

The Woodland Carbon Code (2) – the logic of promoting wood as Carbon Units

Description



Mounding on peat at Far Ralia in 2023. Could the wood carbon produced by planting trees on these mounds ever offset the loss of carbon from the peat? Photo credit Dave Morris.

The Woodland Carbon Code (WCC) takes a very different to measuring the carbon stored in soils and the carbon stored in wood. As my first post in this series explained ([see here](#)), the WCC calculator reduces the multiple different types of soil to just two categories, mineral and organo-mineral, and almost completely disregards the evidence from soil science about the impact of planting trees on Soil Organic Carbon (SOC). This post explains how, by contrast, the WCC calculator measures the potential carbon units stored by trees by individual species and how this re-inforces the plantation model which dominates forestry practice in Scotland.

The Forestry Commission and its successors have for years been researching how best to improve the yield of trees, i.e the amount of timber produced for a given area. An important part of this forestry

science has been consideration of soils but from a timber production, rather than a SOC or nature conservation, perspective. This has resulted in the 'Yield Class' system ([see here](#)):

'an index used in Britain of the potential productivity of even-aged stands of trees. It is based on the maximum mean annual increment of cumulative timber volume achieved by a given tree species growing on a given site and managed according to a standard management prescription. It is measured in units of cubic metres per hectare per year.'

It was a short step for the Forestry Commission to convert the cubic metres of wood produced by tree growth for different species into carbon units, which are measured as tCO₂ absorbed from the atmosphere. The methodology the FC adopted to convert tree biomass (including roots, main stem, branches and foliage) into carbon is set out in their Carbon Assessment Protocol produced in 2018 ([see here](#)). The WCC then incorporates that methodology into their calculator ([see here](#) for version 3) and uses it to predict how much CO₂ planting new woodland could absorb from the atmosphere.

It is the project developer's responsibility to check their calculations have been performed correctly.

Table 2: Assumptions - species, spacing, yield class, management

Section number	Species	Planned spacing (m)	Species model used in lookup table	Spacing used in lookup tables (m)	Error check only - If 'ERROR' then check spacing (column L)	Yield class in Ecological Site Classification	Yield class
	Alder		SAB	1.5	NO		
	Armand's pine		SP	1.4	NO		
	Ash		SAB	2.5	NO		
	Aspen		SAB	3.0	NO		
	Atlas cedar		NF	1.5	NO		
	Austrian pine		CP	1.4	NO		
	Beech		BE	1.2	NO		
	Bhutan pine		SP	4.0	NO		
	Big leaf maple		SAB	5.0	NO		
	Birch (downy/silver)		SAB	3.0	NO		
	Bird cherry		SAB	4.0	NO		

Illustration of options used in Table 2 of the WCC calculator to work out the carbon absorbed by tree management columns to show some of the options available.

Having chosen what trees to plant, for each species (first column) the WCC calculator enables the landowner/manager to work out how many carbon units it will produce given the proposed spacing of the trees, the predicted yield class and whether the trees will be thinned or not.

Depending on the species of tree chosen, the look up tables present specific spacing and yield class options. These vary by individual species. For example, Norway spruce has just one spacing option, 1.5m and the yield class ranges from 6-18, whereas for Scots pine the spacing options are 1.4m, 2m, 2.5m, 3m, 4m and 5m and the yield class ranges from 2-14. While there is in theory nothing in the WCC that prevents woodland developers choosing a different spacing model (column 3), the calculator effectively incentivises woodland developers who wish to sell easily verifiable carbon units to make choices which have been researched and tested by forestry science.

Once a woodland "developer" has filled in the assumptions in Table 3, the WCC calculator spreadsheet combines this with Table 3 on Soil Carbon Emissions (the subject of my first post) and Table 1, on Establishment Emissions (which are treated as being less significant but will be considered in a further post) to produce a "Summary of Carbon Sequestration over time": This shows the "long-term average carbon stock that is projected to accumulate on the site":

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Summary Carbon Sequestration over time

