# Evaluation of alternative harvesting and afforestation scenarios on British softwood timber availability

# Summary

The National Forest Inventory (NFI) provides a record of the size and distribution of forests and woodlands in Great Britain and information on key forest attributes. The NFI report *50-year forecast of softwood timber availability* (2014) forecasts a peak followed by a trough in availability over the next 50 years, which could cause difficulties in sustainable development of the sector. One of the aims of this report is to explore which factors could most influence and smooth this profile of production. The report explores and illustrates the impacts of alternative afforestation and harvesting scenarios on the softwood timber availability profile and provides estimates of long-term softwood timber availability under these scenarios.

Through this process, a scenario has been identified that produces a profile of softwood availability where the trough of softwood availability in the period 2062–66 rises from an average of 11.2 million cubic metres overbark standing (m$^3$ obs) per annum (as reported in the 2014 50-year forecast), to an average of 13.9 million m$^3$ obs per annum.

The estimates provided in this report for the existing woodland are based upon field samples assessed between October 2009 and August 2013, the results of which have been subjected to rigorous data quality assurance procedures. These field samples constitute approximately two-thirds of the sites to be sampled within the first cycle of NFI field sampling. As a consequence, the estimates in this report are classed as provisional and may be subject to later revision when all the samples have been collected. The forecasts and scenarios themselves depend on many underlying assumptions.

# Key findings

- Under the previously published 'headline' scenario of **modified biological potential** management, the long-term profile of softwood availability peaks in the period 2027–31 at an average of 18.4 million m$^3$ obs per annum, then declines until the period 2062–66 to an average of 11.2 million m$^3$ obs per annum and subsequently rises again.
- An alternative management scenario which extends rotation length for 15% of conifer stands over time (Scenario 6 of this report) results in a smoother profile of softwood timber availability. The peak in the period 2027–31 is reduced from an average of 18.4 million m$^3$ obs per annum to 17.5 million m$^3$ obs per annum, with the lowest average annual volume in the period 2062–66 increasing from 11.2 million m$^3$ obs to 11.5 million m$^3$ obs.

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- Afforestation would significantly impact on the long-term profile of softwood availability by increasing availability in later periods.
- A combination of afforestation with shortened rotations for Sitka spruce, and management of existing woodland which extends rotation lengths for 15% of conifers (Scenario 8 of this report) results in the trough of softwood availability rising from an average of 11.2 million m$^3$ obs per annum to an average of 13.9 million m$^3$ obs per annum in the period 2062–66.

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# Introduction

National forest inventories are carried out by the Forestry Commission to provide accurate, up-to-date information about the size, distribution, composition and condition of the forests and woodlands in Great Britain (GB). This information is essential for developing and monitoring policies and guidance to support sustainable forest management.

The current National Forest Inventory (NFI), which began in 2009 (the first cycle is due for completion in 2015), is a multipurpose operation that has involved the production of a forest and woodland map for GB and a continuing programme of field surveys of the mapped forest and woodland areas.

Information and data collected by the NFI will be used for a number of purposes, including estimates of current values and forecasts of future values of forest metrics such as:

- Standing volume
- Timber availability
- Tree growth and increment
- Carbon stocks
- Biomass

This report sets out the results of an exercise looking at how woodland creation scenarios could impact on long-term softwood timber[*] availability. The Public sector estate comprises forests and woodlands managed by Forestry Commission England, Forestry Commission Scotland and Natural Resources Wales.[†] Private sector woodland is all other forests and woodlands owned and managed by other bodies and individuals.

This report builds on the NFI *50-year forecast of softwood timber availability* (2014) report and associated methodology and interpretation reports, all of which are available from www.forestry.gov.uk/inventory.

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[*] Timber is defined in this report as the volume of stemwood to 7 cm top diameter in cubic metres overbark standing ($m^3$ obs including stump (above ground) and usable branchwood (of minimum 3 m length and 7 cm top diameter).

[†] The Natural Resources Wales estate in this report refers to the estate formerly managed by Forestry Commission Wales. It does not include the former holdings in Wales of the Environment Agency or the Countryside Council for Wales, which are treated as Private sector woodland in this report.

# How the estimates of softwood timber availability including afforestation were prepared

This report looks first at the 100-year forecast of softwood timber availability based on the existing woodland resource (including softwood timber arising from restocking currently clearfelled land).

It then looks at the softwood timber availability that could arise from the creation of new woodland over a period of 30 years.

The estimates of softwood availability from the newly created woodland are added to the estimates from the existing woodland resource to provide a picture of the long-term softwood timber availability under different management and planting assumptions.

The report looks at the newly created woodland as a whole and makes no assumptions as to how the land might be apportioned between:
- the Public sector estate and the Private sector estate; or
- the amount of newly created woodland in different countries

and any differences in management that might arise from either of these factors. No assumptions are made about any potential impacts which may arise from future outbreaks of pests and diseases.

This report looks at 10 different scenarios for managing woodland in the Private sector, which are described here and summarised in **Table 1**. This is a selection from many possible scenarios and is intended to illustrate the impacts of factors which affect the long-term availability of softwood timber.

- **Scenario 1** is the long-term forecast of softwood timber availability, published as the 'headline' scenario in the NFI *50-year forecast of softwood timber availability* (2014) report, based on the existing woodland resource. In this scenario we assume that 10% of the conifer felling is converted at restock into equal proportions of broadleaves and open space. Scenarios 2 to 5 examine the effects on the long-term softwood availability profile of the addition of new woodland to the existing resource. This is achieved through the establishment of newly afforested areas at alternative levels and alternative future management scenarios of this additional resource.

    - **Scenario 2** includes softwood timber availability arising from new woodlands created at a rate of 6,000 hectares per annum over the next 30

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years. The newly created woodland is managed using the same modified biological potential scenario as the existing woodland resource.

- o **Scenario 3** includes softwood timber availability arising from new woodlands created at a rate of 10,000 hectares per annum over the next 30 years. The newly created woodland is managed using the same modified biological potential scenario as the existing woodland resource.

- o **Scenario 4** includes softwood timber availability arising from new woodlands created at a rate of 6,000 hectares per annum over the next 30 years. The management of the newly created woodland differs from Scenario 2 in that the rotation length of Sitka spruce (the predominant species[*] assumed for the afforestation) is reduced to 30 years. All other species in the new woodlands are managed according to the modified biological potential assumptions.

- o **Scenario 5** includes softwood timber availability arising from new woodlands created at a rate of 10,000 hectares per annum over the next 30 years. The management of the newly created woodland differs from Scenario 3 in that the rotation length of Sitka spruce is reduced to 30 years. All other species in the new woodlands are managed according to the modified biological potential assumptions.

- **Scenario 6** looks at the effect on the long-term softwood timber availability if the management assumptions for the existing woodland resource in the Private sector are changed to extend rotations for 15% (by area) of all conifer species. As with the preceding scenarios, we assume that 10% of the conifer felling is converted in equal proportions to broadleaves and to open space. Scenarios 7 and 8 then examine the effects on this scenario for existing woodland of the addition of new woodlands in newly afforested areas at alternative rates of creation.

  - o **Scenario 7** includes softwood timber availability arising from new woodlands created at a rate of 6,000 hectares per annum over the next 30 years. The management of the newly created woodland is the same as Scenario 4 in that the rotation length of Sitka spruce (the predominant species assumed for the afforestation) is reduced to 30 years. All other species in the new woodlands are managed according to the modified biological potential assumptions.

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[*] 63% of newly afforested areas – see Table 2.

o **Scenario 8** includes softwood timber availability arising from new woodlands created at a rate of 10,000 hectares per annum over the next 30 years. The management of the newly created woodland is the same as Scenario 5 in that the rotation length of Sitka spruce (the predominant species assumed for the afforestation) is reduced to 30 years. All other species in the new woodlands are managed according to the modified biological potential assumptions.

- **Scenario 9** looks at the effect on the long-term softwood timber availability if, in addition to amending the management assumptions for the existing woodland resource in the Private sector to extend rotations for 15% (by area) of all conifer species, the proportion of conifer converted at felling to broadleaves and open space is 20% rather than the 10% assumed in all preceding scenarios. Scenario 10 then examines the effects on this scenario for existing woodland of the addition of new woodlands in newly afforested areas.

  o **Scenario 10** includes softwood timber availability arising from new woodlands created at a rate of 6,000 hectares per annum over the next 30 years. The management of the newly created woodland is the same as Scenario 4 in that the rotation length of Sitka spruce (the predominant species assumed for the afforestation) is reduced to 30 years. All other species in the new woodlands are managed according to the modified biological potential assumptions.

**Table 1**  Summary of scenarios for long-term softwood timber availability

| Scenario | Existing woodland management (Private sector) | Afforestation | |
| --- | --- | --- | --- |
| | | Annual area (ha per annum) | Rotation length |
| 1 | Modified biological potential 10% conifer felling converted to broadleaves and open space[a] (published 'headline' scenario) | 0 | - |
| 2 | Modified biological potential 10% conifer felling converted to broadleaves and open space[a] | 6,000[d] | maxMAI[f] |
| 3 | Modified biological potential 10% conifer felling converted to broadleaves and open space[a] | 10,000[e] | maxMAI[f] |
| 4 | Modified biological potential 10% conifer felling converted to broadleaves and open space[a] | 6,000[d] | SS 30 years Other species maxMAI[g] |

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| Scenario | Existing woodland management (Private sector) | Afforestation | |
|---|---|---|---|
| | | Annual area (ha per annum) | Rotation length |
| 5 | Modified biological potential 10% conifer felling converted to broadleaves and open space[a] | 10,000[e] | SS 30 years Other species maxMAI[g] |
| 6 | Extended rotations 10% conifer felling converted to broadleaves and open space[b] | 0 | - |
| 7 | Extended rotations 10% conifer felling converted to broadleaves and open space[b] | 6,000[d] | SS 30 years Other species maxMAI[g] |
| 8 | Extended rotations 10% conifer felling converted to broadleaves and open space[b] | 10,000[e] | SS 30 years Other species maxMAI[g] |
| 9 | Extended rotations 20% conifer felling converted to broadleaves and open space[c] | 0 | - |
| 10 | Extended rotations 20% conifer felling converted to broadleaves and open space[c] | 6,000[d] | SS 30 years Other species maxMAI[g] |

| | |
|---|---|
| maxMAI | maximum mean annual increment |
| SS | Sitka spruce |
| a | Existing woodland management option 1. |
| b | Existing woodland management option 2. |
| c | Existing woodland management option 3. |
| d | Afforestation area option 1. |
| e | Afforestation area option 2. |
| f | Afforestation rotation length option 1. |
| g | Afforestation rotation length option 2. |

## Assumptions for the existing woodland resource

Details of the data sources used for the derivation of softwood timber forecasts are fully described in the section 'How forecasts are derived' in the NFI *50-year forecast of softwood timber availability* (2014) report.

All the estimates provided in this report for the existing woodland resource in the Public sector estate assume that it is managed according to the forest design plans and thinning plans approved at 31 March 2012.

In this report, the forecast of softwood timber availability arising from the existing Private sector woodland resource assumes management under a **modified biological potential** scenario. This takes a relatively risk–tolerant approach to the occurrence of thinning and timing of felling with regard to the possibility of windthrow. Where the risk of windthrow is relatively low, stands are thinned and felled at the age of maximum mean annual increment (maxMAI). Where there is a higher risk of windthrow, stands are assumed not to be thinned and are felled at a top height of 25 m. A full explanation of overdue timber can be found in the section 'Assumptions used in the forecast' in the NFI *50-year forecast of softwood timber availability* (2014) report.

Restocking assumptions and restock management are the same for the Public sector estate and the Private sector estate. The restocking assumptions vary by country and are summarised in Tables D3–D5 in the NFI *50-year forecast of softwood timber availability* (2014) report. Woodland felled during the 100 years forecast period, and woodland which is currently classed as clearfelled, is restocked according to the prescription. As part of the restocking prescription, 5% of conifer felled area is converted to open space and 5% to broadleaves. The restocking assumptions include planting of currently felled land. This species restructuring occurs at the time of the first restocking in the 100-year forecast range. No species change is assumed for any subsequent restocking.

All restocking is managed under the modified biological potential scenario.

The report then provides estimates of softwood timber availability under a variation in which the management of the Private sector softwood resource is under a scenario which delays the felling of 15%[*] of the conifers (by area) for 20 years beyond the age of maxMAI. The allocation of overdue timber, restocking assumptions and management of the restocking are as described for the **modified biological potential** scenario.

Results of a further variation of this scenario are also provided, in which the restocking assumptions are changed to that in which 20% of felled conifer area is converted to broadleaves and open land.

## Afforestation scenario description – planting

The afforestation assumptions are based on two conifer productive woodland creation scenarios, identified as 'low cost' and 'high cost' options, proposed by the Scottish Timber Market Impacts Group and based on species breakdowns from an analysis of

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[*] Based on analyses looking at the ratio of actual softwood production to past forecasts and also on the ratio of standing volume to overdue volume.

grant applications. The afforestation scenarios in this report assume that 90% of afforested land is planted according to the 'low cost' option and 10% according to the 'high cost' option. The two options and the resultant species mix across all afforestation are described in **Table 2.** The yield class assumptions are shown in **Table 3**. Afforestation is assumed to take place over a 30-year period.

**Table 2** Description of conifer productive woodland creation scenarios

| Species | Productive conifer (%) 'low cost' | Productive conifer (%) 'high cost' | Proportion of afforested land (%) assumes 90% 'low cost' and 10% 'high cost' |
|---|---|---|---|
| Sitka spruce | 70 | - | 63 |
| Douglas fir | 10 | 40 | 13 |
| Scots pine | - | 40 | 4 |
| Broadleaves[a] | 10 | 10 | 10 |
| Open ground | 10 | 10 | 10 |

    a        birch, oak and alder in equal proportions

**Table 3** Yield classes assumed for the species in afforestation

| Species | Yield class |
|---|---|
| Sitka spruce | 16 |
| Douglas fir | 12 |
| Scots pine | 10 |
| Birch | 4 |
| Oak | 6 |
| Alder | 6 |

## Afforestation scenario description – management

Two scenarios are reported for the management of the afforested land:
- the modified biological potential scenario;
- shortened rotation length for Sitka spruce, with all other species managed according to the modified biological potential scenario.

