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Australian native forest commerciality

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Summary

The Australian Sawlog Commerciality Database is the first spatial database of potential sawlog merchantability and productivity for Australia's native forests. It shows native forests capable of producing sawlogs commercially in Australia. This report describes how the database was developed and validated.

Commerciality is the expected volume yield of commercial sawlog (or veneer log or high-value equivalents) that is available from a forest stand over the long term, assuming good silvicultural practices are followed. Commerciality is derived from a combination of the merchantability and productivity of forest stands. Merchantability is a forest stand attribute based on tree species composition and stand structure, and refers to a forest stand's suitability for pulp, sawlog or speciality wood products. It focuses on commercial production of sawlogs or other high-quality products. Productivity is also a forest stand attribute, and describes the potential yield of sawlogs from a forest stand.

To create the spatial database, ABARES obtained measures of sawlog merchantability and productivity from datasets in the National Forest Inventory (NFI) that had forest and tenure time-stamps of 2006. These measures were combined into attributes useful for mapping forest commerciality on a national scale. The database incorporates forest yield associations, which are groupings of forest types that display similar commerciality attributes. ABARES developed the national database using Regional Forest Agreement datasets, FORWOOD and Resource Assessment Commission data and estimates of productivity, and information provided directly to the NFI or published by state and territory agencies.

ABARES compared mapped outputs from the Australian Sawlog Commerciality Database with Landsat, Google Earth and SPOT5 imagery to validate and determine the accuracy of the mapped layers and yield associations. Advice from the Queensland, South Australian and New South Wales governments on draft database outputs was incorporated to validate the database.

The database covers the six tenure classes used to describe forest tenure in Australia's state of the forests reports. Multiple-use public forest, leasehold forest and private forest are the main tenures reported because forests on these tenures are generally available for sawlog harvesting.

The database was updated with forest and tenure estimates reported in *Australia's state of the forests report 2013*. A total of 36.6 million hectares of native forest were assessed as available and commercially suitable for sawlog harvesting in 2011. Of this, 7.5 million hectares of public native forest were available for commercial sawlog production, all on multiple-use public forest. A further 29.1 million hectares of leasehold and private tenure forests were potentially available and suitable for commercial sawlog production, subject to landholder intent, markets and environmental constraints. Of the 36.6 million hectares, 9.8 million hectares were classified in the database as moderate, high or very high commerciality—4.7 million hectares of public native forest and 5.1 million hectares of leasehold and private tenure forests.

The Australian Sawlog Commerciality Database can be used to analyse forest merchantability and productivity. It fills identified gaps in information on Australia's forest estate, and is an important resource when forecasting native forest wood supply and analysing the effects of climate change on forest commerciality and climate-related forest policy. The database contains data of varying age and the level of confidence for the data input depends on the age of that data. Access to the data is restricted because it contains some commercial-in-confidence information.

1 Introduction

Australia's native forest timber and wood-based products are sourced primarily from multiple-use public native forests and native forests on leasehold and private tenure in New South Wales, Queensland, Tasmania, Victoria and Western Australia. Limited supplies of products are provided periodically from native forests on leasehold and private tenures in the Northern Territory. By regulation, no commercial harvesting occurs in native forests in the Australian Capital Territory or South Australia (MIG 2008; MIG & NFISC 2013).

In 2009, following publication of *Australia's state of the forests report 2008* (MIG 2008), the former Bureau of Rural Sciences (BRS) and the former Australian Bureau of Agricultural and Resource Economics (ABARE) undertook a stocktake and gap analysis of data for Australia's forests and forest-products industries (BRS & ABARE 2009). This stocktake identified the need for a database of commercial sawlog productivity. Such a database was required for national and international reporting and to inform forest policy and forest industry development.

This report describes the development of this national spatial database of native forest sawlog merchantability and productivity—the Australian Sawlog Commerciality Database. This is the first spatial database that shows the extent of potentially commercial forests for sawlog in Australia. This report sets out how the database was derived and built, and the processes used to validate it. Historical data from the 1974 Forestry and Wood-based Industries Development Conference (FORWOOD) (Forest Resources 1974) and the 1992 Forest and Timber Inquiry of the Resource Assessment Commission (RAC inquiry) (Resource Assessment Commission 1992a), as well as recent data, were captured spatially to create the database. The database has already assisted in understanding the biophysical impacts of climate change on the forestry and forest products industries at a regional level (ABARES 2011). It has been used in *Australia's state of the forests report 2013* (MIG & NFISC 2013) and in Australia's submission to the Food and Agriculture Organization of the United Nations Global Forest Resources Assessment to be published in 2015.

In this report the term merchantability describes a tree species' suitability for sawlog, pulp or specialty wood products, focusing on commercial production of sawlogs or high-value equivalents. The merchantability of a forest stand is derived from its yield association, which is generally used as a surrogate of merchantability. A yield association is a grouping of forest types, based on floristic and structural information, that display similar commercial productivity and merchantability attributes. Productivity describes the potential yield of sawlogs from a forest, expressed as mean annual increment—cubic metres sawlog per hectare per year. It describes the volume growth of trees per unit area at peak mean annual increment in fully stocked forest stands provided ideal silvicultural systems are in place. Commerciality is the expected volume yield of sawlog or veneer log (or high-value equivalents—primarily logs classed as girders, poles and piles) from merchantable species that is available from a forest stand over the long term, assuming good silvicultural practices are followed. Commerciality is derived from a combination of the merchantability and productivity. Forest stands with merchantable trees and high productivity have higher commerciality.

The term 'suitable' in this report refers to forest that is commercially suitable for sawlog production, whether historically recognised as such by federal, state and territory forest agencies or mapped as such in the Australian Sawlog Commerciality Database. The term

‘available’ refers to forest where harvesting is permitted and is not legally restricted by legislation, code of practice or management plan (MIG & NFISC 2013).

The Australian Sawlog Commerciality Database covers all tenure classes, but it reports mainly on multiple-use public forest, leasehold forest and private forest because forests on these tenures are generally available for sawlog harvesting; and is spatial at a one-hectare scale. Historical data have been used where updated data were unavailable. Wood-supply zones (forest zones) based on historical forest regions and land-use management regions are linked to the coverage.

The database may be used:

- to describe the merchantability, productivity and commerciality of Australia’s forests
- to identify forests suitable for commercial sawlog production
- when combined with other commercial forest information about management constraints and intent, to predict supply to the forest industry of native forest sawlogs and other forest products
- when combined with other ABARES-held datasets and systems, to analyse the impacts of forest-related policies and decisions and predicted impacts of climate change
- to provide advice for policy development
- when combined with other commercial and environmental information on forests, to assess catchment, bioenergy and agroforestry issues.

2 Methodology

The Australian Sawlog Commerciality Database—previously called Potential Productivity of Australia's Native Forest (2010) (v 1.0) in Mutendeudzi and Stafford-Bell (2011)—is a compilation dataset with contributions from many forest and vegetation agency datasets. ABARES compiled the database using information obtained from the states and territories during forest inquiries and studies including the FORWOOD conference in 1974, the RAC Forest and Timber Inquiry in 1992, Regional Forest Agreement (RFA) assessments in New South Wales, Victoria, Queensland, Western Australia and Tasmania between 1995 and 2000, and more recent data.

ABARES used tabular and spatial data from these inquiries and studies to build a consolidated forest productivity and commerciality database. Tables of productivity, merchantability and commerciality were compiled from RFA, RAC and FORWOOD sources based on yield association.

The native forests spatial layer was built by combining the National Vegetation Information System (NVIS version 3.1) and the National Forest Inventory (NFI) datasets with tabular productivity and commerciality datasets from the RAC inquiry and RFA assessments that identified potential native forest productivity and commerciality across all states and territories. The NFI forest dataset at 2008 (MIG 2008), which incorporates selected attributes of the NVIS version 3.1 dataset and other data (Mutendeudzi & Stafford-Bell 2011), was used as the primary and most up-to-date source of forest cover when the Australian Sawlog Commerciality Database was developed. In New South Wales, NVIS version 3.1 species and structural descriptions were used to classify forest into Research Note No. 17 forest types (Baur 1979) where spatial coverages of these forest types were unavailable. The inputs used to generate each state and territory dataset are further discussed below.

Where spatial yield association data were unavailable, indicator species were used to filter NVIS descriptions to identify merchantable species and, where indicator species were found, the NVIS-ID was assigned a yield association. The yield association was then used to link productivity and commerciality data. Where NVIS was incomplete, inconsistent or unable to supply forest information, NFI and RFA spatial data were used. Potential misclassifications or errors in interpretation or in translating into yield associations were checked against NVIS, NFI data and remotely sensed data (Figure 1 and Table 1).

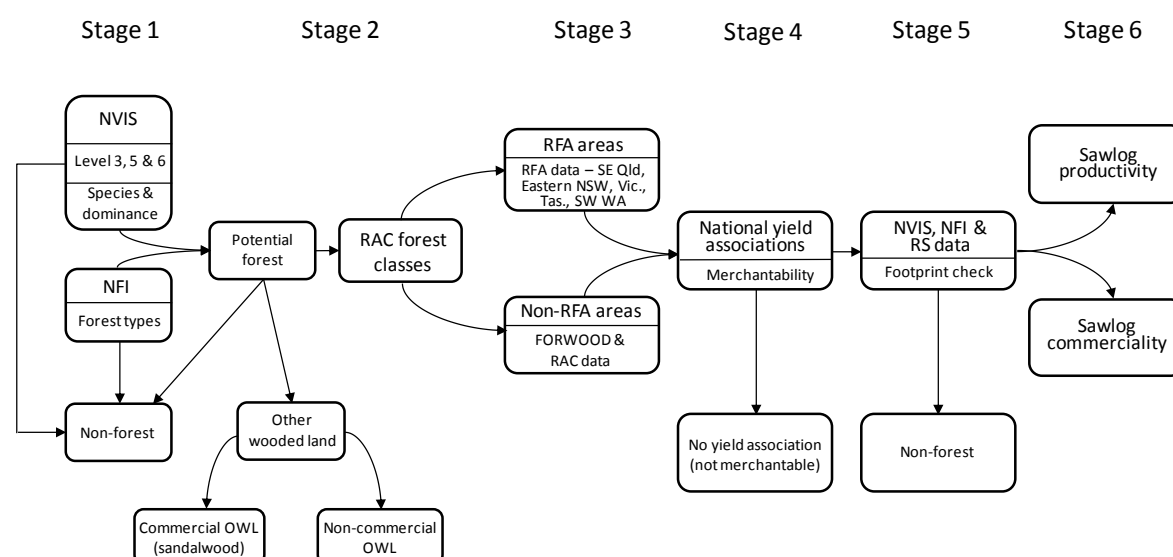
National forest zones were developed based on the FORWOOD, RAC and state-based management zones. The national zones were used to organise the productivity information from FORWOOD, RAC and RFA data sources and to apply zone-specific yield associations and productivity information found in these data sources. FORWOOD and RAC information was used in forest regions not assessed for Regional Forest Agreements.

The input datasets (FORWOOD, RAC and RFA) have inherent limitations. Their data relate to the period before 2003, and productivity values are based on silvicultural regimes, sawlog specifications (including specifications of piles and poles) and forest codes current before or at 2000.

Yield associations identified in the various data sources (FORWOOD, RAC, preliminary classifications by the NFI, and state-based RFA processes) were updated, compiled and classified into national yield associations (described in Appendix A). Appendix B describes

the categories of sawlogs used in Australia. The overall approach to building the database is shown in Figure 1 and Table 1.

Figure 1 Data flow



Note: **FORWOOD** 1974 Forestry and Wood-based Industries Development Conference. **MAI** Mean annual increment. **NFI** National Forest Inventory. **NSW** New South Wales. **NVIS** National Vegetation Information System. **OWL** Other wooded land. **RAC** Resource Assessment Commission. **RFA** Regional Forest Agreement. **RS** Remote sensing. **SE Qld** South-east Queensland. **SW WA** South-west Western Australia. **Tas.** Tasmania. **Vic.** Victoria.

Table 1 Stages in developing the Australian Sawlog Commerciality Database

Stage	Activity	Description
1	NVIS and NFI data input a	NVIS and NFI databases are broadly classed into forest and non-forest categories. NFI data are used where NVIS is incomplete or is only at level 1, 2 or 3. At this stage, the data include areas of potential forest (that is, areas unable to be defined categorically as non-forest).
2	Assembly into RAC forest classes	NVIS and NFI potential forests are classified into the RAC forest classes where species and structural information is available or into 'other wooded land' (OWL) (Figure 1). Sandalwood in other wooded land is identified and classified at this point, and sandalwood in forest is annotated.
3	Sorting into RFA and non-RFA areas	Forests and associated information are divided into two area classes: RFA and non-RFA.
4	Classifying into yield associations for merchantability	Forests are classed into yield associations based on their composition and the yield/productivity and merchantability data garnered through either the RFA process or the information in FORWOOD and RAC data tables. The most up-to-date or complete data take precedence.
5	Checking yield associations	The resulting yield associations are checked for consistency against NVIS and NFI data and inconsistencies are compared against remotely sensed data to assess visually whether the forest yield association matches up with remotely sensed cover information. As a result of this process, NVIS descriptions are further examined and either excluded as non-forest or retained in the yield association database.
6	Assembly of products	Products are mapped and results produced. Productivity and commerciality (combination of merchantability and productivity) are examples of products.

a Levels 1, 2 and 3 refer to the NVIS information hierarchy associated with the availability of NVIS data (1 minimal data to 6 comprehensive). Vegetation data are available at: 1—Class, 2—Structural formation, 3—Broad floristic formation, 4—Sub-formation, 5—Association, 6—Sub-association (see ESCAVI 2003).

When determining productivity and commerciality, economic viability for commercial sawlog production and geographic limitations on accessing the resource have not been considered. As a result, the forests identified in this work should be referred to as potentially commercial.

Input information

National Vegetation Information System and National Forest Inventory

Two national-scale datasets provide floristic information on forests: the National Vegetation Information System (NVIS) and the National Forest Inventory's (NFI) Forests of Australia datasets (see [NVIS](#) and [Forests of Australia 2013](#) websites).

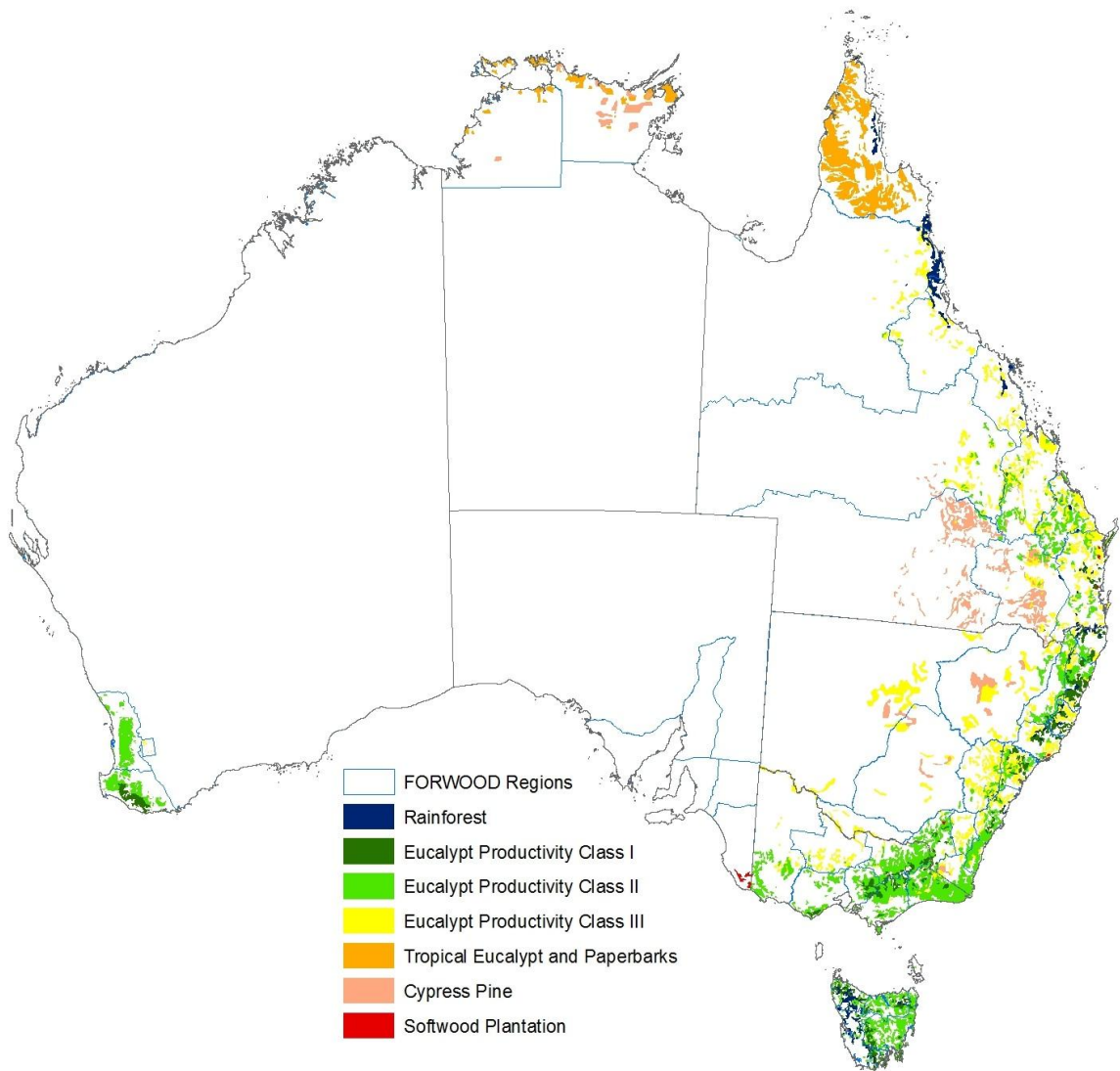
The NVIS comprises a multi-layer nested description of floristic structure; each layer or level describes increasing complexity and strata. Each unique combination of floristics and structure is given a unique value—the NVIS-ID.

The NFI dataset largely comprises a subset of filtered NVIS data, with forest types grouped into nationally reported categories. The NFI dataset lacks the detail required to derive and apply national yield associations, so NVIS data are required as an input.

Forest resource estimates

National forest resource estimates were first compiled for the Forestry and Wood-based Industries Development Conference (FORWOOD) in 1974 (Australian Forestry Council 1975; Forest Resources 1974). At that time, productive and potentially productive native forests (rainforest, eucalypt forest and cypress pine forest) and plantations in Australia occupied an estimated 42.5 million hectares. A further 140 million hectares of forest and woodland were estimated to surround these productive forests, within a coastal band defined by the 500 millimetre isohyets and the Australian coastline. Map 1 and Map 2 show where FORWOOD identified productive forests to occur, classed as FORWOOD forest productivity classes and FORWOOD forest types, respectively.