Cumulative to Year	A:	B = 80% of A	C: Negative	D:	E= B-C-D:	F:	G:	H=E+F-G	I=15- 20% of H	J=H-I	K=
	Cumulative Carbon Sequestrn from lookup tables (tCO ₂ e)	Cumulative Carbon Sequestrn Less 20% model precision	Removal of vegtn and/or Establish ment Emissions (tCO ₂ e)	Cumulative Soil Carbon (loss in year 1 and cumulative accumuln if relevant) (tCO ₂ e)	Total Project Carbon Sequestration (tCO ₂ e)	Baseline (tCO ₂ e) - Normally Zero - No change over time	Leakage (tCO ₂ e) [Emissions are negative] - Normally Zero - No change over	Net Project Carbon Sequestration adjusted for Baseline	20% Contribution to buffer (tCO ₂ e)	Claimable Carbon Sequestration (tCO ₂ e)	
5	452	362	-1836	-8379	-9853	0	0	-9853	-1971	-7882	
10	1896	1517	-1836	-8379	-8698	0	0	-8698	-1740	-6958	
15	6586	5269	-1836	-8379	-4946	0	0	-4946	-989	-3957	
20	20072	16058	-1836	-8379	5843	0	0	5843	1169	4674	
25	37791	30233	-1836	-8379	20018	0	0	20018	4004	16014	
30	56798	45439	-1836	-8379	35224	0	0	35224	7045	28179	
35	78967	63173	-1836	-8379	52958	0	0	52958	10592	42366	
40	92810	74248	-1836	-8379	64033	0	0	64033	12807	51226	
45	105313	84250	-1836	-8379	74036	0	0	74036	14807	59229	
50	118567	94853	-1836	-8379	84639	0	0	84639	16928	67711	
55	128370	102696	-1836	-8379	92481	0	0	92481	18496	73985	
60	137807	110246	-1836	-8379	100031	0	0	100031	20006	80025	
65	145675	116540	-1836	-8379	106325	0	0	106325	21265	85060	
70	151527	121222	-1836	-8379	111007	0	0	111007	22201	88806	
75	156574	125259	-1836	-8379	115044	0	0	115044	23009	92035	
80	160886	128709	-1836	-8379	118494	0	0	118494	23699	94795	
85	164456	131565	-1836	-8379	121350	0	0	121350	24270	97080	
90	167521	134017	-1836	-8379	123802	0	0	123802	24760	99042	
95	172116	137693	-1836	-8379	127478	0	0	127478	25496	101982	
100	174248	139398	-1836	-8379	129183	0	0	129183	25837	103346	

Example of Carbon Sequestration over time from the "Lost Forest" Phase 1 at Kinrara, updated and validated in 2025 just prior to being sold by BrewDog to Oxygen Conservation. The first column A in the assumptions from Table 2.

The Carbon Sequestration table adopts a conservative approach to estimating the amount of Carbon Units which will be produced by planting trees.

First it subtracts 20% (Column B) from the calculations in Column A about how many tCO₂ will be absorbed from the atmosphere over time. If the initial prediction of Carbon Units are later verified by an independent body over time (checks happens five years after planting and then every ten years thereafter) they too can be sold. In theory the 20% should allow for tree planting failures. However, at

BrewDog's Lost Forest at Kinrara, Scottish Forestry found in 2023 that c50% of Scots Pine and c95% of mixed broad-leaves died ([see here](#)). Luckily for the WCC, the scheme was only validated in 2025 i.e after the dead trees had been replaced and as a consequence the documentation on the UK Carbon Registry ([see here](#)) makes no reference to this disaster.

Second, the calculator subtracts a further 20% (Column I) as a permanent buffer to safeguard against over-predicting the amount of carbon absorbed by trees, uncertainty within carbon science and other miscalculations.

From a tree growing perspective, this is all very impressive and it is little wonder that Scottish Forestry and the wider forestry industry as represented by Confor believes the WCC is innovative and deserves awards. The problem is however good the WCC is at calculating the carbon absorbed by trees, the fact is that far more carbon is stored in soils and the WCC is extremely poor at measuring how much of that might be released back to the atmosphere as a result of planting. Whether the 20% buffer in the calculator is sufficient to offset the WCC's failure to incorporate the scientific research on carbon emissions from soils is the crucial point. If not, the whole of the WCC faces collapse.

The implications of the WCC calculator for tree planting

The first three assumptions behind the WCC are that woodland helps remove carbon from the atmosphere, disregarding organic soils, that planting trees is the best way to expand woodland, disregarding natural regeneration and that private investment is required to do this, disregarding non-market alternatives.