As management under these assumptions varies according to the windthrow risk, an even split between planting in areas of low and high windthrow risk is assumed. **Tables**

**4** and **5** show the area planted by species in the low and high risk areas for afforestation at the rate of 6,000 hectares and 10,000 hectares per annum respectively.

**Table 4** Area planted by species for afforestation of 6,000 hectares per annum

| Hectares planted per annum | Low windthrow risk | High windthrow risk | Total |
|---|---|---|---|
| Sitka spruce | 1,890 | 1,890 | 3,780 |
| Douglas fir | 390 | 390 | 780 |
| Scots pine | 120 | 120 | 240 |
| Broadleaves | 300 | 300 | 600 |
| Open ground | 300 | 300 | 600 |
| Total | 3,000 | 3,000 | 6,000 |

**Table 5** Area planted by species for afforestation of 10,000 hectares per annum

| Hectares planted per annum | Low windthrow risk | High windthrow risk | Total |
|---|---|---|---|
| Sitka spruce | 3,150 | 3,150 | 6,300 |
| Douglas fir | 650 | 650 | 1,300 |
| Scots pine | 200 | 200 | 400 |
| Broadleaves | 500 | 500 | 1,000 |
| Open ground | 500 | 500 | 1,000 |
| Total | 5,000 | 5,000 | 10,000 |

The management of the area regarded as low windthrow risk assumes thinning, with felling taking place at age of maxMAI. The management of the area regarded as high windthrow risk assumes no thinning, with felling taking place at a top height of 25 m.

## Afforestation scenario description – restocking

As the afforested land is clearfelled during the forecast it is replanted on a 'like-for-like' basis, meaning that there is no restructuring of the species mix in the restocked areas and no further open space is introduced.

## Afforestation scenario description – restock management

When the afforested land is restocked following clearfelling, the same management assumptions are applied to the restocking as were applied to the new planting in the afforested areas.

- When the first rotation of the newly afforested area is managed under modified biological potential assumptions, the second and subsequent rotations in the newly afforested area is also managed under modified biological potential assumptions.
- When the first rotation of the newly afforested area is managed under modified biological potential assumptions with shortened rotation length for Sitka spruce, the second and subsequent rotations in the newly afforested area is also managed under modified biological potential assumptions with shortened rotation length for Sitka spruce.

As with the newly afforested land, the management of any restocking is based on whether the area is regarded as low or high windthrow risk. In areas of low windthrow risk, we assume thinning, with felling taking place at age of maxMAI. The management of the area regarded as high windthrow risk assumes no thinning, with felling taking place at a top height of 25 m.

# Results

The results presented in this report are estimates of softwood availability under different combinations of management and afforestation.

- **Scenario 1** results are presented in **Figure 1** and **Table 6**.
    - o **Scenario 2** results are presented in **Figure 2** and **Table 7**.
    - o **Scenario 3** results are presented in **Figure 3** and **Table 8**.
    - o **Scenario 4** results are presented in **Figure 4** and **Table 9**.
    - o **Scenario 5** results are presented in **Figure 5** and **Table 10**.
- **Scenario 6** results are presented in **Figure 6** and **Table 11**.
    - o **Scenario 7** results are presented in **Figure 7** and **Table 12**.
    - o **Scenario 8** results are presented in **Figure 8** and **Table 13**.
- **Scenario 9** results are presented in **Figure 9** and **Table 14**.
    - o **Scenario 10** results are presented in **Figure 10** and **Table 15**.

**Figure 11** and **Table 16** illustrate the long-term softwood timber availability from the existing woodland resource under the three management scenarios used in this report. The 2013 softwood production figure is shown for reference.[*]

The values in the tables have been independently rounded, so may not add to the totals shown. In some breakdowns of Private sector estimates, the estimates in the body of the table may not sum to the quoted total because each individual value, including the total, has been independently generate by the estimation procedure used for the results from the NFI sample survey. Sampling standard errors (SEs) attached to Private sector estimates are expressed in relative terms (%) to the right of the relevant estimate.

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[*] Forestry Statistics 2014, Longer time series data for wood production (roundwood removals), for 1976 to 2013 (final)
www.forestry.gov.uk/forestry/infd-7aql5b

## Scenario 1 – 100-year forecast of softwood availability under modified biological potential management assumptions with a 10% conversion of conifers at felling (published 'headline' forecast)

**Figure 1** Scenario 1
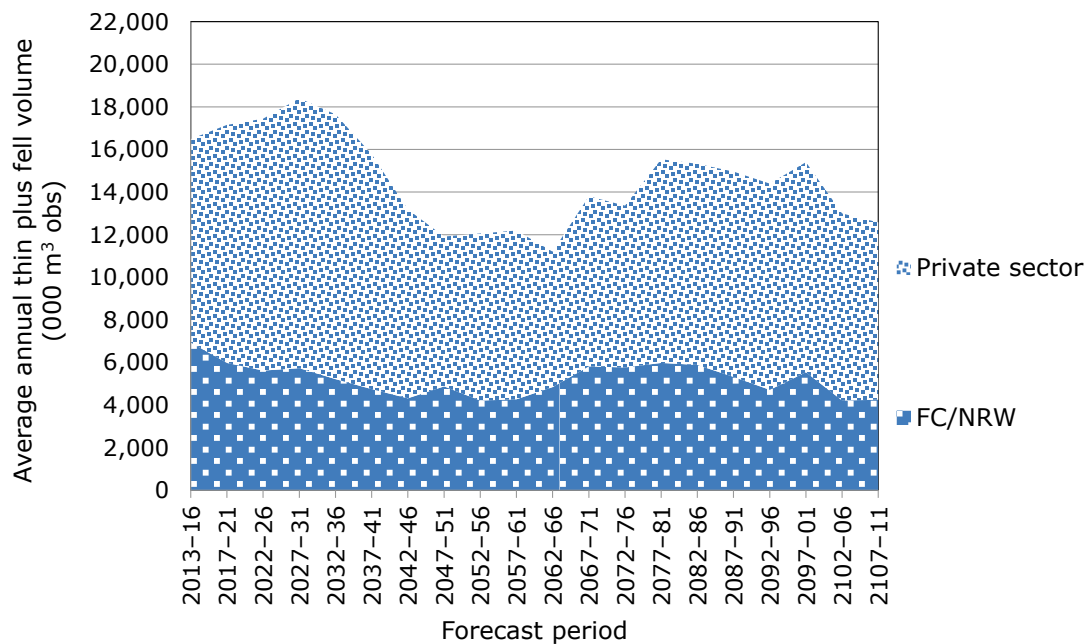


**Table 6** Scenario 1

| Forecast period | FC/NRW volume (000 m³ obs) | Private sector volume (000 m³ obs) | SE% | Total volume (000 m³ obs) |
|---|---|---|---|---|
| Great Britain - softwood | | | | |
| 2013–16 | 6,933 | 9,554 | 4 | **16,487** |
| 2017–21 | 5,980 | 11,171 | 4 | **17,151** |
| 2022–26 | 5,622 | 11,820 | 4 | **17,442** |
| 2027–31 | 5,726 | 12,671 | 4 | **18,398** |
| 2032–36 | 5,216 | 12,433 | 4 | **17,649** |
| 2037–41 | 4,744 | 11,035 | 4 | **15,779** |
| 2042–46 | 4,316 | 8,865 | 4 | **13,181** |
| 2047–51 | 4,879 | 7,030 | 4 | **11,909** |
| 2052–56 | 4,209 | 7,845 | 3 | **12,054** |
| 2057–61 | 4,269 | 7,924 | 3 | **12,193** |
| 2062–66 | 4,840 | 6,357 | 4 | **11,197** |
| 2067–71 | 5,815 | 7,977 | 3 | **13,792** |
| 2072–76 | 5,767 | 7,597 | 3 | **13,364** |
| 2077–81 | 5,974 | 9,567 | 3 | **15,541** |
| 2082–86 | 5,879 | 9,444 | 3 | **15,323** |
| 2087–91 | 5,316 | 9,640 | 3 | **14,956** |
| 2092–96 | 4,717 | 9,680 | 3 | **14,397** |
| 2097–01 | 5,540 | 9,865 | 3 | **15,405** |
| 2102–06 | 4,221 | 8,776 | 3 | **12,997** |
| 2107–11 | 4,248 | 8,326 | 3 | **12,574** |

Scenario 2 – 100-year forecast of softwood availability under modified biological potential management assumptions with a 10% conversion of conifers at felling combined with **afforestation of 6,000 hectares per annum** also under modified biological potential management assumptions

**Figure 2** Scenario 2
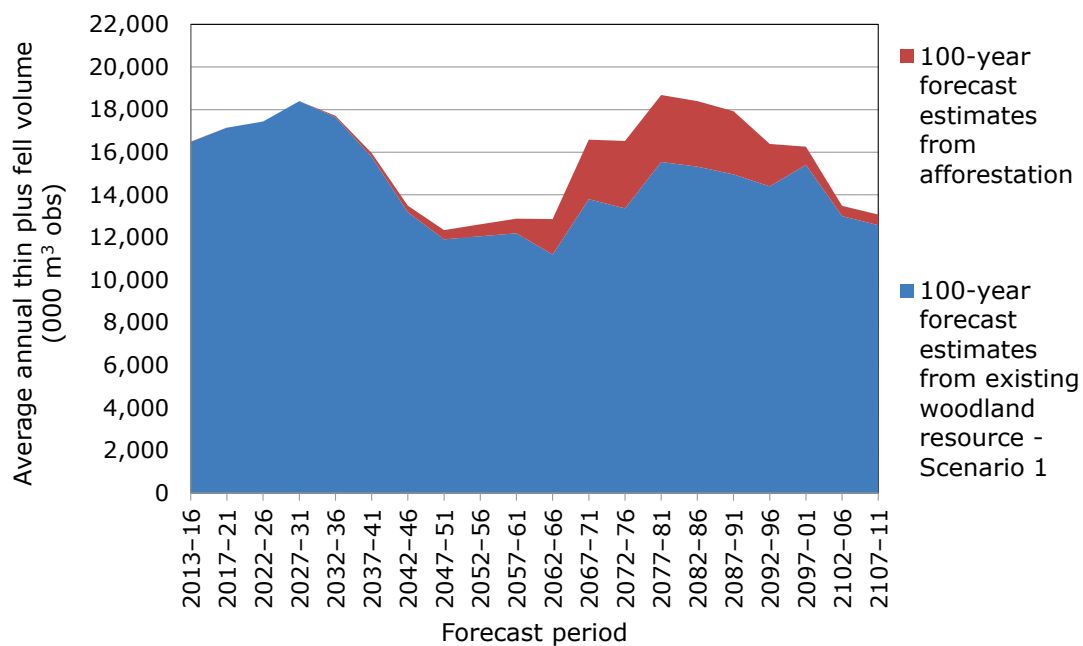


**Table 7** Scenario 2

| Forecast period | FC/NRW | Private sector | | Total | Afforestation | New total |
|---|---|---|---|---|---|---|
| | volume (000 m³ obs) | volume (000 m³ obs) | SE% | volume (000 m³ obs) | volume (000 m³ obs) | volume (000 m³ obs) |
| Great Britain - softwood | | | | | | |
| 2013–16 | 6,933 | 9,554 | 4 | **16,487** | 0 | **16,487** |
| 2017–21 | 5,980 | 11,171 | 4 | **17,151** | 0 | **17,151** |
| 2022–26 | 5,622 | 11,820 | 4 | **17,442** | 0 | **17,442** |
| 2027–31 | 5,726 | 12,671 | 4 | **18,398** | 0 | **18,398** |
| 2032–36 | 5,216 | 12,433 | 4 | **17,649** | 64 | **17,712** |
| 2037–41 | 4,744 | 11,035 | 4 | **15,779** | 182 | **15,961** |
| 2042–46 | 4,316 | 8,865 | 4 | **13,181** | 308 | **13,489** |
| 2047–51 | 4,879 | 7,030 | 4 | **11,909** | 435 | **12,343** |
| 2052–56 | 4,209 | 7,845 | 3 | **12,054** | 561 | **12,615** |
| 2057–61 | 4,269 | 7,924 | 3 | **12,193** | 687 | **12,880** |
| 2062–66 | 4,840 | 6,357 | 4 | **11,197** | 1,664 | **12,861** |
| 2067–71 | 5,815 | 7,977 | 3 | **13,792** | 2,798 | **16,591** |
| 2072–76 | 5,767 | 7,597 | 3 | **13,364** | 3,164 | **16,528** |
| 2077–81 | 5,974 | 9,567 | 3 | **15,541** | 3,145 | **18,686** |
| 2082–86 | 5,879 | 9,444 | 3 | **15,323** | 3,076 | **18,399** |
| 2087–91 | 5,316 | 9,640 | 3 | **14,956** | 2,968 | **17,924** |
| 2092–96 | 4,717 | 9,680 | 3 | **14,397** | 1,991 | **16,388** |
| 2097–01 | 5,540 | 9,865 | 3 | **15,405** | 854 | **16,259** |
| 2102–06 | 4,221 | 8,776 | 3 | **12,997** | 484 | **13,481** |
| 2107–11 | 4,248 | 8,326 | 3 | **12,574** | 499 | **13,073** |

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Scenario 3 – 100-year forecast of softwood availability under modified biological potential management assumptions with a 10% conversion of conifers at felling combined with **afforestation of 10,000 hectares per annum** also under modified biological potential management assumptions

