Flaxley Landcare Group

Local Natural Resource Management Plan

2006

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Government of South Australia
Department of Water, Land and Biodiversity Conservation

Goolwa to Wellington
Local Action Planning Board Inc

Government of South Australia
Adelaide and Mount Lofty Ranges
Natural Resources Management Board

SUMMARY

The Flaxley Landcare Group has been operating now for over fifteen years. The Local Natural Resources Management Plan was undertaken in order to provide an opportunity to review the work of the Group to date and provide direction for future activities.

Some of the key achievements of the Group are:

- almost all (87%) remnant vegetation in the District is protected from stock and managed for conservation
- almost half of all watercourses are fenced from stock
- an increase in the area of native vegetation in the District from 8.5% to 14.1% through revegetation and regeneration
- and increase in the number of patches of native vegetation greater than 10ha from one patch to four
- the majority of revegetation has been strategically sited to increase patch sizes and connections between patches
- perennial pastures comprise almost all of the grazing area
- apart from some historical erosion in watercourses, no evidence of current soil erosion was found in paddocks
- forty three species of birds of conservation have been recorded in the District, with some of these having been observed in revegetation areas.

Recommendations and long term targets for future on-ground works are given (see page 33), as well as monitoring and trialling recommendations.

Analysis of soil types and remnant vegetation were carried out to ascertain the pre-European vegetation communities of the Flaxley District. Revegetation lists for each community are given.

While revegetated areas have many years to go before they provide the ecological functions of remnant vegetation, the establishment of the vegetation has to take place first. Recommendations for the on-going management of revegetation to enhance the biodiversity values are given.

A workshop to plan on-ground and monitoring activities over the next three years was held following the preparation of the first draft of the report, a prioritisation of the threat potential of local weeds was also incorporated. The results are included in Appendix 6 and 7 respectively.

Support provided by the Department for Water, Land and Biodiversity Conservation, the Adelaide and Mt Lofty Ranges NRM Board, & the Goolwa-Wellington LAP

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Members of the Flaxley Landcare Group
Bill New (Rural Solutions SA): maps
Tony Randall (Goolwa – Wellington LAP): project initiation
Amelia Hurren (Bush Management Adviser, DEH): review
Ivan Clarke (Rural Solutions SA): review

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ACRONYMS

DEH	Department for Environment and Heritage
LCG	Landcare Group
NHT	Natural Heritage Trust (a Federal funding source)
NV	Native Vegetation

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1 INTRODUCTION

1.1. The Flaxley Landcare Group

After listening to and meeting with a PIRSA Revegetation Officer, three neighbours at the headwaters of the Angas River were inspired to revegetate their sections of watercourse. In order to access funding they were required to be part of a group, so they formed the Flaxley Landcare Group. When the group held its first public meeting some years later in 1993, the membership grew from three to fifteen and has continued to grow ever since.

Being part of the Landcare Group has been found to have many benefits beyond being able to access funding (in fact this is no longer a requirement for most funding sources). The Group provides the opportunity for landholders to:

- learn from each other's successes and mistakes
- discuss new ideas, learnings and issues
- coordinate activities across properties for greater effectiveness
- be welcomed into the District when they purchase land
- be supported by a social network of environmentally committed landholders.

The members of the Group bring to it a range of skills from their own backgrounds on and off the Land that support the functioning of the Group and can be shared with the members.

One of the keys to the achievements of the Flaxley Landcare Group is that it has created the impetus for landholders to self-educate. Members of the Group actively seek out sources of information (human or written) when they identify gaps in their knowledge, as well as seeking out new ideas.

