4. BOOROWA RIVER CATCHMENT – AN OVERVIEW

4.1 Location

The Boorowa Catchment covers an area of about 2,200 km^2 (220,000 ha) in the headwaters of the Lachlan River (Figure 1). The boundaries of the Boorowa Catchment Action Plan have been defined to include the area within Boorowa River sub-catchment (~1,820 km^2) and Hovells Creek sub-catchment (~380 km^2). This area represents about 2.5% of the Lachlan River Catchment, which covers an area of 84,700 km^2. The north-south trending Catchment covers a length of about 85 km, and varies in width from roughly 30 km wide to less than 10 km wide near the Boorowa River junction with the Lachlan River, just below the Wyangala Dam.

The Catchment straddles the boundary between the Southern Tablelands and South-Western Slopes regions of New South Wales. The centre of the Catchment lies about 110 kilometres NNW of Canberra, between the towns of Yass and Cowra. The southern boundary of the Catchment is located about 15 km north of Yass, and the northern outlet of the Catchment, about 20 km southwest of Cowra. The main town of Boorowa is located in the middle of the catchment, with the smaller villages of Frogmore and Rye Park are located in the eastern part of the catchment (Map 1).

4.2 History

The original inhabitants of the Catchment were the Wallabalooa, who lived to the south of the Wiradjuri of the Lachlan River (Jackson-Nakano, 2002). The early explorers, Hamilton Hume, William Broughton and party, arrived in the area known as the Burrowa Plains in 1821. The Broughton family subsequently settled in the Boorowa District during the same year, in the first grant area surveyed at Broughtonsworth, on the Binalong Road..

By 1871, the Burrowa Police District alone had 3,865 residents, a combination of Free Selectors and miners. The aboriginal word "Burrowa" has been attributed to the bustard or plains turkey, which were common throughout the area. The name of the district was changed to Boorowa in the mid 1900s (Lyold, 1990). The rich historical significance of the District is reflected in entries placed in the Australian Heritage Commission, Register of the National Estate (Table 3)

Dendavilleigh, Scott St, Boorowa	Boorowa Courthouse
Bala TSR Remnant Vegetation Site	Clonoulty, Marsden St, Boorowa *
Frogmore Main Copper Mine & Smelters*	Frogmore Secondary Copper Mine & Smelter*
Frogmore Tungsten Mines*	Glenara, Marsden St, Boorowa*
Kangiara Pre 1909 Village Area*	Kangiara, Post 1909 Village*
St John the Baptist Church Group*	St Patricks Church*
Tarengo, Binalong Road*	Walla Walla Copper Mines*
Wallah Wallah Silver and Lead Mine and Smelter*	**Indicative list*

Table 3 Sites within the Catchment Registered of the National Estate

Although land clearing for agriculture and grazing started during the initial settlement in the 19th century, the greatest clearing activity is thought to have been during the 1920s. Prior to European settlement, Eucalypt species dominated and characterised the native vegetation of

the region. Almost all native communities appear to have been cleared or modified to some extent by agriculture or grazing (Yates and Hobbs, 1997).

4.3 Community Profile

Throughout this document information on the study area is provided from two sources representing different boundaries; the Boorowa Local Government Area or the Boorowa Catchment Area.

Population Structure

The Australian Bureau of Statistics (ABS) Census data indicates that the population of the Boorowa Shire is decreasing, a common feature of most rural communities. In 1995, the population in the Shire was 2,630, whereas in 2001, the population was 2,321, with 1,184 males and 1,137 females. About 1,300 people live within the Boorowa township area.

Selected Averages	Value
Median age	40
Median monthly housing loan repayments	$600-$799
Median weekly rent	$50-$99
Median weekly individual income	$300-$399
Median weekly family income	$700-$799
Median weekly household income	$500-$599
Mean household size	2.5

Table 4 Community profile of selected averages in the Boorowa Local Government Area (2001)

A series of selected average from the 2001 Census (Table 4) show that the median age of people within the Shire was 40 years. In the 1996 Census the median age of people was 37 years, while in the 1991 Census the median age of people was 35 years. The population figures indicate that the area has an ageing population.

Occupation

The majority of people are employed in agricultural industries, directly on farms. The total number of people employed by agriculture has increased slightly between 1996 and 2001 (Table 5). There has also been a minor increase in people working in health, manufacturing and community and personal service industries.

