Forestry Commission Forecast Technical Document

Growing Stock Volume Forecasts

A document describing how growing stock ('standing') volume is handled in the 2011 Production Forecast.

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Background

A forecast of standing volume (or of growing stock) is a fundamental output of the forecast system, consisting of estimated growing stock volume over time.

Growing stock volume forecasts have many applications, notably:

- Growing stock volume is the main measure used in international reporting of estimates of growing stock. Ideally growing stock estimates are based directly on national inventory assessments taken for an appropriate base year. When growing stock estimates are needed for years falling between inventory base years, adjustments to allow for stand growth and removals need to be made to growing stock volume estimates.
- Growing stock volume is usually the measure from which estimates of increment are derived.
- Growing stock forecasts, in conjunction with removals and increment forecasts, are a strategic measure of the sustainability of intended forest management.
- Forecasts of growing stock volume are needed as a component in the calculation of standing biomass and carbon (see relevant documents).
- Forecasts of growing stock volume will be required, to IAS 41 Agriculture standards[1], by the Office for National Statistics for inclusion as ‘natural capital’ in the annual statement of UK Environmental Accounts, as detailed in the UK Government’s White Paper “The Natural Choice: securing the value of nature” (published 7th June 2011).

The calculation of a growing stock volume forecast involves 4 data sets:

- Data on areas of forest in terms of species composition, growth rates, stocking and age distribution.
- Data describing the intended management of forest areas.
- Estimates of stand growth and yield under different management regimes (usually obtained from models).
- A set of parameters to “control” the forecast, *e.g.* to specify the period over which the forecast is calculated and reported.

Appendix 1 contains a detailed example of how these data are used to calculate a growing stock volume forecast for a forest component.

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1 International Accounting Standard 41 Agriculture.

A separate document will describe major variations in the calculations given in Appendix 1 due to data and parameter settings *e.g.* thinning or no thinning, management coupe type.

For the Public Forest Estate (PFE), the required data sets are obtained from the Forester database (the SCDB), with controlling parameters from the Forecast Wizard. For private woodlands, forecasting involves a more complex procedure based on National Forest Inventory (NFI) survey squares and a 'bulking up' procedure (documented elsewhere) requiring reference to the NFI woodland map. Forecasting for private woodlands also uses a bespoke NFI forecast wizard.

Growing stock volume is calculated at a sub-component level and amalgamated across the forecast extent. Appendix 2 indicates how different Forestry Commission SCDB land-use codes are to be treated in the growing stock volume forecast while Appendix 3 provides similar information for NFI component types.

Forecast Types

It is possible to make very different assumptions about intended management of forest areas, depending on the purpose of the forecast. Different 'Forecast Types' can be specified addressing the main applications of forecasting.

The Forecast Wizard in Forester allows for six types of forecast, namely:

- Zero Intervention Forecast;
- Biological Potential Forecast;
- Strategic Regional Forecast;
- Management Plans Forecast;
- Target Assortments Forecast; and
- Quick Forecast.

Full details of these forecast types, including simple examples, can be found in the document '*Forecast Types*'.

The calculation of growing stock volume will be handled differently for each of these forecast types. Growing stock volume is calculated by the forecast system according to the detailed requirements of each Forecast Type, and is reported accordingly (see Appendix 2 for a summary relating to the Public Forest Estate land-use codes, Appendix 3 for a summary relating to NFI component types).

Restocking in the forecast

Standard forecasts usually cover a period of 20 years and it is unlikely that any sub-components re-stocked during the standard forecast period would have any further substantive volume production associated. However, forecasts for longer periods may be required, and these will need to include estimates of growing stock volume from any restock areas which contain trees achieving 7 cm diameter at breast height within the period of the forecast.

The processes by which restocking is handled by the forecast system can be found in the document '*Restocking in the Forecast*'.

Historical growing stock volume (Hindcasting)

In some situations it is necessary to estimate historical growing stock volume (hindcasting) as well as forecasting future development of the growing stock. For example, this is likely to be needed where consistent estimates are required from a historical base year such as 1990 as adopted in the Kyoto Protocol. The version of the forecast system currently under development does not address any requirements for such hindcasting. The system has, however, been designed in order to enable the facility for hindcasting to be incorporated in future versions of the software.

International reporting of growing stock volume

The current international definition of a growing stock (FAO 1998, UNECE 2000, Tomppo *et al*. 2010) refers to:

> "*The living tree component of the standing volume. Volume over bark of all living trees more than X cm in diameter at breast height (dbh), or above buttress if higher. Includes the stem from ground level or stump height up to a top diameter of Y cm, and may also include branches to a minimum diameter of W cm. Countries must indicate the three thresholds (X, Y, W cm) and the parts of the tree that are not included in the volume. They must also indicate whether the reported figures refer to volume above ground or above stump. These specifications should be applied consistently through the time series.*"

The conventions historically adopted and implemented in the UK are:

X = 7 cm (minimum dbh)

Y = 7 cm (minimum top diameter)

W = 7 cm (minimum branch diameter, with a minimum section length of 3 m).

Volume includes the stump (*i.e.* from ground level).

The forecast system will allow these conventions to be used in the future for reporting of the growing stock volume. It will also allow for flexibility in adoption of other reporting conventions, *e.g.* Y = 0 cm and W = 0 cm.

Definition of growing stock volume

The conventional output of a growing stock volume forecast consists of standing volume in terms of the overbark cubic volume of living trees to 7 cm top diameter overbark, *i.e.* including:

- stump;
- stemwood; and
- “utilisable” branch wood [*i.e.* sufficiently straight and with a minimum continuous length of 3 metres] to 7cm top diameter overbark.

Conventions are found in section 3.5, page 56 of Matthews and Mackie (2006) and the Code of Sample Plot Procedure (1976, amended 1981) section 3.19[2]. One key convention defines utilisable (measurable) trees as having DBH 7 cm or greater.

A variation to these conventions involves reporting stem wood 'to tip', *i.e.* to 0 cm diameter over bark and all branch wood (also to 0 cm).

By convention, the volume of dead trees is not included. There is interest amongst some users in obtaining forecasts of standing dead volume available. This is complicated to estimate due to the stochastic nature of tree mortality, variations in the rate of degradation of non-living material, and the potential for accumulation of dead trees over several years. Provision of growing stock volume forecasts including elements of deadwood[3] is not planned in the period 2010-2012.

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[2] For readers with access to the FC intranet, the amended Code of Sample Plot Procedure is available on the Forest Research eConnect pages under ‘Research’.

[3] By definition, deadwood cannot form part of the growing stock (*i.e.* it is no longer growing).

Growing stock volume for young (small) trees

Stands where the mean dbh is significantly smaller than 7 cm are accounted as having a growing stock volume of 0 (zero) cubic metres. Growing stock volume will only be estimated following the age of the first entry in a yield table for a particular species, yield class and management.

How we report growing stock volume

The forecast system calculates estimates of growing stock volume for a sequence of individual years; however the growing stock volume is reported for a sequence of five-year periods. This reflects the fact that the users specify thinning and felling operations on a yearly basis, however in practice actually thinning and felling can deviate by one or more years from that specified in a forecast. For these reasons, forecasts are generally reported for five year periods rather than individual years. The forest design plan process recognises that such deviations of harvesting from specified times may take place.

Users are free to specify bespoke forecast reporting periods if needed.

Scope of volume forecast

In the version of the forecast system proposed for development, growing stock volume can be forecast for any forest area that:

- contains living, standing trees of yield class 0 (zero) or above,
- contains trees of yield class 0 (zero) or above in areas defined as windblown,
- has been assigned the data and parameters needed for the calculations described in Appendix 1.

Later developments to the forecast system may permit more sophisticated forecasts to be calculated for forest areas containing trees of below yield class 4, but such developments are not planned during the period 2010-2012.

Areas of yield class 0 (zero) forests are assumed to contain zero growing stock volume. Yield models are not currently available to represent the stands of yield class 2. In the version of the forecast system proposed for development, growing stock volume in yield class 2 stands will be calculated by applying the yield model of the lowest yield class available for the species and multiplying by a factor of (2 ÷ yield class).

The FC forecasting methodology also includes a number of conventions which can be adopted in order to calculate growing stock volume forecasts where some essential data items have not been specified by the user. These conventions effectively describe default settings for data and parameters which depend upon the type of forecast being calculated as described in detail in the document '*Forecast Types*'.

At present, growing stock volume forecasts cannot be calculated for forest areas containing coppice. The provision of such forecasts is not planned during the period 2010-2012.

Unlike fellings and removals forecasts, growing stock volume forecasts need to include a number of areas where timber production is not identified as a significant objective, such as research areas, seed stands and coupes designated for minimum intervention. Forest components explicitly set by users to be non-forecastable also need to be included. Further details are given in the '*Forecast Types*' document.

Areas currently classed as felled are not normally included in growing stock volume forecasts but do need to be accounted for in long term forecasts. Where the restock plan held in Forester indicates that the land will be managed as a forest habitat in the future, the growing stock volume arising from the stands indicated in the restock layer will be estimated and reported. The combinations of land uses, management types and future habitats are shown in the document '*Restocking in the Forecast*'.

Growing stock volume and production events

In a production forecast, the outputs are tied to specific production events and therefore are tied to specific years (although reporting often groups the years into periods). Over the life cycle of a stand it should be possible to estimate growing stock volume for any year regardless of whether production is taking place in that year or not.

The reported growing stock volume for a year assumes that the production event has taken place, *i.e.* it is reported as:

- the post-thin growing stock volume; and
- 0 (zero) cubic metres for a year where a felling is planned.

Note that, when used in calculation of increment, growing stock volume before production may sometimes be used. The worked example in the document '*Volume Increment Forecasts*' illustrates this.

Handling inconsistent fell years

In some cases, sub-components may be assigned a fell year which is inconsistent with either base data or the forecast period (*i.e.* start year and finish year). Details of these situations are detailed in an appendix to the document '*Felling and Removals Forecasts*'.

