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Remnant Vegetation and Natural Resources of the **Blackwood River Catchment**

A N A T L A S

Shaun B. Grein
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Remnant Vegetation and Natural Resources of the
Blackwood River Catchment

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Shaun B. Grein

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1 INTRODUCTION

The Blackwood River is one of the longest rivers in the South-West of Western Australia, stretching 300 km from Moordjarrup to Augusta. The catchment covers more than 28,000 square kilometres (2.8 million ha) from the Shire of Kent to the Shire of Augusta-Margaret River. It incorporates 17 shires, more than 30,000 people, 18 Land Conservation District Committees (LCDCs) and 143 sub-catchment groups.

The shires in the Catchment are Augusta-Margaret River, Boyup Brook, Bridgetown-Greenbushes, Broomehill, Donnybrook-Balingup, Dumbleyung, Gnowangerup, Katanning, Kent, Kojonup, Nannup, Narrogin, Wagin, West Arthur, Wickepin, Williams and Woodanilling. The shires of Busselton and Kulin are not included in this Atlas as only a small area of each falls within the Catchment boundary.

Shires within the Blackwood Catchment cover 4.12 million hectares, over half of the total area of the shires that fall within the catchment boundary.

The total native vegetation cover, including vegetation on private land and public reserves, in these shires amounts to 1,333,428 ha. This is about 32 per cent of the total area of the 17 shires. However, this figure is not a good indication of native vegetation cover in the catchment. Shires close to the mouth of the Blackwood River (Augusta-Margaret River, Bridgetown-Greenbushes, Donnybrook-Balingup and Nannup) have considerable areas of native bushland in public reserves, national park and gravel and logging reserves, while remnant vegetation on private land is minimal. Shires closer to the headwaters of the Blackwood (Dumbleyung, Katanning, Wagin and Woodanilling) have a longer history of agricultural practices with significant clearing of native vegetation.

The Mediterranean climate of the Catchment has dry, warm summers and cool winters. Annual rainfall ranges from 400 mm to 1200 mm (WA Bureau of Meteorology, 1993).

Agricultural land use in the Blackwood Catchment is predominantly wheat and sheep. In 1991–92, a total of 405,032 ha of the catchment were sown with wheat, 1,914,665 ha with pasture and grasses, 224,222 ha with native pastures, 11,610 ha with hay and 54,961 ha were left fallow (ABS, 1992). The catchment produced 600,000 t of grain in 1991-92. Cadastral and shire boundaries in the catchment are shown in Figure 1 and all 16,852 km of road network in the catchment are shown in Figure 2.

Today the Blackwood River and its Catchment are under serious environmental pressures which are impacting on both the natural and agricultural landscapes. The pressures on the land are largely a result of broad scale clearing of native vegetation and inappropriate agricultural practices. Some of the most obvious problems are due to changes in hydrology, including rising water tables with associated salinity and waterlogging.

Native vegetation in the Blackwood Catchment has been degraded in a variety of ways. In some shires, clearing for agricultural and horticultural purposes has resulted in the removal of 97 per cent of native vegetation, particularly in the east of the Catchment. More than 80 per cent of plant species which are currently recognised as being extinct were formerly found on land now cleared for agriculture.

The Blackwood Catchment has the most active sub-catchment groups and farmers in the State, taking action on a range of land conservation issues.

The South-West of Western Australia has been divided into districts called Natural Resource Zones (Figure 3) on the basis of their natural resources – that is, their vegetation district or subdistrict (Beard), drainage/catchment system and rainfall (Allison *et al.*, 1993). The Blackwood Catchment contains parts of six Natural Resource Zones (Nos. 2, 12, 13, 41, 60 and 71), making it a mosaic of five vegetation districts and subdistricts:

- the Menzies Subdistrict (Southern Jarrah Forest);
- the Warren Subdistrict (Karri Forest);
- the Dale Subdistrict (Northern Jarrah Forest);
- the Avon Botanical District (Wheatbelt); and
- the Roe Botanical District (Mallee Country).

2 VEGETATION

2.1 Vegetation Systems

Vegetation Systems are particular sets of plant communities which recur in a mosaic pattern linked to topographic and geographic features. Each Vegetation System covers a defined area and has a single typical vegetation pattern or a sequence of vegetation types (Beard, 1981).

The vegetation of Western Australia was divided into Botanical Provinces (Figure 4) by J. S. Beard, a prominent botanist who surveyed much of the State's vegetation between 1969 and 1981 (Beard, 1980a, 1981). Plant communities together with physical factors such as climate and soil type are used to describe Botanical Provinces. Their vegetation essentially represents that which existed prior to European settlement.

Most of the south-west of Western Australia, including the Blackwood Catchment, falls within the South-West Botanical Province.

The South-West Botanical Province has been further divided by Beard into Botanical Districts, three of which, the Darling (with the Warren and Menzies Subdistricts), the Avon and the Roe Botanical Districts, cover the Blackwood Catchment.

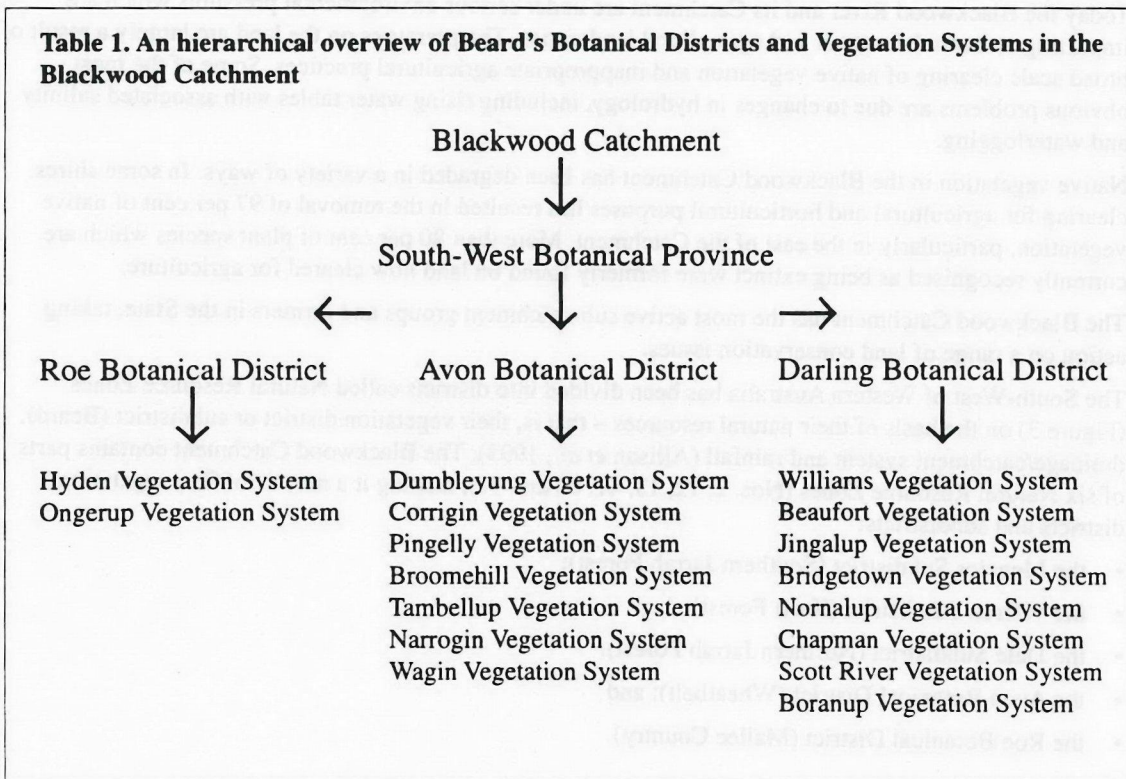
Each Botanical District is further divided into Vegetation Systems (Figure 4). In total there are 18 Vegetation Systems in the Blackwood Catchment.

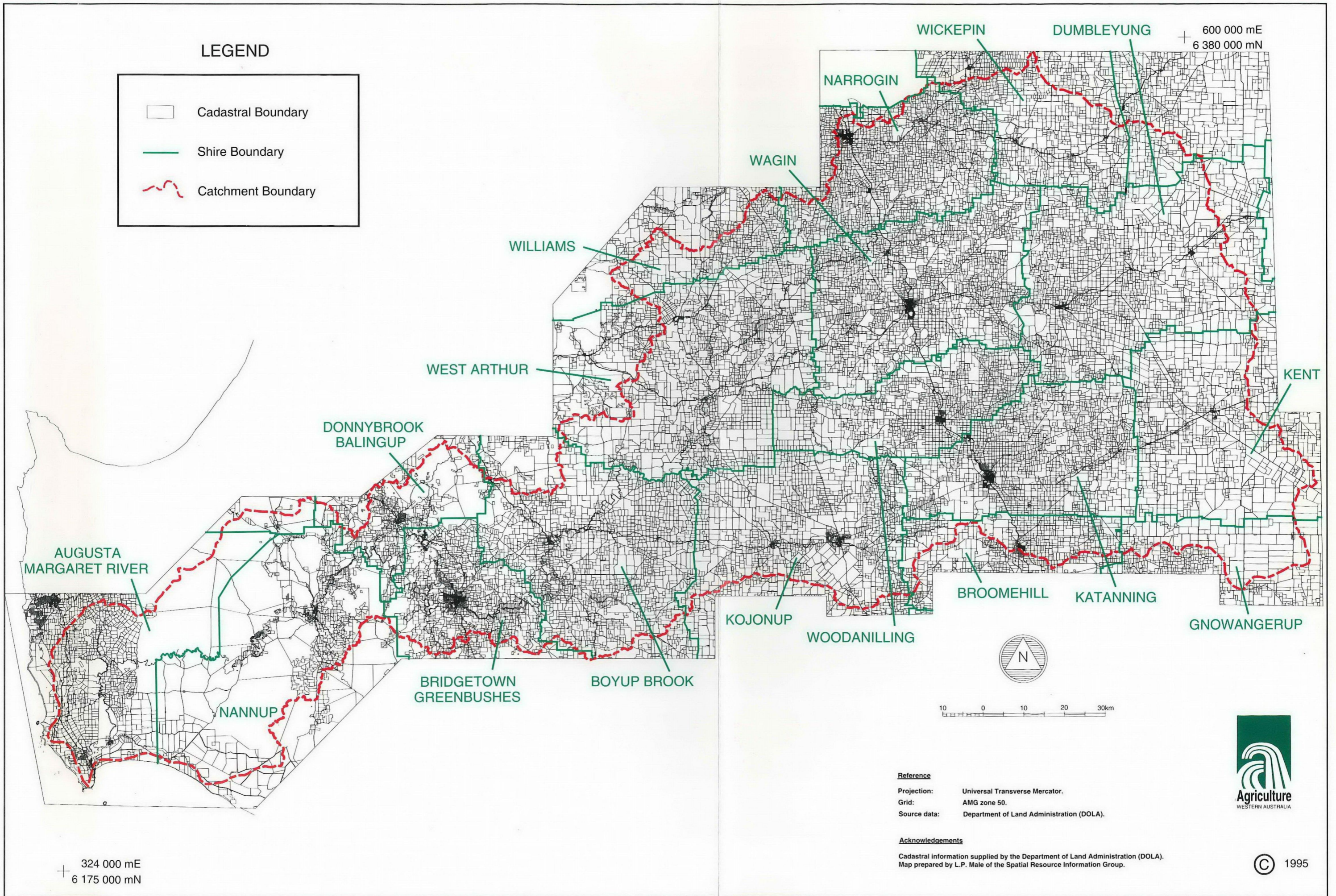
Upper Catchment: Hyden, Ongerup, Dumbleyung, Corrigin, Pingelly, Broomehill, Tambellup, Narrogin and Wagin Vegetation Systems

Middle Catchment: Williams, Beaufort and Jingalup Vegetation Systems

Lower Catchment: Bridgetown, Nornalup, Chapman, Scott River and Boranup Vegetation Systems

Table 1 presents an hierarchical overview of Beard's Botanical Districts and Vegetation Systems in the Blackwood Catchment. Appendices 1 to 13 give plant lists or dominant species lists for the Vegetation Systems in the Catchment.





LEGEND

Cadastral Boundary
 Shire Boundary
 Catchment Boundary

324 000 mE
6 175 000 mN

600 000 mE
6 380 000 mN

Reference
 Projection: Universal Transverse Mercator.
 Grid: AMG zone 50.
 Source data: Department of Land Administration (DOLA).






Acknowledgements
 Cadastral information supplied by the Department of Land Administration (DOLA).
 Map prepared by L.P. Male of the Spatial Resource Information Group.



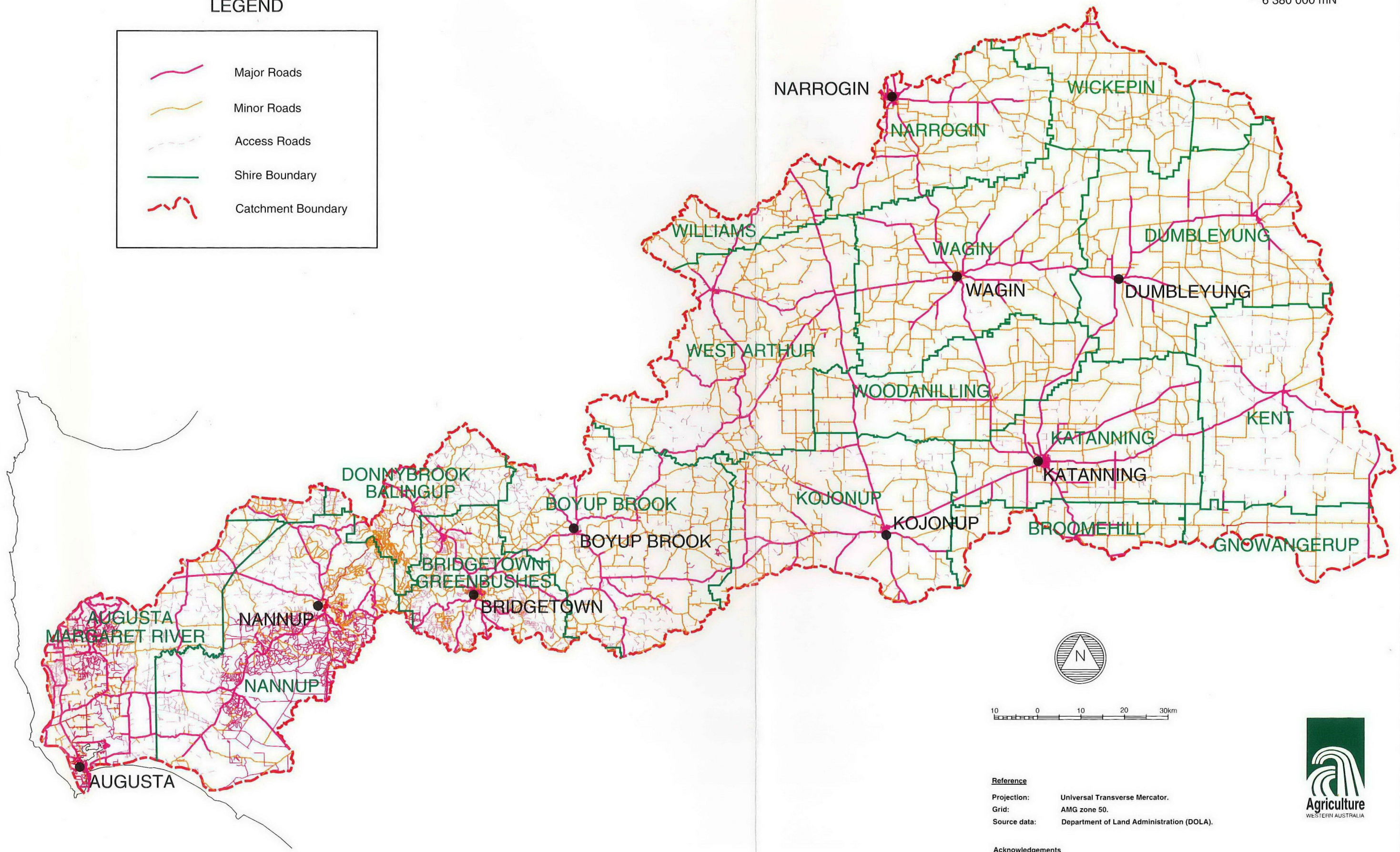
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Figure 1: Cadastral boundaries of the Blackwood Catchment

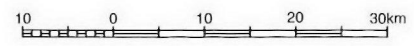
LEGEND

-  Major Roads
-  Minor Roads
-  Access Roads
-  Shire Boundary
-  Catchment Boundary

+ 600 000 mE
6 380 000 mN



+ 324 000 mE
6 175 000 mN



Reference
 Projection: Universal Transverse Mercator.
 Grid: AMG zone 50.
 Source data: Department of Land Administration (DOLA).

Acknowledgements
 Road network information supplied by the Department of Land Administration (DOLA).
 Map prepared by L.P. Male of the Spatial Resource Information Group.

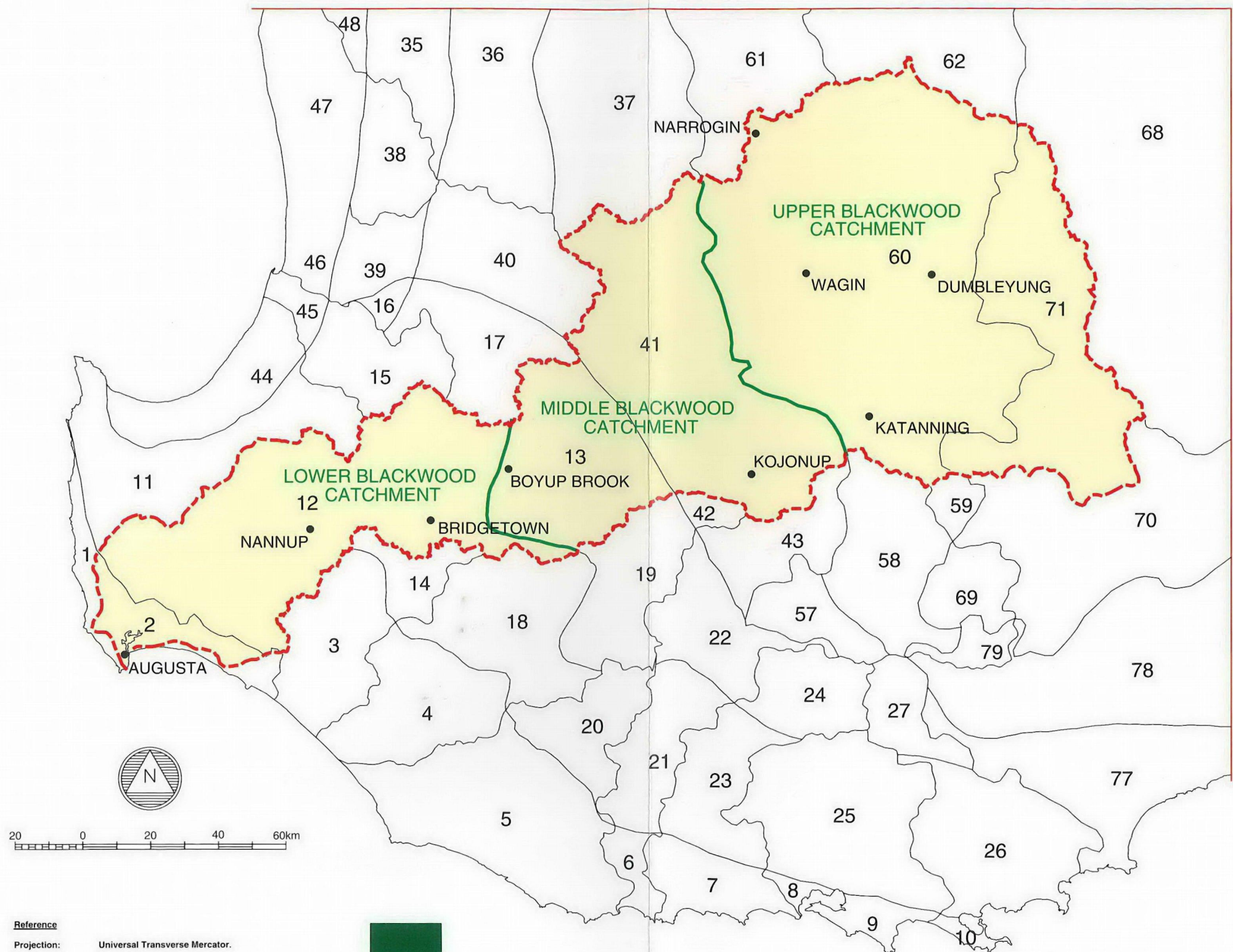


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Figure 2: All major, minor and access roads in the Blackwood Catchment

6 398 000 mN +
260 500 mE

674 800 mE
+ 6 398 000 mN



Reference

Projection: Universal Transverse Mercator.
Grid: AMG zone 50.
Source data: SRIG database.

Acknowledgements

Natural Resource Zones from "Natural Resource Zones of the South - West of Western Australia" (Allison *et.al.*, 1993).
Map prepared by L.P. Male of the Spatial Resource Information Group.



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6 119 700 mN +
260 500 mE

674 800 mE
+ 6 119 700 mN

Figure 3: The Lower, Middle and Upper Blackwood Catchment in relation to the Natural Resource Zones of the South - West Land Division of Western Australia (Allison *et.al.*, 1993)

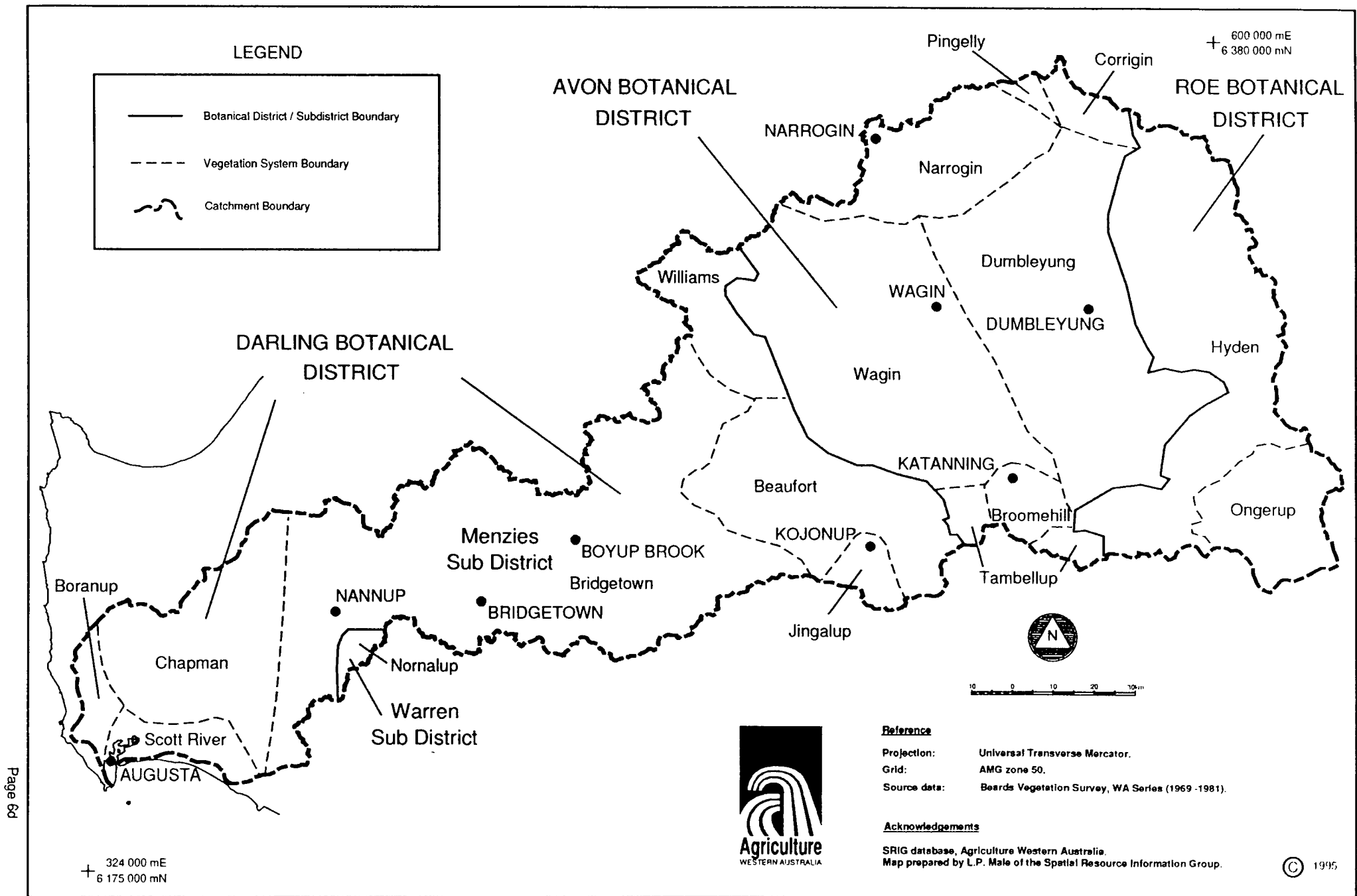


Figure 4: Beard's Botanical Districts, Subdistricts and Vegetation Systems of the Blackwood Catchment

The Blackwood Catchment can also be divided into the upper, middle and lower catchment on the basis of vegetation, topography, landform and land use (Figure 3).

A small portion of the upper catchment (Roe Botanical District) has salmon gum (*Eucalyptus salmonophloia*) and mallee (*Eucalyptus* spp.) as the dominant vegetation.

York gum (*Eucalyptus loxophleba*) and wandoo (*Eucalyptus wandoo*) dominate the middle to upper catchment (Avon Botanical District).

In the lower Blackwood Catchment (the Darling Botanical District), forests of karri (*Eucalyptus diversicolor*) and jarrah (*Eucalyptus marginata*) are the dominant vegetation.

The following is a description of the landscape and vegetation types of each of the Vegetation Systems in the upper, middle and lower Blackwood Catchment. Figure 4 shows the geographic location of Beard's Botanical Districts, Subdistricts and Vegetation Systems and Figure 5 is a map of the vegetation communities in the catchment.

The upper Blackwood

Nine shires have the majority of their area within the upper Blackwood Catchment – Broomehill, Dumbleyung, Gnowangerup, Katanning, Kent, Narrogin, Wagin, Wickepin and Woodanilling.

The eastern half of the Shire of Dumbleyung and large areas of the Shire of Kent are characterised by the **Hyden Vegetation System** (Figure 4). The landscape of the Hyden Vegetation System is broadly undulating with very long, gentle slopes and an altitudinal range of 150 m. High ground is often capped with residual laterite and sand, although the edges are seldom marked by breakaways, so boundaries between laterite and sand are often obscure. There are few granite outcrops and major valleys in the eastern region of the System contain salt lakes, smaller lakes and pans. There are four categories of vegetation in the Hyden Vegetation System: scrub-heath, mallee, woodland and salt country (Beard, 1980b; 1976a).

The Pingarning Hills to the east of the Dumbleyung townsite carry York gum woodland and sheoak low woodland. Otherwise, the pattern of vegetation in the Hyden Vegetation System is a mosaic of scrub-heath on sandplains, mallee on slopes, a mallee woodland mosaic in some valleys and a continuous woodland in valley bottoms.

The dominant mallee species is tall sand mallee (*Eucalyptus eremophila*) with narrow-leaved red mallee (*Eucalyptus angustissima*), redwood (*Eucalyptus transcontinentalis*) and gooseberry mallee (*Eucalyptus calycogona*), merret (*Eucalyptus celastroides*), ridge-fruited mallee (*Eucalyptus incrassata*) and York gum.

Understoreys are dominated by *Melaleuca* spp. In valleys, patches of eucalyptus woodland are interspersed with mallee.

Low mallee woodlands consist of blue mallee (*Eucalyptus gardneri*) and silver mallee (*Eucalyptus falcata*), sometimes with merret occurring on lateritic ridges and breakaways. Understorey vegetation is usually quite open with few species, as the gum dropped by trees contributes to the water repellent nature of soils.

The **Broomehill Vegetation System** is most prominent in the Shire of Katanning, extending from Katanning east to Lake Ewylamartup and south to Peringillup. The System is a plateau forming a flat to gently undulating plain with heavy soils which are subject to inundation. The System has been largely cleared for farming. The area was originally entirely covered by woodland which varied from area to area.

The region is known for blue mallee which associates with wandoo to form the bulk of the woodland population. Brown mallee (*Eucalyptus astringens*) is also present and becomes abundant with blue mallee on lateritic rises. Where the terrain becomes more dissected and undulating, York gum tends to replace blue mallee. Flat-topped yate (*Eucalyptus occidentalis*) and red morrel (*Eucalyptus longicornis*) are occasional species, whereas salmon gum (*Eucalyptus salmonophloia*) is less common. Smaller trees which are still common to the area include jam (*Acacia acuminata*), manna wattle (*Acacia microbotrya*), rock sheoak (*Allocasuarina huegeliana*) and needle tree (*Hakea preissii*). Skirted grasstrees (*Xanthorrhoea reflexa*) are also found (Beard, 1980b).

The **Corrigin Vegetation System** is found in the north-eastern corner of the Shire of Wickepin where its eastern boundary corresponds with the beginning of mallee country. This hilly and deeply dissected

landscape is well drained in its northern area by the upper reaches of the Avon River. The higher ground is capped by large patches of sand and laterite – the laterite usually appears at the surface of the edges of sandplains and rarely as breakaways. There are some salt lakes in the vicinity of Lake Yealering with saltbushes on adjoining flats. Valley floors are not necessarily salt. There are four principal types of vegetation – kwongon (heath/scrub vegetation) on sandplains; patches of mallee; woodland on slopes and flats; and tea-tree thickets and samphire in the valley floors (Beard, 1976b).

Mallee species recorded in this System are principally black marlock (*Eucalyptus redunca*), lerp mallee (*Eucalyptus incrassata*), tall sand mallee and capped mallee (*Eucalyptus pileata*) usually with a closed understorey.

Woodland or low woodland of brown mallet is found on elevated breakaways, while its associate powderbark (*Eucalyptus accedens*) is found in the western part of the System. Brown mallet is replaced by blue mallet in some localities.

Wandoo tends to occur mainly on the upper slopes below the sandplain, while York gum occurs mainly on middle slopes. Salmon gum and red morrel are found on flats with heavy soil, while flooded gum (*Eucalyptus rudis*) occurs along major creeks with lesser bottlebrush (*Callistemon phoeniceus*). Along salty creeks, swamp sheoak (*Allocasuarina obesa*) and *Melaleuca hamulosa* with samphire are common.

The **Dumbleyung Vegetation System** is the most prominent System in the upper Blackwood Catchment and covers the eastern third of the Shire of Katanning, most of the Shire of Dumbleyung, the eastern half of the Shire of Wagin and a small area of the Shire of Wickepin south-east of Lake Toolibin and Lake Taarblin. The System has a southern limit at Lake Coyrecup and its eastern boundary is the beginning of the mallee country. In the Shire of Katanning, the country is gently undulating with scattered alteration cappings prevalent in the north.

The general landscape of the **Dumbleyung Vegetation System** is one of dryandra-dominated heath on laterite residuals and York gum, red morrel, salmon gum and wandoo woodland on the undulating country. Frequently, patches of mallee and tea-tree are found on salt flats with scrub-heath and low woodland on low-level sandplains (Beard, 1980b). Mallee vegetation in the Shire of Dumbleyung includes a number of dominant species – white-leaved mallee (*Eucalyptus albida*), tall sand mallee, narrow-leaved mallee, red morrell ridge-fruited mallee, frog mallee (*Eucalyptus phaenophylla*) and redwood. Tall sand mallee and frog mallee are the most common and the most ecologically important species. Seventy per cent of mallee species also occurs in heath and shrubland vegetation.

Heath of diverse species is found on hard compact laterite without soil, on brown sandy loams and on grey and white sands over laterite. Shrublands occur on light grey sands, while mallee occurs on the sandy clays of light colour and on soils with more clay than heath soils.

Woodlands of York gum, red morrell, salmon gum and wandoo occupy the undulating country with dryandra scrub on the laterite residuals and brown, blue and silver mallet woodlands and low woodlands on weathered laterite residuals and slopes. On pallid zone clays, woodlands are usually of York gum, salmon gum, morrel and wandoo, changing to mallet on lateritic wash.

There have been few changes to the composition of the System since European settlement, other than in the dryandra scrub in the west of the shire, which is increasingly susceptible to fungal dieback.

Lithic complexes found throughout the System occur as isolated granite boulder outcrops. Salt flats and sandplains in the numerous reserves are often affected by increasing salinity and waterlogging. Many areas once timbered are now degraded. Samphires (*Halosarcia lepidosperma*, *Sarcocornia blackiana*), which are efficient colonisers of salt-encrusted areas, are surrounded largely by tea-tree (*Melaleuca acuminata*), broom bush (*Melaleuca uncinata*), *Acacia* spp. and patches of York and salmon gum woodland.

The **Pingelly Vegetation System** extends southwards as far as Wickepin and occupies a small area in the north of the Blackwood Catchment. The eastern boundary extends from the eastern end of Yenyening Lake to Wickepin and the southern boundary from Karping to Wickepin. The landscape is undulating, hilly and deeply dissected with remnants of lateritic crust capping higher ground to form prominent mesas. Numerous granite exposures form conspicuous domes and tors. While there are ten main vegetation types in the **Pingelly Vegetation System**, only a mosaic of tea-tree and scattered York gum is found within the Blackwood Catchment.