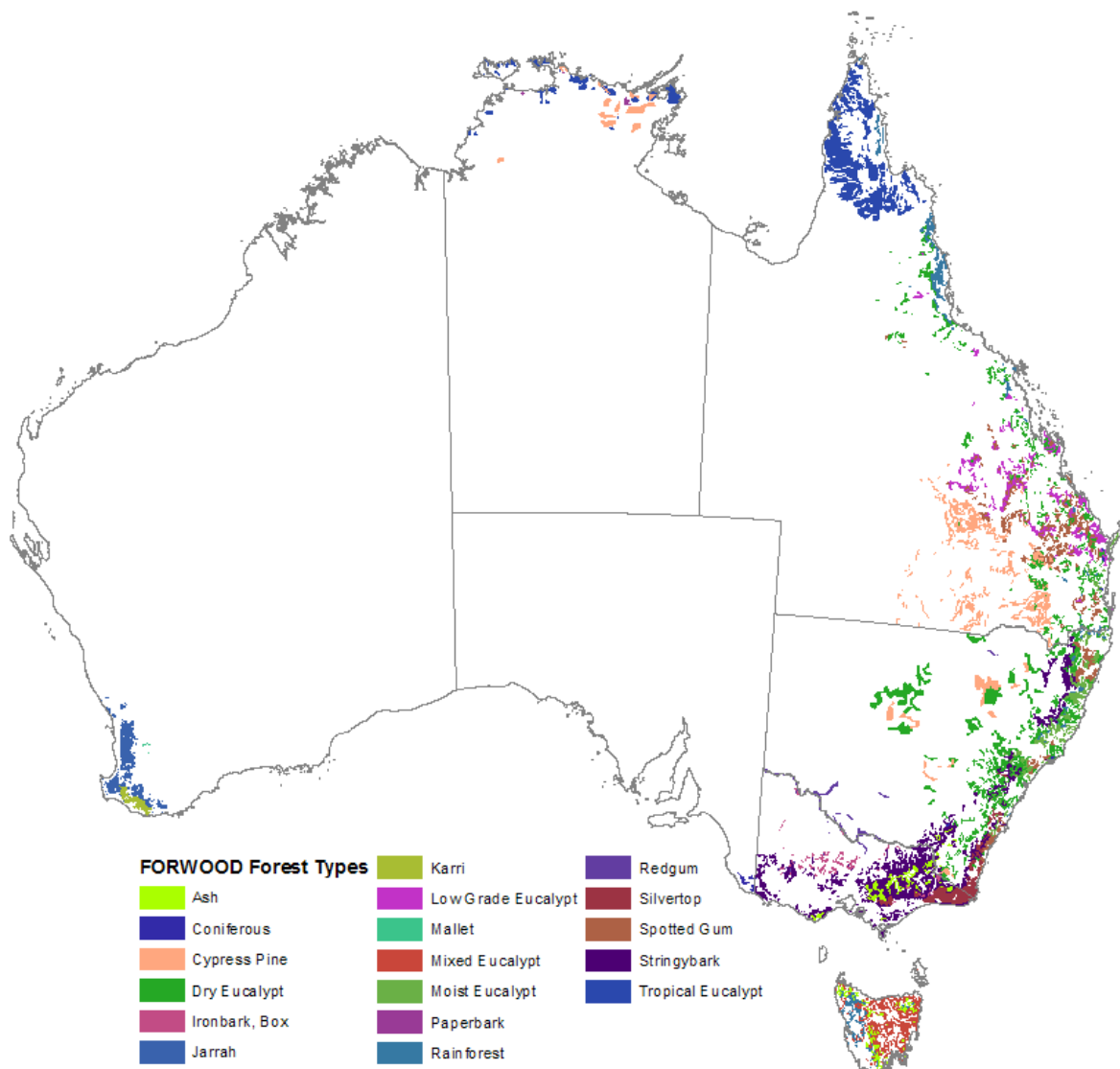
Future wood availability estimates to 2010 were reported at FORWOOD by state and forest region and were based on growth and yield estimates from the states and the Commonwealth (the latter primarily for the Australian Capital Territory and the Northern Territory). These estimates were based on silvicultural practices and utilisation standards at that time, and reported by FORWOOD production forest region (Map 1). Mean annual increments (merchantable cubic metres per hectare per year) were used in these estimates and included both sawlog and pulpwood yield, expressed over the cutting cycle or rotation length. Economic and access constraints were identified in the FORWOOD forest resource estimates for productive forests in Queensland, Western Australia and the Northern Territory (Forest Resources 1974). The Forest and Timber Bureau archived FORWOOD information. The National Forest Inventory accessed archived information in 1990 to help with its strategic planning.

Map 1 FORWOOD 1975 production forest regions and forest productivity classes

Note: In classifying productivity in FORWOOD, Eucalypt Productivity Class I was the highest class and Class III the lowest.
Source map scale 1:2 500 000.

Data sources: ABARES; Australian Forestry Council 1975; DNM & FTB 1973; National Forest Inventory

Map 2 FORWOOD forest types



Note: Coniferous type refers to softwood plantations in Map 1. The Hardwood plantation FORWOOD forest type was not spatially captured in the source map used to derive this map. Source map scale 1:2 500 000.

Data sources: ABARES; Australian Forestry Council 1975; DNM & FTB 1973; National Forest Inventory.

In 1990–91 the Resource Assessment Commission undertook a forest resource assessment (Resource Assessment Commission 1992a) as part of its Forest and Timber Inquiry (Resource Assessment Commission 1992b). The survey covered productive forests and plantations in regions covered by the FORWOOD conference. Forests outside these regions were also assessed where information was available.

The RAC process identified 43.185 million hectares of productive native forests and 1 million hectares of plantations (Resource Assessment Commission 1992a, b). The survey database was based on Australian Forestry Council forest regions (Map 3) (Resource Assessment Commission 1992a). Growth and yield data in the survey updated the state and territory information used in FORWOOD. The inquiry identified a further 92 million hectares of forests and woodlands that were not included in the survey. Information collated during the survey included forest type descriptions and extent, height, forest cover, standing and merchantable volume, area available for harvesting, mean annual increments (sawlog, total merchantable and biomass), product categories and silviculture regime by forest types. Following the

inquiry, the survey database and ancillary information were lodged with the NFI at the then Bureau of Rural Sciences. The NFI continued to compile information on forest yield associations and management data in the period between the inquiry and the start of the Regional Forest Agreement (RFA) processes in 1995.

Map 3 Australian Forestry Council regions



Note: Australian Forestry Council regions at 1989.

Data sources: ABARES; National Forest Inventory (RAC data)

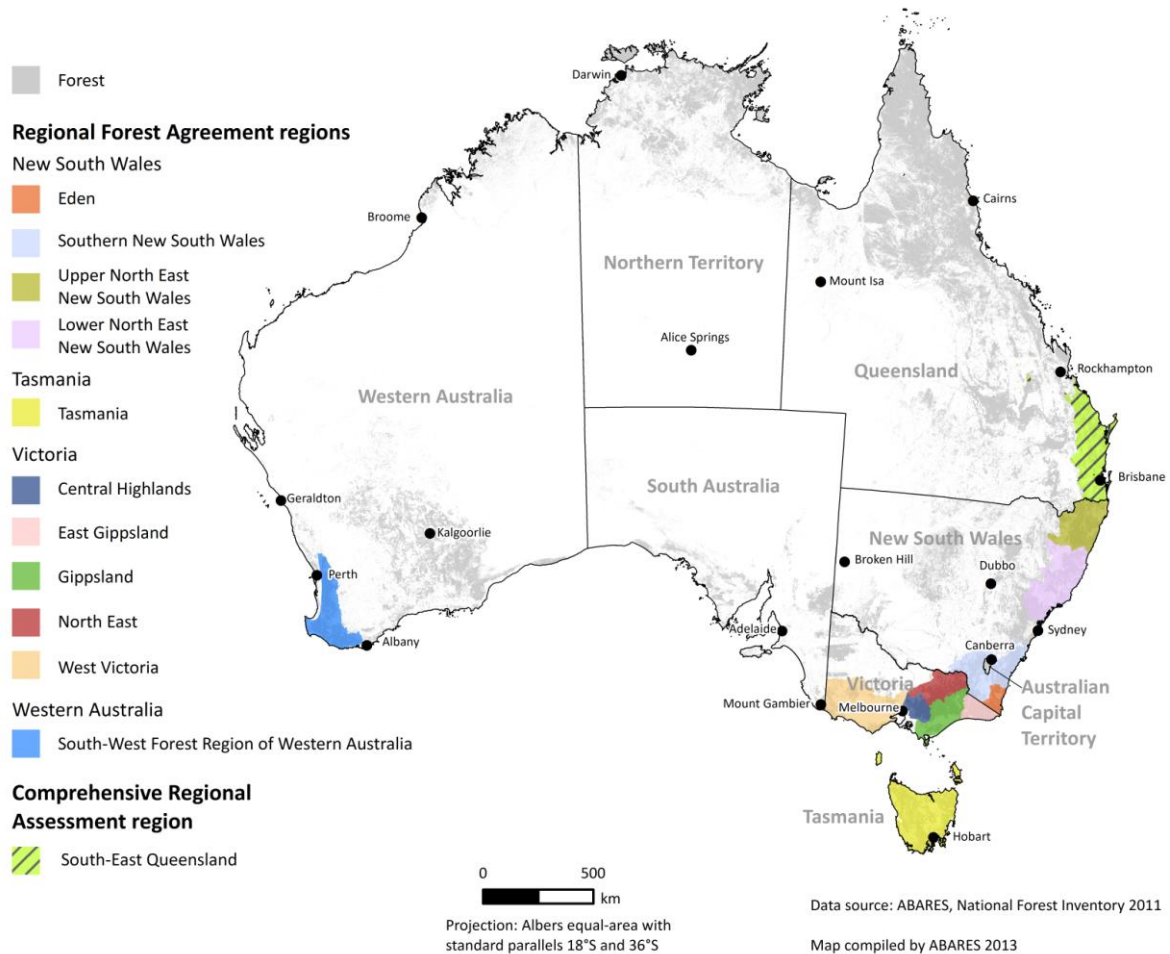
During the RFA process (1995–2001) Australian and state government agencies, with consultants, undertook comprehensive regional assessments and compiled resource information including forest type, product ratios, forest commerciality, and growth and yield information for forests within the forest agreement regions (Map 4).

Spatial capture of yield and forest resource information

ABARES needed to spatially capture yield and resource estimates from previous assessments to inform development of the Australian Sawlog Commerciality Database. Growth and yield information from a variety of sources—FORWOOD, the RAC forest survey database and related Bureau of Rural Sciences data, NFI databases, comprehensive regional assessment (CRA) reports, and Commonwealth–state forest information databases used in RFA processes (Bugg, Spencer & Lee 2002)—were compiled and collated into 47 forest zones (Map 5). These zones are based on previous regions (Map 1 and Map 3) and state-based management zones. Commercial types, yield associations and mean annual increment data from this compilation

were mapped spatially using NFI databases, RFA forest classifications and data systems, and the NVIS.

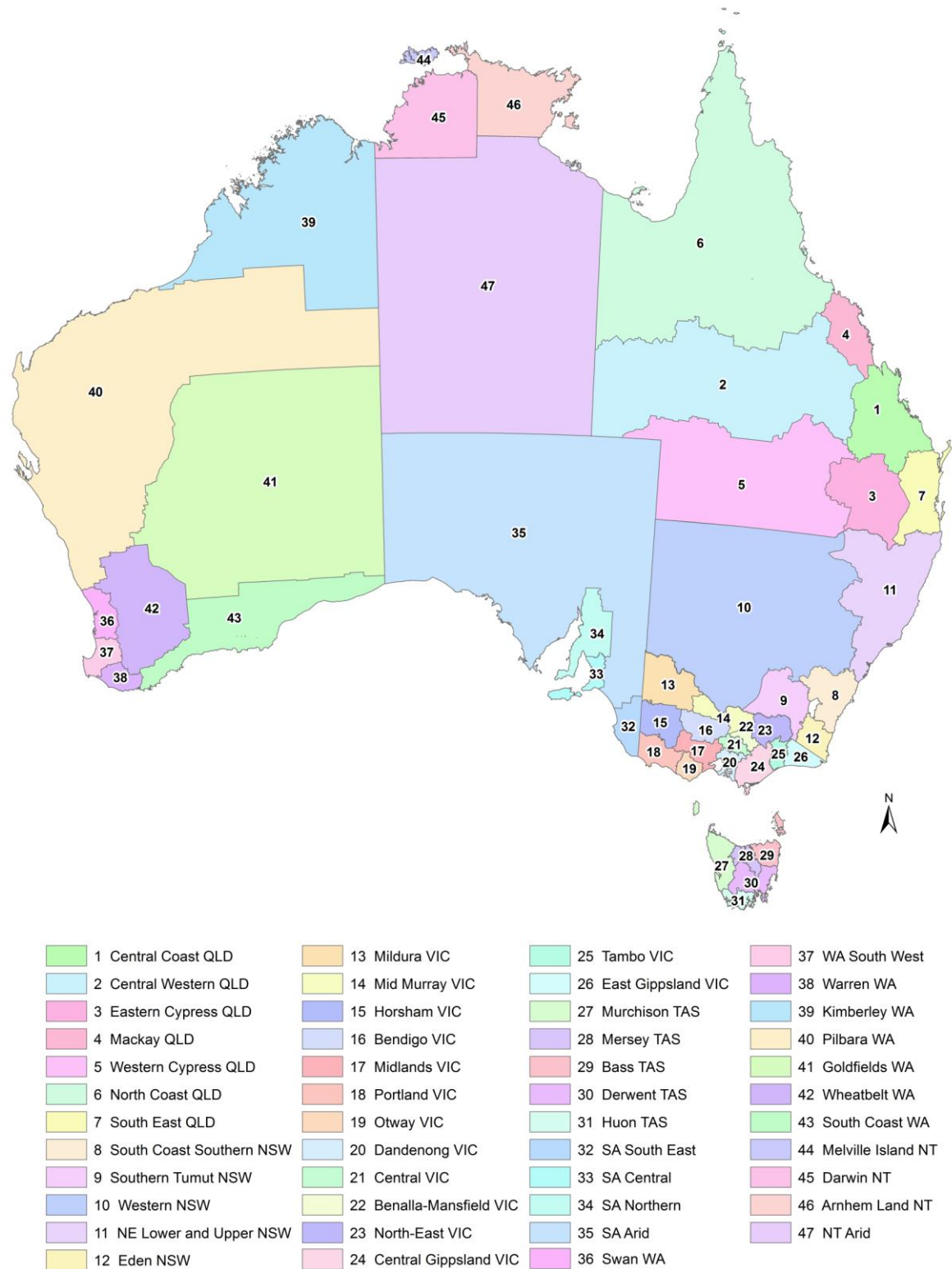
Map 4 Regional Forest Agreement and comprehensive regional assessment regions



Data sources: ABARES; Regional Forest Agreement (RFA), comprehensive regional assessment (CRA) regions and forest cover data are from MIG & NFISC 2013.

In New South Wales, Research Note No. 17 forest types (Baur 1979) and their associated silviculture systems (Baur 1989) formed the basis of the productivity and commerciality assessments of forest types reported in the RAC survey (Resource Assessment Commission 1992b) and the basis of comprehensive regional assessments resource information. NFI forest information databases used in developing the Australian Sawlog Commerciality Database were tagged with Research Note No. 17 forest types across New South Wales to enable RAC and RFA data to be used.

Map 5 Forest zones used in the analysis



Data sources: ABARES; National Forest Inventory

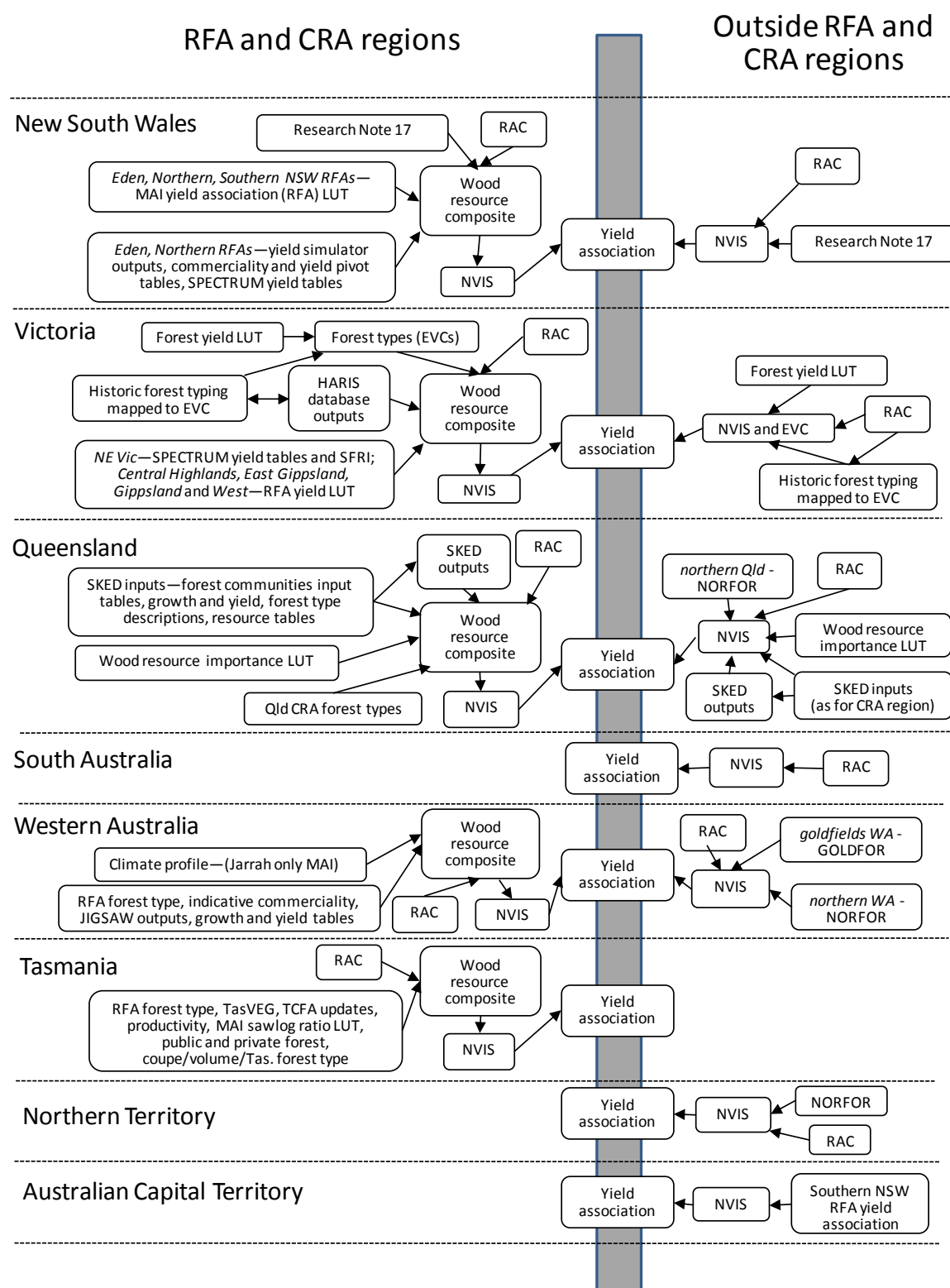
Rule set for classifying forest yield data

The Australian Sawlog Commerciality Database is a spatial database built on a national 100 metre grid in equal area projection. A value attribute table (.vat) containing a range of values and join fields allows the database to be populated with data from other relevant grids and datasets.

Yield indicators for Australian forests fall into two categories: those developed as part of RFA assessments and those that were not. Two rule sets were developed to classify information into forest yield data that could be used to estimate productivity and commerciality, one for RFA/CRA forest areas and one for non-RFA forest areas.

The Bureau of Rural Sciences compiled wood resource composite (WRC) tables during and following completion of the RFAs, from several available RFA data tables. The WRC tables contain all the available resource information for forests in a jurisdiction, and a unifying classification field: the yield association. In many cases the original databases have been lost or are unavailable; the retained output tables from the original databases were used instead. Figure 2 shows the input data used to formulate the WRC tables for the RFA areas. For those areas of identified forest not contained in an RFA/CRA region (called non-RFA areas), yield association tables were compiled using the best available species/structural information for each state. Figure 2 shows the input datasets used for non-RFA areas.

Figure 2 Input data used to create the yield association table



Note: **NVIS** National Vegetation Information System database that has been manipulated by ABARES. **RAC** RAC forest survey database 1991. **HARIS**, **JIGSAW**, **SFRI**, **SKED** and **SPECTRUM** are forest inventory or yield modelling systems. **EVC**, **GOLDFOR**, **NORFOR** and **TasVEG** are vegetation databases. **CRA** Comprehensive regional assessment. **LUT** Lookup table. **MAI** Mean annual increment (sawlog). **RFA** Regional forest agreement. **TCFA** Tasmanian Community Forest Agreement. Data sources: ABARES; National Forest Inventory

Productivity

In this report productivity describes the potential yield of sawlogs from a forest stand. Productivity data were expressed as mean annual increment (MAI)—cubic metres per hectare per year for sawlog—and were drawn from available sources. Notable data sources were RFA datasets, FORWOOD and RAC survey estimates of productivity, and information provided directly to the NFI or published by a state agency. States and territories' definitions of sawlog are described in detail at Appendix B. Further descriptions are contained in James (2001).

Sawlog productivity values—expressed as MAI—were assigned to each yield association containing merchantable species in each forest zone. The MAI values ascribed to the data were further classed into the categories provided in Table 2.

Table 2 Productivity classes

Productivity class	Sawlog MAI range (m ³ /hectare/year)
Limited	0.01–0.07
Very low	0.08–0.14
Low	0.15–0.28
Moderately low	0.30–0.49
Moderate	0.50–0.95
Moderately high	1.0–1.45
High	1.5–1.9
Very high	2.0–2.9
Extremely high	3.0–5.6

Note: The sawlog MAI range of forest with a value of less than or equal to 0.005 was rounded to zero, and the sawlog MAI range of forest with a value greater than 0.005 was rounded to 0.01. Forests that produce no sawlog are allocated a sawlog MAI value of zero.