How to handle areas which currently have no forecastable stands

Where the restock plan held in Forester indicates that the land will be managed as a forest habitat in the future, growing stock volume arising from the stands indicated in the restock layer will be estimated and reported. The combinations of land uses, management types and future habitats are shown in the document '*Restocking in the Forecast*'. The treatment of such land use codes by the forecast system is presented in Appendix 2.

Growing stock volume and windblow

By definition, growing stock volume is assumed to be live volume; however, windblow components will currently have a growing stock volume. This should be estimated as at the reference year of the forecast data and should not be "grown forward" into the future. Note that this may overestimate the growing stock volume for windblow components as:

- there is no information to say when the windblow took place and consequently no indication of when growth ceased; and
- there is no factor to account for degradation of the trees within a windblow stand (see section below).

The treatment of windblown (PWB) areas by the forecast system is outlined in Appendix 2.

Growing stock volume arising from windblow should be shown separately from the growing stock volume arising from other stands. It should only be shown in the first year of the growing stock volume report as removal is assumed.

Any growing stock volume arising from the restocking following clearance of windblow will be included in the main growing stock volume reports.

Growing stock volume and yield adjustment factors

Traditionally, within the production forecast, the user may specify adjustment factors at the stand level that can be applied to the volume and mean dbh of the production volume as estimated from the yield tables. In addition, some standard adjustment factors are generally assumed by the forecast system namely:

- a 5% reduction in volume produced from areas designated with a high windthrow hazard classification (this can be overridden by the user); and
- a 5% reduction in any volume arising from windblow.

It is appropriate to apply any volume and mean dbh adjustment factors, which are applied to the production volume, to the growing stock volume at any point in time. This keeps the estimates of the growing stock and the production consistent.

The adjustment factor for high windthrow hazard areas should be applied to growing stock volume as it is intended to cover an assumed difference in growth pattern from the basic yield models, and is not intended to cover tree loss due to windblow.

The adjustment factor for the volume arising from windblow is intended to allow for a reduction in volume recovered due to degradation. This factor should not be applied to the growing stock volume arising from windblow as this is only reported for a single year.

Forecast reports for growing stock volume

Both tabular and graphical output reports are produced. Examples are presented in Appendix 4.

References

FAO. 1998. FRA 2000 Terms and Definitions. FRA Working Paper 1, FAO Forestry Department. (Available via http://www.fao.org/forestry/58864/en/ or directly at http://www.fao.org/docrep/007/ae217e/ae217e00.htm)

Forestry Commission (2007) *Survey Handbook (Third Edition).* Forestry Commission: Operational Support Unit, Edinburgh.

HM Government (2011) *The Natural Choice: securing the value of nature.* White Paper presented to Parliament by the Secretary of State for Environment, Food and Rural Affairs, June 2011. The Stationery Office, Norwich. ISBN: 9780101808224

Matthews, R.W. and Mackie, E.D. (2006) *Forest Mensuration: A Handbook For Practitioners*. Forestry Commission: Edinburgh. ISBN: 0855386215

Tomppo, E., Gschwantner, Th., Lawrence, M. & McRoberts, R.E. (Eds.) (2010) *National Forest Inventories - Pathways for common reporting.* Springer, 612 pp. ISBN: 978-90-481-3232-4

UNECE (2000) Temperate and Boreal Forest Resource Assessment (TBRFA) 2000. Forest Resources of Europe, CIS, North America, Australia, Japan and New Zealand (industrialised temperate/boreal countries): UN-ECE/FAO Contribution to the Global Forest Resources Assessment 2000. *Geneva Timber and Forest Study Papers, No. 17.*

List of Forecast System Documentation

Forecast Types

Felling and Removals Forecasts
Biomass Removals Forecasts*

Growing Stock Volume Forecasts (this document)
Volume Increment Forecasts
Growing Stock Biomass Forecasts*
Growing Stock Carbon Forecasts*

Straightness Forecasts*

Restocking in the Forecast

*Publication of Forecast Technical Documentation detailing forecasts involving straightness, biomass and carbon will follow.

Appendix 1 – Worked Examples

The following worked examples are all based on the 'Management Plans Forecast Type' (see '*Forecast Types*') and make reference to the use of an 'appropriate growth model'. This is a growth model selected by M1 for each forest sub-component on the basis of tree species, yield class, initial spacing and broad thinning prescription, essentially 'thin' or 'no thin', based on the setting of the '<PREVIOUSLY_THINNED>' flag. It is therefore crucial that this flag is set appropriately for every forecastable sub-component.

The model is selected to reflect how the stand has been managed up to the point that the latest inventory assessment was made, or to the start of the forecast period, in order to determine the initial conditions in the model from which to 'grow' the forest sub-component on from the start of the projection. This is illustrated within each of the examples presented below.

The examples presented below differ in complexity and are based on a forest sub-component with the following standard characteristics.

- Scots pine
- yield class 8
- initial spacing 1.4 m
- planting year 1961
- previously thinned to management tables on a 5-year cycle
- fell at age 78 years (age of maximum MAI)
- windthrow hazard class (WHC) 3.

The forecast period is taken to be from 2012 to 2100.

The above information is coded in a plain text document written in machine-readable 'Extensible Markup Language' (XML) which is used as input by the Forecast System. The Forecast System takes the data contained within the XML file and passes it directly to the M1 growth and yield model *via* internal API (application programming interface) calls, receiving the growth and yield information by return – *i.e.* no intermediate files are written. It is therefore the information contained in the XML file which unambiguously specifies the forecast rules to be applied to each sub-component by the Forecast System and M1. Each sub-component is individually and sequentially processed by the Forecast System and M1, and the resultant outputs are amalgamated into the forecast by the Forecast System.

Example 1 – Standard clearfell, no growing stock estimate available

In addition to the standard characteristics defined for the forest sub-component, Example 1 is based on the additional assumption that:

- an estimate of growing stock is not available (*i.e.* that no growing stock assessment has been made or an assessment has not been entered into the SCDB).

The inputs defining the forecast type and duration applied to Example 1 are shown in Table A1.1.1. The inputs giving the physical description of the sub-component used in Example 1 are presented in Table A1.1.2. The inputs detailing the assumed historical and future management of the sub-component are presented in Table A1.1.3.

Table A1.1.1 The basic inputs defining the forecast.

XML tag expected by the Forecast System	Value read by Forecast System	Description
<FORECAST_TYPE>	**MANAGEMENT_PLANS**	A 'Management Plans' forecast type is being run.
<FIRST_YEAR_OF_PROJECTION>	**2012**	The first year of the forecast.
<LAST_YEAR_OF_PROJECTION>	**2100**	The final year of the forecast.

Table A1.1.2 The basic inputs specifying the physical description of the sub-component (given in the standard order within the <PHYSICAL_DESCRIPTION> section of the XML file).

XML tag expected by the Forecast System	Value read by Forecast System	Description
<SPECIES>	**SP**	Standard FC species code.
<WINDBLOWN>	**N**	Not windblown (N is the default setting).
<SUB_COMPONENT_AREA>	**10000**	The area of the sub-component in m^2. In this example the area of the sub-component is assumed to be 1 hectare.

XML tag expected by the Forecast System	Value read by Forecast System	Description
<WHC>	**3**	Windthrow hazard class. (If blank, defaults are used.)
<LAND_USE_CODE>	**PHF**	Standard SCDB land-use code (PHF = productive high forest).
<GYC>	**8**	General Yield Class ($m^3 ha^{-1} yr^{-1}$).
<SPACING>	**1.4**	Initial planting spacing, in metres (square planting assumed)
<PLANTING_YEAR>	**1961**	Planting year.
<STOREY>	**1**	The storey containing the sub-component.

Table A1.1.3 The basic inputs specifying the historical and future management of the sub-component (given in the standard order within the <MANAGEMENT> section of the XML file).

XML tag expected by the Forecast System	Value read by Forecast System	Description
<CLEARFELL_FELL_YEAR>	**2039**	The clearfell year defined for the sub-component.
<PREVIOUSLY_THINNED>	**Y**	The sub-component has previously been thinned. A thinning-type yield model will therefore be applied in the period up to the start of the forecast (<FIRST_YEAR_OF_PROJECTION>).
<THIN_IN_FUTURE>	**Y**	The sub-component will be thinned. A thinning-type yield model will therefore be applied during the forecast.

In the absence of a growing stock estimate / inventory point, the forecast system starts modelling the sub-component from 1961 (the defined '<PLANTING_YEAR>'). An appropriate growth model is used to work out the development of the growing stock up to the time of first thinning. The actual 'base model' selected automatically within the forecast system is SP ('<SPECIES>'), general yield class 8 ('<GYC>'), 1.4 m initial spacing ('<SPACING>'), intermediate thin to MTI on a 5 year cycle ('<PREVIOUSLY_THINNED>') from age 29, which is the standard age of first thinning in the yield model. From this point, in 1990, thinnings take place at standard intensity every 5 years until 2012 (the final modelled thinning before the forecast will therefore take place at age 49 years, in 2010).

These periodic thinnings obviously result in removals from the growing stock. In this way, the forecast system estimates an initial growing stock for the forecast starting in 2012 (‘<FIRST_YEAR_OF_PROJECTION>’).

It is perhaps worth noting that if the example forest sub-component considered here had been a no-thin sub-component, then a no-thin model would initially be applied and no thinnings would be carried out in the period up to 2012.

From 2012 (the ‘<FIRST_YEAR_OF_PROJECTION>’) onwards, the Forecast System instructs M1 to ‘grow on’ the sub-component by reference to the specified management prescription for the sub-component (‘<THIN_IN_FUTURE>’, ‘<CLEARFELL_FELL_YEAR>’).

From 2012 onwards, the above-ground timber volume production is reported at each scheduled thinning event, and the growing stock is reduced accordingly to become the starting point for the next period of growth. This continues until 9 years before felling (*i.e.* a sub-component age of 69 years, in 2030). Note that M1 defaults to an assumption that there is a minimum of a 6 year no-thin period immediately in advance of the felling date.

