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Native Vegetation Handbook for the Shire of Williams

Shaun B. Grein

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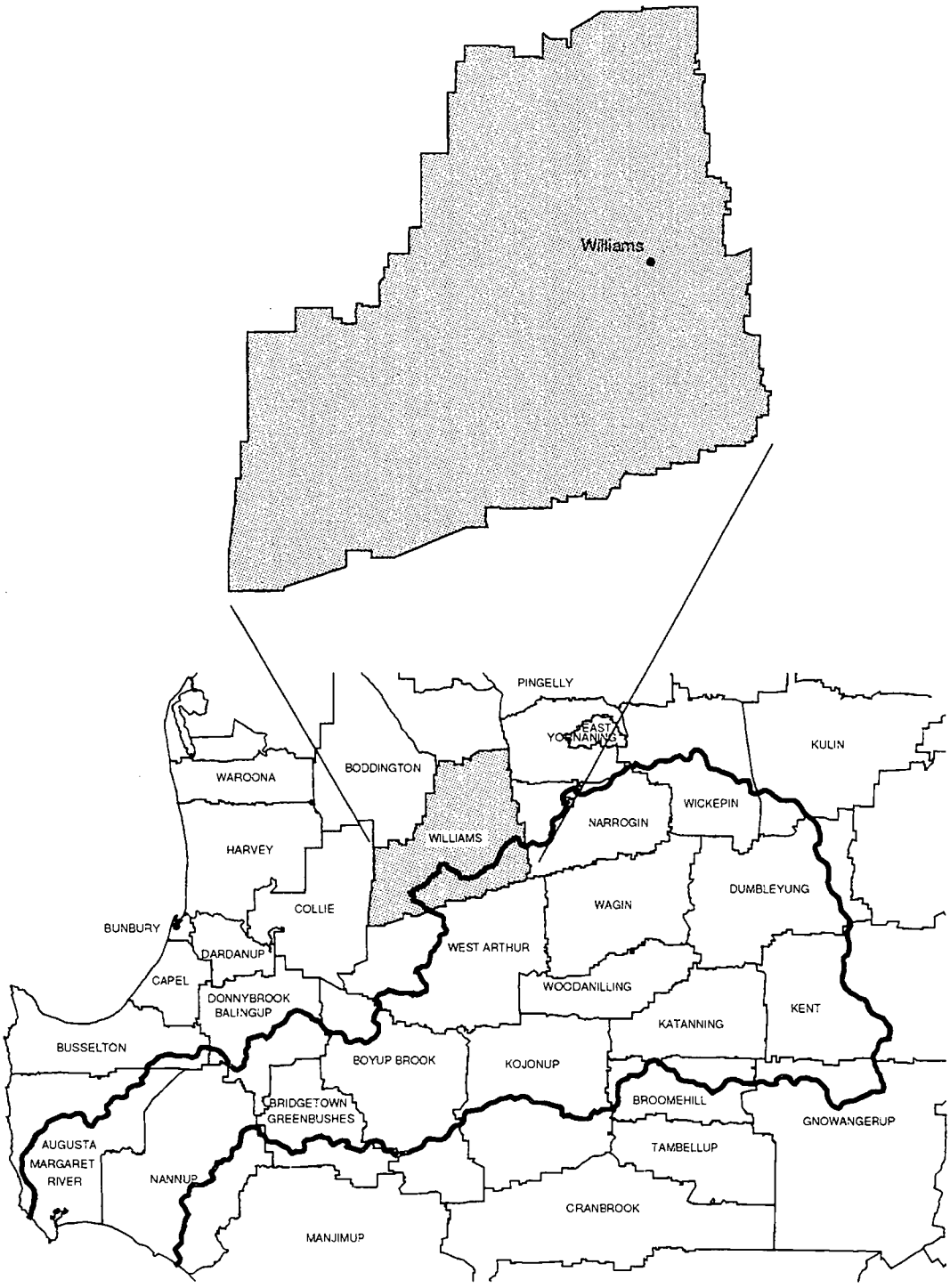

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Acknowledgments

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Copies of the Native Vegetation Handbook for the Shire of Williams are available by contacting:

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Cover: The Shire of Williams in Relation to the Blackwood River Catchment (indicated by bold line).

NATIVE VEGETATION HANDBOOK

FOR THE SHIRE OF WILLIAMS

Shaun B. Grein

Spatial Resources Information Group

Land Management Branch

Division of Regional Operations

Western Australian Department of Agriculture

Produced by the Western Australian Department of Agriculture and Greening Western Australia with the assistance from the Commonwealth Government through the Australian Nature Conservation Agency's Save the Bush Program.

November, 1994

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The Shire of Williams

Introduction

Purpose of this Booklet

This project has arisen from the need to provide data to people in rural communities, land conservation districts (LCDs) and local government authorities who manage the remnant native vegetation within rural areas, whether on a regional, catchment or local basis.

This booklet is one of a series covering the agricultural region of Western Australia. The management of native vegetation and agricultural land is closely related. It is vital that both native vegetation and agricultural land issues are considered within the context of their ecological area of influence. Both have a wide range of effects on each other and as a consequence should be managed together. For example native vegetation has an effect on the hydrology of agricultural land, and nutrients can be transferred from farmland to remnants of native vegetation.

This booklet provides land managers with information relating to the natural resources of the Shire of Williams including the existing vegetation, drainage systems and soils. Some of the problems relating to the management of natural vegetation resources in the Shire of Williams and possible solutions to these problems are also discussed. By providing this information it is hoped this booklet will contribute to the long term viability of the agricultural landscape and the conservation of native vegetation within the Shire.

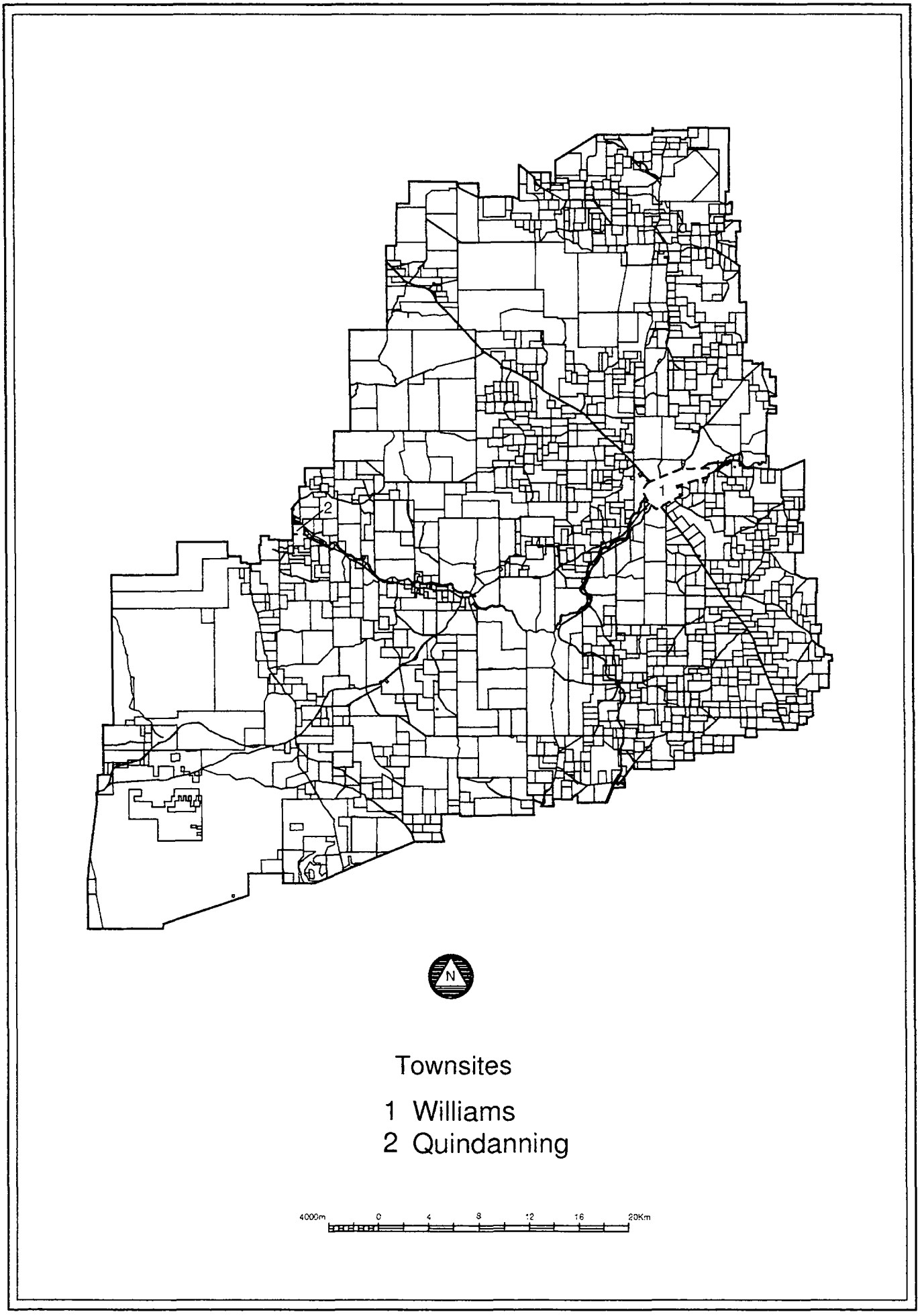


Figure 1: Cadastral boundaries and townsites in the Shire of Williams.

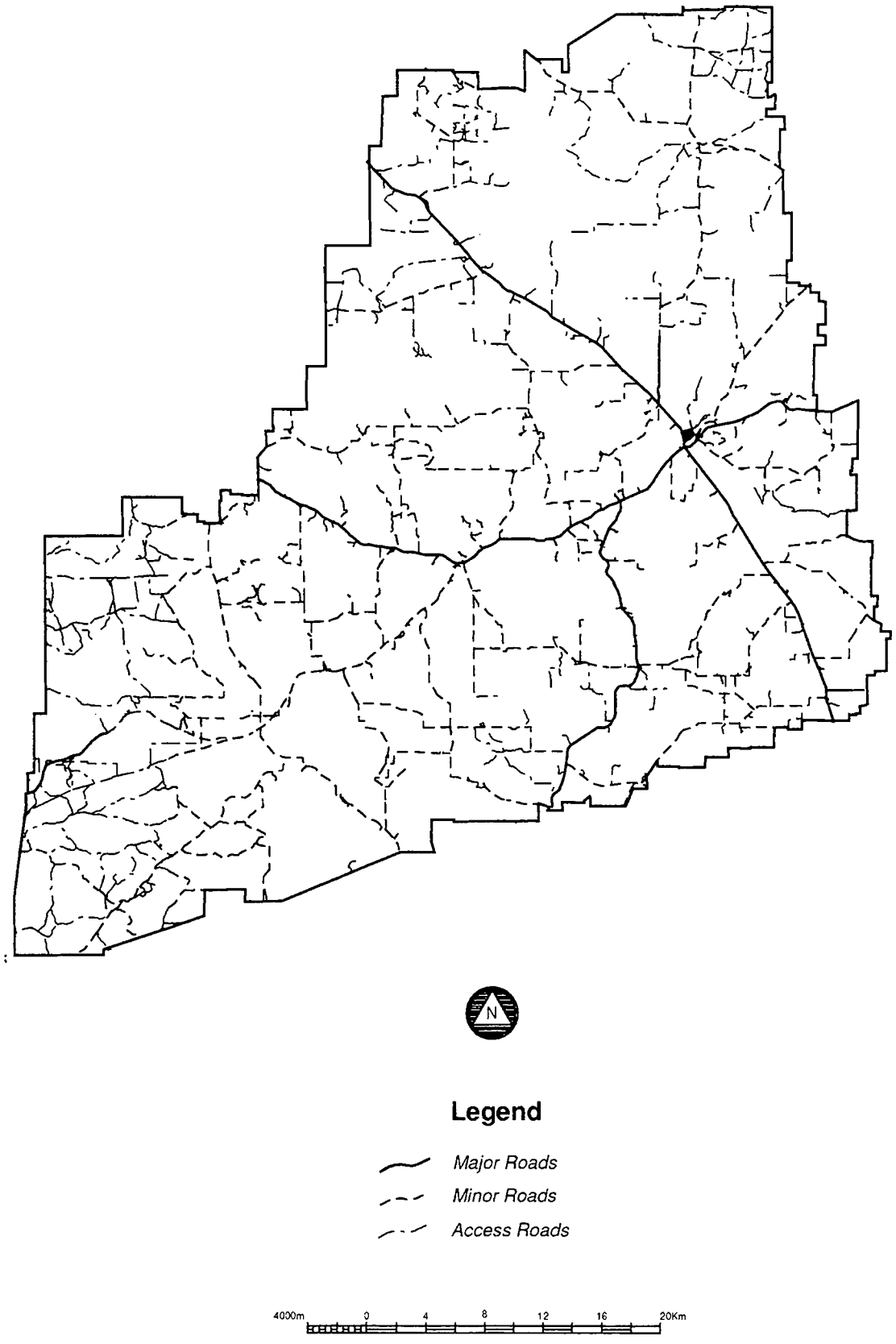


Figure 2: All major, minor and access roads in the Shire of Williams.