From a private investor perspective, whether or not their primary objective is to help offset their own carbon emissions or to make money makes little difference. The first question of any investor to any woodland adviser is likely to be either how they can offset the most carbon or how can they make the most money. There are three main elements to the answers provided by the WCC calculator.

Species of tree

Sitka is generally the fastest growing tree grown in Scotland and therefore, on short to medium term timescales, converts more CO₂ into wood than any other species. This is reflected in the WCC calculator where the range of yield class options for Sitka is 6-24 compared to 2-14 for Scots Pine. The average yield class for Sitka, as reported by Forest Research is 12-14 compared to 8 for Scots Pine. Sitka, already by far the most widely planted tree in Scotland, would therefore appear a no brainer from a carbon perspective.

The WCC, however, is designed to promote new woodland while forestry regulations require existing plantations to be replanted after felling (except where they are on peat over 50cms deep). These requirements have acted as a constraint on market demand along with the various regulations and the UK Forestry Standard which help limit where new Sitka plantations could be created. Nevertheless the recent proliferation of Sitka schemes on moorland and former farmland in the borders (e.g Stobo Hope ([see here](#)) and Todrig) appears to be partially being driven by the opportunity to make money from the sale of Carbon Credits as well as timber sales (I will consider this further in future posts).

The constraints on planting Sitka and other fast growing non-native conifers like Norway spruce (yield class 6-18) and Douglas fir (yield class 8-20) has incentivised the planting of Scots Pine in areas like the Cairngorms National Park. Table 2 for the Kinrara NWC Phase I scheme provides an example:

Assumptions - Species, Spacing, Yield Class - Table 2

Sectn No:	Actual Species	Actual Spacing (m)	Species/Model from Lookup Table	Spacing used in Lookup tables (m)	Error check only - If 'ERROR' then check spacing (column L)	Yield Class in ESC (if different to YC used)	Yield Class Used in Lookup Tables	'E'	C
	Select Species		Select Species First	Select Species First	NO		Select Species First	N	
	Select Species		Select Species First	Select Species First	NO		Select Species First	N	
	Downy birch	5.0	SAB	3.0	NO			4	N
	Silver birch	5.0	SAB	3.0	NO			4	N
	Scots pine	5.0	SP	2.0	NO			6	N
	Goat willow	5.0	SAB	3.0	NO			4	N
	Aspen	2.5	SAB	2.5	NO			4	N
	Bird cherry	2.5	SAB	2.5	NO			2	N
	Blackthorn	2.5	SAB	2.5	NO			2	N
	Common alder	2.5	SAB	2.5	NO			2	N
	Other broadleaves	2.5	SAB	2.5	NO			2	N
	Downy birch	2.5	SAB	2.5	NO			4	N
	Hazel	2.5	SAB	2.5	NO			2	N
	Holly species	2.5	SAB	2.5	NO			2	N
	Pedunculate/common oak	2.5	OK	2.5	NO			4	N
	Sessile oak	2.5	OK	2.5	NO			4	N
	Rowan	2.5	SAB	2.5	NO			2	N
	Scots pine	2.5	SP	2.0	NO			6	N
	Silver birch	2.5	SAB	2.5	NO			4	N
	Grey willow	2.5	SAB	2.5	NO			2	N

There are three entries for Scots pine, Downy birch and silver birch but the two underlined comprise how the first three entries for these species are for more widely spaced planting and each cover less

While the range of yield classes for Scots pine (2-14) is only slightly more than for other species (Downy and Silver birch are 2-12), the average yield if trees are closely spaced is higher at around 8 compared to 4 for Downy birch ([see here](#)). While that for Silver birch is slightly higher, Downy birch grows better on less well-drained soils. Combine this with the economies of mass production in tree nurseries, from a carbon and financial perspective Scots Pine is the next best alternative to non-native conifers with Downy birch often the favoured broad leaf.

From a carbon and financial perspective, the primary reasons that other native species are planted are to meet the UK Forestry Standard and to give the appearance that the WCC also promotes biodiversity. Those other native species, however, are not what drive investment decisions using the WCC calculator. Hence why so many native woodland schemes registered under WCC predominantly comprise of Scots pine and either Downy or Silver birch. These are the commonest species of native tree in upland Scotland and if grazing levels were reduce would spread rapidly through natural regeneration without any need to plant.

