is likely to be a less intensive regime than was undertaken in the first rotation.

The carbon balance in the summary graph below includes carbon in brash, trees, harvested wood products, operations and the soil changes (to a depth of 1 m) over second rotation SS/ALP 50:50 mix of different GYC. Normal stocking density is assumed. The graph indicates that, for normal establishment operations ('maximum disturbance' option) the carbon balance becomes negative below GYC8 SS.

5. Vanguelova, E. and Randle, T. (2012). Unpublished modelling for Forest Enterprise Scotland working group. Note that the models used in this unpublished work were peer reviewed when they were used in the production of Morison et al. (2010), Understanding the GHG implications of forestry on peat soils in Scotland, and Morison et al. (2012), Understanding the carbon and greenhouse gas balance of forests in Britain, Research Report 18.

Figure 15 Total C balance of second rotation SS/LP 50 :50 mix of different YC with different peat disturbance.



Appendix 2: How this guide fits into the Scottish regulatory framework

Regulation

The EC Birds and Habitats Directives led to the creation of Natura sites, which are areas of such significant conservation value that they warrant the highest level of legal protection. Any development that might damage a Natura site or the designated areas within it (Special Areas of Conservation and Special Protected Areas), must be assessed, and then only allowed to go ahead if certain strict conditions are met. The peatland habitats that are protected in Scotland as Special Areas of Conservation include active raised bogs, blanket bogs, bog woodland, degraded raised bog still capable of natural regeneration, and transition mires and quaking bogs. Development proposals on these sites can still sometimes go ahead, but often in a modified form so that they don't compromise the special interest of these protected areas.

The EU Water Framework Directive 2000 (WFD) seeks to protect, enhance and restore the condition of all water in the natural environment. This includes Ground Water Dependent Terrestrial Ecosystems (GWDTEs) such as wetlands or peatland habitats. We have a duty to help protect water quality through our forestry functions, for example by providing expert advice, determining felling licence and forest plan approvals, and offering grant aid. This means that woodland creation schemes, restocking proposals and felling licence applications are all assessed to establish their likely impact on water quality and flow, and their dependent terrestrial habitats.

In line with the Environmental Impact Assessment (Forestry) (Scotland) Regulations 1999, if you wish to gain approval to deforest land and restore it to an open ground peatland then you will need to submit an assessment of the site's restoration potential. The thresholds for determination are low – please ask your local Conservancy office or check the published guidance on EIA for forestry projects.

Potential grant aid

You may be eligible for grant aid towards restocking (for conventional restocking or peatland edge woodland) under the Forestry Grant Scheme of the Scotland's Rural Development Programme (SRDP) 2014–2020. Your local Conservancy office will be able to advise on this. You may also be eligible for grant aid towards a restoration project under the Agri-Environment Climate Scheme of SRDP 2014–2020. Your local SNH office will be able to advise on this.

Appendix 3: Guidance on undertaking a peat survey

The peat soil types used by Forestry Commission Scotland are identified in the FC Field Guide *The identification of soils for forest management* (Kennedy, 2002).

Stage 1

Desk exercise

Carry out a desk exercise to determine if peat is likely to be present using existing soil survey and/or geological survey maps complemented by aerial photos to indicate the presence of peat, vegetation patterns, surface drainage and any erosion features such as gullies or 'hags'. Identify those areas which will require ground survey.

Outputs

- Slope or 2 m contour map, potential drainage map, drainage channels and hags.
- Outline map of likely deep peat areas.

Stage 2

Ground survey

Each polygon derived from Stage 1 aerial photo interpretation should be checked for:

- presence and type of peat (using FC soil classification notation);
- presence and abundance (% cover) of diagnostic vegetation communities related to the FC soils classification (these are ground vegetation species rather than NVC species).

Navigating on open ground should be reasonably straightforward and fast by pacing and compass but navigating through forested areas can be onerous. We therefore recommend using a pre-loaded GPS grid reference, with a pre-selected grid created for all sample areas and the surveyor sampling at the exact grid references. Surveying at 10 m intervals is ideal but a larger grid may be the only practical option.

Tools needed

- Copies of any desk exercise maps for on-site annotation.
- Soil samplers or peat probes (at least 80 cm in length).
- GPS (loaded with grid refs).
- Notebook for vegetation and soil descriptions.