Commerciality

The merchantability of a forest stand is derived from its yield association. For classing forest into commerciality value classes, commerciality is defined as the presence of merchantable species combined with the potential productivity of those species to produce a sawlog. Commerciality estimates were based on merchantability and productivity data from RFA and RAC datasets, FORWOOD estimates of productivity, and information about the commerciality of forest types provided directly to the NFI or published by state agencies over the period 1975 to 2002. Victoria was the only state to use a 'very low' category description to classify forest and was the only state where this category was included in state agency data. Table 3 describes the classes of commerciality used.

Estimates of commerciality are based on the composition of merchantable trees in forest stands (generally described by yield association) and productivity associated with the stand. Higher estimates of commerciality reflect stands that are comprised of larger sawlog volumes per unit area, or that have the potential to produce larger sawlog volumes per unit area because of their productivity.

‘Commercially suitable’ refers to the sum of the commerciality classes very low, low, moderate, high and very high. These class names represent commercial categories used by state agencies.

Table 3 Commerciality classes

Class	Description
No	No commercial value
Sandalwood	Area identified as containing commercial sandalwood species
Plantation	Ancillary information indicates that forest is associated with the plantation estate (including native species in plantation now in the reserve system)
Possible	Of uncertain commercial value with ancillary information indicating commercial potential
Unknown	Forest or woodland of unknown commercial value
Limited	Limited commercial value (contains scattered proportion of commercial species in quantities of limited commercial value)
Limited–acacia	Limited commercial value (acacia of potential commercial value)
Limited–hardwood	Limited commercial value (hardwood species of potential commercial value)
Limited–red gum	Limited commercial value (river red gum of potential commercial value)
Very low	Very low commercial value (Victoria only)
Low	Low commercial value
Moderate	Moderate commercial value
High	High commercial value
Very high	Very high commercial value

Confidence

The contributing data had highly variable quality and currency, so ABARES developed a confidence matrix to help represent uncertainty in the data and to assist with validating the database. An indicative, rather than qualified, assessment of the confidence in the component sources of input data was intended. An intersection of forest zone and forest region (ABARES 2011) was used to produce subdivisions of forest zones, the basic unit used to assess confidence.

Confidence was assessed against seven categories of data (Table 4). For each subdivision of forest zone, each data category was assigned a confidence rating between 1 and 5, with 1 indicating very low confidence and 5 indicating very high confidence based on the contributing datasets for those zones.

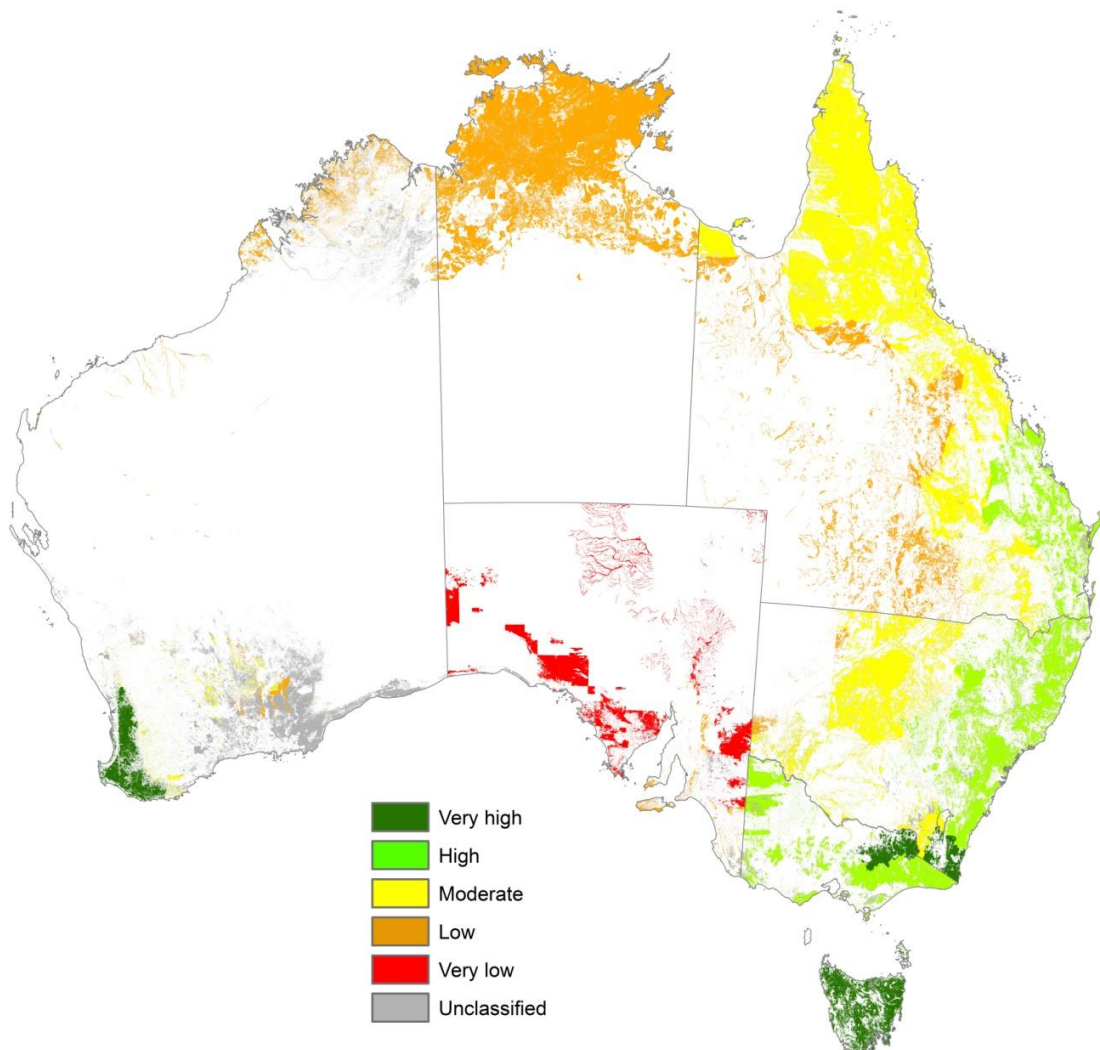
Table 4 Categories of data against which confidence is assessed

Category	Description
Forest mapping	Forest mapping accuracy, currency and completeness
Map resolution	Scale of mapping
Yield association	Degree to which mapping reflects yield associations
Growth stage	Capacity to link MAI with growth stage
Productivity class	Capacity to link productivity to yield association and forest mapping
MAI reliability	Reliability of MAI
MAI age	General age of growth information

Note: **MAI** Mean annual increment.

The ratings for the seven data categories were averaged for each forest zone subdivision, and average confidence was classed to the nearest integer as very low (1), low (2), moderate (3), high (4), and very high (5). This provided an overall average confidence rating for the data used to inform the grid cells found in the forest zone subdivision. Map 6 shows the resulting confidence layer. A full listing of the confidence values applied to the data in each forest zone subdivision is provided at Appendix C.

Map 6 Average level of confidence in input data



Note: 'Unclassified' is forest that has not been classed because of insufficient or incomplete data.
Data sources: ABARES; forest data from Forests of Australia 2008 (NFI 2008a).

Validation process

As an initial validation step, mapped outputs from the database were randomly checked and examined against LandSAT, Google imagery and SPOT5 imagery to assess and determine the accuracy of the mapped productivity and assigned yield associations. One hundred images across forest zones were used. ABARES also validated the national database coverage by crosschecking against available input information. Areas or classifications found to be incorrect, either through incorrect classification or incomplete/incorrect raw data, were either corrected, annotated for further assessment or, if imagery showed that the area was

not correctly classified as forest or potentially forest, removed from the classification of commerciality.

The national database was split into state and territory databases, and copies of these databases were provided to representatives from each jurisdiction for comment and further validation. A metadata statement for the database was supplied with the state and territory coverage, together with an Excel spreadsheet used to classify state and territory yield associations into national yield associations.

3 Results

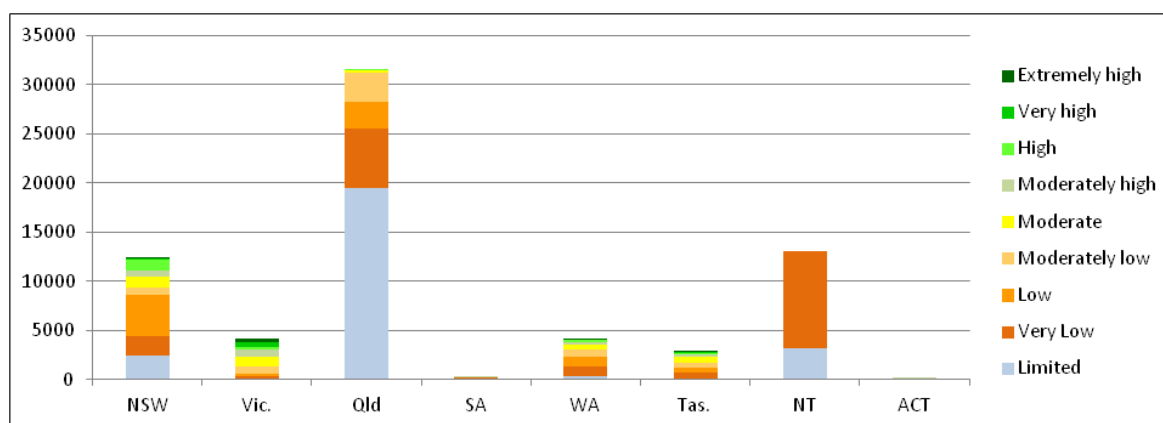
National productivity layer

ABARES built the national sawlog productivity layer using historical and recent data on forest sawlog productivity, and the National Forest Inventory forest layer from 2006 (NFI 2008a; MIG 2008).

In 2006 there were an estimated 68.3 million hectares of forest across Australia for which a potential productivity value above zero was assessed. These forests were allocated to productivity classes (Table 5). Another 61.0 million hectares had a zero value for sawlog MAI and 18.1 million hectares could not be assessed for sawlog productivity.

It is generally accepted nationally that native forests used for commercial sawlog production require an average sawlog MAI of 0.08 or greater; that is, must be at least in the 'very low' productivity class. Of the forest area with an assessed potential productivity value above zero, 42.6 million hectares (or 63 per cent) had productivity values above the 0.08 MAI threshold for commercially viable sawlog production; 25.7 million hectares had productivity values below the 0.08 MAI threshold and thus only limited productivity viability. Most of these limited productivity forests are in Queensland, with some also in New South Wales, the Northern Territory and Western Australia (Figure 3). The area and distribution of productivity classes across states and territories are presented in Table 5, Table 6, Figure 3 and Map 7. Table 5 and Table 7 show the area of forest in each productivity class by tenure. Figure 4 shows the areas of productivity classes of multiple-use, leasehold and private forest tenures, which are the tenures on which most sawlog harvesting occurs.

Figure 3 Area of forest in productivity classes, by state/territory at 2006 ('000 ha)



Note: Forest area data from the National Forest Inventory 2006 forest cover as published in Forests of Australia 2008 (NFI 2008a). Forest not included in this figure has a sawlog MAI value of zero.

Data sources: ABARES; National Forest Inventory

Table 5 Area of forest in productivity classes, by tenure and state/territory at 2006

Tenure/productivity class (MAI range)	State/territory area ('000 ha)								
	NSW	Vic.	Qld	SA	WA	Tas.	NT	ACT	Total
Leasehold									
Extremely high (3.0–5.6)	1	3	–	–	–	–	–	–	4
Very high (2.0–2.9)	3	2	–	–	–	–	–	–	5
High (1.5–1.9)	26	0	–	–	–	–	–	–	26
Moderately high (1.0–1.45)	24	2	1	0	0	–	–	0	27
Moderate (0.5–0.95)	33	8	39	2	–	–	–	0	82
Moderately low (0.3–0.49)	40	6	520	–	–	–	–	–	566
Low (0.15–0.28)	1 275	3	1 131	–	12	–	–	8	2 428
Very low (0.08–0.14)	235	0	3 295	4	190	–	1 751	1	5 476
Limited (0.01–0.07)	357	0	13 452	87	53	–	1 769	2	15 719
Total leasehold	1 993	24	18 438	93	255	–	3 519	12	24 333
Multiple-use forest									
Extremely high (3.0–5.6)	26	180	–	–	0	15	–	–	221
Very high (2.0–2.9)	61	278	–	–	–	93	–	–	432
High (1.5–1.9)	290	181	–	–	60	76	–	–	607
Moderately high (1.0–1.45)	142	466	5	0	110	124	–	0	847
Moderate (0.5–0.95)	237	506	44	0	279	220	–	0	1 287
Moderately low (0.3–0.49)	99	425	316	–	432	145	–	–	1 417
Low (0.15–0.28)	357	97	497	–	220	87	–	0	1 257
Very low (0.08–0.14)	264	107	547	0	13	84	–	0	1 015
Limited (0.01–0.07)	175	3	417	0	9	13	–	0	617
Total multiple-use forest	1 651	2 242	1 827	1	1 122	856	–	0	7 699

Tenure/productivity class (MAI range)	State/territory area ('000 ha)								
	NSW	Vic.	Qld	SA	WA	Tas.	NT	ACT	Total
Nature conservation reserves									
Extremely high (3.0–5.6)	69	86	–	–	2	6	–	–	163
Very high (2.0–2.9)	107	187	–	–	–	24	–	–	318
High (1.5–1.9)	389	79	0	–	76	22	–	–	566
Moderately high (1.0–1.45)	286	230	42	1	122	58	–	3	742
Moderate (0.5–0.95)	327	284	108	8	214	216	–	4	1 161
Moderately low (0.3–0.49)	243	171	955	–	288	203	–	–	1 860
Low (0.15–0.28)	791	112	227	–	240	181	–	86	1 637
Very low (0.08–0.14)	701	104	585	10	123	341	7	3	1 875
Limited (0.01–0.07)	669	8	1 336	9	151	32	0	7	2 212
Total nature conservation reserves	3 583	1 261	3 252	28	1 216	1 084	7	103	10 534
Other Crown land									
Extremely high (3.0–5.6)	1	2	–	–	0	0	–	–	3
Very high (2.0–2.9)	4	5	–	–	–	1	–	–	10
High (1.5–1.9)	21	1	–	–	1	1	–	–	24
Moderately high (1.0–1.45)	12	11	1	0	1	5	–	0	30
Moderate (0.5–0.95)	30	6	5	1	11	9	–	–	62
Moderately low (0.3–0.49)	45	8	187	–	5	18	–	–	262
Low (0.15–0.28)	150	5	48	–	73	9	–	0	284
Very low (0.08–0.14)	94	19	97	1	580	8	189	–	988
Limited (0.01–0.07)	115	0	877	2	32	5	49	0	1 080
Total other Crown land	473	56	1 214	4	703	55	238	0	2 744

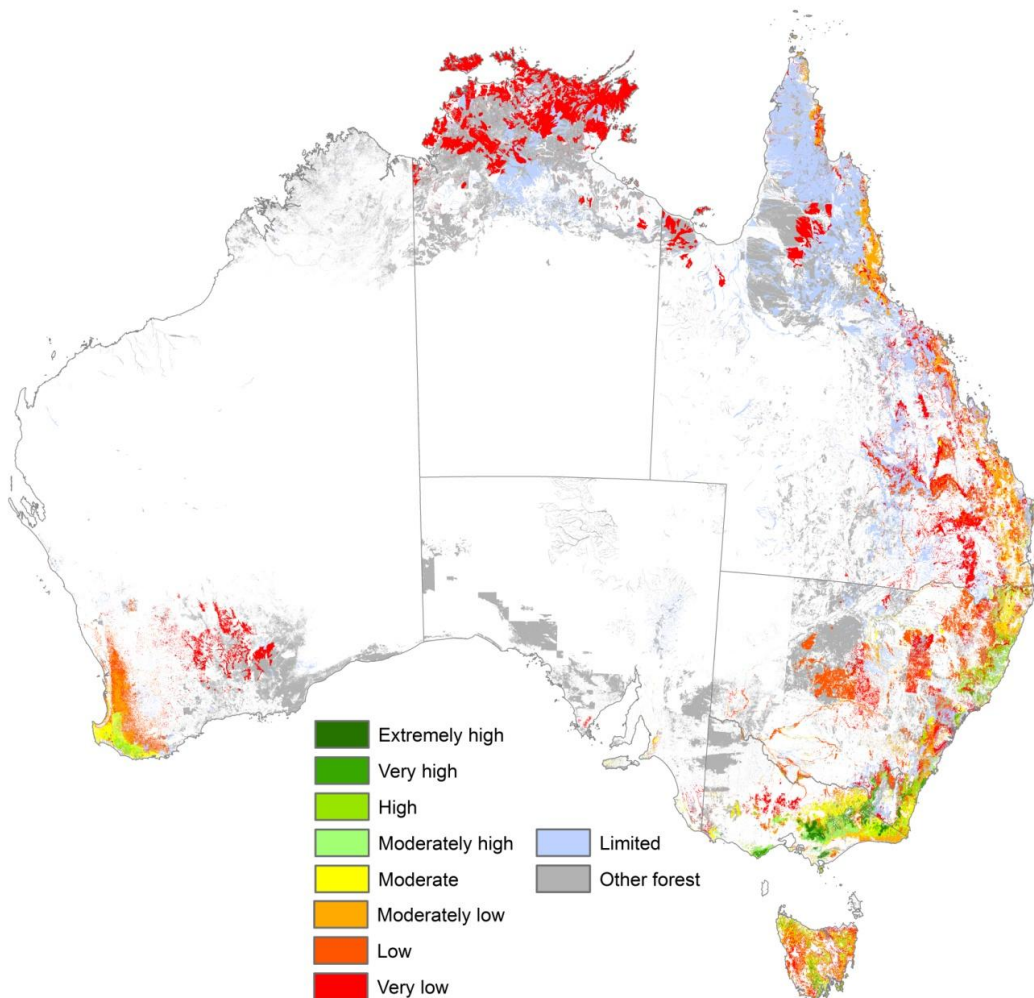
Tenure/productivity class (MAI range)	State/territory area ('000 ha)								
	NSW	Vic.	Qld	SA	WA	Tas.	NT	ACT	Total
Private									
Extremely high (3.0–5.6)	17	17	–	–	1	1	–	–	35
Very high (2.0–2.9)	47	30	–	–	–	8	–	–	85
High (1.5–1.9)	345	34	0	–	9	10	–	–	398
Moderately high (1.0–1.45)	186	74	19	2	3	66	–	0	350
Moderate (0.5–0.95)	433	133	64	16	78	113	–	–	838
Moderately low (0.3–0.49)	296	109	948	–	29	187	–	–	1 569
Low (0.15–0.28)	1 585	71	734	–	436	200	–	–	3 025
Very low (0.08–0.14)	729	53	1 340	35	66	117	7 891	–	10 231
Limited (0.01–0.07)	1 042	10	3 153	17	65	71	1 394	–	5 751
Total private	4 678	530	6 258	70	687	774	9 285	0	22 282
Unresolved tenure									
Extremely high (3.0–5.6)	0	0	–	–	–	–	–	–	0
Very high (2.0–2.9)	0	0	–	–	–	0	–	–	0
High (1.5–1.9)	3	0	0	–	–	0	–	–	3
Moderately high (1.0–1.45)	1	0	1	0	–	0	–	1	4
Moderate (0.5–0.95)	10	1	5	1	–	0	–	–	16
Moderately low (0.3–0.49)	15	2	45	–	–	0	–	–	62
Low (0.15–0.28)	45	1	64	–	–	0	–	3	113
Very low (0.08–0.14)	9	0	114	2	–	0	15	–	140
Limited (0.01–0.07)	13	0	313	1	–	0	2	0	330
Total unresolved tenure	96	6	543	4	–	0	17	4	670
Total	12 474	4 119	31 532	199	3 982	2 769	13 067	119	68 262

Note: Forest area data from the National Forest Inventory 2006 forest cover as published in Forests of Australia 2008 (NFI 2008a). Tenure is from Tenure of Australia's forests 2008 (NFI 2008b). Forest not included in this table has a sawlog MAI value of zero. '0' means an area of 1 to 500 hectares; '–' means an area of zero hectares. Totals may not sum due to rounding.

