

## About wood

### Forests NSW Commercial Services

Wood is an extremely important, versatile and beautiful raw material. In Australia, about one cubic metre (m<sup>3</sup>) or one tonne of wood is used for every man, woman and child each year.

Wood comes from living, growing trees and therefore is a renewable material. In many parts of Australia, and other parts of the world, large areas of forest have been set aside and are managed primarily for the continued production of wood. Sustainable management of our forests, the primary source of the wood we use, ensures a continual supply of wood to meet our present and future needs.

There are many different kinds of wood, produced by different tree species, yet all wood shares common features.

### What is wood?

Wood comes from the trunk (main stem) of trees. A tree's stem serves two main purposes:

- to support the branches, leaves and flowers of the tree, holding these firmly, even against the buffeting of wind and storms
- to transport water and nutrients from the roots to the leaves, and sugar and other food stuffs from the leaves to all the other areas of the living tree.

The cross-section of a tree trunk is made up of four principal layers. The outer-most section is a ring of bark made up of two layers: an outer layer of dead corky material, the outer bark, and an inner layer of live bark, the phloem.

The outer layer is made up of epidermal cells that protect the stem from damage and from drying out.

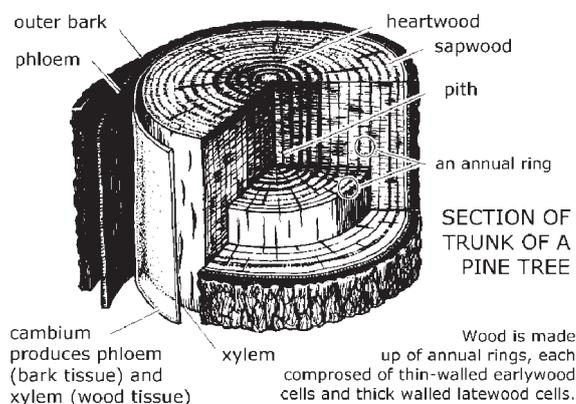
The phloem contains cells which form tall and thin tubes, like capillaries, which transport the sugars and other materials made in the leaves to all the other living cells in the tree.

The next layer is the cambium, which usually feels slimy in a freshly cut stem. This thin layer is made of cells which produce phloem and xylem, the next layer of the stem.

The cambium is the only place in a stem where new growth takes place, and its cells are constantly dividing to form new wood and new bark. As a result of the continual division of cells, the cambium layer slowly moves outwards as the tree increases in girth. As the tree expands in girth, the outer bark periodically splits or is shed and is replaced by the new outer layer.

The innermost layer of a stem is the xylem. Living xylem cells carry water and minerals from the roots to the leaves. Dead xylem cells make up heartwood which is the tissue (group of cells) in the centre of the stem.

Figure 1: Cross-section of a tree trunk



## Different kinds of wood in a tree

Two kinds of wood are found in mature trees. The central part of cross-section of wood (usually the bulk of the cross-section) is the heartwood. Around the heartwood, in a broad ring, lies the sapwood. It is paler in colour compared to the heartwood and is often whitish or cream coloured.

Heartwood consists of dead material. It helps support the tree and has no role in the growth of the tree.

Sapwood, on the other hand, is made up of living cells that carry water and nutrients upwards from the roots. It is this water and nutrient mixture that makes up a tree's sap.

New sapwood is formed by cambium cells as a tree grows. As new sapwood is formed, the innermost sapwood cells die and become heartwood. These cells slowly fill with tannins, resins and other substances, making the wood darker in colour and more resistant to decay and insect attack. The vessels that these cells form eventually become blocked and unable to carry sap.

## Annual rings

Trees that experience an annual growth pattern of slow and rapid growth rates are characterised by annual rings. Each ring represents one year's growth. Annual rings are found in most trees that come from Europe and North America. By counting the number of annual rings, it is possible to determine a tree's age.

In Australia, most native trees do not have annual rings, though a few, like the snow gum, alpine ash and red cedar, do have visible annual rings. It is therefore difficult to readily tell the age of most Australian native trees.

Growth rings are a feature of trees that grow in climates where growth virtually ceases for part of the year, such as during cold winter months. In spring, when these trees burst into growth, wood is formed relatively rapidly and these earlywood cells tend to be large and thin-walled. Later in the season, as tree growth slows, the cells become smaller and thicker-walled. The larger thin-walled cells tend to be paler in colour than the smaller thick-walled cells. An annual ring is made up of these two layers - the layers of thin- and thick-walled cells.

