Forest Research

An assessment of the afforested peat land in England and opportunities for restoration

The Research Agency of the Forestry Commission

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Background

As set out in the Open Habitats Policy (OHP), open habitat restoration is necessary to create a balance of the right habitats and trees in the right places. We need to make balanced decisions to minimise potential negative impacts on greenhouse gas emissions, local community participation, timber supply to local processors and costs of land management.

The UK Forestry Standard requires woodland managers to consider options to extend and improve priority habitats. The Biodiversity Strategy for England aims for an increase in the overall extent of priority habitats by at least 200,000 hectares. The area of restoration of PAWS and open habitat is one of the FC Impact Indicators in the government's 2013 Forestry and Woodlands Policy Statement. Forest Enterprise England has published a strategy for Open Habitat Policy delivery on the Public Forest Estate but no strategy exists for open habitat restoration from other woodland. Of the priority open habitat proposals coming in, peatland restoration proposals present the biggest challenges, including assessing the significance of the contribution of a site to national aspirational outcomes, judging whether a site represents one of the better opportunities for restoration, agreeing among the main stakeholders where to focus restoration efforts, and establishing if sites are viable for restoration.

Project tasks

This project addressed three main tasks:

1. producing improved maps of England's peaty soils and woodlands on deep peat
2. providing maps to help prioritise sites by GIS-based implementation of the Open Habitats Policy decision criteria
3. developing a field assessment tool to assess the viability and relative merits of sites for restoration.

National mapping

Natural England produced the Peaty Soils Location Map in 2009 by combining NSRI 1:250,000 soils data with BGS 1:50,000 drift geology and its own blanket bog BAP habitat mapping. In the current project, this best available peat mapping for England, was used as a basis and improved by overlaying 1:10,000 FC soil maps, which exist in a digitised form for 29% of the Public Forest Estate, approximately 74,000 ha. Obtaining other, more detailed, local peat mapping proved more difficult than anticipated so

potential further improvements were not made. The total of 1.40 million ha of peaty soils on the improved map, is 1% less than the 1.42 million ha on the NE Peaty Soils Location Map. However this difference resulted from improved mapping over a relatively small area and a bigger difference could be expected if further improved mapping became available. The total of 680,000 ha of deep peaty soils on the improved map was only 0.4 % less than on the NE Peaty Soils Location Map. Maps for four case study areas are presented to illustrate the improvements to the mapping.

The 2012 National Forest Inventory, the best available national data on woodland location, which includes all woodlands more than 0.25 ha in extent, was overlaid on the improved peaty soils map to produce a national map of woodland on deep peat. There was a total of 51,447 ha of woodland on deep peat. Of this, 47% was on blanket bog and upland valley mire and the rest was fairly evenly distributed between raised bogs, lowland fens/reedbeds (deep) and lowland fens/reedbeds (wasted). There was an approximate 60:40 split between plantation woodland and native woodland. Woodlands not on the Public Forest Estate accounted for 58% of all woodland on deep peat. SSSIs hold 18% of all woodland on deep peat, two thirds of this in internationally designated sites (i.e. Ramsar, SPA or SAC).

Strategic prioritisation

To help with prioritisation of sites for restoration, the decision framework criteria in sections 5.2.1 (sites we may support) and 5.2.2 (sites we may not allow) of the Open Habitats Policy were, as far as possible, implemented using simple models on a GIS and maps for each criterion were produced.

'Sites we may support' criteria

Of the 51,447 ha of woodland on deep peat, 20,152 ha, if restored, would extend or buffer high quality habitat (blanket bog, lowland fen or lowland raised bog on the NE Priority Habitats layer). The same area, if restored, would contribute to connecting these high quality habitats. 20,216 ha of woodland on deep peat is on SSSIs and might potentially safeguard their open habitat interests features if restored. The relative potential of wooded deep peat sites, if restored, to form, together with adjacent open peatland, a viable patch of peatland priority habitat is shown by a colour-coded map.

'Sites we may not allow' criteria

1,105 ha of woodland on deep peat is on sites in the England Ancient Woodland Inventory so would normally be unsuitable for restoration. Of the 51,447 ha total, 19,109 ha is broadleaved woodland, presumably mostly native but it is not known how

much of it falls into the may-not-allow-restoration category 'mature native woodland'. A colour-coded map is used to show the relative significance that restoration would have in relation to the existing area of open priority peatland habitat in the locality. 3,378 ha of woodland on deep peat is likely to be under high pressure for access (i.e. within 5 km of the homes of 100,000 people) and therefore needs to have the impact on access assessed if considered for restoration. A colour-coded map was produced showing the relative isolation of individual areas of woodland on deep peat to inform the may-not-allow-restoration criterion 'isolated sites'.

For each of the Open Habitats Policy criteria that could be implemented on GIS, a binary variable field was added to the table of attributes for the woodland on deep peat data set. This allows different combinations of the criteria to be used for strategic targeting of restoration. Two different combinations of the criteria are used as examples. Target option 1 combines 'extending or buffering high quality open habitat' with 'designated areas' and the constraints 'not ancient woodland', 'not native woodland' and 'no likely access issues'. This option identifies 8,562 ha as suitable for restoration. Target option 2 combines 'extending or buffering high quality open habitat' with 'designated areas' with the constraint 'not ancient woodland'. This more inclusive option identifies 13,856 ha as suitable for restoration. Five new criteria are suggested for use in prioritising sites that neither emerge as sites where restoration 'is likely to be allowed and may be supported' nor as sites where restoration 'may not be allowed and is unlikely to be supported'.

Field assessment

A field assessment tool developed for assessing the suitability of wooded deep peat sites for restoration to open habitats in Wales was tested to see how well it worked at a range of sites in England. Some shortcomings were identified. It would be difficult to use at many sites due to there being no Forestry Commission soil map for the site. An alternative scoring for the soil type component score was devised so that Soilscape soil mapping, which is freely available, could be used in the absence of FC soil mapping. The need to deduct points for sites where the peat is severely cracked was confirmed but difficulty in detecting peat cracking on sites that are not ploughed was a problem that needs to be solved. The range of sites used for testing included some severely and long degraded sites. To get an appropriate score for such sites, a points adjustment based on presence or absence of remnant bog or mire vegetation was added to the scoring system. A method for favouring restoration in some National Character Areas and not others by adding a 'favoured NCA bonus' to the site's score is discussed.

Project Background

The decision on when to convert woods and forest to open habitat in England is guided by the Open Habitats Policy (Forestry Commission England, 2010).

As set out in the Open Habitats Policy (OHP), open habitat restoration is necessary to create a balance of the right habitats and trees in the right places. During the 20th Century large areas of open, semi-natural habitats, including heathland, moorland, fen, bog and grassland were lost to various changes in land use, including afforestation and more recently by succession to scrub and woodland following land abandonment. Under the requirements of government biodiversity policy and the EC habitats Directive, we now need to restore some of these areas by converting selected woods and forests into open habitat, which in addition will benefit species such as the adder, sand lizard, woodlark, curlew and silver-studded blue butterfly, including helping them cope with climate change. However, we need to make balanced decisions about which woodlands are converted to minimise potential negative impacts on greenhouse gas emissions, local community participation, timber supply to local processors and costs of land management.

The UK Forestry Standard (Forestry Commission, 2011), the Governments' approach to sustainable forestry includes supporting guidelines on Forests and Biodiversity which set out legal and good practice requirements. Good practice in relation to peat land habitats include: (i) considering options to extend and improve priority habitats and to increase and extend populations and ranges of priority species and (ii) avoiding establishing new forests on soil with peat exceeding 50cm depth and on sites that would compromise the hydrology of adjacent bog habitats (also included in Forests and Climate Change and Forests and Soils Guidelines).

The Biodiversity Strategy for England (DEFRA, 2011) builds on the Natural Environment White Paper (HM Government, 2011) and provides a comprehensive picture of how we will implement our international and EU commitments. It sets out the strategic direction for biodiversity policy for the next decade on land (including rivers and lakes) and at sea. One of the outcomes (1B) is an increase in the overall extent of priority habitats by at least 200,000 hectares.

The Forestry Commission England's Corporate Plan 2011-15 (Forestry Commission England, 2011) sets out key Impact and Input Indicators to show contribution towards the wider State of England's Woodlands. The Indicators are also covered in the more recent Corporate Plan 2012-13 (Forestry Commission England, 2012).

The 2013 Indicators Report (Forestry Commission England, 2013) provides the second annual monitoring report on all the Indicators which were defined and developed through 2011-12. The first report was published in May 2012. It reflects the key priorities of

Protection, Improvement and Expansion of England's woodlands, as set out in the recent Government Forestry and Woodlands Policy Statement (January 2013) (DEFRA, 2013). This report includes six Headline key performance indicators (pages 8 to 13). These are reported quarterly. This document also reports on a further 14 Impact indicators (pages 14 to 28) and 4 Input indicators (pages 29 to 32), by which Forestry Commission England measures its performance.

FC Impact Indicator number 5 specifically records the number of hectares of restoration of plantations on ancient woodland sites (PAWS) and open habitat

On the Public Forest Estate the baseline in 2010 was a total of 17,329 ha of priority open habitat, a further 93 hectares was created in 2011-2 and 119 hectares in 2012-13. Open habitats restoration and management proceeds fully in line with agreed Forest Design Plans. For Priority Open Habitat on other woodland, a total of 341 ha were approved for open habitat creation – this was a decrease from the 642 ha of the previous year. The average for the three years including the baseline year is 531 ha per year.

Our assessment of the indicator from the baseline is a trend of improving however whilst there was a commitment in the Government's Forestry and Woodlands Policy Statement (2013) to publish a strategy for Open Habitat Policy delivery on the Public Forest Estate (Forest Enterprise England, 2013) to set out the future priorities for development and management of open habitats across the Estate, there is a lack of evidence or prioritisation for open habitat restoration for other woodland.

Our experience to date suggests that of all the types of priority open habitat proposals coming in, the peat land restoration proposals present the biggest challenges.

Challenges include:

a trying to assess the significance of the contribution of each peat site to national aspirational outcomes;

b whether each site represents one of the better opportunities for restoration;

c a lack of consensus perhaps in terms of focus of restoration efforts between the main stakeholders and;

d absence of an agreed assessment tool to establish if the sites are really viable for restoration.

This project was commissioned to help address the above challenges.

Key desired outcomes of project:

1 National assessment

Produce improved distribution maps of the peat land in England by overlaying FC soil maps of forests and forest blocks on Natural England's NE Report 257 maps (maps 1 & 2). Further improvement may be possible by requesting existing independent local peat maps from organisations involved in peat land restoration, e.g. for the Peak District from Moors for the Future. Using appropriate datasets (National Forest Inventory) strategically assess the deep peat resource under native woodland and/or plantation (using all NFI Interpreted Forest Type categories) in England, and its potential for delivery of ecosystem services.

2 Prioritisation of Sites

Based on the decision making framework contained in the Government's Open Habitat's Policy (Forestry Commission England, 2010) the results of the national assessment will indicate where the best opportunities for restoration are. This will be further refined to meet the geographical aspirations identified for each NCA by Natural England.

These priority sites will be assessed on the ground by experts (NE & FR) in the field to establish if the sites are really viable for restoration by applying the field assessment tool. These sites will be the focus for restoration efforts by Forestry Commission England and Natural England.

3 Field Assessment Tool

In Wales, a field assessment tool has been developed to enable forestry staff (such as planners and conservation managers) to evaluate all the areas of afforested deep peat highlighted in the Welsh national assessment and prioritise those sites where restoration is most viable. The tool is simple and easy to apply, information on soil type, peat depth, area and slope form the basis of this tool.

At least 25 sites (i.e. peat polygons on map), not necessarily the highest priorities but spread over at least 5 woodlands and peat types will be used for adapting the field assessment tool for England. The tool will enable local decision making on the priority sites. It will also guide managers away from committing resources to areas which are not viable or not going to deliver greatest ecosystem service benefit.

The work was conducted between September 2013 and March 2014 under a Service Level Agreement (01000060Q, SLA/13/14/023) between Forestry Commission England and Forest Research.

National Assessment

Key Desired Outcome

The contract specification states:

'Produce improved distribution maps of the peat land in England by overlaying FC soil maps of forests and forest blocks on Natural England's NE Report 257 maps (maps 1 & 2 on p8-9 of Report 257). Further improvement may be possible by requesting existing independent local peat maps from organisations involved in peat land restoration, e.g. for the Peak District from Moors for the Future. Using appropriate datasets (National Forest Inventory) strategically assess the deep peat resource under native woodland and/or plantation (using all NFI Interpreted Forest Type categories) in England, and its potential for delivery of ecosystem services.'

Improved national peaty soils map

The first stage of this work was to produce an improved version of the NE peaty soils map by overlaying more detailed data, where available, particularly FC soil maps.

Source data

The basis for this map was the 2009 Natural England Peaty Soils Location Map (Shepherd, 2008), which had been produced by combining the 1:250,000 scale NSRI National Soils Map, the BGS 1:50,000 drift geology data and NE's BAP habitat mapping for blanket bog (see Appendix 1).

Improvements were made by overlaying Forestry Commission 1:10,000 soil mapping where digitised FC soil maps existed. The area overlaid did not cover the whole of the Public Forest Estate (PFE) in England because not all of it has been soil surveyed nor did it cover the whole area mapped because part of this is only covered by paper maps, the others not having been digitised. Figure 1 shows the digitised and non-digitised FC soil map coverage, including all soil types, not just peats.

Table 1. Soil mapping at 1:10,000 scale on the Public Forest Estate in England.