Table 6 Area of forest in productivity class, by state/territory at 2006 ('000 ha)

Productivity class	NSW	Vic.	Qld	SA	WA	Tas.	NT	ACT	Total
Limited	2 371	21	19 548	116	310	120	3 215	10	25 710
Very low	2 031	283	5 980	52	972	550	9 852	4	19 725
Low	4 202	288	2 700	0	980	477	0	97	8 745
Moderately low	738	720	2 972	0	754	553	0	0	5 737
Moderate	1 069	938	264	28	582	559	0	4	3 444
Moderately high	651	783	68	3	236	253	0	4	1 999
High	1 075	296	0	0	146	109	0	0	1 625
Very high	222	502	0	0	0	126	0	0	850
Extremely high	114	288	0	0	3	22	0	0	427
Total	12 474	4 119	31 532	199	3 982	2 769	13 067	119	68 262

Note: Forest area data from the National Forest Inventory 2006 forest cover as published in Forests of Australia 2008 (NFI 2008a). Productivity classes are described in Table 2. Forest not included in this table has a sawlog MAI value of zero. Totals may not sum due to rounding.

Map 7 Productivity class across all tenures at 2006

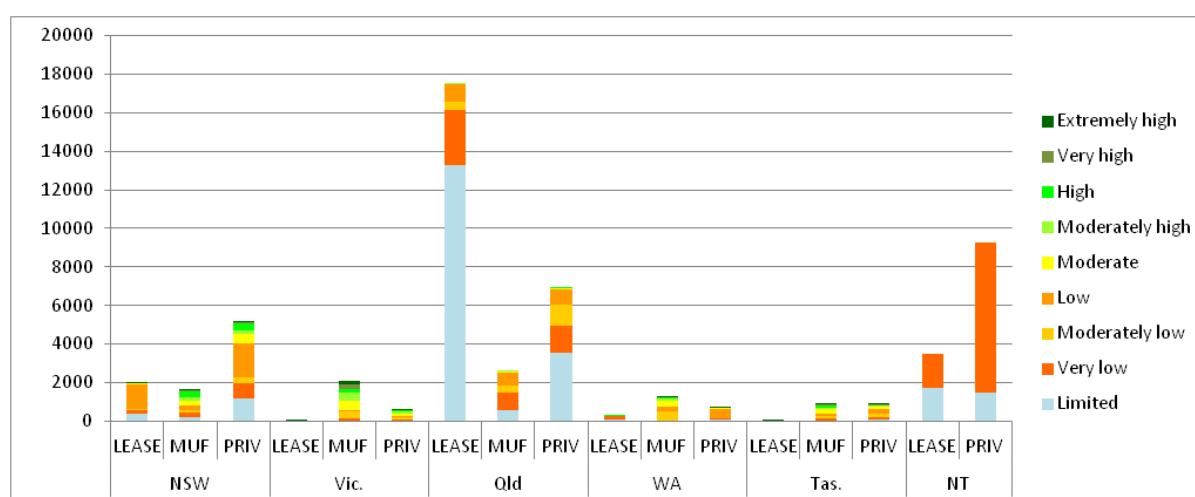
Note: Coverage is of forest reported in Forests of Australia 2008 (NFI 2008a) and provided to the states and territories for validation. 'Other forest' is forest with a sawlog MAI value of zero or assumed to be zero because of lack of data. An area shown in central South Australia had a known error and required further review as part of the validation process.

Data sources: ABARES; National Forest Inventory

Table 7 Area of forest in productivity classes, by tenure ('000 ha)

Productivity class	LEASE	MUF	NCR	OCL	PRIV	Unresolved	Total
Extremely high	4	221	163	3	35	0	427
Very high	5	432	318	10	85	0	850
High	26	607	566	24	398	3	1 625
Moderately high	27	847	742	30	350	4	1 999
Moderate	82	1 287	1 161	62	838	16	3 444
Moderately low	566	1 417	1 860	262	1 569	62	5 737
Low	2 428	1 257	1 637	284	3 025	113	8 745
Very low	5 476	1 015	1 875	988	10 231	140	19 725
Limited	15 719	617	2 212	1 080	5 751	330	25 710
Total	24 333	7 699	10 534	2 744	22 282	670	68 262

Note: Forest area data from the National Forest Inventory 2006 forest cover as published in Forests of Australia 2008 (NFI 2008a). Tenure is from Tenure of Australia's forests 2008 (NFI 2008b). **LEASE** Leasehold forest. **MUF** Multiple-use public forest. **NCR** Nature conservation reserve. **OCL** Other Crown land. **PRIV** Private land. **Unresolved** Unresolved tenure. Forest not included in this table has a sawlog MAI value of zero. Totals may not sum due to rounding.

Figure 4 Area of forest in productivity classes, by tenure, by state/territory ('000 ha)

Note: **LEASE** Leasehold forest. **MUF** Multiple-use public forest. **PRIV** Private land. ACT and SA not shown because values for these jurisdictions are too small to be represented meaningfully in the figure. Forest area data from the National Forest Inventory 2006 forest cover as published in Forests of Australia 2008 (NFI 2008a). Tenure is from Tenure of Australia's forests 2008 (NFI 2008b). Only those tenures used for sawlog harvesting are shown. Forest not included in this figure has a sawlog MAI value of zero.

Data sources: ABARES; National Forest Inventory

National commerciality layer

The productivity layer was intersected with information on yield associations and commerciality estimates to produce the commerciality layer. The National Forest Inventory forest layer from 2006 as published in Forests of Australia 2008 (NFI 2008a) and MIG (2008) was used as the forest coverage.

Of the 147.4 million hectares of native forest reported in the NFI at 2008 (MIG 2008), 18.1 million hectares were unable to be allocated a productivity class, yield association class or commerciality class because of limitations in data attributes or because remote sensing during validation found these areas to be non-forest or other wooded land. Table 8 presents the

distribution of the 128.6 million hectares of forest with a value for commerciality. Victoria is the only state where a 'very low' category description is shown because it is the only state that used this category in data supplied to the NFI.

Table 8 Area of forest with a commerciality classification, by state/territory

Code	Commerciality	State/territory area ('000 ha)								
		NSW	Vic.	Qld	SA	WA	Tas.	NT	ACT	Total
1	No	10 416	3 452	15 529	7 957	2 531	1 012	17 430	7	58 336
2	Sandalwood	–	–	645	–	–	–	–	–	645
3	Plantation	6	5	–	–	–	–	–	–	11
4	Possible	102	–	–	–	–	–	–	–	102
5	Unknown	1 243	2	0	–	–	–	–	–	1 245
6	Limited	1 728	68	11 624	168	1 295	34	3 215	1	18 132
7	Limited–acacia	–	–	165	–	–	–	–	–	165
8	Limited–hardwood	–	–	22	–	–	–	–	–	22
9	Limited–red gum	–	–	13	–	–	–	–	–	13
10	Very low	–	219	–	–	–	–	–	–	219
11	Low	5 307	922	16 365	28	626	1 333	9 852	110	34 544
12	Moderate	2 597	1 345	2 683	3	1 322	553	–	4	8 508
13	High	1 607	1 180	777	–	583	794	–	4	4 946
14	Very high	1 143	371	0	–	149	56	–	–	1 718
Totals	Total (codes 1–14)	24 150	7 565	47 824	8 156	6 506	3 781	30 497	126	128 606
	Sum of codes 6–14	12 382	4 105	31 649	199	3 975	2 770	13 067	119	68 267
	Sum of codes 11–14	10 654	4 037	19 825	31	2 680	2 736	9 852	118	49 935

Note: See Table 3 for a description of the commerciality classes. Sandalwood value does not include sandalwood identified in other wooded land. Area statement is at 2011. '0' means an area of 1 to 500 hectares; '–' means an area of zero hectares. Totals may not sum due to rounding.

As at 2006 Australia had 49.9 million hectares of commercial native forests—that is, forests in commerciality classes from very low to very high (Table 8). Table 9 provides the distribution of commercial forest across all tenure types, including conservation reserves; these commerciality classes are mapped in Map 8.

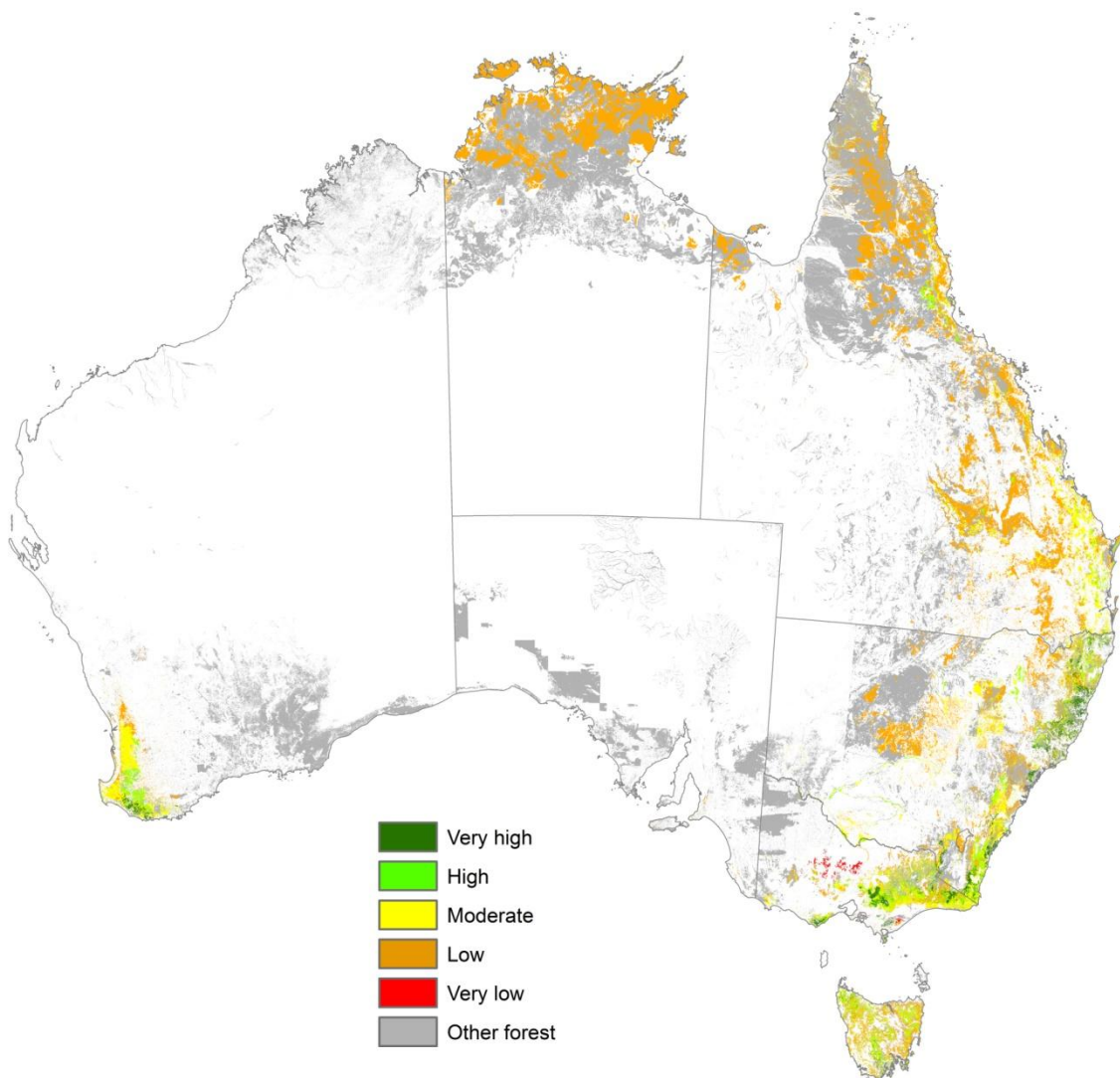
The greatest areas of commercial forest are found in the leasehold and private estate (a total of 32.3 million hectares), but these are predominately of low commerciality. There are 7.3 million hectares of commercial forest in the multiple-use forest estate and 8.6 million hectares in public nature conservation reserves (Table 9).

Only 30 per cent of the area of Australia's commercial forests is classed as having moderate commerciality or higher. However, 68 per cent of the area of commercial multiple-use forests has moderate commerciality or higher.

Table 9 Area of native forest in commerciality classes, by tenure at 2006 ('000 ha)

Tenure	Non-commercial native forest	Commercial native forest (forest commercially suitable for harvesting)						Total native forest in tenure	Proportion of commercial native forest (commerciality)	Proportion of commercial forest in moderate or higher commercial classes (moderate to very high)
		Commerciality class								
		Very low	Low	Moderate	High	Very high	Total commercial forest			
Leasehold	50 920	4	12 978	877	323	30	14 212	65 132	22%	9%
Multiple use forest	2 147	84	2 227	2 508	1 793	651	7 263	9 410	77%	68%
Nature conservation reserve	13 762	71	3 926	2 352	1 652	609	8 609	22 371	38%	54%
Other Crown land	9 592	17	866	246	114	28	1 270	10 862	12%	30%
Private land	19 995	43	14 205	2 438	1 020	398	18 104	38 099	48%	21%
Unresolved	1 048	0	342	86	44	3	476	1 524	31%	28%
Total	97 462	219	34 544	8 508	4 946	1 718	49 935	147 397	34%	30%

Note: Forest area data from the National Forest Inventory 2006 forest cover as published in Forests of Australia 2008 (NFI 2008a). Only Victoria identifies a 'very low' category. 'Non-commercial' includes limited, possible, no, sandalwood and unknown commerciality and forests not assessed because of data limitations or found to be non-forest through validation. Tenure is from Tenure of Australia's forests 2008 (NFI 2008b).

Map 8 Commerciality across all tenures at 2006

Note: 'Other forest' includes areas of forest with no assessed productivity, areas unable to be assessed because of lack of available data, and areas of limited, possible and unknown commerciality. Forest area data from the National Forest Inventory 2006 forest cover as published in Forests of Australia 2008 (NFI 2008a).

Data sources: ABARES; National Forest Inventory

For any tenure, the area of forests rated as commercial does not equal the area available for commercial harvesting. Forests on nature conservation reserve and on private land are protected from logging. Outside conservation reserves, harvesting prescriptions (codes of forest practice) and spatial patterns of commercial forest and terrain help reduce the effective harvestable area of commercial native forest. The distance between commercial native forests and processing centres limits the economic viability of many forests in Australia.

Commercial harvesting in Australia is mostly confined to private, leasehold and public multiple-use forest estates. Table 10 splits the 39.6 million hectares of commercial forests on private, leasehold and public multiple-use forest estates as at 2006 into forests legally restricted from harvesting and forests not legally restricted from harvesting. Appendixes D and E provide more detail of commercial forests on these tenures by forest zone and jurisdiction. More than 37.6 million hectares across these three tenures are assessed as potentially commercial for sawlog production and without legal restriction on harvesting. Of this area 9.9 million hectares

are assessed at moderate commerciality or higher. Commercial forests reserved from harvesting on private land are mainly forests on Indigenous lands in Queensland and the Northern Territory. Figure 5 shows the areas of forest in the five commerciality classes across these tenures by state/territory.

Table 10 Area of forest in commerciality classes, in areas restricted and not legally restricted from harvesting in private, leasehold and multiple-use tenures ('000 ha)

Tenure	Very low	Low	Moderate	High	Very high	Total
Harvesting legally restricted						
Leasehold	0	187	33	15	0	235
Multiple-use forest	0	23	12	9	2	46
Private	1	1 638	10	6	2	1 657
Total	1	1 849	55	31	4	1 939
Harvesting not legally restricted						
Leasehold	4	12 790	845	308	30	13 977
Multiple-use forest	84	2 203	2 496	1 784	649	7 216
Private	42	12 567	2 428	1 013	396	16 447
Total	130	27 561	5 769	3 105	1 075	37 640
Grand total	131	29 410	5 824	3 136	1 079	39 579

Note: Forest area data from the National Forest Inventory 2006 forest cover as published in Forests of Australia 2008 (NFI 2008a). Tenure is from Tenure of Australia's forests 2008 (NFI 2008b). Reserves are from Collaborative Australian Protected Area Database (CAPAD) as published in Forest reserves of Australia 2010 (NFI 2010).

Data sources: ABARES; National Forest Inventory

Validation

The validation map and data provided to the states and territories used the forest cover extent from 2006 as published in Forests of Australia 2008 (NFI 2008a) and MIG (2008). Queensland government agencies considered that the database accurately represented the state's forests, although commerciality may need to be validated if merchantable trees are present in an area on the Northern Territory border. South Australian and New South Wales government agencies identified data gaps that need to be filled with updated information supplied to the NFI and NVIS by these states. The database was adjusted based on Queensland, South Australia and New South Wales feedback.

Improved mapping can address many of the states' issues with validation; the resulting information should be incorporated in an updated database. The states' feedback also highlighted that the Forests of Australia 2008 data (NFI 2008a) needed to be validated, which the NFI subsequently did (Mutendeudzi et al. 2013) and incorporated into Forests of Australia 2013 (NFI 2013a) (see MIG & NFISC 2013).

There were border issues for forest types that cross the New South Wales–Victoria and New South Wales–Queensland borders. These may be a result of differences in mapping or productivity weightings provided to the NFI, or in describing sawlog standards. Anomalies in the RAC/FORWOOD information for the riparian areas of inland rivers were also found; their assigned productivity will require verification.

Allocation of productivity and commerciality for the cypress pine forest associations in New South Wales and Queensland was difficult because of data gaps in site quality (stand height, density and cover). The database lacks updated inventory information from recent New South

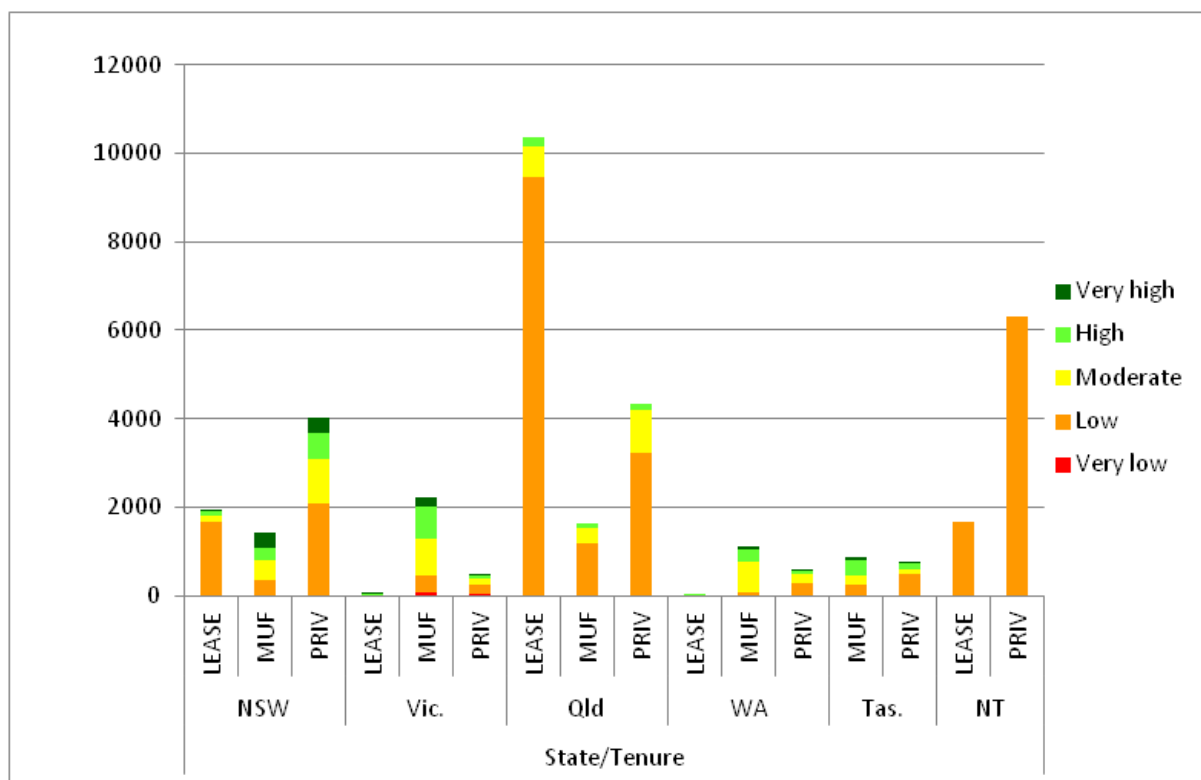
Wales cypress and red-gum assessments. There was a similar issue in identifying productivity and commerciality of stands in the Western Australian goldfields.

Forest mapping in New South Wales, Tasmania, Victoria and Western Australia did not identify forest stands taller than 50 metres. Identifying these taller stands in national databases would have been helpful in applying more precise productivity (MAI) values.

Validation using remote sensing enabled the presence and type of forest to be confirmed. This validation also showed areas of apparent forest degradation (caused by fire, storm, agriculture and disease), the effects of which were unable to be incorporated in the database. The remote sensing validation showed that more detailed assessment and validation of apparent commercial forest stands found on private and leasehold lands is needed. This more detailed assessment and validation would need to focus on stand quality and any consequential effects on future stand productivity, merchantability and commerciality.