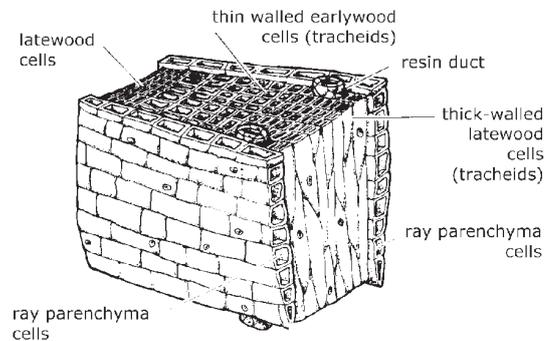
## Softwoods and hardwoods

There are two main types of wood - softwood and hardwood. Softwood and hardwood are terms that refer to the water-conducting cells in a living tree from which timber comes, and not to the hardness

or softness of the wood itself. You can see the differences between the different cells when you look at wood samples through a microscope or under a powerful magnifying glass.

In softwoods, the water-conducting cells are known as xylem tracheids and are tapered in shape, while in hardwoods these cells are tubular-shaped and are known as xylem vessels.

Figure 2: A section of softwood



Conifers are an example of gymnosperms, or cone-producing plants. All conifer species are softwoods, including radiata pine, an introduced pine species grown in softwood plantations in New South Wales.

Angiosperms are flowering plants. Eucalypts are an example of angiosperms and are also a native hardwood species. Balsa wood, although a 'soft' wood, is also a hardwood.

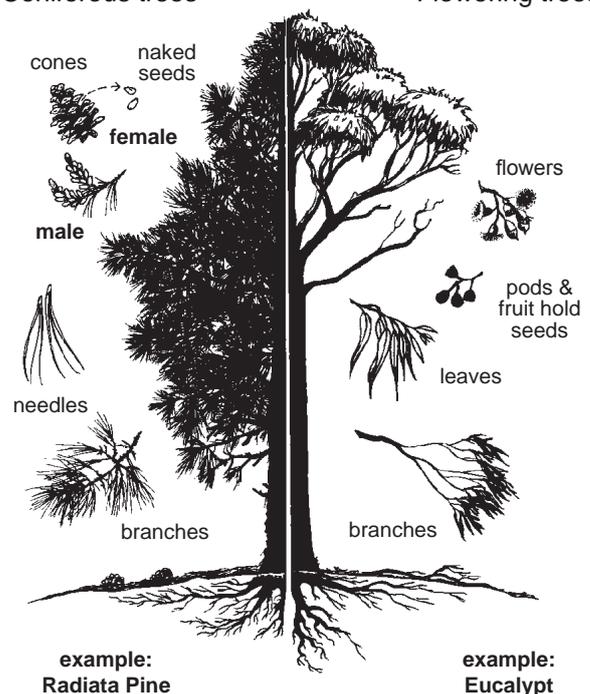
Figure 3: Some differences between gymnosperms and angiosperms.

## GYMNOSPERMS

Coniferous trees

## ANGIOSPERMS

Flowering trees



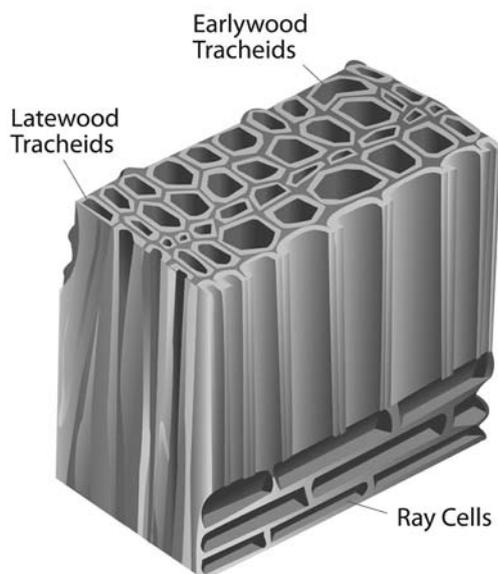
## Softwood

The wood of gymnosperms is commonly referred to as softwood, and sometimes as non-pored wood. An example of softwood timber is pine, sometimes also referred as whitewood.