The forest sub-component is felled in 2039, at age 78.

The growing stock volume forecast outputs for this sub-component are given in Table A1.1.4 (growing stock volume for each year of the forecast) and Table A1.1.5 (average annual growing stock volume during each forecast reporting period).

Table A1.1.4 The outputs of the growing stock volume forecast for this single sub-component. The report has been truncated as this sub-component is not being restocked and all entries between 2039 (the clearfell year) and 2099 are zero.
Note: no gross:net reduction factor has been applied.

Year	All Species	All Conifers	All Broadleaves	Scots Pine
2012	210.32	210.32	0	210.32
2013	221.88	221.88	0	221.88
2014	233.44	233.44	0	233.44
2015	217.00	217.00	0	217.00
2016	228.24	228.24	0	228.24
2017	239.48	239.48	0	239.48
2018	250.72	250.72	0	250.72
2019	261.96	261.96	0	261.96
2020	245.20	245.20	0	245.20
2021	255.96	255.96	0	255.96
2022	266.72	266.72	0	266.72
2023	277.48	277.48	0	277.48
2024	288.24	288.24	0	288.24
2025	271.00	271.00	0	271.00
2026	281.06	281.06	0	281.06
2027	291.12	291.12	0	291.12
2028	301.18	301.18	0	301.18
2029	311.24	311.24	0	311.24
2030	293.30	293.30	0	293.30
2031	302.46	302.46	0	302.46
2032	311.62	311.62	0	311.62
2033	320.78	320.78	0	320.78
2034	329.94	329.94	0	329.94
2035	339.10	339.10	0	339.10
2036	347.16	347.16	0	347.16
2037	355.22	355.22	0	355.22
2038	363.28	363.28	0	363.28
2039	0	0	0	0
2040	0	0	0	0
2041	0	0	0	0
2042	0	0	0	0
2043	0	0	0	0
2044	0	0	0	0
2045	0	0	0	0
2046	0	0	0	0
2047	0	0	0	0
2048	0	0	0	0

Table A1.1.5 The outputs of the standing volume report showing average annual growing stock volume during each forecast period. The low figure relating to the period 2037-2099 occurs because this single sub-component is felled in 2039 and is not restocked. Therefore, in the final 63-year period in this artificially contrived example, there are 61 years where no growing stock is assumed to exist.
Note: no gross:net reduction factor has been applied to the outputs for this single sub-component.

Forecast Period	**Growing stock volume forecast (m^3 ha^{-1}, from M1)**
2012-2016	222.18
2017-2021	250.66
2022-2026	276.90
2027-2031	299.86
2032-2036	329.72
2037-2099	11.40

Example 2 – Standard clearfell, growing stock estimate available

Example 2 is based on the additional assumption that:

- an estimate of growing stock was made in 2011 (see Table A1.2.1), the results of which were entered into the SCDB.

Table A1.2.1 The estimate of the growing stock made in 2011.

Growing stock assessment (April 2011)	
Top height	16.4 m
Number of stems per hectare	998.0 stems
Basal area per hectare	31.2 m^2 ha^{-1}
Average dbh	Not assessed – calculated by M1
Volume per hectare	Not assessed – estimated by M1

The inputs defining the forecast type and duration applied to Example 2 are shown in Table A1.2.2. The inputs giving the physical description of the sub-component used in Example 2 are presented in Table A1.2.3. The inputs detailing the assumed historical and future management of the sub-component are presented in Table A1.2.4.

Table A1.2.2 The basic inputs defining the forecast.

XML tag expected by the Forecast System	**Value read by Forecast System**	**Description**
<FORECAST_TYPE>	**MANAGEMENT_PLANS**	A 'Management Plans' forecast type is being run.
<FIRST_YEAR_OF_PROJECTION>	**2012**	The first year of the forecast.
<LAST_YEAR_OF_PROJECTION>	**2100**	The final year of the forecast.

Table A1.2.3 The basic inputs specifying the physical description of the sub-component (given in the standard order within the <PHYSICAL_DESCRIPTION> section of the XML file).

XML tag expected by the Forecast System	Value read by Forecast System	Description
<SPECIES>	**SP**	Standard FC species code.
<WINDBLOWN>	**N**	Not windblown (N is the default).
<SUB_COMPONENT_AREA>	**10000**	The area of the sub-component in m^2. In this example the area of the sub-component is assumed to be 1 hectare.
<WHC>	**3**	Windthrow hazard class. (If blank, defaults are used.)
<LAND_USE_CODE>	**PHF**	Standard SCDB land-use code (PHF = productive high forest).
<GYC>	**8**	General Yield Class ($m^3ha^{-1}yr^{-1}$).
<SPACING>	**1.4**	Initial planting spacing, in metres (square planting assumed)
<PLANTING_YEAR>	**1961**	Planting year.
<STOREY>	**1**	The storey containing the sub-component.
<TOP_HEIGHT>	**16.4**	The top height of the sub-component, in metres, from the last growing stock assessment.
<TOP_HEIGHT_YEAR>	**2011**	The year the in which top height was assessed.
<TOP_HEIGHT_BEFORE_THIN>	**N**	Was top height assessed immediately before thinning (N is the default).

XML tag expected by the Forecast System	Value read by Forecast System	Description
<NUMBER_OF_TREES_Ha>	**998**	The average number of stems per hectare for the sub-component, from the last growing stock assessment.
<NUMBER_OF_TREES_YEAR>	**2011**	The year the in which the average number of stems per hectare was assessed.
<NUMBER_OF_TREES_BEFORE_THIN>	**N**	Was the average number of stems per hectare assessed immediately before thinning (N is the default).
<BASAL_AREA>	**31.2**	The basal area per hectare of the sub-component, in m^2ha^{-1}, from the last growing stock assessment.
<BASAL_AREA_YEAR>	**2011**	The year the in which the basal area per hectare was assessed.
<BASAL_AREA_BEFORE_THIN>	**N**	Was the basal area per hectare assessed immediately before thinning (N is the default).

Table A1.2.4 The basic inputs specifying the historical and future management of the sub-component (given in the standard order within the <MANAGEMENT> section of the XML file).

XML tag expected by the Forecast System	**Value read by Forecast System**	**Description**
<CLEARFELL_FELL_YEAR>	**2039**	The clearfell year defined for the sub-component.
<PREVIOUSLY_THINNED>	**Y**	The sub-component has previously been thinned. A thinning-type yield model will therefore be applied in the period up to the start of the forecast (<FIRST_YEAR_OF_PROJECTION>).
<THIN_IN_FUTURE>	**Y**	The sub-component will be thinned. A thinning-type yield model will therefore be applied during the forecast.

The forecast starts from the growing stock estimate provided in 2011 ('<TOP_HEIGHT_YEAR>', '<NUMBER_OF_TREES_YEAR>', '<BASAL_AREA_YEAR>'). The assessed top height ('<TOP_HEIGHT>') is passed to M1 by the Forecast System, to allow M1 to assign an appropriate yield class to the sub-component. If the assessed top height indicates that the existing yield class ('<GYC>') is incorrect, M1 will compute an updated yield class and will apply the correct yield model for the newly-estimated yield class. From 2011 to 2012, the forecast system grows the sub-component according to the management prescription originally specified for the sub-component.

The forest sub-component considered in Example 2 involves a thinning prescription (*i.e.* '<PREVIOUSLY_THINNED>' = 'Y'). However, in this instance, no thinnings are scheduled by the chosen model between 2011 (the year in which the growing stock assessment was made) and 2012 ('<FIRST_YEAR_OF_PROJECTION>').

It is perhaps worth noting that if the example forest sub-component considered here had been a no-thin sub-component (*i.e.* '<PREVIOUSLY_THINNED>' = 'N'), then a no-thin model would initially be applied and no thinnings would be carried out in the period up to 2012.

From 2012 (the '<FIRST_YEAR_OF_PROJECTION>') onwards, the Forecast System instructs M1 to 'grow on' the sub-component by reference to the specified management prescription for the sub-component ('<THIN_IN_FUTURE>', '<CLEARFELL_FELL_YEAR>').

From 2012 onwards, the above-ground timber volume production is therefore reported at each scheduled thinning event, and the growing stock is reduced accordingly to become the starting point for the next period of growth. This continues until 9 years before felling (*i.e.* a sub-component age of 69 years, in 2030). Note that M1 defaults to an assumption that there is a minimum of a 6 year no-thin period immediately in advance of the felling date.

The forest sub-component is felled in 2039, at age 78.

The growing stock volume forecast outputs for this sub-component are given in Table A1.2.5 (growing stock volume for each year of the forecast) and Table A1.2.6 (average annual growing stock volume during each forecast reporting period). Note that no thinning operation is assumed to take place in 2035 due to its proximity to the planned clearfell year (2039).

Table A1.2.5 The outputs of the growing stock volume forecast for this single sub-component. The report has been truncated as this sub-component is not being restocked and all entries between 2039 (the clearfell year) and 2099 are zero.
Note: no gross:net reduction factor has been applied.

Year	All Species	All Conifers	All Broadleaves	Scots Pine
2012	227.69	227.69	0	227.69
2013	239.25	239.25	0	239.25
2014	250.81	250.81	0	250.81
2015	234.37	234.37	0	234.37
2016	245.61	245.61	0	245.61
2017	256.85	256.85	0	256.85
2018	268.09	268.09	0	268.09
2019	279.33	279.33	0	279.33
2020	262.57	262.57	0	262.57
2021	273.33	273.33	0	273.33
2022	284.09	284.09	0	284.09
2023	294.85	294.85	0	294.85
2024	305.61	305.61	0	305.61
2025	288.37	288.37	0	288.37
2026	298.43	298.43	0	298.43
2027	308.49	308.49	0	308.49
2028	318.55	318.55	0	318.55
2029	328.61	328.61	0	328.61
2030	310.67	310.67	0	310.67
2031	319.83	319.83	0	319.83
2032	328.99	328.99	0	328.99
2033	338.15	338.15	0	338.15
2034	347.31	347.31	0	347.31
2035	356.47	356.47	0	356.47
2036	364.53	364.53	0	364.53
2037	372.59	372.59	0	372.59
2038	380.65	380.65	0	380.65
2039	0	0	0	0
2040	0	0	0	0
2041	0	0	0	0
2042	0	0	0	0
2043	0	0	0	0
2044	0	0	0	0
2045	0	0	0	0
2046	0	0	0	0
2047	0	0	0	0
2048	0	0	0	0

Table A1.2.6 The outputs of the standing volume report showing average annual growing stock volume during each forecast period. The low figure relating to the period 2037-2099 occurs because this single sub-component is felled in 2039 and is not restocked. Therefore, in the final 63-year period in this artificially contrived example, there are 61 years where no growing stock is assumed to exist.