Industry	1996	2001
Agriculture, Forestry and Fishing	453	466
Mining	6	6
Manufacturing	26	32
Electricity, Gas and Water Supply	4	9
Construction	31	54
Wholesale Trade	24	19
Retail Trade	58	69
Accommodation, Cafes and Restaurants	33	30
Transport and Storage	15	20
Communication Services	10	9
Finance and Insurance	11	9
Property and Business Services	10	19
Government Administration and Defence	59	34
Education	63	61
Health and Community Services	67	77
Cultural and Recreational Services	9	9
Personal and Other Services	6	17
Non-classifiable economic units	3	6

Not stated		34	38
	Total	**922**	**984**

Table 5 Community profile of occupations in the Boorowa Local Government Area

Production Economics

Information on the value of agricultural commodities produced (VACP) in the Boorowa Shire has been collected over the years by the ABS. Part of the data is shown below in Table 6.

The value of most agricultural products has increased over the period 1992 to 2001, with the exception of 1993-94, which was a drought year. These figures do not take into consideration increases in input costs. The returns on livestock products, which in the Boorowa Catchment is comprised largely of sheep products such as wool and to a lesser extent meat, have not shown the increases that crop products have shown.

Although these results are not directly comparable across Censuses, due to differences in methodologies and inflationary factors, there is still an increase in the value of commodities produced in the District.

Selected commodities	1992-93 $'000	1993-94 $'000	1994-95 $'000	1995-96 $'000	1995-96 $'000	2000-01 $'000
Crops						
Pastures and grasses	694.2	642.7	290.3	769.4	586.8	368.6
Cereals for grain	2,827.5	2,822.8	1,454.6	5,936.2	6,802.0	5,539.7
Crops for hay	51.7	50.6	117.9	103.2	21.2	27.6
Nurseries etc	111.1	91.1	121.2	159.6	158.7	219.3
Fruits (inc grapes)	94.2	109.2	243.7	177.0	27.8	76.6
Other crops	457.7	601.5	214.7	738.8	858.8	2,087.3
Total crops	*4,236.4*	*4,318.0*	*2,442.4*	*7,884.5*	*8,454.4*	*8,319.1*
Livestock slaughterings/disposals	6,822.8	8,151.2	9,116.1	7,533.3	7,491.9	11,083.9
Livestock products	17,970.3	15,084.5	20,156.1	15,562.3	18,984.2	19,963.9
Total agriculture	**29,029.5**	**27,553.7**	**31,714.6**	**30,980.2**	**34,930.5**	**39,366.9**

Table 6 Value of agricultural commodities produced (VACP) (Agricultural Census, ABS)

4.4 Climate

The Boorowa River Catchment has a Temperate climate with long summers and cool to cold winters (Figure 5). The annual average maximum temperature in Boorowa is 20.6 °C and the average minimum is 6.2°C. The maximum temperature recorded in Boorowa is 42.8° and the minimum -8.9°.

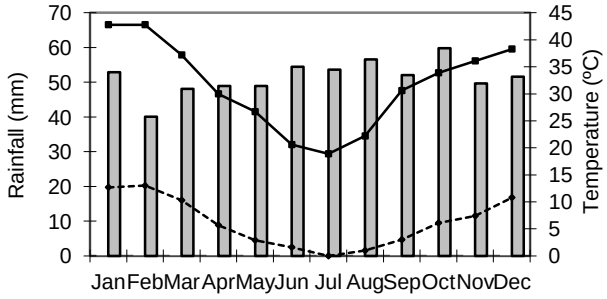


Figure 5 Mean monthly rainfall and minimum and maximum temperature for the Boorowa Post Office (Bureau of Meteorology)

Areas of high elevation generally experience lower temperatures. However, cold air drainage exerts an influence on temperature variation in the region, affecting the lower lying areas within the landscape. Aspect (the direction a slope faces) also exerts an influence over temperature; northwesterly aspects are generally warmer than the opposite southeasterly aspects (Hird 1991).

Rainfall

The average annual rainfall in the Catchment ranges from 570mm in the north to 770mm in the southeast (Hird 1991). The Boorowa township has an annual average rainfall of 619 mm, and Frogmore has an average is 601 mm. Rainfall distribution is slightly winter dominated (Figure 5), and areas of higher elevation have generally higher rainfall.

Long-term Rainfall

The long-term variation in rainfall, compared to the average rainfall at the Boorowa Post Office rainfall station, is shown in Figure 6. The lower graph shows the annual rainfall over one hundred years. The maximum annual rainfall during the period was 1092 mm and the minimum rainfall was 246 mm.