**Figure 3** Scenario 3
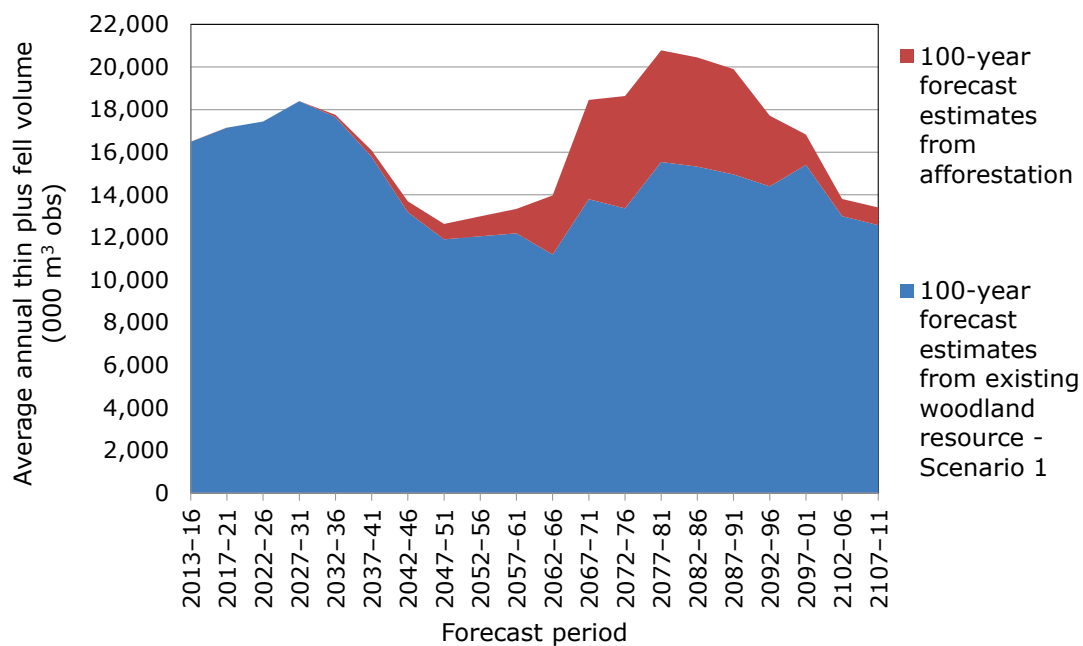


**Table 8** Scenario 3

| Forecast period | FC/NRW volume (000 m³ obs) | Private sector volume (000 m³ obs) | SE% | Total volume (000 m³ obs) | Afforestation volume (000 m³ obs) | New total volume (000 m³ obs) |
|---|---|---|---|---|---|---|
| Great Britain - softwood | | | | | | |
| 2013–16 | 6,933 | 9,554 | 4 | **16,487** | 0 | **16,487** |
| 2017–21 | 5,980 | 11,171 | 4 | **17,151** | 0 | **17,151** |
| 2022–26 | 5,622 | 11,820 | 4 | **17,442** | 0 | **17,442** |
| 2027–31 | 5,726 | 12,671 | 4 | **18,398** | 0 | **18,398** |
| 2032–36 | 5,216 | 12,433 | 4 | **17,649** | 106 | **17,754** |
| 2037–41 | 4,744 | 11,035 | 4 | **15,779** | 303 | **16,082** |
| 2042–46 | 4,316 | 8,865 | 4 | **13,181** | 514 | **13,694** |
| 2047–51 | 4,879 | 7,030 | 4 | **11,909** | 724 | **12,633** |
| 2052–56 | 4,209 | 7,845 | 3 | **12,054** | 935 | **12,989** |
| 2057–61 | 4,269 | 7,924 | 3 | **12,193** | 1,146 | **13,338** |
| 2062–66 | 4,840 | 6,357 | 4 | **11,197** | 2,773 | **13,970** |
| 2067–71 | 5,815 | 7,977 | 3 | **13,792** | 4,664 | **18,456** |
| 2072–76 | 5,767 | 7,597 | 3 | **13,364** | 5,274 | **18,637** |
| 2077–81 | 5,974 | 9,567 | 3 | **15,541** | 5,242 | **20,783** |
| 2082–86 | 5,879 | 9,444 | 3 | **15,323** | 5,126 | **20,449** |
| 2087–91 | 5,316 | 9,640 | 3 | **14,956** | 4,946 | **19,902** |
| 2092–96 | 4,717 | 9,680 | 3 | **14,397** | 3,319 | **17,715** |
| 2097–01 | 5,540 | 9,865 | 3 | **15,405** | 1,423 | **16,828** |
| 2102–06 | 4,221 | 8,776 | 3 | **12,997** | 807 | **13,804** |
| 2107–11 | 4,248 | 8,326 | 3 | **12,574** | 831 | **13,405** |

Scenario 4 – 100-year forecast of softwood availability under modified biological potential management assumptions with a 10% conversion of conifers at felling combined with afforestation of 6,000 hectares per annum with all **additional Sitka spruce on a 30-year rotation**

**Figure 4** Scenario 4
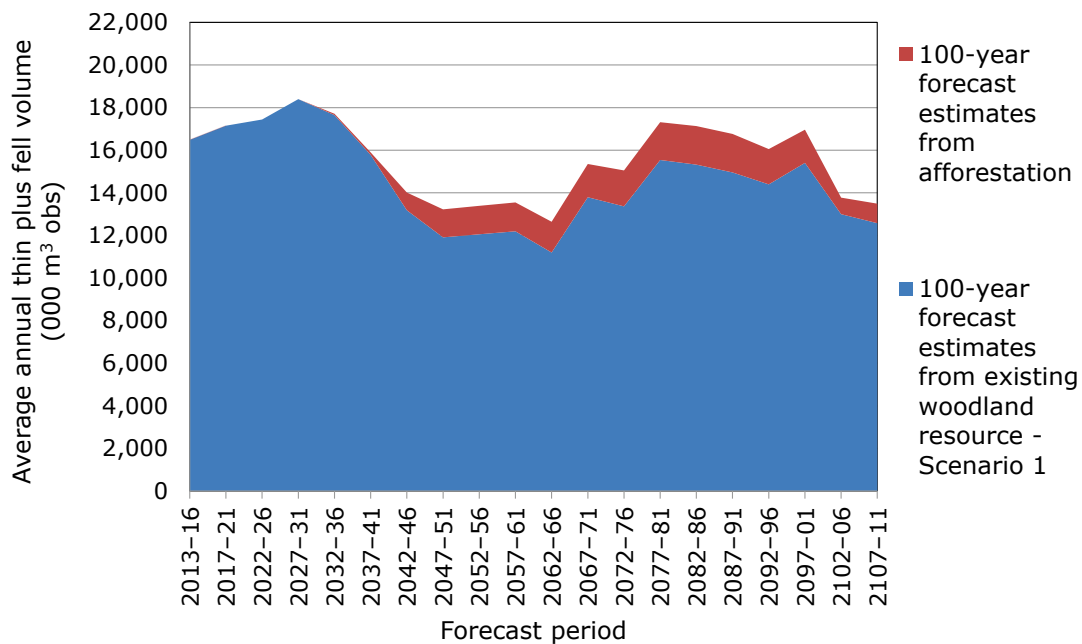


**Table 9** Scenario 4

| Forecast period | FC/NRW volume (000 m³ obs) | Private sector volume (000 m³ obs) | SE% | Total volume (000 m³ obs) | Afforestation volume (000 m³ obs) | New total volume (000 m³ obs) |
|---|---|---|---|---|---|---|
| Great Britain - softwood | | | | | | |
| 2013–16 | 6,933 | 9,554 | 4 | **16,487** | 0 | **16,487** |
| 2017–21 | 5,980 | 11,171 | 4 | **17,151** | 0 | **17,151** |
| 2022–26 | 5,622 | 11,820 | 4 | **17,442** | 0 | **17,442** |
| 2027–31 | 5,726 | 12,671 | 4 | **18,398** | 0 | **18,398** |
| 2032–36 | 5,216 | 12,433 | 4 | **17,649** | 64 | **17,712** |
| 2037–41 | 4,744 | 11,035 | 4 | **15,779** | 118 | **15,897** |
| 2042–46 | 4,316 | 8,865 | 4 | **13,181** | 832 | **14,013** |
| 2047–51 | 4,879 | 7,030 | 4 | **11,909** | 1,315 | **13,224** |
| 2052–56 | 4,209 | 7,845 | 3 | **12,054** | 1,335 | **13,389** |
| 2057–61 | 4,269 | 7,924 | 3 | **12,193** | 1,356 | **13,549** |
| 2062–66 | 4,840 | 6,357 | 4 | **11,197** | 1,444 | **12,641** |
| 2067–71 | 5,815 | 7,977 | 3 | **13,792** | 1,561 | **15,353** |
| 2072–76 | 5,767 | 7,597 | 3 | **13,364** | 1,687 | **15,051** |
| 2077–81 | 5,974 | 9,567 | 3 | **15,541** | 1,775 | **17,315** |
| 2082–86 | 5,879 | 9,444 | 3 | **15,323** | 1,810 | **17,134** |
| 2087–91 | 5,316 | 9,640 | 3 | **14,956** | 1,808 | **16,764** |
| 2092–96 | 4,717 | 9,680 | 3 | **14,397** | 1,657 | **16,053** |
| 2097–01 | 5,540 | 9,865 | 3 | **15,405** | 1,559 | **16,964** |
| 2102–06 | 4,221 | 8,776 | 3 | **12,997** | 777 | **13,774** |
| 2107–11 | 4,248 | 8,326 | 3 | **12,574** | 917 | **13,491** |

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Scenario 5 – 100-year forecast of softwood availability under modified biological potential management assumptions with a 10% conversion of conifers at felling combined with **afforestation of 10,000 hectares per annum** with all additional Sitka spruce on a 30-year rotation

**Figure 5** Scenario 5
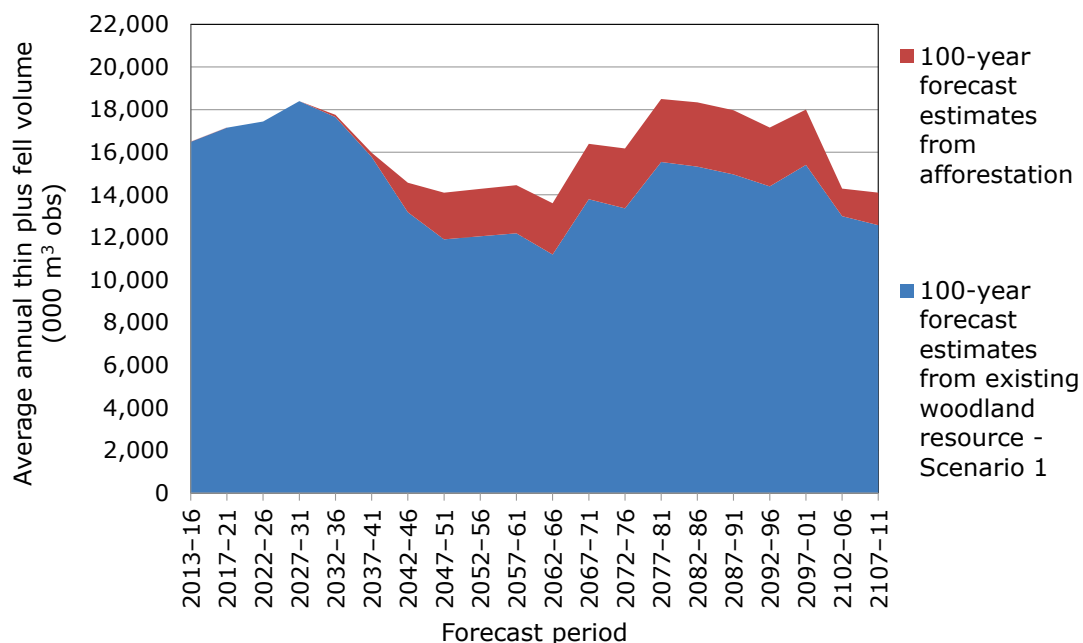


**Table 10** Scenario 5

| Forecast period | FC/NRW volume (000 m³ obs) | Private sector volume (000 m³ obs) | SE% | Total volume (000 m³ obs) | Afforestation volume (000 m³ obs) | New total volume (000 m³ obs) |
|---|---|---|---|---|---|---|
| Great Britain - softwood | | | | | | |
| 2013–16 | 6,933 | 9,554 | 4 | **16,487** | 0 | **16,487** |
| 2017–21 | 5,980 | 11,171 | 4 | **17,151** | 0 | **17,151** |
| 2022–26 | 5,622 | 11,820 | 4 | **17,442** | 0 | **17,442** |
| 2027–31 | 5,726 | 12,671 | 4 | **18,398** | 0 | **18,398** |
| 2032–36 | 5,216 | 12,433 | 4 | **17,649** | 106 | **17,754** |
| 2037–41 | 4,744 | 11,035 | 4 | **15,779** | 197 | **15,976** |
| 2042–46 | 4,316 | 8,865 | 4 | **13,181** | 1,387 | **14,568** |
| 2047–51 | 4,879 | 7,030 | 4 | **11,909** | 2,191 | **14,100** |
| 2052–56 | 4,209 | 7,845 | 3 | **12,054** | 2,226 | **14,279** |
| 2057–61 | 4,269 | 7,924 | 3 | **12,193** | 2,260 | **14,453** |
| 2062–66 | 4,840 | 6,357 | 4 | **11,197** | 2,407 | **13,604** |
| 2067–71 | 5,815 | 7,977 | 3 | **13,792** | 2,601 | **16,394** |
| 2072–76 | 5,767 | 7,597 | 3 | **13,364** | 2,812 | **16,176** |
| 2077–81 | 5,974 | 9,567 | 3 | **15,541** | 2,958 | **18,498** |
| 2082–86 | 5,879 | 9,444 | 3 | **15,323** | 3,017 | **18,341** |
| 2087–91 | 5,316 | 9,640 | 3 | **14,956** | 3,014 | **17,970** |
| 2092–96 | 4,717 | 9,680 | 3 | **14,397** | 2,761 | **17,158** |
| 2097–01 | 5,540 | 9,865 | 3 | **15,405** | 2,598 | **18,003** |
| 2102–06 | 4,221 | 8,776 | 3 | **12,997** | 1,295 | **14,292** |
| 2107–11 | 4,248 | 8,326 | 3 | **12,574** | 1,528 | **14,102** |