The bulk of softwood is made up of long narrow cells, or tracheids, that fit closely together. The cell walls of tracheids are made of cellulose and the centres are hollow. Tracheids lie alongside each other and another substance, lignin, is deposited between the touching cell walls. This helps to hold the tracheids firmly together. Conifer tracheids can be up to four millimetres long, and serve both to transport sap and to strengthen the stem of the tree. Pits in the cell walls of the tracheids enable sap to pass from cell to cell as it moves up the stem.

Australia has very few native softwoods. Cypress, hoop and bunya pines are examples of native softwoods growing in forests in New South Wales. Softwood plantations of introduced (exotic) pine have been established in NSW to meet the communities need for softwood timber. Radiata pine is the main species grown in NSW, largely in plantations near Bathurst, Bombala, Tumut and Walcha.

Figure 4: A close-up section of softwood.



## Hardwood

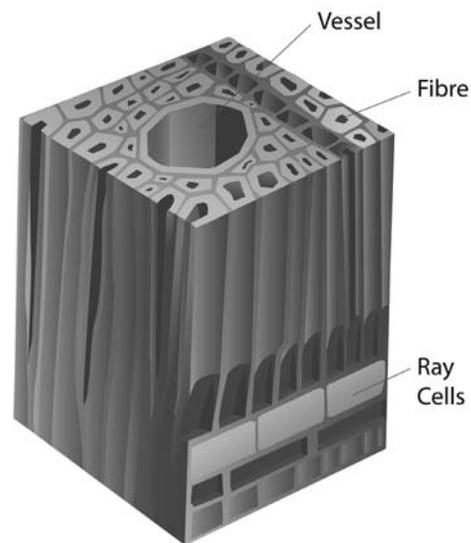
Broad-leaved trees, like eucalypts and red cedar, are hardwood trees. Most Australian native timber trees are hardwoods. The wood of these trees is made up of two distinct types of cells – vessels and fibre cells.

Sap is carried upwards in large ducts known as vessels or pores. These start as wide cells with large cavities, arranged one above the other. In some cells the end walls break down to create long pipes running considerable distances. Vessels can usually be seen with the naked eye. Timbers with vessels

are sometimes called pored timbers (hardwoods), and the arrangement of the vessels in a cross-section is a useful aid to identifying different timbers.

Strength in broad-leaved trees is imparted by other types of cells, called fibres. These are similar to conifer tracheids but are shorter in length (commonly about one millimetre long) and usually thicker-walled. Fibres make up the bulk of the wood in broad-leaved trees and, like tracheids, the walls of these cells are made of cellulose and neighbouring cells are held together by lignin.

Figure 5: A close-up section of hardwood.



## Other wood cells

Among the other types of cells that occur in wood are ray cells. These store food in the stem and are found in all timbers. Unlike the other cells of sapwood which are arranged vertically, ray cells are arranged horizontally, extending radially outwards towards the bark. These cells give wood a distinctive sheen when it is radially split.

Often rays are only one cell wide and several cells high and quite difficult to see without a magnifying lens. However, in some trees the rays are very large and give the wood characteristic patterns, such as the patterns seen in oaks, and other timbers like silky oak and she-oak.

## Properties of wood

Although the wood of all trees consists essentially of cellulose fibres held together by lignin, different trees produce woods with many different properties that make them suitable for different purposes.

The density of wood depends on the thickness of the fibre walls in relation to the size of the cells' hollow centre. Light timbers (for example balsa) have cells with very thin walls and a large hollow,

while in contrast, dense timbers (like ironbark) have cells with thick walls and a narrow hollow.

The colour of wood is determined by various substances, such as polyphenols, which are deposited in the cell walls. In most woods the heartwood is distinctively coloured, commonly red, pink, brown or yellow and sometimes even green and purple. While heartwood is usually evenly coloured, in some woods the colour is unevenly distributed, giving a streaky appearance that can be highly decorative (like walnut, for example). Some woods have pale coloured heartwood not easily distinguished from sapwood.

The figure or pattern of wood is the ornamental appearance produced by the interaction of such features as colour; the arrangement of the vessels, latewood and earlywood; and so on.