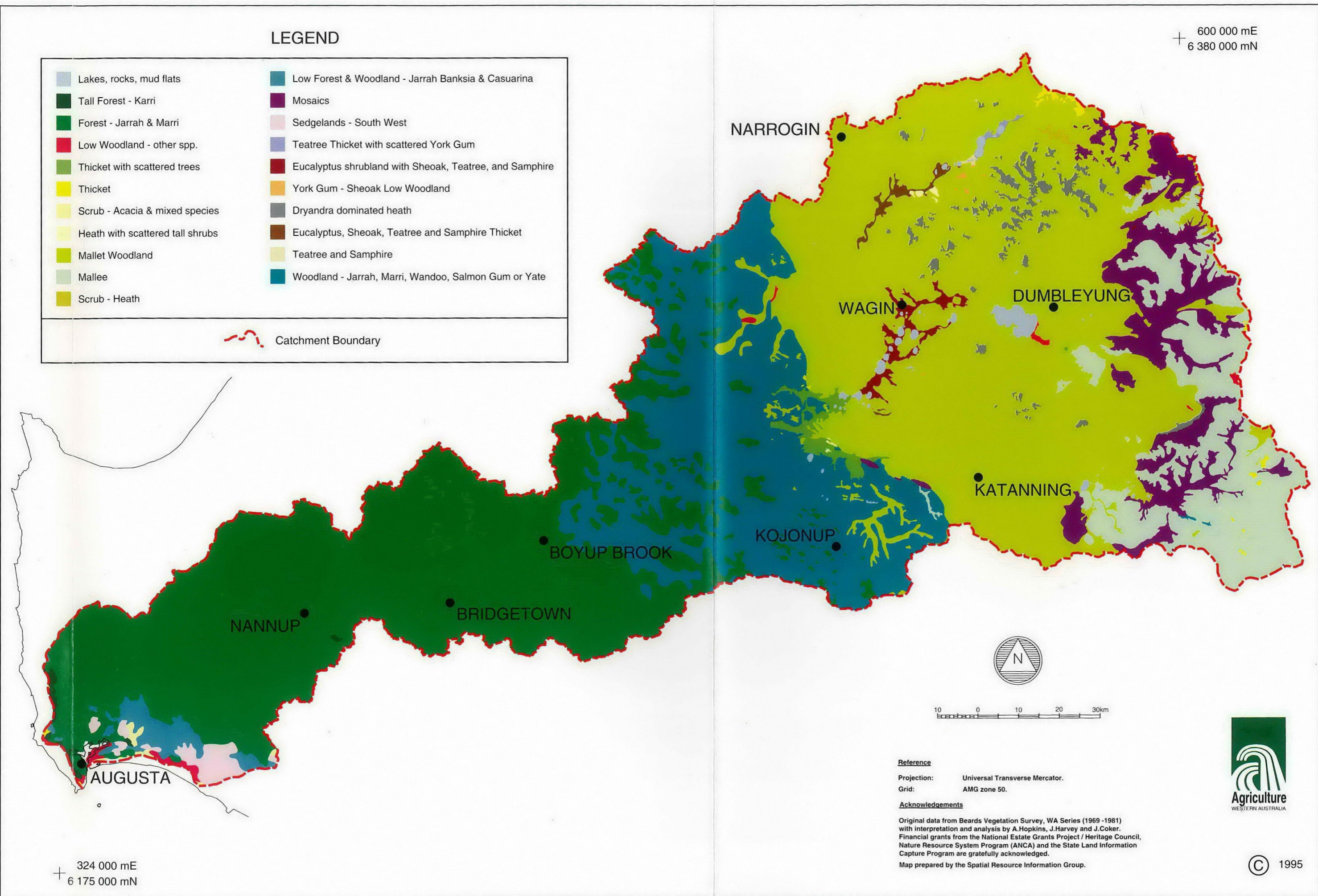


Figure 5: Major vegetation communities in the Blackwood Catchment (according to Beard, 1976a, 1976b, 1980b and 1981) Page 8a

Part of the **Tambellup Vegetation System** covers a small area of the Shire of Katanning between the **Broomehill Vegetation System** and the **Beaufort Vegetation System**. The area is predominantly covered with woodland of wandoo and flat-topped yate (Beard, 1980b; 1979).

The **Ongerup Vegetation System** occupies a flat plain in the north-west corner of the Shire of Gnowangerup. It replicates the topography of the **Broomehill Vegetation System** but has a cover of mallee rather than mallet. Mallee scrub and low woodland cover most of the area, with scrub-heath on lateritic rises, York gum and salmon gum woodland on red soil and woodlands of flat-topped yate and a low forest of moort (*Eucalyptus platypus*) on grey clays and swamps. (Beard, 1980b).

The **Wagin Vegetation System** covers the north-western region of the Shire of Katanning (in a belt approximately 35 km wide from Highbury to Katanning), most of the western half of the Shire of Wagin and the south-west corner of the Shire of Narrogin. The landscape is undulating and well dissected with small remnants of laterite cappings on ridges and mesas, some granite domes and tors, and broad valleys containing salt marshes.

The dominant vegetation is a mosaic of brown mallet and wandoo woodland on laterite mesas and breakaways and low woodland of York gum and wandoo on the slopes of undulating country. Brown mallet is joined by red morrel on breakaways near the townsite of Katanning, an unusual change of habit for a species most commonly associated with calcareous valley soils. Heaths occur on scattered patches of laterite throughout the System, occasionally associated with wandoo, but more frequently with the Drummond's gum (*Eucalyptus drummondii*). Dryandra are generally the dominant species in heath vegetation (Beard, 1980b).

The dominant vegetation in the western region of the Shire of Wagin is a mosaic of brown mallet and wandoo woodland on laterite mesas and breakaways with low woodlands of York gum and wandoo occupying the slopes of undulating country.

In the Shire of Narrogin, the **Wagin Vegetation System** is dominated by a mixed York gum and wandoo woodland on the slopes of the undulating country. Wandoo replaces the powderbark of the **Narrogin Vegetation System**, which does not extend so far south. The vegetation of salt flats south-east of Highbury has been severely affected by the increase in salinity and rising water tables following clearing. It is generally in very poor condition with a dense cover of dead tea-tree thickets. Sapphire species are probably extending their range in the area.

The northern region and most of the Shire of Narrogin is occupied by the **Narrogin Vegetation System**, as is a considerable section of the western half of the Shire of Wickpin. The country is less dissected than surrounding systems with substantial areas of laterite-cruste d plateaux covered by a mosaic of brown mallet and powderbark woodland. Woodlands of York gum and wandoo cover the dissected country below the breakaways with a tendency to topographic separation especially in the west.

East of Narrogin are several large areas of brown mallet woodland. A large part of the more extensive alteration plateaux north-west of Narrogin was declared State Forest when brown mallet was a valuable source of tannin. Powderbark is a common species and varies in height and density, although it is usually shorter and occurs in more open stands than brown mallet. The understorey consists of sparse open shrubs, particularly under brown mallet and includes sandplain poison (*Gastrolobium microcarpum*), prickly poison (*Gastrolobium spinosum*), the one-sided bottlebrush (*Calothamnus quadrifidus*), roadside tea-tree (*Leptospermum erubescens*), the skirted grasstree, *Dryandra cirsioides* and other dryandra species (Beard, 1976b).

The middle Blackwood

The middle Blackwood Catchment covers most of the four shires of Boyup Brook, Kojonup, West Arthur and Williams. Parts of the north-western and south-western regions of the middle Blackwood Catchment are not described in Beard's 1:250,000 vegetation series. However, they are covered in his 1:1,000,000 Swan sheet and in F.G. Smith's 1972-74 vegetation series, although Smith's descriptions of vegetation communities are less detailed than Beard's 1:250,000 series.

The **Beaufort Vegetation System** covers a small area in the south-western corner of the Shire of Katanning and the north-eastern corner of the Shire of Kojonup. Sandy deposits occur along sections of the Carrolup River, and carry a variety of plant communities. The principal elements of this landscape are woodlands of wandoo on laterite residuals, woodlands of York gum and wandoo on undulating country and woodlands of York gum and flat-topped yate on sand patches. Often there is a mosaic of different eucalyptus woodlands on a variety of landscapes (Beard, 1980b).

The **Jingalup Vegetation System** occupies a large area in the north-eastern corner of the Shire of Kojonup. There is a well defined mosaic of jarrah-marri-wandoo woodland on ironstone gravels and marri and wandoo woodland on slopes. Brown mallet often associates with jarrah on breakaways, while flooded gum occurs along minor creeks. Woodlands of marri and wandoo dominate scattered small jam and sheoak (*Allocasuarina* spp.) with some bull banksia (*Banksia grandis*) and Christmas tree (*Nuytsia floribunda*) (Beard, 1980b; 1979).

In the south-western region of the **Jingalup Vegetation System**, wandoo woodland appears in the valleys and on the lower slopes. In some of the damper areas, swamp yate woodland occurs, while low woodlands of flooded gum are common along water courses. Jarrah open forest is generally confined to lateritic hill tops and merges with wandoo woodland on the upper slopes (Smith, 1972).

A small area of the **Williams Vegetation System** occurs in the shires of Williams and West Arthur on undulating plateau country and on a lateritic sheet. On laterite remnants there is a mosaic of jarrah-marri-wandoo woodland with powderbark and brown mallet dominating along breakaways. However, marri-wandoo woodland covers most of the landscape, giving way to York gum on the lower ground (Beard, 1980b; Smith, 1974). Some jarrah occurs where there is laterite, but only in the woodland form. On lateritic hill tops and breakaways, brown mallet forms open forest, whereas on granite hills and slopes, marri and flooded gum form woodlands with rock sheoak forming low open forest, open scrub or closed scrub (Smith, 1974).

The lower Blackwood

The lower Blackwood Catchment shires are Augusta-Margaret River, Bridgetown-Greenbushes, Donnybrook-Balingup and Nannup. The lower Blackwood Catchment was surveyed by F. Smith during the early 1970s and is represented in three vegetation maps (Collie, Busselton-Augusta and Pemberton-Irwin Inlet (Smith, 1972-74). These surveys were not as detailed as those later carried out by J.S. Beard.

Much of the lower Blackwood Catchment (the Darling Botanical District) is dominated by forests of karri and jarrah, particularly along the Darling Scarp. Marri and wandoo woodland is the dominant vegetation throughout the Menzies Subdistrict, interspersed with patches of jarrah-marri-wandoo forest, low woodlands of tea-tree (*Melaleuca* spp.) with sheoak, York gum and peppermint (*Agonis* spp.) occurring less commonly.

Closer to the coast are patches of banksia-jarrah low woodland and reed swamps, usually associated with heath scrubs. Much of this area of the Blackwood Catchment is State Forest and subsequently the vegetation associations occurring in these forested areas are extremely complex, so it is not practicable to name all vegetation types and associations.

The **Bridgetown Vegetation System** covers a significant area in the Menzies Subdistrict. The vegetation of the system is similar to the jarrah-marri forest of the Darling Scarp. Although the system does not contain any of the scarp, marri-wandoo woodlands occur towards its eastern boundary. Along riverbanks, flooded gum forms a fringing forest, and paperbark (*Melaleuca raphiophylla*) forms a dense understorey at the edge of the more permanent rivers.

The **Nornalup Vegetation System** falls within the northern region of the Warren Subdistrict, with karri the dominant vegetation. The system extends from north-west of Manjimup towards the south and south-west almost to the coast. Vegetation on this dissected lateritic plateau sloping gently to the south is a mosaic controlled by topography and geology. Karri tall forest is mainly restricted to red earths, which develop on basic gneiss on lower slopes. Marri becomes co-dominant further upslope with a change to podzolic soils, and may become dominant.

Jarrah dominates on the ridge tops on most soils, generally where laterite or ironstone gravel is present. The stature of the forest varies from tall to low, according to soil depth, permeability and drainage. On the poorest soils trees thin out, leaving thickets of shrubs. On the lower ground towards the sandplains,

drainage becomes poor, with mixed forest of yarri (*Eucalyptus patens*) and bullich (*Eucalyptus megacarpa*), thickets with scattered small trees of these species, thickets with understorey of reeds, and reed swamp. On small hummocks and sand ridges, the cover is jarrah and banksia low woodland.

The **Chapman Vegetation System** is the vegetation of the Blackwood Plateau which is laterite-capped and gently undulating, but locally dissected to reveal the underlying Mesozoic sediments. The dominant jarrah-marri forest is frequently stunted by poor drainage conditions. Some of it was mapped as more open (woodland) or less tall (low forest and woodland) by F. G. Smith in 1972. Bullich and yarri may occur locally as in the **Bridgetown Vegetation System**, while low woodland of moonah (*Melaleuca preissiana*) and banksia occupy damp sites. In the valleys of the lower Blackwood, peppermint becomes a component of the top canopy.

The **Scott River Vegetation System** covers the extensive areas of seasonally swampy flats between the forests of the **Chapman** and **Nornalup Vegetation Systems**, and the coastal sand dunes of the **Boranup Vegetation System**. This is largely jarrah-banksia low woodland with melaleuca and an understorey of small shrubs and sedges. In the area surrounding and to the north of the Scott River is a curious and unique *Viminaria* scrub on sheet laterite.

2.2 Existing Native Vegetation

Since European settlement much of the original vegetation in the Blackwood Catchment has been cleared, particularly in the middle and upper Catchment. The effect of this removal is seen in land degradation, river eutrophication and loss of biodiversity.

Native vegetation has been classified into three categories by Beeston *et al.* (1994).

Remnant Vegetation (RV) (one or more of the following characteristics)

- most closely reflects the natural state of vegetation for a given area
- intact understorey, if forest or woodland
- minimal disturbance by agents of human activity

Modified Vegetation (MV) (one or more of the following characteristics)

- degraded understorey; reduced number of native species; includes weeds
- obvious human disturbance – clearing, mining, grazing, weeds
- affected by salt
- narrow corridors of vegetation which are more likely to be affected by edge effects (usually along road, railway lines, windbreaks, watercourses)

Scattered Vegetation (SV) (one or more of the following characteristics)

- no understorey
- parkland cleared, that is, composed of scattered single trees
- no significant signs or chance of regeneration

The original native vegetation cover in the Blackwood Catchment totals 1,333,428 ha. This is approximately 32 per cent of the total area of the 17 Shires (Figures 6 and 7). However, this percentage is misleading for two reasons. Firstly, it is not an accurate assessment of the cover of native vegetation within the catchment and secondly, some shires have not been as extensively cleared as others. Shires in the upper catchment, such as Dumbleyung, Wickepin and Katanning, have been almost totally cleared.

On average there is less than 14 per cent native vegetation cover in each upper catchment shire, although the average is only 5.3 per cent on private land within the catchment. As the majority of the catchment covers alienated privately-owned land, any future reduction in the amount of native vegetation will inevitably result in serious land degradation and loss of species diversity.

In the middle catchment region, unlike the upper catchment, a considerable amount of native vegetation remains – an average of 29 per cent per shire. Much of this remains on privately-owned land – an average of 11.2 per cent per shire – and many remnant areas are under threat of being degraded. The principal threats are from clearing and stock which graze remnant areas on private land. In the present economic climate, farmers cannot afford the cost of protective fencing or the loss of grazing areas.

Table 2. Remnant vegetation (ha) on private land and public reserves in the shires of the Blackwood Catchment

Shire	Shire area (ha)	Remnant vegetation (ha)	Scattered vegetation (ha)	Modified vegetation (ha)	Public reserves (ha)	RV+Pub Shire Area (%)	Remnant (Shire Area-Pub) (%)	RV+MV+Pub Shire Area (%)	RV+MV Shire Area-Pub (%)
Augusta-Margaret River	222,718.0	37,516.2	0.0	0.0	121,519.6	71.41	37.07	71.41	37.07
Boyp Brook	282,637.7	34,218.0	11,966.4	473.7	68,842.9	36.46	16.01	36.63	16.23
Bridgetown-Greenbushes	135,387.0	7275.8	1871.8	79.8	70,038.2	57.11	11.13	57.16	11.26
Broomehill	119,170.0	7259.6	0.0	0.0	1331.6	7.21	6.16	7.21	6.16
Donnybrook-Balingup	155,143.0	14,814.7	0.0	0.0	87,916.9	66.22	22.04	66.22	22.04
Dumbleyung	253,816.4	17,392.0	0.0	0.0	14,830.0	12.70	7.28	12.70	7.28
Gnowangerup	454,958.0	23,645.5	2094.0	2225.7	86,247.0	24.15	6.41	24.64	7.02
Katanning	153,272.0	5446.6	0.0	0.0	8253.6	8.94	3.76	8.94	3.76
Kent	575,537.0	47,449.9	1906.2	8688.7	114,766.7	28.19	10.30	29.69	12.18
Kojoonup	292,938.1	31,039.0	12,365.3	264.5	4838.0	12.25	10.77	12.34	10.87
Nannup	293,198.0	19,210.7	857.1	0.0	241,057.7	88.77	36.84	88.77	36.84
Narrogin	164,063.0	6559.5	1336.3	3549.6	13,575.7	12.27	4.36	14.44	6.72
Wagin	193,910.0	2702.9	542.0	4695.8	8513.5	5.78	1.46	8.21	3.99
West Arthur	282,614.0	42,319.7	11,009.8	673.6	28,627.9	25.10	16.66	25.34	16.93
Wickepin	202,347.0	9926.6	102.6	305.8	5320.6	7.54	5.04	7.69	5.19
Williams	228,482.0	24,158.2	4041.3	204.4	44,953.3	30.25	13.16	30.34	13.27
Woodanilling	111,769.0	8740.9	261.6	0.0	3584.0	11.03	8.08	11.03	8.08
Total	4,121,960.20	339,675.76	48,354.39	21,161.58	924,217.20	505.36	216.53	512.74	224.88
Average	242,468.25	19,980.93	2844.38	1244.80	54,365.72	29.73	12.74	30.16	13.23
Range	463,768.00	44,747.00	12,365.29	8688.70	239,726.10	82.98	35.61	81.56	33.32
Highest	575,537.00	47,449.90	12,365.29	8688.70	241,057.70	88.77	37.07	88.77	37.07
Lowest	111,769.00	2702.90	0.00	0.00	1331.60	5.78	1.46	7.21	3.76

Source: Remnant Vegetation Inventory in the Southern Agricultural Areas of W.A. (Beeston *et al.*, 1994)

RV = Remnant vegetation

Pub = Public land

MV = Modified vegetation

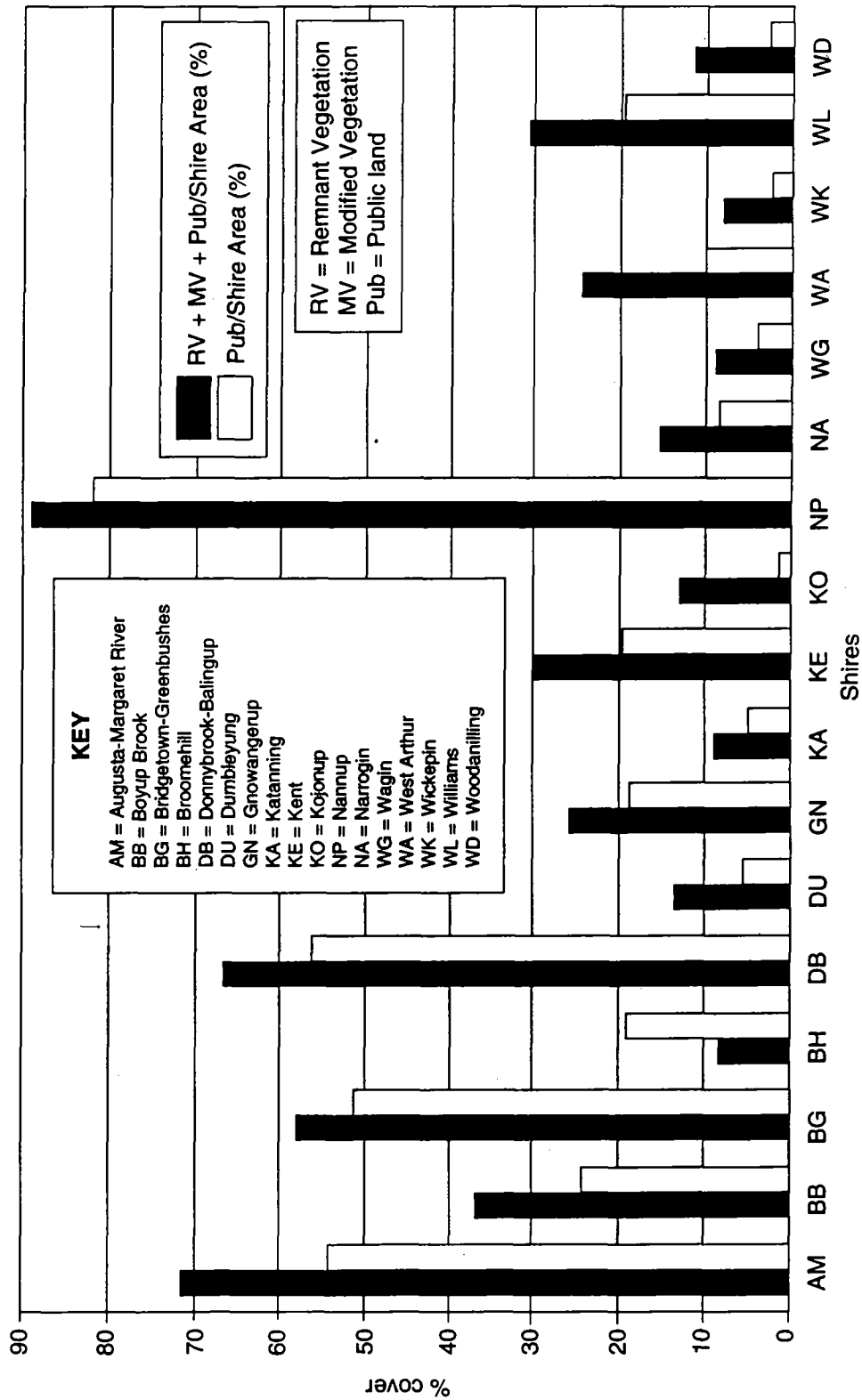




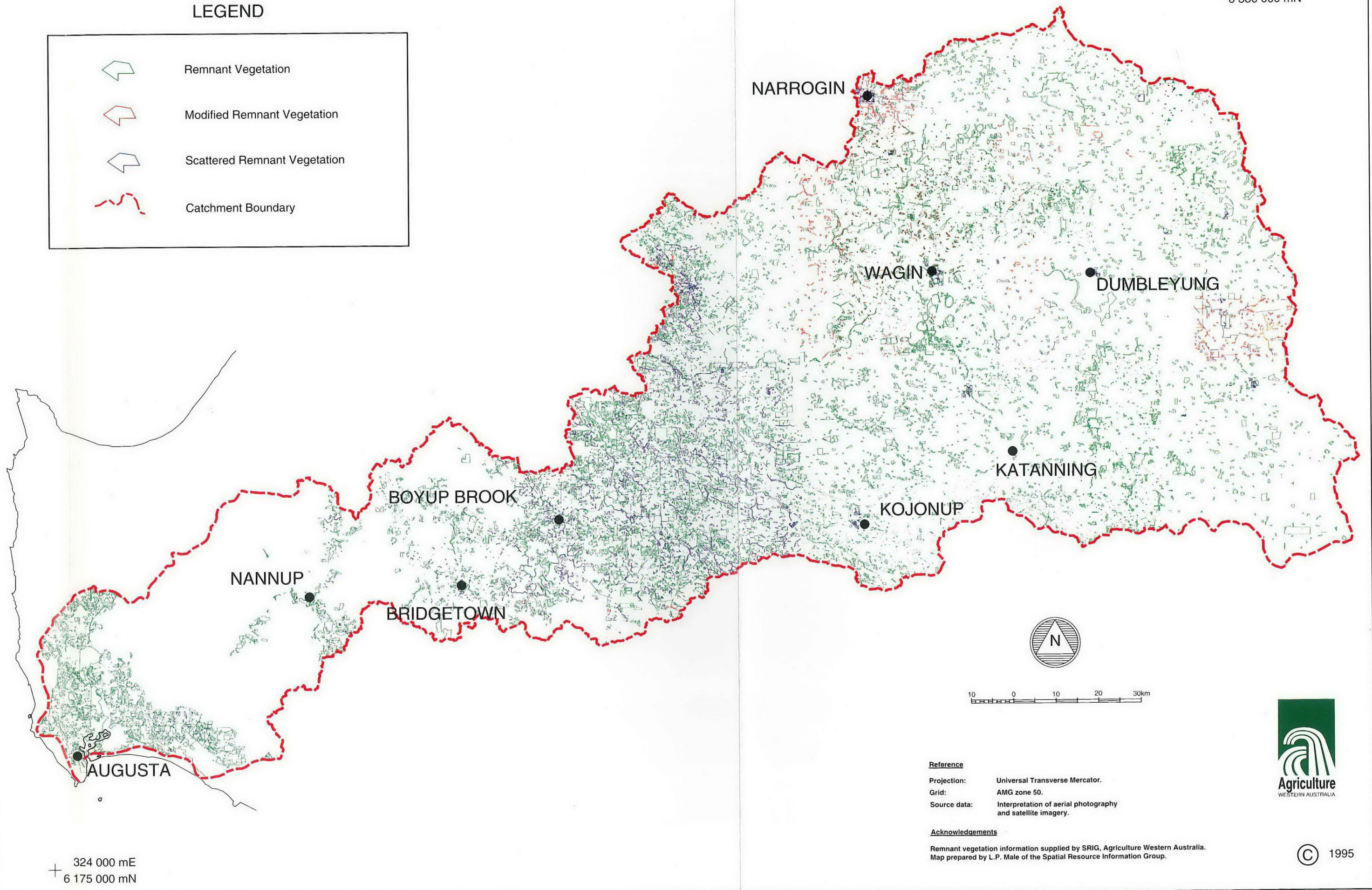


Figure 6. Percentage of original native vegetation in the shires of the Blackwood Catchment

LEGEND

	Remnant Vegetation
	Modified Remnant Vegetation
	Scattered Remnant Vegetation
	Catchment Boundary

+ 600 000 mE
6 380 000 mN



+ 324 000 mE
6 175 000 mN

10 0 10 20 30km



Reference

Projection: Universal Transverse Mercator.
Grid: AMG zone 50.
Source data: Interpretation of aerial photography and satellite imagery.

Acknowledgements

Remnant vegetation information supplied by SRIG, Agriculture Western Australia.
Map prepared by L.P. Male of the Spatial Resource Information Group.



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Figure 7: Remnant vegetation on private land in the Blackwood Catchment

Shires in the lower catchment such as Augusta-Margaret River, Bridgetown-Greenbushes and Nannup have large areas of native vegetation set aside as reserves and State Forests. Although each shire in the lower catchment has, on average, 75 per cent native vegetation cover, an average of only 19 per cent exists as remnant vegetation on alienated land.

Table 2 presents data on the remnant vegetation cover on private land and public reserves within each shire in the Blackwood Catchment. The Table classifies the remnants according to Beeston's three categories, and also presents the percentages of remnant cover for each shire.

Table 3 presents the number of remnants on private land in each shire, according to Beeston's three categories and gives the percentage of remnants that are less than 20 ha. Appendix 14 lists the names and area of reserves vested for the conservation of flora and fauna in Blackwood Catchment shires and Figure 8 shows the distribution of public land in the Catchment.

A survey of on-farm remnant bushland in the Blackwood Catchment was completed by Frans Mollemans (1993). In total, 3448 remnants in 17 shires were surveyed, 90 in detail. The plant communities are representative of the vegetation found in the remnants which were surveyed.

The value of retaining remnant vegetation is increasingly recognised for a number of ecological, economical and sociological reasons. The ecological benefits result from the contribution of remnant vegetation to vital, although usually undervalued, ecosystem services. These include:

- maintaining biodiversity;
- protecting water resources;
- protecting soil resources;
- storage and recycling of nutrients; and
- contributing to the maintenance of regional rainfall patterns.

Remnant vegetation also has a range of direct economic benefits including:

- contributing to erosion control;
- providing shade and shelter to stock;
- providing deep rooted perennial vegetation which prevents water tables from rising, hence preventing salinity;

Table 3. Number of remnants on private land in the shires of the Blackwood Catchment

Shire	No. remnants	% Remnant Vegetation	% Scattered Vegetation	% Modified Vegetation	% of remnants less than 20 ha
Augusta-Margaret River	2755	100			95
Boyup Brook	4950	61	34	5	92
Bridgetown-Greenbushes	860	71	28	1	90
Broomehill	2647	100			97
Donnybrook-Balingup	1777	100			92
Dumbleyung	564	100			66
Gnowangerup	833	76	19	4	74
Katanning	422	100			80
Kent	1375	46	20	33	77
Kojonup	5685	85	15		93
Nannup	1215	81	19	91	
Narrogin	999	35	16	49	85
Wagin	565	20.5	4.5	75	85
West Arthur	4710	70	27	3	91
Wickepin	579	93	4	3	75
Williams	2468	87	12	1	90
Woodanilling	566	97	3		80

Source: Remnant Vegetation Inventory in the Southern Agricultural Areas of W.A. (Beeston *et al.*, 1994)

- providing a habitat for natural predators of crop pests; and
- conserving genetic resources for future development of pharmaceutical products.

The cultural and sociological benefits of remnant vegetation include:

- providing a place for recreation; and
- providing a sense of identify and place.

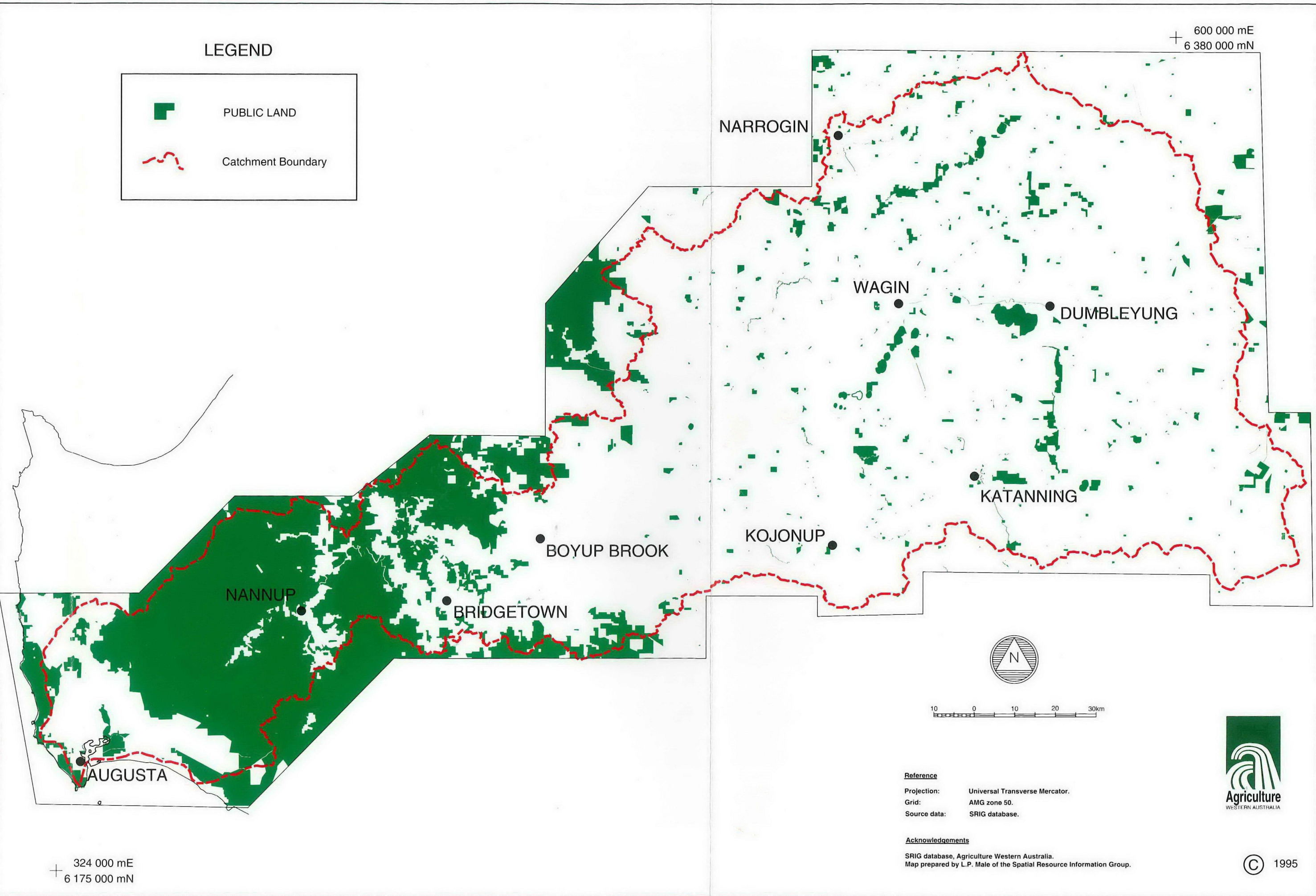


Figure 8: Public land in the Blackwood Catchment

3 WETLANDS AND WATERWAYS

3.1 Wetlands

Wetlands are "... areas of seasonally, intermittently or permanently waterlogged soils or inundated land whether natural or otherwise, fresh or saline, for example, waterlogged soils, ponds, billabongs, lakes, swamps, tidal flats, estuaries, rivers and tributaries." (Wetlands Advisory Committee, 1977).

The rise of saline groundwater as a result of the clearing of native vegetation has been well documented throughout the agricultural region. The wetlands and waterways of the wheatbelt have suffered enormous changes as a result of these salinisation processes.

Environmental changes in the wetlands of the Blackwood Catchment began with the rise of the saline water table that followed the 'opening up' of the wheatbelt in the early 1900s. Salinity changes began to take effect in the early 1940s, which was earlier than many other wheatbelt catchments as the region was settled and cleared earlier. These changes were quickly followed by the death of vegetation fringing lakes and wetlands in the catchment (Sanders, 1991).

The Blackwood River stretches from Moordjarrup to Augusta on the south coast. In the lower Blackwood, from Boyup Brook to Nannup, the river flows through steep landscapes, where many small streams and creeks join it. Balingup Brook, which starts near Boyup Brook, meets the Blackwood south-west of Bridgetown. St John's Brook drains an area north and west of Nannup, while the Scott River drains a flat sandy area along the south coast and joins the Blackwood at its mouth at Flinders Bay. All the major drainage systems in the Blackwood Catchment are shown in Figure 9.

Most of the wetlands in the Blackwood Catchment were fresh or near fresh until the 1940s. They were covered by sheoak, paperbark and tea-tree. Locals recall that it was possible to become lost in the heavy undergrowth on Lake Toolibin when shooting ducks during the late 1930s and early 1940s. Locals also report that Lake Yealering was so fresh in the early 1930s that sheep used to drink directly from it (Sanders, 1991).

In the early 1930s, the Coblinine River had tea-tree flats where it was "...virtually impossible to see through the canopy..." (Sanders, 1991). The Carrolup River was fresh until the 1950s when salinity first took effect and minnows and redfin perch began to disappear from the river. Today the Carrolup River, which connects with the Beaufort River and runs into the Blackwood, is severely affected by salinity and waterlogging. The extensive reedbeds and nardoo (*Marsilea* sp.) that were found in Lake Taarblin were no longer present in any Blackwood Catchment wetland after the early 1970s.

During dry years, when the water receded, fresh water seepage appeared around the perimeter of Lake Norring and many plants germinated. In Lake Wardering, the death of the reedbeds coincided with the floods of the early 1970s.

Animal life in the wetlands of the Blackwood was varied and diverse and quite different to that which occurs today (Sanders, 1991). Many of the vertebrate animals including the water-rat (*Hydromys chysogaster*), water birds, reptiles and frogs that were once common to wetlands and the surrounding areas have disappeared. This could be because of increased wetland salinity, the decline of their prey, predation by introduced animals, habitat destruction or other factors.