The upper graph shows the cumulative difference between the average rainfall for a year and the actual amount of rain that fell for that year. When a string of years has above average rainfall, i.e. wet years, the cumulative difference will increase (adding a string of positive numbers). A string of years has a below average rainfall, the cumulative difference will decrease (adding a string of negative numbers). Similarly, when there is average rainfall for a period, the cumulative difference will be relatively steady.

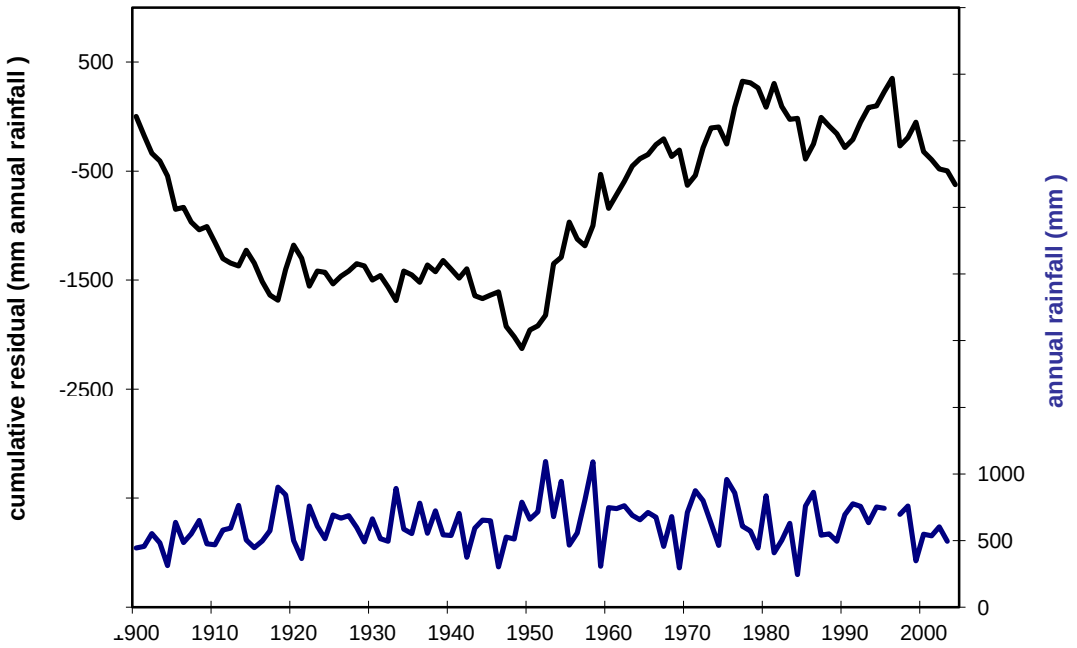


Figure 6 Long-term annual rainfall trends, Boorowa Township

The cumulative trace on the graph shows a distinct change in rainfall occurring at about 1947. Prior to this time monthly rainfall was generally below average, whilst after this time rainfall was above average until the early 1970s. Since then, the rainfall has generally fluctuated around the average rainfall, except for during drought years.

4.5 Physiography and Drainage

The elevation of the catchment ranges from 796 m at the Mount Hume trig station in the southeast, to about 320 m where the Boorowa River enters the Lachlan River. The catchment varies from high relief to gently undulating areas in the headwaters of the Boorowa and Hovells sub-catchments, to low to moderate relief along the Pudman Creek, around the Boorowa Township and in the north. Relief along the middle reaches of the Boorowa River increases to over 150 m where the river has cut a narrow incised valley in granitic material.

The surface drainage network differs from little to no incision, to over hundreds of metres in the headwaters of the Boorowa River. This variation in level of incision has implications for both the interaction of the surface and groundwater, and distribution of salinity outbreaks in the catchment. The Boorowa River flow rate varies from less than an ML/day to over 10,000 ML/day in peak flow conditions. (Evans & Bradd, 2001).

The Catchment can be subdivided into the Boorowa River and Hovells Creek sub-catchments, and a series of eight local sub-catchments (Map 1). The main sub-catchments from south to north are; Pudman Creek, Kangiara Creek, Langs Creek, Yellow Waterhole, Castles Creek, Gunnary Creek, Narallen Creek and Breakfast Creek in the northwest. It is probable that the nature of the Catchment drainage network has changed as a result of human activities. The creeks and streams were initially a series of chain of ponds; many are now incised channels and perennial streams (Eyles, 1977).