The multiple lines of evidence approach reported in Mutendeudzi and colleagues (2013) for validating forest cover estimates provides more certainty in recognising forest. The outcome of this approach was used to produce the 2011 forest cover reported in MIG and NFISC (2013) and Forests of Australia 2013 (NFI 2013a). The 2011 data were used in Map 9.

Figure 5 Area of forest in commerciality classes, across selected tenures, by state/territory ('000 ha)



Note: **LEASE** Leasehold forest. **MUF** Multiple-use public forest. **PRIV** Private land. ACT and SA are not shown because legal restrictions prevent the harvesting of native forests in these jurisdictions (see MIG 2008; MIG & NFISC 2013). Excludes areas of forest legally restricted from harvesting on these tenures using 2008 CAPAD (NFI 2010). Forest area data from the National Forest Inventory 2006 forest cover as published in Forests of Australia 2008 (NFI 2008a). Tenure is from Tenure of Australia's forests 2008 (NFI 2008b).

Data sources: ABARES; National Forest Inventory

Updates using current data

The area statements in earlier tables and the appendixes used National Forest Inventory 2006 forest cover as published in MIG (2008) to derive, validate and report the methodology discussed in Chapter 2. With the methodology developed, the National Forest Inventory 2011 forest cover (NFI 2013a) was applied to update estimates (MIG & NFISC 2013).

The estimated area of native forest available and commercially suitable for sawlog harvesting in 2006 and 2011, based on forest productivity and merchantability, and the area of forest not legally restricted from harvesting are presented in Table 11. Estimates use data on forest cover, tenure and legal protection reported in Forests of Australia 2008 and 2013 (NFI 2013a, 2008a). In 2006, 37.6 million hectares of commercial native forest were available for wood harvesting. In 2011, this had decreased to 36.6 million hectares as a result of increases in areas of forest reserved and changes in the reported total area of Australia's forests (MIG & NFISC 2013). The area of commercial multiple-use forests available for harvesting increased from 7.2 million hectares in 2006 to 7.5 million hectares in 2011 (Table 11) as a result of changes in tenure classification in Queensland (MIG & NFISC 2013).

The national distribution of native forest areas by their assessed level of commerciality in 2011 is shown in Map 9. Of the 36.6 million hectares available and commercially suitable for sawlog production, 7.5 million hectares were public native forest and 29.1 million hectares were leasehold and private tenure forests, subject to landholder intent, markets and environmental constraints (Table 11). The 2011 data classed 9.8 million hectares of native forest as moderate, high or very high commerciality—that is, available for highly commercial wood production—comprising 4.7 million hectares of public native forest and 5.1 million hectares of leasehold and private tenure forests.

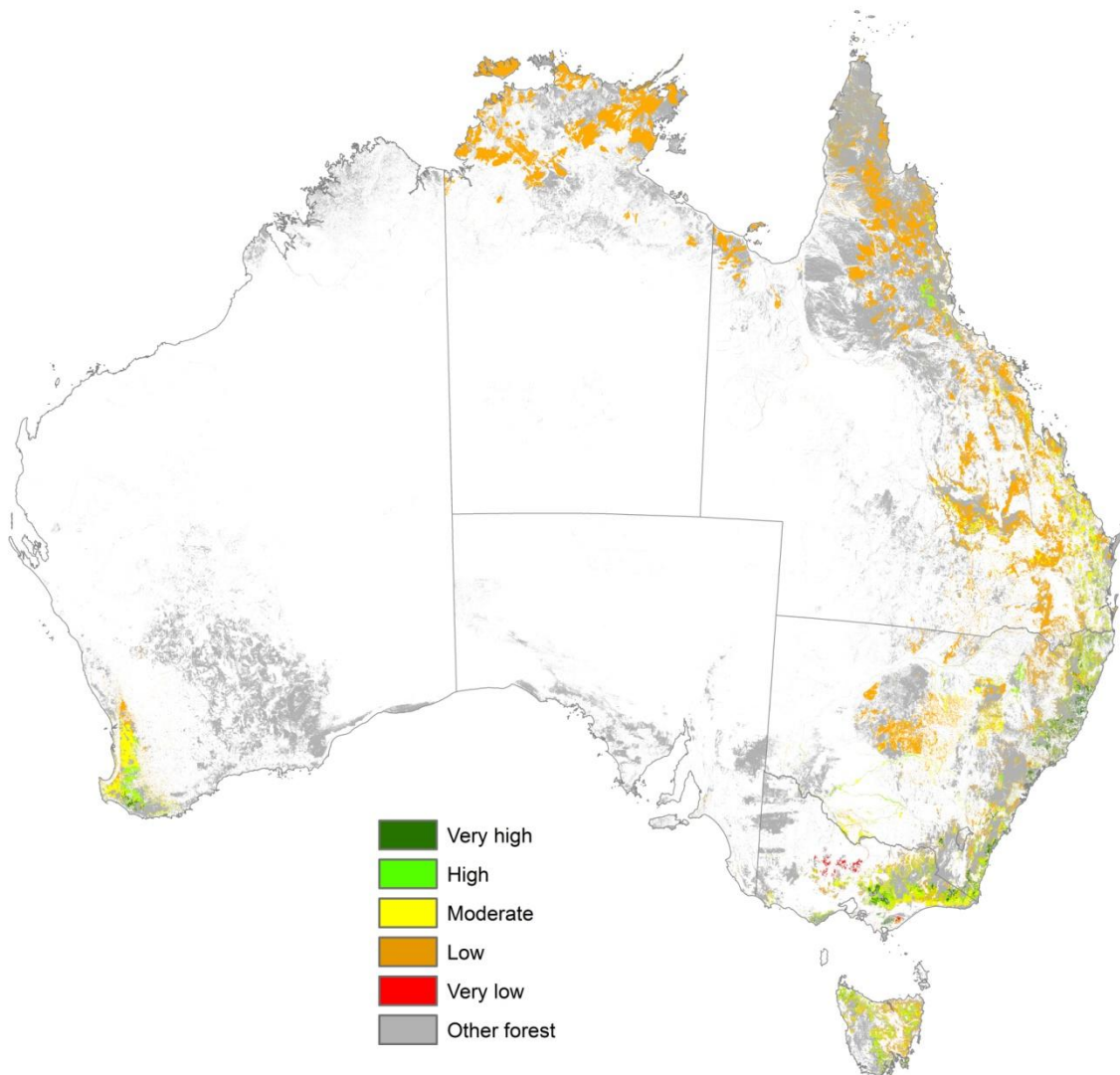
Table 11 Area of leasehold, private and multiple-use native forest, by commerciality class, 2006 and 2011

Year	Tenure	Non-commercial forest and forest legally restricted from harvesting a	Commercial forest (forest available and commercially suitable for harvesting)						Total forest in tenure c	Proportion of commercial forest (commerciality) d
			Commerciality class							
			Very low (1)	Low (2)	Moderate (3)	High (4)	Very high (5)	Total commercial forest b		
2006	Leasehold forest	51 155	4	12 790	845	308	30	13 977	65 132	21
	Multiple-use public forest	2 194	84	2 203	2 496	1 784	649	7 216	9 410	77
	Private land	21 652	42	12 567	2 428	1 013	396	16 447	38 099	43
	Total	75 001	130	27 561	5 769	3 105	1 075	37 640	112 641	33
2011	Leasehold forest	35 737	0	11 753	702	317	24	12 796	48 533	26
	Multiple-use public forest	2 637	86	2 732	2 486	1 615	603	7 522	10 159	74
	Private land	17 099	54	12 156	2 551	1 119	415	16 295	33 394	49
	Total	55 473	140	26 641	5 739	3 051	1 042	36 613	92 086	36

^a Includes forest of limited, possible, unknown or no commerciality; sandalwood; forest of unknown floristics and structure; and conservation reserves on these tenures where harvesting is excluded by covenant or regulation. ^b The sum of the areas of forest of very low, low, moderate, high and very high commerciality. ^c Figures for total forest in each tenure category are from MIG & NFISC 2013 (Indicator 1.1a) for 2011 and MIG 2008 for 2006. These area coverages were used to overlay the commerciality forest layer. Totals may not tally due to rounding. ^d The proportion of total forest in a tenure that is available and commercially suitable for sawlog harvest. Forest area data from the National Forest Inventory 2006 forest cover as published in Forests of Australia 2008 (NFI 2008a); 2011 forest area data is from Forests of Australia 2013 (NFI 2013a). Tenure for 2006 is from Tenure of Australia's forests 2008 (NFI 2008b); 2011 is from Tenure of Australia's forests 2013 (NFI 2013b).

Data sources: ABARES; National Forest Inventory

Map 9 Assessed commerciality of Australia's native forest areas across the leasehold, private and public multiple-use estates, 2011



Note: 'Other' includes forest of limited, possible or no commerciality; sandalwood; forest of unknown floristics and structure; conservation reserves where harvesting is excluded by covenant or regulation; and forests on formal nature conservation reserves, other Crown land and land of unresolved tenure. Forest areas are from MIG and NFISC (2013). The level of commerciality assessed here is further restricted in the Northern Territory and northern Queensland because of accessibility and remoteness; only limited harvesting occurs in those areas.

Data sources: ABARES; National Forest Inventory

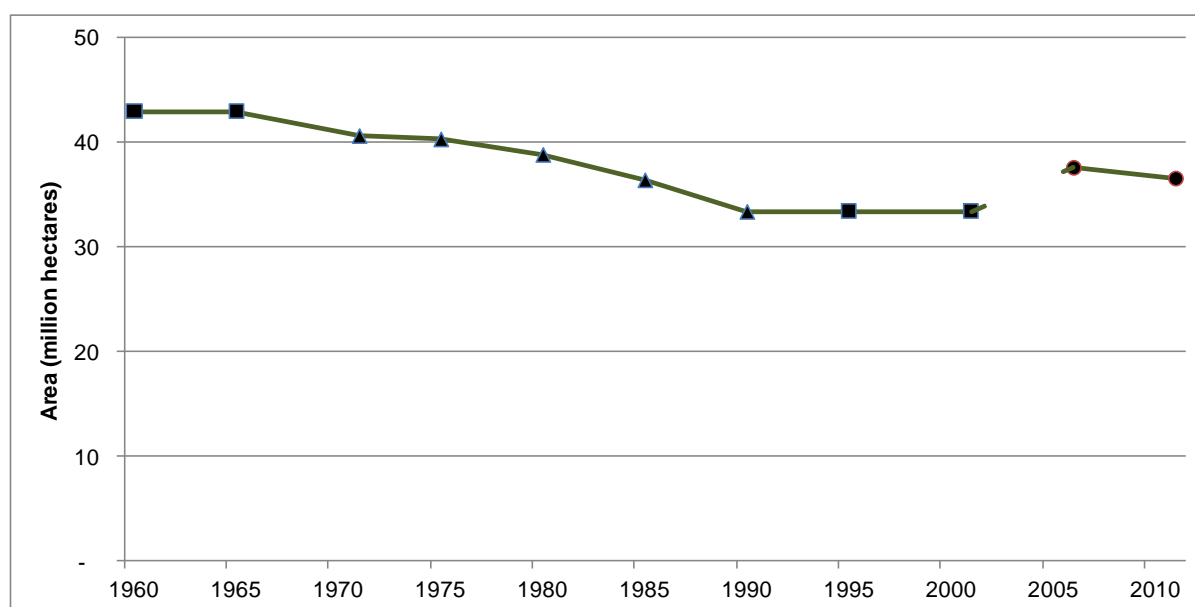
4 Discussion and conclusion

Much of the native forest estate on leasehold and private land contributes minimally to wood supply (MIG & NFISC 2013). This includes forests used predominantly for grazing, forests containing few marketable species in commercial quantities, forests isolated from wood-processing facilities and markets, or forests where harvesting is not operationally feasible. The Northern Territory has relatively little commercial native forest harvesting for a combination of these reasons.

Over the period from 1960 to 1990, state and territory agencies provided data to Australian Government agencies on the area of native forest available and commercially suitable for wood production from multiple-use public forests, leasehold and private forests. Such reporting was discontinued after the Resource Assessment Commission's Forest and Timber Inquiry in 1992. ABARES can add more recent estimates based on the national assessment of commerciality, merchantability and productivity of native forests across all tenures that underpin the Australian Sawlog Commerciality Database. Figure 6 shows the downward trend in the gross area of native forest available and commercially suitable for sawlog production in the period 1960–2003, using historical estimates, followed by a small increase to the estimates developed for this report.

Forests on leasehold, private and particularly multiple-use public forest tenures are increasingly managed for a range of values, including water protection, flora and fauna protection and conservation, as well as (or instead of) wood production. These changing uses have contributed to reduced availability of multiple-use public forests for wood harvesting.

Figure 6 Australian native forests available and suitable for wood production across the leasehold, private and public multiple-use estates



Note: Triangular data points are derived from tabular data provided by state/territory agencies to Australian Government agencies. Square data points are estimates based on the tabular data (triangular data points) and ancillary historical data. Circular data points are based on the recent spatial assessment reported in Table 11 using the Australian Sawlog Commerciality Database.

Data sources: ABARES (including historical forest resource datasets and publications from the Bureau of Agricultural Economics and the Commonwealth Forestry and Timber Bureau); Resource Assessment Commission (1992)

The Australian Sawlog Commerciality Database will form one of several key national forest datasets that provides forest resource information across public and private forests. It fills an identified knowledge gap, providing a context for national estimates of forest growth and yield that should lead to more relevant growth modelling and scenario prediction. The database has also been useful in modelling impacts of climate change on forests and forest industries (ABARES 2011) and in enabling future native forest production to be studied. The database will also be an important input to future Food and Agricultural Organization and Australia's state of the forests reporting, and to decision-making on forest policy. It can support a national system for modelling forest growth and yield across public, private and leasehold forests at the level of wood-supply zones, and can predict future wood supply depending on changing public forest policy or climate change.

The first version of the database described in this report provides a good basis for understanding the merchantability, productivity and commerciality of native forests across Australia. To remain relevant it will need to be updated with new inventory and forest mapping information when available. State forest agencies use information (including type, yield, growth, net harvestable area and product grade) to predict sustainable yields. Public forest data can be updated with this information.

Appendix A: Yield associations

A yield association is a grouping of forest types that display similar commercial attributes (commerciality) in terms of productivity and merchantability. Yield associations identified in FORWOOD, the RAC survey database, preliminary classifications by the NFI and state-based RFA processes were compiled and classified into national yield associations, based on state or territory yield association descriptions. The national yield associations, and translation of yield associations found in states and territories (Tables A1 to A7), are described in Table A8.

New South Wales and the Australian Capital Territory

During the 19th and early 20th centuries timber resources were exploited from New South Wales forests and, by the mid 20th century, vast areas of commercial forests were removed for agriculture or degraded from overcutting (Carron 1985; Forest Resources 1974). Following a report from the Timber Resources Inquiry in 1954 the Forestry Commission of New South Wales ordered an inventory of the native forest resources in New South Wales (Carron 1985). The inquiry considered that the private native forest resource, then supplying about 50 per cent of the demand, was likely to be mostly eliminated in 20 years and that Crown land on its own would be unable to meet future demand.

Forest inventories continued in collaboration with the Commonwealth Forestry and Timber Bureau. The bureau and the Forestry Commission of New South Wales raised concerns about harvesting rates during the 1960s after inventory results showed evidence that the resource was not being managed sustainably (Carron 1985). This led to a comprehensive forest resource inventory (FORINS) commencing in 1971 for New South Wales. Early Baur forest types were used in the FORINS inventory. After they were refined, Baur (1979) published these types. The FORINS inventory and Baur forest types (Research Note No. 17 forest types) were the basis of the New South Wales data supplied to FORWOOD and the RAC inquiry. Similar inventory and type information was available for the Australian Capital Territory (ACT) and supplied to FORWOOD.

A comprehensive regional assessment process was undertaken in eastern New South Wales from 1995 to 2000. During this process, significant inventory work was undertaken to update forest resource information, growth and yield models and develop yield modelling systems (FRAMES inventory and decision support tools, see Bugg, Spencer & Lee 2002) across north-eastern and southern New South Wales.

Thirty-one yield associations were identified (Table A1) for New South Wales and have been applied to the ACT. These associations link to the Baur forest types and are based on the descriptions of yield associations used during the comprehensive regional assessment and FRAMES inventory process. Commercial harvesting of rainforest types in New South Wales had stopped by 1990 (Resource Assessment Commission 1992a).

In the ACT, timber was harvested in native forests from the early 1900s until the early 1970s (Carron 1985). A conservation and recreation emphasis has applied to the territory's public native forest estate since 1980, with no harvesting of native forests for sawlog timber (Carron 1985). Private and leasehold forest resources are limited and protected from harvesting.

Table A1 New South Wales and Australian Capital Territory timber yield associations

NSW yield association	Yield association description	State forest RN 17 types	Links to RFA associations and RAC forest information
1	Northeast moist blackbutt	36, 37	UNE/LNE association 1
2	Southeast blackbutt	36, 37	Southern/Eden association 1
3	Northeast moist coastal eucalypt	45, 46, 47, 48, 49, 51, 52, 53, 54, 55	UNE/LNE association 2
4	Southeast blue gum–bangalay	50	Southern/Eden association 2
5	Northeast semi-moist eucalypt	48, 60, 68, 70, 71, 74, 76, 81, 89, 92, 93	UNE/LNE association 3
6	Southeast spotted gum types	73, 74, 76	Southern/Eden association 3
7	Northeast dry spotted gum and/or blackbutt	37, 38, 39, 70, 72, 74	UNE/LNE association 4
8	Southeast silvertop ash types	54, 101, 112, 113, 114, 162	Southern/Eden association 4
9	Southeast stringybark–bloodwoods–peppermints	66, 102, 121, 123, 130, 132, 133, 169	Southern/Eden association 5
10	Southeast coastal grey box, red gum, woollybark and grey ironbark	63, 85, 86, 88, 92, 206	Southern/Eden association 6
11	Southeast–central ironbark	83, 84	RAC type in south-east NSW—broad-leaved and narrow-leaved ironbark
12	Northeast dry sclerophyll	40, 64, 65, 82, 83, 84, 87, 92, 93, 98, 101, 122, 177	UNE/LNE association 5
13	Southeast apple types	129	Southern/Eden association 7
14	Alpine ash	147, 148	Southern/Eden association 8
15	Moist tableland–messmate, brown barrel	150, 151, 152, 153, 154, 155, 156 and 159, 163 167 in NE NSW	Southern/Eden association 9 and UNE/LNE association 6
16	Southeast tableland gums types	157, 158, 159, 165, 166	Southern/Eden association 10
17	Northeast dry tablelands types	122, 131, 161, 163, 170, 172	UNE/LNE association 7
18	Southeast peppermint–brittle/scribbly gum types	110, 111, 124, 125, 131	Southern/Eden association 11
19	Western box–red gum types	99, 103	Southern/Eden association 12
20	Western box–ironbark types	202–210	RAC type in western NSW—western box-ironbark types
21	Southern snow gum–black sallees	136, 138, 139, 140, 143	Southern/Eden association 13
22	Cypress pine	180–195	RAC and Southern/Eden association 15
23	Southern non-eucalypt forest	31, 211, 214	Southern/Eden association 16
24	River red gum	199, 200	RAC and Southern/Eden association 17
25	Subtropical rainforest	6, 14, 18, 19, 23	Subtropical rainforest league (RN 17 forest types 1–7) (RAC)

NSW yield association	Yield association description	State forest RN 17 types	Links to RFA associations and RAC forest information
26	Warm temperate rainforest	6, 14, 18, 19, 23	Warm temperate rainforest league (RN 17 forest types 10–15) (RAC)
27	Cool temperate rainforest	6, 14, 18, 19, 23	Cool temperate rainforest league (RN 17 forest types 16–20) (RAC)
28	Araucaria rainforest	6, 14, 18, 19, 23	Dry and depauperate rainforest—hoop pine (RN 17 forest type 21) (RAC)
29	Dry–depauperate rainforest	6, 14, 18, 19, 23	Dry and depauperate rainforest—non-hoop pine (RN 17 forest type 22–26) (RAC)—generally non-commercial
30	Dry–depauperate rainforest	–	Unknown but of commercial potential (RAC)
31	Non-commercial forest—forest/woodland	30, 31, 32, 65, 92, 97, 105, 106, 107, 111, 117, 126, 129, 130, 136, 137, 138, 140, 141, 142, 144, 207, 211, 213, 214, 215, 216, 218, 219, 220, 221, 223, 224, 225, 226, 230, 231, 232, 233, 234, 235	Non commercial forest and woodland—not captured above

Note: State forest RN 17 types refer to forest type descriptions found in Baur (1979). **RAC** Resource Assessment Commission. **RFA** Regional Forest Agreement. **RN** Research Note. **UNE/LNE** Upper Northeast Regional Forest Agreement (NSW) / Lower Northeast Regional Forest Agreement (NSW).