Forecast Period	Growing stock volume forecast (m^3 ha^{-1}, from M1)
2012-1016	239.54
2017-2021	268.03
2022-2026	294.27
2027-2031	317.23
2032-2036	347.09
2037-2099	11.96

It should be immediately apparent that the growing stock volumes are higher than those presented in Example 1. This reflects the fact that M1 has ‘grown’ the stand from the growing stock estimate, taken in April 2011, which indicated that the stand contained more volume at that date than would have been suggested by the ‘standard’ model. All relevant values in the growth model were therefore adjusted in order to take account of the actual assessed stocking, giving a more accurate standing volume forecast than in Example 1.

Example 3 – Standard clearfell (moving to LISS management), no growing stock estimate available

In addition to the standard characteristics defined for the forest sub-component, Example 3 is based on the additional assumption that:

- an estimate of growing stock is not available (*i.e.* that no growing stock assessment has been made or an assessment has not been entered into the SCDB)
- the stand was previously thinned to management tables on a 5-year cycle, with LISS management (shelterwood) introduced in 2016 on a 10-year thinning cycle
- LISS final removal year is 2046.

The inputs defining the forecast type and duration applied to Example 3 are shown in Table A1.3.1. The inputs giving the physical description of the sub-component used in Example 3 are presented in Table A1.3.2. The inputs detailing the assumed historical and future management of the sub-component are presented in Table A1.3.3.

Table A1.3.1 The basic inputs defining the forecast.

XML tag expected by the Forecast System	Value read by Forecast System	Description
<FORECAST_TYPE>	**MANAGEMENT_PLANS**	A ‘Management Plans’ forecast type is being run.
<FIRST_YEAR_OF_PROJECTION>	**2012**	The first year of the forecast.
<LAST_YEAR_OF_PROJECTION>	**2100**	The final year of the forecast.

Table A1.3.2 The basic inputs specifying the physical description of the sub-component (given in the standard order within the <PHYSICAL_DESCRIPTION> section of the XML file).

XML tag expected by the Forecast System	Value read by Forecast System	Description
<SPECIES>	**SP**	Standard FC species code.
<WINDBLOWN>	**N**	Not windblown (N is the default setting).
<SUB_COMPONENT_AREA>	**10000**	The area of the sub-component in m^2. In this example the area of the sub-component is assumed to be 1 hectare.
<WHC>	**3**	Windthrow hazard class. (If blank, defaults are used.)
<LAND_USE_CODE>	**PHF**	Standard SCDB land-use code (PHF = productive high forest).
<GYC>	**8**	General Yield Class ($m^3ha^{-1}yr^{-1}$).
<SPACING>	**1.4**	Initial planting spacing, in metres (square planting assumed)
<PLANTING_YEAR>	**1961**	Planting year.
<STOREY>	**1**	The storey containing the sub-component.

Table A1.3.3 The basic inputs specifying the historical and future management of the sub-component (given in the standard order within the <MANAGEMENT> section of the XML file).

XML tag expected by the Forecast System	Value read by Forecast System	Description
<FINAL_REMOVAL_YEAR>	**2046**	The final removal year defined for this '<LISS_TYPE>' sub-component.
<PREVIOUSLY_THINNED>	**Y**	The sub-component has previously been thinned. A thinning-type yield model will therefore be applied in the period up to the start of the forecast (<FIRST_YEAR_OF_PROJECTION>).
<FROM_THIS_YEAR>	**2016**	The sub-component will be thinned from this date according to a bespoke thinning regime.

XML tag expected by the Forecast System	Value read by Forecast System	Description
<LISS>	**Y**	A LISS-type thinning will be applied.
<THINNING_CYCLE>	**10**	The LISS thinning cycle will be 10 years.
<EVEN_NUMBERS />		This null entry within the nested '<FUTURE_THINNING_TYPE>', '<FUTURE_NEUTRAL>' and '<M1_ATC_TYPE>' sections of the XML file indicates that equal numbers of trees will be removed at each thinning intervention.
<ATC_END_YEAR>	**2046**	The alternative to clearfelling (ATC) end year for this sub-component is 2045.

The forecast system starts modelling the sub-component from 1961 (the defined '<PLANTING_YEAR>'). An appropriate growth model is used to work out the development of the growing stock up to the time of first thinning. The actual 'base model' selected automatically within the forecast system is SP ('<SPECIES>'), general yield class 8 ('<GYC>'), 1.4 m initial spacing ('<SPACING>'), intermediate thin to MTI on a 5 year cycle ('<PREVIOUSLY_THINNED>') from age 29, which is the standard age of first thinning in the yield model. From this point, in 1990, thinnings take place at standard intensity every 5 years until 2012 (the final modelled thinning before the forecast will therefore take place at age 49 years, in 2010).

These periodic thinnings obviously result in removals from the growing stock. In this way, the forecast system estimates an initial growing stock for the forecast starting in 2012 ('<FIRST_YEAR_OF_PROJECTION>').

It is perhaps worth noting that if the example forest sub-component considered here had been a no-thin sub-component, then a no-thin model would initially be applied and no thinnings would be carried out in the period up to 2012.

From 2012 (the '<FIRST_YEAR_OF_PROJECTION>') onwards, the Forecast System instructs M1 to 'grow on' the sub-component by reference to the specified LISS management prescription (specified by '<FROM_THIS_YEAR>', '<LISS>', '<THINNING_CYCLE>', '<EVEN_NUMBERS />', '<ATC_END_YEAR>', and '<FINAL_REMOVAL_YEAR>').

From 2012 onwards, the above-ground timber volume production is reported at each scheduled thinning event and, within M1, the growing stock is reduced accordingly to become the starting point for the next period of growth. The first LISS thinning event is scheduled to take place in 2016. Because M1 defaults to an assumption that there is a minimum of a 6 year no-thin period immediately in advance of any bespoke thinning date, the 2015 thinning, defined in the standard management tables for this species/Yield Class combination is ignored. The defined bespoke (shelterwood) thinning continues until the final thinning event (*i.e.* a sub-component age of 75 years, in 2036).

The forest sub-component is felled in 2046, the <ATC_END_YEAR>, at age 85.

The growing stock volume forecast outputs for this LISS (shelterwood-type) sub-component are given in Table A1.3.4 (growing stock volume for each year of the forecast) and Table A1.3.5 (average annual growing stock volume during each forecast reporting period).

Table A1.3.4 The outputs of the growing stock volume forecast for this single sub-component. The report has been truncated as this sub-component is not being restocked and all entries between 2046 (the final removal year) and 2099 are zero.
Note: no gross:net reduction factor has been applied.

Year	All Species	All Conifers	All Broadleaves	Scots Pine
2012	210.32	210.32	0	210.32
2013	221.88	221.88	0	221.88
2014	233.44	233.44	0	233.44
2015	245.00	245.00	0	245.00
2016	192.18	192.18	0	192.18
2017	201.88	201.88	0	201.88
2018	211.82	211.82	0	211.82
2019	222.00	222.00	0	222.00
2020	232.42	232.42	0	232.42
2021	242.62	242.62	0	242.62
2022	253.04	253.04	0	253.04
2023	263.70	263.70	0	263.70
2024	274.46	274.46	0	274.46
2025	285.22	285.22	0	285.22
2026	196.85	196.85	0	196.85
2027	204.04	204.04	0	204.04
2028	211.37	211.37	0	211.37
2029	218.85	218.85	0	218.85
2030	226.47	226.47	0	226.47
2031	233.55	233.55	0	233.55
2032	240.74	240.74	0	240.74
2033	248.04	248.04	0	248.04
2034	255.47	255.47	0	255.47
2035	263.01	263.01	0	263.01
2036	134.88	134.88	0	134.88
2037	138.29	138.29	0	138.29
2038	141.75	141.75	0	141.75
2039	145.26	145.26	0	145.26
2040	148.82	148.82	0	148.82
2041	151.90	151.90	0	151.90
2042	155.02	155.02	0	155.02
2043	158.17	158.17	0	158.17
2044	161.35	161.35	0	161.35
2045	164.57	164.57	0	164.57
2046	0	0	0	0
2047	0	0	0	0
2048	0	0	0	0

Table A1.3.5 The outputs of the standing volume report showing average annual growing stock volume during each forecast period. The low figure relating to the period 2037-2099 occurs because the final removal year of this single LISS sub-component is 2046 and regeneration is assumed to have failed. Therefore, in the final 63-year period in this artificially contrived example, there are 54 years where no growing stock is assumed to exist.

Forecast Period	**Growing stock volume forecast (m^3 ha^{-1}, from M1)**
2012-1016	220.56
2017-2021	222.15
2022-2026	254.65
2027-2031	218.86
2032-2036	228.43
2037-2099	21.67

Appendix 2 – land uses where growing stock volume may be estimated (for current stands)

The details in this section are written assuming that all the data held in Forester is present and valid. The treatment of missing and invalid data is described in detail in a separate low-level specification table, which was produced to guide the development of the Forecast System software. More information about the applicability of Land-Use Codes can be found in Table 4.3-1 (‘*Land Use Codes in the SCDB*’) in the Survey Handbook (Forestry Commission, 2007).