PFE soil map coverage	Area (ha)	% of PFE
Mapped and digitised	74,346	29
Mapped but not digitised	55,403	22
Not mapped	124,170	49

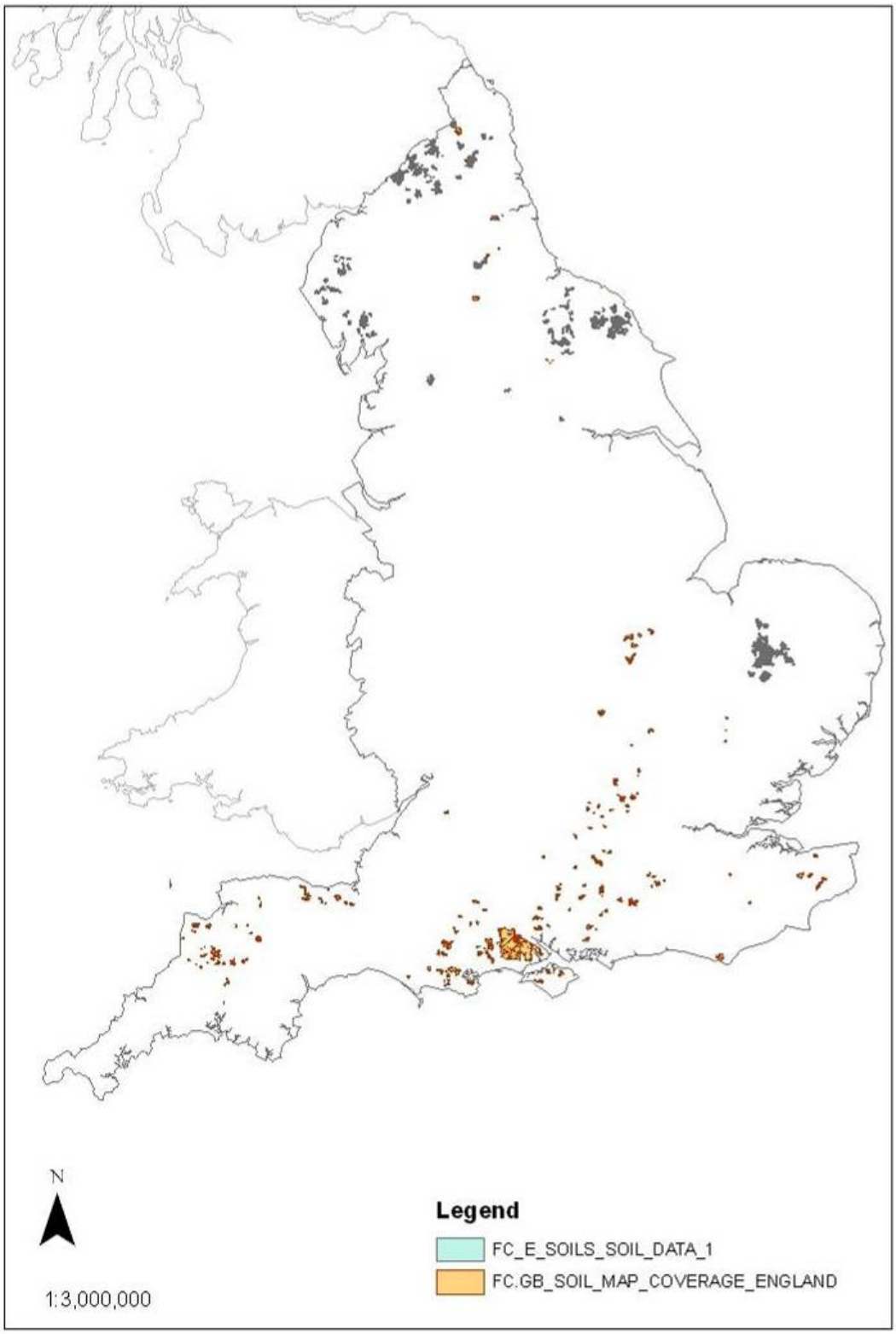


Figure 1. Soil mapping (all soil types) on the Public Forest Estate in England. Orange areas are currently only available as paper maps so were not used in this work.

Potential additional source data

Initially, it was thought that further detailed peat mapping could be obtained easily from some of the larger practical peatland restoration projects. We contacted the largest of these projects, Moors for the Future, but this has not yet provided material. Identifying additional detailed peat mapping suitable for incorporation, combined with the practical issues of licensing, standardising and incorporation amount to more work than has been allocated to this project.

Natural England is producing a new updateable peat map for England, based partly on European soils mapping data, BGS 1:625,000 and elements of moorland line and LFA mapping (Matthew Shepherd, *Pers.Com.27 Aug 2013)*. The map will also incorporate data produced by a model relating peat depth to topographic and climatic factors. It is hoped to make this map updateable so that it can be improved annually by the addition of peat survey data produced by others.

Converting FC soil types to NE peaty soils classes

The FC soil classification (Kennedy, 2002) is summarised at Appendix 2. It uses a threshold peat depth of 45 cm to differentiate deep peats from shallow peats. Polygons are mapped as either a single soil type or a mosaic of up to four soil types, with approximate percentage of each of the types given. All the deep peat types were allocated to the NE category 'deep peaty soils'.

Conversion was done by first assigning each soil type to a broad category as in Table 2 and then using simple rules to assign each polygon to one of the NE peaty soil categories.

Table 2. Conversion of FC soil types to broad categories prior to applying rules to assign soil polygons to NE peaty soil map categories.

FC soil type	Broad category
8a, 8b, 8c, 8d 9a, 9b, 9c, 9d, 9e 10a, 10b 11a, 11b, 11c, 11d 14, 14h, 14w	Deep peat (DP)
6, 6z 13p Any other type with phase = p	Shallow peat (SP)
1, 1u, 1d, 1z 2, 2s, 2m 3, 3m 4, 4z, 4b 5, 5b 7, 7b, 7bv, 7h, 7v, 7z 12, 12a, 12b, 12c, 12t 13b, 13c, 13g, 13r, 13s, 13z 15d, 15e, 15g, 15i, 15s, 15w VC	Mineral soil (MS)

Rules to assign soil polygons defined in terms of polygon area

Using the Broad Soil Categories defined in Table 2, the following four rules were applied to classify peat soils on the digital soil map, to produce the improved peaty soils map.

If DP > 50%, assign polygon to 'Deep peaty soils'

If DP = 0% and SP > 50%, assign polygon to 'Shallow peaty soils'

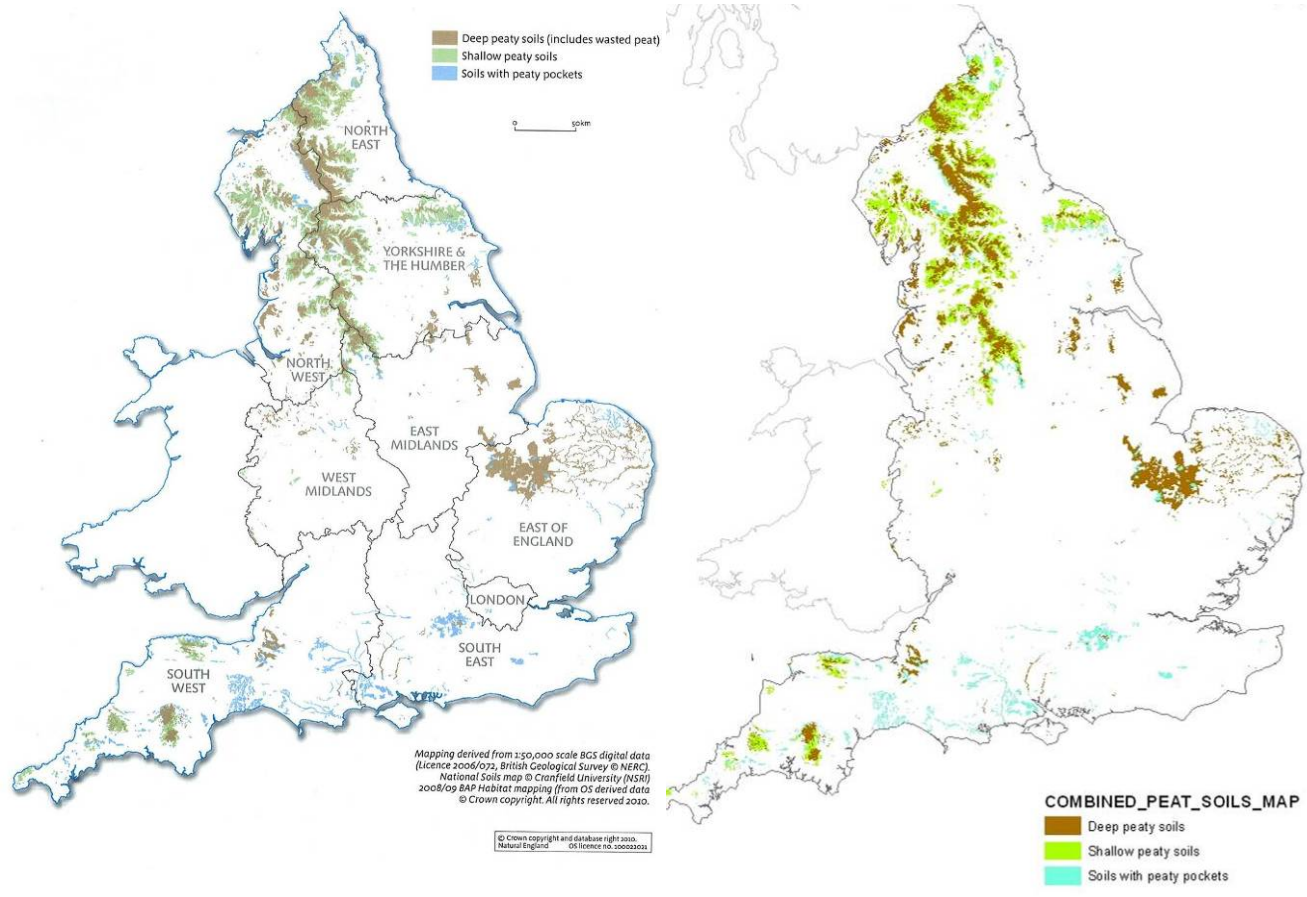
If DP > 0% and ≤ 50% and SP > 50%, assign to 'Soils with peaty pockets'

If MS > 50%, assign polygon to 'Mineral soils'

The improved peaty soils map

Figures 2 a & b show the original NE peaty soils map and the improved peaty soils map respectively. Differences are hard to spot at this scale but are more clearly illustrated for a smaller case study area in Northumberland (Figures 3a-3d). Three further case study areas are similarly illustrated in Appendix 2. Each case study area is shown first on a 1:50,000 or smaller scale OS map (Appendix 2, upper right map on each page). Then the area is shown as the NE peaty soils map. Thirdly the improved peaty soils map is shown. FC soil map polygons are all shown so that the extent of mapping is obvious but only the peaty soil polygons are coloured. Fourthly, woodland cover on peaty soils is shown and coded by its fill pattern for woodland type.

Figure 2. a. Natural England peaty soils map (Natural England, 2010), b. Improved peaty soils map



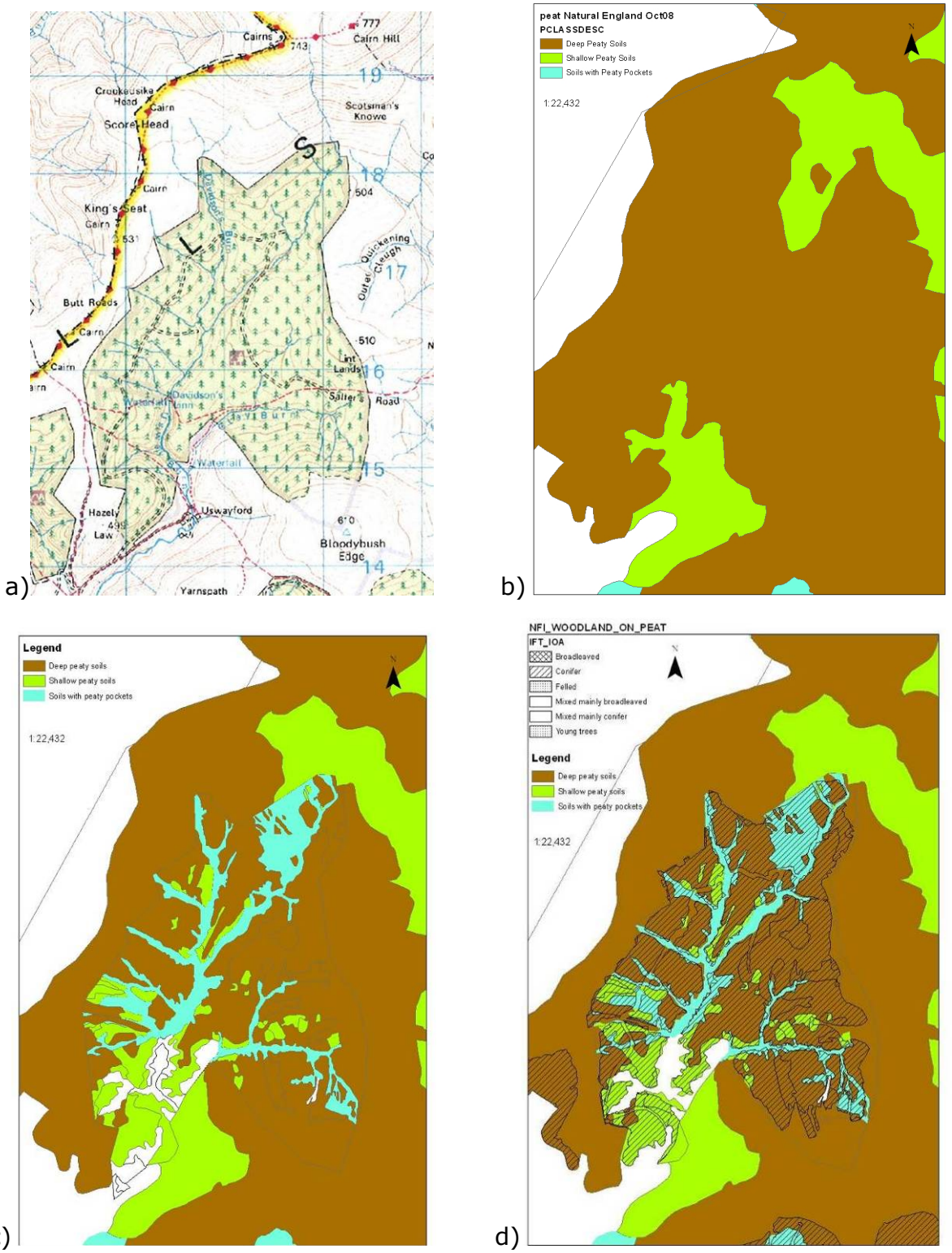


Figure 3. Case study illustration of improved peaty soils map, a) from 1:50k OS map of Usway Ford East, Northumberland, b) NE peaty soils map for area, c) improved peaty soils map for area. The 1:10k FC soil map replaces the NE peaty soils map, d) NFI woodland overlaid on the improved peaty soils map.

Results of mapping improvements

The total area of peaty soils on the Improved Map is 1% less than on the NE Peaty Soils Map (Table 3). This difference arises from replacing NE data with the more detailed FC soil mapping over an area of 74,346 ha.

Table 3. Total areas of peaty soils according to the NE peaty soils map and the improved map.

Peaty soils total area	Area (ha)
NE Peaty Soils Map	1,418,653
Improved Peaty Soils Map	1,401,307

Using four areas as case studies (see Appendix 2) the effects of the mapping improvements are shown. At the local scale, the improvements are substantial in areas with digitised FC soil maps. However, the improvements are very limited at the national scale because the area with digitised FC soil maps is so small. The area of deep peaty soils is marginally reduced on the improved map compared with that on the NE peaty soils map (Table 4 and 5).

Table 4. Total areas of each of the NE peaty soil categories.

Peaty soil category	Area (ha)
Deep peaty soils	677,529
Shallow peaty soils	514,906
Soils with peaty pockets	208,872
TOTAL	1,401,307

Table 5. Total deep peat area according to the NE peaty soils map and the improved map.

Deep peat total area	Area (ha)
NE peaty soils map	679,925
Improved national peat map	677,529

Just over half of the deep peat on the improved peaty soils map is or was originally blanket bog (Table 6). Lowland fens and reedbeds account for the majority of the rest, although two-thirds of these are classed as wasted (i.e. severely degraded). Raised bogs are the least abundant peatland type.

Table 6. Total area of deep peat broken down by habitat of origin.