The Blackwood Catchment has numerous wetland areas and waterways within its boundaries. Some of the main ones include Arthur River, Coblinine River, Lake Dulbining, Lake Toolibin, Lake Dumbleyung, Lake Coomelberrup, Lake Coyrecup, Lake Taarblin, White Lake, Lake Bokan, Lake Parkeyerring, Lake Gundaring, Flagstaff Lake, Lake Martinup, Lake Wardering, Lake Towerrinning, Wildhorse Swamp, Boyup 18239, the Lake Grace System (South) and parts of the Lake Jasper System.

3.2 Waterways

The following descriptions of the main waterways of the Blackwood Catchment are drawn largely from the work of Halse *et al.* (1993).

The **Arthur River** has its origins in the lake system near Lake Toolibin, south of Wickopin. It flows south-west mid-way between Narrogin and Wagin and is joined by the Buchanan River west of Piesseville. It then crosses the Albany Highway at the town of Arthur River and joins the Hillman River, which drains the northern parts near Darkan. The Arthur and Beaufort Rivers join at Moodiarup to become the Blackwood River.

The **Coblinine River** is a moderate-sized, permanently inundated lagoon (191.8 ha with a vegetated area of 142 ha) in the Shire of Katanning, with steep sides and a fringing belt of eucalyptus high on the banks. The water level in the river varies but below the flood mark all trees are dead. These dead trees are not numerous. In some areas, thickets of melaleuca regrowth have become established in the flood zone. Occasional swamp sheoak and eucalyptus seedlings occur in the thickets.

Lake Dulbining, approximately 13 km south-east of Wickepin, is a moderate-sized, brackish, seasonally inundated lake with few areas of open water. Extensive stands of swamp sheoak are present as a woodland over most of the lake and occasionally occur as thickets. Paperbarks occur intermittently amongst the thickets and throughout the woodland when the lake is dry. Samphires such as *Halosarcia pergranulata*, *Halosarcia lepidosperma* and *Crassula* sp. grow on the lake bed. Swamp sheoak also grows above the water mark at the edge of the lake and is replaced on higher ground by eucalypt woodland.

Lake Toolibin is one of the few remaining fresh water lakes in the agricultural area. It lies at the headwaters of the Arthur River, to the east of Narrogin and just south of Lake Dulbining. The lake and the surrounding environment support 24 species of breeding waterbirds, more than any other wetland in the South-West of Western Australia. In total, 41 species of waterbirds have been recorded, the highest species richness of any inland lake in the South-West. It is a large slightly brackish, semi-permanently inundated lake (296.5 ha with a vegetated area of 253.2 ha).

Lake Toolibin contains very dense thickets of swamp sheoak, *Melaleuca strobophylla*, and occasional flooded gums below the water mark. A few swamp sheoaks reach 12 m in height. Many trees have died on the western side of the lake as a result of increasing salinity. There are also a few dead trees (mostly flooded gums) in the open lagoon on the eastern side of the lake. When the lake is dry, samphire species (*Halosarcia lepidosperma*, *H. pergranulata* and *H. indica*) occur on the lake bed as open shrubland. There are patches of *Atriplex exilifolia*, *Carpobrotus* sp., *Goodenia visida* and *Wilsonia humilis* among the samphire.

Lake Dumbleyung is a very large saline, semi-permanently inundated lake (5560 ha with a vegetated area of 1025 ha) bordering the Shires of Wagin and Dumbleyung. When the dead tree zone fringing the lake is dry it contains an open shrubland of *Halosarcia pergranulata* and *Atriplex semibaccata*. *Chenopodium* sp. occurs on slightly higher ground with samphire (*Sarcocornia quinqueflora*) and ruby saltbush (*Enchylaena tomentosa*). Still below the maximum flood mark, but in an area that is rarely inundated, swamp sheoak and eucalyptus seedlings occur. Water from Lake Dumbleyung exits to the west and flows through the system of lakes around Wagin and Woodanilling into the Beaufort River.

Lake Coomelberrup is a moderate-sized, semi-permanently inundated lake in the Shire of Dumbleyung (90.6 ha with a vegetated area of 48.5 ha) with extensive areas of recently dead trees on the western side. There is a dense belt of dead trees (50 to 100 m wide) around most of the lake below the water mark with scattered live melaleuca trees close to the shore. A sparse understorey of samphire occurs beneath the dead and live trees. Above the water mark there are occasional swamp sheoak, which are replaced with eucalypt woodland further up the slope.

Lake Coyrecup is a large saline, semi-permanently inundated lake (448 ha with a vegetated area of 89 ha), approximately 22 km east of Katanning, with extensive areas of dead trees. Around the open water the dead trees consist of very old stags, while towards the shore some of the trees have died more recently. Along the shoreline there are areas of recently dead melaleuca shrubs. Throughout the zone of dead trees and extending above the water mark is an understorey of samphire consisting of *Halosarcia pergranulata*, *Sarcocornia quinqueflora* and *Halosarcia lepidosperma*. Around the edge of the lake are a few healthy saltwater paperbarks (*Melaleuca cuticularis*), behind which is a belt of swamp sheoak and dead eucalypts.

Lake Taarblin, in the north-east of the Shire of Narrogin, is a large brackish to saline, seasonally inundated lake (916 ha with a vegetated area of 766 ha) with extensive areas of long-dead swamp sheoak below the water mark and live swamp sheoak in some raised sections of the lake bed. Samphire (*Halosarcia pergranulata*) and round-leaf wilsonia (*Wilsonia rotundifolia*) grow under the dead trees. Above the water mark live swamp sheoak trees occur, with *Disphyma crassifolium* growing on the ground near the edge of the inundated area.

White Lake is a moderate-sized, seasonally inundated saline lake (208 ha with 60 ha of vegetation) in the Shire of Narrogin with a belt of dead *Melaleuca* aff. *halmaturorum* and swamp sheoak below the water

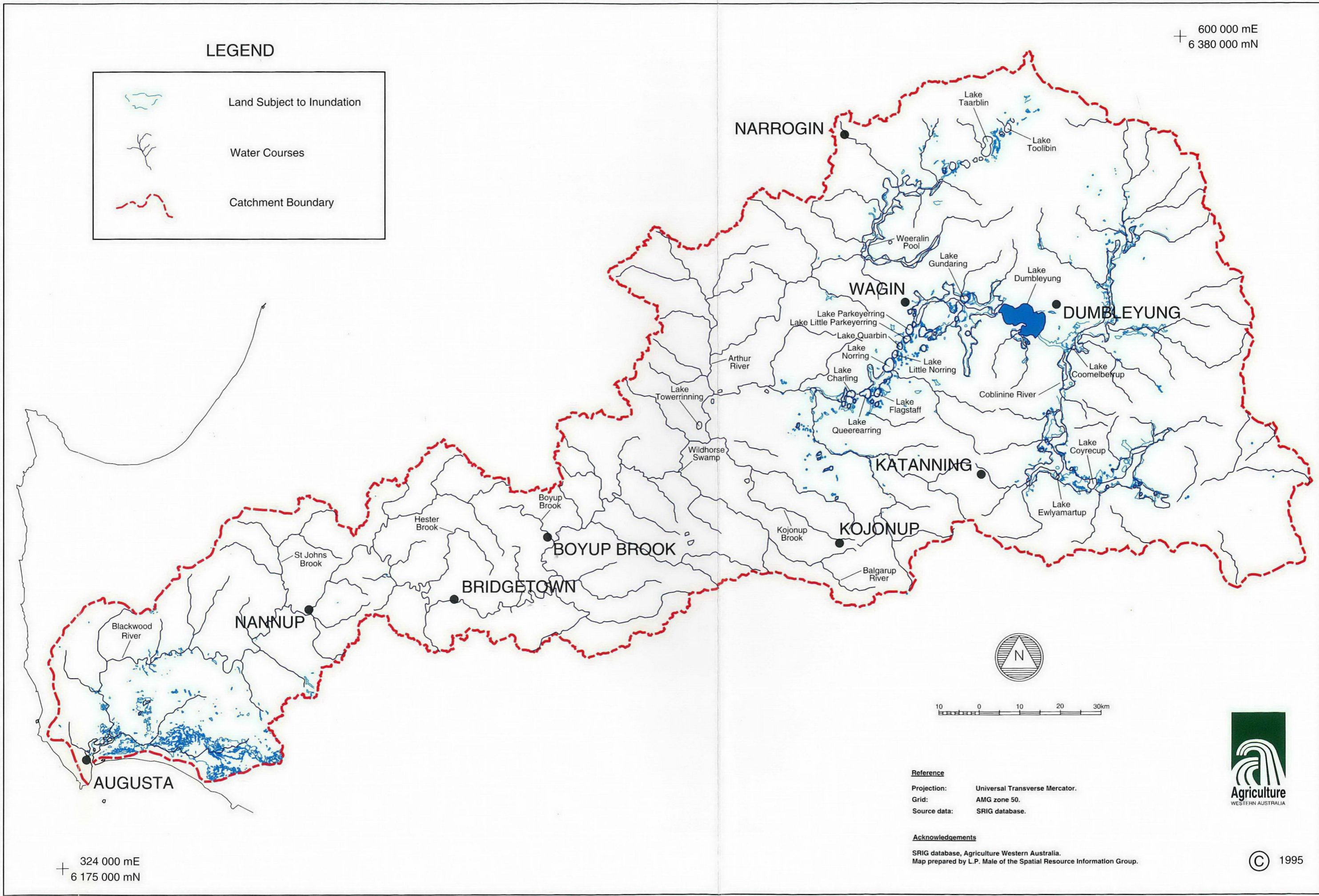


Figure 9: Major drainage systems of the Blackwood Catchment

mark. Occasional living *Melaleuca* aff. *halmaturorum* occur near the water mark with *Halosarcia syncarpa* and *Halosarcia pergranulata* forming an understorey. Above the water mark *Melaleuca* aff. *halmaturorum* and swamp sheoak occur as a low woodland with occasional tea-trees.

Lake Bokan is a moderate-sized, seasonally inundated saline lake (41.2 ha with a vegetated area of 2.9 ha) in the Shire of Narrogin with isolated swamp sheoak trees around the lake margin and a thicket of small dead tea-trees at one end. Swamp sheoak occurs above the water mark with samphires (*Halosarcia lepidosperma*, *Disphyma crassifolium*, *Sarcocornia quinqueflora* and *Halosarcia pergranulata*) as an understorey above and below the water mark.

Lake Parkeyerring is a moderate-sized saline lake (322 ha with a vegetated area of 42 ha) in the Shire of Wagin with an extensive fringe of long-dead melaleuca shrub and saplings on the landward side of which are occasional dead swamp sheoak. There are some regenerating melaleuca spp. saplings amongst the dead trees. Around the perimeter of the wetland is a narrow but dense belt of live swamp sheoak, which are below the maximum water mark, although the lake rarely fills to this level. There is a zone of samphire containing *Halosarcia lepidosperma* on the lake side of the swamp sheoak but it does not extend far into the dead timber.

Lake Gundaring is a moderate-sized saline lake (308 ha with a vegetated area of 221 ha) in the Shire of Wagin with an extensive fringe of dead trees. The samphires *Sarcocornia quinqueflora* and *Halosarcia pergranulata* occur under the dead trees furthest from the water and under a thin belt of live *Melaleuca* aff. *acuminata* above the water mark. Swamp sheoak and occasional flooded gum (*Eucalyptus rudis*) occur behind them.

Flagstaff Lake is a moderate-sized saline lake (223 ha with a vegetated area of 31 ha) in the Shire of Woodanilling with a narrow fringe of dead saplings. Live melaleuca saplings occur occasionally through the sapling belt and just inside the water mark. There is an extensive sparse zone of samphire under the sapling belt which extends into a narrow dense thicket of live melaleucas above the water mark. The principal samphire species are *Halosarcia pergranulata* and *Halosarcia syncarpa*. *Sarcocornia blackiana* grows closest to the centre of the lake and *Wilsonia humilis* grows around the water mark. Swamp sheoaks and eucalypt woodland occur behind the live melaleucas.

Lake Martinup is a moderate-sized saline lake (84 ha with a vegetated area of 12 ha) in the Shire of Woodanilling with a narrow band of dead trees well below the water mark. Live *Melaleuca* aff. *acuminata* trees occur occasionally below the water mark with swamp sheoak above it. *Halosarcia lepidosperma* and *Sarcocornia quinqueflora* grow under all the tree zones.

Lake Wardering is a small saline lake (44.9 ha with a vegetated area of 9.4 ha) in the Shire of Woodanilling with occasional dead trees below the water mark. At one end is a narrow but extensive stand of dead melaleuca trees. At the rear of the dead trees and scattered around the lake just below the water mark are a few live melaleucas. A belt of dense samphire occurs just below the water mark. Above the water mark, swamp sheoak and flooded gum occur with an understorey of *Sporobolus virginicus* and occasional clumps of *Juncus* sp.

Lake Towerrinning is a moderate-sized, previously brackish lake (179.5 ha with a vegetated area of 21.5 ha) in the Shire of West Arthur with several patches of *Baumea articulata* below the water mark and isolated and live *Melaleuca cuticularis* nearby, slightly higher on the shore. There is a narrow fringe of flooded gum above the water mark. *Schoenus* sp. grows sparsely beneath the flooded gum.

Wildhorse Swamp is a moderate-sized, brackish swamp (4.2 ha with a vegetated area of 3.9 ha) in the Shire of West Arthur containing dead stands of paperbark (*Melaleuca rhamnophylla*) throughout the lake-bed with occasional samphire (*Halosarcia lepidosperma*) growing beneath them. Above the water mark there is a closed woodland of paperbark trees and smaller *Melaleuca* aff. *viminea* thickets. The sedge *Schoenus brevifolius* grows under the paperbark. Behind the paperbark zone is a woodland of flooded gum.

Boyup 18239 is a small fresh lake (24.5 ha) in the Kulikup Nature Reserve in the Shire of Boyup Brook. The centre of the lake is covered by *Baumea articulata* and there is no open water. The edge of the lake is a mosaic of several zones of vegetation, with a belt of *Melaleuca cuticularis* shrubs and trees outside the *B. articulata* zone. *Baumea articulata* continues as an understorey species into the middle zone where it is replaced by *Restio* sp. This transition marks the high water mark.

Outside the *Melaleuca cuticularis* zone, *Restio* sp. continues as a low sedgeland until it is replaced by a second species of *Restio* just before the ground rises into a narrow zone of jarrah and marri woodland. This woodland is replaced by a narrow band of *Melaleuca cuticularis*, which probably represents an old flood line, before the ground rises higher and fully developed jarrah and marri woodland vegetation occurs.

The **Lake Grace System (South)** is an extensive saline drainage system (including Lake Altham) that covers an area of 13,200 ha. These lakes are drained by the upper reaches of the Gairdner and Fitzgerald Rivers and are fed by creeks (for example, Deep Creek) and by direct precipitation. This system of lakes is naturally saline, though the level of salinity probably increased after the clearance of the catchment (Jaensch, 1992).

The **Lake Jasper System** includes a series of lakes in the Shire of Nannup, notably Lake Jasper and associated swamps, Quitjup Lake and swamps and Gingilup swamps. In area the system covers a total area of 1600 ha. This includes Lake Jasper (440 ha) and associated swamps (80 ha), Quitjup Lake (70 ha) and associated swamps (150 ha), Gingilup swamps (500 ha), Lakes Wilson and Smith (20 ha) and associated swamps (30 ha). Vegetation consists of 8 to 12 species of sedge around each lake. *Baumea articulata* and *Baumea vaginalis* are dominant over large areas of swamp.

Up to 35 species occur in the wetland scrub surrounding Lake Jasper, large areas of which are dominated, solely or in combination, by *Agonis floribunda*, *Agonis linearifolia*, *Beaufortia sparsa*, *Callistachys lanceolatum*, moonah and *Kunzea ericifolia*.

Seven gazetted Priority 1 or 2 species (see Section 5) occur in the winter-wet areas north-west of the main Gingilup swamps, including *Adenathos detmoldii* and *Melaleuca basiccephala*. The declared rare species *Baeckia arbuscula* also occurs in this area. The Lake Jasper System is unique in supporting very extensive areas of *Agonis floribunda* thicket (Jaensch and Lane, 1992).

A case study

Surveys of waterbird populations show that Lake Toolibin is the most important inland, freshwater wetland in the South-West region. More waterbird species were recorded breeding in Lake Toolibin than in any of the other 251 wetlands examined in surveys conducted by the Royal Australasian Ornithologists Union (R.A.O.U.) between 1981 and 1985 (Northern Arthur River Wetlands Committee, 1987).

The main reason for the high number of waterbirds in Lake Toolibin appears to be the extensive, dense thickets of swamp yate and melaleuca which occur through much of the inundated area. Live vegetation in the lake is of paramount importance in providing suitable nesting sites for most of the species which breed there (Northern Arthur River Wetlands Committee, 1987).

An enormous recovery plan for Lake Toolibin is currently underway, co-ordinated by government agencies and private consultants. The principle goals of the plan are to protect and rehabilitate Lake Toolibin and its environment as a freshwater ecosystem. This will require detailed consideration of requirements for protecting and rehabilitating the total catchment. Considerable sums of money have already been spent on groundwater pumping to discharge the rising water table and on surface water control to prevent waterlogging and surface water run-off. The revegetation of Lake Toolibin is essential for the long-term recovery of the lake and extensive revegetation and regeneration programs will be implemented over the next ten years.

3.3 The future for wetlands

The area of salinised land in agricultural areas is still increasing (Schofield *et al.*, 1988). Wetlands will continue to become saline with resultant changes in wetland vegetation. Although it may be too late to rehabilitate most of the degraded wetlands in the catchment, a better understanding of how and why they have changed will help our management of the few undisturbed wetlands remaining in the wheatbelt.

New State policy for wetland conservation

The Environmental Protection Authority is developing an Environmental Protection Policy (EPP) for wetlands of the South West Agricultural Region, including all of the Blackwood Catchment (Environmental Protection Authority, 1995).

The proposed EPP will provide a framework for wetland protection and conservation. It will establish measures to protect wetlands from direct harmful human intervention whilst setting broad catchment management objectives. To conserve wetlands it is vital that land and water conservation practices are implemented in the wetland catchment – the policy is based on these landcare principles.

The draft EPP proposes three wetland management categories:

- **Conservation** for wetlands which have very important nature conservation values, for example, Kulikup Reserve Swamp and Lake Toolibin.
- **Resource Enhancement** for wetlands which are degraded but retain significant nature conservation values, for example, Coyrecup Lake and Lake Dumbleyung.
- **Multiple Use** for wetlands that are severely degraded and consequently have negligible nature conservation values. These wetlands usually have little or no fringing native vegetation.

A wetlands register will be established under the policy to record all Conservation category wetlands, all wetlands on public lands (which are automatically recorded as Resource Enhancement) and some Resource Enhancement wetlands on private land. Conservation wetlands and Resource Enhancement wetlands on private land are to be registered by the landowner.

Wetlands registered under the policy are protected from illegal filling, mining, discharge of industrial effluent, clearing and destruction of emergent and fringing vegetation, and saline drainage. In consultation with wetland landowners and catchment groups, statutory catchment strategies will be progressively prepared for the catchments of registered wetlands. In these catchments all drainage works to be undertaken must be consistent with catchment plans developed by landowners and catchment groups.

Amongst other matters, the policy requires that

- the Department of Environmental Protection develop an inter-agency partnership agreement to support and promote wetland and catchment management;
- the Department of Environmental Protection and Agriculture Western Australia develop, in consultation with conservation farmers, a set of Best Management Practices (BMPs) for wetland and land management. It is anticipated that BMPs will be an integral part of regional land conservation strategies; and
- Conservation category wetlands be the priority for conservation works and that related catchment strategies are the priority for landcare works, funding and where necessary, further research.

It is anticipated that Conservation category wetlands will be an important element of regional land conservation activity in the Blackwood Catchment.

4 FAUNA

Some of the mammals commonly seen in the Blackwood Catchment include the western grey kangaroo (*Macropus fuliginosus*), the western brush wallaby (*Macropus irma*) and the echidna (*Tachyglossus aculeatus*). Commonly observed reptiles include the bobtail (*Tiliqua rugosa*) and the blue tongue lizard (*Tiliqua occipitalis*), the dugite (*Pseudonaja affinis*), the mulga snake (*Notechis australis*) and a variety of geckos.

The need for conservation programs for fauna species is directly related to the extent of clearing of native vegetation for agriculture and other land uses. Western Australia, with its flat topography, has lost more species of native flora and fauna than any other State – 70 species out of a total of 97 species lost from the Australian continent.

The clearing of large amounts of natural bushland for agriculture, the introduction of feral animals, alterations to fire regimes and other disturbances have caused the local extinction of 8 of the 43 species (19 per cent) of mammals recorded from the wheatbelt since European settlement. Only 12 of the 43 species are now considered to be moderately common to abundant (Kitchener *et al.*, 1980).

Eight species of native mammals are known to have disappeared from the wheatbelt region in the past 100 years:

- the western barred bandicoot (*Perameles bougainville*);
- the pig-footed bandicoot (*Chaerpus ecaudatus*);
- the bilby (*Macrotis lagotis*);
- the burrowing bettong (*Bettongia lesueur*);
- the rufous hare wallaby (*Lagorchestes hirsutus*);
- the banded hare wallaby (*Lagostrophus fasciatus*);
- the crescent nail-tail wallaby (*Onychogalea lunata*); and
- the stick nest rat (*Leporillus* sp.).

Mammals in the wheatbelt region thought to be at high risk of becoming extinct include:

- the red-tailed phascogale (*Phascogale calura*);
- the numbat (*Myrecobius fasciatus*); and
- the western mouse (*Pseudomys occidentalis*) (Sanders and Harold, 1991).

For a complete list of all native mammals in the Katanning and Narrogin CALM districts, see Appendix 15. For a complete list of reptile and frog species seen in the Department of Conservation and Land Management Districts of Katanning and Narrogin, see Appendix 16.

Most of the original species of birds still occur in the wheatbelt, although several species have been lost from particular nature reserves (Kitchener *et al.*, 1982). Birds such as whistlers and fairy wrens have not adapted well to the difficult situations associated with clearing. They are generally declining in numbers and may well become locally extinct. Species such as Carnaby's cockatoo (*Calyptorhynchus funereus latirostris*) and Major Mitchell's cockatoo (*Cacatua leadbeateri*) have undergone a significant reduction through loss of habitat (Saunders *et al.*, 1985).

In the south-west of the State, 83 per cent of the land birds are dependent on native vegetation for all or some of their annual requirements (Smith, 1987). Continued loss of these bird species can be expected due to degradation of remnant vegetation and further clearing. However, some species such as galahs (*Cacatua roseicapilla*), ravens (*Corvus coronoides*), crested pigeons (*Ocyphaps lophotes*), magpies (*Gymnorhina dorsalis*) and wood ducks (*Chenonetta jubata*) have benefited from increased agricultural development and are increasing in numbers. For a detailed bird list, see Appendix 17.

5 RARE AND ENDANGERED FLORA

There are approximately 238 plant taxa declared endangered in Western Australia (Hopper *et al.*, 1990). Many of these can be found within remnants of fragmented native vegetation on private land in the Blackwood Catchment.

The classification Rare and Endangered Flora refers to flora which is

- in danger of extinction or its taxon is in serious risk of disappearing from the wild state within in one to two decades; and
- less than a few thousand adult plants of the taxon exist in the wild.

There are 43 Declared Rare and Endangered species of flora in the Blackwood Catchment (CALM Records).

1. *Acacia depressa* (Echidna wattle) - A compact, much-branched, ground-hugging mat plant only 5 cm high but up to 1 m in diameter, with stiff erect spikes and soft divided leaves. Favours laterite hill east of Lake Grace. Flowering period - December to January.

2. *Adenanthos pungens subsp. pungens* (Spikey adenanthos) - An erect shrub up to 3 m tall. Leaves up to 3 cm long; rigid, sharply pointed and usually divided into three segments, on hairy branchlets. Flowers clustered at the ends of the branchlets, varying from pale-pink to red. Occurs in deep, white, gypsum-bearing sand dunes in association with *Leptospermum* sp. Flowering period - August to November.

3. *Adenanthos pungens subsp. effusa* (Spikey adenanthos) - A compact to moderately open prostrate shrub up to 2.5 m in diameter. Leaves up to 3 cm long, rigid, sharply pointed and usually divided into three segments, on hairy branchlets. Flowers clustered at the ends of the branchlets, varying from pale pink to red. Flowering period - August to November.

4. *Aponogeton hexatepalus* (Stalked water ribbons) - A perennial tuberous aquatic herb with erect leaf stalks 15–40 cm long supporting floating linear leaf blades to 20 cm long and 0.6 cm wide. Occurs in temporary ponds between Perth and Busselton. Flowering period - August to September.

5. *Banksia oligantha* (Wagin banksia) - an erect shrub or small tree to 4 m high with leaves to 4 cm long and a creamy-yellow inflorescence containing 20–35 flowers. Found in sandy soil and open low woodland near salt creeks in the Wagin area.

6. *Caladenia bryceana subsp. bryceana* (Dwarf spider orchid) - Rarely exceeds 9 cm, with an unusually large leaf which often attains a length equal to that of the complete plant. Dainty flowers with a distinctive green to apricot colour. Grows in scattered colonies between Boyup Brook and Boxwood Hills. Flowering period - August to October.

7. *Caladenia christineae* (Christine's spider orchid) - Distinguished from members of the *Caladenia longicauda* complex by its small odourless flowers, relatively short, stiffly-held petals and sepals and short marginal fringe to the labellum. Up to four flowers, often quite tall, regularly reaching 40 cm. Found primarily between Mt Barker and Lake Muir, although isolated colonies are found in winter-wet flats in the southern Blackwood region. Flowering period - September to October.

8. *Caladenia dorrienii* (Cossack spider orchid) - A small spider orchid to 15 cm high with two rows of calli and entire labellum margins. Lateral sepals usually crossed in front. Grows in damp wandoo flats and slopes from Frankland north to the Brookton Highway. Flowering period - September to October.

9. *Caladenia excelsa* (Giant spider orchid) - The tallest growing and largest flowered *Caladenia* found in Western Australia. Height of 90 cm. Flower up to 30 cm long and 15 cm wide. Distributed along the Leeuwin-Naturaliste Ridge in deeply sandy soils amongst dense, low shrubs in banksia, jarrah and marri woodlands. Flowering period - Late September to October.

10. *Caladenia harringtoniae* ms. (Pink spider orchid) - One of the smallest flowered members of the *Caladenia longicauda* complex in Western Australia. Easily distinguished by its small, pale pink flowers, narrowing tapering petals and sepals. Flowering is stimulated by summer fire. Known from only a few scattered populations between Albany and Nannup. Flowering period - October to November.

11. *Caladenia huegelii* (Grand spider orchid) - Closely resembles *C. georgei* but has larger flowers and a much larger labellum. Flowering period - September to October.
12. *Caladenia integra* (Smooth-lipped spider orchid) - Characterised by its upswept lateral sepals and smooth edged labellum. Described by Edith Coleman in 1933. Erect stem, varies from 30 to 70 cm, with two conspicuous bracts and a hairy, broadly lanceolate leaf 10–20 cm long. Large solitary flower, cream and green perianth segments with red central portions. Erect and then reflexed dorsal sepal (45–70 mm). Distinguished from the closely related *Caladenia facata* by its entire, not serrate, labellum. Flowering period - September to October.
13. *Calectasia arnoldii* - Very erect plant to 30 cm with numerous stilt roots. Some projection from upper branches. Found between Corrigin and Dumbleyung. Flowering period - unknown.
14. *Chamelaucium erythrochlora* - Upright sub shrub to 60 cm. Pink flowers. Found on low sloping sandy loams. Flowering period - December to January.
15. *Conostylis drummondii* (Drummond's conostylis) - A tufted herb with erect, finely hairy subterrate leaves to 30 cm long by 0.5 to 1.0 mm wide. Characterised by stamens at two levels in the flower. Occurs in sandy soils in low woodland and heath between Arthur River and Wagin.
16. *Conostylis rogeri* (Kulin conostylis) - A tufted herb with flat leaves to 10 cm long by 0.6–1.5 mm wide. Solitary flowers, to 15 mm long with all six stamens at the same level in the perianth. Occurs in sandheath near Kulin. Flowering period - September.
17. *Conostylis seorsifolia* subsp. *trichophylla* (Hairy mat conostylis) - A prostrate mat-forming herb with solitary flowers and flat silvery leaves to 8 cm long. Grows in winter-wet loam beneath wandoo woodland near Tincurrin. Flowering period - October to November.
18. *Conostylis setigera* subsp. *dasys* (Boscabel conostylis) - A tufted herb with flat leaves to 30 cm. Distinguished by shaggy hairs over the leaf surface which are white on new growth, aging to black. Flowering period - October to November.
19. *Darwinia carnea* (Mogumber bell) - An erect open shrub to 40 cm with clusters of 10 to 14 drooping flowers surrounded by large multicoloured bracts up to 3 cm long. Found amongst dense scrub on lateritic hills near Narrogin. Flowering period - October to December.
20. *Darwinia ferricola* - Domed bush, densely branched to 1 m. Flowers greenish-red, scented. Found on ironstone peaty sand in the Scott River flats region.
21. *Diuris drummondii* (Tall donkey orchid) - Grows to 80 cm with 7 to 8 large flowers - easily the tallest of all our donkey orchids. Found in swampy areas, particularly during the season following summer fire, between Rocky Gully and Perth. Flowering period - November to December.
22. *Diuris micrantha* (Dwarf bee orchid) - Small yellow flowers (1 to 6). Grows up to 60 cm. Confined to swampy flats in the South-West. Flowering period - September to early October.
23. *Drakea confluens* (Late hammer orchid) - Distinguished by a uniformly green leaf, often covered by short dense hairs. A distinctive two-coloured labellum, with a straight rather than upturned apex. Found north-east of Boyup Brook. Flowering period - October to November.
25. *Drakea micrantha* (Dwarf hammer orchid) - Grows to 30 cm. Distinguished from *D. thynniphila* by its diminutive flower, shorter, more-pouched labellum and small, predominantly veined leaf. Occurs in scattered populations between Perth and the Porongurup Ranges. Flowering period - September to October.
26. *Dryandra serratuloides* (Serrate dryandra) - A small, rounded shrub about 1 m high with crowded, narrowly pinnate leaves to 8 cm long and small pale yellow axillary flower heads. Found in gravelly sandy soil around Kulin. Flowering period - June to September.
27. *Gastrolobium tomentosum* (Woolly poison) - A low compact shrub with stiff, erect branches to 60 cm high and rounded undulate leaves covered in white felt-like hairs on the underside. Known only from gravelly-clay soils associated with wandoo between Darkan and Williams. Flowering period - September to October.

28. *Grevillea cirsiifolia* (Varied-leaf grevillea) - A prostrate shrub with erect, narrow leaves to 20 cm long and numerous pale yellow, sweetly scented flowers arranged along erect leafless stalks. Found in gravelly soil, associated with thick shrub under wandoo between Darkan, Boddington and Tenterden. Flowering period - September to December.
29. *Grevillea involucrata* (Pink bract grevillea) - A spreading shrub up to 50 cm high and 2 m in diameter with hairy branches and deeply divided leaves up to 3 cm long. The 15 to 30 leaf segments, usually 0.5 cm long, have margins curled under towards a prominent, central vein. Clusters of 1 to 3 deep pink flowers with a whorl of deep pink persistent bracts. Found between Pingaring and Lake Magenta-Dunn Rock in open heath on white sand over laterite. Flowering period - June to November.
30. *Grevillea prostrata* (Pallerup grevillea) - A prostrate shrub with hirsute stems, becoming glabrous with few branches. Leaves 2 to 4.5 cm long, petiolate, pectinate. Flowers in short, dense racemes on terminal and lateral branches. Style curved, glabrous. Young fruit ovoid, almost sessile, sparsely glandular. Grows in low shrubland on white-yellow sands over laterite. Flowering period - August to October.
31. *Kennedia macrophylla* (Augusta kennedia) - A woody twiner climbing 4 m or more. Divided leaves, each leaflet to 7 cm long. Flowers red with a yellow throat. Restricted to coastal granite areas in the Augusta region. Flowering period - September to November.
32. *Lambertia orbifolia* (Round-leaf honeysuckle) - An erect shrub to 4 m with stems and round opposite leaves to 5 cm in length. Grows in sandy lateritic soil between Busselton and Narrikup. Flowering period - January to February, May to July.
33. *Lechenaultia pulvinaris* (Cushion lechenaultia) - A prostrate shrub forming low cushions to 7 cm tall by 30 cm in diameter. Covered in masses of attractive blue flowers in early summer. Occurs on sandplain, often near low-lying seepage areas between York and Lake Grace. Flowering period - October to December.
34. *Meziella trifida* - Red-leaved prostrate herb to 20 cm in diameter. Red flowers and fruit. Occurs on winter wet flats and low open heath with scattered *Melaleuca presissiana* (moonah) on grey sandy clay over clay east of Augusta. Flowering period - unknown.
35. *Pultenaea pauciflora* (Narrogin pea) - A many-branched spreading shrub to 50 cm high and 1 m in diameter with narrow pointed leaves 1.5 to 1.7 cm long which are hairy when young and crowded towards the ends of the branchlets. Grows in white clayey-sand in low woodland near the Narrogin townsite. Flowering period - October to November.
36. *Rulingia* sp. (Trigwell Bridge rulingia) - Occurs under open jarrah and marri woodland in the Shire of West Arthur. Flowering period - unknown.
37. *Roycea pycnophylloides* (Saltmat) - Many-branched, mat-like sub-shrub with hairy, parallel leaves. Leaves are densely and spirally arranged and tightly overlapping. Flowers are green, small and inconspicuous, unisexual, borne either singly in the upper leaf axils or at the ends of the stems with male and female flowers in separate plants. Found along the margin of a salt lake east of Pingrup where the species dominates on bare grey-brown clay. Flowering period - infrequent, mainly September to November and possibly through to February.
38. *Stylidium plantagineum* (Plantagenet triggerplant) - A tall conspicuous herb to 50 cm high with two or more erect, broadly linear leaves to 40 cm long. Large, pale lilac flowers. Found in jarrah forest in gravel or sandy soil between the Stirling Range, Gnowangerup and Albany. Flowering period - November to December.
39. *Thelymitra psammophila* (Sandplain sun orchid) - A small perennial herb to 20 cm high with one to three yellow flowers and a single narrow linear leaf. Similar to *Thelymitra antennifera*, distinguished by its smaller flowers which lack the reddish colouration on the outside of the sepals. Occurs in low heath between the Stirling Range and Ravensthorpe. Flowering period - September to October.
40. *Thelymitra stellata* (Star sun orchid) - A perennial herb to 30 cm high with a single ovate leaf to 9 cm long. One to ten golden, brown-stripped flowers 2.5 to 3 cm in diameter. Uncommon. Scattered in lateritic soils in forest or heath. Flowering period - October to December.