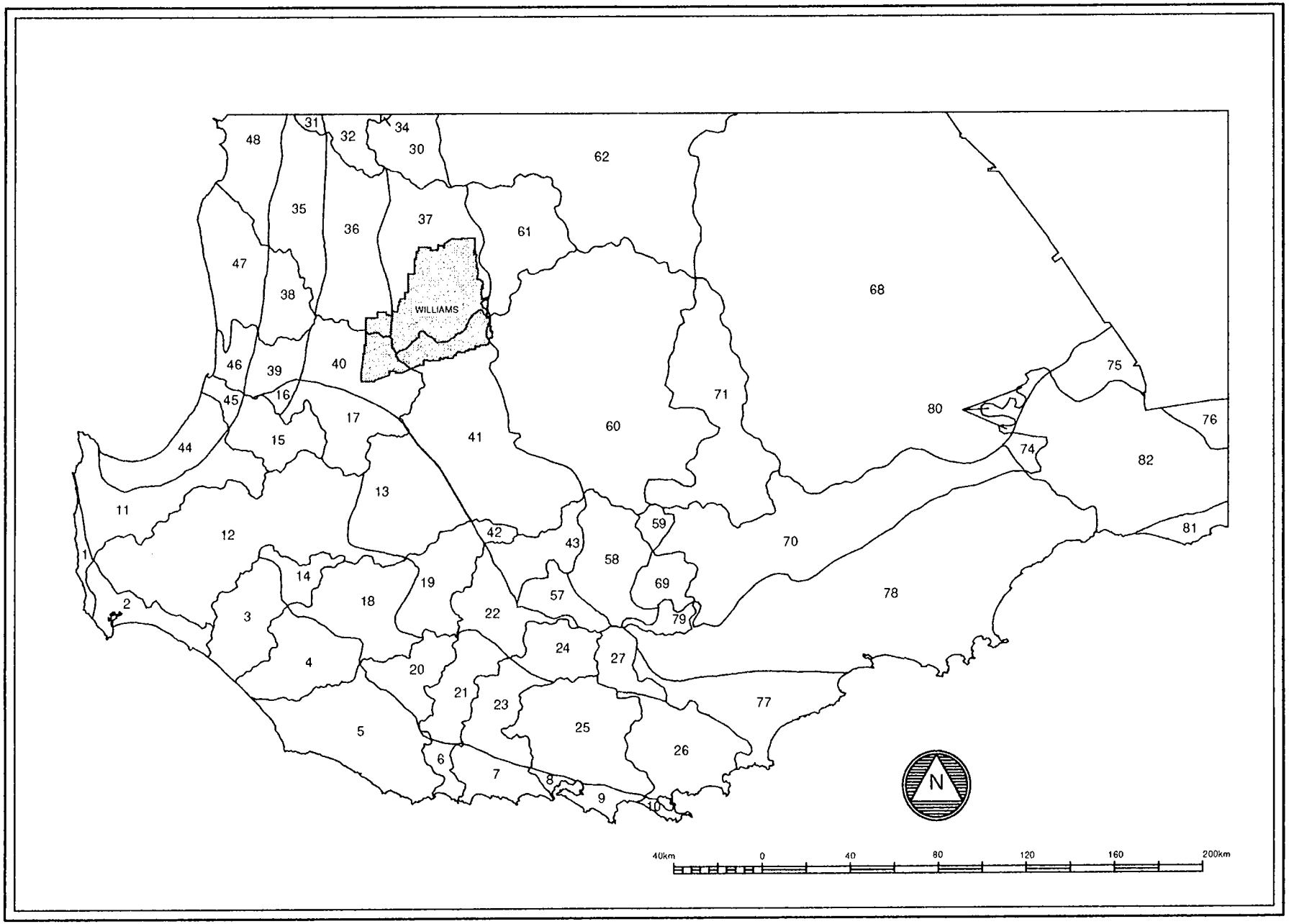


Figure 3. The Shire of Williams in relation to the Natural Resource Zones of the South-West Land Division of Western Australia (Allison, *et.al*1993).

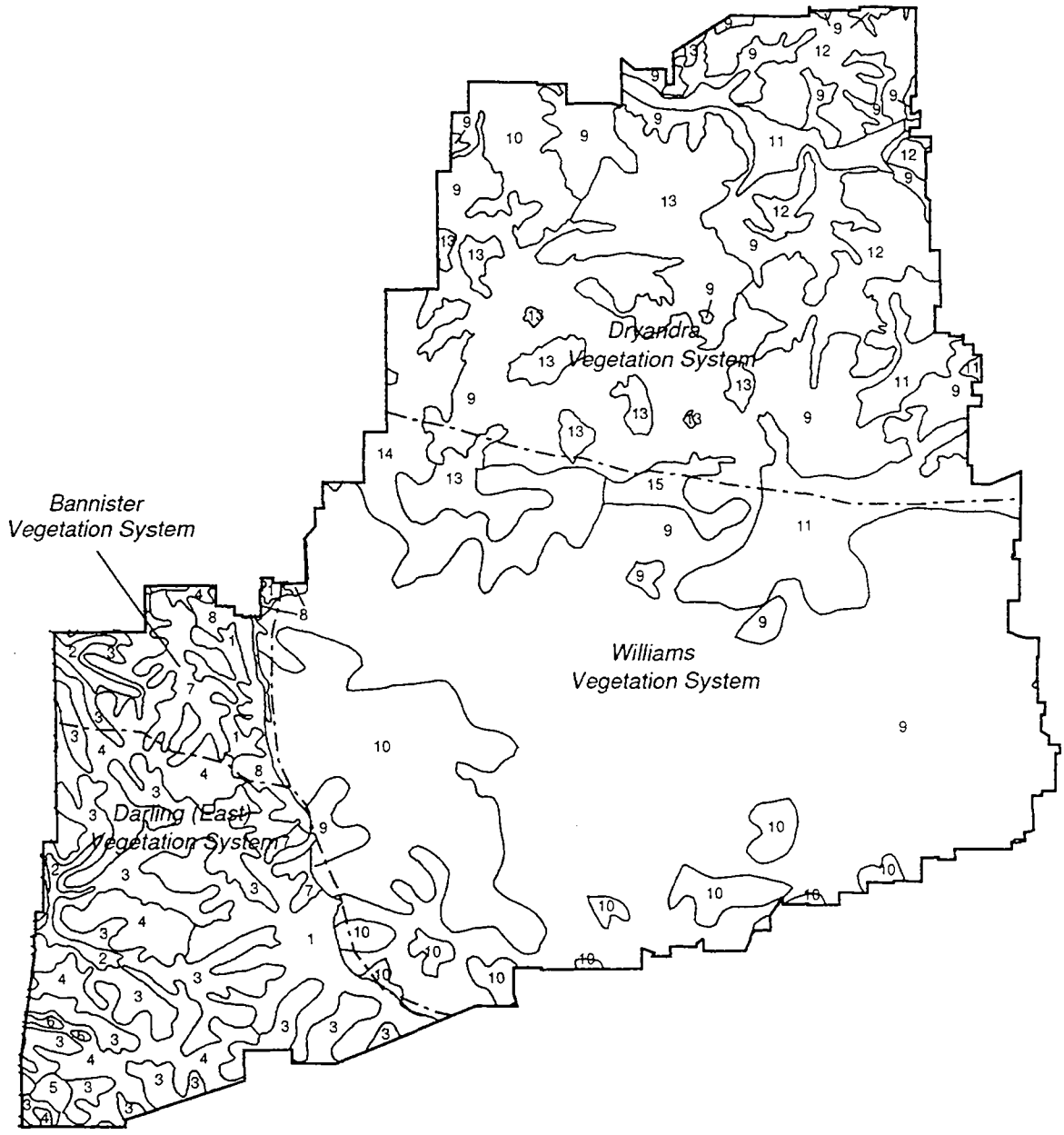
The Shire of Williams

The Shire of Williams covers an area of 228,482 hectares. A portion of the south-eastern corner of the Shire is located in the Blackwood River Catchment (see cover map) with a substantial portion of the western region of the Shire within the Wellington Dam Catchment. The Shire is drained by the Williams, Arthur, Hillman, Beaufort and Blackwood Rivers. Townsites in the Shire include Williams, Quindanning, Dardadine and Tarwonga (Figure 1).

The Shire's climate is regarded as Mediterranean, with dry, warm summers and cool winters. It receives on average 566 mm rainfall per annum. The average maximum temperature ranges from 31^{0}C in January to 14.6^{0}C in July, while the corresponding average minimum temperatures ranges from 15^{0}C in February to 4^{0}C in August. The population of the Shire was 1008 in 1992 (Municipal Directory, 1992). Agricultural land use in the Shire is predominantly wheat and sheep:- in 1991/92 a total of 1385 hectares of the Shire was sown with wheat, 129,351 hectares with sown pasture and grasses, 3608 hectares of native pastures, 496 hectares with hay and 682 hectares left fallow (ABS, 1992). The cadastral boundaries in the Shire are shown in Figure 1 and all 595 kilometres of road network in the Shire is shown in Figure 2

The South-west of Western Australia has been divided into districts (called Natural Resource Zones) on the basis of their natural resources ie vegetation type, drainage/catchment system and rainfall (Allison *et al.*, 1993). The Shire of Williams contains parts of four Natural Resource Zones (No.36, No. 37, No. 40 and No. 41) (Figure 3) making it a mosaic of one vegetation district (Dale subdistrict) and three catchments (Murray, Blackwood and Warren River catchments) within an area receiving less than 500 mm to 1100mm rainfall per annum.

The Williams Land Conservation District (LCD) formed in 1989 and is based on the Shire's boundaries.



Vegetation Type

1. Yalanbee and Dwellingup complex in low rainfall
   Mixture of open forest of *Eucalyptus marginata* (jarrah) *E. callophylla* (Marri) and woodland of *E. wandoo* **(Wandoo)**
2. Swamp Complex
   Vegetation ranges from low open woodland of *Melaleuca preissiana* (moonah), *Banksia littoralis* **(Swamp Banksia) to sedgelands**
3. Pindalup and Yarragil Complex in low to medium rainfall
   Open forest of jarrah-marri on slopes and open woodlandof wandoo with some ***E. patens*** **(Yarri) in lower gullies**
4. Dwellingup, Yalanbee and Hester Complex in low to medium rainfall
   Open forest of jarrah-marri
5. Goonaping Complex
   Open forest of jarrah and low open woodland of *Banksia attenuata* (Slender Banksia) and *B. menziesii* (Firewood Banksia) on dry sites and low open forest of moonah on moist sites
6. Cook Complex
   Vegetation ranging from open forest of jarrah-marri on deep soils through to heath and herbland to lichens on granite rocks
7. Coolakin Complex in low rainfall
   Woodland of wandoo with a mixture of yarri and jarrah
8. Michibin Complex
   Open woodland of wandoo with some york gum, *Acacia acuminata* (Jam) and *Allocasuarina huegelliana* **(Rock Sheoak) dominate the** understorey
9. Marri and wandoo woodland
10. Jarrah and wandoo forest
11. York gum woodland
12. Wandoo and ***E. accedens*** (powderbark) woodland
13. Jarrah,wandoo and powderbark woodland
14. Jarrah and marri forest
15. Powderbark and *E. astringens* (brown mallet) woodland

N

4000m 0 4 8 12 16 20Km

Figure 4: Vegetation systems (italics, dashed line) and major vegetation types (continuous line) in the Shire of Williams (According to Beard, 1981 and Heddle *et al* 1980).

Vegetation of the Shire of Williams - Past And Present

Native vegetation has been degraded in a variety of ways as a consequence of the extensive clearing and agricultural practices. In the South-west of Western Australia, clearing for agricultural purposes has resulted in the removal of 85-95% of native vegetation. More than 80% of plant species now extinct were formerly found on land cleared for agriculture.

Physical factors such as soil and climate combine to produce natural ecological regions, within which the plant life essentially similar. Western Australia is divided into three Botanical Provinces (ie. natural ecological regions) - the South-Western, the Eremaean, and the Northern (Beard, 1980a). The Botanical Provinces are in turn divided into Botanical Districts and then into Vegetation Systems. The Shire of Williams lies within the Darling Botanical Districts of the South-West Botanical Province. Vegetation Systems within the Darling District includes the Williams Vegetation System and the Dryandra System. Each of these Vegetation Systems consists of a series of plant communities occurring in a mosaic pattern which are closely linked to topographic and soil features.

The western third of the shire is not covered by a Beard's 1:250,000 sheet and the detail of vegetation given in his 1:1,000,000 Swan sheet (Beard, 1981) is too general to show on a shire basis. It has therefore been necessary to also use a combination of the System 6 Collie vegetation sheet (Heddle *et al.*, 1980) and Beard's 1:1,000,000 Swan sheet to provide the most detailed vegetation description (Figure 4). The System 6 (Collie sheet) vegetation represented in the south-west corner of Figure 4 is similar in composition to Beards Banister and Darling (east) Vegetation Systems. As Beard's Vegetation Systems are closely linked to the soil type on which they grow, so too are plant communities described in the Collie Vegetation sheet.

Brief Description of the Vegetation Systems and System 6 Vegetation Communities

This section is based on the plant distribution studies of J.S. Beard and CALM (formerly the Department of Environment and Conservation). Further detail can be obtained from the following references -. i) Heddle, E.M., Longeran, O.W. and Havel, J.J. (1980). *Atlas of Natural Resources, Darling Range System, Western Australia. Collie Vegetation Sheet.* Department of Environment and Conservation, Perth. ii) Beard, J.S. (1981). *Vegetation Survey of Western Australia: Swan 1:1,000,000 Vegetation Series with Explanatory Notes.* University of Western Australia Press, Perth.

Description of Vegetation Mapping Units in the Collie Vegetation Sheet

The Collie Vegetation Sheet attempts to depict the original native vegetation that existed before European settlement. Although the Collie Sheet concentrates mainly on the vegetation of the Darling Plateau, a small area of the map to the east of the plateau covers the south-west corner of the Shire of Williams. The Darling Plateau and adjoining areas have been subdivided into 28 vegetation complexes. The vegetation complexes are defined in relation to soil-landform units and, where relevant, to average annual rainfall readings. This means that the main determinants of the vegetation complexes are landform, soil types and annual rainfall. There are 8 vegetation complexes covering the south-western corner of the Shire of Williams and these are described in the following section.

1. Yalanbee and Dwellingup Complex in Low Rainfall

This complex consists of a mixture of open-forest of jarrah (*Eucalyptus marginata*)-marri (*Eucalyptus calophylla*) and a woodland of wandoo (*Eucalyptus wandoo*)-marri and is restricted to areas of low rainfall (600-850 mm). The dominant vegetation types are, the prickly bitterpea (*Daviesia decurrens*), jarrah, *Lepidosperma angustatum*, semaphore sedge (*Mesomelaena tetragona*), hairy flag (*Patersonia rudis*), common pinheath (*Styphelia tenuifolia*), wandoo, honey bush (*Hakea lissocarpha*), zamia (*Macozamia riedlei*), *Leucopogon capitellatus* and *Leucopogon propinquus*. Less dominant vegetation includes pincushions (*Borya sphaerocephala*), fuchsia grevillea (*Grevillea bipinnatifida*), oval-leaved hakea (*Hakea elliptica)*, *Hakea undulata*, Darling Range ghost gum (*Eucalyptus laeliae*) and low open-forest of rock sheoak (*Allocasuarina huegeliana*) and herblands on shallow soils overlying granitic rocks.

2. Swamp Complex

This complex is associated with the swamp valley floors of the Yarragil and Pindalup complexes and small areas of the Goonaping complex. The vegetation is diverse and varied owing to the wide distribution of this complex from high rainfall areas in the west to low rainfall areas to the east of the Darling Plateau. Swamps are most developed in areas surrounding the upper reaches of the Darkan Swamp, the Bingham, Harris and Collie Rivers and Beraking Brook. The vegetation ranges from modong (*Melaleuca preissiana)*-swamp banksia (*Banksia littoralis*) to sedgelands on the wetter soils. Swamps are distinguished by the variety of teatree species which include *Melaleuca cymbifolia*, grey honeymyrtle (*Melaleuca incana*), *Melaleuca subtrigona*, broom bush (*Melaleuca uncinata*), mohan (*Melaleuca viminea*) and robin redbreast bush (*Melaleuca lateritia).* Other species include sandplain cypress (*Actinostrobus*

pyramidalis), variable-leaved hakea (*Hakea varia)* and several *Verticordia* species. The dominant vegetation of the Swamp complex is yarri (*Eucalyptus patens*).

3. Pindalup and Yarragil Complex in Low to Medium Rainfall.

This complex defines the distribution of the most westerly extension of wandoo woodland in the shallow upper valleys. Generally the vegetation complex is predominantly comprised of an open-woodland of wandoo with some marri, yarri and jarrah and an open-forest of jarrah-marri. As the majority of valleys covered with wandoo-yarri woodlands occupied more fertile soils, most have now been cleared to make way for agricultural production.