Habitat of origin	Area (ha)	% of total deep peat
Blanket bog and upland valley mire	354,879 *	52
Raised bog (upland and lowland)	34,960	5
Lowland fens/reedbeds (deep)	95,891	14
Lowland fens/reedbeds (wasted)	190,897	28
No data	901	0.1
TOTAL	677,529	

- These figures are current areas of deep peaty soils originating from these habitats but not necessarily supporting these habitats currently. Comparison with figures for the total area of habitat in England, based on Natural England's Single Habitat Layer show that substantial areas no longer support the habitat of origin.

Woodland on deep peat map

The England 2012 version of the National Forest Inventory (NFI) was used for woodland location. This dataset was produced by aerial photo interpretation and includes all woodlands more than 0.25 ha in extent. For our purposes we selected all NFI land of the Interpreted Forest Types (IFTs) shown in the left-hand column of Table 7. This land was intersected with the 'deep peaty soils' area on the improved peaty soils map. The resulting map of NFI woodland on deep peat is shown as Figure 4.

Table 7. NFI interpreted Forest Types included as woodland and those excluded as non-woodland for the purposes of this work.

NFI Interpreted Forest Types included (i.e. woodland)	NFI Interpreted forest types excluded (i.e. non-woodland)
Assumed woodland	Agricultural land
Broadleaved	Bare area
Cloud/shadow	Grass
Conifer	Open water
Coppice	Other vegetation
Coppice with standards	Power line
Felled	Quarry
Ground prep	River

Low density Mixed mainly broadleaved Mixed mainly conifer Shrub Young trees	Road Urban

Figure 4. NFI woodland on deep peaty soils.

Summary description of the woodland on deep peat resource

Nearly half of all the NFI woodland on deep peat consists of conifer plantations on blanket bog or upland valley mire (Table 8). A small but significant area of native woodland is on this same habitat category. The remaining woodland on deep peat is fairly evenly split between raised bogs, lowland fens/reedbeds (wasted) and lowland fens/reedbeds (deep). Rather more of the woodland on raised bogs is plantation than native. Most woodland on lowland fens/reedbeds is native, whether the peat is wasted or deep. There are small but significant areas of plantation on both categories of lowland fen/reedbed.

Table 8. Area breakdown of woodland on deep peat into habitat of origin for plantations and native woodland. The interpreted forest type 'shrub' was omitted because it could not be categorised into plantation or native, explaining why the total area is slightly greater than the sum of plantation and native areas.

Habitat of origin	Area (ha)			Area as percentage of current habitat total area for England *
	Plantation	Native	Total	
Blanket bog and Upland valley mire	23,153	818	23,987	9%
Raised bog (upland and lowland)	5,169	3,700	8,908	92%
Lowland fens/reedbeds (deep)	1,277	7,963	9,291	32%
Lowland fens/reedbeds (wasted)	1,743	7,429	9,185	
No data	8	66	76	
TOTAL	31,350	19,977	51,447	

* Area of deep peat originating from Blanket bog and upland valley mire is expressed as a percentage of the current area of blanket bog habitat. Area of deep peat originating from raised bog (upland and lowland) is expressed as a percentage of the current area of lowland raised bog habitat. Area of deep peat originating from lowland fens/reedbeds (deep) is expressed as a percentage of the current area of Lowland fens and Reedbeds. It is assumed that all current lowland fens and reedbeds are on deep peat that is deep, rather than wasted.

In terms of restorability, all other things being equal, peat with plantation woodland is more likely to be restorable than peat with native woodland because native woodland colonisation is more likely to have occurred where the peat is already degraded. An unknown proportion of the native woodland on deep peat will either support wet woodland priority habitat or have the capacity to do so if the drains were blocked. This

report concerns restoration to open habitats but in some cases restoration to wet woodland will be more appropriate, restoration of a natural hydrological regime bringing benefits in terms of valuable habitat, potential carbon benefits, flood attenuation, and aquifer recharge. There are also situations, particularly where peat deposits are linear, as they are north of Southampton and around Norwich, where scrub and semi-natural woodland on deep peat can contribute to a future mosaic of different habitats supporting a greater diversity of species.

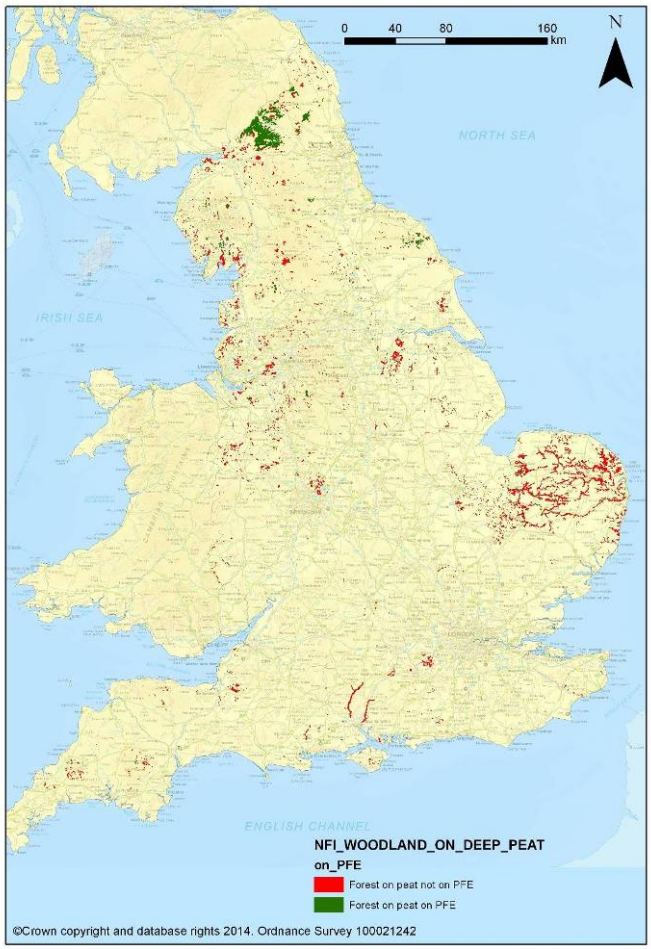
Woodland on deep peat is present both on the public forest estate and in non-PFE woodlands (Figure 5a). The latter hold more of it than the former (Table 9) Opportunities therefore exist for potential restoration (where appropriate and complying with the Open Habitats Policy) on privately owned land subject to owner objectives and motivation for managing their land. In contrast the recently published (Dec 2013) Strategy for Open Habitats Policy Delivery on the Public Forest Estate (PFE) (Forest Enterprise England, 2013) has identified that PFE can contribute very little more beyond what is already proposed to the national total of blanket bog (all un-restored area amounts to only 0.7% of the total existing area). Therefore deep peat habitat types are not a priority for additional restoration on the PFE Estate.

Extensive peat soils derived from former blanket bogs are found in the Public Forest Estate in Northumbria and East Cumbria (accounting for the majority of plantation woodland on deep peat). The following protocol (Spencer & Edwards, 2009) for identifying potentially restorable habitat was developed in consultation with Forest District staff and the Border Mires Group and is consistent with similar protocols adopted by FC Scotland.

Forests on afforested deep peat soils with an average depth of 1 metre or greater were regarded as having potential for restoration. The British Geological Survey publish drift maps in GIS form which identify peat areas over a metre deep and these were used as an initial sift to identify areas with potential for restoration. These areas were then considered and the following assessed;

- The impact of road building and associated infrastructure breaking up areas of blanket bog and irreversibly changing the underlying hydrology.
- The impact of second and third rotation crops and associated drainage that had changed the hydrology beyond effective reversion.
- The scale of restoration and the creation of large contiguous areas of open habitat (either as a result of restoration or as extensions to existing or planned areas), or conversely of small isolated areas of restored peatland habitat. The large areas were termed “areas of significant peat” and included in this study, while smaller isolated areas (less than 50ha in extent) were discounted from consideration.

Mires (mainly in the south of Kielder Forest) occur on the numerous deep peat lenses on peat up to 10 metres deep. These mires, many of which are designated as SSSI, have been the subject of a major mire restoration programme for nearly a decade. Consequently only a small area of afforested mire (as opposed to afforested blanket bog) remains in the potential area for restoration, with all this area planned for restoration in the future.



a)

b)

Figure 5. a) NFI woodland on deep peat soils on and off the Public Forest Estate, b) NFI woodland on deep peat, distinguishing plantation woodland (light green) from native woodland (dark green). Breakdown based on NFI IFTs as shown.

The area of woodland on deep peat is split approximately 40:60 between Public Forest Estate and private ownership (Figure 5a and Table 9).

The area of woodland on deep peat is split approximate 60:40 between plantation and native woodland (Figure 5b and Table 10).

Table 9. Area breakdown of woodland on deep peat into public forest estate (PFE) and other woodland (non-PFE).

Land ownership	Area (ha)	%
PFE	21,401	42
Non-PFE	30,046	58
TOTAL	51,447	

Table 10. Area breakdown of woodland on deep peat according to its origin.

Woodland origin	Area (ha)	%
Plantation	31,350	61
Native woodland	19,977	39
TOTAL	51,447	

Almost one fifth of all woodland on deep peat is designated at international (Ramsar, SPA, SAC) or UK level (SSSI) (Table 11). A figure for the proportion of the remaining area within County Wildlife Sites is not available but it is believed to be substantial.

Table 11. Area breakdown of woodland on deep peat into designated and non-designated at international and national designation levels

Level of designation	Area (ha)	%
International (Ramsar, SPA, SAC)	6,230	12
UK only (SSSI)	3,022	6
County or undesignated	42,195	82
TOTAL	51,447	

Further tables which provide information on the area of peaty soils, deep peat soils, woodland on deep peat, plantation woodland on deep peat and native woodland on deep peat are provided in Appendix 4.

Prioritisation of sites

Key desired outcome

The contract specifies as follows:

'Based on the decision making framework contained in the Government's Open Habitat's Policy the results of the *national assessment* will indicate where the best opportunities for restoration are. This will be further refined to meet the geographical aspirations identified for each NCA by Natural England.

These priority sites will be assessed on the ground by experts (NE & FR) in the field to establish if the sites are really viable for restoration by applying the field assessment tool. These sites will be the focus for restoration efforts by Forestry Commission England and Natural England.'

GIS-based implementation of Open Habitats Policy decision criteria

The decision framework is described in Section 5.2 of the OHP. The criteria forming the framework are set out in sections 5.2.1 (Sites we may support) and 5.2.2 (Sites we may not allow), which are included as Appendix 4 of this report. The criteria are listed in our Table 12 and our method of modelling those that are spatially explicit in GIS is explained. For most of the criteria the area included or, in the case of constraining criteria, excluded by the criterion is also given. Maps showing areas defined by each of the criteria are presented in Figures 6-13. A further output is provided in the form of a set of fields in the table of attributes for the Woodland on deep peat dataset indicating compliance or otherwise with each of the citeria.

It was not possible to model all the OHP decision criteria in GIS because many of the datasets that would be required to do that are non-existent or unavailable. Some criteria, such as Ancient Woodland, can be modelled exactly and others have been modelled as closely as possible but not exactly as set out in the Open Habitats Policy. For example, we have used SSSIs to model the Designated Areas criterion but there is no data suitable for building in whether or not the woodland impacts on its open habitat characteristics. Similarly the Mature Native Woodland constraint criterion has been modelled using the NFI broadleaved woodland dataset but there is no available data on

which woodlands are mature so we have included all NFI broadleaved woodlands in the constraint. FCE Forest Services may wish to omit these inexactly modelled constraints from the 'Not allow' definition so that cases with these as the only potential constraints fall into the 'May allow' category. The criteria can then be considered on a case by case basis using additional information requested from applicants.

Table 12. Implementation of Open Habitats Policy decision criteria for 'Sites we may support'.

Sites we may support	Rationale	Spatially explicit in GIS	Method	Outputs
Extending or buffering high quality habitat	When the new open habitat will extend or buffer areas of high quality existing open habitat, and there is evidence that fragmentation of the current habitat is having a detrimental impact on the wildlife in that habitat.	Yes – partially	Select sites (individual polygons) from 'woodland on deep peat map' which intersect with NE Priority Habitats v1.1 – main habitat = blanket bog (BLBOG), lowland fens (LFENS), lowland raised (LRBOG)	**Figure 6** Fields:bog_ph (1=ph, 0=no ph) Area=20152 ha 39%
Connecting high quality habitat	When the new open habitat will form a viable wildlife link between areas of high quality open habitat (improving 'connectivity') and there is evidence that lack of connectivity is having a significant detrimental impact on the wildlife in that habitat.	Partially, as above		
Designated areas	When the woodland is growing on a site with a national or international conservation designation, such as a site designated under the Habitats Directive for Annex 1 habitat types, as a Site of Special Scientific Interest or National Nature Reserve and the woodland adversely impacts on its open habitat characteristics.	Yes – partially	Select sites (individual polygons) from 'woodland on deep peat map' which intersect with NE SSSI. NOTE: simple intersection between woodland on peat and SSSI boundaries. No indication of features/habitats of SSSI notification or condition or impact of woodland. Ideally we need to distinguish between bog/open habitats and species and woodland habitats and species	**Figure 7** Fields: sssi (1=sssi, 0=no sssi) Area=20216 ha 39%
Grazing	When the new open habitat will extend or link areas of open habitat to allow a practical grazing area to form, and there is evidence that conservation grazing will be established and maintained once the open habitat is created.	No data		
Threshold sizes	When the new open habitat will add to the current area of open habitat to form a patch of continuous or well-connected open habitat that is significantly more viable in the long-term. Minimum desirable patch sizes identified in Habitat Actions Plans can be used as a guide.	Yes – partially	Dissolve NE Priority Habitats v1.1 – main habitat = blanket bog (BLBOG), lowland fens (LFENS), lowland raised (LRBOG) – to create contiguous areas of bog PH and calculate areas for each patch. Spatially join these areas to intersecting sites (individual polygons) from 'woodland on deep peat map'. which intersect with NE Priority Habitats v1.1 – main habitat = blanket bog (BLBOG), lowland fens (LFENS), lowland raised (LRBOG)	**Figure 8** Fields: contig_PH (area) potential to apply a size threshold
Opportunities for species of conservation concern	When there is evidence that converting the woodland to open habitat presents significant opportunities to enhance species of conservation concern	Possibility to add in records for selected bog/open habitat species.		

Table 13. Implementation of Open Habitats Policy decision criteria for 'Sites we may not allow'.