## Scenario 6 – 100-year forecast of softwood availability under management with **extended rotations** and a 10% conversion of conifers at felling

**Figure 6** Scenario 6
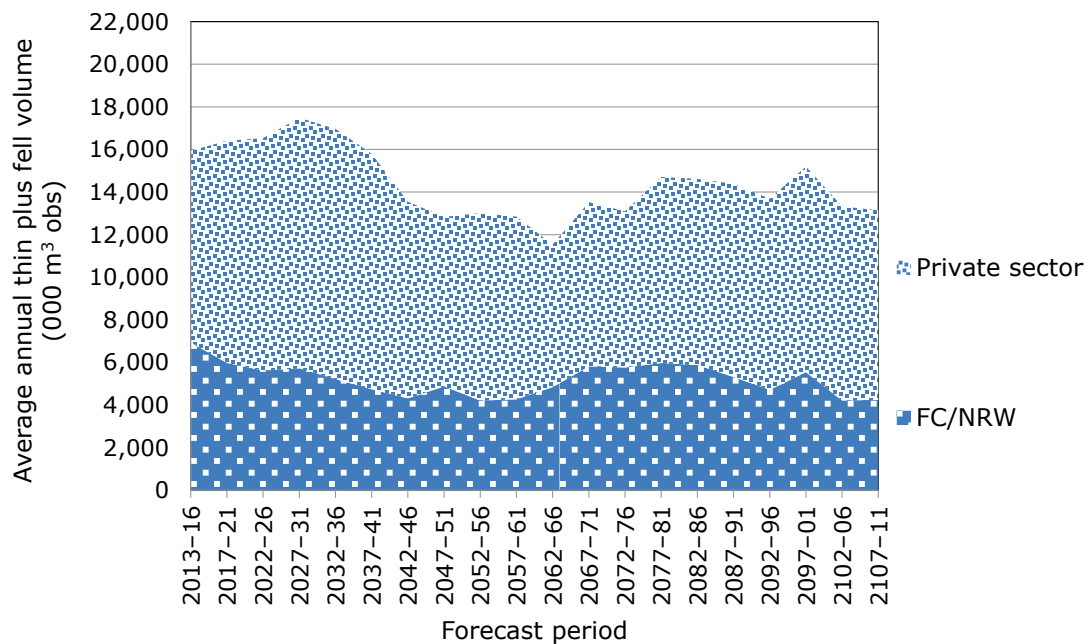


**Table 11** Scenario 6

| Forecast period | FC/NRW volume (000 m³ obs) | Private sector volume (000 m³ obs) | SE% | Total volume (000 m³ obs) |
|---|---|---|---|---|
| Great Britain - softwood | | | | |
| 2013–16 | 6,933 | 9,005 | 4 | **15,938** |
| 2017–21 | 5,980 | 10,433 | 3 | **16,413** |
| 2022–26 | 5,622 | 10,911 | 3 | **16,532** |
| 2027–31 | 5,726 | 11,760 | 3 | **17,486** |
| 2032–36 | 5,216 | 11,752 | 3 | **16,968** |
| 2037–41 | 4,744 | 11,050 | 3 | **15,793** |
| 2042–46 | 4,316 | 9,234 | 3 | **13,550** |
| 2047–51 | 4,879 | 7,955 | 3 | **12,834** |
| 2052–56 | 4,209 | 8,806 | 3 | **13,015** |
| 2057–61 | 4,269 | 8,579 | 3 | **12,847** |
| 2062–66 | 4,840 | 6,697 | 3 | **11,537** |
| 2067–71 | 5,815 | 7,713 | 3 | **13,528** |
| 2072–76 | 5,767 | 7,334 | 3 | **13,101** |
| 2077–81 | 5,974 | 8,740 | 2 | **14,714** |
| 2082–86 | 5,879 | 8,737 | 2 | **14,617** |
| 2087–91 | 5,316 | 9,074 | 2 | **14,389** |
| 2092–96 | 4,717 | 8,970 | 2 | **13,686** |
| 2097–01 | 5,540 | 9,659 | 2 | **15,198** |
| 2102–06 | 4,221 | 9,104 | 2 | **13,325** |
| 2107–11 | 4,248 | 8,893 | 2 | **13,141** |

Scenario 7 – 100-year forecast of softwood availability under management with extended rotations and a 10% conversion of conifers at felling combined with **afforestation of 6,000 hectares per annum** with all additional Sitka spruce on a 30-year rotation

**Figure 7**  Scenario 7
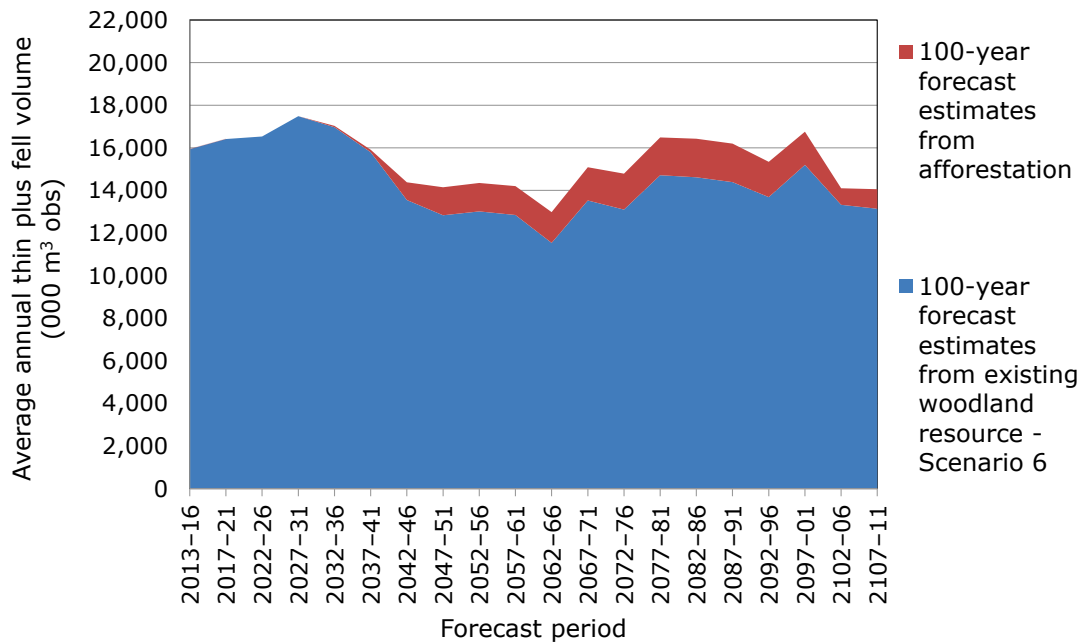


**Table 12**  Scenario 7

| Forecast period | FC/NRW volume (000 m³ obs) | Private sector volume (000 m³ obs) | SE% | Total volume (000 m³ obs) | Afforestation volume (000 m³ obs) | New total volume (000 m³ obs) |
|---|---|---|---|---|---|---|
| Great Britain - softwood | | | | | | |
| 2013–16 | 6,933 | 9,005 | 4 | **15,938** | 0 | **15,938** |
| 2017–21 | 5,980 | 10,433 | 3 | **16,413** | 0 | **16,413** |
| 2022–26 | 5,622 | 10,911 | 3 | **16,532** | 0 | **16,532** |
| 2027–31 | 5,726 | 11,760 | 3 | **17,486** | 0 | **17,486** |
| 2032–36 | 5,216 | 11,752 | 3 | **16,968** | 64 | **17,032** |
| 2037–41 | 4,744 | 11,050 | 3 | **15,793** | 118 | **15,912** |
| 2042–46 | 4,316 | 9,234 | 3 | **13,550** | 832 | **14,382** |
| 2047–51 | 4,879 | 7,955 | 3 | **12,834** | 1,315 | **14,149** |
| 2052–56 | 4,209 | 8,806 | 3 | **13,015** | 1,335 | **14,350** |
| 2057–61 | 4,269 | 8,579 | 3 | **12,847** | 1,356 | **14,203** |
| 2062–66 | 4,840 | 6,697 | 3 | **11,537** | 1,444 | **12,982** |
| 2067–71 | 5,815 | 7,713 | 3 | **13,528** | 1,561 | **15,089** |
| 2072–76 | 5,767 | 7,334 | 3 | **13,101** | 1,687 | **14,788** |
| 2077–81 | 5,974 | 8,740 | 2 | **14,714** | 1,775 | **16,488** |
| 2082–86 | 5,879 | 8,737 | 2 | **14,617** | 1,810 | **16,427** |
| 2087–91 | 5,316 | 9,074 | 2 | **14,389** | 1,808 | **16,198** |
| 2092–96 | 4,717 | 8,970 | 2 | **13,686** | 1,657 | **15,343** |
| 2097–01 | 5,540 | 9,659 | 2 | **15,198** | 1,559 | **16,757** |
| 2102–06 | 4,221 | 9,104 | 2 | **13,325** | 777 | **14,102** |
| 2107–11 | 4,248 | 8,893 | 2 | **13,141** | 917 | **14,057** |

Scenario 8 – 100-year forecast of softwood availability under management with extended rotations and a 10% conversion of conifers at felling combined with **afforestation of 10,000 hectares per annum** with all additional Sitka spruce on a 30-year rotation

**Figure 8** Scenario 8
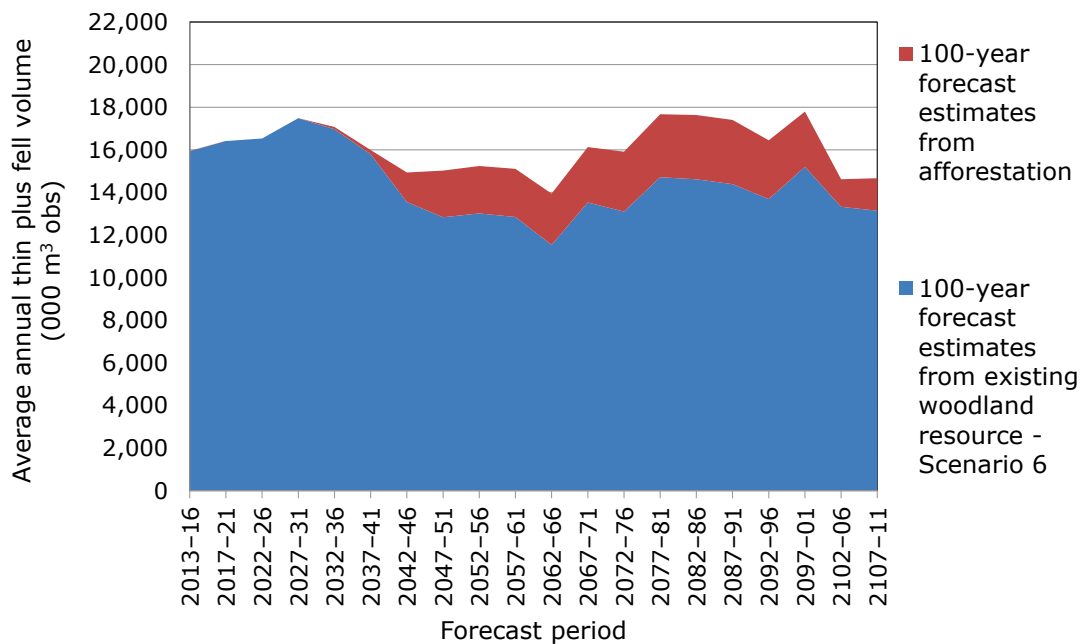


**Table 13** Scenario 8

| Forecast period | FC/NRW volume (000 m³ obs) | Private sector volume (000 m³ obs) | SE% | Total volume (000 m³ obs) | Afforestation volume (000 m³ obs) | New total volume (000 m³ obs) |
|---|---|---|---|---|---|---|
| Great Britain - softwood | | | | | | |
| 2013–16 | 6,933 | 9,005 | 4 | **15,938** | 0 | **15,938** |
| 2017–21 | 5,980 | 10,433 | 3 | **16,413** | 0 | **16,413** |
| 2022–26 | 5,622 | 10,911 | 3 | **16,532** | 0 | **16,532** |
| 2027–31 | 5,726 | 11,760 | 3 | **17,486** | 0 | **17,486** |
| 2032–36 | 5,216 | 11,752 | 3 | **16,968** | 106 | **17,074** |
| 2037–41 | 4,744 | 11,050 | 3 | **15,793** | 197 | **15,990** |
| 2042–46 | 4,316 | 9,234 | 3 | **13,550** | 1,387 | **14,937** |
| 2047–51 | 4,879 | 7,955 | 3 | **12,834** | 2,191 | **15,025** |
| 2052–56 | 4,209 | 8,806 | 3 | **13,015** | 2,226 | **15,241** |
| 2057–61 | 4,269 | 8,579 | 3 | **12,847** | 2,260 | **15,107** |
| 2062–66 | 4,840 | 6,697 | 3 | **11,537** | 2,407 | **13,944** |
| 2067–71 | 5,815 | 7,713 | 3 | **13,528** | 2,601 | **16,129** |
| 2072–76 | 5,767 | 7,334 | 3 | **13,101** | 2,812 | **15,913** |
| 2077–81 | 5,974 | 8,740 | 2 | **14,714** | 2,958 | **17,671** |
| 2082–86 | 5,879 | 8,737 | 2 | **14,617** | 3,017 | **17,634** |
| 2087–91 | 5,316 | 9,074 | 2 | **14,389** | 3,014 | **17,403** |
| 2092–96 | 4,717 | 8,970 | 2 | **13,686** | 2,761 | **16,448** |
| 2097–01 | 5,540 | 9,659 | 2 | **15,198** | 2,598 | **17,796** |
| 2102–06 | 4,221 | 9,104 | 2 | **13,325** | 1,295 | **14,620** |
| 2107–11 | 4,248 | 8,893 | 2 | **13,141** | 1,528 | **14,668** |

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## Scenario 9 – 100-year forecast of softwood availability under management with extended rotations and a **20% conversion of conifers at felling**