Sources: Australian Forestry Council 1975; BRS & SFNSW 1999; L Carron, interviews with author, 1990 and 1991; Forest Resources 1974; RAC survey database 1991 (Resource Assessment Commission 1992a); New South Wales CRA/RFA Steering Committee (1999); data collated during comprehensive regional assessment processes associated with New South Wales Regional Forest Agreements (see Bugg, Spencer & Lee 2002).

Victoria

By the mid 20th century large areas of Victoria's commercial forests were removed for agriculture, degraded by fire and overcutting, or regenerating from the 1939 wildfire (Carron 1985; Forest Resources 1974). A thorough inventory of native forest resources, including growth modelling estimation, began in the early 1960s (Carron 1985) and continued through the 1960s in collaboration with the Commonwealth Forestry and Timber Bureau. Outputs of the inventories and models informed FORWOOD and provided base data for forest planning and management.

Victoria released a timber industry strategy in 1986 that established the basis for regional sustainable harvesting of sawlogs from state forests to facilitate the planning, management and administration of public native forests and to support Victoria's timber industry. Based on resource data (HARIS database) available at the time, sustainable sawlog yield rates were determined for 15 forest management areas identified in the strategy; these informed management plans and the RAC inquiry. The HARIS database grouped Victoria's forests into 14 dominant forest types used for yield estimation (Table A2). These were also used in the resource and economic assessments that led to Victoria's Regional Forest Agreements.

Table A2 Victorian timber yield associations

Vic. yield association	Commercial types	Description
1	Alpine ash (AA)	Alpine ash—predominantly <i>Eucalyptus delegatensis</i>
2	Mountain ash (MA)	Mountain ash—predominantly <i>E. regnans</i>
3	Shining gum (SHG)	Shining gum—predominantly <i>E. nitens</i>
4	Mixed mountain species (MMS)	Mountain mixed species—predominantly <i>E. fastigata</i> , <i>E. obliqua</i> , <i>E. cypellocarpa</i> either in pure stands or in mixture. Other species occurring include <i>E. viminalis</i> , <i>E. globulus</i> , <i>E. radiata</i> , <i>E. baxteri</i> and <i>E. rubida</i> where mature stand height is generally greater than 40 metres
5	Foothill mixed species (FMS)	Foothill mixed species—predominantly <i>E. obliqua</i> , <i>E. cypellocarpa</i> and <i>E. viminalis</i> with some or all of <i>E. rubida</i> , <i>E. ovata</i> , <i>E. dives</i> , <i>E. sieberi</i> and <i>E. radiata</i> where mature stand height is generally greater than 28 metres. <i>E. macrohyncha</i> , <i>E. cephalocarpa</i> and <i>E. goniocalyx</i> can also occur, as can assemblages for mountain mixed species less than 40 metre stand height
6	Coastal mixed species (CMS)	Coastal mixed species—predominantly <i>E. sieberi</i> and <i>E. globoidea</i> in a mixture with other species
7	Alpine mixed species (AMS)	Alpine mixed species—generally peppermint and gum stands at high elevation
8	Snow gum and alpine forest (ALP)	Alpine vegetation—sub-alpine woodland including snow gum <i>E. pauciflora</i>
9	Box ironbark (BIB)	Box–ironbark stands of box or ironbark eucalypt
10	Native (Murray) pine (CP)	Callitris pine—stands of <i>Callitris</i> spp.
11	Closed forest–special species (CF–sp)	Commercial speciality timbers—blackwood, silver wattle and sassafras
12	River red gum (RG)	River red gum— <i>E. camaldulensis</i> communities
13	Rainforest (CF)	Closed forest—cool or warm temperate rainforest
14	Non-commercial forest (NCF)	Non-commercial forest and woodland—including mealy stringybark (<i>E. cephalocarpa</i>) woodlands, mallees, low forests and woodlands of scrubby species (SCB) and other woodland categories not described above

Note: Initials after commercial types are code identifiers for the forest type.

Sources: Australian Forestry Council 1975; L Carron, interviews with author, 1990 and 1991; Forest Resources 1974; HARIS resource information provided to the National Forest Inventory 1990–92 by the Victorian departments of Conservation, Forests and Land, and Conservation and Environment, and Conservation of Natural Resources; RAC survey database 1991 (Resource Assessment Commission 1992a); data collated during comprehensive regional assessment processes associated with Victorian Regional Forest Agreements (see Bugg, Spencer & Lee 2002).

Queensland

As development spread across Queensland in the 19th and early 20th centuries timber resources were extracted from vast stands of eucalypts and subtropical rainforests for a range of uses locally and for export to the south. Bunya pine, kauri pine, cypress pine, red cedar and high-quality eucalypts and rainforest hardwoods were important species for Queensland's development. Harvesting of timber resources typically led to clearing for agricultural land. Vast areas of commercial forests were removed for agriculture or degraded from overcutting by the early 20th century (Carron 1985; Forest Resources 1974). From the 1930s policies sought to improve existing native stands through sustainable harvesting practices and silvicultural systems in public forests. From the mid 20th century significant inventory work was undertaken

to map and understand Queensland's public native forest. As a result there was reasonable forest inventory information to inform FORWOOD and the RAC inquiry as well as state forest planning systems (for example, Queensland's timber scheduling system—SKED). Commercial harvesting of rainforest types in Queensland had stopped by 1990 (Resource Assessment Commission 1992a). A comprehensive regional assessment process was undertaken in south-eastern Queensland from 1995 to 2000.

Eighteen yield associations were identified (Table A3) for Queensland. Description and nomenclature are based on Queensland's SKED forest descriptions that informed the RAC survey database. Similar descriptions were used during the comprehensive regional assessment processes in south-eastern Queensland.

Table A3 Queensland timber yield associations

Qld yield association	Commercial types	Description
1	Wet sclerophyll forest—mixed eucalypts	Wet sclerophyll forest containing species of high-value/high-quality timber actively managed for sawlog timber (e.g. <i>Eucalyptus grandis</i> , <i>E. microcorys</i> , <i>E. saligna</i> , <i>E. cloeziana</i> , <i>E. campanulata</i> , <i>E. dunnii</i> , <i>Syncarpia glomulifera</i>) but not dominated by <i>E. pilularis</i> or <i>Corymbia citriodora</i> . Tall closed forest exceeding 6 metres in height with a well-developed understorey and in which rainforest components may be well represented
2	Wet sclerophyll forest—brush box association	Wet sclerophyll forest containing <i>E. grandis</i> plus <i>Lophostemon confertus</i> and <i>S. glomulifera</i> on lowland alluvials actively managed for sawlog timber. A well-developed understorey dominated by rainforest species and/or sclerophyllous shrubs
3	Wet/moist sclerophyll forest—blackbutt dominated	Wet to mixed forest dominated by <i>E. pilularis</i> but including other species such as <i>E. microcorys</i> , <i>E. acmenoides</i> , <i>C. citriodora</i> , <i>Syncarpia</i> spp. as subdominants. Tall to medium forest with open to closed canopies of mixed species
4	Moist sclerophyll forest—spotted gum dominated	Mixed forest on higher quality sites dominated by <i>C. citriodora</i> but including other species ranging from <i>E. pilularis</i> to <i>E. acmenoides</i> or <i>E. siderophloia</i>
5	Dry sclerophyll forest—spotted gum dominated	Dry forest on lower quality sites dominated by <i>C. citriodora</i> but including other species ranging from bloodwoods (<i>C. clarksoniana</i> , <i>C. intermedia</i>) and ironbarks (<i>E. crebra</i> , <i>E. fibrosa</i> , <i>E. exserta</i>) to <i>Angophora</i> spp. (<i>A. leiocarpa</i> and <i>A. floribunda</i>). Subdominant species of this forest type are generally lignotuberous species
6	Moist sclerophyll forest—mixed eucalypts	Mixed forest containing species of moderate value (<i>E. propinqua</i> , <i>E. acmenoides</i> , <i>E. siderophloia</i> , <i>C. citriodora</i> , <i>E. campanulata</i> , <i>E. tereticornis</i> , <i>E. crebra</i> , <i>C. intermedia</i> , <i>E. moluccana</i> [mixed on ridges with <i>E. longirostrata</i>], <i>E. carnea</i>) with a high proportion of defective (suppressed) trees present. Open to closed forest varying in means of persistence and regeneration depending on dominant species in canopy, with some advanced growth
7	Moist sclerophyll forest—red gum dominated	Mixed moist forest dominated by <i>E. tereticornis</i> on lowland river flats. Other species include <i>C. intermedia</i> , <i>C. tessellaris</i> , <i>C. clarksoniana</i> and <i>A. subvelutina</i>
8	Dry sclerophyll forest/woodland—scribbly gum and red gum dominated	Low to unproductive coastal forest dominated by <i>E. racemosa</i> or woodland (<i>E. bancroftii</i>). Other species include <i>E. umbra</i> , <i>E. tindaliae</i> , <i>E. gummifera</i> and <i>A. leiocarpa</i>
9	Dry sclerophyll forest/woodland—mixed eucalypts	Low to unproductive forest or woodland of species with low commercial value (<i>E. crebra</i> , <i>E. melanophloia</i> , <i>E. populnea</i> , <i>E. intermedia</i> , <i>E. planchoniana</i> , <i>E. tereticornis</i> , <i>E. decorticans</i> , <i>E. dura</i> , <i>A. floribunda</i> , <i>A. leiocarpa</i> and <i>Melaleuca</i> spp.), infrequently harvested for sawlogs. Medium to low open forest types in which grasses are well represented in the groundcover and woody understorey (sclerophyll species) are sparse. Inland forest or woodland in southern/central Queensland dominated by or containing <i>E. crebra</i> , <i>E. fibrosa</i> , <i>E. decorticans</i> ,

Qld yield association	Commercial types	Description
		<i>E. cloeziana</i> and/or <i>Heterodendrum oleifolium</i>
10	Tropical north dry sclerophyll forest/woodland	Low to unproductive tropical forest or woodland of species with low commercial value (tropical eucalypts: <i>E. tetradonta</i> , <i>E. miniata</i> , <i>E. camaldulensis</i> , <i>Corymbia</i> spp., <i>Callitris intratropica</i> and <i>Melaleuca</i> spp.). Infrequently harvested for sawlogs. <i>Melaleuca</i> -dominated forest types are Forest Type 16
11	Upland cool complex notophyll vine forest/mesophyll vine forest	Higher altitude rainforest
12	Lowland and notophyll vine forest	Rainforest on sand islands or coastal dune systems. Lowland and mid-altitude complex notophyll vine forest and notophyll vine forests on sand islands and in fertile gully situations and river flats
13	Araucarian notophyll/microphyll vine forest	<i>Araucaria</i> -dominated rainforests
14	Semi-evergreen vine forest	Low-altitude rainforest, may be semi-deciduous in dry periods; includes dry rainforest, microphyll rainforest and vine thickets in sclerophyll communities
15	Rainforest with Eucalyptus emergents	Rainforest with mixed eucalypts, turpentine, brush box (<i>Lophostemon confertus</i>) or sclerophyll species as emergents (species include <i>E. grandis</i> , <i>E. microcorys</i> , <i>E. saligna</i> , <i>E. cloeziana</i> , <i>E. campanulata</i> , <i>E. dunnii</i> , <i>S. glomulifera</i> and <i>L. confertus</i>)
16	Non-eucalypt commercial forest–melaleuca	<i>Melaleuca</i> forest of lowland coastal areas
17	Non-eucalypt commercial forest–other species	Other non-eucalypt forests including brush box, <i>Callitris</i> spp., <i>Casuarina</i> spp. or brigalow (<i>Acacia harpophylla</i>). (Associations dominated by <i>Callitris</i> spp. subsequently split into an additional yield association.)
18	Non-commercial forest	All other native forest types in Queensland

Note: *Corymbia* and *Lophostemon* were previously grouped within *Eucalyptus* and *Tristania*, respectively.

Sources: Australian Forestry Council 1975; L Carron, interviews with author, 1990 and 1991; Forest Resources 1974; Queensland Forest Service SKED descriptions and resource information provided to the National Forest Inventory 1991; RAC survey database 1991 (Resource Assessment Commission 1992a); data collated during comprehensive regional assessment processes in south-eastern Queensland (see Bugg, Spencer & Lee 2002).

South Australia

South Australia has historically had limited commercial native forests, with much of the commercial forests removed or degraded by the early 20th century. Timber was extracted when forests and woodlands were cleared for agriculture. Commercial timber extraction was increasingly confined to higher quality, better formed forests and woodlands associated with messmate (*E. obliqua*), mixed with brown stringybark (*E. baxteri*) or manna gum (*E. viminalis*) and the river red gum forests (*E. camaldulensis*).

In the early 20th century South Australia implemented a program to convert forest and woodland to plantations because of a significant lack of sawlogs. The FORWOOD conference identified no more than 800 cubic metres of sawlogs available each year from South Australian native forests (Australian Forestry Council 1975). Yield information on these forests was provided to the RAC forest survey and National Forest Inventory based on historical records from Crown forests and red gum forests. Three South Australian yield associations can be identified (Table A4). In addition to sawlogs, timber products from these native forests included construction timbers, poles, posts, sleepers and firewood. No harvesting takes place on native forests in South Australia (MIG 2008; NFI 2003, 1998) although firewood can be obtained under permit (NFI 2003).

Table A4 South Australian timber yield associations

SA yield association	Commercial types	Description
1	SA mixed obliqua open forest and woodlands	Forests containing messmate, stringybark and/or gum timber species
2	SA river red gum forests and woodlands	River red gum forests and woodland associations
3	Non-commercial	Non-commercial native forest types

Sources: L Carron, interviews with the author, 1990 and 1991; RAC Survey database 1991

Western Australia

Two forest formations—the south-west wet eucalypt forests dominated by karri (*Eucalyptus diversicolor*) and the south-west dry eucalypt forest dominated by jarrah (*E. marginata*)—cover most of the area of south-west Western Australia used for timber production. Other commercially important timber species occur as mixtures within these forest formations, including marri (*Corymbia calophylla*), wandoo (*E. wandoo*), Western Australian blackbutt (*E. patens*), powder-barked wandoo (*E. accedens*), bullich (*E. megacarpa*), yellow tingle (*E. guilfoylei*) and Western Australian sheoak (*Allocasuarina fraseriana*). These species are used for sawlog (category 1 and 2), pulpwood and other timber products (including speciality timber, charcoal, firewood, mining and railway timbers, posts and poles).

Some forest resources with commercial attributes do occur in northern Western Australia, but these forests are generally small in scale, scattered and inaccessible, and have low growth rates. Therefore, the tropical forest communities in northern Western Australia are not used for wood production.

Based on information from the WA Department of Conservation and Land Management to the RAC inquiry and NFI in the early 1990s, 10 yield associations are defined for southern Western Australia (numbers 1–9 and 11) with an 11th (number 10) covering northern Western Australia and extending into the Northern Territory and Queensland (Table A5).

Table A5 Western Australian timber yield associations

WA yield association	Commercial types	Description
1	Shannon karri high quality	Very tall karri regrowth forest in Shannon Basin
2	Pure karri (Shannon/non-Shannon)	Tall karri forest in pure stands
3	Karri–jarrah high quality	High-quality karri and jarrah mixtures
4	Jarrah–karri/karri–jarrah	Jarrah and karri mixtures
5	Moist jarrah	Higher quality jarrah types
6	Dryland jarrah	Low rainfall jarrah types
7	Other eucalypt types (wet)	Mixed eucalypt in higher rainfall areas or pure marri
8	Other eucalypt types (dry)–wandoo	Mixed eucalypt in lower rainfall areas (including wandoo types)
9	Goldfield eucalypts	Mixed commercial eucalypts in the goldfields
10	Tropical non-commercial	Tropical north dry sclerophyll forest–woodland (see Table A7)
11	Non-commercial	Non-commercial forest types in southern and northern WA

Sources: L Carron, interviews with the author, 1990 and 1991; FORWOOD 1975; RAC survey database 1991; WA Department of Conservation and Land Management 1991

Most yield associations cover the forests in south-west Western Australia. Goldfield eucalypts are found in the Kalgoorlie region and include some mallee associations. Limited timber production can occur in forest types included in the category non-commercial, depending on proximity to commercial types, species composition and structural attributes.

In the late 1990s Commonwealth information was updated during the comprehensive regional assessment process for forests included in the Western Australian Regional Forest Agreement region. Associations in Table A5 are similar to those used in the comprehensive regional assessment process covering south-west Western Australia.

Tasmania

During the 19th and 20th centuries Tasmania was recognised for the quality and performance of many timbers. By the early 1850s markets for Tasmania's timber were established on mainland Australia and were developing in many other countries, making timber an important part of the Tasmanian economy. The timber industry remains very significant in Tasmania.

Inventory of public forest resources based on aerial photo-interpretation and ground-based plots commenced in the early 1950s and continued in the following decades. Similar inventories commenced on private forest land from the 1980s and applied the techniques practised in public forests (Carron 1985). Outputs of the inventories informed FORWOOD and the RAC survey database 1991. These inventories provided data for forest planning and management during the comprehensive regional assessments of environmental and economic values, with 50 forest communities being mapped (Tasmanian Public Land Use Commission 1996a, b). These communities were grouped into 16 Tasmanian timber yield associations (Table A6) based on work undertaken for the Tasmanian Regional Forest Agreement.

Table A6 Tasmanian timber yield associations

Code	Yield association	Description
1	Regnans forest	Wet sclerophyll <i>Eucalyptus regnans</i> -dominated forest (R), including wet <i>E. globulus</i> forest that can be a co-dominant with <i>E. regnans</i>
2	Tall wet eucalypts	Tall wet sclerophyll forests including <i>E. brookeriana</i> wet forest (BA), King Island <i>E. globulus</i> / <i>E. brookeriana</i> / <i>E. viminalis</i> forest (KG), tall <i>E. nitida</i> forest (NT), tall <i>E. obliqua</i> forest (OT), and wet <i>E. viminalis</i> forest on basalt (VW)
3	Tall alpine ash	Wet sclerophyll forest dominated by tall <i>E. delegatensis</i> in combination with <i>E. dalrympleana</i> and/or <i>E. cordata</i> (DT)
4	Dry ash types	Dry <i>E. delegatensis</i> forest (D) and dry <i>E. obliqua</i> forest (O)
5	Dry peppermint types	Dry sclerophyll forests with a range of species described by the following forest types: coastal <i>E. amygdalina</i> forest (AC), <i>E. amygdalina</i> forest on dolerite (AD), <i>E. amygdalina</i> forest on granite gravel (AG), inland <i>E. amygdalina</i> forest (AI), <i>E. amygdalina</i> forest on sandstone (AS), dry <i>E. nitida</i> forest (N), Furneaux <i>E. nitida</i> forest (NF), <i>E. pulchella</i> – <i>E. globulus</i> – <i>E. viminalis</i> grassy shrubby dry sclerophyll forest (P), <i>E. risdonii</i> forest (RI), <i>E. rodwayi</i> forest (RO), <i>E. tenuiramis</i> forest on granite (T), <i>E. tenuiramis</i> forest on dolerite (TD) and inland <i>E. tenuiramis</i> forest (TI)
6	Dry gum types	Dry sclerophyll forests with a range of gum-barked species described by the following forest types: <i>E. viminalis</i> / <i>E. ovata</i> / <i>E. amygdalina</i> / <i>E. obliqua</i> damp sclerophyll forest (DSC), <i>E. viminalis</i> and/or <i>E. globulus</i> coastal shrubby forest on Holocene sand (G), grassy <i>E. globulus</i> forest (GG), <i>E. morrisbyi</i> forest (MO), <i>E. ovata</i> / <i>E. viminalis</i> forest (OV), <i>E. viminalis</i> grassy forest (V) and Furneaux <i>E. viminalis</i> forest (VF)
7	Sieberi leagues	Dry sclerophyll <i>E. sieberi</i> forests on granite (SG) and other substrates (SO)

Code	Yield association	Description
8	Snow gum forest	Snow gum forest— <i>E. pauciflora</i> on Jurassic dolerite (PJ) and sediments (PS)
9	Sub-alpine eucalypt forest	Sub-alpine eucalypt forest dominated by <i>E. coccifera</i> (C) or <i>E. subcrenulata</i> (SU)
10	Tasmanian rainforest (non-pine)	Tasmanian rainforest described as tall callidendrous and thamnisc rainforest on fertile sites of more than 25 metre stand height (M+) and short thamnisc rainforest on less fertile sites of 8 to 25 metre stand height (M–)
11	Tasmanian rainforest (pine)	Tasmanian rainforest with pines—King Billy pine with deciduous beech (F), Huon pine (H), pencil pine with deciduous beech (PD), pencil pine (PP) and King Billy pine (X)
12	Leptospermum–melaleuca forest	<i>Leptospermum</i> spp.– <i>Melaleuca squarrosa</i> swamp forest (L)
13	Callitris, casuarina, melaleuca, banksia, notelaea forests	Non–eucalypt-dominated forest types including <i>Allocasuarina verticillata</i> (AV), <i>Banksia serrata</i> woodland (BS), <i>Callitris rhomboidea</i> forests (CR), <i>Melaleuca ericifolia</i> forest (ME) and <i>Notelaea ligustrina</i> and/or <i>Pomaderris apetala</i> forest (NP)
14	Blackwood forest on flats	Blackwood <i>Acacia melanoxylon</i> forest on flats (BF)
15	Blackwood, silver wattle forests	Acacia forest consisting of either blackwood <i>Acacia melanoxylon</i> forest on rises (BR) or silver wattle <i>Acacia dealbata</i> (SI)
16	Non-commercial forest	Non-commercial forest and woodland not described above (NCF)

Note: More detailed descriptions of individual forest communities (letters in brackets) are found in Tasmanian Public Land Use Commission (1996b).