Sites we may not allow	Rationale	Spatially explicit in GIS	Method	Outputs
Ancient woodland	We will not allow conversion of any ancient woodland	Yes	Select sites (individual polygons) from 'woodland on deep peat map' which intersect with England AWI v2.6	**Figure 9** Fields: aw (1=aw, 0=no aw) Area=1105 ha 2%
Native woodland	We will allow permanent removal of mature native woodland only in exceptional circumstances, where there is evidence that removal is the only option to realise exceptional biodiversity benefits. Our current working definition of "mature native woodland" for this policy is: • sites currently composed of native broadleaves that have been wooded for at least 80 years; or • sites where a proportion of the current native broadleaved crop is at least 80 years old and where the woodland canopy has been closed (>70% canopy cover) for at least the last 20 years.dd	No details of age of woodland in NFI spatial data to identify mature native woodland. Option to identify all broad-leaved woodland from NFI	Select IFT=broadleaved from 'woodland on deep peat map' NOTE: simple selection of all broad-leaved woodland within 'woodland on deep peat map' as there is no indication of woodland age to identify mature (>80 year) woodland.	**Figure 10** Fields: bw (1=bw, 0=no bw) Area=19109 ha 37%
Protected species and habitats	There are several species of conservation concern that may be damaged by permanent removal of woodland to restore or expand open habitat. Some of these may be European Protected Species with a legal framework preventing damage. There are also some sites with national or international conservation designations that could be similarly damaged by woodland removal. Where there is evidence that loss of woodland will have a negative impact on a protected species or habitat, we are unlikely to allow conversion of woodland to open habitat. If the organisation proposing the conversion can guarantee appropriate mitigation measures, then we may grant permission, but only if the biodiversity benefits of conversion of the woodland to open habitat are exceptional.	Possibility to add in records for selected woodland species.		
Poor condition of current open	When the organisation proposing the conversion controls open habitat similar to that which it is	No		

habitat	proposing to create, (i.e. a similar type in a similar location) we will take into account the condition of the current open habitat when deciding whether to allow conversion. If it is in unfavourable condition, we may only grant permission if the conversion is part of a management plan bringing all similar open habitat in the area under the organisation's control into favourable condition. By unfavourable, we mean that it is not fulfilling its biodiversity potential (for example wet areas are being damaged or there is too much burning so that species of conservation concern are under threat) and, or, is regenerating to woodland due to poor management or lack of management. Note that this does not include cases where there has been an active and appropriate decision to allow natural regeneration, for example as part of a shifting mixture of open habitat and woodland (see Section 5.4.4).			
Insignificant impact	When the new open habitat will be adding a relatively small amount to an already large area of open habitat. In such circumstances, it is unlikely that we will grant permission unless compensatory woodland creation is guaranteed (see Section 5.3.3). An exception could be when the apparently small scale conversion is making an exceptional contribution for reasons other than scale, for example creating an important habitat link.	Yes - partially	Linked to method to calculate threshold sizes (see above). Calculate ratio of size of woodland site (individual polygons) from 'woodland on deep peat map' to the contiguous area of intersecting NE Priority Habitats v1.1 – main habitat = blanket bog (BLBOG), lowland fens (LFENS), lowland raised (LRBOG) as presented in filed Contig_PH. A larger number indicates a small woodland within a large area of contiguous open habitat	**Figure 11** Fields: Sig_ratio (area of woodland/contig_PH)
Access	There can be conflicts between the needs of wildlife and the needs of recreational users of open habitat, for example, ground nesting birds on lowland heathland. In most cases, good site management will minimise the impact of any conflict. However, in some cases it may be necessary to consider alternatives to converting woodland to open habitat to prevent significant conflict between wildlife conservation and people. Where there is heavy recreation pressure on a site, we are unlikely to allow conversion to open habitat unless there is evidence that the access can be managed to minimise potential harm to wildlife without		Select sites (individual polygons) from 'woodland on deep peat map' which intersect with FC.E_WOODS_CLOSE_TO_PEOPLE	**Figure 12** Fields: access (1=access, 0=no access) Area=3378 ha 7%

	excluding access. Only in exceptional circumstances will it be acceptable to convert a wood to open habitat where there is a significant risk that the needs of wildlife will result in additional pressure to exclude people from a site.			
Isolated sites	Where the proposal will create a relatively small area of isolated open habitat with poor connectivity. By applying this framework for decision-making we will be able to apply the principles of the 'right tree in the right place' and the 'right habitat in the right place'. We must also apply the principle of the 'right kind of change at the right pace'.		Potential to use same method as 'threshold sizes' to select small woodland sites with zero-small area of contiguous open habitat.	**Figure 13** Fields: contig_PH (area) potential to apply a size threshold

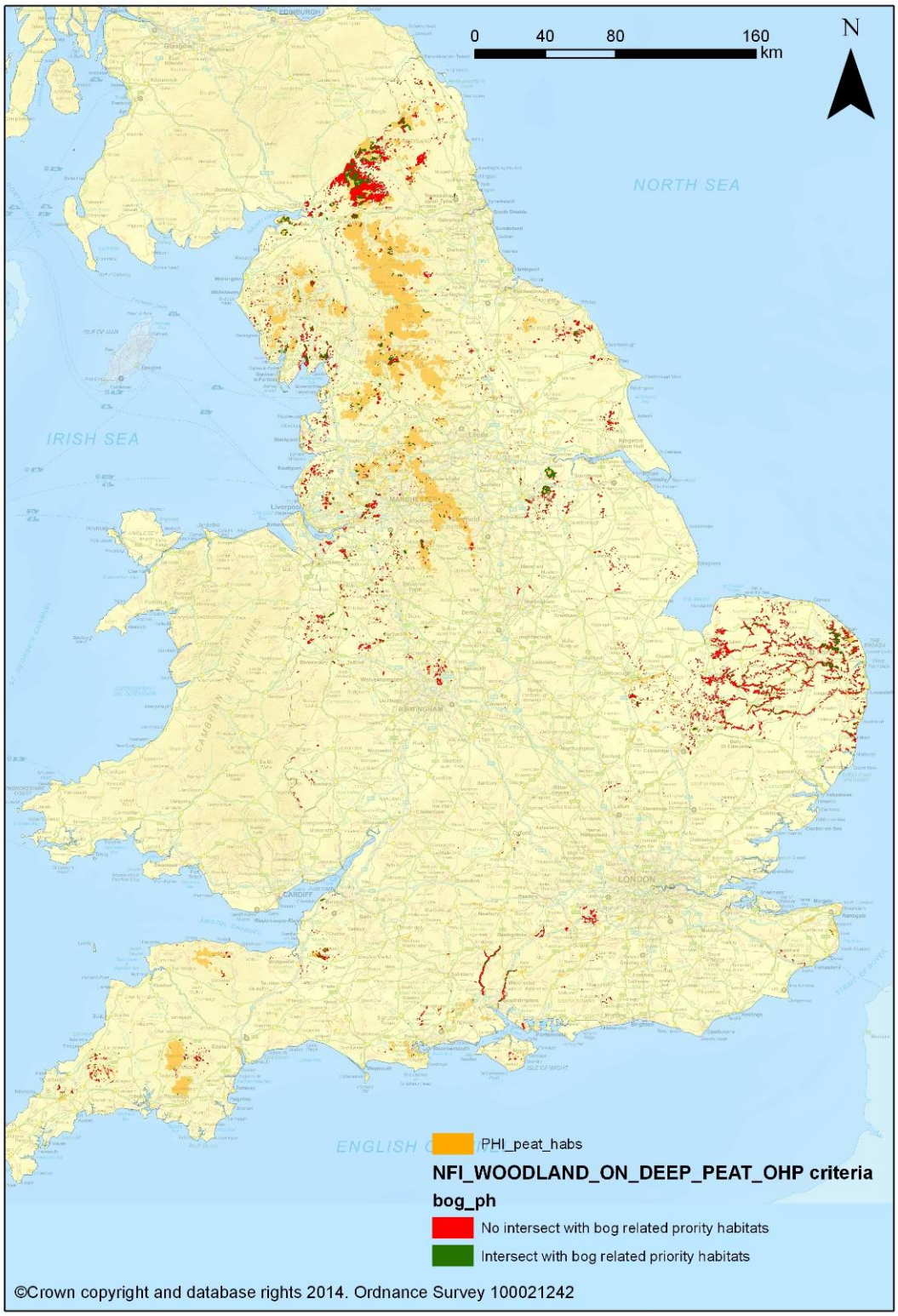


Figure 6. NFI woodland on deep peat close to open peatland habitat, amounting to 20,152 ha.

Figure 7. NFI woodland on deep peat close to sites of special scientific interest (SSSI), amounting to 20,216 ha.

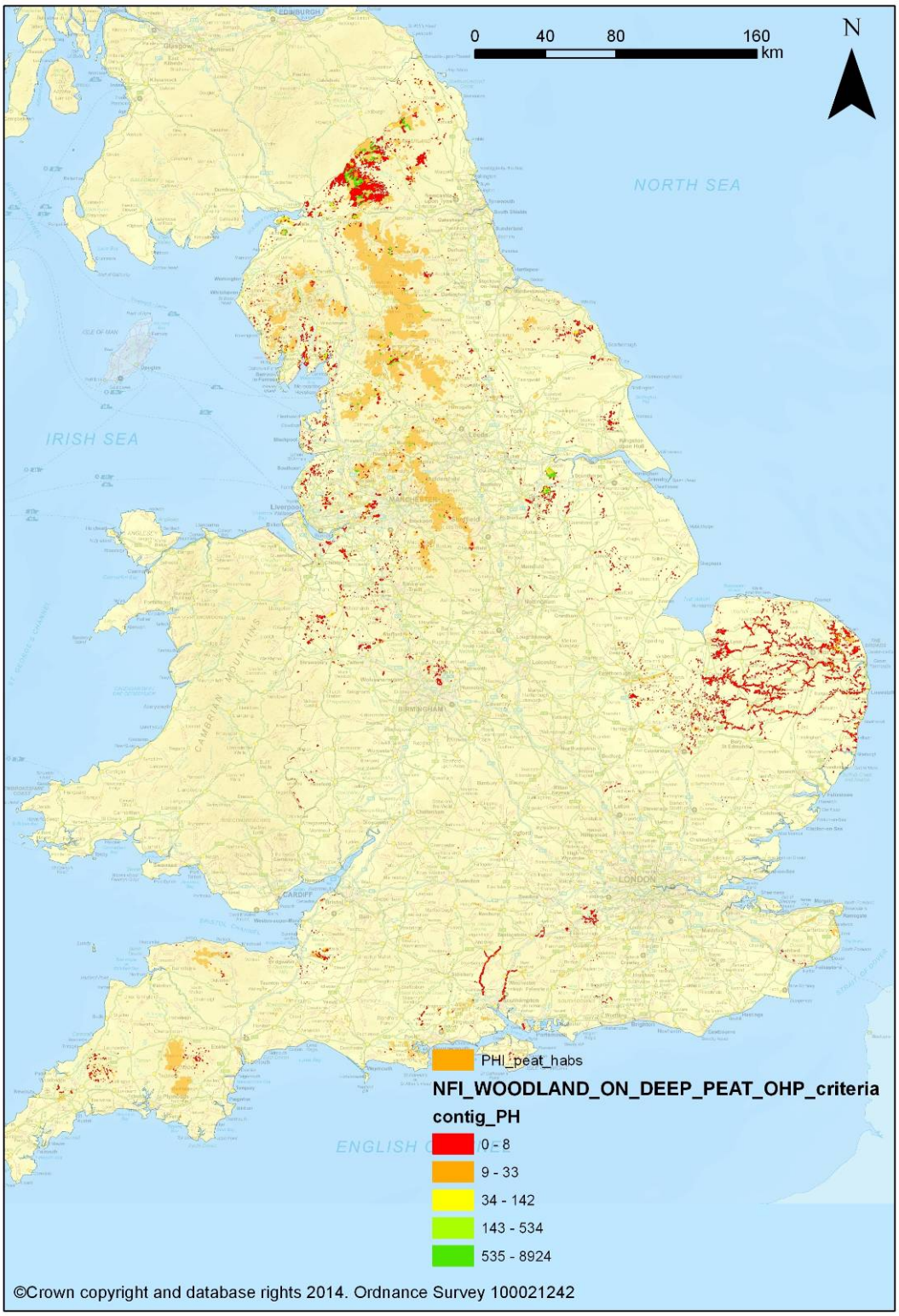


Figure 8. NFI woodland on deep peat contiguous with open peatland habitat. Area that may be supported under this criterion depends on the threshold set.

Figure 9. NFI woodland on deep peat that is classed as ancient woodland, amounting to 1,105 ha.

Figure 10. NFI woodland classed as broadleaved native woodland on deep peat, amounting to 19,109 ha.

Figure 11. NFI woodland on deep peat colour coded to show the significance of the impact of woodland removal in relation to the existing area of contiguous open habitat.

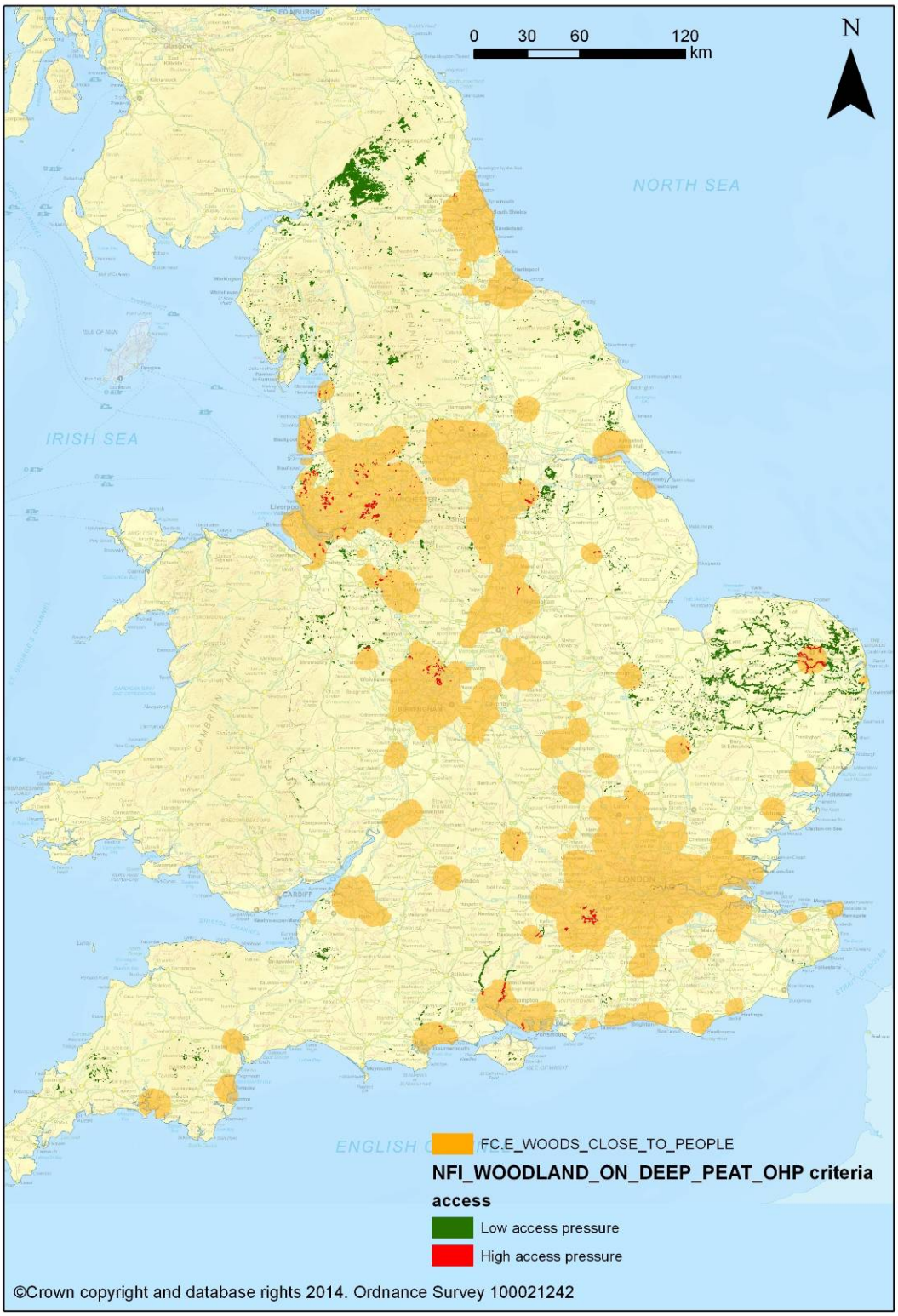


Figure 12. NFI woodland on deep peat that is accessible to large numbers of people, amounting to 3,378 ha.