**Figure 9** Scenario 9
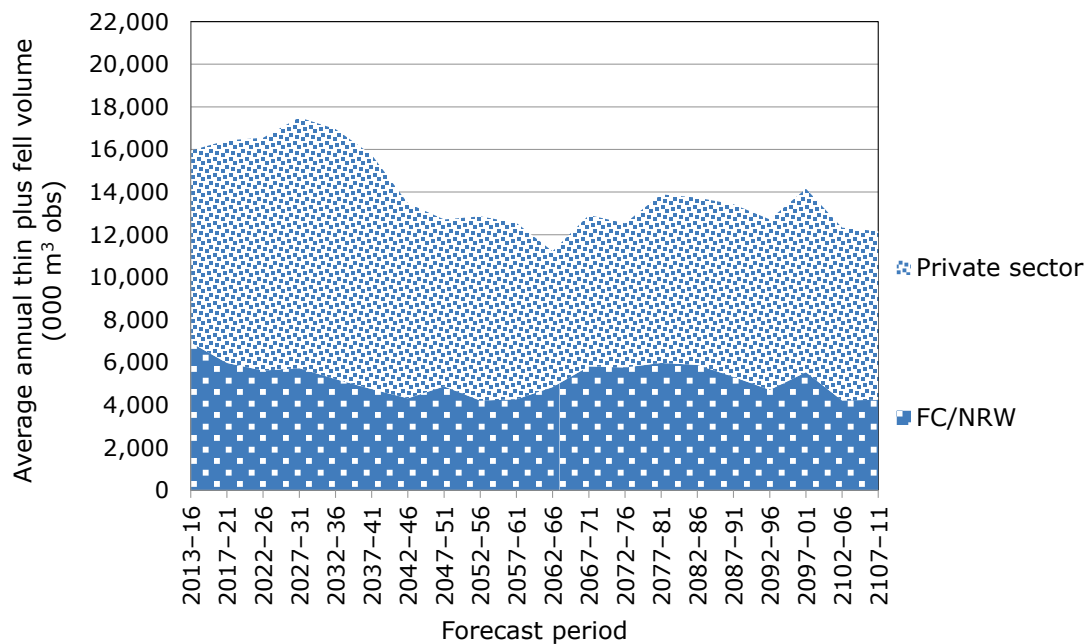


**Table 14** Scenario 9

| Forecast period | FC/NRW volume (000 m³ obs) | Private sector volume (000 m³ obs) | SE% | Total volume (000 m³ obs) |
|---|---|---|---|---|
| Great Britain - softwood | | | | |
| 2013–16 | 6,933 | 9,010 | 4 | **15,943** |
| 2017–21 | 5,980 | 10,449 | 3 | **16,429** |
| 2022–26 | 5,622 | 10,925 | 3 | **16,546** |
| 2027–31 | 5,726 | 11,775 | 3 | **17,501** |
| 2032–36 | 5,216 | 11,739 | 3 | **16,955** |
| 2037–41 | 4,744 | 11,009 | 3 | **15,752** |
| 2042–46 | 4,316 | 9,157 | 3 | **13,473** |
| 2047–51 | 4,879 | 7,836 | 3 | **12,715** |
| 2052–56 | 4,209 | 8,647 | 3 | **12,856** |
| 2057–61 | 4,269 | 8,280 | 3 | **12,548** |
| 2062–66 | 4,840 | 6,382 | 3 | **11,222** |
| 2067–71 | 5,815 | 7,102 | 3 | **12,918** |
| 2072–76 | 5,767 | 6,762 | 3 | **12,529** |
| 2077–81 | 5,974 | 7,916 | 2 | **13,889** |
| 2082–86 | 5,879 | 7,854 | 2 | **13,734** |
| 2087–91 | 5,316 | 8,107 | 2 | **13,423** |
| 2092–96 | 4,717 | 7,994 | 2 | **12,711** |
| 2097–01 | 5,540 | 8,611 | 2 | **14,151** |
| 2102–06 | 4,221 | 8,106 | 2 | **12,327** |
| 2107–11 | 4,248 | 7,913 | 2 | **12,161** |

Scenario 10 – 100-year forecast of softwood availability under management with extended rotations and a 20% conversion of conifers at felling combined with **afforestation of 6,000 hectares per annum** with all additional Sitka spruce on a 30-year rotation

**Figure 10** Scenario 10
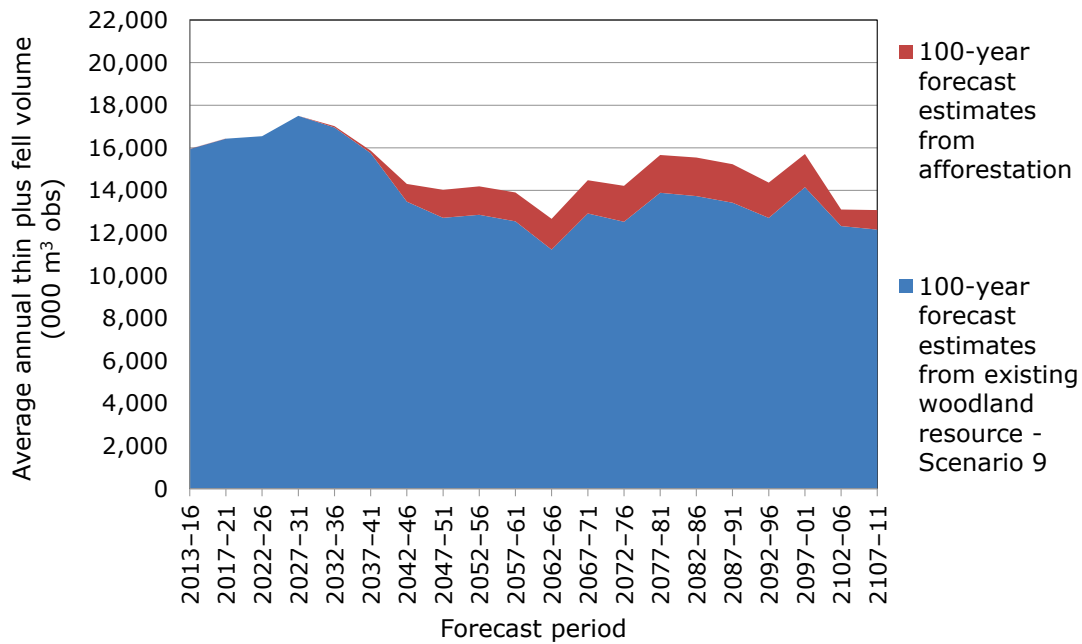


**Table 15** Scenario 10

| Forecast period | FC/NRW volume (000 m³ obs) | Private sector volume (000 m³ obs) | SE% | Total volume (000 m³ obs) | Afforestation volume (000 m³ obs) | New total volume (000 m³ obs) |
|---|---|---|---|---|---|---|
| Great Britain - softwood | | | | | | |
| 2013–16 | 6,933 | 9,010 | 4 | **15,943** | 0 | **15,943** |
| 2017–21 | 5,980 | 10,449 | 3 | **16,429** | 0 | **16,429** |
| 2022–26 | 5,622 | 10,925 | 3 | **16,546** | 0 | **16,546** |
| 2027–31 | 5,726 | 11,775 | 3 | **17,501** | 0 | **17,501** |
| 2032–36 | 5,216 | 11,739 | 3 | **16,955** | 64 | **17,018** |
| 2037–41 | 4,744 | 11,009 | 3 | **15,752** | 118 | **15,870** |
| 2042–46 | 4,316 | 9,157 | 3 | **13,473** | 832 | **14,305** |
| 2047–51 | 4,879 | 7,836 | 3 | **12,715** | 1,315 | **14,029** |
| 2052–56 | 4,209 | 8,647 | 3 | **12,856** | 1,335 | **14,191** |
| 2057–61 | 4,269 | 8,280 | 3 | **12,548** | 1,356 | **13,904** |
| 2062–66 | 4,840 | 6,382 | 3 | **11,222** | 1,444 | **12,666** |
| 2067–71 | 5,815 | 7,102 | 3 | **12,918** | 1,561 | **14,479** |
| 2072–76 | 5,767 | 6,762 | 3 | **12,529** | 1,687 | **14,216** |
| 2077–81 | 5,974 | 7,916 | 2 | **13,889** | 1,775 | **15,664** |
| 2082–86 | 5,879 | 7,854 | 2 | **13,734** | 1,810 | **15,544** |
| 2087–91 | 5,316 | 8,107 | 2 | **13,423** | 1,808 | **15,231** |
| 2092–96 | 4,717 | 7,994 | 2 | **12,711** | 1,657 | **14,367** |
| 2097–01 | 5,540 | 8,611 | 2 | **14,151** | 1,559 | **15,709** |
| 2102–06 | 4,221 | 8,106 | 2 | **12,327** | 777 | **13,104** |
| 2107–11 | 4,248 | 7,913 | 2 | **12,161** | 917 | **13,078** |

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## Comparison of scenarios to production levels in 2013

**Figure 11** 100-year forecast of softwood availability under alternative management assumptions (all ownerships) vs. current production
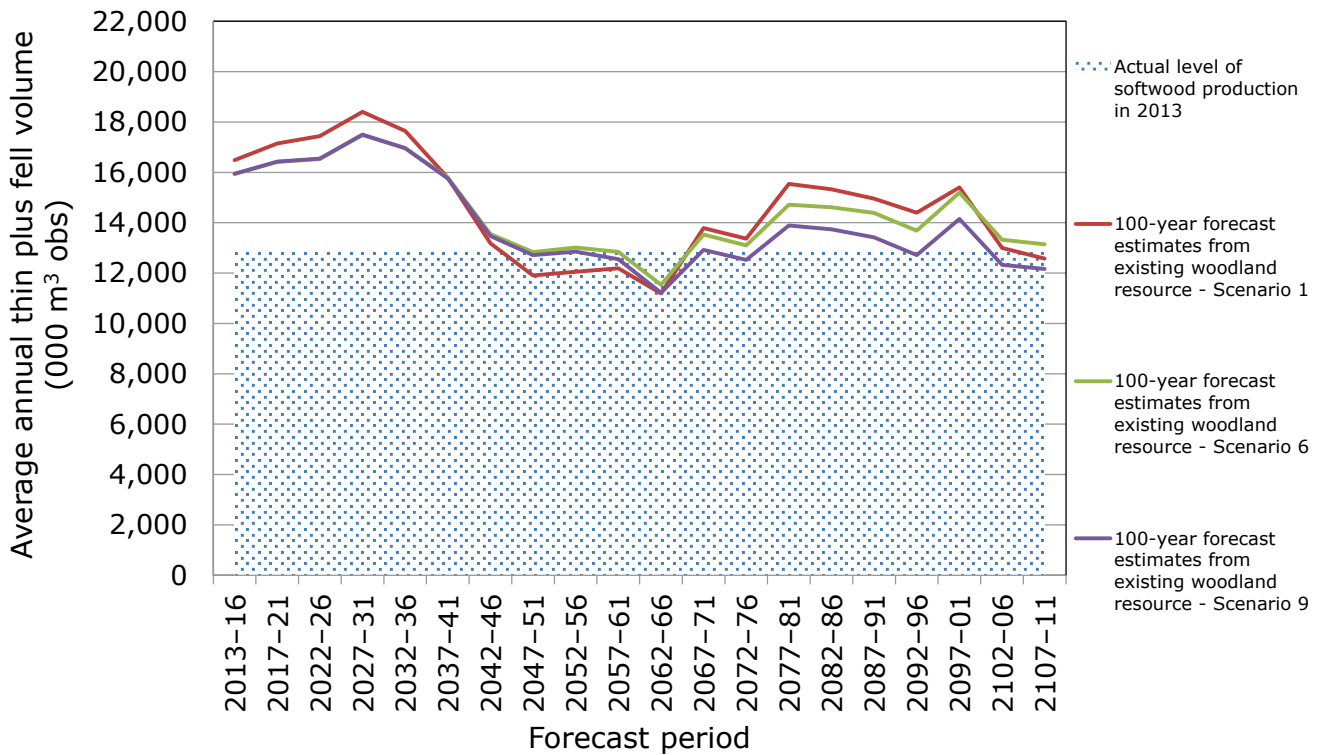
**Table 16** 100-year forecast of softwood availability under alternative management assumptions (Private sector only)

| Forecast period | FC/NRW | Private sector Scenario 1 | | Private sector Scenario 6 | | Private sector Scenario 9 | |
|---|---|---|---|---|---|---|---|
| | volume (000 m³ obs) | volume (000 m³ obs) | SE% | volume (000m³ obs) | SE% | volume (000 m³ obs) | SE% |
| Great Britain - softwood | | | | | | | |
| 2013–16 | 6,933 | 9,554 | 4 | 9,005 | 4 | 9,010 | 4 |
| 2017–21 | 5,980 | 11,171 | 4 | 10,433 | 3 | 10,449 | 3 |
| 2022–26 | 5,622 | 11,820 | 4 | 10,911 | 3 | 10,925 | 3 |
| 2027–31 | 5,726 | 12,671 | 4 | 11,760 | 3 | 11,775 | 3 |
| 2032–36 | 5,216 | 12,433 | 4 | 11,752 | 3 | 11,739 | 3 |
| 2037–41 | 4,744 | 11,035 | 4 | 11,050 | 3 | 11,009 | 3 |
| 2042–46 | 4,316 | 8,865 | 4 | 9,234 | 3 | 9,157 | 3 |
| 2047–51 | 4,879 | 7,030 | 4 | 7,955 | 3 | 7,836 | 3 |
| 2052–56 | 4,209 | 7,845 | 3 | 8,806 | 3 | 8,647 | 3 |
| 2057–61 | 4,269 | 7,924 | 3 | 8,579 | 3 | 8,280 | 3 |
| 2062–66 | 4,840 | 6,357 | 4 | 6,697 | 3 | 6,382 | 3 |
| 2067–71 | 5,815 | 7,977 | 3 | 7,713 | 3 | 7,102 | 3 |
| 2072–76 | 5,767 | 7,597 | 3 | 7,334 | 3 | 6,762 | 3 |
| 2077–81 | 5,974 | 9,567 | 3 | 8,740 | 2 | 7,916 | 2 |
| 2082–86 | 5,879 | 9,444 | 3 | 8,737 | 2 | 7,854 | 2 |
| 2087–91 | 5,316 | 9,640 | 3 | 9,074 | 2 | 8,107 | 2 |
| 2092–96 | 4,717 | 9,680 | 3 | 8,970 | 2 | 7,994 | 2 |
| 2097–01 | 5,540 | 9,865 | 3 | 9,659 | 2 | 8,611 | 2 |
| 2102–06 | 4,221 | 8,776 | 3 | 9,104 | 2 | 8,106 | 2 |
| 2107–11 | 4,248 | 8,326 | 3 | 8,893 | 2 | 7,913 | 2 |

# What the results tell us

The need for this report arose because the previously published 50-year forecast of softwood timber availability projected a profile where availability rose to a significant peak in 2027–31 of 18.4 million m$^3$ obs per annum, which was followed by a reduction in availability to 11.2 million m$^3$ obs per annum in the 2062–66 period. The purpose of this report has been to explore how alternative afforestation and harvesting scenarios would impact upon this profile and to investigate how such scenarios could inform approaches to smoothing the profile.