Table A2.1: Land-Use Codes for which treatment in growing stock volume forecasts is the same for all Forecast Types.

Land Use Group	Growing Stock Volume	Notes
Agriculture (AGR)	Not passed to the forecast system. No growing stock volume is estimated for current components.	Sub-components designated as agricultural land should be excluded irrespective of whether a species has been allocated to the component.
Commercial Recreation (CRC, CRH)	Not passed to the forecast system. No growing stock volume is estimated for current components.	Sub-components designated as commercial recreation should be excluded from the forecast.
Estate Management (EMM, EMO, EMR)	Not passed to the forecast system. No growing stock volume is estimated for current components.	Sub-components designated as estate management should be excluded from the forecast.
Forest Management (FMC, FMD, FMN, FMQ, FMW)	Not passed to the forecast system. No growing stock volume is estimated for current components.	Sub-components designated as Christmas trees (FMC), deer glades (FMD), nursery (FMN), quarries (FMQ), and unplanted (FMW) should be excluded from the forecast. An area report for FMC is, however, produced by direct analysis of SCDB.
Forest Recreation (FRC, FRE, FRO)	Not passed to the forecast system. No growing stock volume is estimated for current components.	Sub-components designated as forest recreation should be excluded from the forecast.

Land Use Group	Growing Stock Volume	Notes
Plantable Land (LHP)	Not passed to the forecast system. No growing stock volume is estimated for current components.	Forecasts for stocking of unstocked forest areas will be handled as a separate, supplementary calculation as part of the 2011 forecast exercise.
Miscellaneous (MAS, MOW)	Not passed to the forecast system. No growing stock volume is estimated for current components.	Sub-components designated as miscellaneous should be excluded from the forecast including archaeological sites which take priority over woodland.
Non-plantation (NAR)	Not passed to the forecast system. No growing stock volume is estimated for current components.	Sub-components designated as non-plantation 'arboreta' (NAR) should be excluded from the forecast. An area report is, however, produced by direct analysis of SCDB.
Open (OPN)	Not passed to the forecast system. No growing stock volume is estimated for current components.	Open land (OPN) cannot have an associated species code in the SCDB; however it may have up to 20% tree cover in practice.
Plantation (PBU, PFA, PFE)	Not passed to the forecast system. No growing stock volume is estimated for current components.	Forecasts for stocking of burnt (PBU), failed (PFA) and felled (PFE) unstocked forest areas will be handled as a separate, supplementary calculation as part of the 2011 forecast exercise.
Plantation (PWC)	Not passed to the forecast system. No growing stock volume is estimated for current components.	Areas designated as plantation worked coppice (PWC) should be excluded from the forecast. An area report is, however, produced by direct analysis of SCDB.
Unplantable (UNP)	Not passed to the forecast system. No growing stock volume is not estimated for current components.	Unplantable land (UNP) cannot have an associated species code in the SCDB; however it may have up to 20% tree cover in practice.

Table A2.2: Zero Intervention Forecast Type: growing stock volume forecasts for the Land-Use Codes not included in Table A2.1.

Land Use Group	Growing Stock Volume	Notes
Forest Management (FMR, FMS)	Growing stock volume is estimated for current components.	Sub-components designated as non-plantation research (FMR) and seed orchard (FMS) are passed to the forecast system and, although these are excluded from forecasts of production, outputs are produced for growing stock volume, biomass and carbon and also volume increment.
Non-plantation (NAO)	Growing stock volume is estimated for current components.	Applicable to New Forest only. Sub-components designated as non-plantation 'ancient and ornamental' (NAO) are passed to the forecast system and, although these are excluded from forecasts of production, outputs are produced for growing stock volume, biomass and carbon and also volume increment.
Plantation (PHF, PRP, PSS)	Growing stock volume is estimated for current components.	All sub-components designated as high forest (PHF), research plantations (PRP) and seed stands (PSS) are passed to the forecast system and, although these are excluded from forecasts of production, outputs are produced for growing stock volume, biomass and carbon and also volume increment.
Plantation (PIB)	Growing stock volume is estimated for current components.	Sub-components designated as intruded broadleaves (PIB) are passed to the forecast system and, although these are excluded from forecasts of production, outputs are produced for growing stock volume, biomass and carbon and also volume increment.
Plantation (PWB)	Growing stock volume is estimated for current components.	Sub-components designated as windblow (PWB) are passed to the forecast system and, although these are excluded from forecasts of production, outputs are produced for growing stock volume, biomass and carbon and also volume increment.

Table A2.3: Biological Potential Forecast (All Sub-Types): growing stock volume forecasts for the Land-Use Codes not included in Table A2.1.

Land Use Group	Growing Stock Volume	Notes
Forest Management (FMR, FMS)	Growing stock volume is estimated for current components.	All forecast outputs are produced for all sub-components designated as non-plantation research (FMR) and seed orchard (FMS), *i.e.* all sub-components are forced to have a FORECAST_FLAG of “F”.
Non-plantation (NAO:)	Growing stock volume is estimated for current components.	Applicable to New Forest only. All forecast outputs are produced for all sub-components designated as non-plantation ‘ancient and ornamental’ (NAO), *i.e.* all sub-components are forced to have a FORECAST_FLAG of “F”.
Plantation (PHF, PRP, PSS)	Growing stock volume is estimated for current components.	All forecast outputs are produced for all sub-components designated as high forest (PHF), seed stands (PSS) and research plantations (PRP), *i.e.* all sub-components are forced to have a FORECAST_FLAG of “F”.
Plantation (PIB, PWB)	Growing stock volume is estimated for current components.	All forecast outputs are produced for all sub-components designated as intruded broadleaves (PIB) and windblow (PWB), *i.e.* all sub-components are forced to have a FORECAST_FLAG of “F”.

Table A2.4: Strategic Regional Forecast Type: growing stock volume forecasts for the Land-Use Codes not included in Table A2.1.

Land Use Group	**Growing Stock Volume**	**Notes**
Forest Management (FMR, FMS)	Growing stock volume is estimated for current components.	All forecast outputs are produced for all sub-components designated as non-plantation research (FMR) and seed orchard (FMS), *i.e.* all sub-components are forced to have a FORECAST_FLAG of “F”.
Non-plantation (NAO:)	Growing stock volume is estimated for current components.	Applicable to New Forest only. All forecast outputs are produced for all sub-components designated as non-plantation ‘ancient and ornamental’ (NAO), *i.e.* all sub-components are forced to have a FORECAST_FLAG of “F”.
Plantation (PHF, PRP, PSS)	Growing stock volume is estimated for current components.	All forecast outputs are produced for all sub-components designated as high forest (PHF), seed stands (PSS) and research plantations (PRP), *i.e.* all sub-components are forced to have a FORECAST_FLAG of “F”.
Plantation (PIB, PWB)	Growing stock volume is estimated for current components.	All forecast outputs are produced for all sub-components designated as intruded broadleaves (PIB) and windblow (PWB), *i.e.* all sub-components are forced to have a FORECAST_FLAG of “F”.

Table A2.5: Management Plans Forecast Type: growing stock volume forecasts for the Land-Use Codes not included in Table A2.1.

Land Use Group	Growing Stock Volume	Notes
Forest Management (FMR, FMS)	Growing stock volume is estimated for current components.	Sub-components designated as non-plantation research (FMR) and seed orchard (FMS), although excluded from forecasts of production, are included the forecast for estimates of growing stock volume, growing stock biomass and carbon.
Non-plantation (NAO)	Growing stock volume is estimated for current components.	Applicable to New Forest only. Sub-components designated as non-plantation 'ancient and ornamental' (NAO) although excluded from forecasts of production, are included the forecast for estimates of growing stock volume, growing stock biomass and carbon.
Plantation (PHF, PIB, PRP,PSS, PWB)	Growing stock volume is estimated for current components.	Estimates of growing stock volume, growing stock biomass and carbon are made for all sub-components designated high forest (PHF), intruded broadleaves (PIB), seed stands (PSS), research plantations (PRP) and windblow (PWB) irrespective of whether the FORECAST_FLAG is set to "F" or "N".

Table A2.6: Quick Forecast Type: growing stock volume forecasts for the Land-Use Codes not included in Table A2.1.

Land Use Group	**Growing Stock Volume**	**Notes**
Forest Management (FMR, FMS)	Growing stock volume is estimated for current components.	All forecast outputs are produced for all sub-components designated as non-plantation research (FMR) and seed orchard (FMS), *i.e.* all sub-components are forced to have a FORECAST_FLAG of “F”.
Non-plantation (NAO:)	Growing stock volume is estimated for current components.	Applicable to New Forest only. All forecast outputs are produced for all sub-components designated as non-plantation ‘ancient and ornamental’ (NAO), *i.e.* all sub-components are forced to have a FORECAST_FLAG of “F”.
Plantation (PHF, PRP, PSS)	Growing stock volume is estimated for current components.	All forecast outputs are produced for all sub-components designated as high forest (PHF), seed stands (PSS) and research plantations (PRP), *i.e.* all sub-components are forced to have a FORECAST_FLAG of “F”.
Plantation (PIB, PWB)	Growing stock volume is estimated for current components.	All forecast outputs are produced for all sub-components designated as intruded broadleaves (PIB) and windblow (PWB), *i.e.* all sub-components are forced to have a FORECAST_FLAG of “F”.

Appendix 3 – NFI Forester component types where growing stock volume may be estimated (for current stands)

The details in this section are written assuming that all the data held in the NFI Forester are present and valid. The treatment of missing and invalid data is described in detail in a separate low-level specification table, which was produced to guide the development of the Forecast System software.

Table A3.1: Zero Intervention Forecast Type: growing stock volume forecasts for NFI Forester component types.