4. Dwellingup, Yalanbee and Hester Complex in Low to Medium Rainfall

This complex is similar to other complexes on the uplands in that it supports an open-forest of jarrah-marri. However the floristic composition of the understorey reflects the lower rainfall and warmer temperatures of the northern and eastern regions of the jarrah forest. This complex extends from Lower Chittering in the north, the full length of the eastern section of the Darling Plateau to the series of ridges just south of Boyup Brook. The dominant vegetation types are the prickly bitterpea, jarrah, blueboy (*Stirlingia latifolia*), honeybush, *Leucopogon capitellatus, Leucopogon cordatus,* zamia, *Patersonia rudis,* and the common pinheath. Occurring less frequently are hairy glandflower (*Adenanthos barbigerus*), bull banksia (*Banksia grandis*), Wilson's grevillea (*Grevillea wilsonii*), holly-leaved hovea (*Hovea chorizemifolia*), false boronia (*Phyllanthus calycinus*) and karri hazel (*Trymalium floribundum*).

5. Goonaping Complex

This complex occurs on shallow depressions and consists of a variety of structural formations. In localised moist, low-lying areas there are similarities with the Swamp Complex. The vegetation ranges from the open-forest of jarrah-marri through to low open-woodland of slender banksia (*Banksia attenuata*)-firewood banksia (*B. menziesii*) to low open-forest of moonah-swamp banksia and low open-woodland of moonah-swamp banksia on the moister soils. The dominant vegetation types are jarrah, common smokebush (*Conospermum stoechadis*), prickly bitterpea, candle hakea (*Hakea ruscifolia*), *Hibbertia polystachya, Leptocarpus tenax,* semaphore sedge and blueboy.

6. Cooke Complex

This complex occurs over a wide area with a large variation in soil depth and subsequently the associated vegetation is extremely varied. The landscape is varied

ranging from granite rocks with associated pincushions herbfields through to heath of fuchsia grevillea, oval-leaved hakea, *Hakea undulata, Hakea trifurcata, Hakea lissocarpha* and several species of *Acacia, Melaleuca* and *Verticordia*; through to the rare occurance of low open-woodland of Darling Range ghost gum to open forest of rock sheoak on shallow soils in the low rainfall areas and woodland of wandoo-marri and open-forest of jarrah-marri on the deeper soils. Dominant vegetation types of this complex include pincushions, marri, jarrah, Darling Range ghost gum, wandoo, swamp sheoak, fuchsia grevillea, *Hakea lissocarpha, Leucopogon capitellatus, Leucopogon propinquus,* zamia and false boronia.

7. Coolakin Complex in Low Rainfall

This complex is dominated by a woodland of wandoo with a mixture of jarrah, marri and yarri. It has strong affinities with the **Pindalup** and **Yarragil** complexes in that it occurs in areas of lower rainfall and supports woodlands of wandoo. Other species include camphor myrtle (*Baeckea camphorosmae*), common smokebush, prickly bitterpea, jarrah, blueboy, *Hakea lissocarpha, Hibbertia lineata, Leucopogon capitellatus, Leucopogon cordatus,* zamia, hairy flag, and false boronia.

8 Michibin Complex

This complex coincides with the low rainfall area along the eastern edge of the Darling Plateau. This distinctive feature of this complex is the predominance of wandoo woodland and the localised mixture of small patches of wandoo and York gum. Jam, rock sheoak and manna wattle (*Acacia microbotyra*) dominates the understorey, with rock sheoak restricted to rock outcrops on steep slopes.

Beards 1:1,000,000 Swan Sheet

The **Williams Vegetation System** occurs on an undulating plateau from which most of the lateritic sheet has been eroded and the hills are of basement rock and is defined by the limit of marri-wandoo woodlands. Some jarrah occurs where the soil is gravelly, but usually only as woodland which often merges with wandoo. On lateritic hill tops and breakaways brown mallet (*Eucalyptus astringens*) forms open forest, while on granitic hills and slopes, marri and flooded gum (*Eucalyptus rudis*) form woodland. On lower slopes of hills and valleys York gum forms woodland with jam understorey.

The **Dryandra Vegetation System** covers the northern third of the shire. The country of this system is well dissected by tributaries of the Dale River in the north and the Hotham River in the south. Rainfall is lower than systems to the west and this is principally responsible for the change in vegetation. There are four vegetation

communities represented in the southern portion of the Dryandra system; a) woodland of powderbark and brown mallet on laterite plateau, b) woodland of wandoo and powderbark on upper slopes with gravel wash below the breakaways, c) marri and wandoo on middle slopes and d) York gum on the lowest slopes close to drainage channels. On the lateritic plateau surfaces there is a mosaic of powderbark, brown mallet, wandoo and rock sheoak each occurring in patches. Powderbark (*Eucalyptus ascedens*) is the most common species, and is variable in height and density, although it is generally a smaller tree than wandoo. Occasional jarrah trees are seen in this system. The understorey is comprised of sparse shrubs, particularly under brown mallet and include sandplain poison (*Gastrolobium microcarpum*) and prickly poison (*Gastrolobium spinosum*), *Dryandra cirsiodes,* one-sided bottlebrush (*Calothamnus quadrifidus*), roadside teatree (*Leptospermum erubescens*) and blackboys. Powderbark woodland tends to open out to mallee-heath with wandoo and marri occurring on favourable sites. Gravelly slopes contain a woodland of wandoo and powderbark with the principal understorey being *Oxylobium parviflorum.* On less gravelly slopes wandoo and powderbark dominate an understorey of jam, rock sheoak and sandplain poison. Stands of York gum are found in valleys.

Current Extent of Native Vegetation

The total area of native vegetation in the Shire of Williams has been reduced through broadscale clearing for agricultural, horticultural and forestry purposes. However, much of the native vegetation that remains in public reserves and on private land is similar in composition to that which existed previously, although the extent of cover has been significantly reduced. The Shire contains a significant number of reserves and areas of uncleared land carrying jarrah/marri forest and wandoo woodland.

Approximately 32% of the Shire of Williams remains covered by original native vegetation, 12.4% (28,403 ha) of which is found on private land. The remaining 19.6% (44,953 ha) exists as public reserves, water reserves, railway reserves, gravel pits, crown land ect, not all of which have a cover of native vegetation.

In the Shire of Williams there are 2468 bush remnants, of which 87% or 2147 remnants are regarded as being "remnant vegetation", 12% or 299 remnants regarded as "scattered trees" and 1% or 22 remnants as "modified vegetation". More than 90% of all bush remnants in the Shire are less than 20 ha in area (Beeston *et al.*, 1994.) (Figure 5).

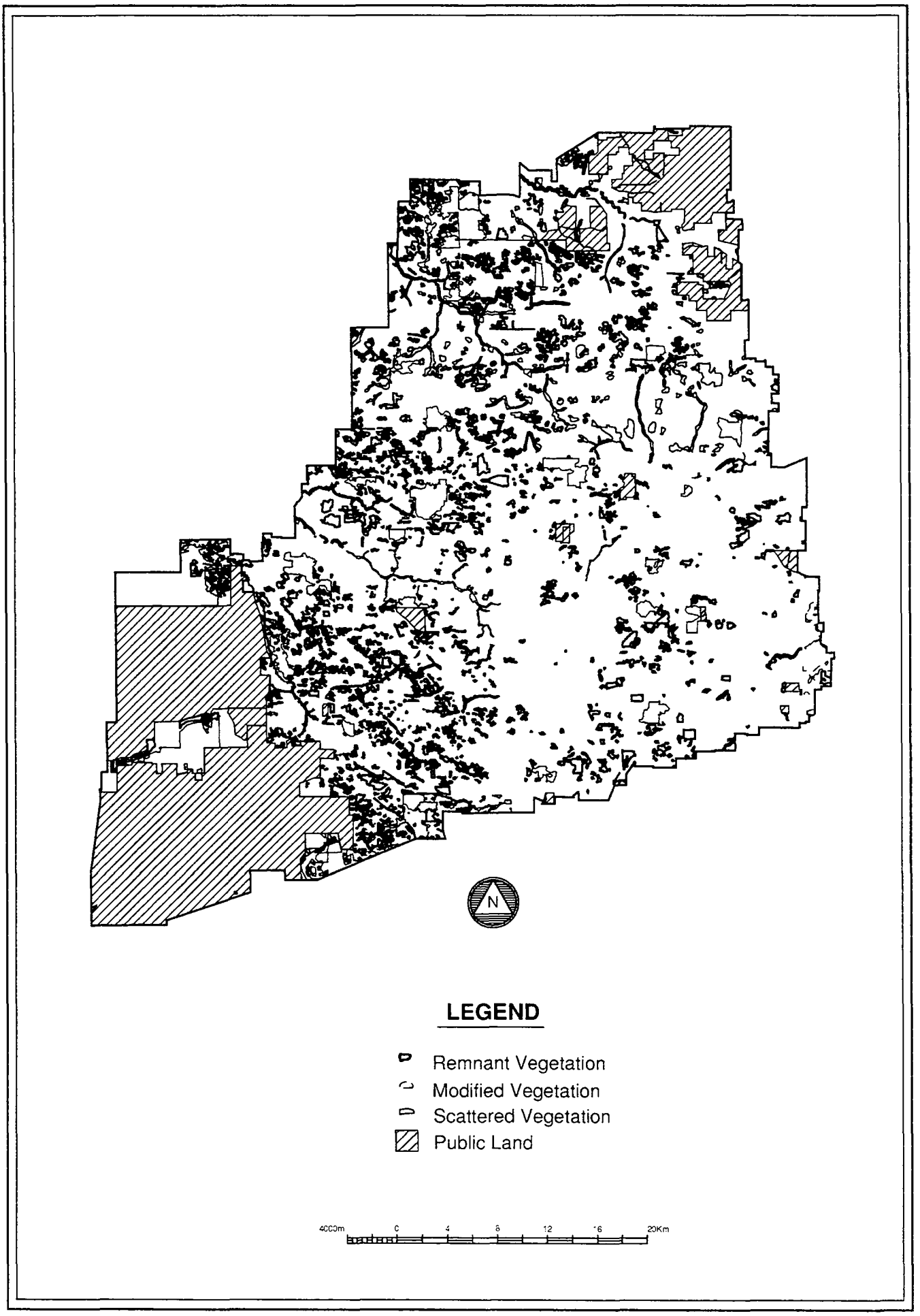


Figure 5: The Shire of Williams showing native vegetation cover. 32 percent of the Shire remains vegetated, with 12.4 percent on private land.

Vegetation classed as "remnant vegetation" has one or more of the following characteristics (Beeston *et al.*, 1994) :

* Most closely reflects the natural state of vegetation for a given area.
* Has an intact understorey (if forest or woodland).
* Has minimal disturbance by agents of human activity.

Vegetation classed as "modified vegetation" has one or more of the following characteristics:

* Degraded understorey (ie. reduction in the number of native species, includes weeds).
* Obvious human disturbance - clearing, mining, grazing, weeds.
* Affected by salt.
* Narrow corridors of vegetation (usually along roads and railway lines or windbreaks), which are more likely to be affected by edge effects.

Vegetation classed as "scattered vegetation" have:

* No understorey.
* Parkland cleared ie. are scattered single trees
* No significant signs or chance of regeneration.

There are three Nature Reserve in the Shire of Williams set aside for the conservation of flora and fauna: Williams Nature Reserve (206 ha), Reserve No. 30394 (76 ha) and Reserve No. 41004 (45 ha).

In 1991 Frans Mollemans undertook a botanical survey of the Shire of Williams (Mollemans, unpub.) (NB Copies of the findings of this survey are available by contacting the Spatial Resource Information Group, WADA, 368 3732) (Figure 5a). A total of 291 bush remnants in the Shire were surveyed by Mollemans including two (Remnant 83 and 84) in detail. For all of Mollemans detailed surveys, each remnant was classified according to its plant communities (ie a,b,c ect).

Remnant 83

Location: [Two Blocks separated by Zilcos Road] 14 km WNW of Williams, 15.5 km ENE of Quindanning Bridge, and 36 km due north of Darkan; 33^30'00"S, 116^43'45"E; c. 360 m.

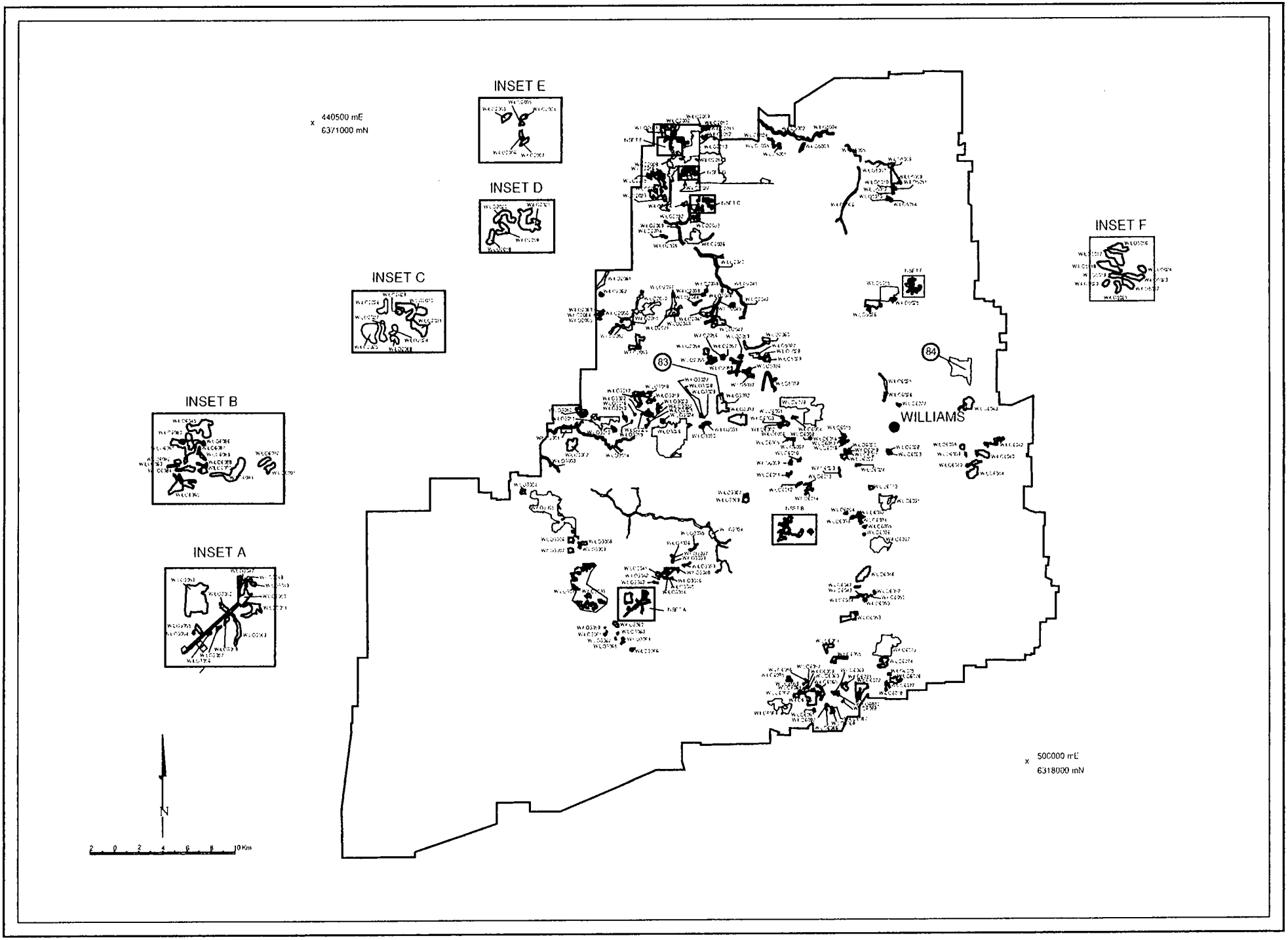


Figure 5a: The Shire of Williams showing remnant vegetation areas surveyed in detail and where information was acquired by general observation.