Activities which the Flaxley Landcare Group have carried out include:

- property management planning – development of property plans, fencing and managing to land type
- land management – pasture improvement, soil improvement, grazing management,
- protection and restoration of watercourses – fencing, willow removal, revegetation, erosion control and crossings
- protection and restoration of remnant vegetation – fencing, weed control, revegetating missing species, rabbit control on private and public land

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- re-establishment of native vegetation – seed collection, propagation, tubestock planting, machine and hand direct seeding
- coordinated weed, rabbit and fox control programs
- monitoring – native vegetation, bats, birds and water quality
- group learning – field days, creek walks, information sharing at meetings and during other activities
- funding – accessing Landcare and NHT funding to help fund on-ground actions
- membership of regional groups – provided local perspectives to regional planning processes.

1.2. Purpose of the Plan

To record and evaluate the past works of the Flaxley Landcare Group and recommend priority actions for future natural resource management.

1.3. Description of the District

The area of the Landcare Group is predominantly the headwaters of the Angas River, which flows into Lake Alexandrina. An area which encompasses all the contiguous current members of the Landcare Group is shown on the map "Overview of Project Area". This is not an exclusive boundary and was only necessary for calculating data for the review. The Landcare Group includes members outside this area and new members are welcomed into the Group.

The average annual rainfall is around 800mm.

The original vegetation consisted of Messmate Stringybark (*Eucalyptus obliqua*), Cup Gum (*E. cosmophylla*) and Pink Gum (*E. fasciculosa*) Forests[1] on the hill tops, grading through Blue Gums and Manna Gum Woodlands[2] on the mid-slope to Red Gum Woodlands on the flats and watercourses with some small swamps. The traditional owners are the Peramangk People.

The soils are predominantly shallow and rocky on the hilltops, with sandy loams over clay or weathered rock on the slopes and alluvial soils in the valley floors.

The native vegetation has now been mostly cleared, except on hilltops and rocky outcrops, and the land has been used for various forms of agriculture. In recent times there has been a major shift away from dairying to grazing beef cattle, this has been in

[1] Forests are defined by having trees with a foliage cover of greater than 30%.
[2] Woodlands are defined by having trees with a foliage cover of less than 30%.

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part due to de-regulation of the dairy industry, increasing land values and family succession planning. Other land uses include chicken farming, horse keeping, dairying, farm forestry and conservation.

Another major change in the district has been from the majority of properties being farms (the use of the property contributed a major portion to the family income) to most now used for rural living (where the property still generates an income but there is significant off-farm income).

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Flaxley LandCare Group- Overview of Project Area

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2 NATURAL WATER RESOURCES

The Flaxley District comprises the headwaters of the Angas River, with approximately 24km of watercourses (including the main channel and tributaries). No literature could be found regarding the quality or quantity of surface water in the District, however landholders who use the water have observed that watercourse salinity generally increases downstream.

There are several small saline seeps throughout the catchment, generally part way up the slopes. Some of these seeps are associated with small wetlands (or perched swamps) which remain damp for the entire year.

In the lowest part of the District there are several permanent pools along the Angas, and water is observed flowing for most of the year. Members of the Landcare Group believe the flow of water in the River is probably heavily influenced by the level of irrigation using groundwater.

While there have been no reports on the quality or quantity of groundwater in the District, data from boreholes at the time of drilling shows the salinity of most bores to be below 3000 ECs and several below 500 Ecs (see map “Groundwater Salinity”).

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3 NATURAL SOIL RESOURCES

The majority of the Flaxley area falls within the area classified as the Flaxley Land System under the State's Land Classification System (PIRSA 2001), with the western ridgeline classified as Mt Torrens Land System and the south-western corner falling in the Bull Creek Land System.

"The Flaxley Land System is undulating to gently rolling terrain characterized by deep texture contrast or gradational soils forming in highly weathered basement rocks. Surfaces are sandy loam to loam overlying clayey subsoils which commonly impede water movement. The predominant sandy loam soils have moderately low natural fertility, a condition exacerbated by the high degree of weathering typical of most soils. All soils are susceptible to acidifications. Most are highly erodible. With more than 95% of the land potentially arable, the potential for erosion is high. The deeply weathered profiles contain substantial reserves of salts, some of which have been mobilised as vegetative water use has declined. This has led to saline seepages developing on lower slopes and drainage depressions, (PIRSA 2001, p. 1195)."