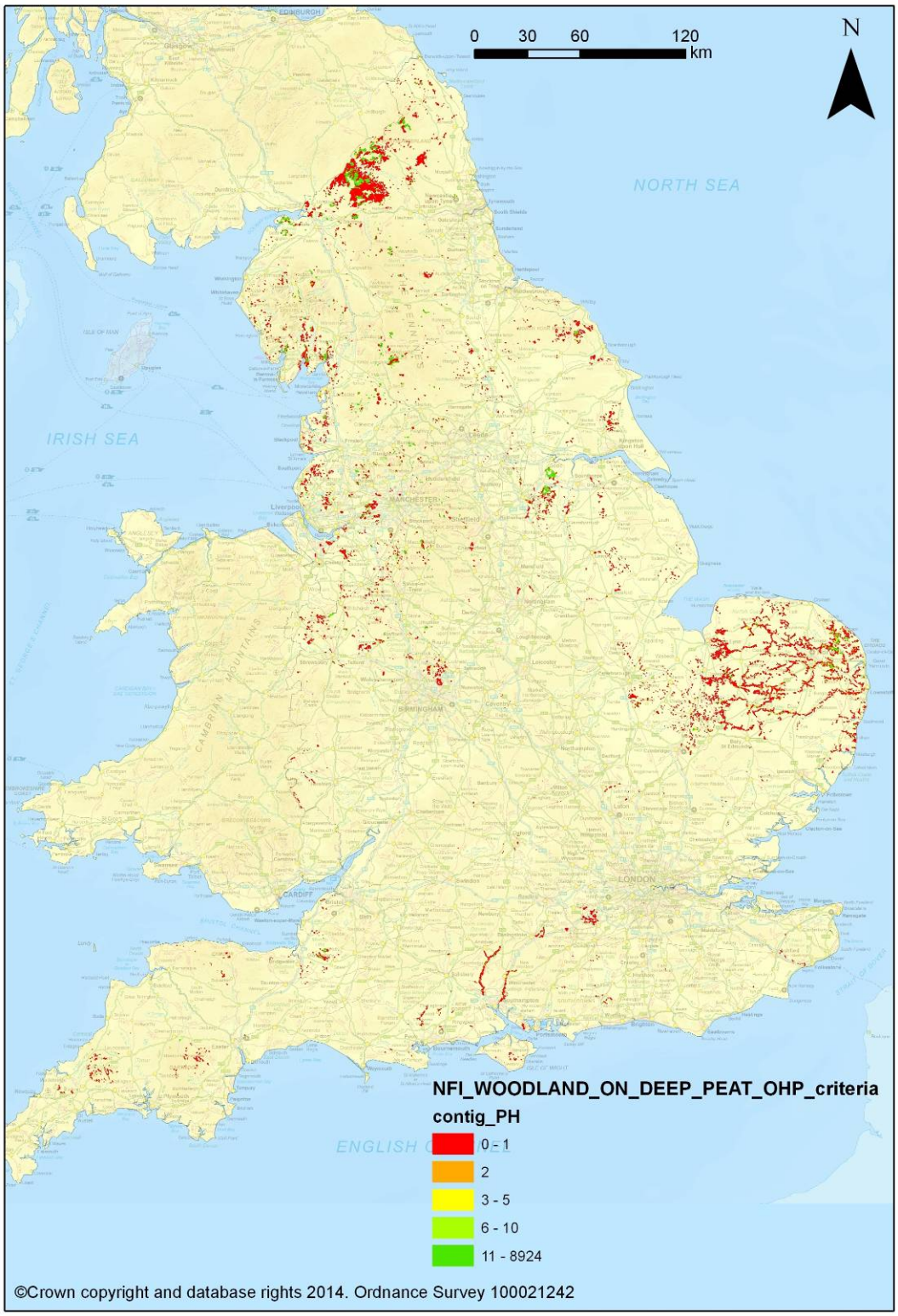


Figure 13. NFI woodland on deep peat colour coded to highlight relatively small isolated patches, the removal of which will contribute little to reducing open habitat fragmentation (green areas).

Potential combinations of OHP decision criteria

For many of the criteria, compliance is recorded against each woodland on deep peat as a binary variable so it is possible to select sites which meet various combinations of OHP criteria. This has the potential to assist FCE to define woodland sites that they are likely to Support, unlikely to allow or that they may allow (Table 13).

For example, a Target Option 1, which could be used to target grant aid for open peatland habitat restoration (Figures 14 and 16):

- **Support category:** extending or buffering high quality open habitat AND part of woodland is within a designated area AND not Ancient woodland AND not Native woodland AND not heavy access pressure.
- **Not Allow category:** Ancient woodland OR Native woodland. This may be overly conservative as it excludes all NFI broadleaved woodland rather than just the mature woodland (>80 years old).
- **May allow category:** all remaining sites. Some might be ruled out due to access issues, which need checked on a case by case basis.

Table 14. Criteria combinations defining the categories and resulting areas for Target Option 1.

Category	Criteria combination defining the category	Area (ha)	Area %
Support	"bog_ph" = 1 AND "sssi" = 1 AND "aw" = 0 AND "bw" = 0 AND "access" = 0	8,562	7%
Not allow	"aw" = 1 OR "bw" = 1	19,392	38%
May allow	All other combinations	23,493	55%

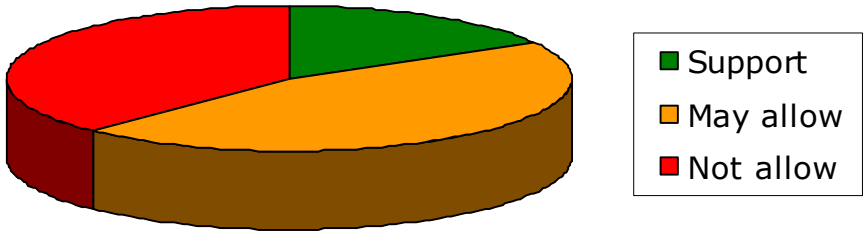


Figure 14. Potential for peatland open habitat restoration under Target Option 1, i.e. for sites contiguous to high quality open habitat, at least partly within SSSIs and which are not classed as ancient woodland or mature native woodland

For example, in Target Option 2, a more supportive and extremely permissive example with the Native woodland and Access issue constraints removed (Table 14 and Figures 15 and 17):

- **Support category:** extending or buffering high quality open habitat AND at least partly within a designated area AND not Ancient woodland
- **Not Allow category:** Ancient woodland This is probably unrealistic as it ignores the mature native woodland constraint.
- **May allow category:** all remaining sites. Some might be ruled out due to access issues, which need checked on a case by case basis.

Table 15. Criteria combinations defining the categories and resulting areas for Target Option 2.

Category	Criteria combination defining the category	Area (ha)	Area %
Support	"bog_ph" = 1 AND "sssi" = 1 AND "aw" = 0	13,856	27%
Not allow	"aw" = 1	1,105	2%
May allow	All other combinations	36,486	71%

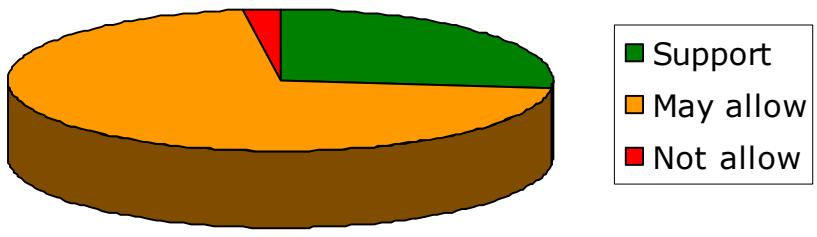


Figure 15. Potential restoration of peatland open habitat for Target Option 2, i.e. for sites contiguous to high quality open habitat, at least partly within SSSIs and which are not classed as ancient woodland

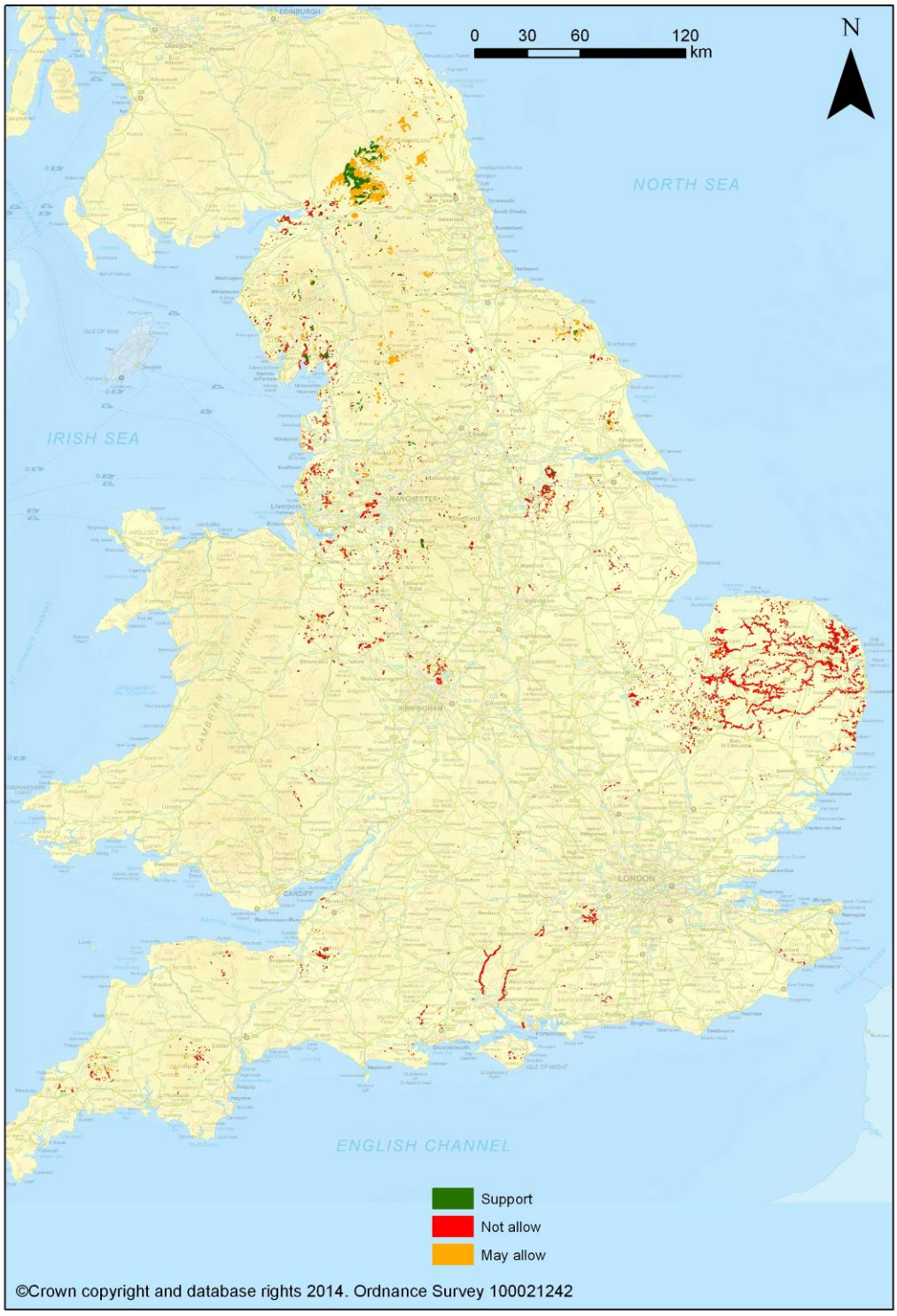


Figure 16. Spatial extent of potential for peatland open habitat restoration under Target Option 1. Support would be given for sites contiguous to high quality open habitat, at least partly within SSSIs and not classed as ancient woodland or mature native woodland. Under this target option, 8, 562 ha would be supported and a further 23,493 might be allowed but would not be supported. 19392 ha would not be allowed.

Figure 17. Spatial extent of potential restoration of peatland under Target Option 2. Support would be given for sites contiguous to high quality open habitat at least partly within SSSIs and not classed as ancient woodland. Under this target option, 13,856 ha would be supported and a further 36,486 ha might be allowed but would not be supported. 1,105 ha would not be allowed.

Recommendations on how to prioritise 'amber' sites

The GIS implementation of the OHP criteria (where criteria are explicit in GIS) will start to indicate some sites as 'green light sites' or 'sites where we are likely to support permanent woodland removal', these theoretically being good candidates for field assessment for restoration. Other sites will emerge as 'red light sites' or 'sites where we may not allow permanent woodland removal', because the OHP constraint criteria apply to them. A third group of sites will not be indicated as either green or red light sites. A method is needed to prioritise among this middle or 'amber light' group of sites. The field assessment can be used for this but it would be useful to have an indicative desk-based method to focus attention on sites with good restoration potential.

The following criteria may be helpful in this prioritisation:

a. High priority site already identified for restoration by Natural England (NE)

b. Use of NE Wetland Vision maps of potential areas for habitat creation for each habitat type, prioritising sites within this zone for the appropriate habitat type.

c. Consider giving high priority to sites with NFI 'young trees' IFT. These sites may still have bog/mire/fen vegetation on the ground and be relatively easy to restore.

d. Give high priority to sites in National Character Areas identified as targets for the peatland habitat type present on the site.

e. Give priority to deep peat sites with slow growing or low-yielding trees.

Following the indicative desk – based assessment, encourage FC and NE staff and applicants to undertake field assessment (using assessment tool) on deep peat sites identified for restoration and consider supporting the restoration of high-scoring sites. The next section of this report describes the development of the field assessment tool for use in England and the proposed basic England Field Assessment is set out in Appendix 5, including a table with suggested thresholds to help interpret the score.

Field assessment tool

Key desired outcome

In Wales, a field assessment tool has been developed to enable forestry staff (such as planners and conservation managers) to evaluate all the areas of afforested deep peat highlighted in the Welsh national assessment and prioritise those sites where restoration is most viable. The tool is simple and easy to apply, information on soil type, peat depth, area and slope form the basis of this tool.