41. *Verticordia fimbrialepis* (Shy feather flower) - An erect small shrub to 60 cm high with slender branches and clusters of attractive purplish-pink flowers. Grows in shallow sand over gravel amongst low mixed heath near Woodanilling. Flowering period - November to December.

There are compelling reasons to focus conservation efforts on endangered flora. From an aesthetic perspective, there is an opportunity to appreciate and study the biological diversity and attractiveness of many of these endangered flora.

Equally compelling is the fact that the extinction of a species constitutes an irreplaceable opportunity for plant utilisation by humans. Some of the world's rare species have been of outstanding economic value. So little is known of the biochemistry of many of these species, there is the possibility of discovering cures to major human diseases. For example, it has recently been publicised that smokebush (*Conospermum* spp.) may provide a potential cure for AIDS.

6 LAND RESOURCES

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6.1 Soils

The landforms and soils of the Blackwood Catchment undergo a number of changes between the headwaters and the Southern Ocean, caused by the geology, climate and geomorphological history of the region.

In the upper and middle catchment there is a pattern of increasing dissection downstream. At the top of the catchment, the landscape is gently undulating with little height difference between the broad valley floors and the hill crests. By the time the Blackwood River has reached Bridgetown it is deeply incised, forming a rugged, steep side valley up to 200 m deep.

The upper and middle catchments lie on the Yilgarn Block. This basement consists of Archaean granite, migmatite, gneiss and granulite. The lateritic profile, formed by deep weathering during the Tertiary Period, once covered vast areas of the Yilgarn Block. Although lateritic plateau still covers large areas in the middle catchment, the lateritic profile has been partially or completely stripped by the process of erosion over most of the upper catchment. A variety of sedimentary deposits are also found overlying the Yilgarn Block.

Gravelly soils and sands are associated with the laterite while grey sandy and loamy duplex soils are found in the upper catchment where the ironstone capping has been stripped. Grey loamy duplex soils have formed on the exposed rocks of the Yilgarn Block in the upper catchment. These are often calcareous and sodic. Downstream there is a tendency for soil pH to become more neutral, or even acid, as rainfall increases. Sodicity is less pronounced and red colours become more common. West of Boyup Brook red, yellow and brown loams grading into clay are commonly found on fresh rock.

In the lower Catchment, after the River passes through the Darling Scarp at Nannup, there is a dramatic change in geology and landforms. The Donnybrook Sunklands lie approximately 150 m below the Yilgarn Block, so the river and its tributaries are much less deeply incised. The underlying geology is the sedimentary rocks of the Perth Basin. Laterite is widespread, giving rise to yellow-brown and grey sandy gravels and sands. At the bottom of the catchment are coastal flats with poorly drained deep loose sands.

Figure 10 presents the distribution of the different soil landscape systems within the Blackwood Catchment. Appendix 18 presents the detailed key to the soil landscape systems map.

The upper Catchment

The Zone of Ancient Drainage

The Zone of Ancient Drainage contains the remnants of an ancient drainage system which now only flows in wet years. The valley floors are broad and have low grades, often 1:1500 or less. They contain salt lake chains at their lowest points.

The Meckering Line forms the western boundary of the Zone of Ancient Drainage and runs through or close to Toolibin, Wagin, Katanning and Broomehill. Towns within the zone include Harrismith, Kukerin, Dumbleyung and Nyabing.

The landscape consists of a gently undulating plateau between 280 and 400 m above sea level. Local relief is usually less than 50 m. On the north-eastern boundary there are broad areas of sandplain and some laterite on the divides. On the sandplains, deep loose grey and yellow sands as well as yellow sands grading into loams are found. Yellow-brown to grey sandy gravels are found on the laterite. Over most of the zone there are shallow sandy duplex soils formed on partially stripped lateritic profiles and grey and red-brown loamy soils formed on fresh rock. Clay subsoils are often calcareous and sodic. These soils occur mainly on long, gentle slopes. There are also small pockets of sandy gravels and deep loose grey sands associated with scattered lateritic remnants.

Average annual rainfall ranges from 350 to 475 mm. The native vegetation includes woodlands of salmon gum, morrel, moort, wandoo and various mallee species. York gums are found on valley flats. Heath and mallee are found on the sandplains. This zone has been extensively cleared for agriculture. The main crops are wheat, barley, oats, lupins and field peas. Sheep are grazed for wool and meat production on legume-based pastures.

Land degradation problems include widespread salinity due to rising water tables, most commonly on valley floors. Wind erosion occurs on sandy soils, especially after cultivation. These soils are also prone to acidification. Water erosion can also occur, especially during summer thunderstorms. Soil structure decline is a common problem on the heavier soils.

Soil landscape systems

The following codes refer to the soil landscape systems map in Figure 10.

Valley floors: Cobline (Cob)

Undulating terrain: Dongolocking (Dgk), Datatine (Dat), East Katanning (Esk), Kukerin (Kkn), Nippering (Npg), Nyabing (Nyb), Tincurrin (Tin) and Tieline (Tne)

The upper-middle Catchment

The Zone of Rejuvenated Drainage

The Zone of Rejuvenated Drainage is an area to the west of the Meckering Line where drainage lines are clearly defined and carry water each year. It is from 70 to 80 km wide and lies between the Zone of Ancient Drainage and the Eastern Darling Range Zone. It extends from Narrogin through Arthur River to Kojonup and Muradup.

This undulating to rolling terrain is between 240 and 380 m above sea level. The dissection of the lateritic profile gives moderately to gently inclined rises and low hills. These are sometimes rounded but often contain small areas of lateritic remnants with breakaways and sandy gravel. Sandy duplex soils are common on the slopes. Where dissection is greatest, large areas of basement rock are exposed and there are some valleys with moderately steep slopes. Drainage lines, although sometimes sluggish, flow in clearly incised courses in winter. Many of the valley floors are broad and have sandy duplex soils and with clayey subsoils which are usually sodic and sometimes alkaline. There are some areas of deep loose sands on dunes.

This zone differs from the dissected eastern edge of the Darling Range in that most of the landscape has formed on the mottled and pallid zones of the lateritic profile or fresh rock rather than lateritic cap and as a result the hills tend to be more rounded. It is more dissected than the Zone of Ancient Drainage. Most of the valley floors are narrower and contain creeks and rivers that flow every winter.

The rainfall ranges from 450 mm to 575 mm a year. The natural vegetation includes wandoo, York gum, marri, jam and rock sheoak woodland with mallet on lateritic hills. The land has been extensively cleared for grazing (mostly sheep with some beef cattle) and cropping (barley, oats, wheat, lupins, field peas, canola and lupins). Many of the valley floors are saline due to rising ground water tables. Saline seeps are found on hillside associated with faults, dykes and other geological structures. There is a risk of water erosion on many of the steeper slopes. Waterlogging due to perched water tables is a widespread problem of the duplex soils.

Soil landscape systems (Figure 10)

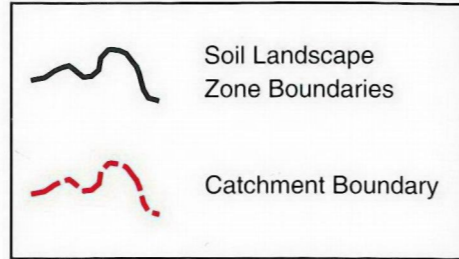
Valley floors: Arthur River (Art), Beaufort (Bea), Hillman (Hmn) and Norring (Nor)

Rises and low hills: Dellyanine (Dye), Carrolup (Car), Farrar (Far) and Whimbin (Wmb)

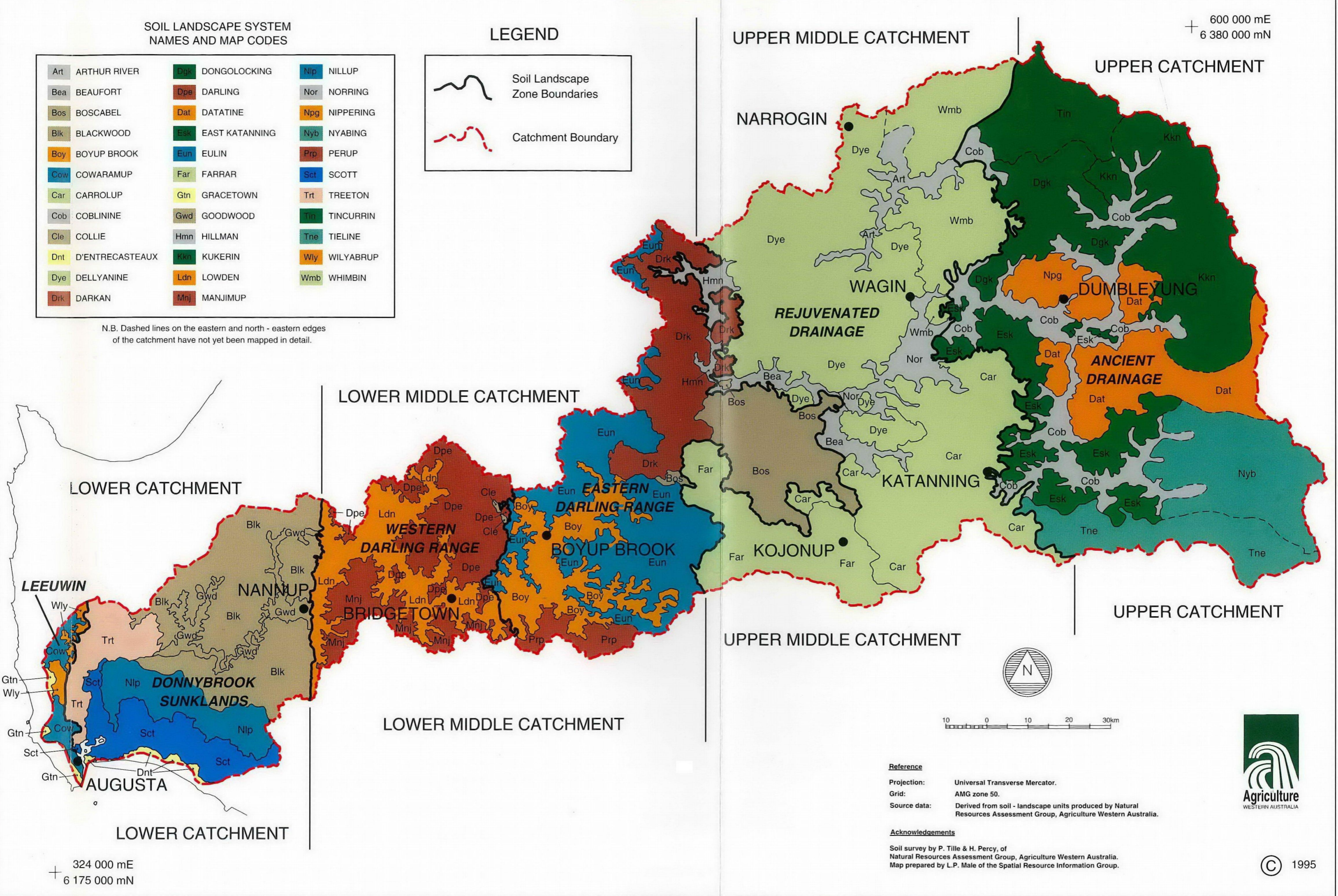
SOIL LANDSCAPE SYSTEM NAMES AND MAP CODES

Art	ARTHUR RIVER	Dgk	DONGOLOCKING	Nlp	NILLUP
Bea	BEAUFORT	Dpe	DARLING	Nor	NORRING
Bos	BOSCABEL	Dat	DATATINE	Npg	NIPPERING
Blk	BLACKWOOD	Esk	EAST KATANNING	Nyb	NYABING
Boy	BOYUP BROOK	Eun	EULIN	Prp	PERUP
Cow	COWARAMUP	Far	FARRAR	Sct	SCOTT
Car	CARROLUP	Gtn	GRACETOWN	Trt	TREETON
Cob	COBLININE	Gwd	GOODWOOD	Tin	TINCURRIN
Cle	COLLIE	Hmn	HILLMAN	Tne	TIELINE
Dnt	D'ENTRECASTEAUX	Kkn	KUKERIN	Wly	WILYABRUP
Dye	DELLYANINE	Ldn	LOWDEN	Wmb	WHIMBIN
Drk	DARKAN	Mnj	MANJIMUP		

LEGEND

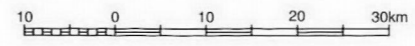


N.B. Dashed lines on the eastern and north-eastern edges of the catchment have not yet been mapped in detail.



600 000 mE
6 380 000 mN

324 000 mE
6 175 000 mN



Reference
 Projection: Universal Transverse Mercator.
 Grid: AMG zone 50.
 Source data: Derived from soil - landscape units produced by Natural Resources Assessment Group, Agriculture Western Australia.

Acknowledgements
 Soil survey by P. Tille & H. Percy, of Natural Resources Assessment Group, Agriculture Western Australia.
 Map prepared by L.P. Male of the Spatial Resource Information Group.



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Figure 10: Soil landscape systems of the Blackwood Catchment (Tille and Percy, unpub.)

The lower-middle Catchment

The Eastern Darling Range Zone

The Eastern Darling Range Zone is 45 to 80 km wide and extends from Darkan down through Duranillin and Moodiarup to Boyup Brook, Mayanup, Dinninup and Qualeup. It also includes the Chittinup-Boscabel district.

The Eastern Darling Range Zone is undulating to rolling, dissected terrain with many large remnants of the lateritic plateau. The elevation of these plateau remnants is between 260 and 360 m above sea level with some hills reaching to 400 m. The plateau remnants contain yellow-brown and grey sandy gravels, yellow-brown loamy gravels and yellow-brown and grey deep loose sands. There are also broad, flat areas of Eocene sedimentary deposits, sitting high in the landscape with similar soils. Both the laterite and Eocene sediments occur as isolated areas separated by valleys dissected into the underlying bedrock. Soils in these valleys include yellow-brown loamy and sandy gravels and yellow and red loamy duplex soils and loams grading into clays. The valley floors lie mostly between 180 and 280 m above sea level and are relatively narrow.

Rainfall ranges from 475 to 775 mm a year. Much of the native vegetation, consisting mainly of forests and woodlands of jarrah, marri and wandoo has been cleared for agriculture. This land is mainly used for the grazing of sheep and beef cattle. Some crops (mostly oats, barley and canola) are grown. There are some small scattered horticultural plantings. Some areas, especially in the south, have been planted to trees, pines for sawlogs and Tasmanian blue gums for wood chips.

The slopes of the valleys are subject to soil erosion where the soil is disturbed or ground cover is not maintained. Salinity problems are widespread but largely contained to narrow valley floors at this stage.

Soil landscape systems (Figure 10)

Dissected lateritic terrain: Darkan (Drk) and Boscabel (Bos)

Plateau remnants: Eulin Uplands (Eun) and Perup Plateau (Prp)

Valleys: Boyup Brook Valleys (Boy)

The Western Darling Range Zone

The Western Darling Range Zone is 45 to 50 km wide and extends south from Wilga, Grimwade and Mullalyup through Balingup, Hester and Greenbushes to Bridgetown and Nannup.

The western edge of the Zone is the Darling Scarp, which abruptly rises 100 to 150 m above the Donnybrook Sunklands Zone. On the top of the Range is the broad, undulating lateritic plateau. This plateau lies between 260 and 320 m above sea level. Sandy and loamy gravels are the dominant soils. There are also areas of deep loose yellow and grey sands. The Blackwood River has cut into the plateau forming a deep, steep sided valley and exposing fresh rock. Here red-brown and yellow-brown loams grading into clay have formed on fresh rock. The narrow valley floor drops from 160 m above sea level downstream from Winnejup to 80 m above sea level at Nannup. The boundary between the Western and Eastern Darling Range Zones is not as obvious as the Darling Scarp. It runs close to the top of the Hester Brook Catchment and crosses the Blackwood River just downstream from Winnejup.

Rainfall ranges from 750 to 1100 mm a year. The natural vegetation is jarrah-marri forest and woodland with some wandoo and blackbutt. State Forests cover much of the plateau surface. Extensive clearing for agriculture has occurred in the valleys. This land is mainly used for grazing sheep and beef cattle. Some fodder crops (mostly oats) are grown where the terrain is not too steep. There are some significant areas of horticultural production, most notably the orchards around Mullalyup. Large areas have been planted to pines for sawlogs production, and an increasing area of Tasmanian blue gums planted for wood chips. There is pressure for special rural development, that is, the subdivision of farmland into blocks used for rural lifestyles, especially around Bridgetown and Balingup.

The slopes of the valleys are subject to soil erosion where the soil is disturbed or ground cover is not maintained. Landslips have occurred on some of the steeper slopes. Salinity problems are greatest in the upper Hester Brook Catchment.

Soil landscape systems (Figure 10)

Lateritic plateau: Darling Plateau (Dpe) and Collie Basin (Cle)

Valleys: Lowden Valleys (Ldn)

The lower Catchment

The Donnybrook Sunkland Zone

The Donnybrook Sunkland Zone extends 60 km westwards from the Darling Scarp at Nannup to the edge of the Leeuwin Block Zone near the mouth of the Blackwood River. Jarrahwood, Rosa Glen, Daradup, Alexander Bridge and East Augusta are some of the localities of the Sunklands.

The Donnybrook Sunkland Zone is level to undulating terrain formed over Cretaceous and Jurassic Perth Basin sedimentary rocks. It rises gently from the Southern Ocean coastline to a height of 120 to 180 m above sea level in the north. Here it consists of the gently undulating lateritic plateau with grey and yellow-brown sandy gravels and deep loose sands. The plateau has been dissected by the Blackwood River and its tributaries to form shallow valleys, the floors of which lie between 20 and 80 m above sea level. Similar soils are found on the slopes of these valleys to those on the plateau, with grey-brown sands and loams also becoming common in the west.

In the south the plateau merges with low-lying coastal plain, a poorly drained area formed on Quaternary sediments. Soils here are deep, loose white or grey sands, often over coffee rock. There are some deep, coloured sands and loams on the river flats. On the southern boundary of the coastal plain are coastal dunes of grey calcareous sands.

Rainfall ranges between 950 and 1100 mm a year. Much of the Sunkland remains under jarrah and marri forest and woodland. Heathland, sedgeland, paperbark woodland and coastal peppermint scrub occur in the south. Clearing for agriculture has occurred on the Scott River Plain, in the Chapman Brook valley and along the Blackwood River. This land is used for grazing beef and dairy cattle and sheep. There is some horticultural development in the Chapman Brook valley. Mineral sands are mined on the Scott River Plain.

There is a risk of water erosion on sloping country. Waterlogging is a problem in low lying areas, especially on the Scott River Plain. There is also a risk of nutrient leaching from these soils. Sand dunes on the Scott River Plain and along the south coast are prone to wind erosion.

Soil landscape systems (Figure 10)

Coastal dunes and plains: D'Entrecasteaux Dunes (Dnt) and Scott River Plain (Sct)

Plateau: Blackwood Plateau (Blk) and Nillup Plain (Nlp)

Dissected terrain: Goodwood Valleys (Gwd) and Treeton Hills (Trt)

Leeuwin Block Zone

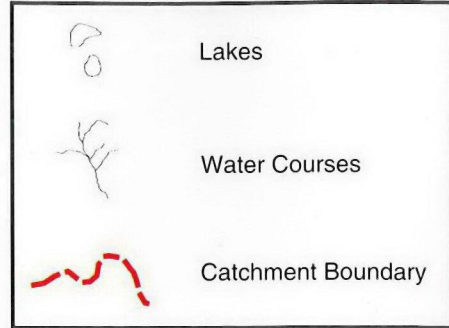
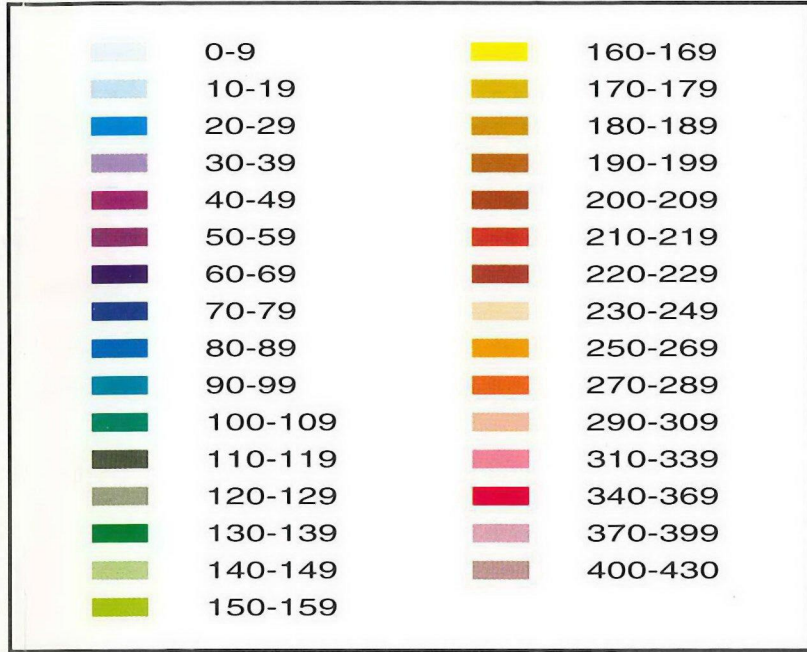
The Leeuwin Block Zone covers a narrow strip of land, less than 10 km wide, on the western edge of the lower catchment. It extends from Augusta through Karridale to Witchcliffe.

The Leeuwin Block Zone has formed on the Leeuwin Block which is made up of Proterozoic granitic rocks overlain by Tertiary laterite and Quaternary limestone. The dominant feature is a lateritic plateau which sits 20 to 80 m above sea level. Soils on the plateau include yellow-brown sandy and gravelly loams and grey-brown sands and loams. Dissection of the eastern margin of the Leeuwin Block has produced slopes and valleys with loamy gravels, loamy duplex soils and loams grading into clay. The western margin of the plateau is overlain by a ridge of limestone and by yellow and red deep loose siliceous sands.

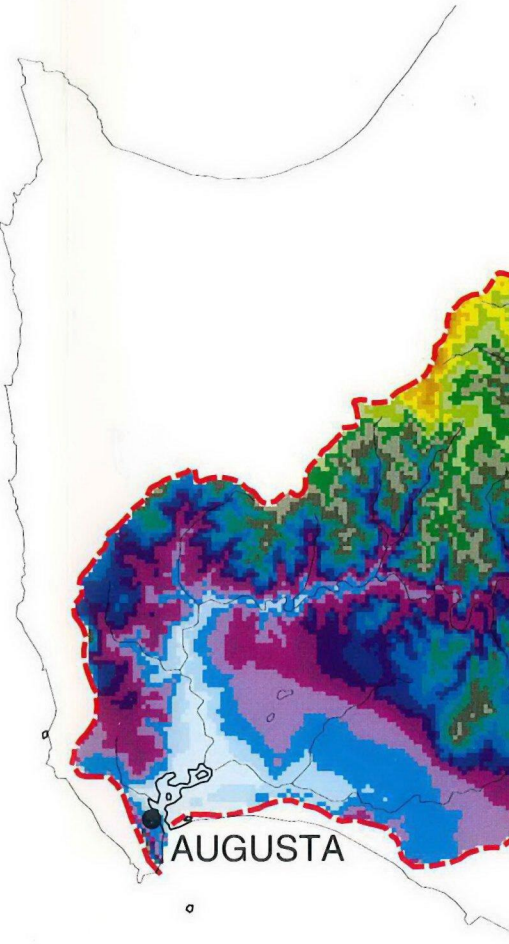
Rainfall ranges from 1100 to 1200 mm a year. The nearby ocean has a moderating effect on temperatures. The original vegetation was mainly jarrah and marri forest with some pockets of karri in the south. Coastal heath and peppermint scrub occur along dunes. The plateau and the valleys have been cleared extensively and are grazed by dairy and beef cattle as well as sheep. There is heavy pressure on the land for special rural and tourism development.

ELEVATION IN METRES

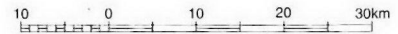
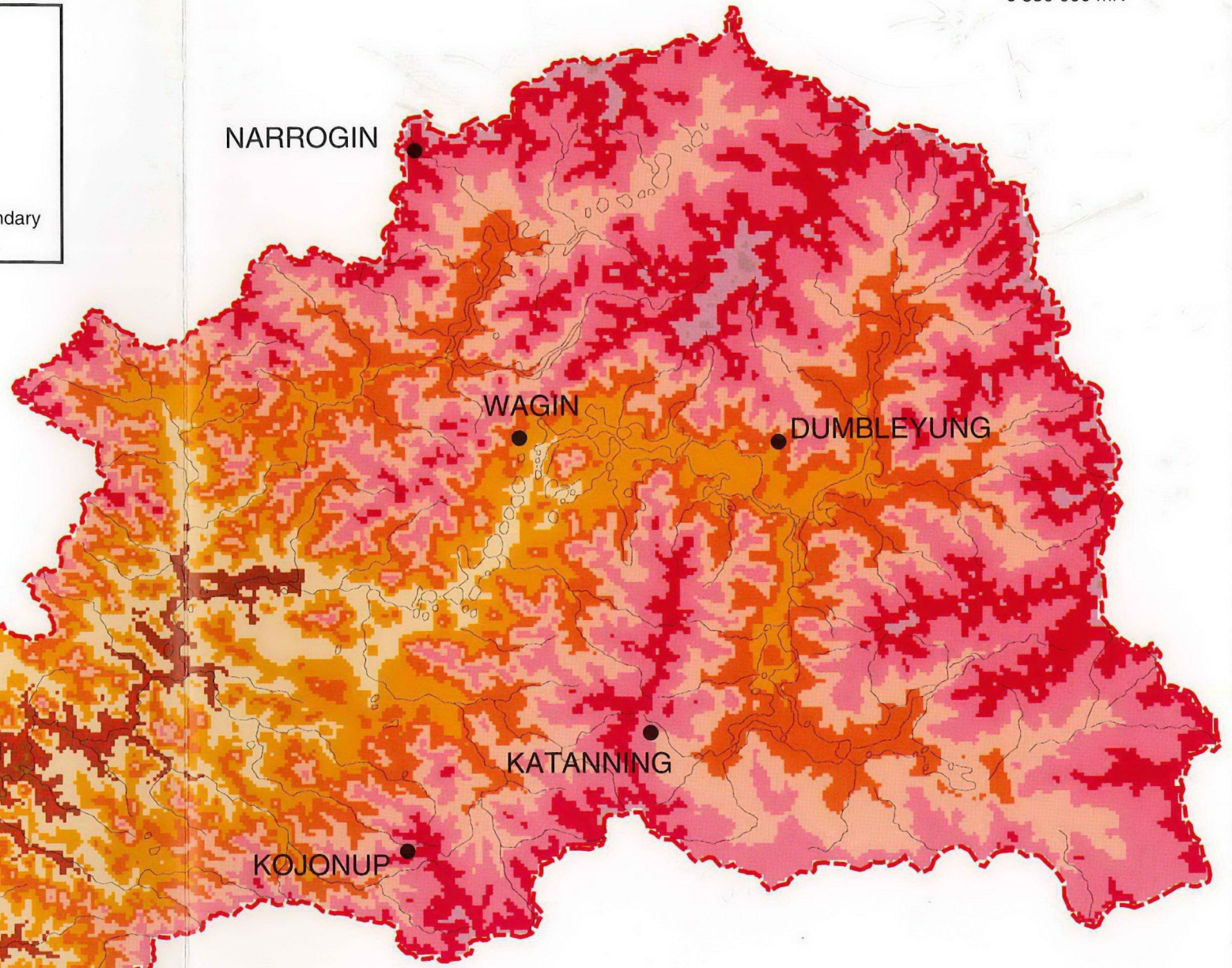
LEGEND



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324 000 mE
6 175 000 mN



Reference
 Projection: Universal Transverse Mercator.
 Grid: AMG zone 50.
 Source data: Digital contour data from DOLA.

Acknowledgements
 This map has been derived from a Digital Elevation Model (DEM), with a 100 metre grid spacing, created by the Intergraph Terrain Modeller software. Produced by C. Ryan, J. Coker and G. Smith of the Spatial Resource Information Group.



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Figure 11: Blackwood Catchment showing elevation above sea level in metres plus the major rivers and lakes

Large areas of the uplands are affected by waterlogging. There is some risk of water erosion in the valleys while wind erosion is a hazard along the coast.

Soil landscape systems (Figure 10)

Limestone ridge: Gracetown Ridge (Gtn)

Plateau: Cowaramup Upland (Cow)

Valleys: Wilyabrup Valleys (Wly)

6.2 Topography

The Blackwood River is the most dominant and important topographical feature in the Blackwood Catchment, flowing through steep landscapes and draining into lakes and streams. Figure 11 is a digital elevation model of the Blackwood Catchment.

Lake Dumbleyung is another significant topographical feature in the catchment. The lake is an erosion feature that developed in the Tertiary Period. The main drainage lines in the Shire of Katanning tend to become disorganised into chains of salt lakes, as seen around Ewlyamartup and Coyrecup Lakes.

Prominent topographic features in the Shire of Kojonup include Saddleback Hill (320 m) to the north-west of the Kojonup townsite, while Thornton Hill (380 m) lies to the north-east.

The Shire of Broomehill is characterised by a well-developed drainage system of rivers (Pallinup, Gordon, Wadjekanup and Blackwood Rivers), brooks and gullies which normally flow during the winter months before drying up during summer.

In the Shire of Woodanilling some the more significant features are the Kojonolokan Hills (290 m) to the north-west of the Woodanilling townsite, while in the Shire of West Arthur, prominent topographical features include Mt Fisher (379 m), Mokup Hill (280 m), the Hillman and Arthur Rivers and Lake Towerrinning.

The topography in the Shire of Williams is varied and undulating, with elevation decreasing from west (140 m) to east (70 m). The main summits in the shire include Mt Hillman, Tarwonga Hill (371 m) and Wanerie Katta (377 m).

The Shire of Boyup Brook is dominated by the Blackwood River, Comidup Hill (250 m) and Spring Hill (260 m).

The main feature of the lower catchment shires of Bridgetown-Greenbushes and Nannup is the Blackwood River.

In the Shire of Wagin, Lake Parkeyerring and Lake Norring are prominent features while the most significant features in the Shire of Wickepin are Walters Hill (381 m), Uleling Hill (364 m) and Lake Toolibin.

The Shire of Kent is characterised by numerous lateritic outcrops in flat-topped hills that give the landscape its undulating appearance. Major topographical features in the Kent region include Lake Magenta, Lake Lockhart, Red Hill, Wolyamup Hill, Woorgabup Range (410 m) and Rock Dam Hill. In the western part of Kent, the topography is more undulating with generally steeper slopes and greater sediment accumulation on slopes. Because of the higher rainfall, this region has been more extensively eroded than the eastern region.

Hardy Inlet, at the mouth of the Blackwood River, is a significant feature in the Shire of Augusta-Margaret River, as is St Patrick's Elbow on the Blackwood.

7 PROJECTS FOR INTEGRATED LAND AND NATURE CONSERVATION MANAGEMENT

The wheatbelt of Western Australia has severe nature conservation and agricultural problems that are a result of previous practices of excessive clearing of native vegetation. The problems associated with land degradation and the maintenance of native vegetation cannot be halted by onsite management alone.

An integrated catchment and land conservation approach, based on districts and farms, is needed to effectively manage the land and native vegetation resources and ensure long-term agricultural production, optimal water use and the maintenance of the diversity of flora and fauna. Retention of remnant vegetation, rehabilitation of degraded areas and strategic revegetation are essential components of this approach. Local ownership of the problems and solutions is the key to success.

In May 1995, the Minister for Primary Industry, the Hon. Monty House, MLA, announced a new government policy on the clearing and retention of remnant vegetation in Western Australia. The principal component of this policy is to discourage clearing in shires where the total remnant vegetation is less than 20 per cent. This will affect the Blackwood Catchment shires of Broomehill, Dumbleyung, Katanning, Kojonup, Narrogin, Wagin, Wickepin and Woodanilling. Proposals to clear in shires where total remnant vegetation cover exceeds 20 per cent will be subjected to land degradation guidelines.

As so much of the conservation and natural resources are under the control of private landowners and local government authorities, the responsibility for co-ordinating their management must ultimately rest with these local managers.

Groups and local governments are achieving positive results with a three-pronged approach:

- protecting remnant vegetation;
- revegetating strategic areas of modified and degraded vegetation; and
- combating land degradation problems.

This chapter looks briefly at projects of local organisations concerned with land and nature conservation in the Blackwood Catchment.

7.1 Remnant Vegetation Protection Scheme

The Remnant Vegetation Protection Scheme (RVPS) was developed by the Western Australian government in 1988 to enhance soil and nature conservation by protecting native vegetation on farm land. The Scheme is jointly administered by the Department of Conservation and Land Management (CALM) and Agriculture Western Australia, with the latter as the lead agency. It provides a 50 per cent subsidy towards the cost of protective fencing for native vegetation on farms. Landowners undertake that the fenced vegetation will be managed for nature conservation for at least 30 years.

To be granted a subsidy, the area of vegetation to be fenced must be 5 ha or more, and in good condition or able to be rehabilitated to good condition.

A major impediment to landholders' ability to conserve native vegetation on their properties is the cost of fencing. About half of all remnants on private land in the catchment are unfenced or inadequately fenced. In many cases, fences are falling into disrepair (Mollemans, unpub.).

RVPS helps to overcome this cost barrier and has proved effective in the Blackwood Catchment. Seventeen shires in the catchment have received 134 RVPS grants to assist in fencing 5161 ha of native vegetation on farm land since 1989 (Figure 12, Table 4). Many of the fenced remnants previously in poor to average condition are now showing obvious signs of regeneration.

However, a significant proportion of the grants have been allocated to properties in the Shires of Gnowangerup and Kent. These Shires fall only partially within the Blackwood Catchment boundaries and many of the fenced remnants are outside the catchment.

This may be improved with the recent increase in RVPS to \$900,000 per year for five years, an increase of over 200 per cent on the previous year's funding.