The timing and the quantity of softwood timber availability is driven by many factors, including:

- current woodland composition (age, size and species distributions);
- proposed management (principally harvesting);
- proposed restocking;
- treatment of the overdue resource;
- outbreaks of pests, diseases and major events such as windblow;
- proposed afforestation;
- proposed management of the afforestation.

This report provides scenarios that quantify the consequences and impacts of these factors and provides the first formal quantified estimates of the impact upon the quantity and timing of softwood timber availability arising from potential afforestation.

The report also explores, for the first time, the impact upon softwood timber availability arising from applying harvesting scenarios in which the timing of the felling of a proportion of stands is substantially varied from the age of maxMAI to both younger and older ages.

Under the alternative harvesting scenarios, the long-term pattern of softwood availability remains broadly similar, peaking in the period 2027–31 then declining until the period 2062–66 before rising again. However, the amplitude of this wave-like profile is typically lessened by the alternative prescriptions investigated in this report.

One of the alternative scenarios for the management of the current resource (Scenario 6) extends the rotation length for 15% of the conifer area on a continuing basis over the forecast period, creating a moderately smoother profile of softwood timber availability. The peak is reduced from an average of 18.4 million m$^3$ obs per annum to an average of 17.5 million m$^3$ obs per annum in the period 2027–31. The

lowest average annual volume increases from 11.2 million m$^3$ obs to 11.5 million m$^3$ obs in the period 2062–66.

It is not unreasonable to assume that 15% of stands will follow this pattern since this corresponds to the current proportion of stands that are overdue. Historical levels of actual production compared to forecast production also imply that such harvesting strategies have been employed in the past.

Levels of afforestation also have an impact on the long-term amount and profile of softwood availability. The size of the impact is entirely proportional to the rate of afforestation and an afforestation programme of 6,000 hectares per annum would significantly boost future availability, raising availability during the period 2070–90 by around 3 million m$^3$ obs per annum.

From the point of view of using afforestation as a means of mitigation of the trough in availability predicted from the evolution of the current resource, the management of the additional crop arising from afforestation is of critical importance. Management using the more 'standard' approaches of the 'headline' forecast scenario of the additional resource leads to enhanced levels of availability mainly after the trough in availability from the current resource has passed (Scenarios 2 and 3), creating availability later in time. By alternatively felling the Sitka spruce in the newly afforested areas at an earlier age, using a 30-year rotation length, the additional availability largely coincides with the trough expected from the current resource, thus noticeably raising total availability through this period (Scenarios 4 and 5). For example, in Scenario 5, the annual availability during the 20-year period 2047–66, corresponding to the period of lowest availability from the current resource under 'standard' management, is increased by an annual average of 2.3 million m$^3$ obs.

Again, this is not an unrealistic assumption since current age profiles observed in NFI survey data, interpreted in conjunction with historical planting trends, indicates that a significant proportion of Sitka spruce is currently harvested on such shorter rotations. Projecting such practice into the future is therefore not an unrealistic assumption.

Scenario 8 provides the results from combining the impacts discussed above by illustrating the scenario where:

- 15% of stands are felled beyond age of maxMAI;
- there is afforestation of 10,000 hectares of productive conifer per annum;
- Sitka spruce planted in newly afforested areas is felled at age of 30.

Under this scenario, average annual availability across the 20-year period 2047–66 is 14.8 million m$^3$ obs, which is almost 3 million m$^3$ obs per annum more than that projected by the 'headline' forecast at 11.8 million m$^3$ obs per annum (Scenario 1).

Clearly it is entirely speculative that the evolution of the creation and management of the resource will occur in such a way as to smooth the availability profile to the extent shown in Scenario 8, but the assumed underlying treatment of the resource does have some basis in practice to date and is not therefore an unreasonable projection of future management practices. Put another way, if we project forward the current policies for planting together with the current industry practice concerning rotation lengths, it is possible that the impacts on future availability patterns over time examined in this report may come to pass.

The forecasts included in this report are based on theoretical scenarios in which afforestation, restocking and time of harvest are examined. There are a large number of things which will affect the actual rates of these factors. These include government policy, market drivers, land availability and trends in agriculture. Choices made by policy-makers and the market will determine how and to what extent these factors develop and evolve and ultimately will dictate the actual profile of timber production in GB.

In future an additional scenario based upon actual levels of thinning, felling, restocking and new planting between 2010 and 2020 will be possible. This will utilise evidence gained from the comparison of field samples taken in both the first and second cycles of the NFI survey programme.

# Appendix A – Additional estimates for Scotland

This appendix explores the impacts of afforestation on the long-term forecast of softwood timber availability from woodlands in Scotland.

The scenarios reported here have been prepared in a similar manner to the scenarios presented in the main body of the report with the exception that the afforestation is assumed to take place over a 10-year rather than a 30-year period. The results are restricted to Scotland.

Scenario A1 is a reproduction of the 'headline' scenario for Scotland from the earlier report *50-year forecast of softwood availability* (2014) while Scenarios A2, A3 and A4 show the results on future availability of adding further resource through afforestation schemes at different rates of establishment, in a similar manner to Scenarios 2 and 3 in the main report.

Scenario A5 looks at the impact of combining shorter rotations for the Sitka spruce planted as part of the afforestation in a similar manner to Scenarios 4 and 5 in the main report.

Scenario A6 reports the forecast for Scotland when extended rotations are applied to a proportion of the existing woodland, in a similar manner to Scenario 6 in the main report.

Scenario A7 combines the alternative forecast with extended rotation for existing woodland management and afforestation with shortened rotation lengths for Sitka spruce, similar to Scenario 7 in the main report.

**Table A1** Summary of scenarios for long-term softwood timber availability

| Scenario | Existing woodland management (Private sector) | Afforestation | |
|---|---|---|---|
| | | Annual area (ha per annum) | Rotation length |
| A1 | Modified biological potential 10% conifer felling converted to broadleaves and open space[a] | 0 | - |
| A2 | Modified biological potential 10% conifer felling converted to broadleaves and open space[a] | 2,000[c] | maxMAI[f] |

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| Scenario | Existing woodland management (Private sector) | Afforestation | |
| --- | --- | --- | --- |
| | | Annual area (ha per annum) | Rotation length |
| A3 | Modified biological potential 10% conifer felling converted to broadleaves and open space[a] | 3,000[d] | maxMAI[f] |
| A4 | Modified biological potential 10% conifer felling converted to broadleaves and open space[a] | 6,000[e] | maxMAI[f] |
| A5 | Modified biological potential 10% conifer felling converted to broadleaves and open space[a] | 6,000[e] | SS 30 years Other species maxMAI[g] |
| A6 | Extended rotations 10% conifer felling converted to broadleaves and open space[b] | 0 | - |
| A7 | Extended rotations 10% conifer felling converted to broadleaves and open space[b] | 6,000[e] | SS 30 years Other species maxMAI[g] |

| maxMAI | maximum mean annual increment |
| --- | --- |
| SS | Sitka spruce |
| a | Scotland existing woodland management option 1 (as GB existing woodland management option 1). |
| b | Scotland existing woodland management option 2 (as GB existing woodland management option 2). |
| c | Scotland afforestation area option 1. |
| d | Scotland afforestation area option 2. |
| e | Scotland afforestation area option 3. |
| f | Scotland afforestation rotation length option 1 (as GB afforestation rotation length option 1). |
| g | Scotland afforestation rotation length option 2 (as GB afforestation rotation length option 2). |

## Scenario A1 – 100-year forecast of softwood availability under modified biological potential management assumptions with a 10% conversion of conifers at felling (published 'headline' forecast)

**Figure A1** Scenario A1
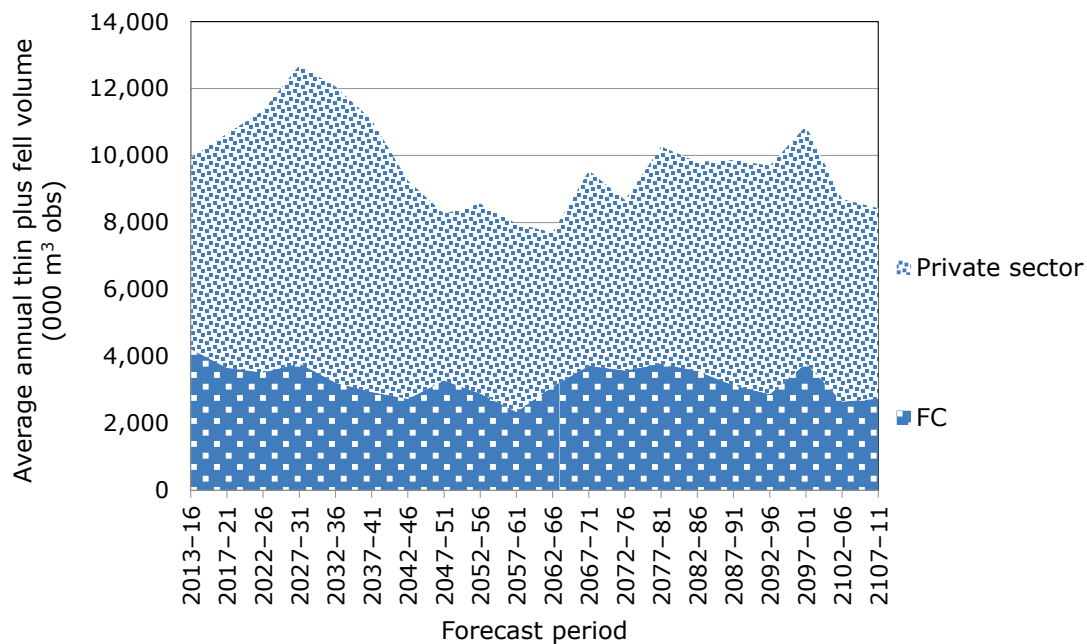


**Table A2** Scenario A1

| Forecast period | FC | Private sector | | Total |
|---|---|---|---|---|
| | volume (000 m³ obs) | volume (000 m³ obs) | *SE%* | volume (000 m³ obs) |
| Scotland - softwood | | | | |
| 2013–16 | 4,220 | 5,708 | 5 | **9,928** |
| 2017–21 | 3,658 | 6,997 | 5 | **10,656** |
| 2022–26 | 3,516 | 7,830 | 5 | **11,346** |
| 2027–31 | 3,789 | 8,910 | 5 | **12,700** |
| 2032–36 | 3,215 | 8,847 | 5 | **12,062** |
| 2037–41 | 2,936 | 8,133 | 5 | **11,069** |
| 2042–46 | 2,730 | 6,527 | 5 | **9,257** |
| 2047–51 | 3,280 | 4,986 | 5 | **8,266** |
| 2052–56 | 2,886 | 5,679 | 4 | **8,566** |
| 2057–61 | 2,339 | 5,627 | 4 | **7,966** |
| 2062–66 | 3,101 | 4,599 | 5 | **7,700** |
| 2067–71 | 3,719 | 5,833 | 4 | **9,552** |
| 2072–76 | 3,577 | 5,098 | 4 | **8,675** |
| 2077–81 | 3,784 | 6,486 | 4 | **10,270** |
| 2082–86 | 3,561 | 6,256 | 4 | **9,817** |
| 2087–91 | 3,132 | 6,738 | 4 | **9,869** |
| 2092–96 | 2,874 | 6,827 | 4 | **9,701** |
| 2097–01 | 3,788 | 7,097 | 4 | **10,885** |
| 2102–06 | 2,649 | 6,051 | 4 | **8,701** |
| 2107–11 | 2,738 | 5,694 | 4 | **8,432** |

Scenario A2 – 100-year forecast of softwood availability under modified biological potential management assumptions with a 10% conversion of conifers at felling combined with **afforestation of 2,000 hectares per annum** also under modified biological potential management assumptions