The catchment has broad alluvial valleys of predominantly sandy loam over brown clay which are moderately fertile but very prone to waterlogging, with watercourses prone to erosion (PIRSA 2001). Consequently, many of these soils have been fenced from stock and revegetated as part of creekline restoration projects.

"The [Mt Torrens] Land System is a long, narrow belt of country formed on massive quartzite beds. The landscape is dominated by discontinuous linear quartzite ridges, including the peaks of Mt Torrens, Mt Charles and Mt Barker… Most of the ridge is moderately steep with sporadic outcrop.

"Most soils [of the Mt Torrens Land System] are formed in freshly or deeply weathered basement rock. Most have sandy loam surfaces which either abruptly overlie clayey subsoils, or merge with them indistinctly. On steeper and/or rocky slopes, soils are shallow and stony directly overlying hard rock… All soils are acidic, at least in their surface layers (PIRSA 2001, p. 1505)." As well as susceptibility to erosion, the ridges have low natural fertility, poor surface structure and are highly erodible (PIRSA 2001). The majority of remnant vegetation in the district is found on these soil types.

The area of the Bull Creek Land System includes similar soils as those described above as well as soils with sporadic ironstone, poor fertility and drainage (PIRSA 2001).

See map "Flaxley District Soil Types".

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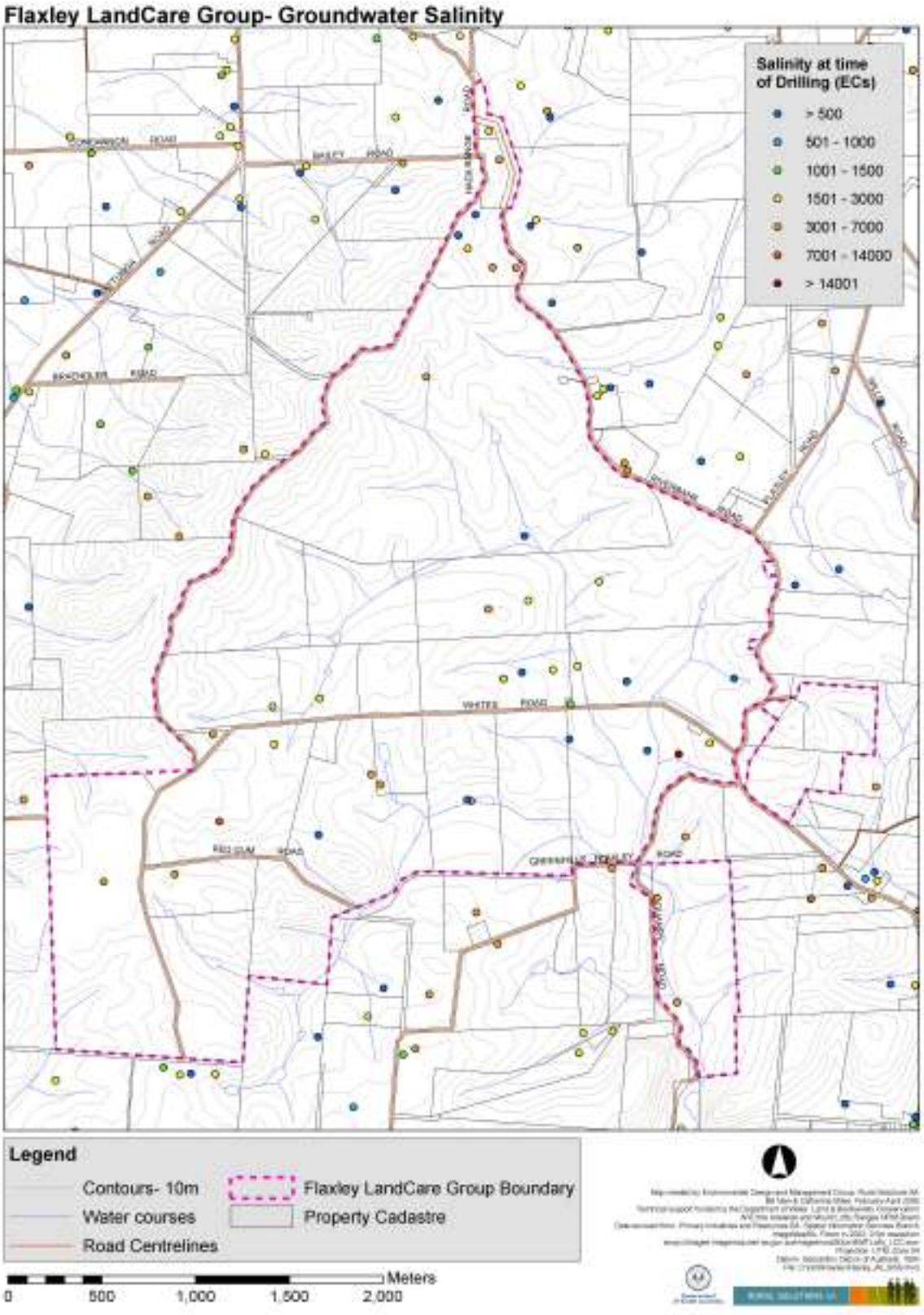