Jarrah - Marri - Wandoo woodland to 15+ m tall over + Dryandra spp. shrubland over c. 80 cm scrub and heath.

Remnant 84

Location: "Rathgar," 7 km NE of Williams (access via Clayton Road); 32^59'38"S, 116^56'00"E.

a - Jarrah + Marri + Wandoo (+ Sheoak) woodland over + *Dryandra* 1.5 m shrubland over ca. 80 cm scrub.
b - Brown mallet woodland over sparse shrubland with a heavy layer of leaf litter (5-10 cm layer, which promotes a non-wetting soil character).
c - Wandoo - Sheoak + Brown mallet (at upper fringe) + Marri woodland over ca. 80 cm shrubland over herb layer.
d - Sheoak + Wandoo woodland over ca. 50-80 cm shrubland and herb layer.

For a complete list of the plant species in Remnants 83 and 84 see Appendices 10 and 11

Wetlands

Wetlands are defined by the Wetlands Advisory Committee as ".... areas of seasonally, intermittently or permanently waterlogged soils or inundated land whether natural or otherwise, fresh or saline, eg. waterlogged soils, ponds, billabongs, lakes, swamps, tidal flats, estuaries, rivers and tributaries".

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

Most of the wetlands in the Blackwood River Catchment were fresh or near fresh until the 1940's. Prior to increases in salinity the wetlands were covered by sheoak, paperbark and teatree. Although the Shire of Williams is covered by the Blackwood River Catchment, the Williams River is the principal water course running through it.

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. The salinity changes in the Blackwood River catchment began to take effect in 1940, 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.

Many of the vertebrate animals (including water-rats (*Hydromys chrysogaster*), water birds, reptiles and frogs) that were once common to wetlands and the surrounding areas have now disappeared. The water rat was noted as being present in the area of Arthur River before disappearing in the early 1960s. This could be because of the increased wetland salinity or the decline of their prey or related to predation by introduced animals, habitat destruction or other factors. Other water birds appear to have colonised wetland areas since they have become saline (Sanders, 1991).

Other than the Williams, Arthur and Hillman Rivers, there are no significant wetlands in the Shire of Williams.

The amount of salinised land in agricultural areas is still increasing (Schofield *et al.*, 1988), which means that wetlands will continue to become saline and that there will be resultant changes in wetland vegetation.

Fauna

In the Shire of Williams animals commonly seen include the western grey kangaroo (*Macropus fuliginosus*) the western brush wallaby (*Macropus irma*) and the echidna (*Tachyglossus aculeatus*) and reptiles including the bobtail (*Tiliqua ragosa*), the blue tongue lizard (*Tiliqua occipitalis*), the dugite (*Pseudonaja affinif*), the mulga snake (*Notechis australis*) and a variety of geckos. Animals which are considered to be the under threat of extinction and are being monitored include the tammar wallaby (*Macropus eugenii*), the red-tailed black-cockatoo (*Calyptorhynchus magnificus naso*) and Carnaby's cockatoo (*Calyptorhynchus funereus latirostris*). Most of these species are under threat because of introduced predators, loss of habitat and of their preferred food. No specific faunal surveys have been undertaken in the Shire, although general reconnaissance surveys have been regularly been carried out by wildlife officers from the Department of Conservation and Land Management's Regional Wheatbelt headquarters Narrogin District Office.

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%) of mammals recorded from the Wheatbelt since European settlement. Only 12 of the 43 species are considered to be moderately common to abundant (Kitchener *et al.*, 1980). Eight species of mammal are known to

have disappeared from the wheatbelt region in the past 100 years region: The western barred bandicoot (*Perameles bougainiville*), 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-nailed tail wallaby (*Onychogalea lunata*) and the stick nest rat (*Leporillus* sp.). Mammals in the Williams region thought to be at high risk of becoming extinct include the red-tailed phascogale (*Phascogale calura*) and the numbat (*Myrecobius fasciatus*). For a complete list of all native mammals in the Narrogin CALM region, see Appendix 12, while for a list of all reptile and frog species seen in the region, see Appendix 13

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 coped well with the changes associated with clearing and are generally declining in numbers. They may well become locally extinct. Species such as Carnaby's cockatoo 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% of the land birds are dependant on native vegetation for all or some of their annual requirements (Smith, 1987). Continued loss of these bird species can therefore be expected due to degradation of remnant vegetation and continued 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 complete list of all avifauna seen in the region, see Appendix 14.

Rare and Endangered Flora

There are approximately 238 plant taxa declared endangered (Hopper *et. al,* 1990) in Western Australia. Many of these can be found within remnants of native vegetation on private land in the Wheatbelt region. There is only one Rare and Endangered species of flora found in the Shire of Williams.

1. ***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.

There are compelling reasons for focussing conservation efforts on endangered species. From an asthetic perspective, it is clear that there lies an opportunity to appreciate and study the biological diversity and attractiveness of many of these endangered flora. Equally compelling is the fact the extinction of a species constitutes an irreplaceable lost opportunity for plant utilisation by humans. Some of the worlds rare species proven to be of outstanding economic value. Also as so little is known of the biochemistry of many of these species, there lies the possibility of discovering cures to major human diseases. For example it has recently been publicised that smokebush (*Conospermum* spp.) may possibly provide a potential cure for AIDS.

Land Resources

Geology

The Shire of Williams is comprised of both strongly and weakly dissected along the alluvial flats surrounding the Williams River. The Saddleback Group (two small, soil-covered rocks 13 km northwest of Quindanning) extends for a short distance into the Shire of Williams where it is terminated by faults along the Williams River (Wilde and Walker, 1982). Near the townsite of Williams are several east-northeast doleritic dykes up to 700m in width which are thought to be up to 2420 $\pm$ 30 million years old (Turek, 1966). A dyke 6 km south of Williams can be traced by sporadic outcrops for at least 585 km eastward across the Yilgarn Block.

Soils

The distribution of the three soil landscape systems for the Shire of Williams is shown on Figure 7 (Northcote *et al.*, 1967). Within some of these are sub-systems known as soil types. The six types within the three soil landscape systems differ mainly in their position within the topographic profile and form a mosaic of soil landscapes.

The shire forms part of the 'zone of younger laterites' (Northcote *et al.*, 1967), bounded on the east by the Meckering Line. A feature of the country is the extensive occurrence of lateritic profiles on the valley sides and floors. The lower slopes along major valleys are laterite-free. Remnants of massive lateritic blocks cap the higher ground and are usually bordered by abrupt breakaways. Such remnants become more extensive and elevated above the valley floor, in a westerly direction. A key to understanding the six soil types which occur in the Shire follows:

1) ***Hard-setting loamy soils with mottled yellow clayey subsoils***

i) **TF 3** - Low hilly terrain comprised of valleys that are frequently narrow and have short fairly steep slopes, along with breakaways, mesas and occasional granite tors. Chief soils are hard acidic yellow mottled soils along with sandy acidic yellow mottled soils all of which contain moderate to large amounts of ironstone gravel.

ii) **Ub 90** - Generally rolling to hilly country with tors; alteration mesas and buttes on some areas. Chief soils are hard neutral and acidic yellow mottled soils, sometimes containing ironstone gravels.

iii) **Ub 96** - Valley plains in which some salinity is present. Chief soils are hard neutral, and also alkaline, yellow mottled soils.

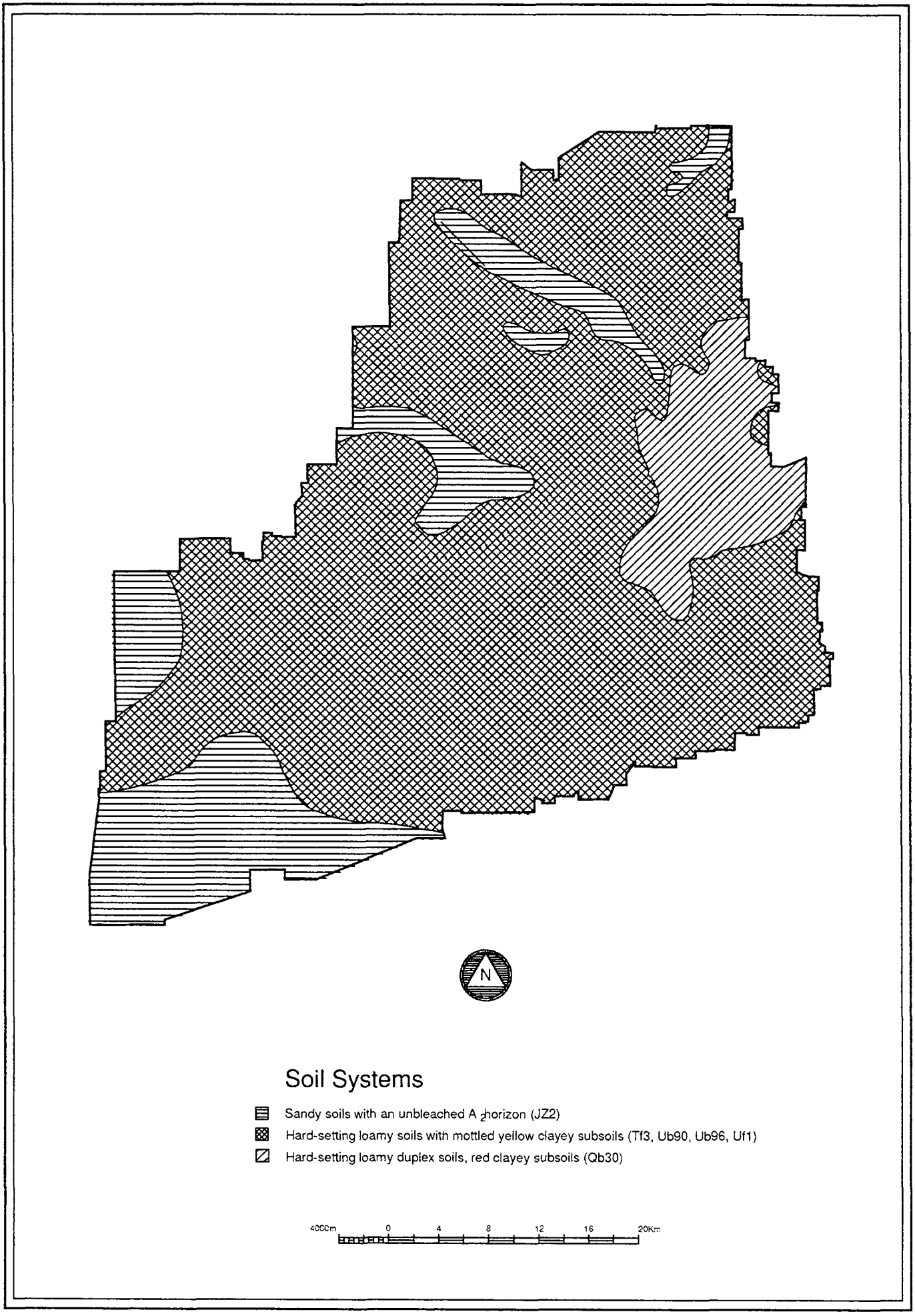


Figure 6: The three main soil systems of the Shire of Williams, each of which is a mosiac of different soil types.

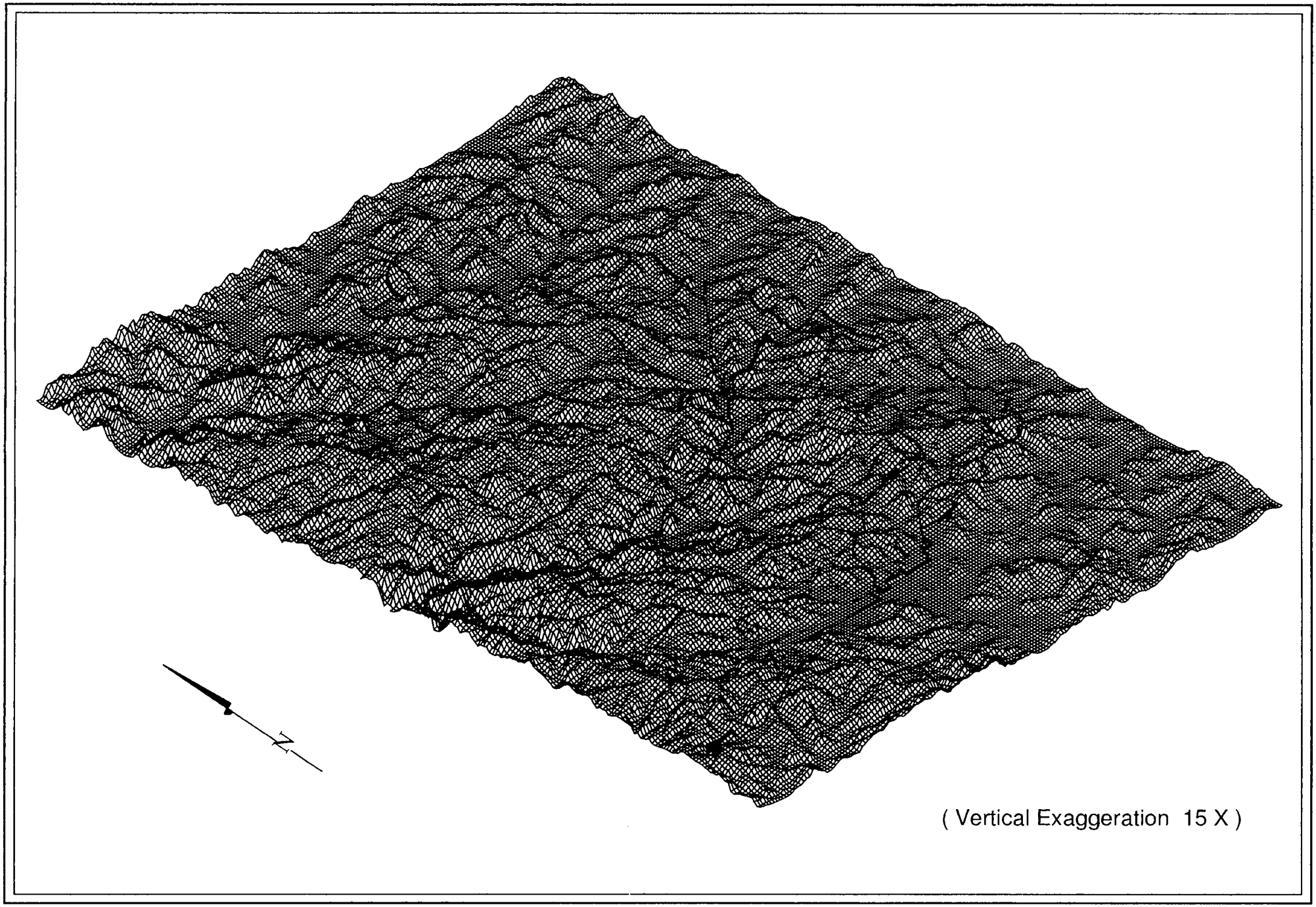


Figure 7: Topographical view of the Shire of Williams

iv) **Uf 1** - Undulating with ridges, spurs and lateritic mesas and buttes. Chief soils on broad undulating ridges and spurs are hard, and also sandy, neutral, and also acidic, yellow mottled soils all containing ironstone gravels.