Other properties vary considerably between species and may have an important bearing on the way the timber is used. These properties include shrinkage as the wood dries; fibre length (important when wood is used for paper making); hardness or resistance to marking; durability against attack by insects, fungi and other agents; strength properties, that can vary markedly between seasoned wood (wood that has been dried) and green wood (wood with a high moisture content, such as wood just cut from a living tree); and flexibility.

### Uses of wood

The product mix is determined by the species and quality of timber grown.

Figure 6: Within a single tree several different products are created from the different grades of timber

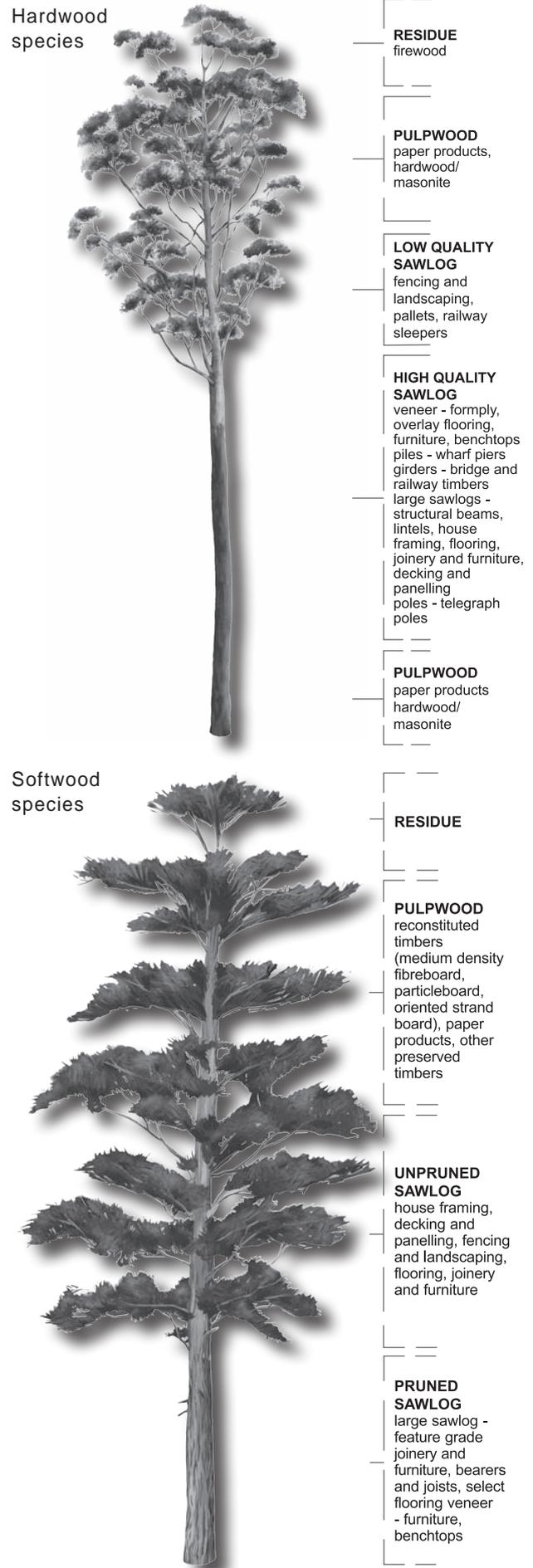


Figure 7: Sawlog product mix from hardwood plantations (Figures from 2006/07)