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4 NATURAL BIODIVERSITY RESOURCES

Native Vegetation

The majority of native vegetation in the Flaxley District is located on private properties and the canopy of most remnants is made up of predominantly Messmate Stringy-bark (*Eucalyptus obliqua*) Open Forest with occasional Pink Gums (*E. fasciculosa*) and Cup Gums (*E. cosmophylla*). The understorey of these remnants is dense and shrubby. These remnants are generally located on the poorest soils in the district. The thin and multiple trunks of most of the trees indicate past logging.

Other vegetation associations that were historically found in the district would have occupied more productive soil types and consisted of less shrubby, more open Woodlands with a significant proportion of native grasses in the understorey. While much of these associations have been cleared, fragments of native grassy understorey, and tree canopy still exist in some pastures (pers. obs).

More detailed description of the vegetation associations are given in Appendix 1. A full list of species recorded in the district is given in Appendix 3.

4.1.1 Plant Species

Flaxley District contains a diverse array of native plants, with 290 species recorded within the immediate area of which eleven species are considered rare in South Australia and two vulnerable (see Appendix 3). Additionally, for the Mount Lofty Ranges, two species are endangered, two vulnerable, one threatened and twenty one rare.

4.1.2 Vegetation of Made and Unmade Roads

Crompton and Williams (1998) surveyed the vegetation of roadsides in the Mt Barker District Council area. The vegetation of Hack Range Road was classified as Category 1, the highest priority for conservation, accurately reflecting the original vegetation communities, with a low degree of weed invasion. The most immediate threats to Hack Range Road were weeds, soil disturbance and roadworks. Other roads were classified between 2 and 3 (see table below).

Categorisation of native vegetation on developed roadsides in Flaxley District, scale: 1 (best) – 5 (poorest), (Crompton & Williams 1998).

Road Name	Category
Flaxley	3
Greenhills	3
Hack Range	1
Jaybee	3

Road Name	Category
Red Gum	2
Quarry	3
Whites	2

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The vegetation of undeveloped roads was surveyed by Clark (2003). Red Gum Road was considered to have the highest conservation significance in the Flaxley District due to the presence of *Eucalyptus viminalis ssp. viminalis* which, as the species alone, is classified as rare in SA, and the Mt Lofty Ranges, and as a community is considered vulnerable in the Mt Lofty Ranges (DEH 2003). However the condition of this and other unmade roads was generally poor.