2) ***Sandy soils with an unbleached A_2 horizon***

i) **JZ 2** - Dissected plateau with gentle undulations with broad swampy drainage-ways and basins. It is characterised by lateritic gravels and block laterite.

3) ***Hard-setting loamy duplex soils, red clayey subsoils***

ii) **Qb 30** - Rolling to hilly with some steep slopes; rock outcrops common with some lateritic mesas and buttes on drainage divides. Chief soils are hard neutral red soils and acidic red soils.

Topography

The topography in the shire is varied and undulating, with elevation decreasing from west to east from 140 to 70 m. The Shire of Williams is dominated by two large river systems which pass westerly through the Darling Plateau in deep gorges. The Williams River rises near the Williams townsite to join the Murray which runs north to eventually flow into the Peel Inlet. The Blackwood River drains most of the eastern part of the shire through its tributaries the Arthur, Hillman, Beaufort and Balgaraup Rivers before flowing into the deepening valleys near Boyup Brook. The principal summits in the shire are Mt Hillman, Tarwonga Hill (371m) and Wanerie Katta (377m). Figure 7 gives a topographic view of the Shire, showing vertical exaggeration, while Figure 8 is a map of the Shire showing contours at 10 metre intervals.

Land Management and Land Degradation Issues of the Shire

Since settlement in the south west of Western Australia and the subsequent clearing and replacement of native vegetation with crops and pastures, problems have arisen for both agricultural production and native vegetation conservation. Some of the most obvious problems are associated with changes in hydrology e.g rising water table with associated salinity and waterlogging. Water erosion and wind erosion are a problem on unprotected soils.

There are several forms of land degradation that occur within the Shire of Williams: salinity, waterlogging, wind and water erosion, soil acidification and subsoil compaction. An integrated approach to tackling these problems uses farm planning to: reorientate paddock boundaries; revegetate and fence drainage lines; protect and

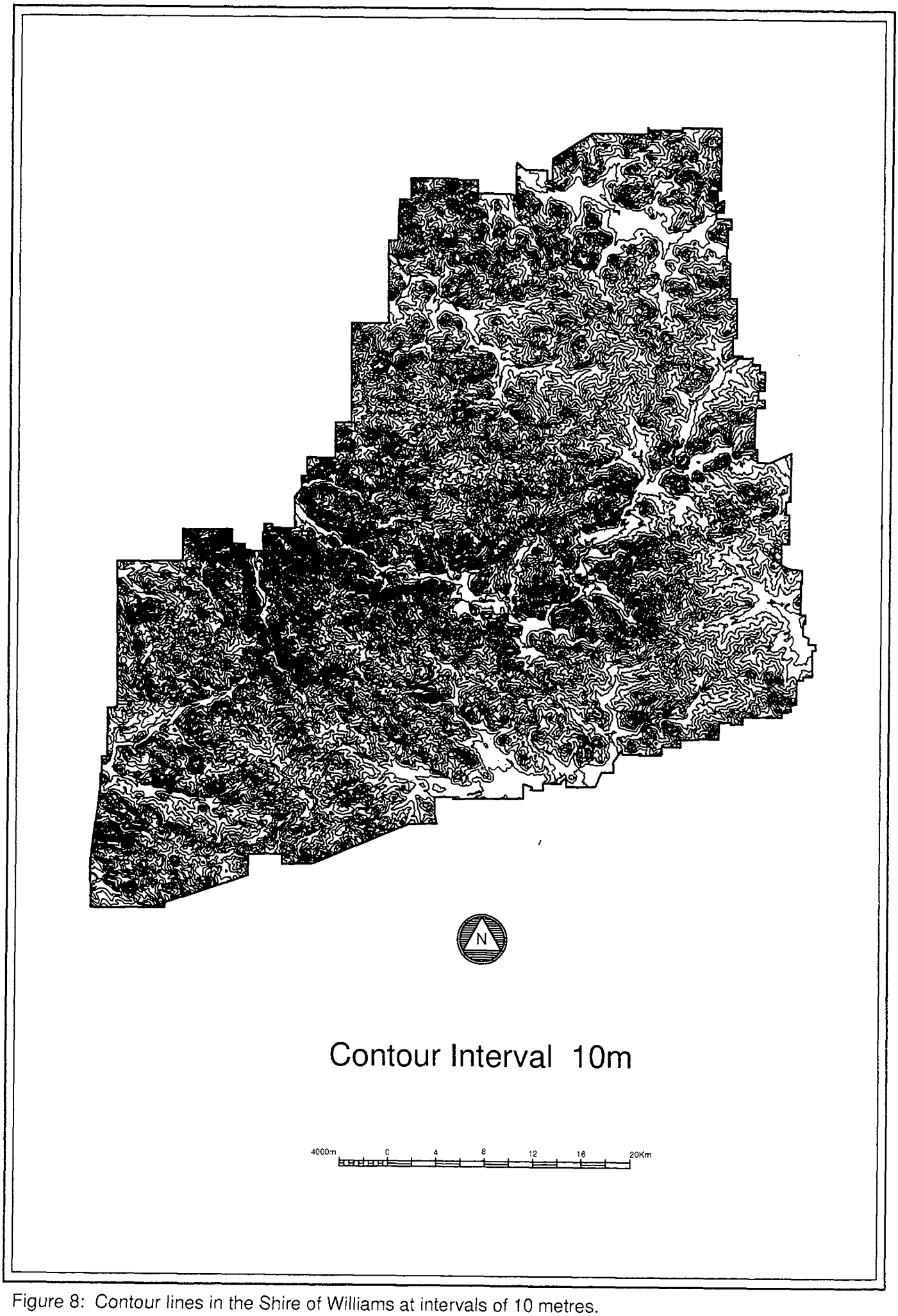


Figure 8: Contour lines in the Shire of Williams at intervals of 10 metres.

connect existing vegetation and establish windbreaks and replant on both recharge and degraded areas. In addition altering management practices to minimum and zero tillage will benefit both agricultural production and wildlife conservation.

Most farmers now recognise that replanting the trees and shrubs that existed prior to clearing is one of the most effective means of reversing the current trend towards land degradation. One of the main problems has been a lack of information about how to go about revegetation and what, when and where to plant. The "Revegetation Guide to the Central Wheatbelt" (Lefroy *et al.*, 1991) is an excellent resource book which attempts to address these problems by providing lists of local species grouped according to the specific soil types of a particular area.

Clearing

The Shire of Williams has been less extensively cleared than many other neighbouring shires and has more original native remaining on private and public land than most other shires in the Blackwood River Catchment.

Current clearing guidelines recommend that for an area receiving between 500 and 700 mm/annum rainfall (e.g. Shire of Williams), the minimum proportion of native vegetation considered necessary to be left to use sufficient groundwater to ensure water tables remain stable in that subcatchment is 25% or 1000 ha/catchment. (Clark, 1992; Holm, 1994). Currently the shire has 32% native vegetation cover.

There are several actions being undertaken by the State Government and Local Government authorities to address the clearing of native vegetation. Clearing of vegetation on private land is currently under the control of the Soil and Land Conservation Act which requires all landowners to give notice to the Commissioner of Soil Conservation of their intent to clear land. The guidelines for assessing notices of intent to clear land are directed at preventing further land degradation problems (Select Committee into Land Conservation, 1992). In addition many local government authorities have implemented planning schemes which may give them scope to effectively control the clearing of land.

Continued clearing of vegetation is obviously not compatible with the desire for native vegetation to persist. Much of the south west was cleared during major agricultural developments following World War II, and little thought was given to nature conservation requirements.

A great deal of the native vegetation that remains was set aside by the government as crown reserves for townsites, water catchments and sites of gravel extraction etc. Many of these small patches of native vegetation were designated by the government as conservation reserves in the 1960s and 1970s. However their conservation value varies because most of the patches of vegetation that are now nature or conservation reserves are fragmented and represent only a very small percentage of the region's vegetative cover.

Rising Water Tables and Salinity

The principle cause for increased soil surface salinisation in much of the Wheatbelt has been the removal of native vegetation. Native vegetation uses more water than pasture species as native plants posses extensive root systems and transpire all year, whereas crops and pastures possess shorter roots and transpire for only 6 months of the year. The replacement of native vegetation with crops and pastures has resulted in changes to the water balance of the soil, bringing rising water tables and soluble salts to the surface.

There are two main effects of vegetation clearance in salt-prone areas: firstly, deep-rooted plants no longer draw groundwater for transpiration so water accumulates instead of being discharged in the atmosphere; and secondly, there is a decrease in the infiltration of rainwater because there is no vegetation to intercept it and as a consequence of this lack of water use the water table rises and dissolves the accumulated salts. Quite often the effects of salinity are not seen for 15-20 years following native vegetation removal.

Trees affected by salt display a reduction in growth and stunting compared to those that survive. Further salination among intolerant species results in the death of the lower leaves and branches proceeding from the base upwards followed by wilting, death of growing tip and eventual tree death.

The Shire of Williams had 2,573 ha (1.74% of arable land) affected by severe salinity in 1989 (George, 1990). This low figure is a reflection of the relatively high percentage of native vegetation remaining in shire.

Biological solutions to salinity problems can emulate more expensive engineering methods because perennial vegetation can be used to pump out more water from aquifers that have become saline or are in danger of doing so than can annual crops and

pastures. Obviously salt tolerant species are required for salt affected sites, not only to control the salt levels but also as a measure to prevent and manage erosion. Recharge and discharge areas should be replanted with trees or shrubs to reduce the amount of water entering or leaving the system. Some of the more commonly planted salt tolerant species include saltbush (*Atriplex* spp.), river red gum (*Eucalyptus camaldulensis*) wandoo and various samphire species. Planting swamp sheoak, orange wattle (*Acacia saligna*) and a number of *Melaleuca* species will aid in reversing the problems associated with waterlogged and salt affected areas. Planting trees such as salt river gum (*Eucalyptus sargentii*), flat-topped yate, moort (*Eucalyptus platypus*) and coastal moort (*Eucalyptus platypus* var *heterophylla*) will lower the watertable in most salt affected areas. Flat topped yate has both qualities of high water use and salt tolerance. Around salt lakes where soils are often waterlogged as well as saline, the soil will need to be mounded before planting. It may be more viable for farmers to plant salt tolerant shrubs in salt affected areas. Although these species may be less palatable to sheep than many herbaceous pasture species, they are grazed heavily when the herbaceous species are absent (Runciman and Malcolm, 1991).

It has been suggested (Lefroy *et al.*, 1991) that for the soils indigenous to the Shire of Williams, York gum, jam, rock sheoak and manna wattle could be planted. On the soils following drainage lines and around the fringes of salt lake, it is suggested that planting salt river gum (*Eucalyptus sargentii*) and swamp sheoak will help to reverse both salinity and waterlogging problems.

Alley farming systems are beginning to gain acceptance amongst farmers, and provides a cost effective method of combating the problem of salinity. This has been due in part to the death of bluegum (*Eucalyptus globulus*) plantations as a result of poor site selection, too high densities and the effects of salinity.

It is also worth noting that planting deep-rooted crops such as lupins in saline susceptible areas can emulate the task of perennial native species and prevent saline water from rising to the surface. The benefits of planting such a crop are manyfold. Not only can lupins control salinity, and provide feed for stock, but it also leaves residual nitrogen in the soil, reducing the need for applying expensive nitrogen-based fertilisers.

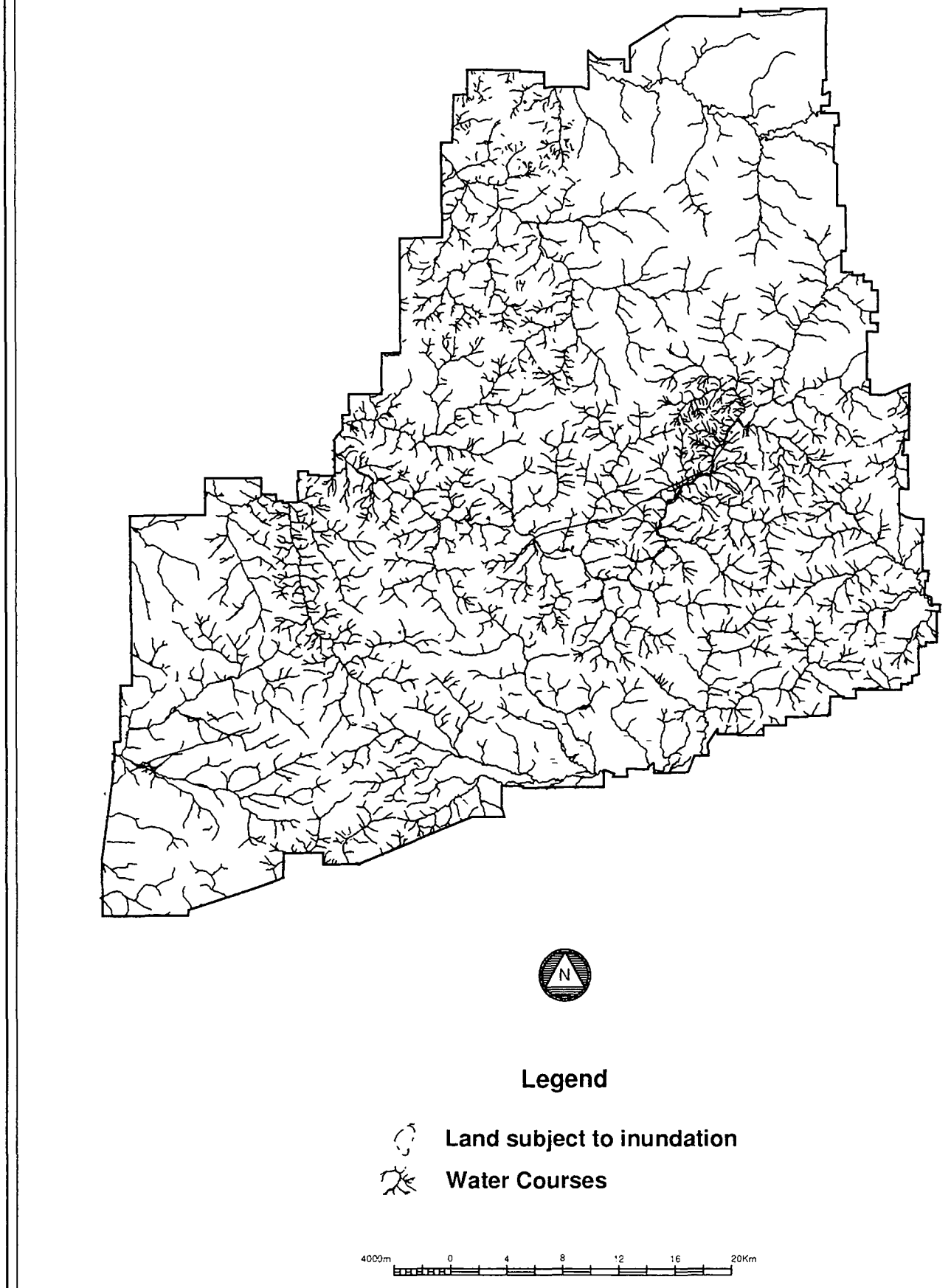


Figure 9: Major drainage systems of the Shire of Williams showing areas subject to inundation and major water courses.