NFI Land Use Group	Growing Stock Volume	Notes
Stand	Growing stock volume is estimated for current components.	Outputs are not produced for volume and biomass production, nor for straightness. Outputs are produced for standing volume, biomass and carbon and also volume increment.
Young	Growing stock volume is estimated for current components.	Outputs are not produced for volume and biomass production, nor for straightness. Outputs are produced for standing volume, biomass and carbon and also volume increment.
Thicket	Growing stock volume is estimated for current components.	Outputs are not produced for volume and biomass production, nor for straightness. Outputs are produced for standing volume, biomass and carbon and also volume increment.

NFI Land Use Group	Growing Stock Volume	Notes
Windblow	The component is 'grown' up to the ASSESSMENT_YEAR according to the strategic regional forecast type. No growing stock volume is estimated for current components.	The component is assumed to become windblow in the ASSESSMENT_YEAR. Under the zero intervention forecast type, no volume is produced and no restocking takes place. Consequently reporting for Windblow consists of a separate report of the volume associated with the Windblow component(s) just for the ASSESSMENT_YEAR. The volume is neither harvested nor 'grown on' and no restocking is allowed for. The volume associated with Windblow sub-components in the ASSESSMENT_YEAR is obtained from the calculations carried out for the strategic regional forecast type up to the ASSESSMENT_YEAR, therefore no further calculations are required for Windblow as part of a zero intervention forecast.
Stand (STATUS = DEAD) Young (STATUS = DEAD) Thicket (STATUS = DEAD) Windblow (STATUS = DEAD)	The component is 'grown' up to the ASSESSMENT_YEAR according to the strategic regional forecast type. No growing stock volume is estimated for current components.	The component is assumed to become DEAD in the ASSESSMENT_YEAR. Under the zero intervention forecast type, no volume is produced and no restocking takes place. Consequently reporting for DEAD Stand components consists of a separate report of the volume associated with the DEAD Stand component(s) just for the ASSESSMENT_YEAR. The volume is neither harvested nor 'grown on' and no restocking is allowed for. The volume associated with DEAD Stand components in the ASSESSMENT_YEAR is obtained from the calculations carried out for the strategic regional forecast type up to the ASSESSMENT_YEAR, therefore no further calculations are required for DEAD components as part of a zero intervention forecast.

Table A3.2: Biological Potential Forecast (All Sub-Types): growing stock volume forecasts for NFI Forester component types.

NFI Land Use Group	Growing Stock Volume	Notes
Stand	All forecast outputs are produced.	All forecast outputs are produced for all NFI components designated as ‘Stand’, where STATUS = (A)LIVE.
Young	All forecast outputs are produced.	All forecast outputs are produced for all NFI components designated as ‘Stand’, where STATUS = (A)LIVE.
Thicket	All forecast outputs are produced.	All forecast outputs are produced for all NFI components designated as ‘Stand’, where STATUS = (A)LIVE.
Windblow	Effectively restock components only (*i.e.* following clearance of windblow). Assume NFI_BASIC_TYPE changes to "Stand" and NFI_LAND_USE_CODE changes to PHF on restock. Restock components will follow strict no thinning and felling at time of maximum MAI (for no thin regime).	The sub-component is 'grown' up to the ASSESSMENT_YEAR according to the strategic regional forecast type. (In many cases this means calculating the growing stock in the ASSESSMENT_YEAR, without 'growing on'.) However, the sub-component is assumed to become windblow in the ASSESSMENT_YEAR. Volume production is based on the quantity that would be clearfelled in the ASSESSMENT_YEAR, subject to a discount factor. However, under a strategic regional forecast, this volume is assumed to be removed in conjunction with a scheduled harvesting event as specified in the strategic regional prescription. The treatment is different under a biological potential forecast, with harvesting assumed to occur in year NOW. This means that all forecast calculations for Windblow components up to the ASSESSMENT_YEAR are covered under strategic regional prescriptions and the only relevant calculations from the year NOW concern restock.

NFI Land Use Group	Growing Stock Volume	Notes
Stand (STATUS = DEAD) Young (STATUS = DEAD) Thicket (STATUS = DEAD) Windblow (STATUS = DEAD)	Effectively restock components only (*i.e.* following clearance of dead trees). Assume NFI_BASIC_TYPE changes to "Stand" and NFI_LAND_USE_CODE changes to PHF on restock. Restock components will follow strict no thinning and felling at time of maximum MAI (for no thin regime).	The component is 'grown' up to the ASSESSMENT_YEAR according to the strategic regional forecast type. (In many cases this means calculating the growing stock in the ASSESSMENT_YEAR, without 'growing on'.) However, the component is assumed to become DEAD in the ASSESSMENT_YEAR. Volume production is based on the quantity that would be clearfelled in the ASSESSMENT_YEAR, subject to the same discount factor as used for live Windblow (NFI_WINDBLOW_ADJUSTMENT). However, under a strategic regional forecast, this volume is assumed to be removed in conjunction with a scheduled harvesting event as specified in the strategic regional prescription. The treatment is different under a biological potential forecast, with harvesting assumed to occur at NOW. This means that all forecast calculations for DEAD components up to the ASSESSMENT_YEAR are covered under strategic regional prescriptions and the only relevant calculations from NOW concern restock.

Table A3.3: Strategic Regional Forecast Type **and** Management Plans Forecast Type: growing stock volume forecasts for NFI Forester component types.

NFI Land Use Group	Growing Stock Volume	Notes
Stand	All forecast outputs are produced.	All forecast outputs are produced for all NFI components designated as ‘Stand’, where STATUS = (A)LIVE.
Young	All forecast outputs are produced.	All forecast outputs are produced for all NFI components designated as ‘Stand’, where STATUS = (A)LIVE.
Thicket	All forecast outputs are produced.	All forecast outputs are produced for all NFI components designated as ‘Stand’, where STATUS = (A)LIVE.
Windblow	All forecast outputs are produced. All sub-components are included in volume production, biomass production and straightness forecast outputs for windblow, *i.e.* the presumption is that windblow will be 'harvested'.	The sub-component is 'grown' up to the ASSESSMENT_YEAR according to the strategic regional forecast type. (In many cases this means calculating the growing stock in the ASSESSMENT_YEAR, without 'growing on'.) However, the sub-component is assumed to become windblow in the ASSESSMENT_YEAR. Volume production is based on the quantity that would be clearfelled in the ASSESSMENT_YEAR, subject to a discount factor. However, this volume is assumed to be removed in conjunction with a scheduled harvesting event as specified in the Strategic regional management plan. 1. If an associated fell year or final removal year is no more than five years later than the ASSESSMENT_YEAR, allocate the (discounted) volume to this year. 2. If an associated fell year or final removal year is more than five years later than the ASSESSMENT_YEAR, allocate the (discounted) volume to the year of next thinning, assuming this is no more than five years later than the ASSESSMENT_YEAR. 3. If no operation is planned within five years of the ASSESSMENT_YEAR, the (discounted) volume is presented in a separate table and not included in the main volume forecast reports. This table should list the component / coupe combinations and the estimate of the (discounted) volume.

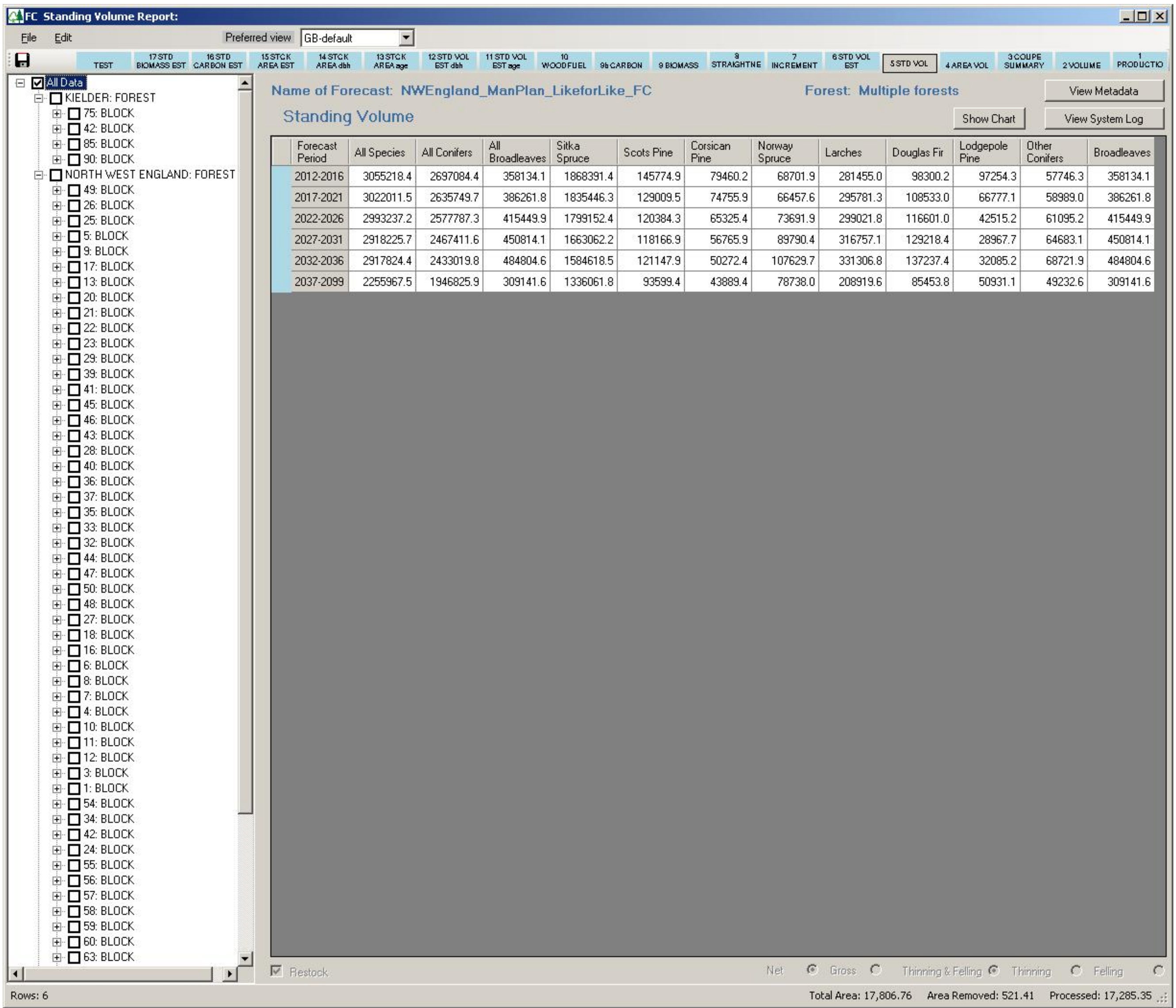
NFI Land Use Group	Growing Stock Volume	Notes
Stand (STATUS = DEAD) Young (STATUS = DEAD) Thicket (STATUS = DEAD) Windblow (STATUS = DEAD)	All forecast outputs are produced. All sub-components are included in volume production, biomass production and straightness forecast outputs for windblow, *i.e.* the presumption is that the DEAD trees will be 'harvested'.	The component is 'grown' up to the ASSESSMENT_YEAR according to the strategic regional forecast type. (In many cases this means calculating the growing stock in the ASSESSMENT_YEAR, without 'growing on'.) However, the sub-component is assumed to become DEAD in the ASSESSMENT_YEAR. Volume production is based on the quantity that would be clearfelled in the ASSESSMENT_YEAR, subject to the same discount factor as used for Windblow (NFI_WINDBLOW_ADJUSTMENT) . However, this volume is assumed to be removed in conjunction with a scheduled harvesting event as specified in the Strategic regional management plan. 1. If an associated fell year or final removal year is no more than five years later than the ASSESSMENT_YEAR, allocate the (discounted) volume to this year. 2. If an associated fell year or final removal year is more than five years later than the ASSESSMENT_YEAR, allocate the (discounted) volume to the year of next thinning, assuming this is no more than five years later than the ASSESSMENT_YEAR. 3. If no operation is planned within five years of the ASSESSMENT_YEAR, the (discounted) volume is presented in a separate table and not included in the main volume forecast reports. This table should list the component / coupe combinations and the estimate of the (discounted) volume.