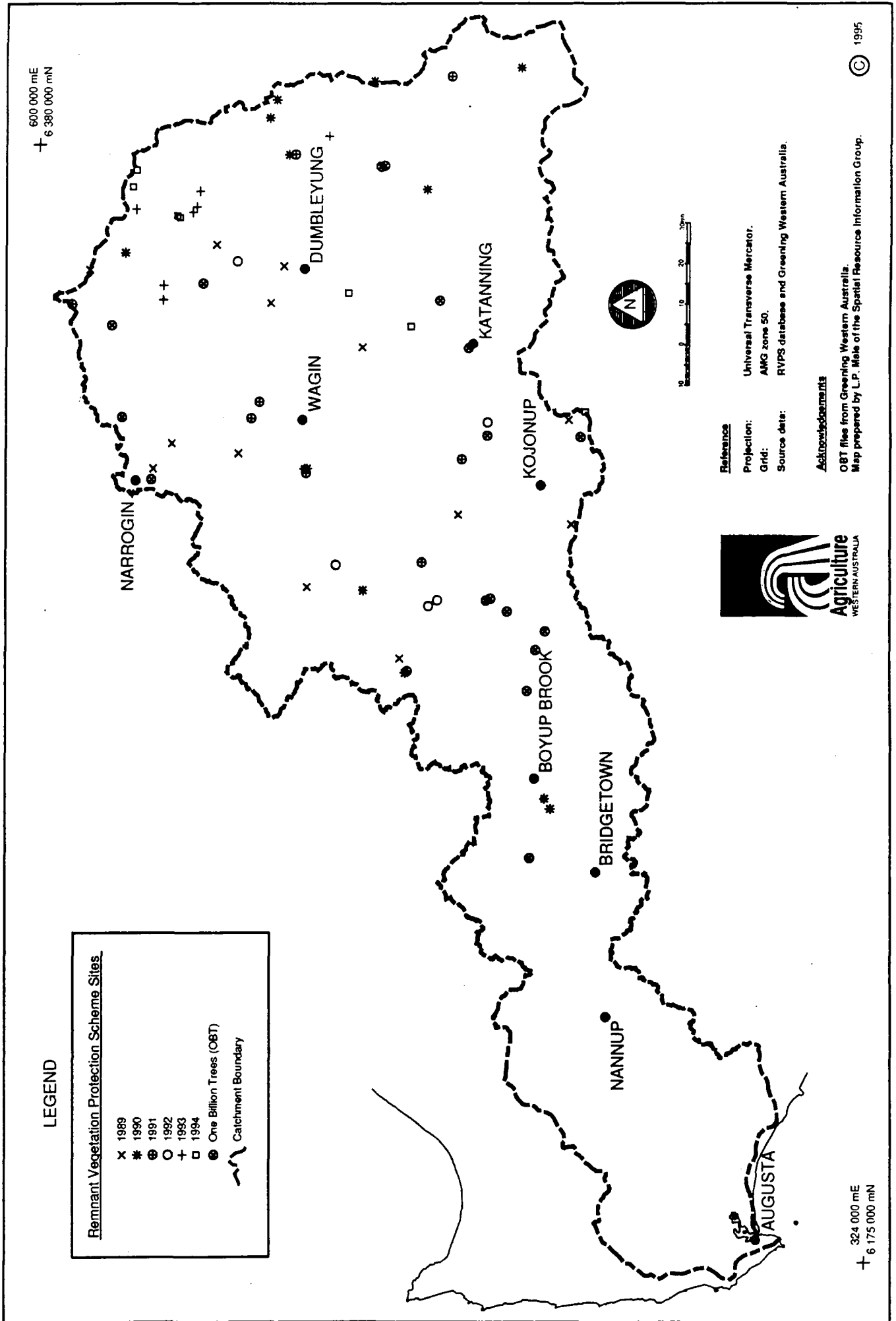


Figure 12: Remnant Vegetation Protection Scheme (RVPS) and One Billion Trees (OBT) sites in the Blackwood Catchment

Table 4. Remnant Vegetation Protection Scheme grants in the shires of the Blackwood Catchment

Shire	No. grants	Area fenced (ha)
Augusta-Margaret River	0	0
Boyup Brook	2	23.4
Bridgetown-Greenbushes	0	0
Broomehill	5	82.7
Donnybrook-Balingup	0	0
Dumbleyung	17	543.5
Gnowangerup	45	1854.4
Katanning	1	48
Kent	17	1053
Kojonup	7	112.5
Nannup	0	0
Narrogin	3	125
Wagin	6	290
West Arthur	12	424
Wickepin	18	521.5
Williams	1	60
Woodanilling	1	24
Total : 134		Total: 5161

Source: Remnant Vegetation Inventory in the Southern Agricultural Areas of W.A. (Beeston *et al.*, 1994)

7.2 Save the Bush

The Save the Bush Program (STB) was established by the Federal Government in 1989 to assist with the preservation of biological diversity by the protection and management of remnant vegetation. It is administered by the Australian Nature Conservation Agency (ANCA) and by CALM in Western Australia. Grants from this scheme encourage, facilitate and support programs, action and activities associated with the protection, management and investigation of remnant bush.

Since 1989, 10 shires within the Blackwood Catchment have received over \$204,000 from the Save the Bush Program to support 21 conservation programs (See Appendix 19).

In 1990, environmental consultants Matiske Consulting Pty Ltd were commissioned by the STB to review the conservation value of remnants of native vegetation along three disused Westrail corridors – the Wagin to Narrogin line (50 km), the Wagin to Lake Grace line (119 km) and the Narrogin to Bowelling line (109 km). Details are available by contacting Matiske Consulting Pty Ltd on (09) 257 1625.

7.3 One Billion Trees

The One Billion Trees Program (OBT) was initiated in 1989 by the Federal Government to catalyse revegetation projects aimed at land and nature conservation. It is administered in Western Australia by Greening Western Australia (GWA). The program provides grants for revegetation projects through the one-stop-shop for community groups under the National Landcare Program.

Appendix 20 gives details of OBT projects in the shires of the Blackwood Catchment. Figure 12 shows the areas in the Blackwood Catchment which have received OBT grants.

7.4 National Landcare Program

The National Landcare Program (NLP) grew out of the National Soil Conservation Program (NSCP) which was established by the Federal Government in 1983. NSCP aimed to develop and implement a national strategy for the rehabilitation and sustainable use of the nation's soil and land resources. The program has provided funds to government, education and research institutions and landcare and other community groups for soil conservation projects, with particular emphasis on fostering co-operation and co-ordination amongst government agencies and those in the local community working on land degradation problems.

In 1992-93, the Community Grants section of the National Soil Conservation Program (NSCP), the One Billion Trees Program (OBT), the Save the Bush Program (STB) and the Federal Water Resources Assistance Program were integrated into a one-stop-shop for community grants under the National Landcare Program (NLP). The aim of the NLP is to encourage community groups to responsibly manage and conserve land, water and biological diversity in their area.

Over \$2.1M in NLP/NSCP funds has been received by Blackwood Catchment projects (Appendix 21).

7.5 State Landcare Program

The Western Australian government introduced the State Landcare Program in the 1987 to support Land Conservation District Committees (LCDCs) and catchment groups in combating land degradation problems in rural areas. Financial support is provided to LCDCs to undertake projects in catchment planning, demonstrate conservation practices and for communications and training.

Appendix 22 gives details and contact persons for State Landcare Program projects in the Blackwood Catchment.

7.6 Roadside Conservation Committee

The Roadside Conservation Committee (RCC) was set up by the Western Australian government in 1985 to co-ordinate and promote the conservation and effective management of rail and roadside vegetation for the benefit of the environment and the people of the State. The program is administered by the Department of Conservation and Land Management (CALM).

Road verges in the Blackwood Catchment were surveyed for their vegetation conservation status with the assistance of the RCC. Community volunteers on a shire basis used a pro-forma developed by the RCC to survey 3181 km (22.3 per cent) of the 14,250 km of road network in Blackwood Catchment shires (Table 5).

The Shire of Wickpin was the first in the State to complete its surveys of roadside vegetation (Lamont, 1993a). Bridgetown-Greenbushes and Boyup Brook have also been completely surveyed (Lamont, 1993b, c).

7.7 Gordon Reid Foundation for Conservation

The Gordon Reid Foundation for Conservation provides funds and other support to enhance community involvement in conservation within Western Australia. Funds are provided for:

- the conservation of the Western Australian environment with emphasis on native flora and fauna;
- the identification and conservation of critical habitats and ecosystems;
- the conservation of rare, threatened and endangered species in Western Australia;
- public education and awareness of environmental issues within Western Australia; and
- research or other studies into matters related to any of the above.

Table 5. Roadside vegetation surveys co-ordinated by the Roadside Conservation Committee in the Blackwood Catchment

Shire	Total roads (km)	No. roads surveyed	Roads surveyed (km)	%	Mapping status
Augusta-Margaret River	1619	31	431.8	26.7	incomplete
Boyup Brook	1150	88	948.3	82.5	complete
Bridgetown-Greenbushes	743	100	550.5	74.1	complete
Donnybrook-Balingup	705	1	44	6.2	incomplete
Dumbleyung	1178	8	96.9	8.2	incomplete
Katanning	764	13	117.1	15.3	incomplete
Kent	1395	6	113.8	8.2	incomplete
Kojonup	1452	1	23.2	1.6	incomplete
Nannup	450	11	222.1	49.4	incomplete
Narrogin	700	15	102.2	14.6	incomplete-survey ongoing
Wagin	863	15	189	21.9	incomplete
West Arthur	880	100	800	90	first draft
Wickepin	911	91	777.5	85.3	complete
Woodanilling	533	4	61	11.4	incomplete

Source: Roadside Conservation Committee, 1994

7.8 Ribbons of Green and Plants for Conservation

Ribbons of Green is a community based project of Greening Western Australia (GWA) which started in 1989 to replant and regenerate cleared strips of land with native plants and trees. The 'Ribbons' follow roads, rail reserves or waterways or link patches of bush to provide bush corridors for the conservation of wildlife. The details of what to plant, where and when to plant are developed by the local community in consultation with GWA, government departments (Agriculture Western Australia, CALM and Main Roads Western Australia), local government authorities, consultants and community groups.

Plants for Conservation supports groups and individuals undertaking revegetation projects aimed at land and nature conservation.

The Plants for Conservation program provides more than 300,000 seedlings each year. It is managed by Greening Western Australia and sponsored by ALCOA Australia and the Hamel Nursery. Participating groups and individuals contribute additional seedlings, materials and labour towards the projects.

7.9 Other projects

There are several projects currently underway in the catchment which aim to strategically revegetate sparsely vegetated areas. One is the **Lake Toolibin Recovery Plan**. In late 1980s, the Northern Arthur River Wetlands Committee commissioned a report entitled *The Status and Future of Lake Toolibin as a Wildlife Reserve* (Northern Arthur River Wetlands Committee, 1987) to assess the status of Lake Toolibin.

Lake Toolibin is one of the few remaining inland, freshwater lakes with a healthy emergent (lake-bed) vegetation and is seriously threatened by salinisation. One recommendation of the report was that Lake Toolibin and the surrounding catchment be extensively revegetated.

The Lake Toolibin Recovery Plan is an enormous project involving the expenditure of up to \$4 million over the next 10 years. The Plan's primary objective is to ensure the long-term maintenance of Lake Toolibin and its surrounding nature reserves as a healthy and resilient ecosystem, suitable for continued waterbird usage at current high levels.

The Plan is based on an integrated strategy of short-term and ongoing measures at a local and catchment scale. Some of its principle elements include:

- Watertable drawdown by staged groundwater pumping to lower the saline watertable beneath the lake and reserves.
- Surface water drainage of the Toolibin Flats to reduce waterlogging and saline inflows to the lake.
- Lake outlet control to improve flushing efficiency.
- Enhancement of vegetation in the lake and its adjoining reserves through grazing control, planting and fire management, to improve regeneration and maintain waterbird habitats.
- Revegetation in the catchment to establish and maintain a more favourable hydrological equilibrium for the Lake Toolibin Catchment in the long term. This will be achieved through land management planning, the promotion of fodder crops, the revegetation of salt affected land and broad scale revegetation of groundwater recharge and discharge areas.

The Lake Toolibin Recovery Plan will be implemented by a major co-operative effort by government agencies, private consultants, landholders and community organisations.

ALCOA Australia has made substantial contributions, both financial and advisory, to land and nature conservation in the Shire of Wickiepin over the past few years. In 1991-92 ALCOA provided \$17,500 towards the construction of nine drainage channels across the Lake Toolibin catchment as well as enabling their hydrologist, Ken Macintosh, to assist the planning group.

Extensive floods in February 1955 caused freshwater to be diverted from Lake Towerrinning in the Shire of West Arthur. Since 1989 the **Lake Towerrinning Landcare Catchment Group** has worked to return freshwater to the lake via a 12 km re-diversion waterway. In an endeavour to reverse the situation, more than 40,000 tonnes of salt which was choking the lake has been removed.

In recognition of their work, the group was the national winner of the 1993 Combined Rural Traders Community Landcare Group category of the Landcare Australia Awards.

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9 GLOSSARY

Alteration cappings: Any change in the mineral composition of rock brought about by physical or chemical means

Alteration plateau: A phase in the metamorphism of a plateau, which is usually milder and more localised

Duricrust: Ironstone gravel that forms a continuous pavement or caprock

Fresh rock: Rock on which younger and more fertile soils are formed, usually freshly weathered granite and gneiss

Geomorphological rejuvenation: Rejuvenation of landscapes

Lateritic: Sandy surface soils and the underlying yellow and red mottled sandy clays consisting of mainly oxides of iron and aluminium

Lithic complexes: Medium-grained sedimentary rock containing abundant fragments of previously formed rock

Migmatite: A composite rock composed of igneous or igneous-appearing metamorphic materials

Mottled zone: Zone of soil that is irregularly marked with spots or patches of different colours, usually indicating poor aeration or seasonal wetness

Pallid zone: Deep, white pale clay zone

Podzolic soils or podzols: A group of zonal soils having an organic mat and a very thin organic-mineral layer

Secondary salinisation: The accumulation of soluble salts by evaporation of the water that brings them to the soil surface

Sodicity: Salt affected

Topographic separation: The relationship between two parts of the landscape or two kinds of topography that are out of adjustment with one another

APPENDICES

Appendix 1 Plant list for the Dumbleyung Vegetation System, Avon Botanical District (Beard, 1980b)

Botanical name	Common name (if known)
Woodland species	
Trees	
<i>Acacia acuminata</i>	Jam
<i>Allocasuarina huegeliana</i>	Rock sheoak
<i>Eucalyptus astringens</i>	Brown mallet
<i>Eucalyptus falcata</i>	White mallet
<i>Eucalyptus gardneri</i>	Blue mallet
<i>Eucalyptus longicornis</i>	Morrel
<i>Eucalyptus wandoo</i>	Wandoo
<i>Eucalyptus loxophleba</i>	York gum
<i>Eucalyptus salmonphloia</i>	Salmon gum
Shrubs	
<i>Acacia lasiocarpa</i> var. <i>sedifolia</i>	
<i>Acacia microbotryra</i>	Manna wattle
<i>Acacia pulchella</i>	Prickly Moses
<i>Astroloma prostratum</i>	
<i>Astroloma compactum</i>	
<i>Astroloma pallidum</i>	
<i>Astroloma serratifolium</i>	Kondrung
<i>Beaufortia bracteosa</i>	
<i>Daviesia brevifolia</i>	
<i>Daviesia colletioides</i>	
<i>Dodonaea bursariifolia</i>	
<i>Dryandra cirsioides</i>	
<i>Dryandra drummondii</i>	Drummond's dryandra
<i>Dryandra fraseri</i>	
<i>Dryandra ferruginea</i>	
<i>Dryandra nivea</i>	Couch honeypot
<i>Dryandra sessilis</i>	Parrot bush
<i>Gastrolobium crassifolium</i>	Thick-leaved poison
<i>Hakea lissocarpa</i>	Honey bush
<i>Hakea multilineata</i>	Grass-leaved hakea
<i>Hakea sphaerocephala</i>	Frog hakea
<i>Hibbertia enervia</i>	
<i>Melaleuca uncinata</i>	Broom bush
<i>Platysace maxwellii</i>	Karno
<i>Santalum acuminatum</i>	Quandong
<i>Spyridium denticuliferum</i>	
<i>Westringia cephalantha</i>	
Herbs	
<i>Aira caryophylla</i>	Silvery hairgrass
<i>Angianthus pusillus</i>	Dwarf angianthus
<i>Borya sphaerocephala</i>	Pincushions
<i>Dampiera spicigera</i>	Spiked dampiera
<i>Laxmannia</i> sp.	
<i>Lepidosperma angustatum</i>	
<i>Lepidosperma brunonianum</i>	

Appendix 1 Plant list for the Dumbleyung Vegetation System,
(continued) Avon Botanical District (Beard, 1980b)

Botanical name	Common name (if known)
<i>Lepidosperma drummondii</i>	
<i>Lepidosperma gracile</i>	Slender sword sedge
<i>Lepidosperma scabrum</i>	
<i>Lepidosperma tenue</i>	
<i>Lomandra effusa</i>	Scented matrush
<i>Loxocarya</i> sp.	
Poaceae sp.	
<i>Stipa hemipogon</i>	
<i>Waitzia acuminata</i>	Orange immortelle
Climbers	
<i>Billardiera variifolia</i>	
Mallee species	
Trees	
<i>Eucalyptus albida</i>	White-leafed mallee
<i>Eucalyptus eremophila</i>	Tall sand mallee
<i>Eucalyptus foecunda</i>	Narrow-leafed red mallee
<i>Eucalyptus incrassata</i>	Ridge-fruited mallee
<i>Eucalyptus redunca</i>	Black marlock
<i>Eucalyptus transcontinentalis</i>	Redwood
<i>Eucalyptus falcata</i>	Silver mallet
<i>Eucalyptus gardneri</i>	Blue mallet
Shrubs	
<i>Dryandra cirsioides</i>	
<i>Gastrolobium</i> spp.	
<i>Leptospermum erubescens</i>	Roadside tea-tree
<i>Melaleuca pungens</i>	
<i>Melaleuca uncinata</i>	Broom bush
Shrubland species	
<i>Acacia stenoptera</i>	Narrow-winged wattle
<i>Acacia varia</i>	
<i>Banksia baueri</i>	Woolly banksia
<i>Billardiera variifolia</i>	
<i>Calytrix cephalantha</i>	
<i>Cassytha</i> sp.	
<i>Daviesia pachyphylla</i>	Ouch bush
<i>Dodonaea amplyophylla</i>	
<i>Dryandra cuneata</i>	Wedge-leafed dryandra
<i>Eucalyptus foecunda</i>	Narrow-leafed red mallee
<i>Gastrolobium spinosum</i>	Prickle poison
<i>Hakea ruscifolia</i>	Candle hakea
<i>Hibbertia verrucosa</i>	
<i>Lambertia inermis</i>	Chittick
<i>Lepidosperma tenue</i>	
<i>Leucopogon</i> aff. <i>ozothamnoides</i>	
<i>Melaleuca lateritia</i>	Robin redbreast bush
<i>Restio sphacelatus</i>	

Appendix 1 Plant list for the Dumbleyung Vegetation System,
(continued) Avon Botanical District (Beard, 1980b)

Botanical name	Common name (if known)
Heath species	
Scattered trees	
<i>Allocasuarina huegeliana</i>	Rock sheoak
<i>Banksia attenuata</i>	Slender banksia
<i>Eucalyptus astringens</i>	Brown mallet
<i>Eucalyptus gardneri</i>	Blue mallet
<i>Eucalyptus incrassata</i>	Lerp mallee
<i>Eucalyptus wandoo</i>	Wandoo
<i>Nuytsia floribunda</i>	Christmas tree
Shrubs	
<i>Acacia cuneata</i>	
<i>Acacia pulchella</i>	Prickly Moses
<i>Adenanthos argyreus</i>	Little woollybush
<i>Adenanthos cygnorum</i>	Common woollybush
<i>Adenanthos flavidiflora</i>	
<i>Allocasuarina humilis</i>	Scrub sheoak
<i>Allocasuarina microstachya</i>	
<i>Andersonia caerulea</i>	Foxtails
<i>Astartea heteranthera</i>	
<i>Astroloma compactum</i>	
<i>Astroloma serratifolium</i>	Kondrung
<i>Baeckea grandibracteata</i>	
<i>Banksia sphaerocarpa</i>	Brown banksia
<i>Beaufortia bracteosa</i>	
<i>Beaufortia incana</i>	
<i>Beaufortia micrantha</i>	Little bottlebrush
<i>Calothamnus planifolius</i>	
<i>Calothamnus presissii</i>	
<i>Calothamnus</i> aff. <i>villosus</i>	
<i>Calytrix brachyphylla</i>	
<i>Calytrix fraseri</i>	Pink summer calytrix
<i>Calytrix stipulosa</i>	
<i>Chamaelaucium ciliatum</i>	
<i>Chamaelaucium megalopetalum</i>	Large waxflower
<i>Choretrum glomeratum</i>	Common sour bush
<i>Cryptandra miliaris</i>	
<i>Daviesia</i> aff. <i>acanthoclona</i>	
<i>Daviesia brevifolia</i>	
<i>Daviesia cardiophylla</i>	
<i>Daviesia</i> aff. <i>preissii</i>	
<i>Daviesia rhombifolia</i>	
<i>Daviesia variophylla</i>	
<i>Dodonea divaricata</i>	
<i>Dryandra cirsioides</i>	
<i>Dryandra nobilis</i>	Golden dryandra
<i>Dryandra nivea</i>	Couch honeypot
<i>Dryandra sessilis</i>	Parrot bush
<i>Dryandra</i> 2 spp. unidentified	
<i>Eremaea paucifolia</i>	
<i>Gastrolobium hookeri</i>	

Appendix 1 Plant list for the Dumbleyung Vegetation System,
(continued) Avon Botanical District (Beard, 1980b)

Botanical name	Common name (if known)
<i>Gastrolobium laytonii</i>	Breelya
<i>Gastrolobium tricuspdatum</i>	
<i>Gastrolobium trilobium</i>	Bullock poison
<i>Goodenia pinifolia</i>	Pine-leaved goodenia
<i>Grevillea aff. uncinulata</i>	Hooked-leaved grevillea
<i>Hakea adnata</i>	
<i>Hakea ambigua</i>	
<i>Hakea baxteri</i>	Fan hakea
<i>Hakea corymbosa</i>	Cauliflower hakea
<i>Hakea crassifolia</i>	Thick-leaved hakea
<i>Hakea falcata</i>	
<i>Hakea ferruginea</i>	
<i>Hakea gilbertii</i>	
<i>Hakea incrassata</i>	Marble hakea
<i>Hakea lehmanniana</i>	Blue hakea
<i>Hakea prostrata</i>	Harsh hakea
<i>Hakea trifurcata</i>	Two-leaved hakea
<i>Hibbertia enervia</i>	
<i>Hypocalymma angustifolium</i>	White myrtle
<i>Isopogon drummondii</i>	
<i>Isopogon teretifolius</i>	Nodding coneflower
<i>Lambertia ilicifolia</i>	Honey-leaved honeysuckle
<i>Leptospermum erubescens</i>	Roadside tea-tree
<i>Leucopogon dielsianus</i>	
<i>Leucopogon hamulosus</i>	
<i>Leucopogon minutifolius</i>	
<i>Leucopogon phyllostachys</i>	
<i>Lysinema ciliatum</i>	Curry flower
<i>Melaleuca conferta</i>	
<i>Melaleuca pungens</i>	
<i>Melaleuca seriata</i>	
<i>Melaleuca aff. subtrigona</i>	
<i>Microcorys lenticularis</i>	
<i>Micromyrtus imbricata</i>	
<i>Olax benthamiana</i>	
<i>Persoonia striata</i>	Kauberry
<i>Petrophile conferta</i>	
<i>Petrophile ericifolia</i>	
<i>Petrophile seminuda</i>	
<i>Petrophile squamata</i>	
<i>Petrophile stricta</i>	
<i>Spyridium complicatum</i>	
<i>Stirlingia latifolia</i>	Blueboy
<i>Verticordia brownii</i>	Common cauliflower
<i>Xanthorrhoea reflexa</i>	Skirted grass tree

Appendix 1 Plant list for the Dumbleyung Vegetation System,
(continued) Avon Botanical District (Beard, 1980b)

Botanical name	Common name (if known)
Herbs	
<i>Borya sphaerocephala</i>	Pincushions
<i>Conostylis breviscapa</i>	
<i>Conostylis</i> aff. <i>setigera</i>	Bristly cottonhead
<i>Dampiera</i> sp.	
<i>Dampiera spicegera</i>	Spiked dampiera
<i>Dampiera</i> aff. <i>juncea</i>	Rush-like dampiera
<i>Harperia laterifolia</i>	
<i>Lepidosperma gracile</i>	Slender sword sedge
<i>Lepidosperma pubisquameum</i>	
<i>Loxocarya</i> sp.	
<i>Loxocarya fasciculata</i>	
<i>Lyginea tenax</i>	
<i>Mesomelaena uncinata</i>	
<i>Neurachne</i> sp.	Foxtail
Poaceae 2 spp.	
Restionaceae sp.	
<i>Schoenus brevifolius</i>	Short-leafed bog rush
<i>Schoenus compressus</i>	
<i>Schoenus curvifolius</i>	
<i>Schoenus</i> aff. <i>globifer</i>	
<i>Schoenus</i> 2 spp. unidentified	
<i>Stipa hemipogon</i>	
<i>Stylidium repens</i>	Matted triggerplant
<i>Waitzia paniculata</i>	Woolly waitzia
Rock outcrop species	
Trees	
<i>Allocasuarina huegeliana</i>	Rock sheoak
Shrubs	
<i>Acacia acuminata</i>	Jam
<i>Spartochloa scirpoidea</i>	
<i>Thryptomene australis</i>	Hook-leafed thryptomene
Herbs	
<i>Borya sphaerocephala</i>	Pincushions
<i>Lepidosperma angustatum</i>	
<i>Lepidosperma drummondii</i>	
<i>Stypandra imbricata</i>	Blind grass
Lichens and mosses	
<i>Grimmea</i> sp.	
<i>Permelia</i> spp.	
<i>Rhizocarpon</i> sp.	

Appendix 2 Plant List for the Hyden Vegetation System,
Roe Botanical District (Beard, 1976)

Botanical name	Common name (if known)
Woodland species	
Trees	
<i>Eucalyptus annulata</i>	Open-fruited mallee
<i>Eucalyptus falcata</i>	Silver mallet
<i>Eucalyptus occidentalis</i>	Flat-topped yate
<i>Eucalyptus salmonophloia</i>	Salmon gum
<i>Eucalyptus flocktoniae</i>	Merrit
<i>Eucalyptus redunca</i>	Black merret
<i>Eucalyptus loxophleba</i>	York gum
<i>Eucalyptus longicornis</i>	Red morrel
<i>Santalum acuminatum</i>	Quandong
Understorey	
<i>Acacia celastrifolia</i>	
<i>Acacia subglauca</i>	
<i>Alyogyne hakeifolia</i>	
<i>Choretrum glomeratum</i>	
<i>Dryandra ferruginea</i>	
<i>Exocarpus aphyllus</i>	
<i>Gahnia ancistrophylla</i>	Hook-leafed saw sedge
<i>Gastrolobium spinosum</i>	Prickly poison
<i>Grevillea huegelii</i>	
<i>Melaleuca adnata</i>	
<i>Melaleuca lateriflora</i>	Gorada
<i>Melaleuca uncinata</i>	Broom bush
<i>Olearia muelleri</i>	Goldfields daisy
Salt country species	
Trees	
<i>Eucalyptus longicornis</i>	Red morrel
<i>Eucalyptus salmonophloia</i>	Salmon gum
Shrubs	
<i>Atriplex vesicaria</i>	Samphire
<i>Melaleuca lateriflora</i>	Gorada
Mallee species	
Trees	
<i>Choretrum glomeratum</i>	Common sour bush
<i>Dodonaea bursariifolia</i>	
<i>Eucalyptus falcata</i>	Silver mallee
<i>Eucalyptus calycogona</i>	Gooseberry mallee
<i>Eucalyptus celastroides</i>	Mirret
<i>Eucalyptus incrassata</i>	Lerp mallee
<i>Eucalyptus loxophleba</i> var. <i>gratiae</i>	Lake Grace gum
<i>Eucalyptus eremophila</i>	Tall sand mallee
<i>Eucalyptus foecunda</i>	Narrow-leafed red mallee
<i>Eucalyptus redunca</i>	Black marlock

Appendix 2 Plant List for the Hyden Vegetation System,
(continued) Roe Botanical District (Beard, 1976)

Botanical name	Common name (if known)
<i>Eucalyptus trancontinentalis</i>	Redwood
<i>Eucalyptus kondininensis</i>	Kondinin blackbutt
<i>Hakea subsulcata</i>	
<i>Melaleuca uncinata</i>	
<i>Melaleuca</i> aff. <i>scabra</i>	
<i>Phebalium filifolium</i>	Slender phebalium
Shrubs	
<i>Acacia assimilis</i>	
<i>Allocasuarina acutivalvis</i>	
<i>Banksia sphaerocarpa</i>	Round-fruited banksia
<i>Boronia crassifolia</i>	
<i>Brachyloma concolour</i>	
<i>Callitris huegelii</i>	
<i>Dryandra</i> sp.	
<i>Gastrolobium crassifolium</i>	Thickleaf poison
<i>Gastrolobium trilobium</i>	
<i>Grevillea hookeriana</i>	Red toothbrushes
<i>Grevillea integrifolia</i>	Entire-leafed grevillea
<i>Hakea falcata</i>	
<i>Hakea lissocarpa</i>	Honey bush
<i>Hakea subsulcata</i>	
<i>Isopogon polycephalus</i>	Clustered coneflower
<i>Leptospermum erubescens</i>	Roadside tea-tree
<i>Leucopogon minutifolius</i>	
<i>Melaleuca cuticularis</i>	Saltwater paperbark
<i>Melaleuca eleutherostachya</i>	
<i>Melaleuca lateriflora</i>	Gorada
<i>Melaleuca spathulata</i>	
<i>Melaleuca spicigera</i>	
<i>Melaleuca uncinata</i>	Broom bush
<i>Templetonia sulcata</i>	Centipede bush
Herbs	
<i>Dampiera</i> sp.	
<i>Gahnia ancistrophylla</i>	Hooked-leafed saw sedge
<i>Lepidosperma brunonianum</i>	
<i>Lepidosperma gracile</i>	Slender sword sedge
<i>Restionaceae</i> sp.	
Shrubland species	
Shrubs	
<i>Acacia assimilis</i>	
<i>Acacia celastrifolia</i>	Glowing wattle
<i>Acacia grisea</i>	
<i>Actinostrobus arenarius</i>	Sandplain cypress
<i>Adenanthos argyreus</i>	Little woollybush
<i>Adenanthos cygnorum</i>	Common woollybush
<i>Allocasuarina acutivalvis</i>	
<i>Allocasuarina pinaster</i>	
<i>Allocasuarina</i> sp. inedit.	
<i>Astroloma</i> sp.	