Wind Erosion

Wind erosion is the action of the wind removing and redepositing soil. It can result in the loss of vegetation through sand blasting and smothering, and it reduces plant growth because of the loss of soil structure and fertility. The predominantly sandy-surfaced soils of Western Australia are naturally prone to wind erosion when vegetation is insufficient to protect the soil surface. The most susceptible areas are those which are prone to sustained droughts extended over several growing seasons. The extent and severity of wind erosion depends on seasonal conditions.

The Shire of Williams, particularly the area surrounding the Williams River, is largely comprised of sandy soils with contrasting profiles and are considered to be moderately susceptible to wind erosion (State of the Environment Report, 1992).

No-till methods of cropping, direct seeding of crops into stubble and the establishment of windbreaks for shelter will help in ameliorating the effect of wind erosion. Ideally windbreaks should be several rows wide and should include a mix of trees and shrubs.

Water Erosion

Water erosion is the loss of topsoil due to runoff from the soil surface. Water erosion occurs in three forms of increasing severity: sheet, rill and gully erosion.

Western Australian soils are particularly susceptible to water erosion because they are inherently infertile and have a sandy, loose texture. Their susceptibly is further increased by cultivation, overgrazing and stock trampling. An estimated 0.7 million hectares of the 6 million hectares of land cropped annually in the wheatbelt is affected by water erosion.

In the Shire of Williams water erosion can be expected to occur on all soil types particularly on slopes steeper than 1%. Clayey soils tend to be more prone to water erosion. (State of the Environment Report, 1992). Figure 9 shows some of the areas of the Shire which may be susceptible to inundation and water erosion.

Contour banks can reduce the speed of runoff water flow. They do this by restricting all cultivation to the contour, by diverting any runoff to a well grassed waterway, or by storing excess water in the channel above the bank. Vegetation can also reduce the possibility of water erosion by reducing the impact of raindrops on the soil.

Acidity

The acidification of topsoils and subsoils can inhibit the growth of plant roots of both native and pasture species. Although some soils are predisposed to acidic conditions, agricultural practices are a major cause for the acceleration of the acidification process. This happens through using ammonium based fertilisers and growing clover pastures. Acidic soils tend to be more susceptible to degradation by wind and water erosion (State of the Environment Report, 1992) as soil particles do not bind together effectively under conditions of low pH.

In the Shire of Williams, most of the soils are regarded as being of moderate to high risk of developing subsurface soil acidification at depths of greater than one metre (State of the Environment Report, 1992). Solutions to ameliorating soil acidity include the rotation of legume-based pastures with non-legume based pastures, reduction in the use of chemical fertilisers and increased liming and gypsum applications.

Soil Compaction

Soil compaction by stock and heavy farm machinery is a major degradation problem experienced by many Wheatbelt Shires including Williams. Stock and heavy machinery compact the soil and prevent infiltration of both water and air. This inevitably results in reduced plant growth and an increase in wind and water erosion. The problem can be rectified by using lighter farm machinery and restricting machinery traffic on the land through using minimum or zero tillage to establish crops. Fencing remnant vegetation will prevent stock causing soil compaction within the bush.

Waterlogging

Waterlogging is the temporary or permanent saturation of the soil by rainfall or runoff and is usually a result of poor drainage. The problem is often exacerbated by excessive or inappropriate clearing of deep-rooted native vegetation and soil compaction by livestock and heavy machinery. The principal cause of waterlogging is a combination of excess rainfall, poor external drainage (runoff), poor internal drainage (water movement in the soil profile) and the inability of the soil to store much water.

Waterlogging is most prevalent in the 400-500 mm rainfall area of the Wheatbelt and the problem is usually seasonal, although areas with soils of low permeability in valleys downslope of areas which shed water will be prone to waterlogging in years of high rainfall. There are a number of indicators of waterlogging:

* The presence of weeds such as canary grass (*Phalaris* sp.) that tolerate waterlogging.
* The absence of waterlogging-sensitive species such as clovers.
* The presence of red, yellow or grey mottles in the soil profile (Cox and McFarlane, 1990).

There are several species of native vegetation that can be planted that are tolerant to and can significantly curtail waterlogging. These include swamp mallet (*Eucalyptus spathulata*), swamp sheoak, salt water paperbark (*Melaleuca cuticularis*) and the fiery bottle-brush (*Callistemon phoenecius*).

Managing Existing Vegetation

Protecting existing vegetation is often easier than replanting. However, the survival of existing vegetation is affected by a number of factors including: grazing by stock of unfenced bush (passive clearing); changes in hydrology; increased exposure to the elements; increased fertiliser regimes; pests, herbicide drift and weed invasion. Native plants are often choked or covered by fast growing introduced plants that become weeds when they escape from pastures. Weeds compete with native plants for water and nutrients, increase the risk of fire and often do not provide the food and shelter that wildlife need.

Specific recommendations on how to manage existing bush are provided in "Managing your Bushland: A Guide for Western Australian Landowners" (Hussey and Wallace, 1993).

The long term solution to the problems of land degradation and the loss of local plant and animal species lies in taking a catchment approach to the management of natural resources within the Shire of Williams.

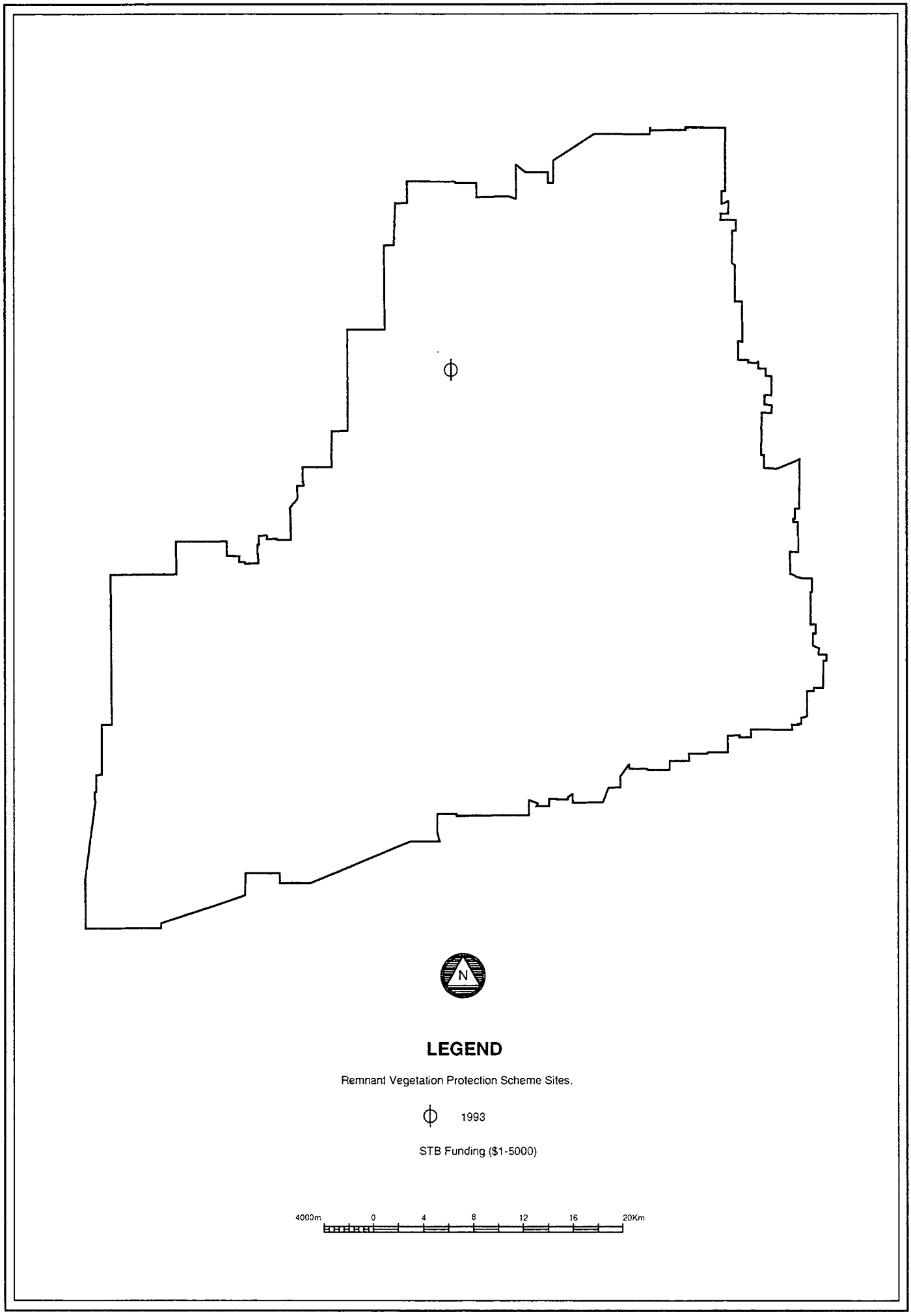


Figure 10: Remnant Vegetation Protection Scheme sites and Save the Bush funding in the Shire of Williams.

Bringing It All Together

Integrated Management for Land and Nature Conservation in the Shire

The Wheatbelt of Western Australia today has severe nature conservation and agricultural problems resulting from the excessive clearing of native vegetation. The problems associated with land degradation and the maintenance of native vegetation are problems which cannot be halted by onsite management alone. An integrated catchment/land conservation district/farm-based approach 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. Ownership of the problems and solutions at a local scale is the key to success.

As so much of the conservation resource lies under the control of private landowners and the local government authorities, the responsibility for the co-ordination of the conservation and management of natural resources must ultimately stem from these locally based groups. The Shire of Williams has a number of different organisations working towards land and nature conservation in the Shire.

The Williams Land Conservation District (LCD) has been a prime mover in this field. Within the LCD are several catchment groups including Wangeling Gully, Crossman River and Dardadine Creek Catchment Groups.

Projects in the Shire

A combination of measures and solutions aimed at protecting remnant vegetation, strategically revegetating areas degraded or void of native vegetation, and combating land degradation problems in the Shire of Williams have proven to be an effective method of achieving positive results.

One major impediment to farmers' motivation to conserve the native remnant vegetation on their properties is the cost of fencing. In recent years this problem has been partially alleviated by the introduction of the Remnant Vegetation Protection Scheme (RVPS). The Remnant Vegetation Protection Scheme was developed by the State Government in 1988 to enhance soil and nature conservation by protecting native vegetation on farm land. It has been an effective scheme in the Shire of Williams. Since 1988/89, the Shire has received only one RVPS grant to assist in the fencing of 60 hectares of native vegetation on farm land (Figure 10). Approximately half of all

remnants on private land in the Shire are either unfenced or inadequately fenced or in many cases fences are present but are falling into disrepair (Mollemans, unpub.).

There are several examples of projects with the aim of strategically revegetating sparsely vegetated areas currently underway in the Shire of Williams.

Road verges in the Shire of Williams were surveyed for their vegetation conservation status with the assistance of the Roadside Conservation Committee (RCC). The surveys were undertaken by community volunteers using the method developed by the RCC. In the Shire of Williams, approximately 20.8km of the 595 km (3.5%) of roads have been surveyed.

The Williams Conservation District Committee has endeavoured to reverse land degradation problems with assistance from several programs. In 1994/95 the Williams LCDC received $4,500 from the National Landcare Program towards to cost of undertaking a groundwater monitoring project. In 1991/92 NLP was responsible for contributing $5,000 towards the cost of purchasing a tree planter $6,960 to the Williams saltland and water quality monitoring project in 1992/93. The aim of this project was to train catchment group members to select monitoring sites for the installation of groundwater observation bores, to collate results from catchment to detect trends and to relate changes in water quality and water table depth to land management techniques and promote those changes that lead to favourable results. Also in 1992/93, the Williams LCD on behalf of the Wangeling Gully catchment group, received $8,850 from the National Landcare Program to demonstrate rehabilitation and monitoring in Wangeling Gully Stream.

The Williams LCDC has received only grant from the Save the Bush Program since its inception in 1989: $3115 in 1993/94 towards the cost of funding the Williams River Remnant Vegetation and Wildlife Habitat Project (Figure 10). The shire has received also been the recipient of only one grant of financial assistance through the State Landcare Program; in 1992/93 $15,701 was granted to the Williams LCDC to assist in production of aerial photographs to improve on new and existing farm catchment plans.

Reducing the cost of conservation

It is now widely recognised that planting native trees and shrubs can be used to remedy land degradation problems. However the cost of revegetation is a relatively expensive

practice. However there are methods of protecting remnant vegetation and planting native trees and shrubs in a cost-effective way. Initial costs are offset by long-term increases in productivity and decreases in land degradation.

To reduce the establishment costs for vegetation projects, a landholder could consider:
* cheaper fencing - (electric or re-cycled)
* collecting native plant seed from nearby sources instead of buying it (N.B. if the seed collector does not own the land, a licence will be needed. Check with CALM for details.)
* growing their own seedlings instead of buying in.
* direct seeding instead of planting seedlings
* include deep-rooted perennial fodder species for multiple use of revegetation areas.

Developing new products and industries from planted trees has the potential to provide farmers with an additional source of income. Some possibilities for the development of tree-farm products include eucalypt and tea tree oils; tannins from acacia and eucalypt species; cut wildflowers and wildflower seeds; and value-added wood products such as tool handles, craftwood and laminated wood products for furniture manufacture. Contact CALM Narrogin for advice (098) 811 444.

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Local Contacts

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2. Shire of Williams Offices - Phone: (098) 85 1005

3. Department of Conservation and Land Management, Wheatbelt Regional Headquarters (Narrogin) Phone: (098) 811 444.

4. Western Australia Department of Agriculture (Narrogin) - Phone: (098) 810022

5. National Landcare Program Project Officer, Jenny Crisp - Department of Agriculture (Narrogin) - Phone: (098) 810022

6. Blackwood Catchment Co-ordinating Group Centre, Co-ordinator - Sue Masterson. P.O. Box 27, Boyup Brook, 6244. Phone: (097) 651401

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Appendix 1.