Undeveloped Roads Native Vegetation Survey, overall significance scale: A (highest) – E (lowest), (Clark 2003).

Road Name	Overall Significance	Overall Condition	Conservation Significance	Recommendation
Red Gum (5)	B, C, D	Mod – V. Poor	*E. viminalis ssp. viminalis*	Bushcare, rehabilitation
Off Quarry Rd (8)	D, E	V. Poor		
Schofield (61)	D-E	Poor – V. Poor		Rehabilitation (parts)
Jay Bee (62)	D-E	Poor – V. Poor		Rehabilitation (parts)

4.1.3 Wetlands

The wetlands of the Flaxley District were not surveyed in the recent Wetland Inventory of the Fleurieu Peninsula (Harding 2005).

Several small perched swamps exist in the catchment. These areas stay wet throughout the year and, when fenced from stock, the sedges (Cyperaceae), rushes (Juncaceae) and other small swamp species regenerate readily. Several of these swamps exist on 'Battunga' and were surveyed as part of this project, the results are given in Appendix 5.

Significant Fauna

Fauna of conservation significance recorded from the area by DEH are Peregrine Falcon, Olive Snake-lizard *Delma inornata* and Carpet Python *Morelia spilota*. Collation of the records of bird surveys in the area shows many more birds with conservation significance.

Birds

Ninety-one bird species have been recorded in the Flaxley District (the full list is shown in Appendix 4). At the State level three species are considered rare, and four vulnerable. At the regional level, three species are considered rare, six vulnerable and one uncommon. Thirty-two species that are considered to be declining in the Mt Lofty Ranges have also been recorded in the District.

Birds of high conservation significance recorded in the district are:

Common Name	Scientific Name	Ratings
Black-eared Cuckoo	*Chrysococcyx osculans*	MLR:R
Crested Shrike-tit	*Falcunculus frontatus*	SA:V, MLR:V
Diamond Firetail	*Stagonopleura guttata*	SA:V, MLR:V
Flame Robin	*Petroica phoenicea*	SA:R, MLR U
Peregrine Falcon	*Falco peregrinus*	SA: R, MLR R
Restless Flycatcher	*Myiagra inquieta*	MLR:V
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*	SA:R, MLR:R
White-naped Honeyeater	*Melithreptus lunatus*	SA:V, MLR:V
Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*	SA:V, MLR:V

4.1.4 Bats

A bat survey was carried out on the properties of landholders in the Flaxley District in 2004, the results reported by Terry Reardon of the SA Museum (July 2004) are:

		Property recorded at						
Common Name	Scientific Name	Kebbel	Skinner	Christie	Kuchel	White	Farnhill	Coldrey
White-striped freetail bat	*Tadarida australis*	X		X		X	X	X
Southern freetail bat	*Mormopterus petersi*	X			X	X	X	X
Gould's wattled bat	*Chalinolobus gouldii*	X	X	X	X	X	X	X
	Mp or Cg		X					
Large forest bat	*Vespadelus darlingtoni*	X	X	X	X	X	X	X
Southern forest bat	*Vespadelus regulus*	X	X	X	X	X	X	X
Small forest bat	*Vespadelus vulturnus*							
	Vr or VV	X						
Chocolate wattled bat	*Chalinolobus morio*	X	X	X	X		X	
	Vv or Cm					X		X
Lesser long-eared bat	*Nyctophilus geoffroyi*	X	X	X	X	X	X	X

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4.1.5 Reptiles & Amphibians

DEH records for the area include the Olive Snake-lizard (*Delma inornata*) and Carpet Python (*Morelia spilota*), nearby records for Eastern Bluetongue Lizards (*Tiliqua scincoids*) and Garden Skink (*Lampropholis guichenoti*). A survey was undertaken at 'Banksia Ridge' as part of a University of South Australia study, the following species were found:

Common Name	Scientific Name	No.
Brown Tree-frog	*Litoria ewingi*	2
Common Toadlet	*Crinia signifera*	1
Spotted Grass-frog	*Limnodynastes tasmaniensis*	1
Bullfrog	*Limnodynastes dumerilli*	1
Marbled Gecko	*Christinus marmoratus*	10
Garden Skink	*Lampropholis guichenoti*	13
Three-toed Earless Skink	*Hemiergis decresiensis*	4

None of these species are of conservation significance. In addition, the following species have been observed in the District:

- Sleepy Lizard (*Tiliqua rugosa*)
- Eastern Bearded Dragon (*Pogona barbata*)
- Eastern Brown Snake (*Pseudonaja textiles*)
- Red-bellied Black-snake (*Pseudechis porphyriacus*)

4.1.6 Mammals and Monotremes

There are no DEH records within the area.

Species observed by members of the Landcare Group are:

Species	Comments
Echidna	Diggings often observed although no recent observations of animals. Considered common throughout the Mt Lofty Ranges (Hurren pers. com.)
Ring-tailed Possum	Commonly seen
Brush-tailed Possum	Rarely seen. Considered to be declining in the Mt Lofty Ranges and proposed to be listed as rare under the *National Parks and Wildlife Act 1972* (Hurren pers. com.).
Kangaroos	Numbers increasing
Koalas[3]	One recent sighting

[3] Not native to the region

5 REVIEW OF WORK TO DATE AND NEW TARGETS

Methodology

Each of the members of the Flaxley Landcare Group were visited by the author. Works carried out on the property were marked on an aerial photo and observations made in the field. The on-ground works were subsequently recorded in a GIS (Geographical Information System) to analyse the information, (see map "Flaxley On-Ground Works").

Analysis of Spatial Information

5.1.1 Area of remnant native vegetation managed for conservation and condition

- Whilst remnant vegetation is protected from clearance by the *Native Vegetation Act 1991*, many small remnants could still be removed altogether or significantly reduced through exemptions for maintenance of fencelines, firebreaks, roads etc.
- Without long-term management, many existing remnants of vegetation will be lost in the long time where young plants are either grazed or smothered by weeds.
- Grazing is probably the main threat to remnant vegetation on private land, whilst damage through inappropriate road maintenance threatens public roadside vegetation (Crompton & Williams 1998).
- Weeds are the second main threat to both public and privately owned remnant vegetation, active management to reduce weeds is required in most situations.
- A system for measuring and monitoring the condition of native vegetation has been developed by the Nature Conservation Society of South Australia (Croft et al 2005), which takes into consideration
    - the type of plant community
    - plant species diversity
    - weed abundance and threat
    - structural diversity (ground cover, and variety of plant life forms)
    - regeneration
    - tree and shrub health
    - tree habitat features
    - feral animals
    - total grazing pressure
    - fauna species diversity
    - bushland degradation risk.

Area of remnant vegetation currently managed for conservation 2005: 73ha, 87% of remnant vegetation, increased from no vegetation managed for conservation when the group started.

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There has been no monitoring of the condition of the vegetation in the District, but all members of the Group have observed improvements in the condition of indicators of vegetation health (eg regeneration and weed reduction).

Actions

- Protect remaining remnant vegetation from grazing by stock and manage for conservation.
- Encourage Heritage Agreements over remnant vegetation to ensure it's protection in the long term and secure investments made.
- Continue to manage remnant vegetation, following bush management principles.
- Establish monitoring sites using the 'Bushland Condition Monitoring Manual' , in particular this may help measure weeds distribution and impacts (eg 'Sticky Willy'), and monitor tree health.

Target

Protection of all remnant vegetation on private land through fencing (11ha).

Management of all areas of remnant vegetation (86ha).