Appendix 2 Plant List for the Hyden Vegetation System,
(continued) Roe Botanical District (Beard, 1976)

Botanical name	Common name (if known)
<i>Banksia baueri</i>	Woolly banksia
<i>Banksia sphaerocarpa</i>	Round-fruited banksia
<i>Beaufortia bracteosa</i>	
<i>Beaufortia incana</i>	
<i>Beaufortia macrostemon</i>	
<i>Boronia inornata</i>	Desert boronia
<i>Calytrix brachyphylla</i>	
<i>Calytrix fraseri</i>	Pink summer calytrix
<i>Callitris roei</i>	Roe's cypress pine
<i>Calothamunus elegans</i>	
<i>Chloanthes coccinea</i>	
<i>Chamaelaucium megalopetalum</i>	Large waxflower
<i>Choretrum glomeratum</i>	Common sour bush
<i>Conospermum amoenum</i>	Blue smokebush
<i>Conospermum ephedroides</i>	
<i>Cryptandra glabriflora</i>	
<i>Cryptandra leucophracta</i>	Rusty poison
<i>Cryptandra pungens</i>	
<i>Cryptandra</i> sp. inedit.	
<i>Daviesia brevifolia</i>	
<i>Daviesia colletiodes</i>	
<i>Dryandra</i> aff. <i>cirsoides</i>	
<i>Dryandra ferruginea</i>	
<i>Dryandra nivea</i>	Couch honeypot
<i>Dryandra horrida</i>	Prickly dryandra
<i>Dryandra runcinata</i>	
<i>Dryandra pteridifolia</i>	Tangled honeypot
<i>Dryandra</i> sp. inedit.	
<i>Eremaea pauciflora</i>	
<i>Eucalyptus albida</i>	White-leafed mallee
<i>Eucalyptus eremophila</i>	Tall sand mallee
<i>Eucalyptus flocktoniae</i>	Merrit
<i>Eucalyptus calycogona</i>	Gooseberry mallee
<i>Eucalyptus incrassata</i>	Lerp mallee
<i>Gastrolobium spinosum</i>	Prickly poison
<i>Gastrolobium trilobum</i>	Bullock poison
<i>Gastrolobium</i> sp. inedit.	
<i>Gastrolobium insignis</i>	Wax grevillea
<i>Gastrolobium excelsior</i>	
<i>Gastrolobium pritzelii</i>	
<i>Gastrolobium</i> aff. <i>unicinulata</i>	
<i>Goodenia scapigera</i>	White goodenia
<i>Grevillea apiculoba</i>	Black toothbrushes
<i>Grevillea eryngioides</i>	Curly grevillea
<i>Grevillea hookeriana</i>	Red toothbrushes
<i>Hakea ambigua</i>	
<i>Hakea crassifolia</i>	
<i>Hakea falcata</i>	
<i>Hakea incrassata</i>	Marble hakea
<i>Hakea lissocarpa</i>	Honey bush
<i>Hakea obliqua</i>	Needles and corks

Appendix 2 Plant List for the Hyden Vegetation System,
(continued) Roe Botanical District (Beard, 1976)

Botanical name	Common name (if known)
<i>Hakea subsulcata</i>	
<i>Hibbertia enervia</i>	
<i>Hibbertia verrucosa</i>	
<i>Hybanthus floribundus</i>	
<i>Isopogon drummondii</i>	
<i>Isopogon villosus</i>	
<i>Isopogon teretifolius</i>	Nodding coneflower
<i>Leptomeria</i> sp.	
<i>Leptospermum ellipticum</i>	Swamp tea-tree
<i>Leptospermum spinescens</i>	
<i>Lechenaultia billoba</i>	Blue leschenaultia
<i>Lechenaultia formosa</i>	Red leschenaultia
<i>Logania</i> sp.	
<i>Lysinema ciliatum</i>	Curry flower
<i>Melaleuca cardiophylla</i>	Tangling melaleuca
<i>Melaleuca pungens</i>	
<i>Melaleuca</i> sp. inedit.	
<i>Melaleuca</i> aff. <i>scabra</i>	
<i>Melaleuca seriata</i>	
<i>Melaleuca uncinata</i>	Broom bush
<i>Petrophile ericifolia</i>	
<i>Petrophile seminuda</i>	
<i>Petrophile squamata</i>	
<i>Pityrodia bartlingii</i>	Woolly dragon
<i>Spyridium denticuliferum</i>	
<i>Synaphea petiolaris</i>	Synaphea
<i>Xanthorrhoea nana</i>	Dwarf grasstree
Herbs	
<i>Caladenia deformis</i>	Blue fairy orchid
<i>Dampiera dura</i>	
<i>Dampiera</i> sp. inedit.	
<i>Goodenia glareicola</i>	
<i>Goodenia laevis</i>	Smooth goodenia
<i>Laxmannia</i> sp.	
<i>Lepidosperma angustatum</i>	
<i>Lepidosperma brunonianum</i>	
<i>Lepidosperma</i> aff. <i>gracile</i>	
<i>Mesomelaena tetragona</i>	Semaphore sedge
<i>Mesomelaena uncinata</i>	
Poaceae sp.	
Restionaceae sp.	
<i>Schoenus brevifolius</i>	Short-leaved bog rush
<i>Stylidium breviscapum</i>	Boomerang triggerplant

Appendix 3 Dominant species list for the Beaufort Vegetation System (Beard, 1980b)

Botanical name	Common name (if known)
Shrubs	
<i>Acacia saligna</i>	Black wattle
<i>Adenanthos cygnorum</i>	Common woollybush
<i>Allocasuarina corniculata</i>	Tamma
<i>Allocasuarina humilis</i>	Scrub sheoak
<i>Baeckea preissiana</i>	
<i>Calothamnus quadrifidus</i>	Common one-sided bottlebrush
<i>Calothamnus planifolius</i>	
<i>Daviesia polycephala</i>	
<i>Eremaea paucifolia</i>	
<i>Hakea incrassata</i>	Marble hakea
<i>Hakea trifurcata</i>	Two-leafed hakea
<i>Hibbertia acerosa</i>	Needle-leafed Guinea flower
<i>Isopogon</i> aff. <i>latifolius</i>	
<i>Kunzea recurva</i>	
<i>Leptosperma erubescens</i>	Roadside tea-tree
<i>Lechenaultia biloba</i>	
<i>Petrophile squamata</i>	
<i>Verticordia habrantha</i>	Hidden featherflower
<i>Xanthorrhoea preissii</i>	Common grasstree
Herbs	
<i>Anigozanthus humilis</i>	Catspaw
<i>Patersonia</i> sp.	
<i>Podolepis canescens</i>	Bright podolepis

Appendix 4 Plant List for the Wagin Vegetation System,
Avon Botanical District (Beard, 1980b)

Botanical name	Common name (if known)
Woodland species	
Trees	
<i>Allocasuarina huegeliana</i>	Rock sheoak
<i>Allocasuarina obesa</i>	Swamp sheoak
<i>Allocasuarina humilis</i>	Scrub sheoak
<i>Eucalyptus astringens</i>	Brown mallet
<i>Eucalyptus wandoo</i>	Wandoo
<i>Eucalyptus loxophleba</i>	York gum
<i>Eucalyptus longicornis</i>	Red morrel
<i>Eucalyptus calophylla</i>	Marri
<i>Eucalyptus gardneri</i>	Blue mallet
<i>Eucalyptus drummondii</i>	Drummond's gum
<i>Eucalyptus eremophila</i>	Tall sand mallee
<i>Eucalyptus occidentalis</i>	Flat-topped yate
Understorey	
<i>Acacia acuminata</i>	Jam
<i>Adenanthos</i> aff. <i>cygnorum</i>	
<i>Amphipogon debilis</i>	
<i>Astroloma microcalyx</i>	Native cranberry
<i>Borya sphaerocephala</i>	Pincushions
<i>Bossiaea eriocarpa</i>	Common brown pea
<i>Choretrum glomeratum</i>	Common sourbush
<i>Dampiera</i> sp.	
<i>Daviesia brevifolia</i>	
<i>Dryandra nobilis</i>	Golden dryandra
<i>Dryandra cirsioides</i>	
<i>Dryandra hewardiana</i>	
<i>Dryandra nivea</i>	Couch honeypot
<i>Dianella revoluta</i>	Blueberry lily
<i>Dryandra rhomifolia</i>	
<i>Gastrolobium crassifolium</i>	Thickleaf poison
<i>Gastrolobium parvifolium</i>	Poison berry
<i>Hakea lissocarpha</i>	
<i>Hakea gilbertii</i>	
<i>Hypocalymma angustifolium</i>	White myrtle
<i>Jacksonia eremodendron</i>	
<i>Lepidosperma tenue</i>	
<i>Lepidosperma gracile</i>	Slender sword sedge
<i>Lepyrodia</i> sp.	
<i>Leucopogon blepharolepis</i>	
<i>Lomandra effusa</i>	Scented matrush
<i>Mirbelia spinosa</i>	
<i>Olearia revoluta</i>	
<i>Persoonia striata</i>	
<i>Petrophile divaricata</i>	
<i>Petrophile squamata</i>	
<i>Santalum acuminatum</i>	Quandong

Appendix 5 Dominant species list for the Broomehill Vegetation System,
Avon Botanical District (Beard, 1980b)

Botanical name	Common name (if known)
Woodland species	
Trees	
<i>Acacia acuminata</i>	Jam
<i>Acacia microbotrya</i>	Manna wattle
<i>Allocasuarina huegeliana</i>	Rock sheoak
<i>Eucalyptus gardneri</i>	Blue mallet
<i>Eucalyptus wandoo</i>	Wandoo
<i>Eucalyptus astringens</i>	Brown mallet
<i>Eucalyptus occidentalis</i>	Flat-topped yate
<i>Eucalyptus longicornis</i>	Red morrel
<i>Eucalyptus salmonphloia</i>	Salmon gum
<i>Hakea preissii</i>	Needle tree
Shrubs	
<i>Xanthorrhoea reflexa</i>	Skirted grasstree

Appendix 6 Dominant species list for the Tambellup Vegetation System,
Avon Botanical District (Beard, 1980b)

Botanical name	Common name (if known)
Woodland species	
Trees	
<i>Acacia acuminata</i>	Jam
<i>Allocasuarina huegeliana</i>	Rock sheoak
<i>Eucalyptus gardneri</i>	Blue mallet
<i>Eucalyptus wandoo</i>	Wandoo
<i>Eucalyptus astringens</i>	Brown mallet
<i>Eucalyptus occidentalis</i>	Flat-topped yate
<i>Jacksonia sternbergiana</i>	Stinkwood
Shrubs	
<i>Acacia lasiocarpa</i> var. <i>bracteolata</i>	Panjang
<i>Bossiaea eriocarpa</i>	Common brown pea
<i>Calytrix tenuifolia</i>	
<i>Chorizema aciculare</i>	Needle-leafed chorizema
<i>Dampiera teres</i>	Terate-leafed dampiera
<i>Gastrolobium calycinum</i>	York Road poison
<i>Hibbertia montana</i>	Mountain primrose
<i>Pimelia angustifolia</i>	Narrow-leafed pimelea
Herbs	
<i>Borya sphaerocephala</i>	Pincushions
<i>Caladenia flava</i>	Cowslip orchid
<i>Thelymitra antennifera</i>	Vanilla orchid

Appendix 7 Dominant species list for the Narrogin Vegetation System (Beard, 1976)

Botanical name	Common name (if known)
Woodland species	
Trees	
<i>Acacia acuminata</i>	Jam
<i>Allocasuarina huegeliana</i>	Rock sheoak
<i>Cryptandra dielsii</i>	
<i>Dianella revoluta</i>	Blueberry lily
<i>Dryandra cirsioides</i>	
<i>Dryandra hewardiana</i>	
<i>Dryandra</i> sp.	
<i>Eucalyptus astringens</i>	Brown mallet
<i>Eucalyptus accedens</i>	Powderbark wandoo
<i>Eucalyptus wandoo</i>	Wandoo
<i>Eucalyptus loxophleba</i>	York gum
<i>Eucalyptus rudis</i>	Flooded gum
<i>Gastrolobium microcarpum</i>	Sandplain poison
<i>Gastrolobium spinosum</i>	Prickly poison
<i>Grevillea pulchella</i>	Beautiful grevillea
<i>Gastrolobium hookeri</i>	
<i>Glischrocaryon flavescens</i>	
<i>Hakea lissocarpa</i>	Honey bush
<i>Hemiandra pungens</i>	Snakebush
<i>Hovea chorizemifolia</i>	Holly-leafed hovea
<i>Hovea pungens</i>	Devil's pins
Shrubs	
<i>Acacia pulchella</i>	Prickly Moses
<i>Astroloma pallidum</i>	Kick bush
<i>Adenanthos cygnorum</i>	Common woollybush
<i>Borya</i> sp.	Pincushions
<i>Billardiera variifolia</i>	
<i>Bossiaea eriocarpa</i>	Common brown pea
<i>Calothamnus quadrifidus</i>	One-sided bottlebrush
<i>Conostylis setigera</i>	Bristly cottonhead
<i>Jacksonia floribunda</i>	Holly pea
<i>Jacksonia furcellata</i>	Grey stinkwood
<i>Leptospermum erubescens</i>	Roadside tea-tree
<i>Lechenaultia biloba</i>	Blue leschenaultia
<i>Leucopogon conostephioides</i>	
<i>Neurachne</i> sp.	
<i>Pimelea</i> aff. <i>microcephala</i>	Shrubby riceflower
<i>Santalum murrayanum</i>	Bitter quandong
<i>Stylidium repens</i>	Matted triggerplant
<i>Xanthorrhoea preissii</i>	Blackboy
<i>Xanthorrhoea reflexa</i>	Skirted grasstree
Herbs	
<i>Harperia laterifolia</i>	
<i>Lepidosperma pubisquameum</i>	
<i>Lepidosperma tenue</i>	
<i>Lepidosperma gracile</i>	Slender sword sedge
<i>Lomandra effusa</i>	Scented matgrass
<i>Stipa elegantissima</i>	Feather speargrass

Appendix 8 Dominant species list for the Corrigin Vegetation System (Beard, 1976)

Botanical Name	Common name (if known)
Woodland species	
<i>Acacia acuminata</i>	Jam
<i>Allocasuarina obesa</i>	Swamp sheoak
<i>Callistemon phoeniceus</i>	Lesser bottlebrush
<i>Ennaepogon caerulescens</i>	Limestone grass
<i>Eucalyptus accedens</i>	Powderbark wandoo
<i>Eucalyptus astringens</i>	Brown mallet
<i>Eucalyptus gardneri</i>	Blue mallet
<i>Eucalyptus longicornis</i>	Red morrel
<i>Eucalyptus loxophleba</i>	York gum
<i>Eucalyptus rudis</i>	Flooded gum
<i>Eucalyptus salmonphloia</i>	Salmon gum
<i>Eucalyptus wandoo</i>	Wandoo
<i>Gahnia ancistrophylla</i>	Hook-leafed saw sedge
<i>Gastrolobium crassifolium</i>	Thickleaf poison
<i>Hakea preissii</i>	Needle tree
<i>Lepidosperma drummondii</i>	
<i>Lepidosperma tenue</i>	
<i>Melaleuca hamulosa</i>	
<i>Melaleuca laxiflora</i>	
<i>Santalum acuminatum</i>	Quandong
<i>Waitzia acuminata</i>	Orange immortelle
Mallee species	
<i>Acacia acuminata</i>	Jam
<i>Acacia brachyclada</i>	
<i>Acacia dermatophylla</i>	
<i>Acacia erinacea</i>	
<i>Acacia graffiana</i>	Tan wattle
<i>Acacia merrallii</i>	
<i>Acacia microbotrya</i>	Manna wattle
<i>Acacia multispicata</i>	
<i>Acacia sulcata</i>	
<i>Allocasuarina campestris</i>	Tamma
<i>Astroloma epacridis</i>	
<i>Calytrix brachyphylla</i>	
<i>Daviesia brevifolia</i>	
<i>Daviesia teretifolia</i>	
<i>Dodonaea amblyophylla</i>	
<i>Dodonaea caespitosa</i>	
<i>Eremophila</i> aff. <i>brevifolia</i>	Spotted eremophila
<i>Eremophila lehmanniana</i>	
<i>Eucalyptus redunca</i>	Black marlock
<i>Eucalyptus calycogona</i>	Gooseberry mallee
<i>Eucalyptus flocktiana</i>	Merrit
<i>Eucalyptus loxophleba</i>	York gum
<i>Eucalyptus wandoo</i>	Wandoo
<i>Eucalyptus ovularis</i>	Small-fruited mallee
<i>Eucalyptus incrassata</i>	Lerp mallee
<i>Eucalyptus eremophila</i>	Tall sand mallee
<i>Eucalyptus pileata</i>	Capped mallee

Appendix 8 Dominant species list for the Corrigin Vegetation System (Beard, 1976)
(continued)

Botanical Name	Common name (if known)
<i>Exocarpus aphyllus</i>	Leafless ballart
<i>Grevillea</i> aff. <i>acuaria</i>	
<i>Grevillea huegelii</i>	
<i>Hakea adnata</i>	
<i>Halgania</i> sp.	
<i>Leptospermum erubescens</i>	Roadside tea-tree
<i>Lhotskya violacea</i>	
<i>Melaleuca acuminata</i>	
<i>Melaleuca adnata</i>	
<i>Melaleuca eleutherostachya</i>	
<i>Melaleuca hamulosa</i>	
<i>Melaleuca laterifolia</i>	Gorada
<i>Melaleuca laxiflora</i>	
<i>Melaleuca pauciflora</i>	
<i>Melaleuca scabra</i>	Wongon melaleuca
<i>Melaleuca uncinata</i>	Broom bush
<i>Olearia</i> aff. <i>adenolasia</i>	Woolly-glandular daisy bush
<i>Olearia muelleri</i>	Goldfields daisy
<i>Olearia revoluta</i>	Daisy bush
<i>Rhagodia preissii</i>	
<i>Rhagodia</i> sp.	
<i>Santalum spicatum</i>	Sandalwood
<i>Santalum acuminatum</i>	Quandong
<i>Templetonia sulcata</i>	Kerosene bush
<i>Thomasia tenuivesta</i>	
Kwongan species	
<i>Allocasuarina campestris</i>	Tamma
<i>Dryandra cirsioides</i>	
<i>Eucalyptus macrocarpa</i>	Mottlecah
<i>Hakea subsulcata</i>	
Shrub species	
<i>Astroloma serratifolium</i>	Kondrung
<i>Baeckea crispiflora</i>	
<i>Banksia sphaerocarpa</i>	Round-fruited banksia
<i>Beaufortia micrantha</i>	Little bottlebrush
<i>Calytrix empetroides</i>	
<i>Choretrum pritzelii</i>	
<i>Cryptandra myriantha</i>	
<i>Daviesia benthamii</i>	
<i>Gastrolobium acanthaclona</i>	
<i>Gastrolobium parviflorum</i>	Berry poison
<i>Gastrolobium spinosum</i>	Pickly poison
<i>Grevillea hookeriana</i>	Red toothbrushes
<i>Hakea baxteri</i>	Fan hakea
<i>Hakea incrassata</i>	Marble hakea
<i>Hakea scoparia</i>	
<i>Hibbertia pungens</i>	
<i>Isopogon divergens</i>	Spreading coneflower
<i>Leptospermum erubescens</i>	Roadside tea-tree
<i>Leucopogon carinatus</i>	

Appendix 8 Dominant species list for the Corrigin Vegetation System (Beard, 1976)
(continued)

Botanical Name	Common name (if known)
<i>Leucopogon crassifolius</i>	
<i>Lysinema ciliatum</i>	Curry flower
<i>Melaleuca seriata</i>	
<i>Opercularia vaginata</i>	Dog weed
<i>Petrophile trifida</i>	
<i>Persoonia striata</i>	Kauberry
<i>Phebalium tuberculatum</i>	
<i>Pityrodia axillaris</i>	Native foxglove
<i>Santalum acuminatum</i>	Quandong
<i>Synaphea polymorpha</i>	Albany synaphea
Herb species	
<i>Chamaexeros fimbriata</i>	
<i>Dampiera juncea</i>	Rush-like dampiera
<i>Ecdeiocola monostachya</i>	Cord rush
<i>Harperia</i> sp.	
<i>Lepidosperma drummondii</i>	
<i>Lyginea barbata</i>	
<i>Mesomelaena uncinata</i>	
<i>Schoenus subbulbosus</i>	

Appendix 9 Dominant species list for the Pingelly Vegetation System,
Avon Botanical District (Beard, 1976)

Botanical name	Common name (if known)
Trees	
<i>Acacia acuminata</i>	Jam
<i>Allocasuarina huegeliana</i>	Rock sheoak
<i>Eucalyptus accedens</i>	Powderbark wandoo
<i>Eucalyptus wandoo</i>	Wandoo
Shrubs	
<i>Acacia acuminata</i>	Jam
<i>Acacia lasiocalyx</i>	Wilyurwur
<i>Acacia lasiocarp</i>	Panjang
<i>Acacia pulchella</i>	Prickly Moses
<i>Allocasuarina humilis</i>	Scrub sheoak
<i>Astroloma pallidum</i>	Kick bush
<i>Acacia serratifolium</i>	Kondrung
<i>Calytrix</i> aff. <i>fraseri</i>	Pink summer calytrix
<i>Casuarina microstachya</i>	
<i>Choretrum glomeratum</i>	Common sourbush
<i>Comesperma scoperia</i>	Broom milkwort
<i>Daviesia brevifolia</i>	
<i>Daviesia cardiphylla</i>	
<i>Dodonaea bursariifolia</i>	
<i>Dryandra cirsioides</i>	
<i>Dryandra hewardiana</i>	
<i>Eucalyptus falcata</i>	Silver or white mallet
<i>Eucalyptus redunca</i>	Black marlock
<i>Gastrolobium crassifolium</i>	Thick-leafed poison
<i>Gastrolobium hookeri</i>	
<i>Gastrolobium spinosum</i>	Prickly poison
<i>Hakea lissocarpha</i>	Honey bush
<i>Hakea petiolaris</i>	Sea urchin hakea
<i>Hakea prostrata</i>	Purple-flowered hakea
<i>Hibbertia pungens</i>	
<i>Isopogon formosus</i>	Rose coneflower
<i>Jacksonia racemosa</i>	
<i>Olearia revoluta</i>	
<i>Persoonia striata</i>	Kauberry
<i>Persoonia</i> aff. <i>rufiflora</i>	
<i>Spyridium tridentatum</i>	
<i>Thomasia</i> aff. <i>foliosa</i>	
<i>Westringia cephalantha</i>	
<i>Westringia rigida</i>	Stiff westringia
<i>Xanthorrhoea reflexa</i>	Skirted grasstree
Herbs	
<i>Borya sphaerocephala</i>	Pincushions
<i>Caustis dioica</i>	
<i>Dampiera</i> aff. <i>coronata</i>	Wedge-leafed dampiera
<i>Dampiera juncea</i>	Rush-like dampiera
<i>Dianella revoluta</i>	Blueberry lily
<i>Glischrocaryon flavescens</i>	
<i>Harperia laterifolia</i>	

Appendix 9 Dominant species list for the Pingelly System,
(continued) Avon Botanical District (Beard, 1976)

Botanical name	Common name (if known)
<i>Lepidosperma tenue</i>	
<i>Lomandra effusa</i>	Scented matrush
<i>Loxocarya fasciculata</i>	
<i>Schoenus compressus</i>	
<i>Stipa elegantissima</i>	Feather speargrass
<i>Stypandra imbricata</i>	Cluster-leafed blindgrass

Appendix 10 Dominant species list for the Ongerup Vegetation System,
Avon Botanical District (Beard, 1976)

Botanical name	Common name (if known)
Trees	
<i>Eucalyptus loxophleba</i>	York gum
<i>Eucalyptus salmonophloia</i>	Salmon gum
<i>Eucalyptus platypus</i>	Moort
<i>Eucalyptus longicornis</i>	Red morrel
<i>Eucalyptus annulata</i>	Open-fruited mallee
<i>Eucalyptus eremophila</i>	Tall sand mallee
<i>Eucalyptus incrassata</i>	Lerp mallee
<i>Eucalyptus redunca</i>	Black marlock
<i>Eucalyptus oleosa</i>	Giant mallee
<i>Eucalyptus foecunda</i>	Narrow-leafed red mallee
<i>Eucalyptus spathulata</i>	Swamp mallet
Shrubs	
<i>Banksia media</i>	Southern Plains banksia
<i>Hakea laurina</i>	Pincushion hakea
<i>Lambertia inermis</i>	Chittick
<i>Melaleuca uncinata</i>	Broom bush
<i>Melaleuca nesophila</i>	Mindiyed

Appendix 11 Dominant species list for the Williams Vegetation System,
Darling Botanical District (Beard, 1980)

Botanical name	Common name (if known)
Trees	
<i>Acacia acuminata</i>	Jam
<i>Allocasuarina huegeliana</i>	Rock sheoak
<i>Eucalyptus calophylla</i>	Marri
<i>Eucalyptus wandoo</i>	Wandoo
<i>Eucalyptus astringens</i>	Brown mallet
<i>Eucalyptus marginata</i>	Jarrah
<i>Eucalyptus rudis</i>	Flooded gum
<i>Eucalyptus loxophleba</i>	York gum

Appendix 12 Dominant species list for the Jingalup Vegetation System,
Darling Botanical District (Beard, 1980)

Botanical name	Common name (if known)
Woodland species	
Trees	
<i>Acacia acuminata</i>	Jam
<i>Allocasuarina huegeliana</i>	Rock sheoak
<i>Banksia grandis</i>	Bull banksia
<i>Eucalyptus calophylla</i>	Marri
<i>Eucalyptus marginata</i>	Jarrah
<i>Eucalyptus rudis</i>	Flooded gum
<i>Eucalyptus wandoo</i>	Wandoo
<i>Melaleuca cuticularis</i>	Saltwater paperbark
<i>Melaleuca viminea</i>	Mohan
<i>Nuytsia floribunda</i>	Christmas tree
Understorey	
<i>Acacia lasiocarpa</i> var. <i>bracteolata</i>	
<i>Acacia saligna</i>	Orange wattle
<i>Allocasuarina baxterana</i>	
<i>Brachysema praemorsum</i>	
<i>Dampiera lavanandulacea</i>	
<i>Dryandra formosa</i>	Showy dryandra
<i>Dryandra sessilis</i>	Parrot bush
<i>Hakea prostrata</i>	Harsh hakea
<i>Hypocalymma angustifolium</i>	White myrtle
<i>Jacksonia sternbergiana</i>	Stinkwood
<i>Leptospermum erubescens</i>	Roadside tea-tree
<i>Lechenaultia formosa</i>	Red leschenaultia
<i>Stypandra imbricata</i>	Cluster-leafed blindgrass

Appendix 13 Dominant species list for the Bridgetown
Vegetation System, Menzies Subdistrict (Beard, 1981)

Botanical name	Common name (if known)
Trees	
<i>Banksia</i> spp.	
<i>Eucalyptus megacarpa</i>	Bullich
<i>Eucalyptus patens</i>	Blackbutt
<i>Eucalyptus rudis</i>	River gum
<i>Melaleuca raphiophylla</i>	Paperbark
<i>Melaleuca preissiana</i>	Moonah

Appendix 14 Reserves vested for the conservation of
flora and fauna in the Blackwood Catchment

Shire	Reserve name	Area (ha)	Vesting
Augusta-Margaret River	Leeuwin-Naturaliste National Park	8275	National Parks Authority of WA
Augusta-Margaret River	Scott National Park	3273	National Parks Authority of WA
Augusta-Margaret River	Reserve No. 42065	3207	National Parks and Nature Conservation Authority
Augusta-Margaret River	Reserve No. 8437	300	Museum of Western Australia
Augusta-Margaret River	Reserve No. 8436	16	National Parks and Nature Conservation Authority
Boyup Brook	Redhill Nature Reserve	253	WA Wildlife Authority
Boyup Brook	Reserve No. 9708	81	National Parks and Nature Conservation Authority
Boyup Brook	Kulikup Nature Reserve	62	National Parks and Nature Conservation Authority
Boyup Brook	Reserve No. 26508	16	National Parks and Nature Conservation Authority
Boyup Brook	Mistaken Island Nature Reserve	12	National Parks and Nature Conservation Authority
Bridgetown-Greenbushes	Alco Nature Reserve	1912	WA Wildlife Authority
Bridgetown-Greenbushes	Reserve No. 12381	748	National Parks and Nature Conservation Authority
Donnybrook-Balingup	Powalup Nature Reserve	67	WA Wildlife Authority
Donnybrook-Balingup	Reserve No. 26238	36	National Parks and Nature Conservation Authority
Broomehill	Perringillup Nature Reserve	388	WA Wildlife Authority
Broomehill	Reserve No. 39399	134	National Parks and Nature Conservation Authority
Broomehill	Reserve No. 19068	44	National Parks and Nature Conservation Authority
Broomehill	Ngopitchup Nature Reserve	40	Minister for Water Resources
Broomehill	Reserve No. 24707	11	WA Wildlife Authority
Broomehill	Broomehill Nature Reserve	11	WA Wildlife Authority
Dumbleyung	Dumbleyung Lake Nature Reserve	5560	WA Wildlife Authority
Dumbleyung	Tarin Rocks Nature Reserve	2010	WA Wildlife Authority
Dumbleyung	Dongolocking Nature Reserve	1061	WA Wildlife Authority
Dumbleyung	Merilup Nature Reserve	575	WA Wildlife Authority
Gnowangerup	Corackerup Nature Reserve	4334	WA Wildlife Authority
Gnowangerup	Camel Lake Nature Reserve	3215	WA Wildlife Authority
Gnowangerup	Reserve No. 26792	1039	National Parks and Nature Conservation Authority
Gnowangerup	Reserve No. 26264	768	WA Wildlife Authority
Gnowangerup	Reserve No. 17298	251	WA Wildlife Authority
Gnowangerup	Reserve No. 15756	209	National Parks and Nature Conservation Authority
Gnowangerup	Reserve No. 26569	128	National Parks and Nature Conservation Authority
Gnowangerup	Reserve No. 24770	105	National Parks and Nature Conservation Authority
Gnowangerup	Reserve No. 28549	63	National Parks and Nature Conservation Authority
Gnowangerup	Reserve No. 12590	51	WA Wildlife Authority
Gnowangerup	Reserve No. 9159	38	National Parks and Nature Conservation Authority
Gnowangerup	Reserve No. 39971	30	National Parks and Nature Conservation Authority
Gnowangerup	Reserve No. 16901	17	National Parks and Nature Conservation Authority
Gnowangerup	Reserve No. 16395	6	Minister for Water Resources

Appendix 14 Reserves vested for the conservation of
(continued) flora and fauna in the Blackwood Catchment

Shire	Reserve name	Area (ha)	Vesting
Katanning	Coblinine Nature Reserve	3869	WA Wildlife Authority
Katanning	Coyrecup Nature Reserve	471	WA Wildlife Authority
Katanning	Johns Well Nature Reserve	385	National Parks and Nature Conservation Authority
Katanning	Reserve No. 24282	308	Minister for Water Resources
Katanning	Reserve No. 27481	107	National Parks and Nature Conservation Authority
Katanning	Reserve No. 24072	49	WA Wildlife Authority
Katanning	Moojebing Nature Reserve	44	National Parks and Nature Conservation Authority
Katanning	Carrolup Nature Reserve	30	WA Wildlife Authority
Kent	Comeecup Nature Reserve	1952	WA Wildlife Authority
Kent	Reserve No. 10129	1892	Water Authority of WA
Kent	Cairlocup Nature Reserve	1577	WA Wildlife Authority
Kent	Lakeland Nature Reserve	1529	National Parks and Nature Conservation Authority
Kent	Reserve No. 29020	1528	National Parks and Nature Conservation Authority
Kent	Lake Bryde Nature Reserve	1454	Minister for Water Resources
Kent	McDougall Nature Reserve	336	WA Wildlife Authority
Kent	Reserve No. 28273	331	WA Wildlife Authority
Kent	Reserve No. 32663	322	WA Wildlife Authority
Kent	Kwobrup Nature Reserve	277	Water Authority of WA
Kent	Nyabing Nature Reserve	169	Minister for Water Resources
Kent	Reserve No. 36967	146	National Parks and Nature Conservation Authority
Kent	Reserve No. 19081	134	National Parks and Nature Conservation Authority
Kent	Reserve No. 31603	93	
Kent	Reserve No. 19080	80	National Parks and Nature Conservation Authority
Kent	Reserve No. 38553	78	National Parks and Nature Conservation Authority
Kent	Holland Rocks Nature Reserve	50	National Parks and Nature Conservation Authority
Kent	Reserve No. 24827	49	
Kent	Reserve No. 25212	44	WA Wildlife Authority
Kent	Reserve No. 14450	20	Minister for Water Resources
Kent	Reserve No. 25697	16	National Parks and Nature Conservation Authority
Kojonup	South Jingalup Nature Reserve	551	National Parks and Nature Conservation Authority
Kojonup	Jingalup Nature Reserve	427	National Parks and Nature Conservation Authority
Kojonup	Mettabinup Nature Reserve	164	National Parks and Nature Conservation Authority
Kojonup	Narlingup Nature Reserve	145	National Parks and Nature Conservation Authority
Kojonup	Birdwood Nature Reserve	46	National Parks and Nature Conservation Authority
Kojonup	Cootayerup Nature Reserve	40	WA Wildlife Authority
Kojonup	Reserve No. 5796	41	WA Wildlife Authority
Kojonup	Reserve No. 9774	40	Shire of Kojonup
Kojonup	Yellerup Nature Reserve	40	National Parks and Nature Conservation Authority
Kojonup	Mongelup Nature Reserve	39	WA Wildlife Authority

Appendix 14 Reserves vested for the conservation of
(continued) flora and fauna in the Blackwood Catchment

Shire	Reserve name	Area (ha)	Vesting
Kojonup	Wandoora Nature Reserve	22	WA Wildlife Authority
Kojonup	Reserve No. 15061	16	National Parks and Nature Conservation Authority
Kojonup	Reserve No. 13102	16	National Parks and Nature Conservation Authority
Kojonup	Maragoonda Nature Reserve	13	National Parks and Nature Conservation Authority
Kojonup	Cherry Tree Pool Nature Reserve	4	WA Wildlife Authority
Nannup	D'Entrecasteaux National Park	36502	National Parks and Nature Conservation Authority
Nannup	Gingilup Swamps Nature Reserve	4323	WA Wildlife Authority
Narrogin	Highbury Reserve	4142	National Parks and Nature Conservation Authority
Narrogin	Arthur River Nature Reserve	3164	WA Wildlife Authority
Narrogin	Taarblin Lake Nature Reserve	1391	National Parks and Nature Conservation Authority
Narrogin	Dryandra State Forest	1200	National Parks and Nature Conservation Authority
Narrogin	Bokan Nature Reserve	431	National Parks and Nature Conservation Authority
Narrogin	Carmody Nature Reserve	392	National Parks and Nature Conservation Authority
Narrogin	Reserve No. 17115	183	National Parks and Nature Conservation Authority
Narrogin	Reserve No. 21067	106	National Parks and Nature Conservation Authority
Narrogin	Reserve No. 26787	105	National Parks and Nature Conservation Authority
Narrogin	Quongunnerunding Nature Reserve	68	National Parks and Nature Conservation Authority
Narrogin	Reserve No. 20895	64	National Parks and Nature Conservation Authority
Narrogin	Reserve No. 26669	54	National Parks and Nature Conservation Authority
Narrogin	Reserve No. 15855	40	National Parks and Nature Conservation Authority
Narrogin	Reserve No. 27644	34	National Parks and Nature Conservation Authority
Narrogin	Ibis Lake Nature Reserve	27	WA Wildlife Authority
Narrogin	Reserve No. 20878	25	National Parks and Nature Conservation Authority
Narrogin	Highbury Nature Reserve	17	National Parks and Nature Conservation Authority
Narrogin	Reserve No. 29611	8	National Parks and Nature Conservation Authority
Wagin	Dumbleyung Lake Nature Reserve	3959	WA Wildlife Authority
Wagin	Parkeyerring Nature Reserve	712	WA Wildlife Authority
Wagin	Gundaring Lake Nature Reserve	316	WA Wildlife Authority
Wagin	Casuarina Nature Reserve	197	WA Wildlife Authority
Wagin	East Collanilling Nature Reserve	172	National Parks and Nature Conservation Authority
Wagin	Cobline Nature Reserve	164	WA Wildlife Authority
Wagin	Buchanan Nature Reserve	129	WA Wildlife Authority
Wagin	Reserve No. 13279	116	National Parks and Nature Conservation Authority
Wagin	Reserve No. 20836	113	National Parks and Nature Conservation Authority

Appendix 14 Reserves vested for the conservation of
(continued) flora and fauna in the Blackwood Catchment

Shire	Reserve name	Area (ha)	Vesting
Wagin	Reserve No. 21064	111	National Parks and Nature Conservation Authority
Wagin	Reserve No. 19095	108	National Parks and Nature Conservation Authority
Wagin	Nallian Nature Reserve	97	WA Wildlife Authority
Wagin	Bockaring Nature Reserve	91	WA Wildlife Authority
Wagin	Concaring Nature Reserve	85	National Parks and Wildlife Authority
Wagin	Reserve No. 9098	85	National Parks and Conservation Authority
Wagin	Reserve No. 20479	65	National Parks and Nature Conservation Authority
Wagin	Reserve No. 2087	63	WA Wildlife Authority
Wagin	Jaloran Nature Reserve	63	National Parks and Nature Conservation Authority
Wagin	North Wagin Nature Reserve	62	National Parks and Nature Conservation Authority
Wagin	Dongolocking Nature Reserve	52	National Parks and Nature Conservation Authority
Wagin	Gnarkaryelling Nature Reserve	17	WA Wildlife Authority
West Arthur	Wildhorse Nature Reserve	419	WA Wildlife Authority
West Arthur	Beaufort Bridge Nature Reserve	263	Water Authority WA
West Arthur	Hillman Nature Reserve	248	National Parks and Nature Conservation Authority
West Arthur	Trigwell Nature Reserve	244	National Parks and Nature Conservation Authority
West Arthur	Boolading Nature Reserve	163	National Parks and Nature Conservation Authority
West Arthur	Towerninning Nature Reserve	162	National Parks and Nature Conservation Authority
West Arthur	Reserve No. 38371	72	National Parks and Nature Conservation Authority
West Arthur	Arthur River Nature Reserve	70	National Parks and Nature Conservation Authority
West Arthur	Reserve No. 38415	40	National Parks and Nature Conservation Authority
West Arthur	Haddleton Springs Nature Reserve	40	National Parks and Nature Conservation Authority
West Arthur	Reserve No. 35163	6	WA Wildlife Authority
Wickepin	Toolibin Nature Reserve	497	National Parks and Nature Conservation Authority
Wickepin	Reserve No. 19089	465	WA Wildlife Authority
Wickepin	Birdwhistle Nature Reserve	396	National Parks and Nature Conservation Authority
Wickepin	Dulbining Nature Reserve	343	WA Wildlife Authority
Wickepin	Mallee Plain Nature Reserve	316	WA Wildlife Authority
Wickepin	East Yomaning Nature Reserve	248	National Parks and Nature Conservation Authority
Wickepin	Reserve No. 9617	245	National Parks and Nature Conservation Authority
Wickepin	Reserve No. 25708	239	National Parks and Nature Conservation Authority
Wickepin	Reserve No. 19118	208	National Parks and Nature Conservation Authority
Wickepin	Reserve No. 19090	150	WA Wildlife Authority