Plant Species List of the Yalanbee and Dwellingup Complex in Low Rainfall (Heddle et al 1980)

Botanical Name	Common name (if known)
Acacia extensa	Wiry Wattle
Allocasuarina huegeliana	Rock Sheoak
Baeckea camphorosmae	Camphor Wattle
Borya sphaerocephala	Pincushions
Daviesia pectinata	Prickly Bitterpea
Dilwynia cinerascens	Grey Parrot-Pea
Eucalyptus calophylla	Marri
Eucalyptus laeliae	Darling Range Ghost Gum
Eucalyptus marginata	Jarrah
Eucalyptus patens	Yarri
Eucalyptus wandoo	Wandoo
Grevillea diversicolor	Variable-leaved Grevillea
Grevillea bipinnatifida	Fuchsia Grevillea
Hakea cyclocarpa	Ramshorn
Hakea elliptica	Oval-leaf Hakea
Hakea lissocarpha	Honey Bush
Hakea ruscifolia	Candle Hakea
Hakea undulata	Wavy-leaved Hakea
Hypocalymma angustifolium	White Myrtle
Isopogon dubius	Pinecushion Coneflower
Lasiopetalum floribundum	Free Flowering Lasiopetalum
Lepidosperma angustatum	
Leptomeria cunninghamii	
Leucopogon capitellatus	
Leucopogon propinquus	
Macrozamia riedlei	Zamia
Mesomelaena tetragona	Semaphore Sedge
Patersonia rudis	Hairy Flag
Phyllanthus calycinus	False Boronia
Sphaerolobium medium	
Stirlingia latifolia	Blueboy
Styphelia tenuiflora	Common Pinheath
Synaphea petiolaris	Synaphea
Trymalium ledifolium	

Appendix 2.

Plant Species List of Swamp Complex (Heddle et al 1980)

Botanical Name	Common name (if known)
Actinostrobus pyramidalis	Swamp Cypress
Adenanthos obovatus	Basket Flower
Astartea fascicularis	
Banksia littoralis	Swamp Banksia
Dasypogon bromeliaefolius	Pineapple Bush
Eucalyptus calophylla	Marri
Eucalyptus patens	Yarri
Hakea ceratophylla	Horned leaf Hakea
Hakea varia	Variable-leaved Hakea
Hypocalymma angustifolium	White Myrtle
Lepidosperma angustatum	
Leptocarpus scariosus	
Leptospermum ellipticum	Swamp Teatree
Melaleuca preissiana	Modong
Melaleuca cymbifolia	
Melaleuca incana	Grey Honeymyrtle
Melaleuca subtrigona	
Melaleuca uncinata	Broom Bush
Melaleuca viminea	Mohan
Melaleuca lateritia	Robin Redbreast Bush
Mesomelaena tetragona	Semaphore Sedge
Synaphea petiolaris	Synaphea
Verticordia acerosa	
Verticordia densiflora	Compacted Featherflower
Verticordia grandiflora	Claw Featherflower

Appendix 3.

Plant Species List of Pindalup and Yarragil Complex in Low to Medium Rainfall (Heddle et al 1980)

Botanical Name	Common name (if known)
Acacia extensa	Wiry Wattle
Adenanthos obovatus	Basket Flower
Allocasuarina huegeliana	Rock Sheoak
Astartea fascicularis	
Baeckea camphorosmae	Camphor Wattle
Borya sphaerocephala	Pincushions
Caustis dioica	Chinese Puzzle
Dampiera alata	Winged-stem Dampiera
Dasypogon bromeliaefolius	Pineapple Dasypogon
Daviesia decurrens	Prickly Bitterpea
Dillwynia sp.	Grey Parrot-Pea
Diplolaena drummondii	
Eucalyptus calophylla	Marri
Eucalyptus laeliae	Darling Range Ghost Gum
Eucalyptus marginata	Jarrah
Eucalyptus patens	Yarri
Eucalyptus wandoo	Wandoo
Grevillea diversicolor	Variable-leaved Grevillea
Grevillea bipinnatifida	Fuchsia Grevillea
Hakea ceratophylla	Horn Leak Hakea
Hakea cyclocarpa	Ramshorn
Hakea elliptica	Oval-leaf Hakea
Hakea lissocarpha	Honey Bush
Hakea ruscifolia	Candle Hakea
Hakea undulata	Wavy-leaved Hakea
Hibbertia lineata	
Hibbertia polystachya	
Hypocalymma angustifolium	White Myrtle
Isopogon dubius	Pinecushion Coneflower
Kingia australis	Black Gin
Lasiopetalum floribundum	Free Flowering Lasiopetalum
Lepidosperma angustatum	
Leptospermum ellipticum	Swamp Teatree
Leptocarpus scariosus	
Leptomeria cunninghamii	
Leucopogon capitellatus	
Leucopogon cordatus	
Leucopogon propinquus	
Macrozamia riedlei	Zamia
Melaleuca preissiana	Modong
Mesomelaena tetragona	Semaphore Sedge
Patersonia occidentalis	Purple Flag
Patersonia rudis	Hairy Flag
Phyllanthus calycinus	False Boronia
Sphaerolobium medium	
Stirlingia latifolia	Blueboy
Styphelia tenuiflora	Common Pinheath
Synaphea petiolaris	Synaphea
Trymalium ledifolium	

Appendix 4.

Plant Species List of Dwellinup, Yalanbee and Hester Complex in Low to Medium Rainfall (Heddle et al 1980)

Botanical Name	Common name (if known)
Adenanthos barbigerus	Hairy Glandflower
Banksia grandis	Bull Banksia
Daviesia decurrens	Prickly Bitterpea
Eucalyptus marginata	Jarrah
Grevillea wilsonii	Wilson's Grevillea
Hakea lissocarpha	
Hovea chorizemifolia	
Leucopogon capitellatus	
Leucopogon cordatus	
Macrozamia riedlei	Zamia
Patersonia rudis	Hairy rudis
Phyllanthus calycinus	False Boronia
Styphelia tenuiflora	Common Pinheath
Trymalium florabundum	Karri Hazel

Appendix 5.

Plant Species List of the Goonaping Complex (Heddle et al 1980)

Botanical Name	Common name (if known)
Adenanthos barbigerus	Hairy Glandflower
Adenanthos obovatus	Basket Flower
Allocasuarina fraseriana	Sheoak
Astartea fascicularis	
Baeckea camphorosmae	Camphor Myrtle
Banksia littoralis	Swamp Banksia
Caustis dioica	Chinese Puzzle
Conospermum stoechadis	Common Smokebush
Dasypogon bromeliaefolius	Pineapple Bush
Daviesia pectinata	Prickly Bitterpea
Eucalyptus calophylla	Marri
Eucalyptus marginata	Jarrah
Eucalyptus patens	Yarri
Grevillea wilsonii	Wilsons Grevillea
Hakea ceratophylla	Horned leaf Hakea
Hakea cyclocarpa	Ramshorn
Hakea ruscifolia	Candle Hakea
Hakea varia	Variable-leaved Hakea
Hibbertia polystachya	
Hypocalymma angustifolium	White Myrtle
Isopogon dubius	Pincushion Coneflower
Lepidosperma angustatum	
Leptocarpus scariosus	
Pericalymma ellipticum	Swamp Teatree
Leucopogon cordatus	
Leptocarpus tenax	Slender Twine Rush
Melaleuca preissiana	Modong
Mesomelaena tetragona	Semaphore Sedge
Nuytsia floribunda	Christmas Tree
Patersonia occidentalis	Purple Flag
Patersonia rudis	Hairy Flag
Sphaerolobium medium	
Stirlingia latifolia	Blueboy
Styphelia tenuiflora	Common Pinheath

Appendix 6.

Plant Species List of the Cooke Complex (Heddle et al 1980)

Botanical Name	Common name (if known)
Adenanthos barbigerus	Hairy Glandflower
Allocasuarina huegeliana	Rock Sheoak
Allocasuarina humilis	Scrub Sheoak
Baeckea camphorosmae	Camphor Myrtle
Borya sphaerocephala	Pincushions
Dampiera alata	Wing-stem Dampiera
Dillwynia cinerascens	Grey Parrot-Pea
Eucalyptus calophylla	Marri
Eucalyptus marginata	Jarrah
Eucalyptus laeliae	Darling Range Ghost Gum
Eucalyptus wandoo	Wandoo
Grevillea bipinnatifida	Fuschia Grevillea
Hakea elliptica	Oval-leaf Hakea
Hakea lissocarpha	Honey Bush
Hakea undulata	Waxy-leaved Hakea
Hypocalymma angustifolium	White Myrtle
Lepidosperma angustatum	
Leptomeria cunninghamii	
Leucopogon capitellatus	
Leucopogon propinquus	
Macrozamia riedlei	Zamia
Patersonia occidentalis	Purple Flag
Phyllanthus calycinus	False Boronia
Styphelia tenuiflora	Common Pinheath
Trymalium ledifolium	

Appendix 7.

Plant Species List of the Coolakin Complex in Low Rainfall (Heddle et al 1980)

Botanical Name	Common name (if known)
Baeckea camphorasmae	Camphor Myrtle
Dampiera alata	Winged-stem Damperia
Daviesia pectinata	Prickly Bitterpea
Dillwynia cinerascens	Grey Parrot-Pea
Eucalyptus calophylla	Marri
Eucalyptus marginata	Jarrah
Eucalyptus patens	Swan River Blackbutt
Eucalyptus wandoo	Wandoo
Gastrolobium calycinum	York Road Poison
Hakea lissocarpha	Honey Bush
Hakea ruscifolia	Candle Hakea
Hibbertia lineata	
Hibbertia polystachya	
Hypocalymma angustifolium	White Myrtle
Lasiopetalum floribundum	Free Flowering Lasiopetalum
Lepidosperma angustatum	
Leptocarpus scariosus	
Leptomeria cunninghamii	
Leucopogon capitellatus	
Leucopogon propinquus	
Macrozamia riedlei	Zamia
Mesomelaena tetragona	Semaphore Sedge
Patersonia occidentalis	Purple Flag
Patersonia rudis	Hairy Flag
Phyllanthus calycinus	False Boronia
Styphelia tenuiflora	Common Pinheath
Trymalium ledifolium	

Appendix 8.

Plant Species List of the Michibin Complex (Heddle et al 1980)
Dominant Species

Botanical Name	Common name (if known)
Acacia acuminata	Jam
Acacia microbotrya	Manna Wattle
Allocasuarina huegeliana	Rock Sheoak
Eucalyptus loxophleba	York Gum
Eucalyptus wandoo	Wandoo

Appendix 9.

Plant List-Dominant Species of the Williams Vegetation System (Beard, 1980)

Botanical Name	Common name (if known)
Trees	
Acacia acuminata	Jam
Allocasuarina huegeliana	Rock Sheoak
Eucalyptus calophylla	Marri
Eucalyptus wandoo	Wandoo
Eucalyptus astringens	Brown Mallet
Eucalyptus marginata	Jarrah
Eucalyptus rudis	Flooded Gum
Eucalyptus loxophleba	York Gum

Appendix 10.

Remnant 83 Plant List - based on initial herbarium identifications (Mollemans, unpub.)

Botanical Name	Common Name (if known)
Acacia nervosa	Rib Wattle
Acacia willdenowiana	Grass Wattle
Astroloma pallidum	Kick Bush
Astroloma sp.	
Billardiera sp.	
Boronia ramosa	
Bossiaea eriocarpa	Common Brwon Pea
Bossiaea ornata	Broad Leaved Brown Pea
Caesia parviflora	Pale Grass Lily
Cassytha sp.	
Chaemaescilla prolifera	
Chamescilla corymbosa	
Chorizema aciculare	Needle-leaved Chorizema
Comesperma acerosum	
Conostylis bealiana	
Crassula pedicallosa	
Cryptandra nutans	
Dampiera alata	Winged-stem Dampiera
Dampiera haematotricha	
Dampiera linearis	Common Dampiera
Dampiera roycei	
Daviesia aff. longifolia	
Daviesia preissii	
Dryandra calophylla	
Dryandra nivea	Couch Honeypot
Dryandra subpinnatifida	
Gastrolobium bilobum	Heart leaf Poison
Gompholobium capitatum	Yellow Pea
Gompholobium knightianum	
Gompholobium margiratum	
Grevillea leptobotrya	Tangled Grevillea
Grevillea pulchella	Beautiful Grevillea
Hakea undulata	Waxy-leaved Hakea
Hibbertia acerosa	Nedle Leaved Guinea Flower
Hibbertia hypericoides	Yellow Buttercups
Hibbertia pilosa	Hairy Guinea Flower
Hovea chorizemifolia	Holly-leaved Hovea
Hybanthus floribundus	
Hylosperma cotula	
Kunzea affinis	
Labichea punctata	Lance-leaved Cassia
Lepidosperma angustatum	
Lepidosperma squamatum	
Lepidosperma tenue	
Lomandra odora	Tiered Mat Rush
Lomandra purpurea	Purple Matrush
Lomandra sonderi	
Mitrasacme paradoxa	Wiry Mitrewort
Monotaxis grandiflora	Diamond of the Desert
Neurachne alopecuroidea	Foxtail Mulga Grass
Parentucellia latifolia	Common Bartsia
Patersonia juncea	Rush Leaved Patersonia

Patersonia occidentalis	Purple Flag
Petrophile sulphurea	
Phyllanthus calycinus	False Boronia
Pimelia angustifolia	Narrow-leaved Pimelia
Poa drummondiana	Knotted Poa
Scaevola calliptera	
Sollya heterophylla	Australian Bluebell
Sphaerolobium medium	
Stackhousia scoparia	
Stipa campylachne	
Stylidium breviscapum	Boomerang Triggerplant
Stylidium junceum	Reed Triggerplant
Tetraria octandra	
Tetratheca hirsuta	Hairy Tetratheca
Tetratheca virgata	
Thysanotus multiflorus	Many-flowered Fring Lily
Tripterococcus brunonis	Winged Stackhousia
Xanthosia huegelii	

Appendix 11.

Remnant 84 Plant List - based on initial herbarium identifications (Mollemans, unpub.)