4.6 Geology

The Boorowa River Catchment lies within the Palaeozoic Lachlan Fold Belt of southeastern Australia. The Catchment's hard rock geology can be ascribed to four main types, Ordovician sedimentary rocks, Ordovician volcanic and sedimentary rocks, that include the Kenyu Formation, Silurian volcanics and minor sediments, and Siluro-Devonian granites intrusions. Some minor Devonian age acid volcanics occur in the central west of the Catchment, and a small Tertiary basalt flow is preserved in the north (Map 2).

The oldest rocks in the catchment are metamorphosed Ordovician sandstones, siltstones and shale that form the hill country to the east and northeast of Rye Park. These rocks form poor soils and are prone to erosion if not carefully managed. In the central northern part of the Catchment, another sequence of Ordovician volcanic and sediments, representing remnants of a volcanic arc, runs from Frogmore in the east around the edge of the granite country towards Breakfast Creek (Evans & Bradd, 2001).

Most of the Catchment is dominated by Silurian ignimbrites and tuffs with associated interbedded sediments of the Douro Group, which is dominated by the Hawkins Volcanics. These volcanics run in a belt through the main part of the Catchment, then further north through the western parts of the Catchment towards Breakfast Creek. A major fault zone separates the Douro Group from the sedimentary rocks of Ordovician age to the east.

The northeast parts of the Catchment are comprised of granites of the Wyangala Batholith that intrude both the Ordovician and Silurian sequences. West of Boorowa Township a small granite body outcrops, part of the larger Young Granodiorite.

Since the end of the Palaeozoic, the geological history of the region has been that of regional uplift during the Cretaceous (~100 my) followed by weathering and erosion to form the present day topography. A series of major faults and shear zones have influenced the topography of the catchment, many of the creeks in the Catchment are structurally controlled. The most recent deposits are the Quaternary deposits of colluvium derived from weathered bedrock that are deposited on hillslopes in the catchment. Sands, gravels and fine-grained alluvium accumulated along narrow floodplains, adjacent to the major drainage systems.

4.7 Soils

The soils of the Catchment area are highly variable and generally of moderate to low fertility. The surface texture of the soils is usually correlated to the underlying rock materials, e.g. coarse-textured surface soil horizons derived from granites and coarse-textured sediments. Soils generally display an acid reaction trend, becoming more alkaline in poorly drained and lower lying areas. The principal soils are described as lithosoils, gradational soils and duplex soils, which exhibit a strong texture contrast between the A and B horizons.

- *Lithosoils* are characterised by shallow stony soil profiles overlying rocky parent material on hills and ridge crests, where erosion is the dominant landscape process, irrespective of parent material e.g. lithosols and siliceous sands. These profiles generally have a high stone and gravel content and a low moisture holding ability. They are nutritionally poor and on the steeper slopes are liable to erosion when native vegetation is removed or they are disturbed by mechanical means. Minor areas of poorly structured alluvial soils occur along narrow floodplains adjacent to drainage lines.
- *Gradational soils* are characterised by profiles having a gradual increase in clay content with depth e.g. red and yellow earths. They are common where soils are derived from acid parent materials and develop on well-drained sites in upper parts of the landscape. They are common in the central and southern part of the Catchment. These are deep, relatively fertile soils and are relatively resistant to erosion, except in areas where slope is a factor, they will erode if the land is cleared.
- *Duplex* soils dominate the Catchment. They are characterised by a distinct change in particle size at a depth of 15-30 cm. The topsoil is light in colour, coarse textured and often quite sandy. The subsoils tend to be reddish on the hills and yellow in the valleys, quite clayey and often shrink and swell with water content change, which sometimes presents engineering problems.

  Mid-slope soils are generally deeper, with Red and Yellow Podzolic soils commonly associated with acid parent materials. On foot-slopes, neutral Soloths and alkaline trending Solodic soils are characterised by profiles with strongly leached upper horizons (Hird 1991). Well-structured and fertile Non calcic Brown soils, derived from basic parent materials (e.g. basalts), and are suited to more intensive agriculture

  The surface structure of most these soils are fragile and, if overgrazed or poorly cultivated, the topsoil becomes relatively impermeable and hard setting. With poor infiltration of rainfall, water tends to run across the surface and, if focused in depressions, soon forms erosion gullies. These soils are particularly vulnerable to erosion on the slopes and where native vegetation has been cleared and the surface left unprotected. In addition, their clay subsoil often contains sodium salts, making

this soil type dispersible if exposed by mechanical means or by erosion after clearing. Much of the turbidity of rivers in the Catchment after heavy rain is caused by erosion of these soils.