Appendix 14 Reserves vested for the conservation of
(continued) flora and fauna in the Blackwood Catchment

Shire	Reserve name	Area (ha)	Vesting
Wickepin	Walbyring Nature Reserve	144	National Parks and Nature Conservation Authority
Wickepin	Reserve No. 19087	130	National Parks and Nature Conservation Authority
Wickepin	Reserve No. 19119	40	National Parks and Nature Conservation Authority
Wickepin	Mungerungcutting Nature Reserve	21	National Parks and Nature Conservation Authority
Wickepin	Reserve No. 15787	2	National Parks and Nature Conservation Authority
Wickepin	Reserve No. 15788	2	National Parks and Nature Conservation Authority
Williams	Williams Nature Reserve	206	WA Wildlife Authority
Williams	Reserve No. 30394	76	National Parks and Nature Conservation Authority
Williams	Reserve No. 41004	45	National Parks and Nature Conservation Authority
Woodanilling	Flagstaff Lake Nature Reserve	424	National Parks and Nature Conservation Authority
Woodanilling	Reserve No. 28471	253	National Parks and Nature Conservation Authority
Woodanilling	Strathmore Hill Nature Reserve	170	National Parks and Nature Conservation Authority
Woodanilling	Reserve No. 13145	133	National Parks and Nature Conservation Authority
Woodanilling	Murapin Nature Reserve	54	National Parks and Nature Conservation Authority
Woodanilling	King Rock Nature Reserve	51	WA Wildlife Authority
Woodanilling	Reserve No. 17258	42	WA Wildlife Authority
Woodanilling	Reserve No. 5339	40	National Parks and Nature Conservation Authority
Woodanilling	Miripin Nature Reserve	28	National Parks and Nature Conservation Authority
Woodanilling	Beaufort Bridge Nature Reserve	263	WA Water Authority

Source: Spatial Resource Information Group Database, Agriculture Western Australia

Appendix 15 Native mammals of the Katanning and Narrogin CALM districts
(Sanders and Harold, 1991)

Taxa	Common name	Conservation status
<i>Tachyglossus aculeatus</i>	Echidna	
<i>Dasyurus geoffroii</i>	Chudditch	G1, AR
<i>Phascogale calura</i>	Red-tailed phascogale	G1, AR, RP
<i>Anthechinus flaviceps</i>	Mardo	NR
<i>Sminthopsis gilberti</i>	Common dunnart	
<i>Sminthopsis griseoventer</i>	Common dunnart	PO, NR
<i>Sminthopsis crassicaudata</i>	Fat-tailed dunnart	
<i>Sminthopsis granulipes</i>	White-tailed dunnart	
<i>Antichinomys laniger</i>	Kultarr	NR
<i>Myrmecobius fasciatus</i>	Numbat	G1, AR
<i>Isooden obesulus fusciventer</i>	Brown bandicoot	G1, AR
<i>Perameles bougainville</i>	Barred bandicoot	ER, G1
<i>Macrotis lagotis</i>	Bilby	ER, G1
<i>Pseudocheirus peregrinus occidentalis</i>	Common ringtail possum	G1, AR, NR
<i>Trichosurus vulpecula</i>	Brush-tailed possum	
<i>Cercartetus concinnus</i>	South-west pygmy possum	
<i>Tarsipes rostratus</i>	Honey possum	
<i>Bettongia penicillata</i>	Woylie	G1, AR
<i>Bettongia lesueur</i>	Burrowing rat-kangaroo	ER, G1
<i>Onychogalea lunata</i>	Crescent nail-tailed wallaby	ER, G1
<i>Macropus eugenii</i>	Tammar wallaby	G1, AR
<i>Macropus irma</i>	Western brush wallaby	
<i>Macropus fuliginosus</i>	Western grey kangaroo	
<i>Tadarida australis</i>	White-striped bat	
<i>Mormopterus planiceps</i>	Little mastiff bat	NR
<i>Nyctophilus major</i>	Greater long-eared bat	
<i>Nyctophilus gouldi</i>	Gould's long-eared bat	NR
<i>Nyctophilus geoffroyi</i>	Lesser long-eared bat	
<i>Chalinologus morio</i>	Chocolate bat	
<i>Scotorepens balstoni</i>	Western broad-nosed bat	NR
<i>Falsistrellus mackenziei</i>		
<i>Hydromys chysogaster</i>	Water rat	
<i>Pseudomys shortridgei</i>	Blunt-faced mouse	G1, A
<i>Pseudomys albocinereus</i>	Ash-grey mouse	
<i>Pseudomys occidentalis</i>	Western mouse	G1, AR, RP
<i>Notomys mitchellii</i>	Mitchell's hopping mouse	
<i>Notomys alexis</i>	Brown hopping mouse	

Conservation status key

AR - At risk within the region

ER - Extinct within the region

G1 - Gazetted as Schedule 1 under Wildlife Conservation Act 1950

NR - Not recorded in the region since 1980

PO - Possibly occurring in the region but not yet recorded

RP - Population mainly within the region

Appendix 16 Reptiles and frogs of the Katanning and Narrogin CALM districts
(Sanders and Harold, 1991)

Taxa	Common name	Conservation status
Frogs and tree frogs		
<i>Leptodactylidae</i> (Frogs)		
<i>Crinia georgiana</i>		NK; AR
<i>Crinia pseudinsignifera</i>		NK; AR
<i>Heleioporus albopunctatus</i>		AR
<i>Heleioporus eyrei</i>	Moaning frog	AR
<i>Heleioporus inornatus</i>		AR
<i>Heleioporus psammophilus</i>		NR; AR
<i>Limnodynastes dorsalis</i>	Western banjo frog	AR
<i>Myobatrachus gouldii</i>	Turtle frog	AR
<i>Neobatrachus albipes</i>		RP; AR
<i>Neobatrachus kunapalari</i>		AR
<i>Neobatrachus pelobatoides</i>	Humming frog	AR
<i>Neobatrachus sutor</i>	Shoemaker frog	NR; AR
<i>Pseudophryne guentheri</i>	Gunther's toadlet	AR
<i>Pseudophryne occidentalis</i>	Oranged-crowned toadlet	NK; AR
<i>Hylidae</i> (Tree frogs)		
<i>Litoria adelaidensis</i>	Slender tree frog	AR
<i>Litoria cyclorhynchus</i>	Spotted-thighed frog	AR
<i>Litoria moorei</i>	Western green frog	AR
Reptiles		
<i>Chelidae</i> (Aquatic turtles)		
<i>Chelodina oblonga</i>	Oblong turtle	
<i>Gekkonidae</i> (Geckos)		
<i>Crenadactylus ocellatus ocellatus</i>	Clawless gecko	
<i>Diplodactylus granariensis</i>		
<i>Diplodactylus polyophthalmus</i>		
<i>Diplodactylus pulcher</i>		
<i>Diplodactylus spinigerus inornatus</i>	Western spiny-tailed gecko	
<i>Gehyra variegata</i>	Tree dtella	
<i>Oedura reticulata</i>	Reticulated velvet gecko	
<i>Phyllodactylus marmoratus marmoratus</i>	Marbled gecko	
<i>Underwoodisaurus milii</i>	Thick-tailed gecko	
<i>Pygopodidae</i> (Snake-lizards)		
<i>Aprasia pulchella</i>		
<i>Aprasia repens</i>		
<i>Delma australis</i>		
<i>Delma fraseri</i>		
<i>Delma greyii</i>		NR
<i>Lialis burtonis</i>	Burton's snake-lizard	
<i>Pygopus lepidopodus lepidopodus</i>	Common scaly-foot	NK
<i>Agamidae</i> (Lizards)		
<i>Ctenophorus cristatus</i>		
<i>Ctenophorus maculatus griseus</i>		
<i>Ctenophorus ornatus</i>		
<i>Ctenophorus salinarum</i>		
<i>Moloch horridus</i>	Thorny devil	
<i>Pogona minor minor</i>		
<i>Tymanocryptis adelaidensis</i>		NR
<i>Scincidae</i> (Lizards)		
<i>Bassiana trilineata</i>		

Appendix 16 Reptiles and frogs of the Katanning and Narrogin CALM districts
(continued) (Sanders and Harold, 1991)

Taxa	Common name	Conservation status
<i>Cryptoblepharus plagiocephalus</i>		
<i>Ctenotus catenifer</i>		NK
<i>Ctenotus gemmula</i>		NR
<i>Ctenotus impar</i>		
<i>Ctenotus labillardieri</i>		NR
<i>Ctenotus schomburgkii</i>		
<i>Egernia kingii</i>	King skink	NR
<i>Egernia multiscutata bos</i>		
<i>Egernia napoleonis</i>		
<i>Egernia richardi</i>		
<i>Hemiernis peronii</i>		
<i>Lerista microtis</i>		
<i>Menetia greyii</i>		
<i>Morethia butleri</i>		NR
<i>Morethia lineocellata</i>		NR
<i>Morethia obscura</i>		
<i>Tiliqua occipitalis</i>	Western blue-tongued lizard	
<i>Tiliqua rugosa rugosa</i>		
Varanidae (Lizards)		
<i>Varanus gouldii</i>	Gould's goanna or sand monitor	
<i>Varanus tristis tristis</i>		NK
<i>Varanus rosenburgi</i>		
Typhlopidae (Burrowing snakes)		
<i>Ramphotyphlops australis</i>		
<i>Ramphotyphlops pinguis</i>		NK
<i>Ramphotyphlops waitii</i>		
Boidae (Pythons)		
<i>Morelia spilota imbricata</i>	Carpet python	G2; AR
<i>Morelia stimsoni stimsoni</i>		PO(K); NK
Elapidae (Viper snakes)		
<i>Acanthophis antarcticus</i>	Common death adder	PO(K); NK
<i>Notechis coronatus</i>		PO(K); NK
<i>Notechis curtus</i>		
<i>Notechis scutatus occidentalis</i>	Mainland tiger snake	NR
<i>Pseudonaja australis</i>		NR
<i>Pseudonaja affinis affinis</i>	Dugite	
<i>Pseudonaja modesta</i>	Ringed brown snake	NK
<i>Pseudonaja nuchalis</i>	Western brown snake	
<i>Rhinoplocephalus bicolor</i>		NK
<i>Rhinoplocephalus gouldii</i>		
<i>Rhinoplocephalus nigriceps</i>		
<i>Vermicella bertholdi</i>		
<i>Vermicella bimaculata</i>		PO(K); NK
<i>Vermicella semifasciata semifasciata</i>		

Conservation status key
 AR - At risk within the region
 G2 - Gazetted as Schedule 2 under Wildlife Conservation Act 1950
 NR - Not recorded in the region since 1980
 PO - Possibly occurring in the region but not yet recorded
 PO(K) - Possibly occurring in the Katanning district
 NK - Date of last record not known
 RP - Population mainly within region

Appendix 17 Bird species in the Blackwood Catchment
(Barratt *et al.*, 1994; Garstone, 1970)

Scientific name	Common name
<i>Dromaius novaehollandiae</i>	Emu
<i>Podiceps cristatus</i>	Great crested grebe
<i>Podiceps novaehollandiae</i>	Australasian grebe
<i>Podiceps poliocephalus</i>	Hoary-headed grebe
<i>Phalacrocorax melanoleucos</i>	Little pied cormorant
<i>Pelecanus conspicillatus</i>	Pelican
<i>Anhinga melanogaster</i>	Darter
<i>Phalacrocorax carbo</i>	Great cormorant
<i>Phalacrocorax sulcirostris</i>	Little black cormorant
<i>Ardea pacifica</i>	Pacific heron
<i>Ardea noveahollandiae</i>	White-faced heron
<i>Egretta alba</i>	Great egret
<i>Nycticorax caledonicus</i>	Rufous night heron
<i>Botaurus stellaris</i>	Australasian bittern
<i>Threskiornis spinicollis</i>	Straw-necked ibis
<i>Platalea flaviceps</i>	Yellow-billed spoonbill
<i>Cygnus atratus</i>	Black swan
<i>Stictonetta naevosa</i>	Freckled duck
<i>Tadorna tadornoides</i>	Australian shelduck
<i>Anas superciliosa</i>	Pacific black duck
<i>Anas gibberifrons</i>	Grey teal
<i>Anas castanea</i>	Chestnut teal
<i>Anas rhynchotis</i>	Australian shoveler
<i>Malacorhynchus membranaceus</i>	Pink-eared duck
<i>Aythya australis</i>	Hardhead
<i>Chenonetta jubata</i>	Wood duck
<i>Oxyura australis</i>	Blue-billed duck
<i>Biziura lobata</i>	Musk duck
<i>Elanus caeruleus</i>	Black-shouldered kite
<i>Lophoictinia isura</i>	Square-tailed kite
<i>Haliastur sphenurus</i>	Whistling kite
<i>Accipiter fasciatus</i>	Brown goshawk
<i>Accipiter cirrocephalus</i>	Collared sparrowhawk
<i>Aquila audax</i>	Wedge-tailed eagle
<i>Circus assimilis</i>	Spotted harrier
<i>Circus aeruginosus</i>	Marsh harrier
<i>Falco peregrinus</i>	Peregrine falcon
<i>Falco longipennis</i>	Australian hobby
<i>Falco berigora</i>	Brown falcon
<i>Falco cenchroides</i>	Australian kestrel
<i>Leipoa ocellata</i>	Malleefowl
<i>Coturnix novaehollandiae</i>	Stubble quail
<i>Turnix varia</i>	Painted button-quail
<i>Turnix velox</i>	Little button-quail
<i>Porzana pusilla</i>	Baillon's crake
<i>Porzana tabuensis</i>	Spotless crake
<i>Gallinula ventralis</i>	Black-tailed native-hen
<i>Porphyrio porphyrio</i>	Purple swamphen
<i>Fulica atra</i>	Eurasian coot
<i>Otis australis</i>	Australasian bustard

Appendix 17 Bird species in the Blackwood Catchment
(continued) (Barratt *et al.*, 1994; Garstone, 1970)

Scientific name	Common name
<i>Burhinus grallarius</i>	Bush thick-knee
<i>Vanellus tricolor</i>	Banded lapwing
<i>Charadrius cucullatus</i>	Hooded plover
<i>Charadrius dubius</i>	Red-capped plover
<i>Charadrius melanops</i>	Black-fronted plover
<i>Peltohyas australis</i>	Inland dotterel
<i>Charadrius alexandrinus</i>	Red-capped dotterel
<i>Charadrius melanops</i>	Black-fronted dotterel
<i>Himantopus himantopus</i>	Black-winged stilt
<i>Cladorhynchus leucocephalus</i>	Banded stilt
<i>Recurvirostra novaehollandiae</i>	Red-necked avocet
<i>Tringa hypoleucos</i>	Common sandpiper
<i>Tringa nebularia</i>	Greenshank
<i>Tringa stagnatilis</i>	Marsh sandpiper
<i>Limosa limosa</i>	Black-tailed godwit
<i>Calidris acuminata</i>	Sharp-tailed sandpiper
<i>Calidris ferruginea</i>	Curlew sandpiper
<i>Larus novaehollandiae</i>	Silver gull
<i>Sterna hydrida</i>	Whiskered tern
<i>Phaps chalcoptera</i>	Common bronzewing
<i>Phaps elegans</i>	Brush bronzewing
<i>Ocyphaps lophotes</i>	Crested pigeon
<i>Calyptorhynchus magnificus</i>	Red-tailed black cockatoo
<i>Calyptorhynchus latirohynchus</i>	Carnaby's cockatoo
<i>Calyptorhynchus baudinii</i>	Baudin's black cockatoo
<i>Cacatua roseicapilla</i>	Galah
<i>Cacatua tenuirostris</i>	Long-billed corella
<i>Glossopsitta porphyrocephala</i>	Purple-crowned lorikeet
<i>Polytelis anthopeplus</i>	Regent parrot
<i>Melopsittacus undulatus</i>	Budgerigar
<i>Platycercus spurius</i>	Red-capped parrot
<i>Platycercus icterotis</i>	Western rosella
<i>Barnardius zonarius</i>	Port Lincoln parrot
<i>Psephotus varius</i>	Mulga parrot
<i>Neophema elegans</i>	Elegant parrot
<i>Cuculus pallidus</i>	Pallid cuckoo
<i>Cuculus flabelliformis</i>	Fan-tailed cuckoo
<i>Chrysococcyx osculans</i>	Black-eared cuckoo
<i>Chrysococcyx basalis</i>	Horsefield's bronze cuckoo
<i>Chrysococcyx lucidus</i>	Shining bronze cuckoo
<i>Ninox novaeseelandiae</i>	Southern boobook owl
<i>Ninox connivens</i>	Barking owl
<i>Podargus strigoides</i>	Tawny frogmouth
<i>Aegotheles cristatus</i>	Owlet nightjar
<i>Eurostopodus guttatus</i>	Spotted nightjar
<i>Dacelo gigas</i>	Laughing kookaburra
<i>Halycon sancta</i>	Sacred kingfisher
<i>Merops ornatus</i>	Rainbow bee-eater
<i>Hirundo neoxena</i>	Welcome swallow
<i>Hirundo nigricans</i>	Tree martin
<i>Hirundo ariel</i>	Fairy martin

Appendix 17 Bird species in the Blackwood Catchment
(continued) (Barratt *et al.*, 1994; Garstone, 1970)

Scientific name	Common name
<i>Anthus novaeseelandiae</i>	Richard's pippit
<i>Corocina novaehollandiae</i>	Black-faced cuckoo shrike
<i>Lalage leucomela</i>	White-winged triller
<i>Drymodes brunneopygius</i>	Southern scrub robin
<i>Petroica multicolor</i>	Scarlet robin
<i>Petroica goodenovii</i>	Red-capped robin
<i>Petroica cucullata</i>	Hooded robin
<i>Eopsaltria georgiana</i>	Western yellow robin
<i>Microeca leucophaea</i>	Jacky winter
<i>Falcunculus frontatus</i>	Crested shrike-tit
<i>Pachycephala pectoralis</i>	Golden whistler
<i>Pachycephala rufiventris</i>	Rufous whistler
<i>Colluricincla harmonica</i>	Grey shrike-thrush
<i>Oreoica gutturalis</i>	Crested bellbird
<i>Rhipidura fuliginosa</i>	Grey fantail
<i>Rhipidura leucophrys</i>	Willy wagtail
<i>Psophodes nigrogularis</i>	Western whipbird
<i>Cinclosoma castanotum</i>	Chestnut quail-thrush
<i>Pomatostomus superciliosus</i>	White-browed babbler
<i>Acrocephalus stentoreus</i>	Clamorous reed warbler
<i>Megalurus gramineus</i>	Little grassbird
<i>Cincloramphus mathewsi</i>	Restless songlark
<i>Cincloramphus cruralis</i>	Brown songlark
<i>Malurus pulcherrimus</i>	Blue-breasted fairy wren
<i>Stipiturus malachurus</i>	Southern emu-wren
<i>Sericornis frontalis</i>	White-browed scrubwren
<i>Sericornis cautus</i>	Shy hylacola
<i>Pyrrholaemus brunneus</i>	Redthroat
<i>Sericornis fuliginosus</i>	Calamanthus
<i>Smicromis brevirostris</i>	Weebill
<i>Gerygone fusca</i>	Western gerygone
<i>Acanthiza apicalis</i>	Inland thornbill
<i>Acanthiza chrysorrhoa</i>	Chestnut-rumped thornbill
<i>Acanthiza inornata</i>	Western thornbill
<i>Acanthiza chrysorrhoa</i>	Yellow-tailed thornbill
<i>Daphoenositta chrysoptera</i>	Varied sittella
<i>Climacteris rufa</i>	Rufous tree-creeper
<i>Anthochaera carunculata</i>	Red wattlebird
<i>Anthochaera chrysoptera</i>	Little wattlebird
<i>Acanthagenys rufogularis</i>	Spiny-cheeked honeyeater
<i>Meliphaga cratitia</i>	Purple-gaped honeyeater
<i>Helithreptus brevirostris</i>	Brown-headed honeyeater
<i>Helithreptus lunatus</i>	White-naped honeyeater
<i>Lichmera indistincta</i>	Brown honeyeater
<i>Phylidonyris novaehollandiae</i>	New Holland honeyeater
<i>Phylidonyris melanops</i>	Tawny-crowned honeyeater
<i>Phylidonyris nigra</i>	White-cheeked honeyeater
<i>Acanthorhynchus superciliosus</i>	Western Spinebill
<i>Certhionyx niger</i>	Black honeyeater
<i>Epithianura tricolor</i>	Crimson chat
<i>Ephthianura albifrons</i>	White-fronted chat

Appendix 17 Bird species in the Blackwood Catchment
(continued) (Barratt *et al.*, 1994; Garstone, 1970)

Scientific name	Common name
<i>Dicaeum hirundinaceum</i>	Mistletoebird
<i>Pardalotus punctatus</i>	Spotted pardalote
<i>Pardalotus xanthopygus</i>	Yellow-rumped pardalote
<i>Pardalotus striatus</i>	Striated pardalote
<i>Zosterops gouldi</i>	Western silvereve
<i>Poephila guttata</i>	Zebra finch
<i>Grallina cyanoleuca</i>	Australian magpie lark
<i>Artamus personatus</i>	Masked woodswallow
<i>Artamus cinereus</i>	Black-faced woodswallow
<i>Artamus cyanopterus</i>	Dusky woodswallow
<i>Cracticus torquatus</i>	Grey butcherbird
<i>Cracticus nigrogularis</i>	Pied butcherbird
<i>Gymnorhina tibicen</i>	Australian magpie
<i>Strepera versicolor</i>	Grey currawong
<i>Corvus coronoides</i>	Australian raven
<i>Corvus bennetti</i>	Little crow

Appendix 18 Key to the soil landscape systems map (Figure 10)

The soil landscape systems map is derived from soil landscape maps produced by the Natural Resources Assessment Group of Agriculture Western Australia. These were prepared at scales ranging from 1:50 000 to 1:150 000 by Churchward (1993), Percy (unpub.), Tille and Percy (unpub.) and Tille and Lantzke (1990). Land system boundaries on the eastern and north-eastern edges of the catchment are shown as dashed lines as these areas have not yet been mapped in detail (Figure 10).

Art - Arthur River System (Zone of Rejuvenated Drainage - upper-middle catchment)

The Arthur River System is an alluvial plain of the Arthur River downstream to its junction with the Buchanan River. The soils are formed on sand and clay deposited by the river, which have been redistributed by the wind. It includes plain, levee, river channel, dune and swamp landform elements.

The plain landform dominates the system and has shallow sandy duplex soils with grey or brown sodic clay subsoils with neutral to slightly alkaline pH. The shallow duplex soils are associated with smaller areas of deep duplex soils and hard-setting grey loamy duplex soils. The system has small dunes running parallel to the river which have loose yellow or brown sands. It includes lakes and swamps as well as the dune and swale elements associated with them.

About 30 per cent of the system's soils are affected by secondary salinisation, that is, salinity which has resulted from the clearing of natural vegetation in the surrounding countryside.

Bea - Beaufort System (Zone of Rejuvenated Drainage - upper-middle catchment)

The Beaufort System is an alluvial plain of the Beaufort River downstream of the Carrolup River and Lake Charling. The soils are formed on sand and clay deposited by the river, which have been redistributed by the wind. It includes plain, levee, river channel, dune, prior stream and swamp landform elements.

The plain landform dominates the system and has deep sandy duplex soils with grey or brown sodic clay subsoils with neutral to slightly alkaline pH. The deep duplex soils are associated with smaller areas of shallow duplex soils and hard setting grey loamy duplex soils. The system has dunes running parallel to the river which have loose yellow or brown sands. These sands also appear in small areas in old stream channels or on levees.

About 20 per cent of the system's soils are affected by secondary salinisation.

Bos - Boscabel System (Eastern Darling Range Zone - lower-middle catchment)

The Boscabel System's gently undulating rises and small alluvial plains north of Kojonup are drained by the 52 Creek and Kojonup Brook, directly to the Beaufort and Arthur Rivers.

The soils on the mid-slope and upper slopes and crests are mainly deep sandy gravels with loose white sands. Duricrust and shallow sandy gravels are common on hill crests. Deep sandy duplex soils occur on the mid and lower slopes, valley flats and small alluvial plains. These soils often contain gravel layers and have either yellow or brown clayey or loamy subsoils.

Deep loose yellow or brown sands occur on the valley flats and on the eastern margins of swamps and lakes. These small lakes and swamps may occur on the valley flats, alluvial plains or the upper slopes and crests on the rises. They may also be associated with deep loose white sands.

Blk - Blackwood Alluvial Plain (Donnybrook Sunkland Zone - lower catchment)

The Blackwood Plateau System consists of a broad, gently undulating plateau. It is dominated by broad, lateritic divides with yellow-brown and grey sandy gravels. There are areas of grey and yellow-brown deep loose sands and shallow sandy gravels over duricrust. There are occasional tracts of swampy terrain.

Shallow, minor valleys with gravelly and sandy soils are common. Some are U-shaped with swampy floors. Others are more deeply incised, V-shaped valleys with narrow floors.

The soils mostly have neutral to acidic pH.

Appendix 18 Key to the soil landscape systems map (Figure 10) (continued)

Boy - Boyup Brook Valleys System (Eastern Darling Range Zone - lower-middle catchment)

The Boyup Brook Valleys System have formed where the Blackwood River has dissected the Eulin Uplands System to form shallow to moderately incised (15 to 50 m deep) valleys with yellow-brown loamy and sandy gravels and reddish or brownish loamy duplex soils. The latter often have sodic clay subsoils but are not calcareous.

Deeper valleys (to 100 m deep) are found downstream from Boyup Brook. Here red to brown loams grading into clay and granitic rock outcrop are often found. On the floors of the valleys are narrow waterlogged flats, usually salt affected. Along the Blackwood River are well-drained flats with deep, loose brown sands.

Cow - Cowaramup Uplands System (Leeuwin Block Zone - lower catchment)

The Cowaramup Uplands System is a gently undulating to undulating plateau formed on the lateritized granite basement of the Leeuwin Block. The most common soils are yellow-brown sandy and loamy gravels. There are extensive poorly drained flats with grey-brown sands and loams. Deep loose grey sands are often found along the western margin.

The soils mostly have neutral to acidic pH.

Car - Carrolup System (Zone of Rejuvenated Drainage - upper-middle catchment)

The Carrolup System's gently undulating to undulating rises and low hills are drained by the Carrolup River, Gordon River, Wadjekanup River, Carlecatup Creek, Boyerine Creek and by the Cobline River on its eastern edge.

The soils are formed on colluvial deposits derived from weathered granite and deeply weathered ancient soil profiles. The dominant soils are deep sandy duplex with sodic, neutral yellow or brown subsoils.

Along the catchment divides, shallow sandy duplex, loamy duplex and deep coarse sand, formed on weathered granite or quartz, become more common. Soils formed on weathered dolerite are shallow sandy duplex and, less often, loamy duplex soils which are reddish-brown in colour and often have neutral, sodic clay subsoils.

The lower slopes and valley flats have shallow and deep sandy duplex soils with grey or brown sodic subsoils. These soils are prone to waterlogging and are often affected by secondary salinisation.

The system also includes the small alluvial plain along the Carrolup and Carlecatup Creeks which have deep sandy duplex and loose yellow or brown sands in dunes and levees along the river. The crests and upper slopes of the Carrolup System have sandy gravels and small pockets of loose white sand.

Cob - Cobline System (Zone of Ancient Drainage - upper catchment)

The Cobline System covers the broad, level to very gently sloping alluvial plain of the Cobline River and its tributaries, including the Lefroy River and Dongolocking Creek.

Soils are mainly shallow and deep sandy duplex with grey or brown clay subsoils which are sodic and calcareous. At least 50 per cent of these soils are affected by secondary salinity with much of the remainder at high risk of salinisation and waterlogging.

Minor soils in the Cobline System include cracking clays and calcareous loams. The system includes lakes such as Lake Dumbleyung. On the east and south-eastern sides of lakes are dune and swale systems which contain deep sandy duplex soils with small areas of loamy duplex and loose yellow or brown sands.

Cle - Collie Basin System (Western Darling Range Zone - lower-middle catchment)

The Collie Basin System is found where two small Permian sedimentary basins containing coal fields occur on the Darling Plateau south of Wilga.

This system is dominated by broad, lateritic divides with grey and yellow-brown sandy gravels. Deep loose grey and yellow-brown sands are also common. In between the divides are broad tracts of swampy terrain with deep loose grey sands over coffee rock and shallow, minor valleys with swampy floors.

The soils mostly have neutral to acidic pH.

Appendix 18 Key to the soil landscape systems map (Figure 10) (continued)

Dnt - D'Entrecasteaux Dunes System (Donnybrook Sunkland Zone - lower catchment)

The D'Entrecasteaux Dunes System consists of 20 to 80 m high coastal sand dunes. Soils are deep loose grey siliceous sands and calcareous sands, with some areas of deep loose yellow-brown siliceous sands over limestone.

Dye - Dellyanine System (Zone of Rejuvenated Drainage - upper-middle catchment)

The Dellyanine System is a major system in the Wagin and eastern West Arthur shires. It consists of gently undulating to undulating rises and low hills north of the Beaufort River, extending west to the Hillman River and north to the Blackwood Catchment divide. The system extends east to approximately the Great Southern Highway and is drained by the Arthur, Beaufort, Buchanan and Hillman Rivers.

The soils are mainly deep sandy duplex with loamy sand or clayey sand topsoil over yellow or brown, neutral to slightly acid subsoils. The subsoils are usually clayey and are generally sodic if located on lower slopes, in valley floors or formed on the weathered dolerite or kaolinitic clay layers of the deeply weathered ancient soil profiles.

The rises and low hills are capped with sandy gravel, duricrust and small areas of loose white or grey sand. These are usually bounded by shallow sandy duplex soils often with acidic, sodic subsoils.

The alluvial plain of the Arthur River, downstream from the Arthur River System, is included in the Dellyanine System.

Drk - Darkan System (Eastern Darling Range Zone - lower-middle catchment)

The Darkan System's gently undulating to undulating rises and low hills are drained by the Arthur, Blackwood and Hillman Rivers.

The hill slopes are usually loamy or sandy gravels, particularly the rises adjacent to the Blackwood Catchment divide. Closer to the valley flats, the rises and low hills have soils formed on weathered granite or dolerite. These soils tend to be deep sandy duplex soils and loamy duplex soils.

The rises and low hills are capped with duricrust and loamy gravels and are often bounded by steep short breakaways.

Dgk - Dongolocking System (Zone of Ancient Drainage - upper catchment)

The Dongolocking System has gently undulating to undulating rises with sandy gravels on the crests and upper slopes, sometimes associated with small areas of deep loose white or grey sand.

Shallow sandy duplex soils dominate the hill slopes. These soils have sodic brown or grey subsoils and are usually calcareous.

The Dongolocking System includes shallow sandy duplex soils and small areas of deep coarse sand formed on weathered granite or gneiss and reddish-brown shallow sandy duplex or loamy duplex soils formed on weathered dolerite.

Calcareous sodic shallow sandy duplex soils commonly affected by secondary salinisation occur on the valley flats.

Dpe - Darling Plateau System (Western Darling Range Zone - lower-middle catchment)

The Darling Plateau System consists of an undulating plateau surface dominated by broad, lateritic divides formed over a crystalline basement. It is found north of the Blackwood River.

The major soils of the divides are yellow-brown sandy and loamy gravels. Grey sandy gravels and deep loose grey and yellow sands are also common, especially over sedimentary deposits. The soils mostly have neutral to acidic pH.

Some of the divides are almost level with extensive areas of poor drainage. Most of these have formed over old sedimentary deposits.

Reddish-brown loamy gravels are found on ridges running off the southern edge of the Plateau. Shallow (5 to 20 m deep), minor valleys with gravels and sands are common. Downstream, loams grading into clay may be found.

The upper valleys are often U-shaped with swampy floors. Salinity is a problem on the floors of these valleys in the upper Hester Brook Catchment.

Appendix 18 Key to the soil landscape systems map (Figure 10) (continued)

Dat - Datatine System (Zone of Ancient Drainage - upper catchment)

The Datatine System has undulating rises with soils formed on weathered gneiss or colluvium derived from weathered gneiss. The soils are reddish-brown in colour and include shallow sandy duplex and loamy duplex soils with sodic, calcareous subsoils.

Other common soils are reddish-brown or red calcareous loams with minor areas of red cracking clay. The rises are capped with small areas of sandy gravels and have foot slopes which commonly have calcareous loams or cracking clays.

The system includes the valley flats. In some places, the foot slopes and valley flats have gilgai micro relief, that is, an undulating soil surface commonly called crabholes or melon holes.

Esk - East Katanning System (Zone of Ancient Drainage - upper catchment)

The East Katanning System's gently undulating rises east and north-east of Katanning are drained by the Coblinine River.

The soils are mainly shallow sandy duplex soils with calcareous yellow, brown or grey sodic subsoils. Gravel layers are common in these soils, particularly on the upper slopes and crests.

There are no large sandplain areas in this system with very small patches of deep loose white or grey sands associated with sandy gravels on the hill crests and summits.

Eun - Eulin Uplands System (Eastern Darling Range Zone - lower-middle catchment)

The Eulin Uplands System is found in association with the Boyup Brook Valleys System. The Uplands are similar in nature to the Darling Plateau System, which often adjoins. They consist of plateaus and plateau remnants (mostly lateritic) containing ridges and divides with yellow-brown loamy and sandy gravels. Pockets of sandy soils are also present.