Botanical Name	Common Name (if known)
Actinobole uliginosum	Flannel Cudweed
Astroloma pallidum	Kick Bush
Astroloma sp.	
Calandrinia calyptrata	Pink Purslane
Comesperma acersum	
Dampiera linearis	Common Dampiera
Danthonia caespitosa	Common Wallaby Grass
Danthonia setigera	
Galium murale	Small Goosegrass
Gastrolobium parvifolium	Berry Poison
Gompholobium capitatum	Yellow Pea
Helichrysum leucopideum	
Hibbertia cotula	
Hibbertia pilosa	Hairy Guinea Flower
Hibbertia spicata	
Lepidosperma gracilis	
Lepidosperma tenue	
Loxocarya flexuosa	
Patersonia sp.	
Phyllanthus calycinus	False Boronia
Pimelia ciliata	White Banjine
Podolepis gracilus	Slender Podolepis
Poranthera microphylla	Small Poranthera
Pterochaeta paniculata	
Sollya heterophylla	Australian Bluebell
Sphaerolobium sp.	
Spyridium sp.	
Stylidium repens	Matted Triggerplant
Stylidium sp.	
Tetratheca confertifolia	
Tetratheca hirsuta	Black Eyed Susan
Tetratheca setigera	
Tetratheca virgata	
Thysanotus sp.	
Trachymene pilosa	Spongefruit
Tricoryne elatior	Yellow Autumn Lily
Trymalium ledifolium	
Velleia trinervis	

Appendix 12

Native Mammals of the Narrogin CALM District (Sanders and Harold, 1991)

Taxa	Common Name	Conservation Status
Tachyglossus aculeatus	Echidna	
Dasyurus geoffroii	Chudditch	G1, AR
Phascogale calura	Red-tailed Phascogale	G1,AR, RP
Anthechinus flaviceps	Mardo	
Sminthopsis dolichura	Common Dunnart	NK
Sminthopsis gilberti	Common Dunnart	
Sminthopsis griseoventer	Common Dunnart	PO, NK
Sminthopsis crassicaudata	Fat-tailed Dunnart	
Sminthopsis granulipes	White-tailed Dunnart	
Ningaui yvonneae		NK
Antichinomys laniger	Kultarr	NR
Myrmecobius fasciatus	Numbat	G1, AR, RP
Isooden obsesulus fusciventer	Brown Bandicoot	G1, AR
Chaeropus ecaudatus	Pig-footed Bandicoot	E
Macrotis lagotis	Bilby	ER, G1
Peudocheirus peregrinus occidentalis	Common Ringtail	G1, AR,NK
Trichosurus vulpecula	Brush-tailed Possum	
Cercartetus concinnus	South-west Pygmy Possum	
Tarsipes rostratus	Honey Possum	
Bettongia penicillata	Woylie	G1, AR
Bettongia lesueur	Burrowing Rat-kangaroo	ER, G1
Largostrophus fasciatus	Western Hare-Wallaby	ER, G1
Onychogalea lunata	Cresent Nail-tailed Wallaby	ER, G1
Petrogale lateralis	Black-footed Rock- Wallaby	G1, NK
Macropus eugenii	Tammar Wallaby	G1, AR
Macropus irma	Western Brush Wallaby	
Macropus fuliginosus	Western grey Kangaroo	
Macropus robustus	Euro	
Tadarida australis	Whire-striped Bat	
Mormopterus planiceps	Little Mastiff-Bat	NR
Nyctophilus major	Greater Long-eared Bat	
Nyctophilus gouldi	Gould's Long-eared Bat	
Nyctophilus geoffroyi	Lesser long-eared Bat	
Chalinologus morio	Chocolate Bat	
Scotorepens balstoni	Western Broad-nose Bat	
Falsistrellus mackenziei		
Eptesicus finlaysoni		
Hydromys chysogaster	Water Rat	
Pseudomys shortridgei	Blunt-faced Mouse	G1, AR, NR
Pseudomys albocinereus	Ash-grey Mouse	
Pseudomys occidentalis	Western Mouse	G1, AR, RP
Notomys mitchellii	Mitchell's Hopping Mouse	
Notomys alexis	Brown hopping-Mouse	NK

Status Key

AR - At risk within the region
E - Extinct throughout its former range
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 - Have population mainly within the region

Appendix 13

Reptiles and Amphibians of the Narrogin CALM District (Sanders and Harold, 1991)

Taxa	Conservation Status
	Amphibians
Leptodactyldae	
Crinia pseudinsignifera	NK;AR
Heleioporus albopunctatus	AR
Heleioporus barycragus	AR
Heleioporus inornatus	AR
Heleioporus psammophilus	NR;AR
Limnodynastes dorsalis	AR
Myobatrachus gouldii	AR
Neobatrachus albipes	RP;AR
Neobatrachus kunapalari	AR
Neobatrachus pelobatoides	AR
Neobatrachus sutor	NR;AR
Pseudophryne guentheri	AR
Pseudophryne occidentalis	NK;AR
Hylidae	
Litoria cyclorhynchus	AR
Litoria moorei	AR
	Reptiles
Chelidae	
Chelodina oblonga	
Gekkonidae	
Crenadactylus ocellatus ocellatus	
Diplodactylus granariensis	
Diplodactylus polyophthalmus	
Diplodactylus spinigerus inornatus	
Gehyra variegata	
Heteronotia binoei	
Nephrurus stellatus	PO;NK
Oedura reticulata	
Phyllodactylus marmoratus marmoratus	
Underwoodisaurus milii	
Pygopodidae	
Aprasia pulchella	
Aprasia repens	
Delma australis	
Delma fraseri	
Delma greyii	NR
Lialis burtonis	

Pygopus lepidopodus lepidopodus	NK
Agamidae	
Ctenophorus cristatus	
Ctenophorus maculatus griseus	
Ctenophorus ornatus	
Ctenophorus reticulatus	
Ctenophorus salinarum	
Moloch horridus	
Pogona minor minor	
Tymanocryptis adelaidensis	NR
Scincidae	
Bassiana trilineata	
Cryptoblepharus plagiocephalus	
Ctenotus atlas	NK
Ctentus fallens	PO;NK
Ctentus impar	
Ctenotus labillardieri	NR
Ctenrus pantherinus pantherinus	
Ctentus schomburgkii	
Ctentus uber uber	PO;NR
Cyclodemorphus melanops	PO;NK
Egernia inornata	NR
Egernia kingii	NR
Egernia multiscutata bos	
Egernia napoleonis	
Egernia richardi	
Egernia stokesii badia	NR
Eremiascincus richardsonii	
Hemiergis peronii	
Lerista macroisthopus macropisthopus	
Lerista muelleri	PO;NR
Lerista picturata	PO
Menetia greyii	
Morethia butleri	NR
Morethia lineoocellata	NR
Morethia obscura	
Tiliqua occipitalis	
Tiliqua rugosa rugosa	
Varanidae	
Varanus gouldii	
Varanus tristis tristis	NK
Varanus rosenburgi	
Typhlopidae	
Ramphotyphlops australis	
Ramphotyphlops hamatus	PO;NK
Ramphotyphlops pinguis	NK
Ramphotyphlops waitii	

Boidae	
Aspidites ramsayi	G2;AR;NK
Morelia spilota imbricata	G2;AR
Morelia stimsoni stimsoni	PO(N);NK
Elapidae	
Acanthophis antarcticus	PO(N);NK
Demansia psammophis reticulata	NK
Denisonia atriceps	NK;RE
Denisonia fasciata	NR
Notechis coronatus	PO(N);NK
Notechis curtus	
Notechis scutatus occidentalis	NR
Pseudonaja australis	NR
Pseudonaja affinis affinis	
Pseudonaja modesta	NK
Pseudonaja nuchalis	
Rhinoplocephalus gouldii	
Rhinoplocephalus nigriceps	
Vermicella bertholdi	
Vermicella bimaculata	PO(N);NK
Vermicella semifasciata semifasciata	

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 (district shown in brackets)
NK - Date of last record not known
RE - Regionally endemic
RP - Have population mainly within region

Appendix 14.

Bird Species seen in the Shire of Williams (Saunders and Ingram, 1994)

Common Name	Scientific Name
Australasian Little Grebe	*Podiceps novaehollandiae*
Australian Magpie	*Gymnorhina tibicen*
Australian Magpie Lark	*Grallina cyanolueca*
Australian Pelican	*Pelecanus conspicillatus*
Australian Raven	*Corvus coronoides*
Banded Plover	*Vanellus tricolor*
Barn Owl	*Tyto alba*
Black Cormorant	*Phalacrocorax carbo*
Black Duck	*Anas superciliosa*
Black-eared Cuckoo	*Chrysococcyx osculans*
Black-faced Cuckoo Shrike	*Coracina novaehollandiae*
Black-faced Woodswallow	*Artamus cinereus*
Black-fronted Dotterel	*Charadrius melanops*
Black-shouldered Kite	*Milvus migrans*
Black-tailed Native Hen	*Gallinula ventralis*
Blue-breasted Wren	*Malurus pulvherrimus*
Boobook Owl	*Ninox novaeseelandiae*
Broad-tailed Thornbill	*Acanthiza apicalis*
Brown Falcon	*Falco berigora*
Brown Goshawk	*Accipiter fasciatus*
Brown Honeyeater	*Lichmera indistincta*
Brown Song Lark	*Cincloramphus cruralis*
Brown-headed Honeyeater	*Melithreptus lunatus*
Budgerygar	*Melopsittacus undulatus*
Bush Stone Curlew	*Burhinus grallarius*
Carnaby's Cockatoo	*Calyptorhynvhus latirostris*
Collared Sparrowhawk	*Accipiter cirrocephalus*
Common Bronzewing	*Phaps chalcoptera*
Crested Pigeon	*Ocyphaps lophotes*
Diamond Dove	*Geopelia cuneata*
Domestic Pigeon	
Dusky Moorhen	*Gallinula tenebrosa*
Dusky Woodswallow	*Artamus cyanopterus*
Elegant Parrot	*Neophema elegans*
Emu	*Dromaius novaehollandiae*
Fan-tailed Cuckoo	*Cuculus variolosus*
Galah	*Cactaua roseicapilla*
Golden Whistler	*Pachycephala pectoralis*
Grey Butcherbird	*Cracticus torquatus*
Grey Currawong	*Strepera versicolor*
Grey Fantail	*Rhipidura fuliginosa*
Grey Shrike-Thrush	*Colluricincla harmonica*
Grey Teal	*Anaa gibberifrons*
Hoary-headed Grebe	*Podiceps poliocephalus*
Hooded Robin	*Petroica cucullata*
Horsfield's Bronze Cuckoo	*Chrysococcyx basqlis*
Jacky Winter	*Micoeca leucophaea*
Laughing Kookaburra	*Dacelo gigas*
Laughing Turtledove	*Streptopelia senegalensis*
Little Button Quail	*Turnix velox*
Little Crow	*Corvus bennetti*
Little Eagle	*Aquila morphnoides*

Little Falcon	*Falco longipennis*
Little Pied Cormorant	*Phaloacrocorax melanoleucas*
Little Wattlebird	*Anthochaera chrysopteraa*
Masked Woodswallow	*Artamus personatus*
Mistletoe Bird	*Dicaecum hirundinaceum*
Mountain Duck	*Tadorna tadnoroides*
Mulga Parrot	*Patycercus varius*
Nankeen Kestrel	*Falco cenchroides*
New Holland Honeyeater	*Phylidonyris novaehollandiae*
Owlet-nightjar	*Aegotheles cristatus*
Painted Button Quail	*Turnix varia*
Pallid Cuckoo	*Cuculus pallidus*
Peregrine Falcon	*Falco peregrinus*
Pied Butcherbird	*Cracticus nigrogularis*
Pied Stilt	*Himantopus himantopus*
Pink-eared Duck	*Melacorhynchus membranaceus*
Port Lincoln Ringneck	*Platycercus zonarius*
Purple-crowned Lorrikeet	*Glossopsitta porphyrocephala*
Rainbow Bee-eater	*Merops ornatus*
Red Wattlebird	*Anthochaera carunculata*
Red-capped Dotterel	*Charadrius ruficapillus*
Red-capped Parrot	*Patycercus zonarius*
Red-capped Robin	*Petroica goodenovii*
Red-tailed Black Cockatoo	*Calyptorhynchus magnificus*
Regent Parrot	*Polytelis anthopeplus*
Restless Flycatcher	*Myiagra inquieta*
Richard's Pipit	*Anthus novaeseelandiae*
Rufous Song Lark	*Cincloramphamus methewsi*
Rufous Treecreeper	*Climacteris melanura*
Rufous Whistler	*Pachycephala rufiventris*
Sacred Kingfisher	*Halycon sancta*
Scarlet Robin	*Petroica multicolor*
Shining Bronze Cuckoo	*Chrysococcyx lucidus*
Silvereye	*Zosterops lutea*
Singing Honeyeater	*Meliphaga virescens*
Square-tailed Kite	*Lophoictinia isura*
Straw-necked Ibis	*Threskiornis spinicollis*
Striated Pardalote	*Pardolotus striatus*
Stubble Quail	*Coturnix novaezelandiae*
Tawny Frogmouth	*Podargus strigoides*
Tree Martin	*Hirundo nigricans*
Varied Sittella	*Daphoenositta chrysoptera*
Wedge-tailed Eagle	*Aquila audax*
Weebill	*Smicrornis brevirostris*
Welcome Swallow	*Hirundo neoxena*
Western Rosella	*Platycercus icterotis*
Western Thornbill	*Acanthiza inornata*
Western Warbler	*Gerygone fusca*
Western Yellow Robin	*Eopsaltria australis*
Whistling Kite	*Haliastur sphenurus*
White-backed Swallow	*Cheramoeca leucosterna*
White-browed Babbler	*Pomatostomus superciliosus*
White-cheeked Honeyeater	*Phylidonyris nigra*
White-eared Honeyeater	*Meliphaga leucotis*
White-faced Heron	*Ardea novaehollandiae*
White-fronted Chat	*Epithianura albifrons*
White-naped Honeyeater	*Melithreptus lunatus*
White-necked Heron	*Ardea pacifica*

White-winged Triller	*Lalage sueurii*
Willie Wagtail	*Rhipidura leucophrys*
Wood Duck	*Chenonetta jubata*
Yellow-plumed Honeyeater	*Meliphaga ornata*
Yellow-rumped Pardalote	*Pardoltus xanthopygus*
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*
Yellow-throated Miner	*Manrina flavigula*

Appendix 15.

Sources of funding for projects aimed at land and nature conservation

Remnant Vegetation Protection Scheme

The Remnant Vegetation Protection Scheme (RVPS) was developed by the State Government in 1988 to enhance soil and nature conservation by protecting native vegetation on farm land. The Scheme (which is jointly administered by CALM and Western Australian Department of Agriculture (WADA), with WADA as the lead agency) provides a fifty percent subsidy towards to cost of protective fencing of native vegetation on farms. Landowners give an undertaking that the fenced vegetation will be managed for nature conseravation for a period of at least thirty years.

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

National Landcare Program

The National Soil Conservation Program (NSCP) was established by the Federal Government in 1983 with the aim of developing and implementing 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 given to 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. The aim of the NLP is to encourage community groups to responsibly manage and conserve land, water and biological diversity in their area.

One Billion Trees

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

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.

Ribbons of Green

Ribbons of Green is a community based Greening Western Australia Project which started in 1989 with the aim of replanting and regenerating cleared strips of land with native plants and trees. The "Ribbons" are corridors along roads or rail reserves, along waterways or linking patches of bush. These 'Ribbons' may only contribute slightly to overall land conservation, but they are important for the conservation of wildlife by providing bush corridors. The details of what to plant, where and when to plant, are developed by the local community in consultation with Greening Western Australia, government departments (WADA, CALM and MRD), local government authorities, consultants and community groups.

Plants for Conservation

The aim of Plants for Conservation (PFC) is to support 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 for revegetation projects aimed at land and nature conservation. It is managed by Greening Western Australia and sponsored by ALCOA of Australia and by the Hamel Nursery. With the sponsors support, Greening Western Australia provides the seedlings. Participating groups and individuals contribute additional seedlings, materials and labour towards the projects.

Gordon Reid Foundation for Conservation

The Gordon Reid Foundation for Conservation aims to provide funds or other support for the purposes of enhancing 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 WA;

* public education and awareness of environmental issues within WA;
* and research or other studies into other matters related to any of the above.

State Landcare Program

The State Government introduced the State Landcare Program in the 1987 to support Land Conservation District Committees 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. There have been only one successful State Landcare grants made to any groups with the Shire of Williams to date.