Soil Landscapes

Regional Soil Landscape maps (Map 3, pg 94) are useful for grouping soil types that are related to similar climatic zones, geology, landforms, vegetation and existing land use (Hird 1991). Each soil landscape is characterised by a dominant soil type within the Soil Landscape unit. Although several soil types (e.g. Lithosols, Yellow Podzolic) may occur within an individual Soil Landscape unit, major changes in individual soil types cannot be mapped at a regional scale. The following is a summary of the main features of the Soil Landscape units within the Catchment, derived from Hind, 1991.

- **Shallow Soils** - *Lickinghole*,
  Soil on steep (over 30% slope) Ordovician metasediments terrain; mainly lithosols, i.e. little or no structure or soil horizon formation with abundant rock fragments, or red or yellow earths on upper slopes with local podzolics on lower slopes. Associated with extensive outcropping rock; Prone to erosion
  Oak Creek
  Soil on steep (over 30% slope) Silurian volcanic terrain; Lithosols, or red or yellow earths on upper slopes with local podzolics on lower slopes.
  Pine Mountain
  Soil on very steep (over 30% slope) granitic terrain; Sandy lithosols, or siliceous sands with large granitic tors, with local podzolics on lower slopes.

- **Alluvial Soils** - *Goulburn*,
  Minor alluvial soils developed along mid to upper Hovells Creek; local red podzolics developed on adjacent river terraces.

- **Siliceous Sands** - *Pipe Clay Creek*.
  Sandy (quartz-rich) alluvial fan deposits formed on rhyolitic Silurian volcanics; Low relief and slopes, stony siliceous sands on slopes with solodics in some drainage lines profiles; Prone to erosion.
  Wyangala
  Soils developed on rolling low granitic hills with slopes ranging from 10-30%; Siliceous sands and red earths on crests and upper slopes with red duplex soils on side slopes and yellow duplex soils in some drainage lines.

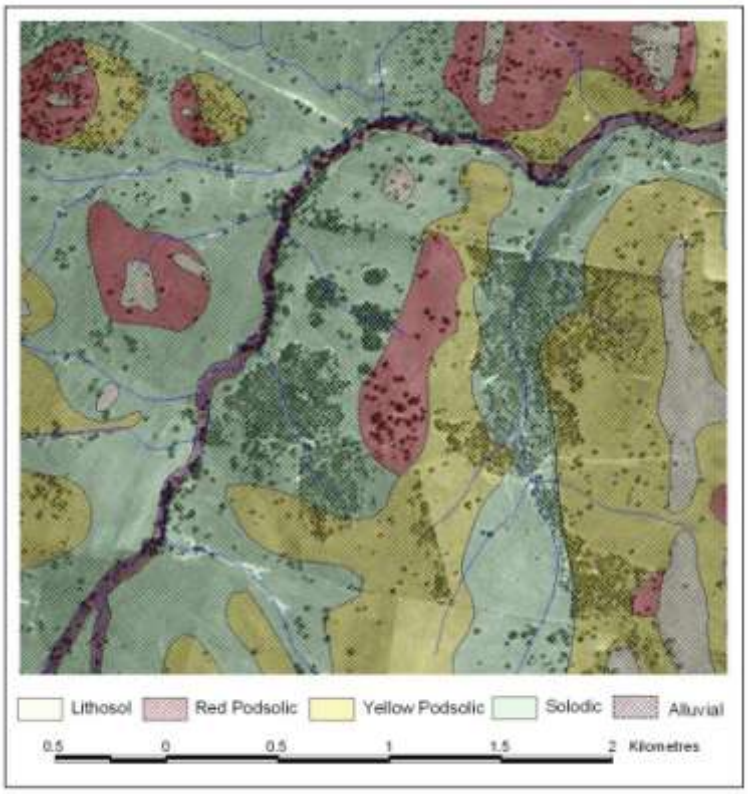
- **Solodic** Soils - *Illunie*.
  Undulating to rolling Silurian volcanic hills; Yellow earths and lithosols on upper slopes and crests; Solodic soils with strong textural differentiation with a very abrupt boundary between A and B horizons in lower slopes and drainage lines; Soils associated with poorly drained sites, such as in enclosed basins, capable of producing soluble salts. Possible salinisation.

- **Soloths** - *Blakney Creek*.
  Soils developed on undulating to rolling terrain, footslopes and valley floors; Moderately to slightly acid throughout the profile and usually have significant amounts of soluble salts or exchangeable sodium in the lower B horizons; Possible salinisation.