Data sources: RAC survey database 1991 (Resource Assessment Commission 1992a); resource information provided to the National Forest Inventory 1990–92 by Forestry Tasmania; data collated during comprehensive regional assessment processes associated with the Tasmanian Regional Forest Agreement

Northern Territory

Northern Territory forest associations are similar to those found in northern Western Australia and northern Queensland. Much of this forest is non-commercial because of tree development, termite activity, past disturbance regimes (fire, cyclones, agricultural practice, harvesting), lack of merchantable species or inaccessibility. Much of the commercial forest was removed for agriculture or degraded from overcutting by the mid 20th century (Carron 1985; Forest Resources 1974).

Forest Resources (1974) identified commercial resources in the Northern Territory in the tropical eucalypt forests (greater than 20 metres in height), cypress pine–mixed eucalypt forests, rainforest and paperbark forests, 75 per cent of which were in Indigenous reserves. The FORWOOD conference identified around 80 000–120 000 cubic metres of sawlog and around 1.9 million cubic metres of pulpwood potentially available in Northern Territory native forests during the period 1975 to 2010 (Australian Forestry Council 1975; Forest Resources 1974). Significant uncertainty was attached to these estimates, particularly in the quality and quantity of pulpwood and the access limitations associated with harvesting sawlog (Forest Resources 1974). A parliamentary inquiry (House of Representatives Standing Committee on Expenditure 1978) subsequently found significant overestimation in the Northern Territory FORWOOD estimates; sawlog projections were estimated to be approaching zero. The inquiry also identified the difficulties of establishing satisfactory criteria of merchantability of trees characteristically found in the Northern Territory (Carron 1985). Five yield associations were identified for the Northern Territory (Table A7), with equivalent types in northern Western Australia and Queensland.

Resource Assessment Commission (1992a) reported 100 cubic metres per year of sawlog from private forests in the Northern Territory in 1990–91. Over the past two decades 53 000 cubic metres of hardwood sawlogs have been exported (Australian forest and wood products statistics 1990–2010, ABARES data) from private forests in the Northern Territory. These exports were primarily associated with native forest conversion to plantations on the Tiwi Islands.

Table A7 Northern Territory timber yield associations

NT yield association	Commercial types	Description
1	Tropical north dry sclerophyll forest–woodland	Low to unproductive tropical eucalypt forest or woodland of species with low commercial value (dominated by tropical eucalypts: <i>E. tetradonta</i> , <i>E. miniata</i> , <i>E. camaldulensis</i> , <i>Corymbia</i> spp.) but also containing <i>Callitris intratropica</i> and commercial <i>Melaleuca</i> species
2	Non-eucalypt commercial forest–melaleuca	<i>Melaleuca</i> forest of lowland coastal areas
3	Non-eucalypt commercial forest–other species	Non-eucalypt dominated forests and woodland with commercial species including brushbox (<i>Lophostemon confertus</i>), <i>Callitris</i> spp., <i>Casuarina</i> spp. or brigalow (<i>Acacia harpophylla</i>)
4	Rainforest	Rainforest, may be semi-deciduous in dry periods and includes dry rainforest, microphyll rainforest and vine thickets in sclerophyll communities
5	Non-commercial	All other native forest types

Sources: L Carron, interviews with the author, 1990 and 1991; Forest Resources 1974 data; RAC survey database 1991

National

Table A8 National translation of state/territory yield associations

Code	National forest yield association	NSW–ACT	Vic.	Qld	SA	WA	Tas.	NT
1	Regnans	–	2	–	–	–	1	–
2	Victorian shining gum	–	3	–	–	–	–	–
3	High-quality karri	–	–	–	–	1	–	–
4	Karri	–	–	–	–	2	–	–
5	High-quality karri–jarrah	–	–	–	–	3	–	–
6	Moist blackbutt	1, 2	–	3	–	–	–	–
7	Moist east coast eucalypts	3, 4	–	1	–	–	–	–
8	Moist east coast brush box	–	–	2	–	–	–	–
9	Semi-moist east coast eucalypts	5, 6	–	4	–	–	–	–
10	Karri–jarrah mix	–	–	–	–	4	–	–
11	High-quality jarrah	–	–	–	–	5	–	–
12	Tasmanian tall wet eucalypt	–	–	–	–	–	2	–

Code	National forest yield association	NSW–ACT	Vic.	Qld	SA	WA	Tas.	NT
13	Tasmanian tall alpine ash	–	–	–	–	–	3	–
14	Alpine ash	14	1	–	–	–	4	–
15	Moist tableland brown barrel–messmate	15	4	–	–	–	–	–
16	New South Wales moist tableland gum	16	–	–	–	–	–	–
17	Victorian and South Australian foothill mixed species	–	5	–	1	–	–	–
18	Queensland moist sclerophyll types	–	–	6, 7	–	–	–	–
19	Tasmanian dry peppermint types	–	–	–	–	–	5	–
20	Tasmanian dry gum types	–	–	–	–	–	6	–
21	Dry spotted gum and blackbutt types	7	–	5	–	–	–	–
22	Southern silvertop ash types	8	6	–	–	–	7	–
23	Dryland jarrah	–	–	–	–	6	–	–
24	Coastal stringybark bloodwood	9	–	–	–	–	–	–
25	Dry sclerophyll ironbarks–mixed eucalypts	11	–	9	–	–	–	–
26	Commercial dry sclerophyll northeast NSW and coastal Queensland	12	–	8	–	–	–	–
27	Northeast New South Wales dry tableland eucalypts	17	–	–	–	–	–	–
28	Grey box–ironbark leagues	10	–	–	–	–	–	–
29	Commercial apple leagues	13	–	–	–	–	–	–
30	Eastern dry sclerophyll	18	7	–	–	–	–	–
31	Western box–red gum	19	–	–	–	–	–	–
32	Box–ironbark	20	9	–	–	–	–	–
33	Commercial snow gum leagues	21	–	–	–	–	8	–
34	Tasmanian and Victorian sub-alpine eucalypt forest	–	8	–	–	–	9	–
35	Western Australian other wet eucalypt types	–	–	–	–	7	–	–
36	Western Australian other dry eucalypt types	–	–	–	–	8	–	–
37	Western Australian goldfield eucalypts	–	–	–	–	9	–	–
38	Tropical dry sclerophyll forest and woodland	–	–	10	–	10	–	1
39	Cypress pine	22	10	17a	–	–	–	–

Code	National forest yield association	NSW–ACT	Vic.	Qld	SA	WA	Tas.	NT
40	Commercial non-eucalypt forest	23	–	–	–	–	13	–
41	River red gum	24	12	–	2	–	–	–
42	Tasmanian Leptospermum–Melaleuca forest	–	–	–	–	–	12	–
43	Blackwood–silver wattle forests	–	11	–	–	–	14, 15	–
44	Southern mainland rainforest	(25–29 ^b)	13	–	–	–	–	–
45	Tasmanian rainforest (non pine)	–	–	–	–	–	10	–
46	Tasmanian rainforest (pine)	–	–	–	–	–	11	–
47	Upland tropical/subtropical rainforest	–	–	11	–	–	–	–
48	Lowland tropical/subtropical rainforest	25	–	12	–	–	–	–
49	Warm temperate rainforest	26	–	–	–	–	–	–
50	Cool temperate rainforest	27	–	–	–	–	–	–
51	Araucaria rainforest	28	–	13	–	–	–	–
52	Dry-depauperate rainforest	29, 30	–	14	–	–	–	4
53	Queensland ecotonal rainforests	–	–	15	–	–	–	–
54	Commercial Melaleuca forest	–	–	16	–	–	–	2
55	Northern Australia non–eucalypt - dominated dry commercial forest	–	–	17	–	–	–	3
92	Non-commercial forest–forest/woodland	31	14	18	3	11	16	5

^a Associations dominated by *Callitris* spp. in Queensland yield association 17 subsequently split into an additional yield association and placed here in Cypress pine. ^b Includes only commercial rainforest based on historical data that was unable to be classified into NSW associations 25–29.

Note: Refer to code numbers in Tables A1–A7.

Appendix B: Sawlog definitions

This appendix outlines the definitions of sawlog used in deriving productivity and merchantability values for the database. Table B1 presents those sawlog categories included in the database. James (2001) includes a more detailed description of log grades used in Australia.

Table B1 State sawlog definitions

State	Definition
Tasmania	High quality (category 1, 3 and 4 sawlogs)
Victoria	D+, durable
New South Wales	Quota, high quality, durable
Australian Capital Territory, Northern Territory, Queensland, South Australia and Western Australia	Sawlog (including bole sawlog)

Note: ACT, NT and SA definitions of sawlog from native forest are those used in FORWOOD. Sawlogs are no longer harvested from native forests in the ACT and SA.

New South Wales

Table B2 New South Wales' sawlog definitions

Quota logs (sawlogs)	Include logs that meet length, diameter, species, straightness and presence of defects specifications and comprise the better quality, larger diameter logs (generally with centre diameters greater than 40 cm)
Non-quota logs	Include logs higher in quality than quota logs, sound small diameter logs and low-quality logs with defects above the acceptable limits for quota quality logs
High-quality sawlogs	Include quota and non-quota sawlogs that are either small diameter logs that meet high quality and size specifications or have very high specifications for both quality and size such as poles, piles, veneer, and girders High-quality large sawlogs (>40 cm native, >18 cm cypress, >24 cm softwood) High-quality small sawlogs (<40 cm native, <18 cm cypress, <24 cm softwood)
Durable sawlogs	Include logs that meet sawlog and timber durability specifications; examples include river red gum, red gum, ironbark, box species and turpentine

Source: BRS & SFNSW 1999

Victoria

State of Victoria (2005) defines a sawlog as any log of merchantable species which is at least 2.7 metres in length, has a small-end diameter of 25 centimetres or greater, does not have a sweep or crook that exceeds 1/5 diameter from a 2.4 metre straight edge and is of grade D or better (i.e. grades A, B and C; D+ refers to grades A, B, C and D together). Durable hardwood-grade sawlog refers to sawlogs from the river red gum and box-ironbark species. For further information on log grading see VicForests (2012).

Western Australia

Table B3 Western Australian sawlog definitions

First grade sawlog jarrah	A log cut from the bole of a jarrah tree that is a minimum of 2.1 metres in length, has a minimum under-bark diameter of 200 millimetres and has a minimum of 50 per cent millable timber on the worst end face
First grade sawlog karri	A log cut from the bole of a karri tree that is a minimum of 2.4 metres in length, a minimum under-bark diameter of 300 millimetres and has a minimum of 50 per cent millable timber on the worst end face. This is the normal specification and individual contracts will vary
Second grade sawlog jarrah	A log cut from the bole of a jarrah tree that is a minimum of 2.1 metres in length, has a minimum under-bark diameter of 250 millimetres and has a minimum of 30 per cent millable timber on the worst end face
Second grade sawlog karri	A log cut from the bole of a karri tree that is a minimum of 2.4 metres in length, has a minimum under-bark diameter of 300 millimetres and has a minimum of 30 per cent millable timber on the worst end face
Bole sawlog	The bole of the felled tree but docked at each end so that there is a minimum of one second-grade sawlog
Other bole log	A log cut from the bole of a tree that is below second-grade sawlog specifications; may also be referred to as third-grade sawlog

Source: Conservation Commission of Western Australia 2003

Tasmania

Table B4 Tasmanian sawlog definitions

Category 1 and 3 sawlog	High-quality eucalypt sawlog as specified in the Forestry Regulations 1993 Schedule 5 Part 1. Eucalypt sawlogs from mature and over-mature forest are termed 'Category 1 sawlogs' and those from regrowth and plantation forests are termed 'Category 3 sawlogs'
Category 2 sawlog	Second-grade eucalypt sawlog. These sawlogs arise from high-quality eucalypt sawlog operations
Category 4	Sawlog. First-grade sawlog from special species timbers such as blackwood, myrtle, sassafras, celery-top pine, Huon pine and leatherwood
Category 8	Log. Eucalypt log with a quality below Category 2 specifications. These sawlogs arise from high-quality eucalypt sawlog operations

Source: Forestry Tasmania 2008

Appendix C: Fields and explanatory notes for confidence matrix

Table C1 Confidence rating applied to forest regions used to calculate an overall confidence score

State	Forest zone a	Forest region a	Zone/region ID a	Forest mapping	Map resolution	Yield assoc.	Growth stage	Productivity class	MAI reliability	MAI age	Average
ACT	ACT	SE NSW/E Vic.	1	4	5	4	2	4	3	2	3.43
NSW	Albury	Desert	2	3	3	2	2	2	2	2	2.29
NSW	Albury	Other	3	3	3	3	2	3	2	3	2.71
NSW	Albury	SE NSW/E Vic.	4	4	4	3	3	3	3	4	3.43
NSW	Batemans Bay	SE NSW/E Vic.	5	5	5	4	4	5	4	4	4.43
NSW	Bathurst	Other	6	3	3	3	3	4	3	3	3.14
NSW	Bathurst	SE NSW/E Vic.	7	4	5	4	4	5	4	4	4.29
NSW	Coffs Harbour	Northern NSW/Southern Qld	8	4	5	4	4	4	4	4	4.14
NSW	Dubbo	Desert	9	2	3	2	2	2	2	2	2.14
NSW	Dubbo	Northern NSW/Southern Qld	10	4	5	4	4	4	4	4	4.14
NSW	Dubbo	Other	11	3	3	3	3	4	3	3	3.14
NSW	Dubbo	SE NSW/E Vic.	12	4	5	4	4	5	4	4	4.29
NSW	Eden	SE NSW/E Vic.	13	4	5	5	5	5	4	4	4.57
NSW	Glen Innes	Northern NSW/Southern Qld	14	4	5	4	4	4	4	4	4.14
NSW	Glen Innes	Other	15	3	3	3	3	4	3	3	3.14
NSW	Glen Innes	SE NSW/E Vic.	16	4	5	4	4	5	4	4	4.29
NSW	Newcastle	Northern NSW/Southern Qld	17	4	5	4	4	4	4	4	4.14
NSW	Newcastle	SE NSW/E Vic.	18	4	5	4	4	5	4	4	4.29
NSW	Port Macquarie	Northern NSW/Southern Qld	19	4	5	4	4	4	4	4	4.14

State	Forest zone a	Forest region a	Zone/region ID a	Forest mapping	Map resolution	Yield assoc.	Growth stage	Productivity class	MAI reliability	MAI age	Average
NSW	Port Macquarie	SE NSW/E Vic.	20	4	5	4	4	4	4	4	4.14
Vic.	Benalla–Mansfield	SE NSW/E Vic.	21	5	5	5	4	5	4	4	4.57
Vic.	Bendigo	Green Triangle	22	5	5	4	3	3	3	3	3.71
Vic.	Bendigo	Other	23	5	5	3	3	3	3	3	3.57
Vic.	Bendigo	SE NSW/E Vic.	24	5	5	4	3	3	3	4	3.86
Vic.	Central	SE NSW/E Vic.	25	5	5	4	4	5	4	4	4.43
Vic.	Central Gippsland	SE NSW/E Vic.	26	5	5	4	4	4	3	4	4.14
Vic.	Dandenong	SE NSW/E Vic.	27	5	5	4	4	5	4	4	4.43
Vic.	East Gippsland	SE NSW/E Vic.	28	5	5	4	4	5	3	4	4.29
Vic.	Horsham	Green Triangle	29	5	5	3	3	3	3	3	3.57
Vic.	Horsham	Other	30	5	5	3	3	3	3	3	3.57
Vic.	Horsham	SE NSW/E Vic.	31	5	5	3	3	3	3	3	3.57
Vic.	Mid Murray	Other	32	5	5	3	3	3	3	3	3.57
Vic.	Mid Murray	SE NSW/E Vic.	33	5	5	3	3	3	3	3	3.57
Vic.	Midlands	Green Triangle	34	5	5	4	4	4	3	4	4.14
Vic.	Midlands	SE NSW/E Vic.	35	5	5	4	4	4	3	4	4.14
Vic.	Mildura	Other	36	5	5	3	3	3	3	3	3.57
Vic.	North-East	SE NSW/E Vic.	37	5	5	5	4	5	4	4	4.57
Vic.	Otway	Green Triangle	38	5	5	4	4	4	3	4	4.14
Vic.	Otway	SE NSW/E Vic.	39	5	5	4	4	4	4	4	4.29
Vic.	Portland	Green Triangle	40	5	5	3	3	3	3	4	3.71
Vic.	Portland	SE NSW/E Vic.	41	5	5	3	4	3	3	4	3.86
Vic.	Tambo	SE NSW/E Vic.	42	5	5	4	4	4	4	4	4.29

State	Forest zone a	Forest region a	Zone/region ID a	Forest mapping	Map resolution	Yield assoc.	Growth stage	Productivity class	MAI reliability	MAI age	Average
NT	Arnhem Land	Northern Australia	43	4	3	2	2	2	2	2	2.43
NT	Arnhem Land	Other	44	4	3	2	2	2	2	1	2.29
NT	Darwin	Northern Australia	45	4	3	2	2	2	2	2	2.43
NT	Darwin	Other	46	4	3	2	2	2	2	1	2.29
NT	Melville Island	Northern Australia	47	4	3	2	2	2	2	2	2.43
NT	NT Arid	Desert	48	3	2	2	2	2	2	1	2.00
NT	NT Arid	Northern Australia	49	4	3	2	2	2	2	1	2.29
NT	NT Arid	Other	50	3	2	2	2	2	2	1	2.00
Qld	Central Western	Desert	51	3	2	1	2	2	1	3	2.00
Qld	Central Western	Northern Australia	52	3	2	2	2	3	2	3	2.43
Qld	Central Western	Northern NSW/Southern Qld	53	3	3	3	2	3	3	3	2.86
Qld	Central Western	Other	54	3	2	2	2	2	2	3	2.29
Qld	Eastern Cypress	Northern NSW/Southern Qld	55	4	3	4	2	4	3	3	3.29
Qld	Eastern Cypress	Other	56	3	3	3	2	3	3	3	2.86
Qld	Mackay	Northern Australia	57	3	2	3	2	3	3	3	2.71
Qld	Mackay	Northern NSW/Southern Qld	58	3	3	3	2	3	3	3	2.86
Qld	North Queensland	Desert	59	3	1	1	2	2	1	3	1.86
Qld	North Queensland	Northern Australia	60	3	2	3	2	3	3	3	2.71
Qld	North Queensland	Other	61	3	2	1	2	2	2	3	2.14
Qld	Qld Central Coast	Northern NSW/Southern Qld	62	4	3	4	3	3	4	4	3.57
Qld	Qld South East	Northern NSW/Southern Qld	63	5	4	4	3	4	5	4	4.14
Qld	Western Cypress	Desert	64	3	1	1	2	2	1	3	1.86