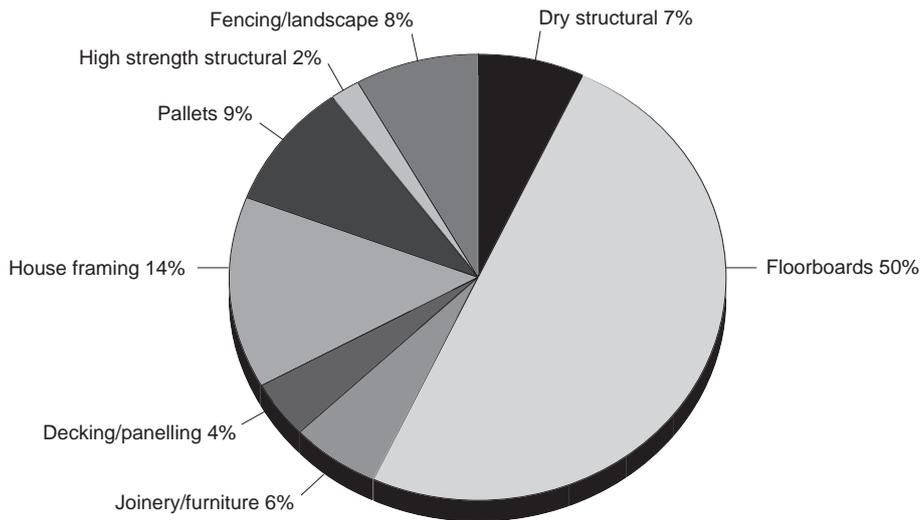


Figure 8: Sawlog product mix from softwood plantations (Figures from 2006/07)

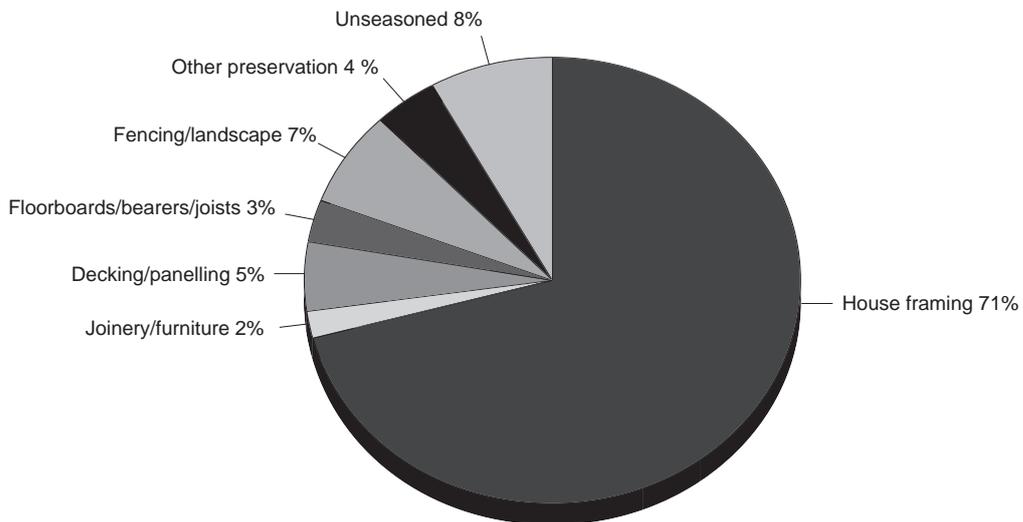
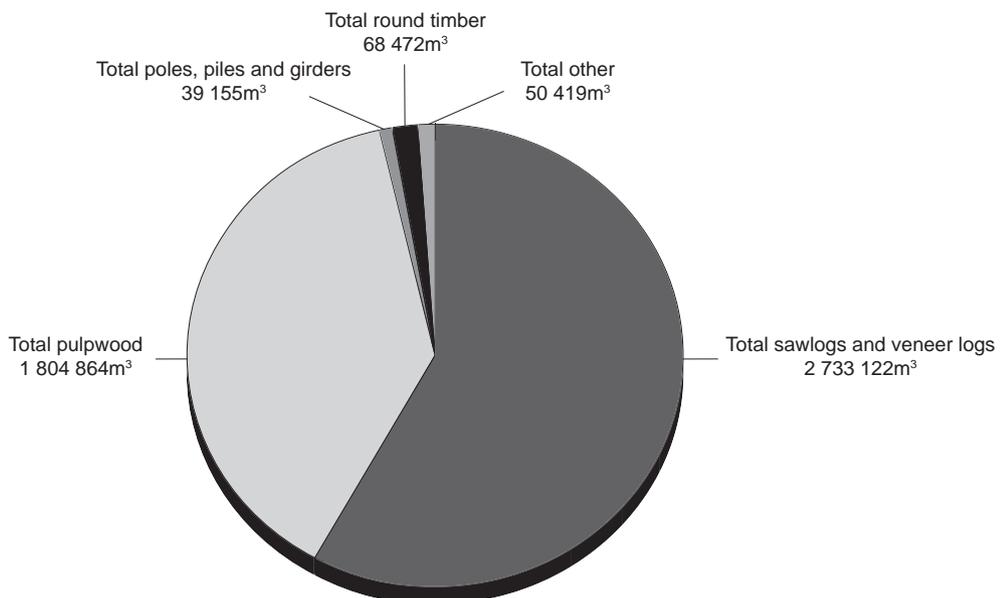