- **Yellow Earths** - *Binalong*,.
  Soils developed on undulating low relief volcanic terrain; Yellow brown to yellow (locally red) massive predominantly sandy texture with earthy fabric, weak profile differentiation on crests and upper slopes. Minor non-calcic brown and podzolics on lower slopes with soloths or solodics on valley floors; Possible salinisation.
  Cockatoo
  Soils developed on rolling to low hills Silurian volcanic terrain; Bright yellow and red earths and minor duplex soils or lithosols on crests and upper slopes.
  Midgee
  Soils developed on rolling low hills in Ordovician metasediments terrain; commonly acid stony yellow earths and yellow podzolics on crests and sideslopes; Possible salinisation.

- **Euchrozems and Non Calcic Brown**- *Cudal*
  Deep soils developed on basalt flows; Red to reddish-brown euchrozems, well-structured soils with a high clay content and weak horizontal texture differentiation on crests and upper slopes.
  Kenyu
  Soils developed on undulating to rolling hills on Ordovician volcanic units; Non calcic brown, red duplex soils or red earths on upper slopes, with euchrozems or yellow podzolics on lower slopes.

- **Yellow Podzolic** - *Boorowa.*
  Soils from siliceous parent material in rolling to gently undulating volcanic terrain under poor drainage conditions; Generally strongly differentiated profiles; Yellow to light red duplex soils on crests and slopes that are often hard setting, with solodic soils in drainage lines; Possible salinisation.
  Garland
  Soils developed on low lying rises and valleys between rolling hills in granitic terrain; Yellow duplex soils on mid to lower slopes with light red podzolics or yellow/red earths on upper slopes with siliceous sans in drainage lines.



Over the past 10 years students, from the Australian National University and University of Canberra have mapped the soils types around the Boorowa Township at a scale of 1:10,000. An extract from some of the mapping is shown in Figure 7.

Figure 7 Distribution of soil types in the *Boorowa* Soil Landscape unit. Note the changes in soil type from crests of hills (lithosols and red podzolics) to slopes (yellow podzolics) and valley floor and drainage lines (solodics and alluvial soils)

4.8 Land Capability

Land capability is the ability of land to accept a type and intensity of use permanently, or for specified periods under specific management, without permanent damage. Land capability mapping by the NSW Soil Conservation Service during the late 1980s classified rural land into 8 classes, defined by Roman numerals (I to VIII). The classification has a hierarchical sequence, ranging from land with the greatest potential for agricultural or pastoral use (Class I), to that which is entirely unsuitable for either (Class VIII). Table 7 below defines the main elements of this classification system.

The direct application of land capability boundaries to individual properties is not recommended, as the mapping is based on 1:100,000-scale mapping. Most of the Catchment area can be ascribed to Class IV and Class V, i.e. suitable for grazing and occasional cropping, (Map 4).

Class	Land Use	Management Options
I	Mainly cropping	Wide variety of uses – vegetables and fruit production, grain crops, energy crops and fodder, sugar cane. No special soil conservation works or practices necessary.
II		Soil conservation practices such as strip cropping, conservation tillage and adequate crop rotations.
III		Structural soil conservation works such as graded banks and waterways are necessary, together with soil conservation practices as in Class II.

IV	Mainly grazing	Occasional cultivation, better grazing land. Soil conservation practices such as pasture improvement, stock control, application of fertiliser and minimal cultivation for the establishment or re-establishment of permanent pasture, maintenance of good ground cover.
V		Similar to IV, structural soil conservation works such as diversion banks and contour ripping, together with the practices in Class IV like the maintenance of good ground cover.
VI	Grazing	Not capable of cultivation. Soil conservation practices including limitation of stock, broadcasting of seed and fertiliser, promotion of native pasture regeneration, prevention of fire and destruction of vermin. This may require some structural works and maintenance of good ground cover.
VII	Tree cover	Land best protected by trees. Very important habitat areas for protecting biodiversity.
VIII	Unsuitable for agriculture	Cliffs, lakes or swamps and other lands where it is impractical to grow crops or graze pastures.

Table 7: Rural Land Capability Classes (Emery, undated)

4.9 Land Use

There are no large reserves of Crown or public land in the Catchment, and consequently the majority of land is privately owned. The area supports varied agricultural enterprises, although most of the Catchment is used for grazing. A majority of farms support sheep for wool production, or in breeding programs for prime lambs or beef cattle on improved, or unimproved pasture. Dryland cropping includes wheat, winter oats, lucerne, canola, triticale and lupins. Cropping is mainly restricted to the flat-lying areas around the Boorowa Township, and the extent of cropping varies annually, depending on commodity prices and climate.