Outputs

- Polygon map of peatland vegetation cover and drainage features.
- GPS record of each sampling point (with peat depth to nearest 5 cm, when less than 50 cm in depth).
- Grid point map of peat depths coded by depth or linked into contours (if possible).

Peat depth

The polygon should be walked in a regular grid pattern of 10–50 m (depending on terrain, for example where peat overlies glacial moraines and rock outcrops, 10–20 m is likely required to identify the greater detail in the peat depth). Vegetation samples with peat depth should be measured at every grid intersection. As the sample grid is variable, intervals should be close enough to identify local variation and show gradations or contours of peat depth change (rather than random depth changes).

Peaty mineral soil type(s)

Where there are no exposures of soil profiles available, soil pits should be dug to at least 60 cm depth. Litmus paper or a field pH meter will help determine basic pH of deep peat soils. The pH reading has a bearing upon the potential suitability of the peat to grow native broadleaved tree species.

Vegetation assessment

A sampling quadrat of at least 2 m x 2 m or 5 m radius (grid point as the centroid), should be used for the description of vegetation communities, individual species % cover or bare ground and should be representative of the surrounding area.

Comment on the previous crop's performance (GYC or harvesting records) would also be useful since harvesting disturbance might have made it difficult to estimate tree growth potential by the soil nutrient regime and soil moisture regime as derived from the vegetation community. This data could include stump diameter, ring width, variation in ring width which may indicate previous fertiliser applications, number of growth rings, and frequency of stump size range. Poor growth is likely to be found in areas of deeper peat and poorer drainage.

Hydrology

Local hydrology can be assessed through a desk exercise. Digital Terrain Maps and spatial manipulation software can be used to show catchment extent and lines of potential drainage across the site – this might be particularly useful for complex or very flat sites. On many sites, sufficient details will be gained from the contours on 1:25,000 OS maps. Open pools and drainage networks may also be identifiable from aerial photos and confirmed by the ground survey.

Appendix 4: Indicative matching of soil type, peat type and vegetation

Soil group	FC soil code	National Vegetation Community	Peat type
8. *Juncus* or flushed basin bogs	8a	Various swamp, mire & fen types	*Phragmites* (or Fen) bog
	8b	Mire 6d	*Juncus articulatus* or *acutiflorus* bog
	8c	Mire 6c	*Juncus effusus* bog
	8d	Various mire and swamp types	*Carex* bog
9. *Molinia* or flushed blanket bogs	9a	Mire 25	*Molinia*, *Myrica*, *Salix* bog
	9b	Mire 25 & Mire 15	Tussocky *Molinia* bog; *Molinia*, *Calluna* bog
	9c	Transitional M25 to M19 & M20	Tussocky *Molinia*, *Eriophorum* bog
	9d	Mire 17	Non-tussocky *Molinia*, *Eriophorum*, *Trichophorum* bog
	9e	Mire 17 (probably)	*Trichophorum*, *Calluna*, *Eriophorum*, *Molinia* bog (weakly flushed)
10. Sphagnum or unflushed flat/ raised bogs	10a	Mire 18	Lowland *Sphagnum* bog
	10b	Mire 17	Upland *Sphagnum* bog
11. *Calluna*, *Eriophorum*, *Trichophorum* or unflushed blanket bogs	11a	Mire 19	*Calluna* blanket bog
	11b	Mire 19	*Calluna*, *Eriophorum* blanket bog
	11c	Mire 17 (probably)	*Trichophorum*, *Calluna* blanket bog
	11d	Mire 20	*Eriophorum* blanket bog
Eroded bogs	14	Mire 19	Shallow hagged eroded bog
	14h	Mire 17, Mire 1 & Mire 2	Deeply hagged eroded bog
	14w		Pooled eroded bog

This guide will help forest managers and agents in Scotland decide the best future management option for afforested deep peat sites (defined here as soils with a peat layer of 50 cm or more). It explains the principles and assessment methods of the *Forestry on peatland habitats* supplementary guidance that Forestry Commission Scotland published in 2014 to support the FC Guideline Note *Forests and Peatland Habitats* (2000).

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