Table A3.4: Quick Forecast Type: growing stock volume forecasts for NFI Forester component types.

NFI Land Use Group	Growing Stock Volume	Notes
Stand, Young, Thicket, and Windblow (Irrespective of STATUS)	The Quick Forecast Type is not relevant to NFI forecasts.	This Forecast Type is only relevant to the Public Forest Estate.

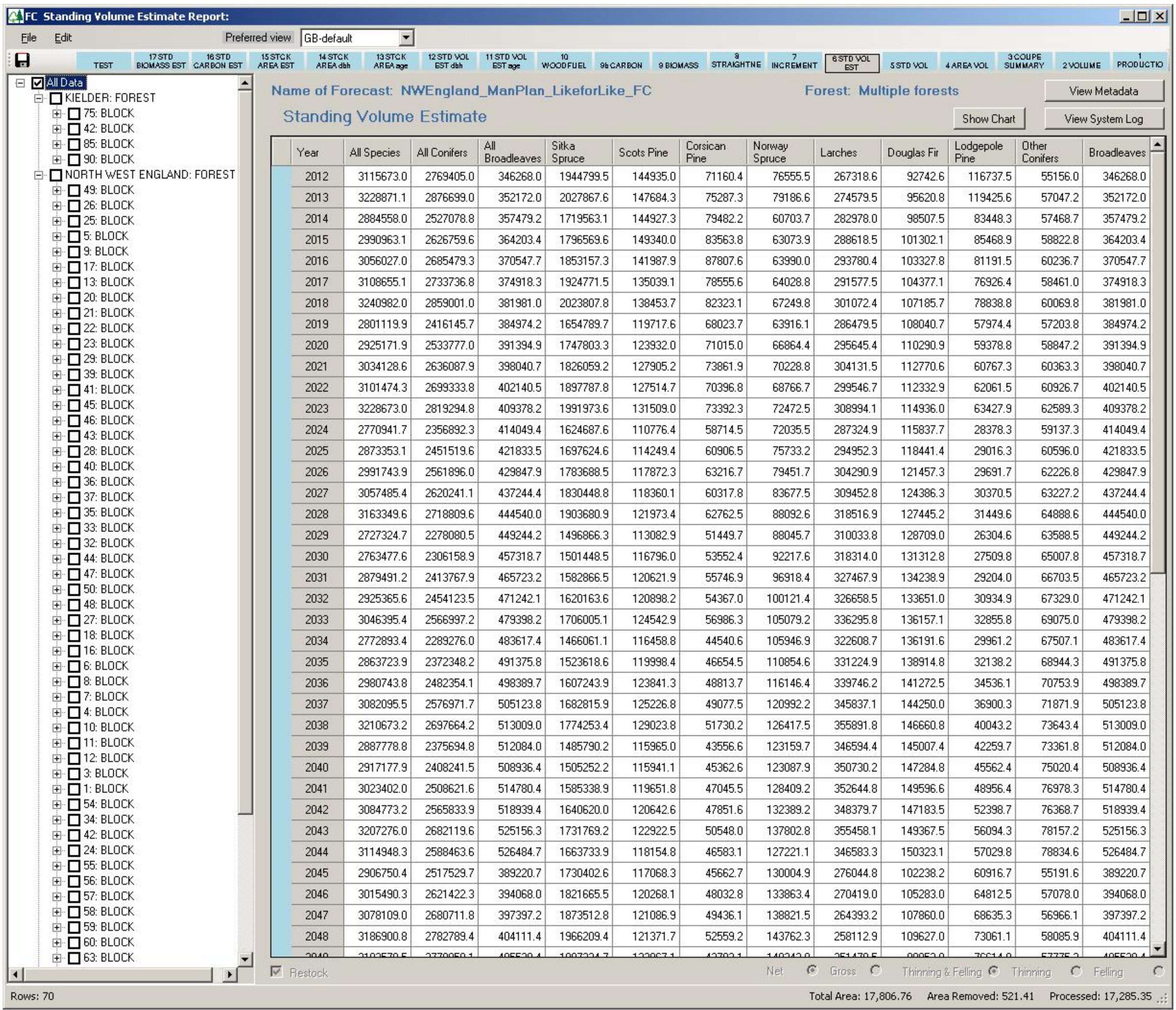
Appendix 4 – Growing stock volume outputs

Example of output screen (Public Forest Estate, North West England)



Forecast Period	All Species	All Conifers	All Broadleaves	Sitka Spruce	Scots Pine	Corsican Pine	Norway Spruce	Larches	Douglas Fir	Lodgepole Pine	Other Conifers	Broadleaves
2012-2016	3055218.4	2697084.4	358134.1	1868391.4	145774.9	79460.2	68701.9	281455.0	98300.2	97254.3	57746.3	358134.1
2017-2021	3022011.5	2635749.7	386261.8	1835446.3	129009.5	74755.9	66457.6	295781.3	108533.0	66777.1	58989.0	386261.8
2022-2026	2993237.2	2577787.3	415449.9	1799152.4	120384.3	65325.4	73691.9	299021.8	116601.0	42515.2	61095.2	415449.9
2027-2031	2918225.7	2467411.6	450814.1	1663062.2	118166.9	56765.9	89790.4	316757.1	129218.4	28967.7	64683.1	450814.1
2032-2036	2917824.4	2433019.8	484804.6	1584618.5	121147.9	50272.4	107629.7	331306.8	137237.4	32085.2	68721.9	484804.6
2037-2099	2255967.5	1946825.9	309141.6	1336061.8	93599.4	43889.4	78738.0	208919.6	85453.8	50931.1	49232.6	309141.6

Figure A4.1 Estimates of standing volume by forecast period.