Figure 9: The total volume of wood harvested is divided up into product type to meet the demand for wood products depending on the species and quality (Figures from 2006/07)



## Major timber species

Well over 100 different species of trees grown in State forests of New South Wales are used for timber, around 40 are used commercially. A few of the most important tree species grown in New South Wales are:

- Blackbutt (*Eucalyptus pilularis*) - an important native hardwood grown in coastal districts. It produces pored hardwood timber, light brown in colour and coarse in texture. The basic density of the timber is 720 kg/m<sup>3</sup>. The timber is hard, strong and tough, making it a durable timber used for general building construction, flooring, poles and railway sleepers.
- Spotted gum (*Corymbia maculata*) - an attractive large hardwood of the east coast, as well as a timber species it is often planted as an ornamental tree. It produces a pale to dark brown heartwood with paler sapwood, coarse in texture. The basic density of the timber is 740kg/m<sup>3</sup>. The timber is used for piles, poles, flooring and heavy engineering construction. It is the main Australian species for handles subject to high-impact forces, such as axe handles.
- Radiata pine (*Pinus radiata*) - an introduced (exotic) tree species originating from California. It is widely planted in tableland area of south-eastern Australia, in particular the southern tablelands of New South Wales. It is currently the most important single softwood species in the State. It produces a non-pored softwood timber, pale to light brown in colour, with marked annual rings. The basic density of the timber is 380-480 kg/m<sup>3</sup>. The timber is easy to work, making it a timber with low natural durability. It is used for joinery, flooring, panelling, building frame-work, packaging, paper pulp and particleboard manufacture.
- Messmate (*Eucalyptus obliqua*) - a large hardwood, common in Tasmania, Victoria and the tablelands of New South Wales and Queensland. The heartwood is pale brown with pale yellow sapwood. The basic density of the timber is 630kg/m<sup>3</sup>. The timber is used for furniture, flooring and panelling.
- Sydney blue gum (*Eucalyptus saligna*) - is another hardwood species that grows in coastal districts of New South Wales. It produces a pored timber, pink to red in colour and with a coarse texture. The basic density of the timber is 690 kg/m<sup>3</sup>. The timber is easy to work, moderately durable and strong, making it suitable for use in general construction, flooring, weatherboards and panelling.
- Flooded gum (*Eucalyptus grandis*) - Also known as rose gum because the heartwood is pink to pale red brown. It is a fast growing hardwood plentiful in northern New South Wales and southern Queensland. The basic density of the timber is 510kg/m<sup>3</sup>. The timber often features the work of the scribbly borer. This insect leaves a small trail in a 'scribbling' pattern on the timber. The timber is used for joinery, panelling and

furniture. It is good for fruit boxes as the shooks are not easily affected by fungal staining.

- White cypress (*Callitris glauca*) - is a native softwood occurring in the western districts. The timber is non-pored, streaky yellow to dark brown in colour with numerous dark knots. It has a distinctive scent and fine texture. The basic density of the timber is 590 kg/m<sup>3</sup>. The timber is rather brittle and very durable, however it is not one of the stronger timbers produced by native species. It is used in flooring, weatherboards, panelling, building framework and poles.

## Further Reading

- Bootle, K,R. (2006) *Wood in Australia* - Second Edition. McGraw-Hill Book Company, Sydney.
- CSIRO publications provide excellent guides to the identification of major Australian timbers.
- Skills Book Publishing PTY LTD. (1994) *The Australian timber buyer's guide*. Skills Book Publishing Pty Ltd, Rozelle, NSW.
- Wallis, N.K. (1970) *Australian timber handbook*. (Third Edition) Angus and Robertson, Sydney.

## Websites

- For more information about timber from NSW State forests and its uses, see *Forests NSW Social, Environmental and Economic (Seeing) Report* at: [www.dpi.nsw.gov.au/forests](http://www.dpi.nsw.gov.au/forests)
- The Australian Timber Information website, administered by the Timber Development Association: <http://www.timber.net.au>
- The Australian Hardwood Network: <http://www.australianhardwood.net.au>

## Further information

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