At least 25 sites (i.e. peat polygons on a digital map) will be used for adapting the field assessment tool for England. The sites will not necessarily have the highest priority for restoration, but provide a spread across at least 5 woodlands and intersect a range of peat types. The tool will enable local decision making on the priority sites. It will also guide managers away from committing resources to areas which are not viable or not going to deliver greatest ecosystem service benefit.

Testing the Wales tool in England

Method

The Field Assessment Tool developed for use in Wales was used to assess fifteen wooded deep peat sites in England (Table 14). Of the fifteen, eleven were in private woodlands and four were on the Public Forest Estate. Most were suggested either by FC Forest Services staff dealing with felling applications for permanent woodland removal to restore open habitats or by NE area staff. Some of the sites were associated with the Morecambe Bay and Meres and Mosses Nature Improvement Areas. Most of the blanket bog sites and a few of the lowland sites were just chosen as potential areas for restoration and not necessarily as sites where there is any intention to restore.

The assessments were done without access to detailed soil maps. This affects the assessment of the peat type and the deep peat area. Peat type was inferred from vegetation in rides and unplanted roadsides close to the sites or in some cases from the topography. Deep peat areas were estimated. For some sites, we used the NE peaty soils map but this is generally too broad-brush to be useful for estimating areas of deep peat at the site level. Estimates for the lowland raised bog and basin mire sites will be reasonably accurate whereas those for the blanket bog sites may be very inaccurate.

Results

Table 14 summarises the site assessments. It includes a subjective assessment of restorability (R=restorable, PR= probably restorable, DR= doubtfully restorable i.e. probably not restorable) and its quality as a candidate for restoration (Poor, Fair, Good, Very good). It also includes a subjective ordering by Russell Anderson of the sites' suitability/priority for restoration, taking account of the feasibility of restoration at each site, the fact that lowland peatland habitats are, area for area, more highly valued than blanket bog habitats, the suitability of some of the lowland sites for development of, or

conversion to, wet woodlands and the evidence from current vegetation that restoration will restore good quality habitat.

Using the scoring system developed for Wales, the sites visited had overall scores ranging from 2.2 to 25. Seven out of the fifteen scored more than 15 points (the 'green light' threshold adopted for Wales) and all but three of the fifteen scored more than 7.5 points (the mid-point of the 'amber' range for Wales). None scored less than 0 points (the 'red light' threshold adopted for Wales), although it is possible for sites to have negative scores.

At least two of the lowland sites, Pikes End Moss and Holiday Moss, had severely cracked peat. At Pikes End, large scale reticulate cracking was seen in the root plate of a wind blown tree while the remnant primary (i.e. not cut over) surface of Holiday Moss had deep cracks wide enough to fall into at the ground surface. Cracking wasn't found on any other sites but the method employed for detecting cracking was designed for ploughed peat and none of the lowland sites appeared to be ploughed. A further two of the degraded lowland sites, Birch Moss Covert and Tidnock Wood, had quite high scores, 10.8 and 9.6 respectively. Their peat type scores were high because they had peat types 8d (Carex mire) or 10a (lowland raised bog), as will most lowland mires. Cracking might well have been present at all the lowland raised bog sites and possibly at the basin mire sites, too. The Wales Field Assessment Tool subtracts 10 points for severe peat cracking, which brought the scores for Pikes End and Holiday Moss down to 2.2 and 2.4 respectively. These are probably more appropriate scores, perhaps a bit high still, for such degraded sites. Similar scores are probably appropriate for Birch Moss Covert and Tidnock Wood.

Given that there is not yet a tried and tested method of detecting peat cracking in unploughed ground, it could be difficult to consistently score for this within the formal scoring system of the assessment. Users should be aware of the possibility of peat cracking and should look for it when assessing ploughed sites. If the peat is found to be severely cracked (i.e. cracks not just confined to plough furrows but also forming a network in between them), the site should be regarded as unrestorable unless site topography would allow effective retention of water, e.g. the site is very flat (i.e. < 1% slope) or is developed in a basin or trough.

Two of the sites assessed (Pikes End Moss and Birch Moss Covert) had lost all their characteristic open peatland vegetation, having been drained and wooded for many years. While this does not necessarily make restoration to open peatland habitat impossible, it makes the restoration process much slower and likely to give limited benefits in terms of habitat, carbon sequestration, water regulation, etc. in the foreseeable future. These sites will normally be lower priorities for restoration to open habitat than sites retaining some remnant vegetation. A scoring component reflecting this is needed in the assessment and the simple scoring set out in Table 13, which would be added to the other component scores in the Wales field assessment tool, is proposed. Sites such as these may however offer excellent opportunities to restore wet woodland following judicious blacking of drains and general raising of water levels.

Table 16. Remnant Vegetation Score proposed for addition to the Wales field assessment tool.

Remnant bog/mire vegetation	Score
None	-5 pts
Some	5 pts

Discussion

In England, the intention for the field assessment method is to assess private woodland sites, and this means that FC soil maps will usually not be available for sites being assessed. This makes it difficult for non-experts to assign a Soil Type Score for a site. However, the only soil maps readily available for England (e.g. Soilscape mapping on MAGIC and NSRI websites) are based on the NSRI 1:250,000 National Soil Map, which is too broad brush to be reliable for site assessment but which may help users to assign the correct peat type. Unfortunately, Soilscape uses a simplified soil classification so that deep peat is only divided into three classes: blanket bog peat soils, raised bog peat soils or fen peat soils. This makes it impossible to distinguish between upland *Sphagnum* bog, flushed and unflushed blanket bog, which is an important difference when it comes to deciding the suitability for restoration because it reflects differences in both forest productivity and habitat value. Upland Sphagnum bog is a highly valued habitat providing high levels of some ecosystem services but does not support productive forestry. Unflushed blanket bog is more common and therefore a slightly less valued habitat. It only supports productive forestry if inputs are relatively high. Flushed blanket bog can support productive forest and as open bog, tends to have vegetation dominated by purple moor grass (*Molinia caerulea*), providing relatively low levels of other ecosystem services.

The best solution is to retain the FC soil classification as the ideal basis for assigning a Soil Type Score but to provide an alternative Soil Type Score chart based on the Soilscape peat soil classes (Figure 18). User training for the field assessment will cover the basics of identifying the peat types in the FC soil classification. Users will be encouraged to use the FC classification if commissioning soil surveys.

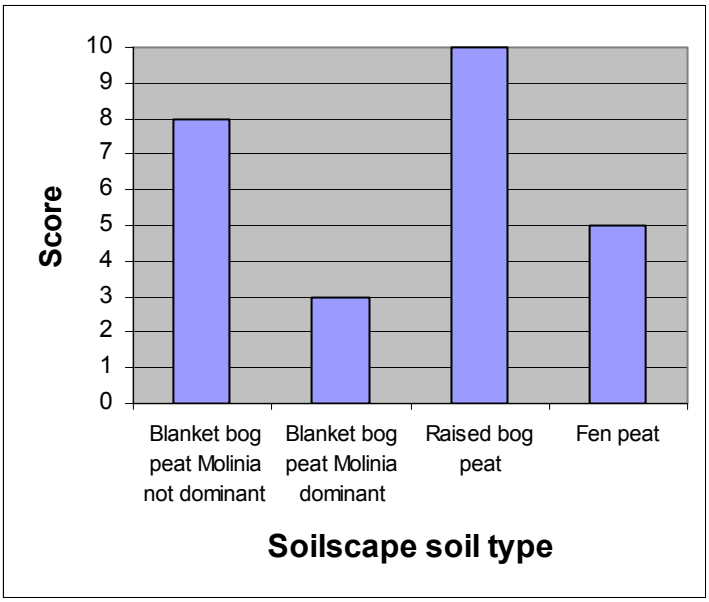


Figure 18. Soil score based on the deep peat soil types used in the Soilscape soil map of England. Blanket bog peat has been subdivided based on whether Molinia is dominant in the vegetation.

In some parts of England's lowlands where open peatland habitats are rare, even degraded remnants may be highly valued and may have to be restored to fulfil our Habitats Directive requirement to restore Annex 1 habitats across their range so that regional variation is represented. This increases the amount of effort and expenditure people are willing to put in to restoring them. Holiday Moss exemplifies this, with the Lancashire Wildlife Trust going to great lengths to attempt to restore the remaining primary bog there. Restorability of damaged peatlands is partly dependent on how much people are willing to spend. Thus sites that are severely degraded may be considered a high priority for restoration in Lancashire or Cheshire even though they may be deemed as lower priorities in areas where the habitat is not rare. FCE and NE need to consider how to allow for this effect.

For strategic purposes FCE and NE may wish to give particular encouragement to peatland habitat restoration activity in some places, for example those areas supporting or offering opportunities to restore particularly high value or rare habitats, for example EC Habitats Directive Annex 1 habitats. One approach would be to use a supplementary or bonus score linked to National Character Areas (NCA) to shift scores up where appropriate. The simplest way would be to add, say 5 points to the overall score for sites in NCAs where restoration is encouraged.

The proposed basic England Field Assessment is set out at Appendix 5.

Site name	Grid Ref	Date	Assessors	Peatland type §	FC soil type	Area (ha)	Peat depth (m)	Slope (%)	Peat cracked ?	Wales score	Subjective assessment	RA's subjective ordering
Ireland Moss	SD334846	07-Feb-14	RA NR IC	LRB	10a	20	3	2	?*	18	R/VG	2
Rusland Moss	SD335887	07-Feb-14	RA NR IC	LRB	10a	28	3	2	?*	19.6	R/VG	1
Blakebank Moss	SD458908	11-Feb-14	RA IC	LRB	10a	4	2	3	?*	11.8	PR/F	11
Cock Moss	SD461901	11-Feb-14	RA IC	LRB	10a	7	1.5	3	?*	11.4	PR/F	10
Savinhill Moss	SD466891	11-Feb-14	RA IC	LRB	10a	13	5	2	?*	20.6	R/VG	3
Butterburn 1	NY660749	12-Feb-14	RA IC	BB	10b/9b	60	3.6	5	N	24.2	R/VG	4
Butterburn 2	NY661750	12-Feb-14	RA IC	BB	11b/10b	75	2.7	5	N	20.4	R/VG	6
Butterburn 3	NY669742	12-Feb-14	RA IC	BB	11b/10b	100	5	5	N	25	R/VG	5
Top Moss	SJ570270	25-Feb-14	RA NR ID	LRB/BM	10a/8d	45	2.5	0	?*	24	R/G	8
Pikes End Moss	SJ441318	25-Feb-14	RA NR ID	BM/LRB	8d/10a	11	1.5	1	Y	2.2	PR/P	15
Tidnock Wood	SJ869694	26-Feb-14	RA NR JT	BM/LRB	8d/10a	6	1.2	2	?*	9.6	R/F	12
Holiday Moss	SD498017	26-Feb-14	RA NR JT	LRB	10a	2	2.5	3	Y	2.4	DR/F	13
Birch Moss Covert	SJ750909	26-Feb-14	RA NR JT	LRB	10a	4	1.5	3	?*	10.8	DR/F	14
Threestoneburn	NT961203	14-Mar-14	RA	BB	11b	6.5	2.9	5	N	10.1	R/VG	7
Gisburn	SD751608	14-Mar-14	RA IC	BB	11b	4	0.7	3	N	7.3	R/G	9

* Peat cracking may have gone undetected at this site because our detection method is for ploughed surfaces whereas this site had no ploughing.

† Assessors: RA=Russell Anderson, NR=Neil Riddle, IC=Ian Crosher (NE), ID=Iain Diack (NE), JT=Jake Thompson (FCE)

§ Peatland types: LRB=Lowland raised bog, BB=Blanket bog, BM=Basin mire

Table 17. Summary of sites used for testing the Wales Field Assessment Tool.

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Appendix 1. The Forestry Commission soil classification (Kennedy, 2002)

The Forestry Commission soil classification system

Under this system soils are divided into groups, types and phases. (Phase descriptions provide a means of communicating local variations in the more widespread soil types.) The keys provided in Section 2 should be followed for identification, but for reference purposes, Tables 1–3 summarise the 15 soil groups and the types within them.

Table 1 The FC classification system for the main mineral and shallow peaty soils

	Soil group	Soil type	Code
Soils with well-aerated subsoil	1. Brown earths	Typical brown earth	1
		Basic brown earth	1d
		Upland brown earth	1u
		Podzolic brown earth	1z
	3. Podzols	Typical podzol	3
		Hardpan podzol	3m
	4. Ironpan soils	Typical ironpan soil	4
		Podzolic ironpan soil	4z
		Intergrade ironpan soil	4b
	12. Calcareous soils	Rendzina	12a
		Calcareous brown earth	12b
		Argillic brown earth	12t
Soils with poorly aerated subsoil/gleys	5. Ground-water gley soils	Typical ground-water gley	5
	6. Peaty (surface-water*) gley soils	Typical peaty surface-water gley	6
		Podzolic peaty surface-water gley	6z
	7. Surface-water gley soils	Typical surface-water gley	7
		Podzolic surface-water gley	7z
		Brown surface-water gley	7b

*Can be omitted for brevity

6 THE IDENTIFICATION OF SOILS FOR FOREST MANAGEMENT

Table 2 The FC classification system for Deep peats

	Soil group	Soil type	Code
Flushed peatlands	8. *Juncus* (or basin) bogs	*Phragmites* (or Fen) bog	8a
		Juncus articulatus or *acutiflorus* bog	8b
		Juncus effusus bog	8c
		Carex bog	8d
	9. *Molinia* (or flushed blanket) bogs	*Molinia, Myrica, Salix* bog	9a
		Tussocky *Molinia* bog, *Molinia, Calluna* bog	9b
		Tussocky *Molinia, Eriophorum vaginatum* bog	9c
		Non-tussocky *Molinia, Eriophorum vaginatum, Trichophorum* bog	9d
		Trichophorum, Calluna, Eriophorum, Molinia bog (weakly flushed)	9e
Unflushed peatlands	10. *Sphagnum* (or flat or raised) bogs	Lowland *Sphagnum* bog	10a
		Upland *Sphagnum* bog	10b
	11. *Calluna, Eriophorum, Trichophorum* (or unflushed blanket) bogs	*Calluna* blanket bog	11a
		Calluna, Eriophorum vaginatum blanket bog	11b
		Trichophorum, Calluna blanket bog	11c
		Eriophorum blanket bog	11d
	14. Eroded bogs	Shallow hagged eroded bog	14
		Deeply hagged eroded bog	14h
		Pooled eroded bog	14w

Table 3 Other soils covered by the FC classification system

Soil group	Soil type	Code
2. Man-made soils	Mining spoil, stony or coarse textured	2s
	Mining spoil, shaly or fine textured	2m
13. Rankers and Skeletal soils	Brown ranker	13b
	Gley ranker	13g
	Peaty ranker	13p
	Podzolic ranker	13z
	Rock	13r
	Scree	13s
15. Littoral soils	Shingle	15s
	Dunes	15d
	Sand with deep water-table (or Excessively drained sand)	15e
	Sand with moderately deep water-table	15i
	Sand with shallow water-table	15g
	Sand with very shallow water-table	15w