**Figure A2** Scenario A2



**Table A3** Scenario A2

| Forecast period | FC volume (000 m³ obs) | Private sector volume (000 m³ obs) | SE% | Total volume (000 m³ obs) | Afforestation volume (000 m³ obs) | New total volume (000 m³ obs) |
|---|---|---|---|---|---|---|
| Scotland - softwood | | | | | | |
| 2013–16 | 4,220 | 5,708 | 5 | **9,928** | 0 | **9,928** |
| 2017–21 | 3,658 | 6,997 | 5 | **10,656** | 0 | **10,656** |
| 2022–26 | 3,516 | 7,830 | 5 | **11,346** | 0 | **11,346** |
| 2027–31 | 3,789 | 8,910 | 5 | **12,700** | 0 | **12,700** |
| 2032–36 | 3,215 | 8,847 | 5 | **12,062** | 21 | **12,084** |
| 2037–41 | 2,936 | 8,133 | 5 | **11,069** | 61 | **11,130** |
| 2042–46 | 2,730 | 6,527 | 5 | **9,257** | 82 | **9,338** |
| 2047–51 | 3,280 | 4,986 | 5 | **8,266** | 84 | **8,350** |
| 2052–56 | 2,886 | 5,679 | 4 | **8,566** | 84 | **8,650** |
| 2057–61 | 2,339 | 5,627 | 4 | **7,966** | 84 | **8,050** |
| 2062–66 | 3,101 | 4,599 | 5 | **7,700** | 389 | **8,088** |
| 2067–71 | 3,719 | 5,833 | 4 | **9,552** | 764 | **10,317** |
| 2072–76 | 3,577 | 5,098 | 4 | **8,675** | 582 | **9,257** |
| 2077–81 | 3,784 | 6,486 | 4 | **10,270** | 200 | **10,470** |
| 2082–86 | 3,561 | 6,256 | 4 | **9,817** | 55 | **9,871** |
| 2087–91 | 3,132 | 6,738 | 4 | **9,869** | 25 | **9,894** |
| 2092–96 | 2,874 | 6,827 | 4 | **9,701** | 27 | **9,728** |
| 2097–01 | 3,788 | 7,097 | 4 | **10,885** | 60 | **10,945** |
| 2102–06 | 2,649 | 6,051 | 4 | **8,701** | 79 | **8,780** |
| 2107–11 | 2,738 | 5,694 | 4 | **8,432** | 81 | **8,513** |

Scenario A3 – 100-year forecast of softwood availability under modified biological potential management assumptions with a 10% conversion of conifers at felling combined with afforestation **of 3,000 hectares per annum** also under modified biological potential management assumptions
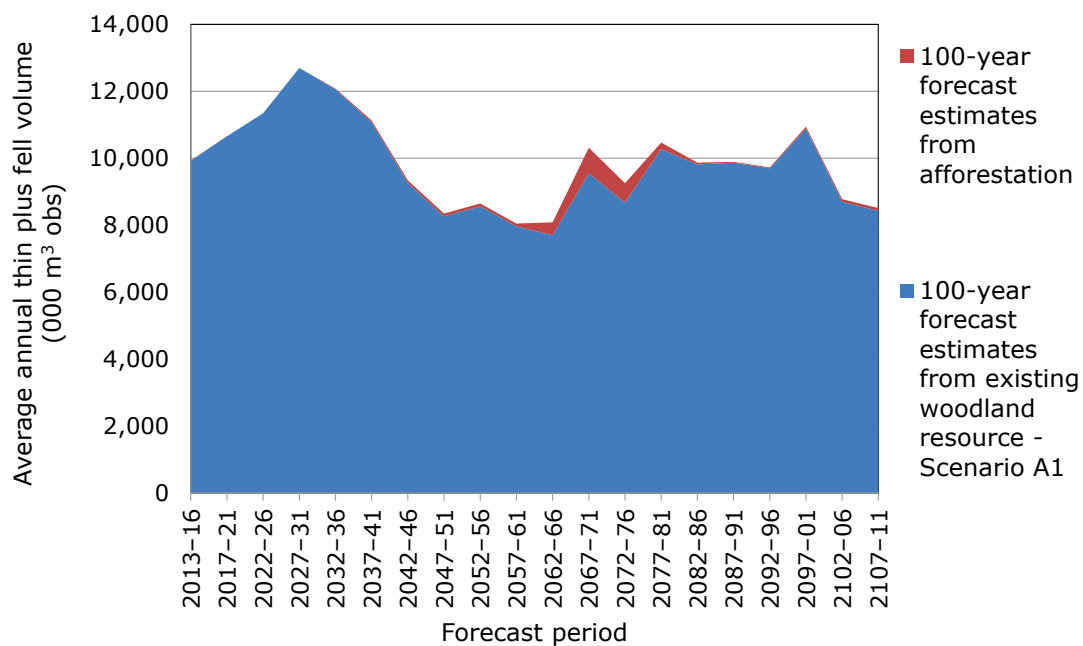
**Figure A3**  Scenario A3



**Table A4**  Scenario A3

| Forecast period | FC volume (000 m³ obs) | Private sector volume (000 m³ obs) | SE% | Total volume (000 m³ obs) | Afforestation volume (000 m³ obs) | New total volume (000 m³ obs) |
|---|---|---|---|---|---|---|
| Scotland - softwood | | | | | | |
| 2013–16 | 4,220 | 5,708 | 5 | **9,928** | 0 | **9,928** |
| 2017–21 | 3,658 | 6,997 | 5 | **10,656** | 0 | **10,656** |
| 2022–26 | 3,516 | 7,830 | 5 | **11,346** | 0 | **11,346** |
| 2027–31 | 3,789 | 8,910 | 5 | **12,700** | 0 | **12,700** |
| 2032–36 | 3,215 | 8,847 | 5 | **12,062** | 32 | **12,094** |
| 2037–41 | 2,936 | 8,133 | 5 | **11,069** | 91 | **11,160** |
| 2042–46 | 2,730 | 6,527 | 5 | **9,257** | 122 | **9,379** |
| 2047–51 | 3,280 | 4,986 | 5 | **8,266** | 126 | **8,392** |
| 2052–56 | 2,886 | 5,679 | 4 | **8,566** | 126 | **8,692** |
| 2057–61 | 2,339 | 5,627 | 4 | **7,966** | 126 | **8,092** |
| 2062–66 | 3,101 | 4,599 | 5 | **7,700** | 583 | **8,283** |
| 2067–71 | 3,719 | 5,833 | 4 | **9,552** | 1,146 | **10,699** |
| 2072–76 | 3,577 | 5,098 | 4 | **8,675** | 872 | **9,548** |
| 2077–81 | 3,784 | 6,486 | 4 | **10,270** | 300 | **10,570** |
| 2082–86 | 3,561 | 6,256 | 4 | **9,817** | 82 | **9,899** |
| 2087–91 | 3,132 | 6,738 | 4 | **9,869** | 37 | **9,907** |
| 2092–96 | 2,874 | 6,827 | 4 | **9,701** | 41 | **9,742** |
| 2097–01 | 3,788 | 7,097 | 4 | **10,885** | 90 | **10,975** |
| 2102–06 | 2,649 | 6,051 | 4 | **8,701** | 119 | **8,820** |
| 2107–11 | 2,738 | 5,694 | 4 | **8,432** | 122 | **8,554** |

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Scenario A4 – 100-year forecast of softwood availability under modified biological potential management assumptions with a 10% conversion of conifers at felling combined with **afforestation of 6,000 hectares per annum** also under modified biological potential management assumptions
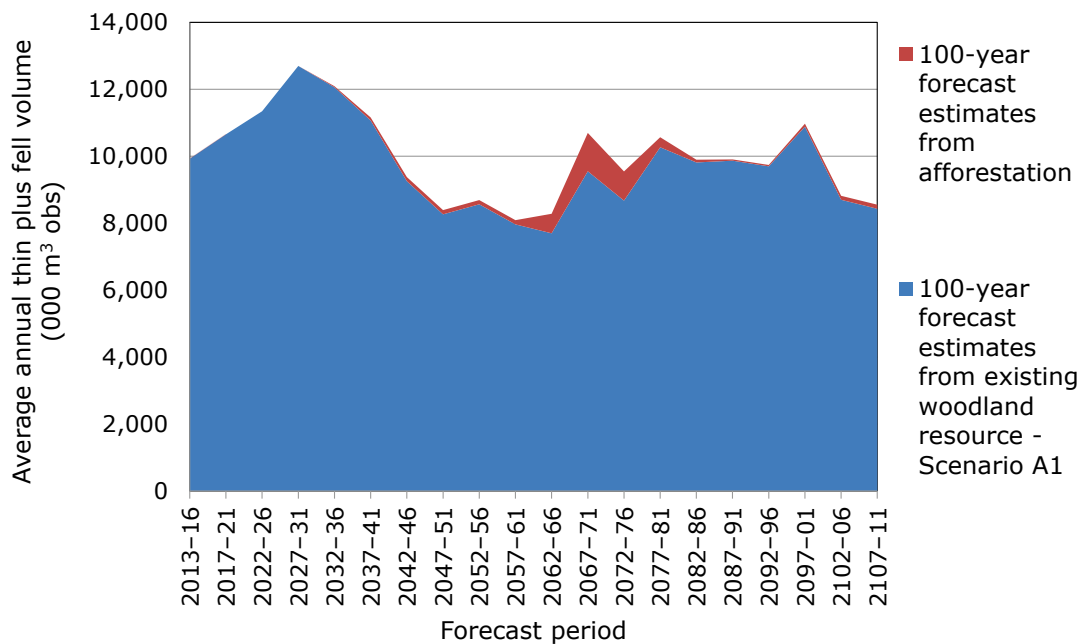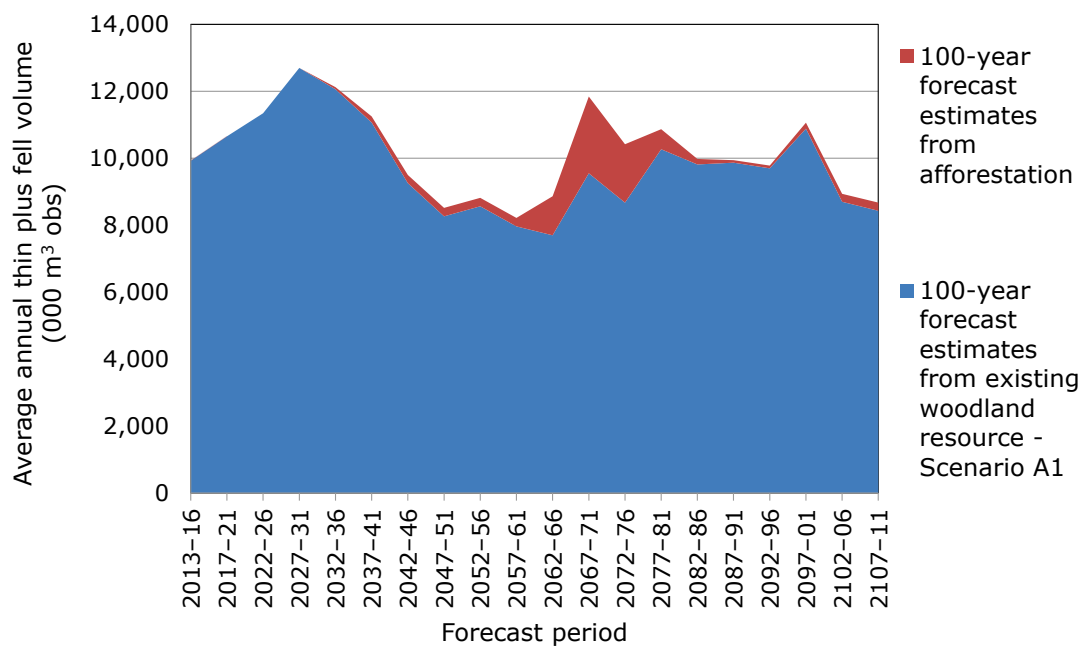
**Figure A4**  Scenario A4



**Table A5**  Scenario A4

| Forecast period | FC volume (000 m$^3$ obs) | Private sector volume (000 m$^3$ obs) | SE% | Total volume (000 m$^3$ obs) | Afforestation volume (000 m$^3$ obs) | New total volume (000 m$^3$ obs) |
|---|---|---|---|---|---|---|
| Scotland - softwood | | | | | | |
| 2013–16 | 4,220 | 5,708 | 5 | **9,928** | 0 | **9,928** |
| 2017–21 | 3,658 | 6,997 | 5 | **10,656** | 0 | **10,656** |
| 2022–26 | 3,516 | 7,830 | 5 | **11,346** | 0 | **11,346** |
| 2027–31 | 3,789 | 8,910 | 5 | **12,700** | 0 | **12,700** |
| 2032–36 | 3,215 | 8,847 | 5 | **12,062** | 64 | **12,126** |
| 2037–41 | 2,936 | 8,133 | 5 | **11,069** | 182 | **11,251** |
| 2042–46 | 2,730 | 6,527 | 5 | **9,257** | 245 | **9,501** |
| 2047–51 | 3,280 | 4,986 | 5 | **8,266** | 253 | **8,519** |
| 2052–56 | 2,886 | 5,679 | 4 | **8,566** | 253 | **8,819** |
| 2057–61 | 2,339 | 5,627 | 4 | **7,966** | 253 | **8,219** |
| 2062–66 | 3,101 | 4,599 | 5 | **7,700** | 1,166 | **8,866** |
| 2067–71 | 3,719 | 5,833 | 4 | **9,552** | 2,293 | **11,845** |
| 2072–76 | 3,577 | 5,098 | 4 | **8,675** | 1,745 | **10,420** |
| 2077–81 | 3,784 | 6,486 | 4 | **10,270** | 600 | **10,869** |
| 2082–86 | 3,561 | 6,256 | 4 | **9,817** | 164 | **9,981** |
| 2087–91 | 3,132 | 6,738 | 4 | **9,869** | 75 | **9,944** |
| 2092–96 | 2,874 | 6,827 | 4 | **9,701** | 82 | **9,782** |
| 2097–01 | 3,788 | 7,097 | 4 | **10,885** | 179 | **11,064** |
| 2102–06 | 2,649 | 6,051 | 4 | **8,701** | 238 | **8,938** |
| 2107–11 | 2,738 | 5,694 | 4 | **8,432** | 244 | **8,676** |