The following land use figures (Table 8) are based on Landsat satellite land cover classification in the Boorowa Catchment (Newham & Field, 1999). Classification of native, annual and perennial pasture types is difficult due to the composite nature of pasture species, and varying environmental conditions. Recent advances in land use mapping, using remote sensing techniques enables more accurate determination of land use patterns across the landscape, (Keith Emery pers. com. 2003).

Land use (BRC)	Area (%)	Area (ha)
Annual Pasture	34	73,424
Native Pasture	36	77,323
Perennial Pasture	15	33,303
Crop	7	15,444
Woodland	7	16,124
Lucerne	<1	1,925
Water bodies	<0.001	3

Table 8 Land cover in the Boorowa Catchment Area (from Newman and Field, 1999)

Remnant woodland covers an area of about 7% of the Catchment based on Newham & Field, (1999). Improved mapping techniques utilised by NSW NPWS suggest a remnant woodland cover of about 15%, which includes grassy woodland remnants.

4.10 Native Vegetation

A recent study by the NSW National Park and Wildlife Service (NPWS) of native vegetation in the Boorowa Shire has shown that over 85% of the Shire has been cleared (Priday and others, 2002). The study identified nine vegetation communities within the Shire. The vegetation communities in the southern-most part of the Catchment (i.e. not within the Boorowa Shire boundaries) were mapped on a more regional basis by a State and Commonwealth Governments regional forest agreements program (Thomas et al., 2000).

The distribution of vegetation in Boorowa Shire strongly relates to soil type, geology, and position in the landscape (i.e. valley floor or ridge top). Three broad plant communities occur: riparian forests, grassy woodlands and dry forests. The vegetation communities have been named according to the dominant species (e.g. White Box Woodland). The communities, their current extent and their estimated pre-clearance cover within the Shire boundaries are shown in Table 9. It should be noted that the figures of total existing area, include all representations of a particular vegetation type, regardless of individual patch condition.

Pre-clearing extent

Riparian forests of Red Gum or She Oak occurred along the rivers and major creeks. Woodland communities, dominated by Blakely's Red Gum and Yellow Box, occur along most creek lines and lower slopes. A Red Stringy-bark – Long Leaved Box forest occurs on sedimentary rocks on the lower slopes in the south-east of the Shire. White Box woodlands with a grassy understorey formerly occupied most of the undulating slopes in the Shire, while a grassland/open woodland occupied much of the broad basin centred on Boorowa. Ridge-lines and upper slopes support dry forest in which Red Stringy-bark is always a dominant species.

Name of Vegetation Ecosystem	**Pre-1750 Area (ha)**	**Existing Area (ha)**	**% Cleared**
River Red Gum forest	3,063	577	81%
River Oak riparian forest	738	111	85%
Blakely's Red Gum – Yellow Box Woodland	50,071	4,093	94%
Kangaroo Grass – Red Leg grassland/open woodland	24,269	418	98%
White Box Woodlands	39,700	2,204	96%
Red Stringybark/Long-leaved Box/Candlebark Open Forest/Woodland	17,297	2,197	87%
Callitris endlicheri-Red Stringybark-Red Box shrub forest	2,379	828	65%
Red Stringybark Dry Shrub Forests	72,955	9,492	87%
Red Stringybark -Joycea grass tussock open forest	47,205	8,965	81%
TOTAL	**257,659**	**28,862**	**88%**

Table 9 Vegetation communities in the Boorowa Shire (Priday et al., 2002)

Remnant Vegetation Loss

Satellite data analysis has shown that about 1,390 ha of remnant vegetation, i.e. about 0.6% of Catchment, was lost from remnant patches in about 27 years, from 1973 to 2000. There has also been an increase of the vegetation in the Catchment of about 220 ha in the same period, i.e. 0.1% of Catchment (Rassoul Mahiny, ANU, pers. comm.). These figures were generated through a comparative analysis of satellite images of area, taken over the time frame indicated.

Current extent

Most of the remaining large blocks of vegetation are dry forests on rocky ridgelines unsuitable for agriculture. These large blocks have been rated as "near pristine" to "some disturbance". These patches were generally characterised by sparse to dense shrub cover and significant amounts of regeneration. These areas tend to be located on the eastern margin of the catchment, with isolated pockets on the higher elevations within the Catchment. The rest of the woodland cover consists of isolated paddock trees and small patches of less than 2ha (200m x 100m). Understorey is non-existent in most areas; particularly those used for the grazing of stock. These patches have been categorised as "disturbance evident, some regeneration" to "severely degraded, no regeneration". The majority of native vegetation is restricted to ungrazed roadsides and reserves. The vegetation of Boorowa is highly fragmented and dysfunctional. The remaining remnants are under considerable stress from increased salinity, over fertilisation, grazing, herbicide drift and soil compaction.