Appendix 2. Case studies illustrating improvements in peat mapping

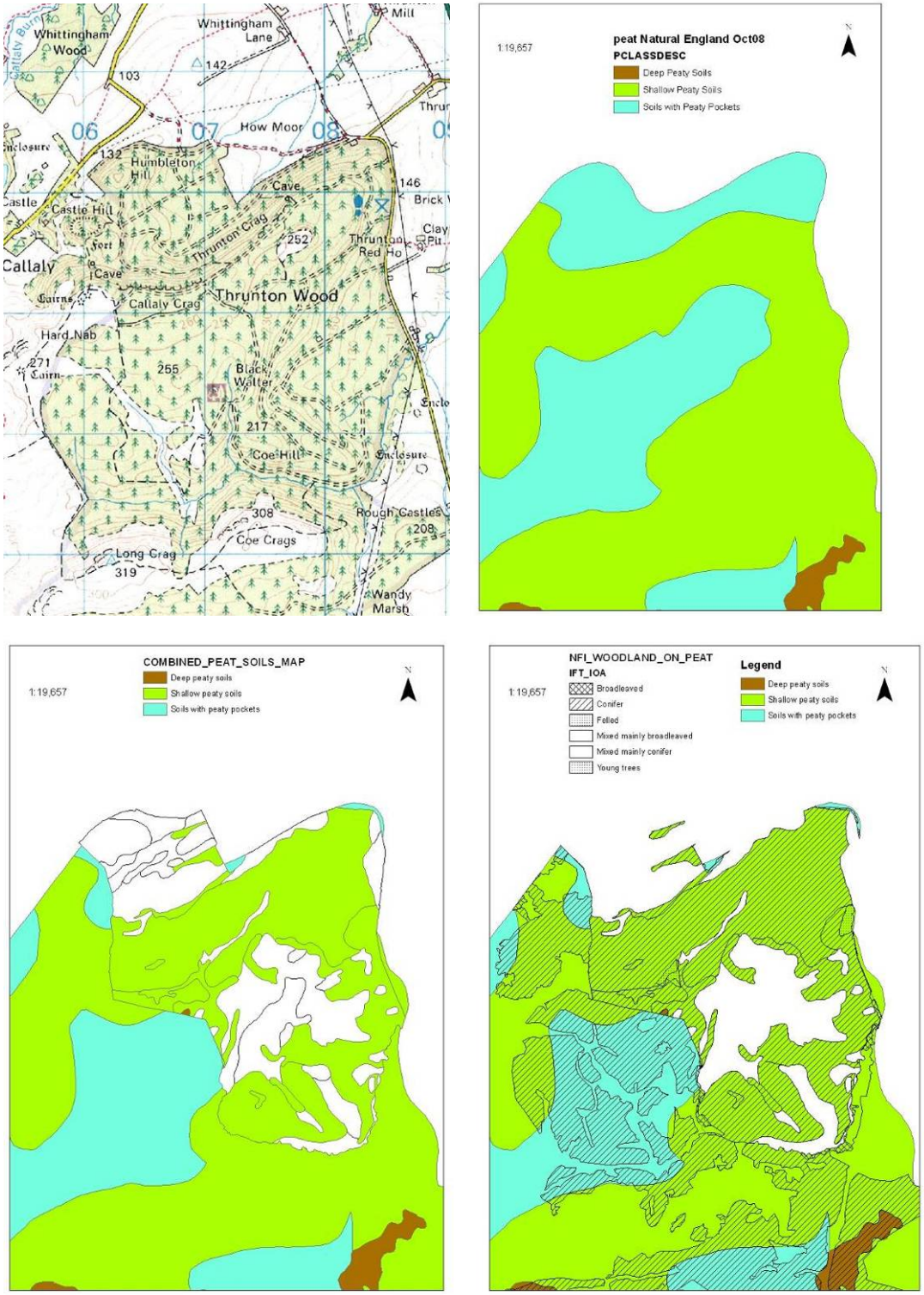


Figure 19. Case study 2. Thrunton Wood, Rothbury, Northumberland

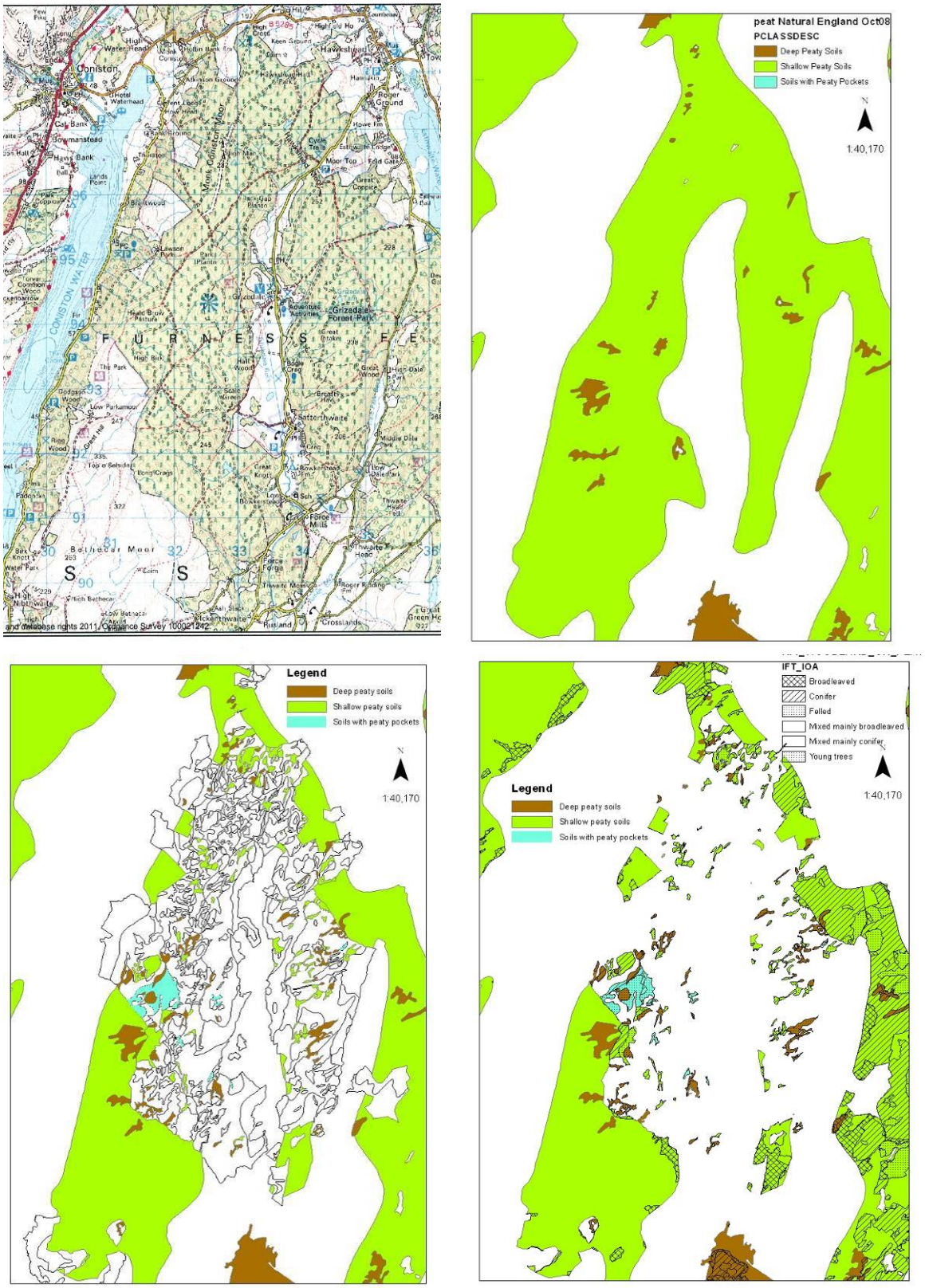


Figure 20. Case study 3. Grizedale Forest, Cumbria

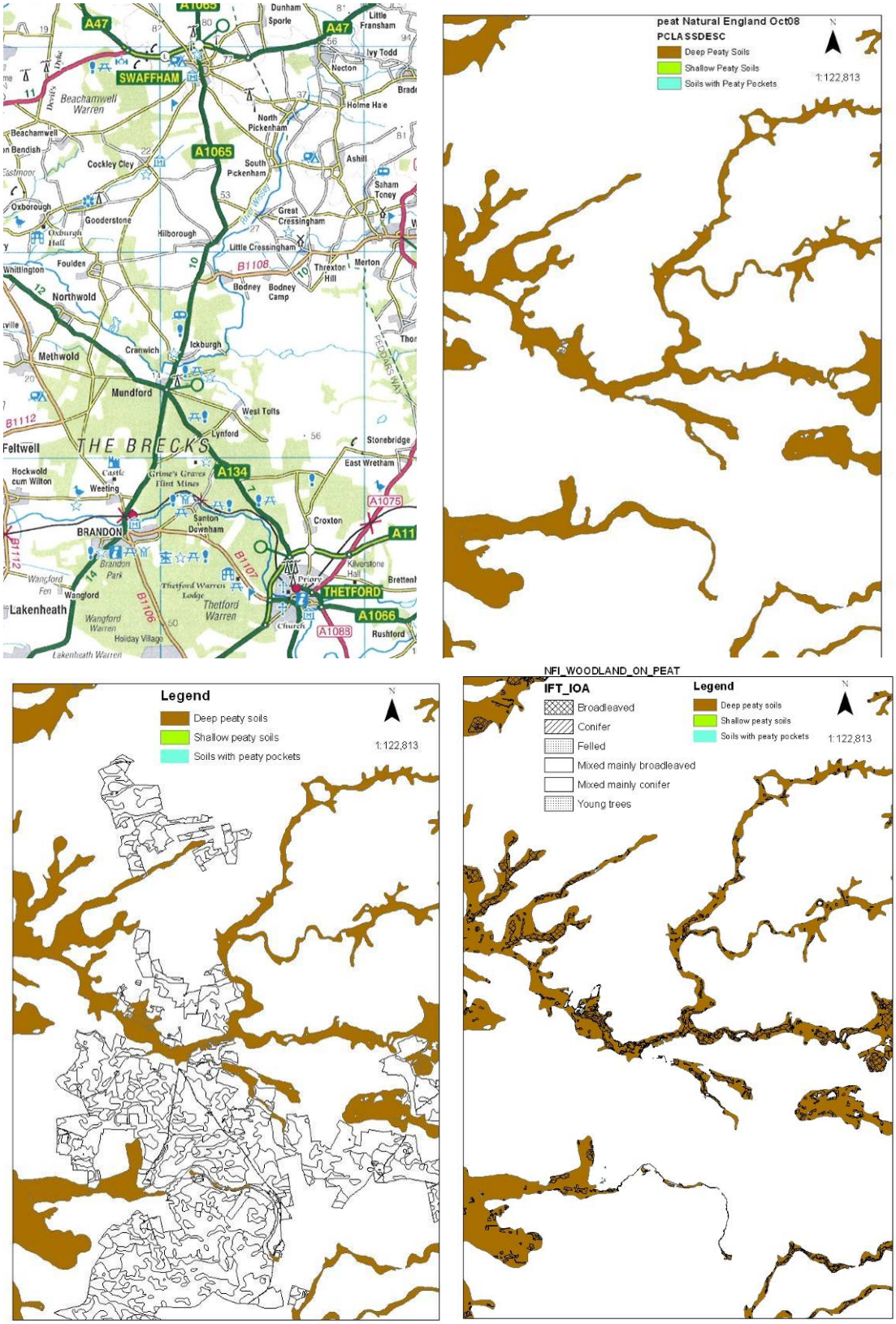


Figure 21. Case study 4. Thetford Forest, East Anglia

Appendix 3. Area breakdown tables for peaty soils, deep peat soils, NFI woodland on peaty soils, NFI woodland on deep peat, plantation woodland on deep peat and native woodland on deep peat

3.1 All peaty soils

Table 18. Data source

Data source	Area (ha)	Area (sq km)
NE peaty soils map	1,379,935	13,799
FC soil maps	21,371	214
TOTAL	1,401,307	14,013

Table 19. PFE/Non-PFE

	Area (ha)	Area (sq km)
PFE	88,643	886
Non-PFE	1,312,664	13,127
TOTAL	1,401,307	14,013

3.2 Deep peat only

Table 20. Site designations*

Site desgnations	Area (ha)	Area (sq km)
Ramsar+SPA+SAC+SSSI+LNR	9.6	0
Ramsar+SPA+SAC+SSSI	19,137	191
Ramsar+SPA+SAC+SSSI	0	0
Ramsar+SPA+SSSI	11,154	112
Ramsar+SPA	5	0
Ramsar+SAC+SSSI+LNR	23	0
Ramsar+SAC+SSSI	2,103	21
Ramsar+SAC	0	0
Ramsar+SSSI	665	7
SPA+SAC+SSSI+LNR	146	1
SPA+SAC+SSSI	242,902	2,429
SPA+SAC	1	0
SPA+SSSI+LNR	356	4
SPA+SSSI	24,046	240
SPA	0	0
SAC+SSSI+LNR	81	1
SAC+SSSI	80,848	808
SAC	144	1
SSSI+LNR	356	4
SSSI	49,880	499
LNR	1,171	12
TOTAL	433,028	4,330
Undesignated	968,279	9,683

*Some combinations do not exist in reality - figures reflect boundary slivers

3.3 NFI woodland on all peaty soils

Table 21. Data source

Data source	Area (ha)	Area (sq km)	%
NE	145,230	1,452	88
FC	19,872	199	12
TOTAL	165,102	1,651	

Table 22. PFE/Non-PFE

Data source	Area (ha)	Area (sq km)	%
PFE	66,182	662	40
Non-PFE	98,920	989	60
TOTAL	165,102	1,651	

Table 23. Peaty soil category

Peaty soil category	Area (ha)	Area (sq km)	%
Deep peaty soils	51,447	514	31
Shallow peaty soils	67,322	673	41
Soils with peaty pockets	46,333	463	28
TOTAL	165,102	1,651	

Table 24. Habitat of origin

Habitat of origin	Area (ha)	Area (sq km)	%
Blanket bog and Upland valley mire	23,989	240	15
Raised bog (upland and lowland)	8,908	89	5
Lowland fens/reedbeds (deep)	9,291	93	6
Lowland fens/reedbeds (wasted)	9,185	92	6
Wet heath etc	53,733	537	33
Dry heath etc	45,449	454	28
No data	14,546	145	9
TOTAL	165,102	1,651	

Table 25. Interpreted forest type (IFT)

IFT	Area (ha)	Area (sq km)	%
Conifer	78,082	781	47
Broadleaved	52,195	522	32
Mixed mainly conifer	2,093	21	
Mixed mainly broadleaved	1,795	18	
Coppice	50	0	
Coppice with standards	0	0	
Young trees	15,885	159	10
Low density	833	8	
Shrub	516	5	
Felled	8,181	82	5
Ground prep	1,743	17	
Assumed woodland	3,727	37	
Cloud/shadow	2	0	
TOTAL	165,102	1,651	