State	Forest zone a	Forest region a	Zone/region ID a	Forest mapping	Map resolution	Yield assoc.	Growth stage	Productivity class	MAI reliability	MAI age	Average
Qld	Western Cypress	Northern NSW/Southern Qld	65	4	3	3	2	3	3	3	3.00
Qld	Western Cypress	Other	66	3	2	1	2	2	2	3	2.14
SA	SA Arid	Desert	67	1	2	1	1	2	2	1	1.43
SA	SA Arid	Green Triangle	68	2	2	2	1	2	2	1	1.71
SA	SA Arid	Other	69	1	2	1	1	2	2	1	1.43
SA	SA Central	Green Triangle	70	3	2	3	1	2	2	1	2.00
SA	SA Central	Other	71	3	2	3	1	2	2	1	2.00
SA	SA Northern	Desert	72	2	2	2	1	2	2	1	1.71
SA	SA Northern	Other	73	2	2	2	1	2	2	1	1.71
SA	SA South East	Green Triangle	74	3	2	3	1	2	2	1	2.00
SA	SA South East	Other	75	3	2	3	1	2	2	1	2.00
Tas.	Bass	Tasmania	76	5	5	5	4	5	4	4	4.57
Tas.	Derwent	Tasmania	77	5	5	5	4	5	5	4	4.71
Tas.	Huon	Tasmania	78	5	5	5	4	5	5	4	4.71
Tas.	Mersey	Tasmania	79	5	5	5	4	5	4	4	4.57
Tas.	Murchison	Tasmania	80	5	5	5	4	5	5	4	4.71
WA	Goldfields	Desert	81	3	2	2	2	2	2	3	2.29
WA	Goldfields	Other	82	3	3	2	2	3	2	3	2.57
WA	Kimberley	Desert	83	2	2	2	2	2	2	1	1.86
WA	Kimberley	Northern Australia	84	3	2	2	2	2	2	2	2.14
WA	Kimberley	Other	85	2	2	2	2	2	2	1	1.86
WA	Pilbara	Desert	86	2	2	2	2	2	2	1	1.86
WA	Pilbara	Other	87	2	3	2	2	2	2	1	2.00
WA	Pilbara	SW WA	88	3	2	2	2	2	2	1	2.00

State	Forest zone a	Forest region a	Zone/region ID a	Forest mapping	Map resolution	Yield assoc.	Growth stage	Productivity class	MAI reliability	MAI age	Average
WA	South Coast	Desert	89	2	3	2	2	2	2	1	2.00
WA	South Coast	Other	90	2	3	2	2	2	2	4	2.43
WA	South Coast	SW WA	91	4	4	3	2	3	4	4	3.43
WA	Swan	SW WA	92	4	5	5	3	5	5	5	4.57
WA	WA South West	SW WA	93	4	5	5	3	5	5	5	4.57
WA	Warren	SW WA	94	4	5	5	3	5	5	5	4.57
WA	Wheatbelt	Other	95	3	3	3	2	3	3	3	2.86
WA	Wheatbelt	SW WA	96	3	4	3	2	4	4	4	3.43

a Forest zone and forest region were used to assign categories of confidence nationally. Each zone/region combination was given a unique zone/region identifier (ID). Forest zones are presented in Map 5 of the main report. Forest regions are the study regions presented in ABARES (2011).
Note: Each category class was assigned a rating from 1 to 5, with 1 indicating a very low confidence and 5 indicating very high confidence. The seven category ratings were then averaged to provide an indicative overall confidence in the data presented for the grid cell. The intention was to provide an indicative assessment of the confidence held in the source components rather than a quantifiable one.

Appendix D: Commerciality by forest zone

Table D1 Commerciality by forest zone on selected tenures (ha)

Forest zone	Tenure	Very low	Low	Moderate	High	Very high	Total
ACT	Total	–	11 417	134	6	–	11 557
	LEASE	–	11 128	125	5	–	11 258
	MUF	–	289	9	1	–	299
Arnhem Land (NT)	Total	–	5 450 094	–	–	–	5 450 094
	LEASE	–	122 445	–	–	–	122 445
	PRIV	–	5 327 649	–	–	–	5 327 649
Bass (Tas.)	Total	–	190 993	99 015	105 997	1 378	397 383
	MUF	–	92 078	71 597	91 257	1 327	256 259
	PRIV	–	98 915	27 418	14 740	51	141 124
Benalla–Mansfield (Vic.)	Total	31	37 549	77 221	27 407	551	142 759
	LEASE	–	898	3 925	77	–	4 900
	MUF	–	18 225	60 833	24 709	551	104 318
	PRIV	31	18 426	12 463	2 621	–	33 541
Bendigo (Vic.)	Total	102 515	8 515	1	341	–	111 372
	LEASE	–	5	–	–	–	5
	MUF	75 846	2 873	–	–	–	78 719
	PRIV	26 669	5 637	1	341	–	32 648
Central (Vic.)	Total	520	25 143	81 518	81 396	41 720	230 297
	LEASE	–	13	236	382	8	639
	MUF	–	8 652	64 281	69 091	40 891	182 915
	PRIV	520	16 478	17 001	11 923	821	46 743
Central Coast (Qld)	Total	–	2 069 788	710 378	54 393	–	2 834 559
	LEASE	–	923 096	223 805	8 703	–	1 155 604
	MUF	–	362 754	89 043	15 340	–	467 137
	PRIV	–	783 938	397 530	30 350	–	1 211 818
Central Gippsland (Vic.)	Total	20 929	52 421	176 199	199 227	79 034	527 810
	LEASE	4 038	1 241	826	1 083	3 765	10 953
	MUF	7 516	42 188	154 093	180 732	61 902	446 431
	PRIV	9 375	8 992	21 280	17 412	13 367	70 426
Central Western (Qld)	Total	–	1 471 374	63 009	6 088	–	1 540 471
	LEASE	–	1 195 779	53 169	5 608	–	1 254 556
	MUF	–	78 207	2 398	16	–	80 621
	PRIV	–	197 388	7 442	464	–	205 294
Dandenong (Vic)	Total	4 469	16 198	19 138	41 726	24 417	105 948
	LEASE	–	1	–	–	–	1
	MUF	9	817	8 273	24 816	20 989	54 904
	PRIV	4 460	15 380	10 865	16 910	3 428	51 043
Darwin (NT)	Total	–	3 384 329	–	–	–	3 384 329

Forest zone	Tenure	Very low	Low	Moderate	High	Very high	Total
	LEASE	–	1 438 499	–	–	–	1 438 499
	PRIV	–	1 945 830	–	–	–	1 945 830
Derwent (Tas.)	Total	–	299 604	77 736	177 252	8 105	562 697
	MUF	–	45 687	46 528	121 731	7 704	221 650
	PRIV	–	253 917	31 208	55 521	401	341 047
East Gippsland (Vic.)	Total	–	133 629	210 013	191 373	59 679	594 694
	MUF	–	116 886	196 054	183 701	59 466	556 107
	PRIV	–	16 743	13 959	7 672	213	38 587
Eastern Cypress (Qld)	Total	–	1 376 250	117 091	802	–	1 494 143
	LEASE	–	402 170	52 754	31	–	454 955
	MUF	–	390 752	39 925	–	–	430 677
	PRIV	–	583 328	24 412	771	–	608 511
Eden (NSW)	Total	–	43 268	120 108	93 083	68 501	324 960
	LEASE	–	3 185	8 764	435	831	13 215
	MUF	–	4 781	53 389	66 959	44 356	169 485
	PRIV	–	35 302	57 955	25 689	23 314	142 260
Horsham (Vic.)	Total	568	2 268	1 307	5 006	–	9 149
	LEASE	–	21	–	–	–	21
	MUF	113	841	–	259	–	1 213
	PRIV	455	1 406	1 307	4 747	–	7 915
Huon (Tas.)	Total	–	9 401	23 794	40 179	13 205	86 579
	MUF	–	6 249	12 721	26 904	11 896	57 770
	PRIV	–	3 152	11 073	13 275	1 309	28 809
Mackay (Qld)	Total	–	1 096 982	91 803	46 693	–	1 235 478
	LEASE	–	652 333	68 451	27 268	–	748 052
	MUF	–	107 600	4 650	9 163	–	121 413
	PRIV	–	337 049	18 702	10 262	–	366 013
Melville Island (NT)	Total	–	557 039	–	–	–	557 039
	PRIV	–	557 039	–	–	–	557 039
Mersey (Tas.)	Total	–	131 144	52 963	65 217	965	250 289
	MUF	–	33 972	29 027	41 816	920	105 735
	PRIV	–	97 172	23 936	23 401	45	144 554
Mid Murray (Vic.)	Total	24	8 245	20	40 268	–	48 557
	MUF	–	1 155	12	38 300	–	39 467
	PRIV	24	7 090	8	1 968	–	9 090
Midlands (Vic.)	Total	938	81 691	36 030	39 634	442	158 735
	LEASE	9	2 695	163	217	–	3 084
	MUF	573	35 175	27 940	23 040	376	87 104
	PRIV	356	43 821	7 927	16 377	66	68 547
Mildura (Vic.)	Total	50	621	–	2 278	–	2 949
	MUF	46	418	–	1 295	–	1 759
	PRIV	4	203	–	983	–	1 190
Murchison (Tas.)	Total	–	90 242	79 988	118 526	21 445	310 201

Forest zone	Tenure	Very low	Low	Moderate	High	Very high	Total
	MUF	–	54 725	43 973	92 160	20 448	211 306
	PRIV	–	35 517	36 015	26 366	997	98 895
North Coast (Qld)	Total	–	6 468 761	240 814	218 394	–	6 927 969
	LEASE	–	5 599 083	103 798	189 532	–	5 892 413
	MUF	–	87 783	42 905	17 830	–	148 518
	PRIV	–	781 895	94 111	11 032	–	887 038
North-East (Vic)	Total	4	109 256	205 097	71 931	4 933	391 221
	LEASE	–	809	1 916	336	–	3 061
	MUF	–	64 979	177 830	68 874	4 933	316 616
	PRIV	4	43 468	25 351	2 721	–	71 544
NE Lower and Upper (NSW)	Total	–	1 109 280	532 447	529 759	538 877	2 710 363
	LEASE	–	146 533	45 314	36 114	21 641	249 602
	MUF	–	133 679	127 577	136 222	234 897	632 375
	PRIV	–	829 068	359 556	357 423	282 339	1 828 386
NT Arid	Total	–	252 058	–	–	–	252 058
	LEASE	–	191 976	–	–	–	191 976
	PRIV	–	60 082	–	–	–	60 082
Otway (Vic.)	Total	107	282	27 911	19 103	10 507	57 910
	LEASE	–	–	245	198	57	500
	MUF	–	13	14 272	11 943	4 668	30 896
	PRIV	107	269	13 394	6 962	5 782	26 514
Pilbara (WA)	Total	–	19 786	–	–	–	19 786
	LEASE	–	5 250	–	–	–	5 250
	PRIV	–	14 536	–	–	–	14 536
Portland (Vic.)	Total	103	10 864	37 141	523	139	48 770
	LEASE	–	91	214	–	–	305
	MUF	–	8 408	30 903	67	89	39 467
	PRIV	103	2 365	6 024	456	50	8 998
SA Arid	Total	–	2	–	–	–	2
	PRIV	–	2	–	–	–	2
SA Central	Total	–	8 469	1 741	–	–	10 210
	LEASE	–	1 133	6	–	–	1 139
	MUF	–	46	18	–	–	64
	PRIV	–	7 290	1 717	–	–	9 007
SA Northern	Total	–	484	–	–	–	484
	LEASE	–	90	–	–	–	90
	PRIV	–	394	–	–	–	394
SA South East	Total	–	9 761	–	–	–	9 761
	LEASE	–	963	–	–	–	963
	MUF	–	98	–	–	–	98
	PRIV	–	8 700	–	–	–	8 700
South Coast (WA)	Total	–	7 105	17 854	421	420	25 800
	LEASE	–	239	223	34	–	496

Forest zone	Tenure	Very low	Low	Moderate	High	Very high	Total
	MUF	–	–	4	13	–	17
	PRIV	–	6 866	17 627	374	420	25 287
South Coast— Southern (NSW)	Total	–	302 393	164 603	131 006	94 341	692 343
	LEASE	–	21 129	15 770	6 140	3 341	46 380
	MUF	–	21 778	41 124	58 006	41 379	162 287
	PRIV	–	259 486	107 709	66 860	49 621	483 676
South East (Qld)	Total	–	427 468	569 095	130 714	1	1 127 278
	LEASE	–	29 351	30 291	3 702	1	63 345
	MUF	–	66 869	122 116	51 486	–	240 471
	PRIV	–	331 248	416 688	75 526	–	823 462
Southern—Tumut (NSW)	Total	–	66 958	56 752	3 620	13 902	141 232
	LEASE	–	5 406	1 882	1	0	7 289
	MUF	–	18 721	36 446	2 426	13 781	71 374
	PRIV	–	42 831	18 424	1 193	121	62 569
Swan (WA)	Total	–	146 187	384 638	28 198	–	559 023
	MUF	–	26 388	325 633	18 453	–	370 474
	PRIV	–	119 799	59 005	9 745	–	188 549
Tambo (Vic)	Total	564	95 267	102 681	106 023	16 327	320 862
	LEASE	–	2	4	–	–	6
	MUF	23	78 637	90 559	105 215	16 279	290 713
	PRIV	541	16 628	12 118	808	48	30 143
WA South West	Total	–	87 925	340 963	185 445	186	614 519
	LEASE	–	5	–	–	–	5
	MUF	–	40 415	284 219	146 575	88	471 297
	PRIV	–	47 505	56 744	38 870	98	143 217
Warren (WA)	Total	–	11 116	104 701	141 750	68 854	326 421
	LEASE	–	66	–	–	–	66
	MUF	–	532	59 433	122 689	60 011	242 665
	PRIV	–	10 518	45 268	19 061	8 843	83 690
Western (NSW)	Total	–	2 565 234	711 562	227 808	11 062	3 515 666
	LEASE	–	1 488 274	74 612	42 003	161	1 605 050
	MUF	–	166 055	179 604	41 899	4 062	391 620
	PRIV	–	910 905	457 346	143 906	6 839	1 518 996
Western Cypress (Qld)	Total	–	1 059 065	275 515	1 283	–	1 335 863
	LEASE	–	728 003	191 921	1 283	–	921 207
	MUF	–	93 748	70 854	–	–	164 602
	PRIV	–	237 314	12 740	–	–	250 054

Forest zone	Tenure	Very low	Low	Moderate	High	Very high	Total
Wheatbelt (WA)	Total	–	103 088	14 499	2 818	–	120 405
	LEASE	–	5 702	382	–	–	6 084
	MUF	–	14 057	–	–	–	14 057
	PRIV	–	83 329	14 117	2 818	–	100 264
Total		130 822	29 409 238	5 824 074	3 135 688	1 078 991	39 578 813

Note: Only forest zones with very low to very high commerciality are shown. Area statement of these tenures combine legally and not legally restricted from harvesting (refer to Table 11). In the ACT and SA timber harvesting of native forest is not permitted on any tenures. Tenure is from Tenure of Australia's forests 2008 (NFI 2008b). State and territory abbreviations for each forest zone are in brackets.

Appendix E: Forest areas across private, leasehold and multiple-use estates and associated commerciality

Table E1 Commercial native forest area across private, leasehold and multiple-use estates and associated commerciality, by state/territory (ha)

State/tenure	Commerciality					
	Very low	Low	Moderate	High	Very high	Total
New South Wales	–	4 086 960	1 585 559	985 312	726 684	7 384 515
LEASE	–	1 664 526	146 352	84 694	25 975	1 921 547
MUF	–	345 014	438 140	305 532	338 475	1 427 161
PRIV	–	2 077 420	1 001 067	595 086	362 234	4 035 807
Victoria	130 822	581 949	974 277	826 203	237 749	2 751 000
LEASE	4 047	5 776	7 529	2 293	3 830	23 475
MUF	84 126	379 267	825 050	732 022	210 144	2 230 609
PRIV	42 649	196 906	141 698	91 888	23 775	496 916
Queensland	–	13 972 249	2 066 212	458 364	–	16 496 825
LEASE	–	9 532 199	722 770	236 126	–	10 491 095
MUF	–	1 187 713	371 891	93 835	–	1 653 439
PRIV	–	3 252 337	971 551	128 403	–	4 352 291
South Australia	–	18 716	1 741	–	–	20 457
LEASE	–	2 186	6	–	–	2 192
MUF	–	144	18	–	–	162
PRIV	–	16 386	1 717	–	–	18 103
Western Australia	–	375 207	862 655	358 632	69 460	1 665 954
LEASE	–	11 262	605	34	–	11 901
MUF	–	81 392	669 289	287 730	60 099	1 098 510
PRIV	–	282 553	192 761	70 868	9 361	555 543
Tasmania	–	721 384	333 496	507 171	45 098	1 607 149
MUF	–	232 711	203 846	373 868	42 295	852 720
PRIV	–	488 673	129 650	133 303	2 803	754 429
Northern Territory	–	9 641 356	–	–	–	9 641 356
LEASE	–	1 750 533	–	–	–	1 750 533
PRIV	–	7 890 823	–	–	–	7 890 823
Australian Capital Territory	–	11 417	134	6	–	11 557
LEASE	–	11 128	125	5	–	11 258
MUF	–	289	9	1	–	299
Grand total	130 822	29 409 238	5 824 074	3 135 688	1 078 991	39 578 813

Note: Area statement of these tenures combine forests legally and not legally restricted from harvesting. In the ACT and South Australia timber harvesting of native forest is not permitted on any tenures. Tenure is from Tenure of Australia's forests 2008 (NFI 2008b).

Glossary

Available	Forest where harvesting is permitted and is not legally restricted by legislation, code of practice or management plan.
Commerciality	Expected volume yield of commercial sawlog or veneer log (or high-value equivalents) from merchantable species that is available from a forest stand over the long term, assuming good silvicultural practices are followed. Commerciality is derived from a combination of merchantability and productivity.
CRA	Comprehensive regional assessment
D+ sawlog	Victorian classification of sawlog grades combining sawlog grades A, B, C and D.
EVC	Ecological vegetation class (a Victorian vegetation classification system)
Forest stand	A contiguous area containing trees that are more or less homogeneous in species composition, density, size, forest structure and/or silvicultural description.
FORINS	A New South Wales statewide forest resource inventory undertaken during the 1970s and 1980s.
FORWOOD	The 1974 Forestry and Wood-based Industries Development Conference.
GoldFOR	NFI database covering the Goldfield region of Western Australia.
HARIS	Victorian forest inventory database before SFRI.
JIGSAW	An Australian Government database used during the Western Australia comprehensive regional assessment for assessing impacts of reserve design decisions on wood yields.
LNE	Lower Northeast Regional Forest Agreement (NSW)
LUT	Lookup table
Mean annual increment (MAI)	Growth increment of sawlog expressed as cubic metres per hectare per year. The measure applies to volume growth of trees per unit area at peak mean annual increment in fully stocked forest stands under ideal silvicultural systems.
Merchantability	Suitability of a tree species for sawlog, pulp, or speciality wood products with an emphasis on commercial production of sawlogs or high-value equivalents.
MUF	Multiple-use public forest
NCR	Nature conservation reserve
NFI	National Forest Inventory

NORFOR	NFI database covering Northern Australia (north Queensland, Northern Territory and northern Western Australia).
NVIS	National Vegetation Information System
OCL	Other Crown land
Other wooded land (OWL)	A non-forest vegetation type: open woodland, heathland or shrubland with actual or potential tree height greater than 2 metres, but either actual or potential tree canopy crown cover of 5–20 per cent or combined cover of shrubs and trees greater than 10 per cent.
PRIV	Private land
Productivity	The potential capacity of a forest to produce a sawlog, measured by mean annual increment.
RAC	Refers to the 1992 Resource Assessment Commission Forest and Timber Inquiry (RAC inquiry) and its supporting data and reports.
RFA	Regional forest agreement
RN 17	Forestry Commission of New South Wales Research Note 17 (see Baur 1979)
SFRI	Statewide Forest Resources Inventory (Victoria)
SKED	Wood yield modelling system used in Queensland before and during the South East Queensland comprehensive regional assessment.
SPECTRUM	Wood yield modelling system used in New South Wales and North East Victoria during comprehensive regional assessments.
Suitability	Forest that federal, state and territory forest agencies have historically recognised as being commercially suitable for sawlog production, and/or that are recognised in the Australian Sawlog Commerciality Database as being commercially suitable for sawlog production.
TasVEG	Tasmanian vegetation classification system
TCFA	Tasmanian Community Forest Agreement, 2005 Supplementary Agreement to the Tasmanian Regional Forest Agreement.
UNE	Upper Northeast Regional Forest Agreement (NSW)
.vat	Value attribute table
WRC	Wood resource composite
Yield association	A grouping of forest types that display similar commercial attributes (commerciality) in terms of productivity and merchantability.

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