This is not to claim that the carbon units generated by planting other tree species might not create a useful source of income for conservation-minded landowners looking to fund the creation of different types of woodland. For example there are some riparian woodland schemes which have been planted with species other than Scots pine and birch, registered under the WCC . There are some WCC schemes which predominantly involve planting species other than Scots pine and birch. Such schemes, however, tend to be smaller than investor led schemes and every much in the minority.

Woodland structure

While in theory the WCC allows for different approaches to growing trees, including natural regeneration, in practice the amount of carbon absorbed by tree growth outside of plantations is very hard to measure. As Forest Research puts it *“Yield class is an index used in Britain of the potential productivity of even-aged stands of trees. It is based on the maximum mean annual increment of cumulative timber volume achieved by a given tree species growing on a given site and managed according to a standard management prescription.”* They go on to explain the limitations:

“The yield tables are designed mainly for application to even-aged silvicultural systems. They have limited application to forest stands with more complex structure and silvicultural practice, for example uneven-aged stands of trees” this is a subject of ongoing research and development. A characteristic stand growth pattern and a particular management prescription have been assumed in the construction of each yield table. Any deviation from the assumed growth pattern or management prescription will result in different stand characteristics compared with predictions.”

As a consequence, while the WCC calculator is able to convert predicted yield into Pending Issuance Units (PIUs) and predicted carbon units for even aged plantations with a reasonable degree of accuracy, anything else is far more challenging to count and convert into a financial value. In the case of natural regeneration, predicting when and how many saplings will become established is more than an art than a science which then requires intensive surveys on the ground to determine, tree by tree, how much carbon has been stored in wood.

Any landowner wanting therefore to sell easily verifiable woodland carbon units is likely to be advised to stay away from natural regeneration and plant as many trees as possible at the same time. And if that planting involves relatively few species, the counting is made even easier” another reason why so many native woodland schemes mainly comprise of Scots pine and birch.



Mounding at Kinrara. Trees planted in straight lines are easy to count, while close spacing maximise

For investors wishing to maximise their financial returns, the WCC calculator also leads to the use of spacing options which research shows maximises yield, while at the same time meeting the UK Forestry Standard which requires foresters to leave a certain amount of open space and more natural areas. This explains why in Table 2 for Kinrara Phase 1 above, a small proportion of the Scots pine, Downy and Silver birch were planted 5m rather than 2.5m apart. There is also an incentive for investors to plant trees that grow upwards, like Scots pine and birch, rather than spreading outwards, like willow and hazel, because upward growing trees produce more wood carbon per square metre of ground.

The overall outcome of the WCC calculator incentivising investors to plant the same two or three evenly aged and closely spaced native species are new native woodland plantations which appear little different from anything that would be planted by the commercial timber industry.

Protecting trees and promoting tree growth

For investors wishing to maximise wood carbon and financial returns, it also makes sense to adopt the methods adopted by the commercial timber industry to maximise yield so long as the carbon costs of doing so do not outweigh the benefits. The carbon costs of these methods are incorporated into in Table I of the calculator on Establishment Emissions and include fencing, the removal of vegetation, the use of herbicide and plastic tree shelters.

The methods also includes ground preparation, such as mounding, which are listed in Table 3 and, like other carbon emissions caused by planting on organic soils, are only allowable because the WCC calculator like the UK Forestry Standard fails to account for them properly.

How the WCC calculator drives plantation forestry

The WCC calculator is based on the assumptions that woodland is an important means of removing carbon from the atmosphere and that planting more trees is the way to achieve this. The calculator contains lots of clever stuff, founded in forestry science, which establishes how much CO2 each species of tree or mix of species absorbs from the atmosphere each year and how to maximise this. It then converts the result into tradeable into carbon units..

This provides a means of measuring the potential carbon benefits of each WCC scheme case by case and at first sight appears robust.. The underlying logic, however, is to add to the drive by the commercial forest industry to plant sitka and to incentivise the planting of native trees in plantations. Hence the industrial scale planting at Kinrara and Far Ralia in the Cairngorms National Park.

Given the lead role of Scottish Forestry, It should come as little surprise that the WCC calculator promotes similar types of forestry and forestry practices to the Scottish Forestry Grants system. A future post will explore the relationship between these two systems further.

Category

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2. Policy

Tags

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