In some areas, such as Kulikup, Qualeup and Haddleton, there are extensive flats with poor drainage formed on Eocene sedimentary deposits. Gravelly and sandy soils are common on these as well as on some low hills rising above the plateau surface. Shallow, minor valleys with gravelly, sandy and loamy soils and swampy floors are common between the divides. The soils mostly have neutral to acidic pH.

Far - Farrar System (Zone of Rejuvenated Drainage - upper-middle catchment)

The Farrar System's undulating rises and low hills are drained by the Balgarup River. Soils are formed on weathered granite or dolerite or from colluvium derived from weathered rock.

The soils derived from granitic parent material are deep sandy and shallow sandy duplex soils, often with loamy sand or clayey sand surface textures. Doleritic parent material produced shallow sandy duplex or loamy duplex soils which are brown or reddish-brown in colour.

This system has only small areas of sandy gravels, which often sit above breakaways of shallow sandy duplex soils with acid subsoils. The valley flats have shallow sandy duplex which are slightly affected by secondary salinity. Hillside seeps are common where the shallow bedrock forces ground water close to the surface.

Gtn - Gracetown Ridge System (Leeuwin Block Zone - lower catchment)

The Gracetown Ridge System consists of a discontinuous high ridge of Tamala Limestone reaching 210 m above sea level. It is overlain by deep loose yellow and red siliceous sands and fields of parabolic dunes formed from calcareous sands deposited in the late Pleistocene or Holocene.

Gwd - Goodwood Valleys System (Donnybrook Sunkland Zone - lower catchment)

The Goodwood Valleys System consists of low (20 to 50 m deep) valley systems. These have formed as a result of the dissection of the Blackwood Plateau by the Blackwood River, St John's Brook and Rosa Brook.

The valley side slopes have gradients mostly between 3 and 25 per cent and are covered with yellow-brown and grey gravel sands and sands. River terraces with deep loose brown sands and deep red loams are often present on the valley floors. The soils are usually neutral to acidic pH.

Appendix 18 Key to the soil landscape systems map (Figure 10) (continued)

Hmn - Hillman System (Zone of Rejuvenated Drainage - upper-middle catchment)

The Hillman System consists of the alluvial plain of the Hillman River and its tributaries, containing plain, stream channel, dune, levee and terrace elements.

The soils are similar to those of the Beaufort System, being deep sandy duplex soils with grey or brown sodic clay subsoils. Deep yellow or brown sands occur on the dunes and levees.

About 20 per cent of the soils in this system are affected by secondary salinisation.

Kkn - Kukerin System (Zone of Ancient Drainage - upper catchment)

The Kukerin System has gently undulating to undulating rises with sandy gravel and loose white or grey sands on the upper slopes and crests. Shallow sandy duplex soils with calcareous sodic subsoils are found on the hill slopes.

Calcareous grey or brown loams are common on the rises immediately adjacent to the alluvial plain on the Dongolocking Creek (Coblinine System). The system includes valley flats and areas of deep sandy duplex soils formed on weathered granite.

Ldn - Lowden Valleys System (Western Darling Range Zone - lower-middle catchment)

The Lowden Valleys System consists of dissected terrain (mostly 40 to 200 m deep) where the Blackwood River and its tributaries have eaten into the Darling Plateau, exposing fresh rock. It also occurs along the Darling Scarp.

The deeply incised valleys have moderate to steep slopes and red to yellow loams grading to clays. Rock outcrop is sometimes present.

Moderately incised valleys with loams and red to yellow loamy gravels are found upstream. Along the valley floors are river flats with deep loose brown sands and deep red loams.

Near Mullalyup there are some slopes with gravelly and sandy soils derived from Kirup Conglomerate. Some low slopes with gravels are found along the Darling Scarp.

The soils mostly have neutral to acidic pH.

Mnj - Manjimup Plateau System (Warren Southland Zone - lower-middle catchment)

The Manjimup Plateau System consists of a gently undulating plateau surface south of the Blackwood River. It is dominated by broad, lateritic divides with yellow-brown to red loamy and sandy gravels. There are some low hills with similar soils rising above the plateau surface.

Broad tracts of poorly drained flats with deep loose grey sands and sandy duplex soils are present near Yornup.

Shallow, minor valleys with gravels and deep loose yellow to grey sands are common. Some are U-shaped valleys with swampy floors. In the more deeply incised, V-shaped valleys, loams grading to clays are often found.

The soils mostly have neutral to acidic pH.

Nlp - Nillup Plain System (Donnybrook Sunkland Zone - lower catchment)

The Nillup Plain System is a level to gently undulating plain with extensive areas of poor drainage, lying between the southern edge of the Blackwood Plateau and the Scott River Plain.

Soils are mainly grey-brown sands and loams and yellow-brown sandy and loamy gravels. There are also areas of deep loose grey sands.

The soils mostly have neutral to acidic pH.

Appendix 18 Key to the soil landscape systems map (Figure 10) (continued)

Nor - Norring System (Zone of Rejuvenated Drainage - upper-middle catchment)

The Norring System covers the broad, level to very gently sloping alluvial plain of the Beaufort River east and lower reaches of Boyerine Creek.

Soils are mainly shallow, deep sandy duplex soils with grey or brown clay subsoils which are sodic and neutral to slightly calcareous. At least 60 per cent of these soils are affected by secondary salinity with much of the remainder at high risk of salinisation and waterlogging.

Minor soils in the Norring system include cracking clays and non-cracking grey clays.

The system includes lakes such as Lake Norring. On the east and south-eastern sides of lakes are dune and swale systems which contain fertile deep sandy duplex soils with small areas of loamy duplex and infertile loose yellow or brown sands. The system also includes a small sandplain east of Lake Norring which has loose white or grey sand and deep sandy duplex soils.

Npg - Nippering System (Zone of Ancient Drainage - upper catchment)

The Nippering System has undulating rises and low hills north of Lake Dumbleyung with loamy duplex, shallow sandy duplex and calcareous loams associated with weathered gneiss or colluvium derived from weathered gneiss.

Small areas of sandy gravels occur on the hill crests of the rises and shallow sandy duplex soils occur on the valley flats.

Nyb - Nyabing System (Zone of Ancient Drainage - upper catchment)

The Nyabing System has gently undulating rises with shallow sandy duplex soils, sandy gravels and loose white sands. It is located east of Moojebing and south of Moulyinning.

Prp - Perup Plateau System (Warren-Denmark Southland Zone - lower-middle Catchment)

The Perup Plateau System consists of gently undulating lateritic plateau. It formed on granite and Tertiary sediments and has extensive swampy plains and depressions. Gravelly and sandy yellow duplex soils are dominant, with yellow solonetzic soils and podzols being found in swamps.

Sct - Scott River Plain System (Donnybrook Sunkland Zone - lower catchment)

The Scott River Plain System is a broad, poorly drained, level to gently undulating coastal plain formed on Quaternary sediments. It ranges in elevation from sea level to 40 m above sea level.

Most of the Plain consists of poorly drained flats with deep loose grey to white sands, often over coffee rock. These sometimes have a dark topsoil due to the high organic matter content.

In some areas shallow sands or loams over bog iron ore are found. Low dunes of deep loose grey sands are common. Along the Blackwood River are well drained flats with deep yellow to brown sands or loams.

The soils mostly have neutral to acidic pH.

Trt - Treeton Hills System (Donnybrook Sunkland Zone - lower catchment)

The Treeton Hills System's undulating rises and rolling low hills were formed by the dissection of the lateritised Perth Basin sedimentary rocks by the upper Chapman and Rosa Brooks.

Yellow-brown sands and gravels are found on the ridges and hill crests while similar gravels and grey-brown sands and loams are found on side slopes. Some valley floors are swampy while other have narrow strips of well-drained deep red loams.

The soils mostly have neutral to acidic pH.

Tin - Tincurrin System (Zone of Ancient Drainage - upper catchment)

The Tincurrin System consists of gently undulating rises with shallow duplex soils, sandy gravels and yellow-brown sands grading to loams over a small area north of Moulyinning.

Appendix 18 Key to the soil landscape systems map (Figure 10) (continued)

Tne - Tieline System (Zone of Ancient Drainage - upper catchment)

The Tieline System covers the level to gently undulating plain and gently undulating rises east of Broomehill and north of Gnowangerup.

The soils are mainly shallow sandy duplex or hard-setting grey loamy duplex soils formed on kaolinised, highly weathered gneiss or granite. The clay subsoils are sodic but range from acidic, neutral to calcareous.

Soils formed on weathered dolerite are reddish-brown and are mainly shallow sandy duplex or loamy duplex soils but also include cracking clays and calcareous loams. Very small areas of loose white or grey sand occur on the upper slopes.

Wly - Wilyabrup Valleys System (Leeuwin Block Zone - lower catchment)

The Wilyabrup Valleys System has undulating to rolling low valleys formed by the dissection of the Cowaramup Plateau.

Soils include yellow-brown loamy gravels, reddish-brown loams grading to clays and sandy duplex soils. There are some areas of deep loose grey sands in the headwaters of McLeod Creek.

The soils mostly have neutral to acidic pH.

Wmb - Whimbin System (Zone of Rejuvenated Drainage - upper-middle catchment)

The Whimbin System consists of gently undulating to undulating rises east of the Great Southern Highway, between Wagin and Highbury. The system is drained by the Arthur and Buchanan Rivers.

Sandy gravels extend from the hill crests to the lower hill slopes on the gently undulating rises along the Arthur River.

Hill slopes of the undulating rises have shallow sandy duplex soils and loamy duplex soils with neutral to alkaline pH which are slightly calcareous.

Appendix 19 Save the Bush projects in the Blackwood Catchment

Year	Recipient	Project description	Amount funded (\$)
1989/90	Carlecatup LCD	Carlecatup Creek remnant native vegetation program	21,080
	Katanning Shire Council	O'Callaghan Park revegetation	4,274
1990/91	Dumbleyung LCDC	Fencing of unformed road reserves	20,000
1991/92	Dongolocking Corridors Group Shire of Dumbleyung	Save the Bush at Dongolocking II	3,000
		Recording remnant vegetation on undeveloped road reserves	8,000
1992/93	Katanning LCDC and Carrolup Catchment Sub-Group	Carrolup River remnant vegetation program	20,000
		Upper Tone River Sub-catchment Group	Undertaking revegetation projects
	Middle Tone River Sub-catchment Group	Undertaking revegetation projects	14,850
	Carlecatup LCD	Formation of Dort sub-catchment group	16,500
	Towerlup North Catchment Group	Rehabilitation of remnant bush and degraded areas	2,000
	Southern Aboriginal Corporation	Marribank endangered flora project	14,280
1993/94	Shire of Dumbleyung	Catalogue and filing of flora samples remnant vegetation survey	1,000
	Dongolocking Farming Community	Monitoring small and large invertebrates in planted corridors	3,000
	A. & A. Woithe	Cooririnyup Hill bushland revegetation	1,350
	Williams LCDC	Williams River remnant vegetation and wildlife habitat	3,115
	Towerlup North Catchment Group	Vegetation protection and land rehabilitation	9,600
1994/95	Narrogin LCDC	Narrogin free range piggery shelter water use corridor revegetation project	4,760
	Katanning Creek Catchment Group and Katanning Corridor Revegetation Group	Creepline Corridor revegetation project 1995/97	12,000
	Lower Balgerup Catchment Group	Increasing vegetation in the Lower Balgerup	7,500
	South Bryde Catchment Group and Lake Bryde LCDC	Revegetation of the Lake Bryde drainage line	14,740
	Changerup Catchment Group	Revegetate catchment using monitoring, trees and perennial vegetation	6,000
Total: \$204,900			

Appendix 20 One Billion Trees projects in the Blackwood Catchment

Year	Recipient	Project description	Amount funded (\$)
1989/90	Lake Toolibin Catchment Group		5,000
	Gnowangerup LCD		20,000
	M. McFall		4,371
1990/91	P. Blight		1,230
	Woodanilling LCD		17,000
1991/92	Boongadoo Catchment Group		200
	West Wadjekanup Catchment Group		3,000
	M. McFall		3,000
	Lower Balgarup Catchment Group	Addressing revegetation and landcare problems in the catchment	8,000
1992/93	Lake Toolibin Catchment Group	Demonstration of Seeding	788
	Nyabing/Pingrup LCD	Slee's 'Greening and Water Use Project'	2,003
	Lower Balgarup Catchment Group	Addressing revegetation and landcare problems in the catchment	16,500
	Carlecatup LCD	Direct seeding of corridors project	3,116
	Flat Rocks Catchment Group	Developing agroforestry in the upper landscape	8,400
	Towerlup North Catchment Group	Rehabilitate remnant bush and degraded areas in the catchment	12,946
	M. Taylor		573
1993/94	Dongolocking Farming Community	Seedlings for wildlife corridors	1,600
	East Narrogin Catchment Group	Yilliminning Townsite revegetation and rehabilitation demonstration	2,000
	Gnowangerup LCD and Woolaganup Moana Catchment Group	Bottom Crown seep	1,400
	Byenup Hill Catchment Group	Implementing a revegetation strategy for wildlife corridors and creek stabilization	6,250
	Ryans Brook Catchment Group	Regeneration of Ryans Brook	10,000
	Lower Balgarup Catchment Group	Rehabilitate salt and waterlogged affected corridors in the catchment	10,120
	Wattle Creek Sub-catchment Group	Fence and regenerate natural waterways in the catchment	7,200
1994/95	Boongadoo Soil Conservation Group	Revegetation of Boongadoo Creek Catchment to control salinity	16,500
	Narrogin LCD	Free-range piggery shelter, water use, corridor revegetation project	3,652
	South Bryde Catchment Group	Revegetation of the Lake Bryde drainage line to link two nature reserves and to control salinity	14,740
	Catterick Catchment Group and Bridgetown-Greenbushes LCDC	Regenerating the Upper Hester Catchment for land and water protection	10,500
	Minnigin Brook Catchment Group and Narrogin LCDC	Minnigin Brook Catchment integrated revegetation and remnant vegetation protection using local provenance seed	17,636
	Katanning Creek Catchment Group	Creating corridors of vegetation along natural drainage line of Katanning Creek	12,000
	Lower Balgarup Catchment Group	Continue to increase vegetation in the Lower Balgarup Catchment	7,500
Total: \$227,225			

**Appendix 21 National Landcare Program projects in the Blackwood Catchment
(previously National Soil Conservation Program)**

Year	Recipient	Project description	Amount funded (\$)
1989/90	Dumbleyung LCD and Woodanilling LCD	Soil conservation strategies for the Dumbleyung	210,584 (over 4 years)
	Wickepin LCD and Narrogin LCD	Narrogin Catchment Project Officer	200,175 (over 6 years)
	Nyabing/Pingrup LCD	Nyabing/Pingrup LCD Tree Planting Project	9,000
1990/91	Nyabing/Pingrup LCD and Katanning LCD and Katanning LCDs	Towards sustainable agriculture in Nyabing/Pingrup	312,800 (over 4 years)
1991/92	Boyup Brook LCD and Broomehill LCD	Community Facilitator	162,649 (over 4 Years)
	Wagin, Dumbleyung, Woodanilling, Katanning, Broomehill and Kent Shires	Katanning land capability assessment	309,551 (over 4 years)
1992/93	Wagin LCD	Saltland revegetation project	10,000
	Williams LCD	Wangeling Gully stream rehabilitation and monitoring demonstration	8,850
	Katanning LCD	Group Co-ordination and local resource utilisation in the Katanning LCDC	19,000
	Boyup Brook LCD	Landcare understanding in the Boyup Brook LCD	2,250
	Dumbleyung, Wickepin and Kulin LCDs	Investigation of subsurface water and soils to formulate catchment plans	9,475
	Broomehill and Carlecatup LCDs	Airborne geophysical survey of the west of the Broomehill Shire and upper Carlecatup catchment	40,000
	Bridgetown-Greenbushes LCD Flat Rocks Catchment Group and Kojonup Shire	High rainfall land use planning Agroforestry in the upper landscape	49,910 13,460
1993/94	Woodanilling LCD	Assessment of groundwater levels	5,000
	Wagin Shire	Purchase of a seeding machine for revegetating saltland areas	5,000
	Lower Blackwood LCD	Investment of the characteristics of land in the catchment	4,580
	Carlecatup LCD	Carlecatup wetland project	4,855
1994/95	Wajekanup/Byenup Hill Landcare Group	Groundwater inventory and truthing of airborne geological survey	17,500
	St. Brigid's Primary School, Bridgetown	Bridgetown Wetlands rehabilitation project	720
	Woodanilling LCDC	Co-ordination of LCDC projects throughout the catchment area	42,000
	Blackwood Catchment Ribbons of Blue	Community assessment of the state of the middle Blackwood River system	64,500

Appendix 21 National Landcare Program projects in the Blackwood Catchment
(continued) (previously National Soil Conservation Program)

Year	Recipient	Project description	Amount funded (\$)
1994/95	Wahkinup Creek Catchment Group	Evaluating the water use of trees and perennials on a quartz seepage	1,120
	Katanning LCDC	Katanning Landcare Show - facilitating community education and awareness	6,905
	Lake Toolibin Catchment Group (Wickepin LCDC)	Lake Toolibin Revegetation Strategy	18,000
	Dumbleyung, Kulin, Wickepin and Nyabing LCDs	Regional Landcare Co-ordinator for Upper Blackwood Catchment	177,110
	Upper Great Southern LCDC groupings	Upper Great Southern key farmers sustainable systems promotion	11,560
	Williams LCDC	Williams LCDC groundwater monitoring project	4,500
	Geological Survey of Western Australia	Blackwood River Catchment - hydrogeological resource base for management	32,450
Total: \$2.07 million			

Appendix 22 State Landcare Program projects in the Blackwood Catchment

1988-92

Project Title: Soil Conservation Strategies, Dumbleyung and Woodanilling LCDs

Objectives: *To accelerate the adoption of soil conservation and land management practices in the area.*

State assistance provided: \$10,000 a year over for the duration of the project.

1988/89

Project Title: Wickepin Soil Conservation Register

Project Location: Wickepin

Project Description: Detailed survey of land management and conservation practices has just been carried out throughout the 140 farms in the Shire of Wickepin. One of the principal aims of the survey is to identify, document and map the location of outstanding on-farm projects in the fields of soil and water conservation. This information will then be published and made available as a reference guide for all landowners in the Shire.

State assistance provided: \$2,000

Contact person: Mrs L. Chadwick

PO Box 386

Narrogin WA 6312

Ph: (098) 82 7065

1989/90

Project Title: Wogolin Creek Catchment-Stage I

Project Location: 40 km east of Wickepin (eight farms involved)

Project Description: The eight farmers involved are in the Wogolin Catchment which runs from Dudinin down to Yealering Lake. Between the eight farmers there is 3400 ha of land which is at risk of becoming salty. At present only 20 per cent of this land is affected by salinity. There is a need for more surface drainage to help alleviate some of the waterlogging problems. 15,000 trees have been planted by farmers since 1989. The intention of this project is to sink 200 bore holes to measure the level of the water table, to study the soil profile in some problem areas, conduct a magnetrometer and EM survey to study dolerite dykes and salt concentrations in the landscape and to hire a land care assistant to plan and survey most of the surface drainage area.

State assistance provided: \$8,400

Contact person: Mr Ashley Lewis

RMB 126 East Wickepin WA 6370

Ph: (098) 88 6040

Project Title: Wickepin Project II-Windbreak network for the Upper Toolibin Lake Catchment

Project Location: Twenty properties in the Upper Toolibin Catchment, south-east of Wickepin

Project Description: Toolibin Lake is an important wetland area threatened by a rising salt water table. This project aims to address recharge problems in the catchment in two ways. The main approach focuses on the planting of a major regional windbreak system with three-row windbreaks, at a rate of 20 km per year for the next five years. The second strategy involves fencing off 2000 ha of deep sand for tagasaste establishment and management.

State assistance provided: \$25,000

Contact person: Mrs L. Chadwick

PO Box 386

Narrogin WA 6312

Ph: (098) 82 7065

Appendix 22 State Landcare Program projects in the Blackwood Catchment (continued)

Project Title: Mapping of subsurface formations likely to affect groundwater movement causing land degradation.

Project Location: Dumbleyung, Gnowangerup, Broomehill, Boyup Brook LCDs

Objectives: To map affected areas in order to determine the location of features below ground level that influence the levels of salinity within designated sites. To develop effective counter measures based on information gained in the survey.

State assistance provided: \$10,000

Project Title: Installation of piezometers to map subsurface watertables in designated saline areas.

Project Location: Dumbleyung, Woodanilling, Broomehill and Boyup Brook.

Objectives: To map watertables within degraded site, or sites with a high potential for degradation.

State assistance provided: \$10,000

Project Title: Mallen Niche Seeder

Project Location: Dumbleyung

Objectives: It has been decided that a Mallen Niche seeder to plant salt tolerant and other fodder shrubs and trees on areas prone to degradation will help to alleviate the problems of salinity, waterlogging and wind erosion.

State assistance provided: \$9,250

Project Title: Interpretation and ground truthing of infra-red photography as tool in the assessment of the severity of degradation.

Project Location: Woodanilling

Project Description: A previous grant from State Landcare covered part of the cost of an E M survey. At the same time that this was undertaken, infra-red photography of the area was also undertaken and paid for by the 20 landholders within the Cartmesticup catchment group. The group now aims to develop a five year self help program based upon the surveys to overcome land degradation within the area.

State assistance provided: \$10,000

Contact person: Barry Shackley

PO Box 103

Woodanilling WA 6316

Ph: (098) 22 8027

Project Title: Colour aerial photo coverage of the Wagin Shire

Project Location: Wagin Land Conservation District

Project Description: The landscape of the Wagin Shire is dominated by two valley systems (the Arthur River and the lake chain overflow from Lake Dumbleyung). Salinity is a major concern to landholders (3 per cent of the cleared area was salt affected in 1979 and 6.73 per cent affected by 1989). Colour aerial photo coverage of the Shire would be of great assistance in problem definition and catchment planning.

State assistance provided: \$5,760

Contact person: Mr Phillip Blight

PO Box 102

Wagin WA 6315

Ph: (098) 61 1562

Project Title: Installation of piezometers to map subsurface watertables in designated saline areas

Project Location: Woodanilling, Boyup Brook, Broomehill and Dumbleyung

Project Description: Within the Great Southern region the principal cause of land degradation is that of rising watertables. This project proposed to map watertables within degraded sites, formulate effective control measures based on information gained and initiate effective counter measures.

State assistance provided: \$10,000

Contact person: Angus Woithe

PO Box 59

Broomehill WA 6318

Ph: (098) 24 1232

Appendix 22 State Landcare Program projects in the Blackwood Catchment (continued)

Title: Water utilization demonstration

Project Location: Kojonup

Project Description: The aim of this project was to demonstrate techniques in regenerating various types of vegetation on poorly drained and salt affected areas, resulting in an increase in groundwater usage.

State assistance provided: \$6,210

Contact person: Alan Anderson

PO Box 11

Kojonup WA 6395

Ph: (098) 32 8055

1990/91

Project Title: Kimberley Seeds tree planter

Location: Dumbleyung

Objectives: To make seed planter available to all landowners within the LCD.

State assistance provided: \$9,000

Project Title: Demonstration of revegetation techniques upon laterite caps to control recharge and provide windbreaks.

Dumbleyung LCD, South-Kukerin-Merilup Sub Catchment Group

State funds provided: \$3,000

Project Title: Saltland agronomy trials

Project Location: Nyabing/Pingrup LCD

Objectives: To assess viable plant species that can be utilized on soils affected by salinity and flooding.

State assistance provided: \$1,315

Project Title: Purchase of a mobile drilling rig for drilling piezometers and observation wells

Project Location: Nyabing/Pingrup, Pingaring and Lakes LCDs

Objective: By installing piezometers, farmer education and awareness of salinity processes will be enhanced.

State assistance provided: \$3,500

Project Title: Purchase of surveying equipment

Project Location: Mynelup Catchment Group

Objective: It is proposed to purchase a set of surveying equipment for use by the LCD and the catchment group.

State assistance provided: \$1,104

Project Title: Hillside seepage reclamation demonstration

Project Location: West Arthur

Project Description: The Lake Towerrinning Landcare Group is a catchment group that formed in 1989 to reverse the deterioration in Lake Towerrinning and to address land degradation in the catchment. The Group decided to establish a demonstration of hillside seepage control using both vegetative and mechanical reclamation techniques. A seepage beside a road near Moodiarrup was selected. Piezometers were installed, R.B.S.I. were surveyed and fencing planned. Reverse bank interceptors were constructed above the seepage and eight hectares of land surrounding the seepage were planted with trees. The site was eventually moved to Chris and Wendy Cochrane's property near Capercup. This site was surveyed, fenced and planted to trees.

State assistance provided: \$1,300

Contact person: Mr K. O'Connor

c/ Shire of West Arthur

Darkan WA 6392

Appendix 22 State Landcare Program projects in the Blackwood Catchment (continued)

Project Title: Perennial pasture demonstration

Project Location: West Arthur

Project Description: The aim of this project was to establish a 10 hectare demonstration of perennial grass pasture that could be grazed under commercial conditions on the Hillman River flats.

State assistance provided: \$1,700

Contact person: Mr K. O'Connor

c/ Shire of West Arthur

Darkan WA 6392

Project Title: To demonstrate the feasibility of a combination of drainage and agroforestry to combat increasing waterlogging and salinity

Project Location: Dailup Creek Catchment

Project Description: The demonstration consisted of a shallow drainage system to reduce waterlogging and tree planting to reduce salinity. Over three to four years this is expected to entail 14 km of fencing.

State assistance provided: \$4,800

Contact person: Mr K. O'Connor

c/ Shire of West Arthur

Darkan WA 6392

Project Title: Saltland monitoring in the Colanilling Catchment

Project Location: Farms in the Colanilling Catchment of the Wagin Shire

Project Description: Thirteen farmers in the Colanilling Gully Catchment (131,000 ha) have formed a group to reverse land degradation in the catchment. Salinity is a major problem and one of their goals is to monitor watertable levels to assess the area of land at risk, and long term watertable changes. The project aims to establish conservation bores at strategic sites throughout the catchment, and further bores are to be in a deep drainage demonstration and to monitor any effect of drainage of watertables.

State assistance provided: \$500

Contact person: J. Farrow

PO Box 138

Wagin WA 6315

Ph: (098) 61 1681

Project Title: Catchment mapping - Colanilling Gully Catchment

Project Location: Colanilling Gully Catchment

Project Description: A major goal of the Wagin Land Conservation District Committee is to promote the formation of functional catchment groups. The Colanilling Gully Catchment Group is the first group to have formed and the Land Conservation District Committee (LCDC) wishes to promote Colanilling Gully as an example of successful group action. As part of their objectives for the next five years, group members have decided to map their problems, seek out advice, find solutions and prepare a catchment plan. In this project, each member will map soil types and degradation problems onto an aerial photograph. This information will be transferred onto a Geographic Information System (GIS) to produce a map of the entire catchment.

State assistance provided: \$1,000

Contact person: J. Farrow

Wagin WA 6315

Ph: (098) 61 1681

Project Title: Land conservation within the Lower Balgarup Catchment Group

Project Location: Kojonup

Project Description: To purchase a Shelterbelter 200 seedling tree planter to activate land conservation in the Lower Balgarup Catchment Group area.

State assistance provided: \$5,375

Contact Person: Phillip Grice

RMB 522

Kojonup WA 6395

Ph: (098) 33 1202

Appendix 22 State Landcare Program projects in the Blackwood Catchment
(continued)

Project Title: Banks and trees for water control

Project Location: Kojonup (Middle Kojonup Brook Catchment Group)

Project Description: The Middle Kojonup Brook Catchment Group has formed to improve agricultural production, by reducing waterlogging, controlling hillside seepages, stabilising the valley floor salinity and farm planning.

The aim of this project is to grade banks and culverts, to construct a levee system and to plant and fence trees in agro-forestry spacings.

State assistance provided: \$1,345

Contact person: Greg Paini

RMB 509

Kojonup WA, 6395

Ph: (098) 32 8049

1991/92

Project Title: Demonstration of co-ordinated and planned valley floor drainage

Location: Shire of Wickiepin

Project Description: This demonstration requires the construction of nine drains to channel floodwaters across Lake Toolibin Flats and around/through the reserve to Lake Toolibin lake. This main drain is 8.6 km long and 13 m wide and will separate salt and freshwater flows of surface water.

State assistance provided: \$15,000

Contact Person: Mrs Mary Taylor

PO Box 37

Tincurrin WA 6361

Ph: (098) 83 2044

Project Title: Fence Road Lucerne Project

Location: Dumbleyung

Objectives: To establish lucerne on a whole paddock and to demonstrate its application in the Dumbleyung LCD.

State assistance provided: \$4,000

Project Title: Carrolup Catchment groundwater recharge treatment

Project Location: Katanning

Project summary: Valley floor salinity has extensively affected Carrolup Creek Catchment. The opportunity for "tree help" and "educational projects" exists. This project links these two themes in one demonstration.

Objectives: The LCD committee and the Catchment group intend setting up a practical demonstration on this site: 1) To control excess surface water with drains. 2) To establish trees (local seed/species) by ripping and mounding. 3) To establish salt tolerant grasses and shrubs. 4) To encourage a closer unity between farmers and city folk.

State assistance provided: \$3,400

Contact Person: Mr Bill Coleman

PO Box 172, Katanning 6317

Ph: (098) 21 0012

Project Title: Conservation planning workshop for smallholders

Location: Katanning

Project summary: Many small landholders are concentrated in the Katanning Creek Catchment and they have recognised the value of conservation planning.

Objectives: 1) To provide conservation workshops with emphasis on planning strategies for small landholders; 2) To have the attendance of all small landholders in the Katanning Creek catchment at a planning workshop.

State assistance provided: \$2,000

Contact person: Norman Flugge

Box 312, East Katanning 6317

Ph: (098) 22 1505

Appendix 22 State Landcare Program projects in the Blackwood Catchment
(continued)

Project Title: Land stabilisation and management

Location: Katanning

Project summary: The site is to be used to demonstrate practical management techniques which will stabilise a light sand soils type subject to wind erosion and increase its productive capacity.

Objectives: To establish and manage a sustainable and productive farming system on a problem soil type. The project will provide a practical demonstration and "hands on" opportunities for farmers regarding:
1) Establishment techniques for perennials on fragile soil types. 2) Practical management requirements for long-term maintenance of the site. 3) Production information which farmers can utilise when making planning decisions for their own properties.

State assistance provided: \$4,937

Contact person: Lynne Coleman

Secretary, Katanning LCD

PO Box 172, Katanning 6317

Ph: (098) 21 0047

Project Title: Whole catchment planning workshop for smallholders

Location: Kojonup

Project Description: 74 small landholders are concentrated in the Upper Kojonup Brook Catchment and they recognise the value of conservation planning. The aim of the workshop is to help to co-ordinate the catchment group and to create a willingness of catchment group members to work together and foster close co-operation between smallholders.

State Assistance Provided: \$2,000

Contact person: Jenny Gardner

PO Box 135

Kojonup WA 6395

Ph: (098) 31 1576

Project Title: Rehabilitating severe erosion and salinity

Project Location: Kojonup (Wahkinup Creek Catchment group)

Project Description: To set up a visual demonstration in the area for raising awareness, demonstrating the control of gully salinity and erosion and to encourage local co-operation and involvement.

State assistance provided: \$3,100

Contact person: W.M. Webb

"Marbarrup"

PO Box 126

Kojonup WA 6395

Ph: (098) 32 3025

Project Title: Cure for hillside seepage

Project Location: Carlecatup

Project Description: It is proposed to increase the water usage of the vegetation with the area concerned so that waterlogging and seepage is reduced, and no outflow of water except in periods of extreme rainfall. This will be done by strategically establishing deep-rooted perennials within the site which will use far more water than the present shallow-rooted annual pastures.

State assistance provided: \$7,862

Contact person: Mr Neil Young

RMB 232

Kojonup WA 6395

Ph: (098) 21 0026

Appendix 22 State Landcare Program projects in the Blackwood Catchment
(continued)

1992/93

Project Title: Agroforestry for the Great Southern

Project Location: Carlecatup

Project Description: The principal objective of this project is to establish 50 hectares of valley floor with wide spaced rows of eucalypts, with the trees to be managed to produce saw logs.

State assistance provided: \$5,150

Contact Person: Mr Robert O'Halloran

"Cherry Tree Estate"

RMB 219

Kojonup WA 6395

Ph: (098) 21 0060

Project Title: Demonstrating perennial pastures in the farm system

Project Location: Byenup Hill Catchment

Project Description: The first intention of this project is to demonstrate that by selecting suitable land management units, pasture species and management practices, the farming systems will become more profitable. The second intention is to show that the 'new' farming system will use more water than the current one. In doing so, that it will help reduce salinity on site and prevent degradation of land further down the catchment.

State assistance provided: \$3,584

Contact person: Roger Bilney

PO Box 88

Kojonup WA 6395

Ph: (098) 34 1012

Project Title: Demonstrating run-off control as part of a farm plan

Project Location: Wattle Creek Catchment, Kojonup

Project Description: The project proposes a combination of treatment to land degradation and future farm planning principles in a large self-contained catchment. Also it plans to measure all run-off of surface water through two types of drainage systems, to measure the affect of these drains, trees and perennials on the water table and on productivity, and to develop a system of corridors for wildlife from two large remnant bush areas.

State assistance provided: \$9,955

Contact person: Andrew Stewart

"Wendouree Downs"

RMB 717

Kojonup WA 6395

Ph: (098) 32 1063

Project Title: Lower Balgarup Catchment farm plans

Project Location: Kojonup

Project Description: The catchment and individual farms will be mapped into land management units (based on soil types), saline and waterlogged areas, drainage line, remnant vegetation, erosion areas, roads and fence lines using Geographic Information Systems (GIS).

State assistance provided: \$7,000

Contact person: Paul Ayers

"Dandaloo"

RMB 538

Kojonup WA 6395

Ph: (098) 33 2222

**Appendix 22 State Landcare Program projects in the Blackwood Catchment
(continued)**

Project Title: Albany Highway-Tarwillie Road - 52 Creek Catchment Group

Project Location: Kojonup

Project Description: Subsequent to a well attended group meeting, members agreed to follow a systematic approach for treating land degradation on a whole catchment basis

State assistance provided: \$9,562

Contact person: John Kelly

RMB 569

Kojonup WA 6395

Ph: (098) 33 1229

Project Title: Cartmeticup map storage and whiteboard

Project Location: Woodanilling LCD

Project Description: This funding will purchase a 6 drawer map cabinet and a whiteboard/pin board to improve the storage and use of resources collected since the LCDC was formed.

State assistance provided: \$2,416

Contact person: Mrs Rose Kerr

PO Box 160

Wagin WA 6315

Ph: (098) 22 8020

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