3.4 NFI woodland on deep peat

Table 26. Data source

Data source	Area (ha)	Area (sq km)
NE	46,047	460
FC	5,400	54
TOTAL	51,447	514

Table 27. Interpreted Forest type (IFT)

IFT	Area (ha)	Area (sq km)	%
Conifer	22,328	223	43
Broadleaved	19,109	191	37
Mixed mainly conifer	490	5	1
Mixed mainly broadleaved	465	5	1
Coppice	27	0	
Young trees	4,619	46	9
Low density	377	4	
Shrub	119	1	
Felled	2,567	26	5
Ground prep	469	5	1
Assumed woodland	877	9	2
TOTAL	51,447	514	

Table 28. Site designations

Site desgnations	Area (ha)	Area (sq km)
Ramsar+SPA+SAC+SSSI	1,425	14
Ramsar+SPA+SSSI	223	2
Ramsar+SAC+SSSI+LNR	19	0
Ramsar+SAC+SSSI	449	4
Ramsar+SSSI	149	1
SPA+SAC+SSSI+LNR	0	0
SPA+SAC+SSSI	1,508	15
SPA+SSSI+LNR	1	0
SPA+SSSI	325	3
SPA	0	0
SAC+SSSI+LNR	19	0
SAC+SSSI	2,094	21
SAC	18	0
SSSI+LNR	44	0
SSSI	2,977	30
LNR	99	1
TOTAL	9,350	94
Undesignated	42,097	421

Table 29. Level of designation

Level of designation	Area (ha)	Area (sq km)	%
International	6,230	62	12
UK not international	3,022	30	6
Local only	99	1	
Not designated	42,097	421	82
TOTAL	51,447	514	

Table 30. Ancient woodland (incl. PAWS)

Ancient Woodland	Area(ha)	Area (sq km)
ASNW	339	3
PAWS	241	2
TOTAL	580	6

3.5 Plantation on deep peat

Table 31. Data source

Data source	Area (ha)	Area (sq km)
NE	26,118	261
FC	5,232	52
TOTAL	31,350	314

Table 32. Habitat of origin

Habitat of origin	Area (ha)	Area (sq km)
Blanket bog and Upland valley mire	23,153	232
Raised bog (upland and lowland)	5,169	52
Lowland fens/reedbeds (deep)	1,277	13
Lowland fens/reedbeds (wasted)	1,743	17
No data	8	0
TOTAL	31,350	314

Table 33. Interpreted forest type (IFT)

IFT	Area (ha)	Area (sq km)
Conifer	22,328	223
Mixed mainly conifer	490	5
Assumed woodland	877	9
Ground prep	469	5
Young trees	4,619	46
Felled	2,567	26
TOTAL	31,350	314

3.6 Native woodland on deep peat

Table 34. Data source

Data source	Area (ha)	Area (sq km)
NE	19,810	198
FC	167	2
TOTAL	19,977	200

Table 35. Habitat of origin

Habitat of origin	Area (ha)	Area (sq km)
Blanket bog and Upland valley mire	818	8
Raised bog (upland and lowland)	3,700	37
Lowland fens/reedbeds (deep)	7,963	80
Lowland fens/reedbeds (wasted)	7,429	74
No data	66	1
TOTAL	19,977	200

Table 36. Interpreted forest type (IFT)

IFT	Area (ha)	Area (sq km)
Broadleaved	19,109	191
Mixed mainly broadleaved	465	5
Coppice	27	0
Low density	377	4
TOTAL	19,977	200

Appendix 4. Open Habitats Policy decision criteria

When to convert woods and forests to open habitat in England: Government policy

5.2.1 Sites we may support

Sites where we may support and will normally allow the conversion of woodland to open habitat.

- **Extending or buffering high quality habitat.** When the new open habitat will extend or buffer areas of high quality existing open habitat, and there is evidence that fragmentation of the current habitat is having a detrimental impact on the wildlife in that habitat.
- **Connecting high quality habitat.** When the new open habitat will form a viable wildlife link between areas of high quality open habitat (improving 'connectivity') and there is evidence that lack of connectivity is having a significant detrimental impact on the wildlife in that habitat.
- **Designated areas.** When the woodland is growing on a site with a national or international conservation designation, such as a site designated under the Habitats Directive for Annex 1 habitat types, as a Site of Special Scientific Interest or National Nature Reserve and the woodland adversely impacts on its open habitat characteristics.
- **Grazing.** When the new open habitat will extend or link areas of open habitat to allow a practical grazing area to form, and there is evidence that conservation grazing will be established and maintained once the open habitat is created.
- **Threshold sizes.** When the new open habitat will add to the current area of open habitat to form a patch of continuous or well-connected open habitat that is significantly more viable in the long-term. Minimum desirable patch sizes identified in Habitat Actions Plans can be used as a guide (Section 8.4).
- **Opportunities for species of conservation concern.** When there is evidence that converting the woodland to open habitat presents significant opportunities to enhance species of conservation concern[13].

[13] Under section 41 of the Natural Environment and Rural Communities Act, the Secretary of State must, for England, publish a list of the living organisms and types of habitat which in the Secretary of State's opinion are of principal importance for the purpose of conserving biodiversity. See http://www.defra.gov.uk/environment/biodiversity/uk/legislation.htm.

15 | Dominic Driver | Forestry Commission | 26 March 2010

5.2.2 Sites we may not allow

Sites where we may not allow and are unlikely to support converting woodland to open habitat.

- **Ancient woodland.** We will not allow conversion of any ancient woodland sites to open habitat regardless of the age of the current trees and their native or semi-natural status on the site.
- **Native woodland.** We will allow permanent removal of mature native woodland only in exceptional circumstances, where there is evidence that removal is the only option to realise exceptional biodiversity benefits. Our current working definition of "mature native woodland" for this policy is:
  - sites currently composed of native broadleaves that have been wooded for at least 80 years; or
  - sites where a proportion of the current native broadleaved crop is at least 80 years old and where the woodland canopy has been closed (>70% canopy cover) for at least the last 20 years.

The first element picks up sites which have a relatively long history as woodland and are currently under native trees but these trees may be relatively young if felling has recently taken place. The second element picks up sites where some of the current native trees are relatively old but these have been in rather open landscapes for much of their lives with younger trees growing up between them more recently, for example, wood-pasture that has regenerated to woodland. If the canopy closed recently (less than twenty-years ago) such sites may be a priority for conversion back to woodpasture or other open landscapes with trees.

There are other cases where we may not allow the permanent removal of younger native woodland, for example certain wet woodlands, native woodland buffering ancient woodland, or to avoid woodland fragmentation.

- **Protected species and habitats.** There are several species of conservation concern that may be damaged by permanent removal of woodland to restore or expand open habitat. Some of these may be European Protected Species with a legal framework preventing damage. There are also some sites with national or international conservation designations that could be similarly damaged by woodland removal. Where there is evidence that loss of woodland will have a negative impact on a protected species or habitat, we are unlikely to allow conversion of woodland to open habitat. If the organisation proposing the conversion can guarantee appropriate mitigation measures, then we may grant permission, but only if the biodiversity benefits of conversion of the woodland to open habitat are exceptional.
- **Poor condition of current open habitat.** When the organisation proposing the conversion controls open habitat similar to that which it is proposing to create, (i.e. a similar type in a similar location) we will take into account the condition of the current open habitat when deciding whether to allow conversion. If it is in unfavourable condition, we may only grant permission if the conversion is part of a management plan bringing all similar open habitat in the area under the organisation's control into favourable condition. By unfavourable, we mean that it is not fulfilling its biodiversity potential (for example wet areas are being damaged or there is too much burning so that

species of conservation concern are under threat) and, or, is regenerating to woodland due to poor management or lack of management. Note that this does not include cases where there has been an active and appropriate decision to allow natural regeneration, for example as part of a shifting mixture of open habitat and woodland (see Section 5.4.4).

- **Insignificant impact.** When the new open habitat will be adding a relatively small amount to an already large area of open habitat. In such circumstances, it is unlikely that we will grant permission unless compensatory woodland creation is guaranteed (see Section 5.3.3). An exception could be when the apparently small scale conversion is making an exceptional contribution for reasons other than scale, for example creating an important habitat link.
- **Access.** There can be conflicts between the needs of wildlife and the needs of recreational users of open habitat, for example, ground nesting birds on lowland heathland. In most cases, good site management will minimise the impact of any conflict. However, in some cases it may be necessary to consider alternatives to converting woodland to open habitat to prevent significant conflict between wildlife conservation and people. Where there is heavy recreation pressure on a site, we are unlikely to allow conversion to open habitat unless there is evidence that the access can be managed to minimise potential harm to wildlife without excluding access. Only in exceptional circumstances will it be acceptable to convert a wood to open habitat where there is a significant risk that the needs of wildlife will result in additional pressure to exclude people from a site.
- **Isolated sites.** Where the proposal will create a relatively small area of isolated open habitat with poor connectivity.

By applying this framework for decision-making we will be able to apply the principles of the 'right tree in the right place' and the 'right habitat in the right place'. We must also apply the principle of the 'right kind of change at the right pace'.

5.3 Managing the rate of conversion.

The Government supports targets in the England Biodiversity Strategy for expanding and restoring priority open habitat as being aspirational, and shared with the UK Biodiversity Partnership. Conversion of woodland to open habitat can contribute to achieving these targets. The Government also has aspirations for creating more woodland in England as part of moving to a low-carbon economy and to further increase the many benefits from all types of woodland. The UK Low Carbon Transition Plan[14] states that an additional 10,000 ha per year of woodland creation would make a significant contribution to targets for reducing greenhouse gases.

We will make sure that there is a balance between the rate of conversion of woodland to open habitat and the rate of expansion of woodland. This does not mean that any increase in woodland area will automatically lead to an increase in

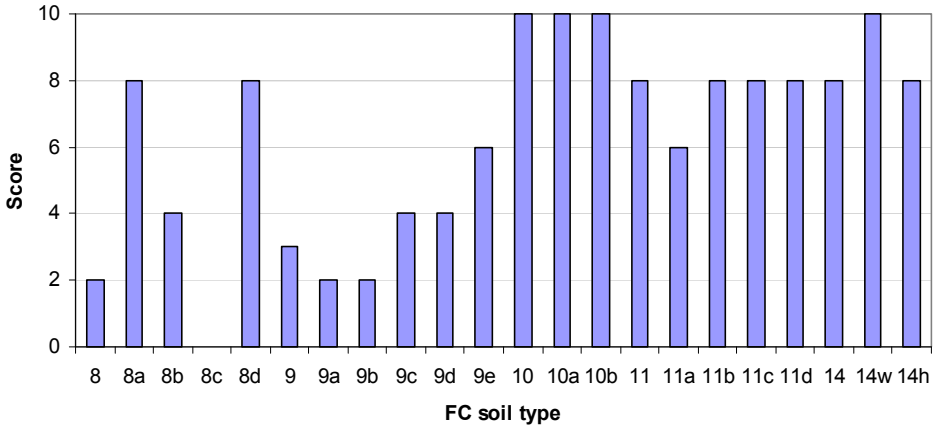
14 http://www.decc.gov.uk/en/content/cms/publications/lc_trans_plan/lc_trans_plan.aspx.

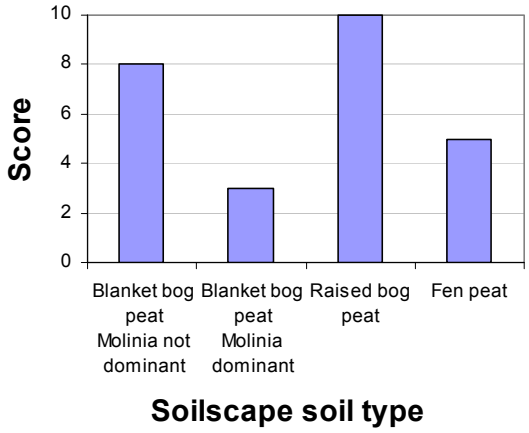
Appendix 5. England field assessment

Component scores

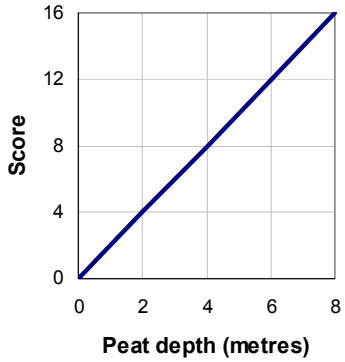
The assessment combines the following six component scores:

1. **Soil type score**. Use the appropriate chart for the soil classification used.

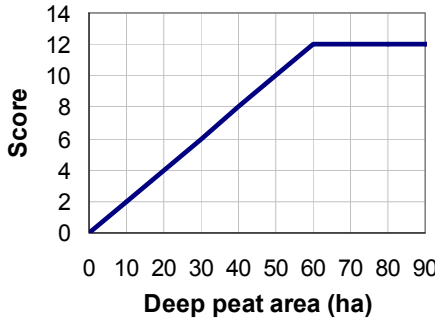




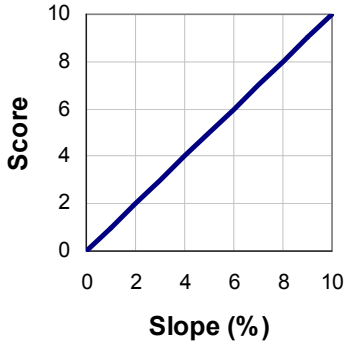
2. **Peat depth score**



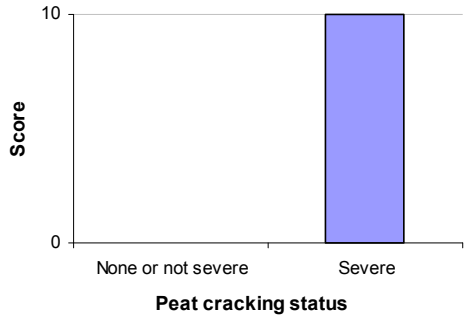
3. **Area score**



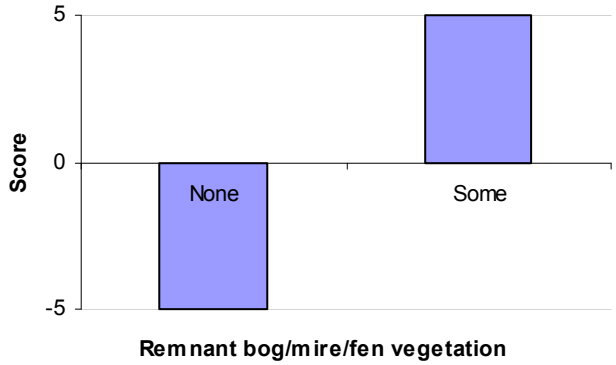
4. **Slope score**



5. **Peat cracking score**



6. **Remnant vegetation score**



Combining the component scores

Overall score = Soil type score + Peat depth score + Area score – Slope score – Peat cracking score + Remnant vegetation score

Interpreting the overall score

Overall score in range	Feasibility of restoration	Likely benefits of attempting restoration	Potential benefits of restoration if successful
-25 - 5	Probably not restorable	Low	Low to very high
5 - 20	Probably restorable	Medium	Medium to very high
20 - 40	Restorable	High	High to very high