Year	All Species	All Conifers	All Broadleaves	Sitka Spruce	Scots Pine	Corsican Pine	Norway Spruce	Larches	Douglas Fir	Lodgepole Pine	Other Conifers	Broadleaves
2012	3115673.0	2769405.0	346268.0	1944799.5	144935.0	71160.4	76555.5	267318.6	92742.6	116737.5	55156.0	346268.0
2013	3228871.1	2876699.0	352172.0	2027867.6	147684.3	75287.3	79186.6	274579.5	95620.8	119425.6	57047.2	352172.0
2014	2884558.0	2527078.8	357479.2	1719563.1	144927.3	79482.2	60703.7	282978.0	98507.5	83448.3	57468.7	357479.2
2015	2990963.1	2626759.6	364203.4	1796569.6	149340.0	83563.8	63073.9	288618.5	101302.1	85468.9	58822.8	364203.4
2016	3056027.0	2685479.3	370547.7	1853157.3	141987.9	87807.6	63990.0	293780.4	103327.8	81191.5	60236.7	370547.7
2017	3108655.1	2733736.8	374918.3	1924771.5	135039.1	78555.6	64028.8	291577.5	104377.1	76926.4	58461.0	374918.3
2018	3240982.0	2859001.0	381981.0	2023807.8	138453.7	82323.1	67249.8	301072.4	107185.7	78838.8	60069.8	381981.0
2019	2801119.9	2416145.7	384974.2	1654789.7	119717.6	68023.7	63916.1	286479.5	108040.7	57974.4	57203.8	384974.2
2020	2925171.9	2533777.0	391394.9	1747803.3	123932.0	71015.0	66864.4	295645.4	110290.9	59378.8	58847.2	391394.9
2021	3034128.6	2636087.9	398040.7	1826059.2	127905.2	73861.9	70228.8	304131.5	112770.6	60767.3	60363.3	398040.7
2022	3101474.3	2699333.8	402140.5	1897787.8	127514.7	70396.8	68766.7	299546.7	112332.9	62061.5	60926.7	402140.5
2023	3228673.0	2819294.8	409378.2	1991973.6	131509.0	73392.3	72472.5	308994.1	114936.0	63427.9	62589.3	409378.2
2024	2770941.7	2356892.3	414049.4	1624687.6	110776.4	58714.5	72035.5	287324.9	115837.7	28378.3	59137.3	414049.4
2025	2873353.1	2451519.6	421833.5	1697624.6	114249.4	60906.5	75733.2	294952.3	118441.4	29016.3	60596.0	421833.5
2026	2991743.9	2561896.0	429847.9	1783688.5	117872.3	63216.7	79451.7	304290.9	121457.3	29691.7	62226.8	429847.9
2027	3057485.4	2620241.1	437244.4	1830448.8	118360.1	60317.8	83677.5	309452.8	124386.3	30370.5	63227.2	437244.4
2028	3163349.6	2718809.6	444540.0	1903680.9	121973.4	62762.5	88092.6	318516.9	127445.2	31449.6	64888.6	444540.0
2029	2727324.7	2278080.5	449244.2	1496866.3	113082.9	51449.7	88045.7	310033.8	128709.0	26304.6	63588.5	449244.2
2030	2763477.6	2306158.9	457318.7	1501448.5	116796.0	53552.4	92217.6	318314.0	131312.8	27509.8	65007.8	457318.7
2031	2879491.2	2413767.9	465723.2	1582866.5	120621.9	55746.9	96918.4	327467.9	134238.9	29204.0	66703.5	465723.2
2032	2925365.6	2454123.5	471242.1	1620163.6	120898.2	54367.0	100121.4	326658.5	133651.0	30934.9	67329.0	471242.1
2033	3046395.4	2566997.2	479398.2	1706005.1	124542.9	56986.3	105079.2	336295.8	136157.1	32855.8	69075.0	479398.2
2034	2772893.4	2289276.0	483617.4	1466061.1	116458.8	44540.6	105946.9	322608.7	136191.6	29961.2	67507.1	483617.4
2035	2863723.9	2372348.2	491375.8	1523618.6	119998.4	46654.5	110854.6	331224.9	138914.8	32138.2	68944.3	491375.8
2036	2980743.8	2482354.1	498389.7	1607243.9	123841.3	48813.7	116146.4	339746.2	141272.5	34536.1	70753.9	498389.7
2037	3082095.5	2576971.7	505123.8	1682815.9	125226.8	49077.5	120992.2	345837.1	144250.0	36900.3	71871.9	505123.8
2038	3210673.2	2697664.2	513009.0	1774253.4	129023.8	51730.2	126417.5	355891.8	146660.8	40043.2	73643.4	513009.0
2039	2887778.8	2375694.8	512084.0	1485790.2	115965.0	43556.6	123159.7	346594.4	145007.4	42259.7	73361.8	512084.0
2040	2917177.9	2408241.5	508936.4	1505252.2	115941.1	45362.6	123087.9	350730.2	147284.8	45562.4	75020.4	508936.4
2041	3023402.0	2508621.6	514780.4	1585338.9	119651.8	47045.5	128409.2	352644.8	149596.6	48956.4	76978.3	514780.4
2042	3084773.2	2565833.9	518939.4	1640620.0	120642.6	47851.6	132389.2	348379.7	147183.5	52398.7	76368.7	518939.4
2043	3207276.0	2682119.6	525156.3	1731769.2	122922.5	50548.0	137802.8	355458.1	149367.5	56094.3	78157.2	525156.3
2044	3114948.3	2588463.6	526484.7	1663733.9	118154.8	46583.1	127221.1	346583.3	150323.1	57029.8	78834.6	526484.7
2045	2906750.4	2517529.7	389220.7	1730402.6	117068.3	45662.7	130004.9	276044.8	102238.2	60916.7	55191.6	389220.7
2046	3015490.3	2621422.3	394068.0	1821665.5	120268.1	48032.8	133863.4	270419.0	105283.0	64812.5	57078.0	394068.0
2047	3078109.0	2680711.8	397397.2	1873512.8	121086.9	49436.1	138821.5	264393.2	107860.0	68635.3	56966.1	397397.2
2048	3186900.8	2782789.4	404111.4	1966209.4	121371.7	52559.2	143762.3	258112.9	109627.0	73061.1	58085.9	404111.4

Figure A4.2 Annual estimates of standing volume.

Examples of graphical output

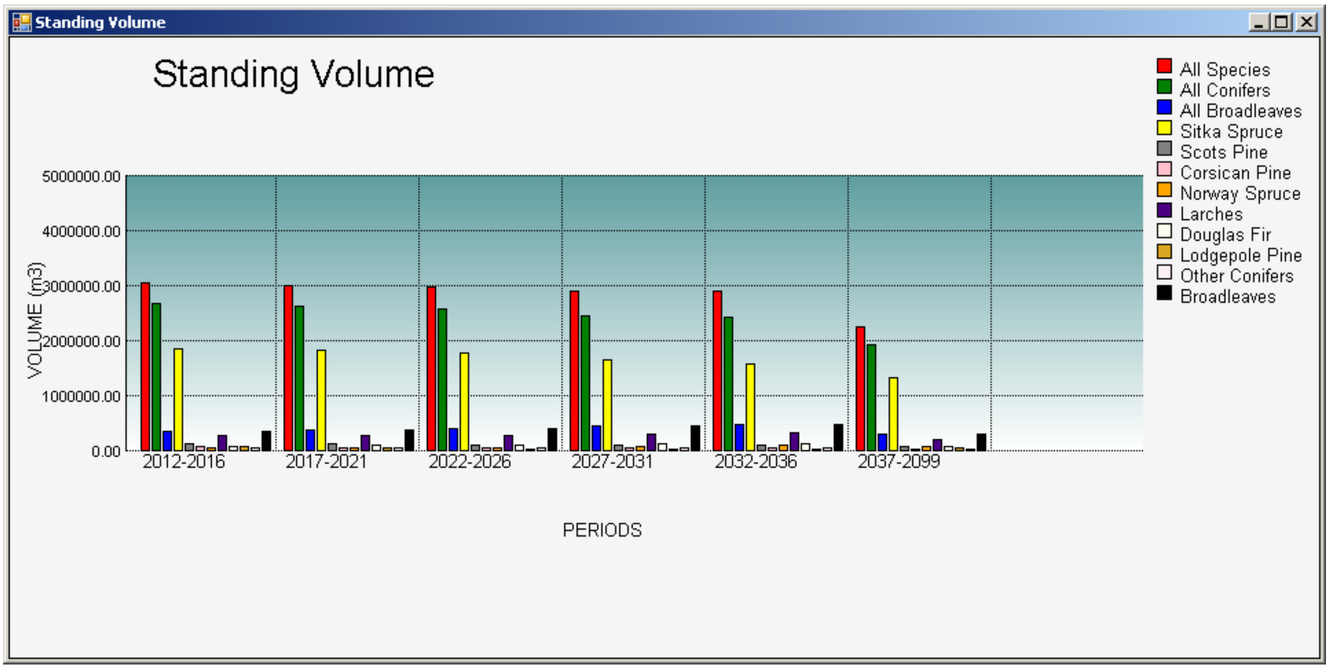


Figure A4.3 Graphical display of the estimates of standing volume by forecast period.

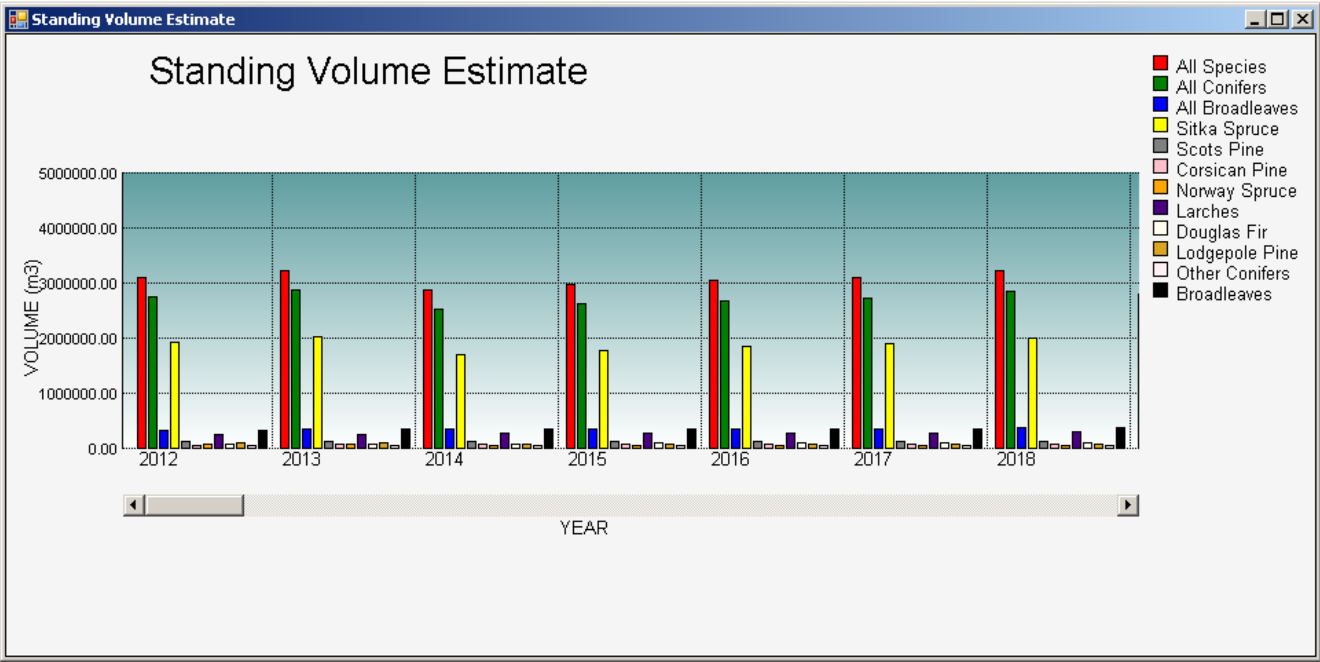


Figure A4.4 Graphical display of the annual estimates of standing volume (note the slider bar).