## Scenario A5 – 100-year forecast of softwood availability under modified biological potential management assumptions with a 10% conversion of conifers at felling combined with afforestation of 6,000 hectares per annum with all **additional Sitka spruce on a 30-year rotation**
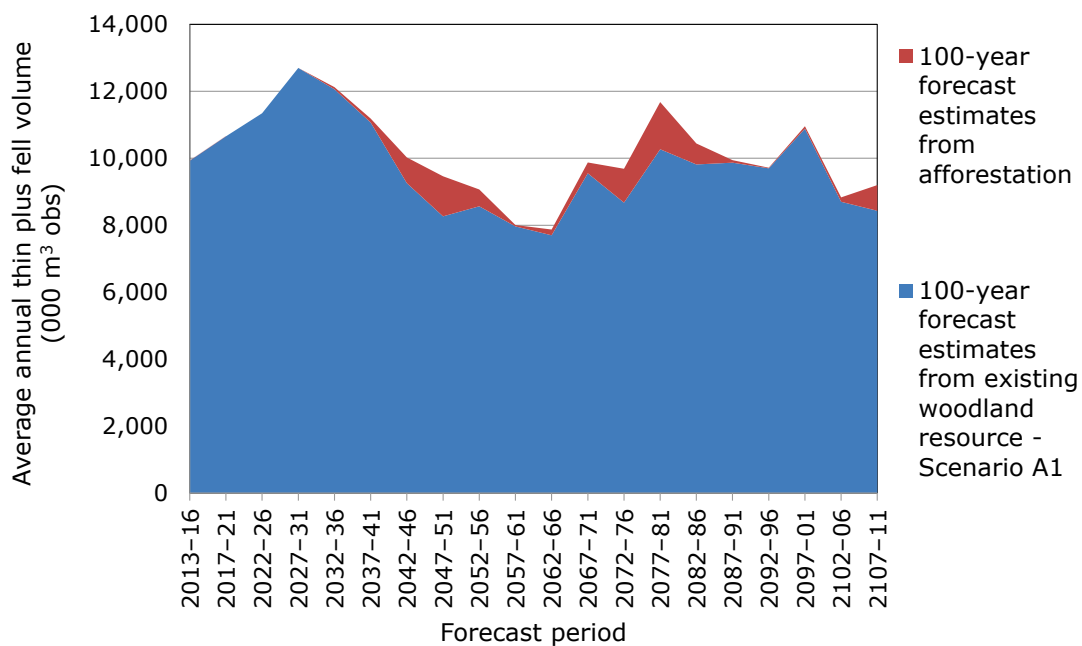
**Figure A5**  Scenario A5



**Table A6**  Scenario A5

| Forecast period | FC volume (000 m³ obs) | Private sector volume (000 m³ obs) | SE% | Total volume (000 m³ obs) | Afforestation volume (000 m³ obs) | New total volume (000 m³ obs) |
|---|---|---|---|---|---|---|
| Scotland - softwood | | | | | | |
| 2013–16 | 4,220 | 5,708 | 5 | **9,928** | 0 | **9,928** |
| 2017–21 | 3,658 | 6,997 | 5 | **10,656** | 0 | **10,656** |
| 2022–26 | 3,516 | 7,830 | 5 | **11,346** | 0 | **11,346** |
| 2027–31 | 3,789 | 8,910 | 5 | **12,700** | 0 | **12,700** |
| 2032–36 | 3,215 | 8,847 | 5 | **12,062** | 64 | **12,126** |
| 2037–41 | 2,936 | 8,133 | 5 | **11,069** | 118 | **11,187** |
| 2042–46 | 2,730 | 6,527 | 5 | **9,257** | 769 | **10,025** |
| 2047–51 | 3,280 | 4,986 | 5 | **8,266** | 1,197 | **9,463** |
| 2052–56 | 2,886 | 5,679 | 4 | **8,566** | 503 | **9,069** |
| 2057–61 | 2,339 | 5,627 | 4 | **7,966** | 41 | **8,007** |
| 2062–66 | 3,101 | 4,599 | 5 | **7,700** | 172 | **7,872** |
| 2067–71 | 3,719 | 5,833 | 4 | **9,552** | 323 | **9,875** |
| 2072–76 | 3,577 | 5,098 | 4 | **8,675** | 1,012 | **9,687** |
| 2077–81 | 3,784 | 6,486 | 4 | **10,270** | 1,410 | **11,680** |
| 2082–86 | 3,561 | 6,256 | 4 | **9,817** | 626 | **10,443** |
| 2087–91 | 3,132 | 6,738 | 4 | **9,869** | 75 | **9,944** |
| 2092–96 | 2,874 | 6,827 | 4 | **9,701** | 18 | **9,719** |
| 2097–01 | 3,788 | 7,097 | 4 | **10,885** | 73 | **10,959** |
| 2102–06 | 2,649 | 6,051 | 4 | **8,701** | 132 | **8,833** |
| 2107–11 | 2,738 | 5,694 | 4 | **8,432** | 768 | **9,200** |

## Scenario A6 – 100-year forecast of softwood availability under management with **extended rotations** and a 10% conversion of conifers at felling
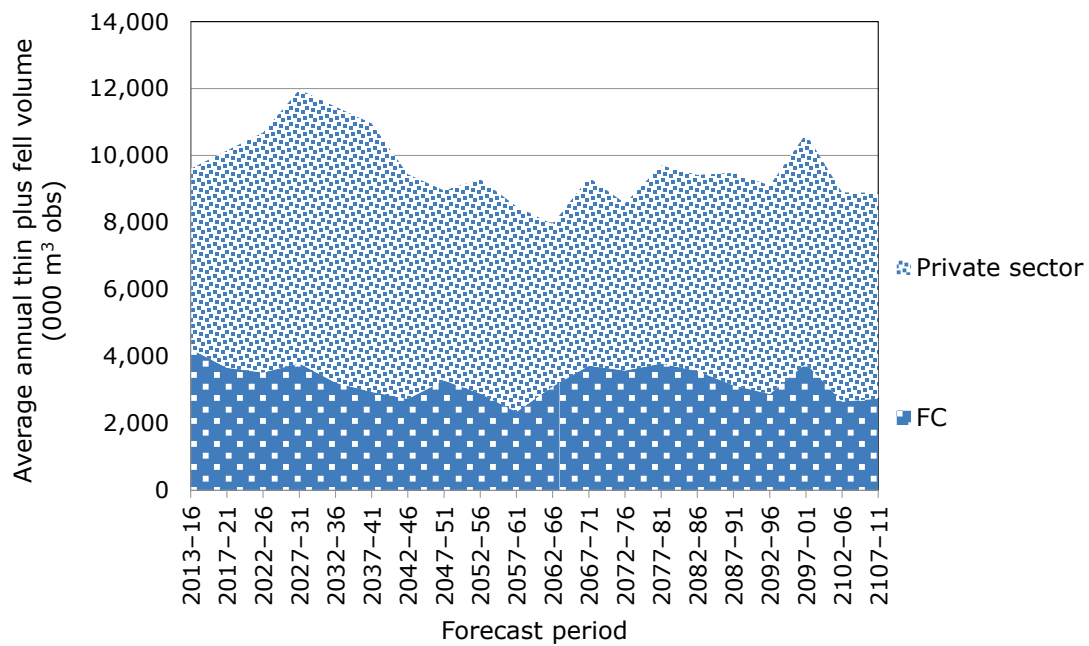
**Figure A6**  Scenario A6



**Table A7**  Scenario A6

| Forecast period | FC | Private sector | | Total |
| | volume (000 m³ obs) | volume (000 m³ obs) | SE% | volume (000 m³ obs) |
|---|---|---|---|---|
| Scotland - softwood | | | | |
| 2013–16 | 4,220 | 5,386 | 5 | **9,605** |
| 2017–21 | 3,658 | 6,492 | 4 | **10,150** |
| 2022–26 | 3,516 | 7,174 | 5 | **10,690** |
| 2027–31 | 3,789 | 8,181 | 4 | **11,970** |
| 2032–36 | 3,215 | 8,243 | 4 | **11,458** |
| 2037–41 | 2,936 | 8,022 | 4 | **10,958** |
| 2042–46 | 2,730 | 6,712 | 4 | **9,442** |
| 2047–51 | 3,280 | 5,675 | 4 | **8,955** |
| 2052–56 | 2,886 | 6,405 | 3 | **9,292** |
| 2057–61 | 2,339 | 6,145 | 3 | **8,485** |
| 2062–66 | 3,101 | 4,852 | 4 | **7,953** |
| 2067–71 | 3,719 | 5,625 | 3 | **9,344** |
| 2072–76 | 3,577 | 4,998 | 3 | **8,575** |
| 2077–81 | 3,784 | 5,922 | 3 | **9,706** |
| 2082–86 | 3,561 | 5,862 | 3 | **9,422** |
| 2087–91 | 3,132 | 6,350 | 3 | **9,482** |
| 2092–96 | 2,874 | 6,233 | 3 | **9,107** |
| 2097–01 | 3,788 | 6,862 | 3 | **10,651** |
| 2102–06 | 2,649 | 6,251 | 3 | **8,900** |
| 2107–11 | 2,738 | 6,153 | 3 | **8,892** |

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Scenario A7 – 100-year forecast of softwood availability under management with extended rotations and a 10% conversion of conifers at felling combined with **afforestation of 6,000 hectares per annum** with all additional Sitka spruce on a 30-year rotation
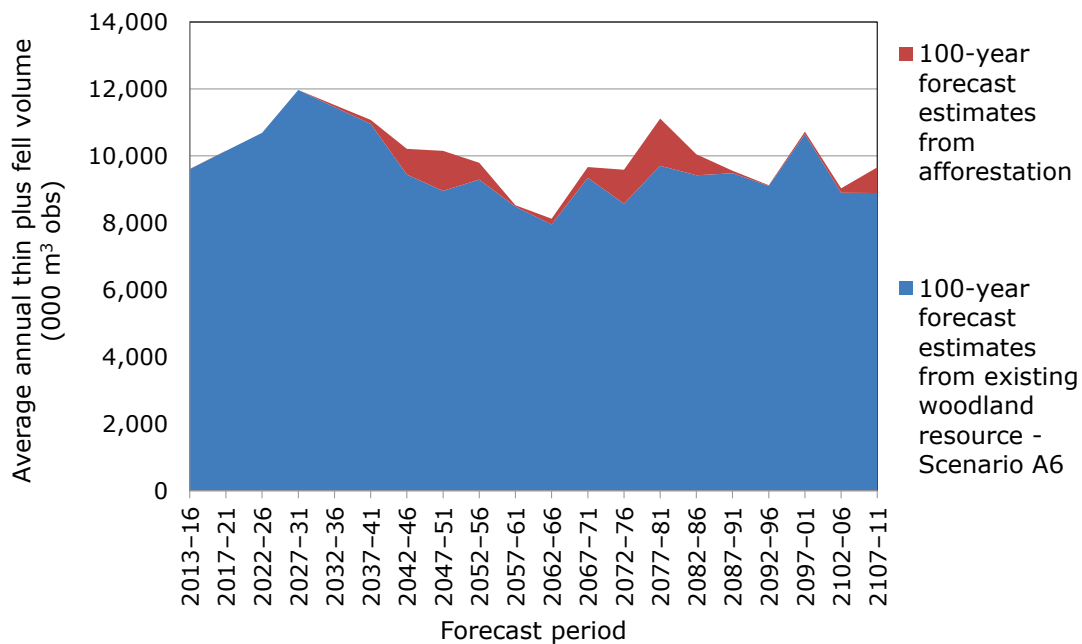
**Figure A7**  Scenario A7



**Table A8**  Scenario A7

| Forecast period | FC | Private sector | | Total | Afforestation | New total |
|---|---|---|---|---|---|---|
| | volume (000 m³ obs) | volume (000 m³ obs) | SE% | volume (000 m³ obs) | volume (000 m³ obs) | volume (000 m³ obs) |
| Scotland - softwood | | | | | | |
| 2013–16 | 4,220 | 5,386 | 5 | **9,605** | 0 | **9,605** |
| 2017–21 | 3,658 | 6,492 | 4 | **10,150** | 0 | **10,150** |
| 2022–26 | 3,516 | 7,174 | 5 | **10,690** | 0 | **10,690** |
| 2027–31 | 3,789 | 8,181 | 4 | **11,970** | 0 | **11,970** |
| 2032–36 | 3,215 | 8,243 | 4 | **11,458** | 64 | **11,522** |
| 2037–41 | 2,936 | 8,022 | 4 | **10,958** | 118 | **11,077** |
| 2042–46 | 2,730 | 6,712 | 4 | **9,442** | 769 | **10,211** |
| 2047–51 | 3,280 | 5,675 | 4 | **8,955** | 1,197 | **10,151** |
| 2052–56 | 2,886 | 6,405 | 3 | **9,292** | 503 | **9,795** |
| 2057–61 | 2,339 | 6,145 | 3 | **8,485** | 41 | **8,526** |
| 2062–66 | 3,101 | 4,852 | 4 | **7,953** | 172 | **8,125** |
| 2067–71 | 3,719 | 5,625 | 3 | **9,344** | 323 | **9,667** |
| 2072–76 | 3,577 | 4,998 | 3 | **8,575** | 1,012 | **9,587** |
| 2077–81 | 3,784 | 5,922 | 3 | **9,706** | 1,410 | **11,116** |
| 2082–86 | 3,561 | 5,862 | 3 | **9,422** | 626 | **10,048** |
| 2087–91 | 3,132 | 6,350 | 3 | **9,482** | 75 | **9,556** |
| 2092–96 | 2,874 | 6,233 | 3 | **9,107** | 18 | **9,125** |
| 2097–01 | 3,788 | 6,862 | 3 | **10,651** | 73 | **10,724** |
| 2102–06 | 2,649 | 6,251 | 3 | **8,900** | 132 | **9,032** |
| 2107–11 | 2,738 | 6,153 | 3 | **8,892** | 768 | **9,660** |

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# NFI national reports and papers

The principal themes reported on for the 2011 woodland profile and future forecasts are:

- 2011 preliminary estimates of broadleaved species in British woodlands
- 2011 standing coniferous timber volume
- 25-year forecast of softwood availability
- 25-year forecast of coniferous standing volume and increment
- 2011 biomass in live woodland trees in Britain
- 2011 carbon in live woodland trees in Britain

The principal themes reported on for the 2012 woodland profile and future forecasts are:

- 50-year forecast of hardwood availability
- 50-year forecast of softwood availability

Each theme has a series of associated reports, papers and data, tailored for different audiences and uses. All the documents and data can be found on the NFI website www.forestry.gov.uk/inventory.

# Glossary

A glossary of terms is presented in the full suite of forecast reports which can be found at www.forestry.gov.uk/forecast.