Native Vegetation Communities

The perilous state of the Shire's vegetation means that its retention, regeneration and rehabilitation on private land are crucial to its survival. The NPWS report provides information that can be used as a guide to the selection of suitable species for planting, and contains specific conservation advice. It also provides further justification for the allocation of Landcare and Natural Heritage Trust funding to the Catchment. Roadsides and Travelling Stock Reserves are generally the areas that retain the greatest plant diversity within the Shire. Council has the key responsibility for protecting remaining roadside vegetation, while rural Lands Protection Boards are responsible for the stock reserves.

Endangered Vegetation Communities

Given the extent of vegetation clearing, it is not surprising that many threatened plant and animal species occur within the Catchment. The habitat for most of the threatened species is predominantly woodland. Threatened flora species are provided in Table 10. The most threatened vegetation communities are White Box woodland, Blakely's Red Gum – Yellow Box woodland and Kangaroo Grass – Red Leg grassland/open woodland communities are listed below. Retention and enhancement of woodland remnants and their understorey is the key issue for retaining viable populations of the threatened species within Boorowa Shire.

Common Name	Species	Status in Catchment area
Tarengo Leek Orchid	*Prasophyllum petilum*	The Terengo TSR supports the largest known population of this species.
Yass Daisy	*Ammobium craspedioides*	Requires relatively undisturbed grassy woodlands, and is under threat due to grazing pressure.

Table 10 Threatened flora in the Catchment area (from Priday et al., 2002)

4.11 Native Fauna

A recent survey in the Catchment by CSIRO (Freudenberger, 2001) reported that "*The Boorowa River catchment in not a biological desert. It may only have 7% cover of remnant*

woodland, but 115 species of birds were recorded across a diversity of woodland types, remnant sizes and habitat structures within the catchment." The following (Table 11) is a list of threatened fauna in the Boorowa Shire.

Common Name	Species	Status in Catchment area
Birds		
Bush Stone Curlew	*Burhinus gralarius*	Extremely Rare; southern part of its range
Superb Parrot	*Polytelis swainsonii*	Adopted as a symbol of the Boorowa region
Swift Parrot	*Lathamus discolor*	Autumn/winter visitor, feeds on Whitebox & Red Ironbark
Barking Owl	*Ninox connivens*	Rare, southern part of its range
Speckled Warbler	*Cthonichola saggitata*	Recorded in several sites
Hooded Robin	*Melanodryas cuculatus*	Few sightings, inhabits grasslands & woodlands
Black-chinned Honeyeater	*Melithreptis brevisrostis*	Rare, although reported in several sites
Painted Honeyeater	*Grantiella picta*	No formal sightings, feeds on Mistletoe species
Regent Honeyeater	*Xanthomyza phrygia*	No formal sightings, Inhabits Box-Ironbark woodlands
Grey-crowned Babbler	*Pomatostomus temporalis*	Several families in region, inhabits gassy woodlands
Brown Treecreeper	*Climacteris picumnus victoriae*	Recorded in several sites, requires large remnants of native vegetation for survival
Diamond Firetail Finch	*Stagonopleura guttata*	Rare, Inhabits grasslands and woodlands
Mammals		
Squirrel Glider	*Petaurus norfolcensis*	Rare, southern part of its range
Koala	*Phascolarctos cinereus*	Few sightings, inhabits woodlands & forests in east
Large-footed Myotis Bat	*Myotis adversus*	Rare, western part of its range, inhabits riparian zones
Common Name	**Species**	**Status in Catchment area**
Insects		
Golden Sun Moth	*Synemon plana*	Recorded in several Travelling Stock Reserves
Perunga Grasshopper	*Perunga ochracea*	Rare, restricted to grasslands/open woodlands

Table 11 Threatened fauna in the Catchment area (from Priday et al., 2002)

The removal of fallen timber and nesting trees, including isolated paddock trees and roadside trees, are all contributing factors in the reduction of biological diversity in the Catchment. A reduction in foraging habitats due to land clearing poses the most serious threats to species in the Catchment. Predation by the feral animals such as foxes and cats, also poses a major threat.