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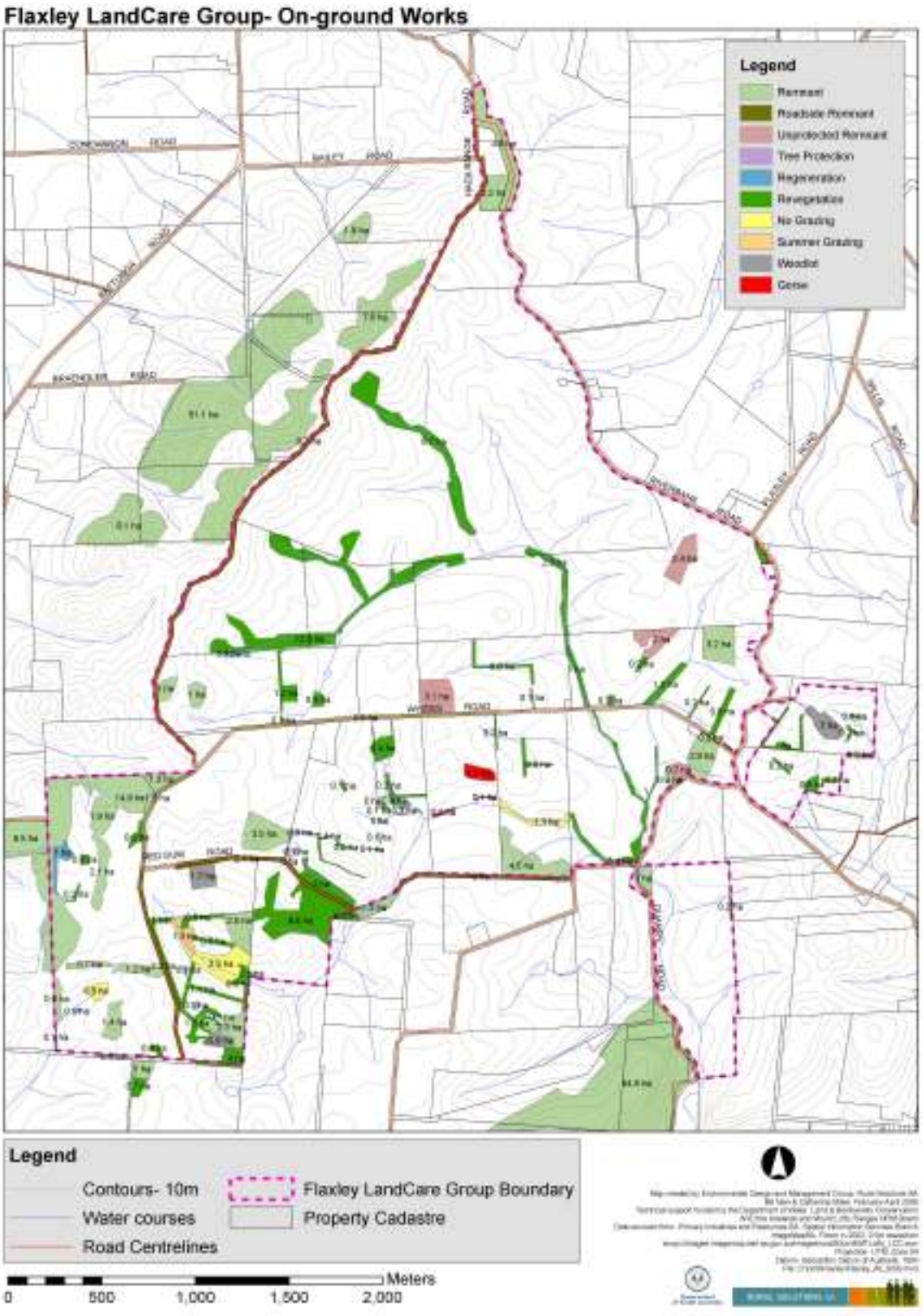
(Total Area)



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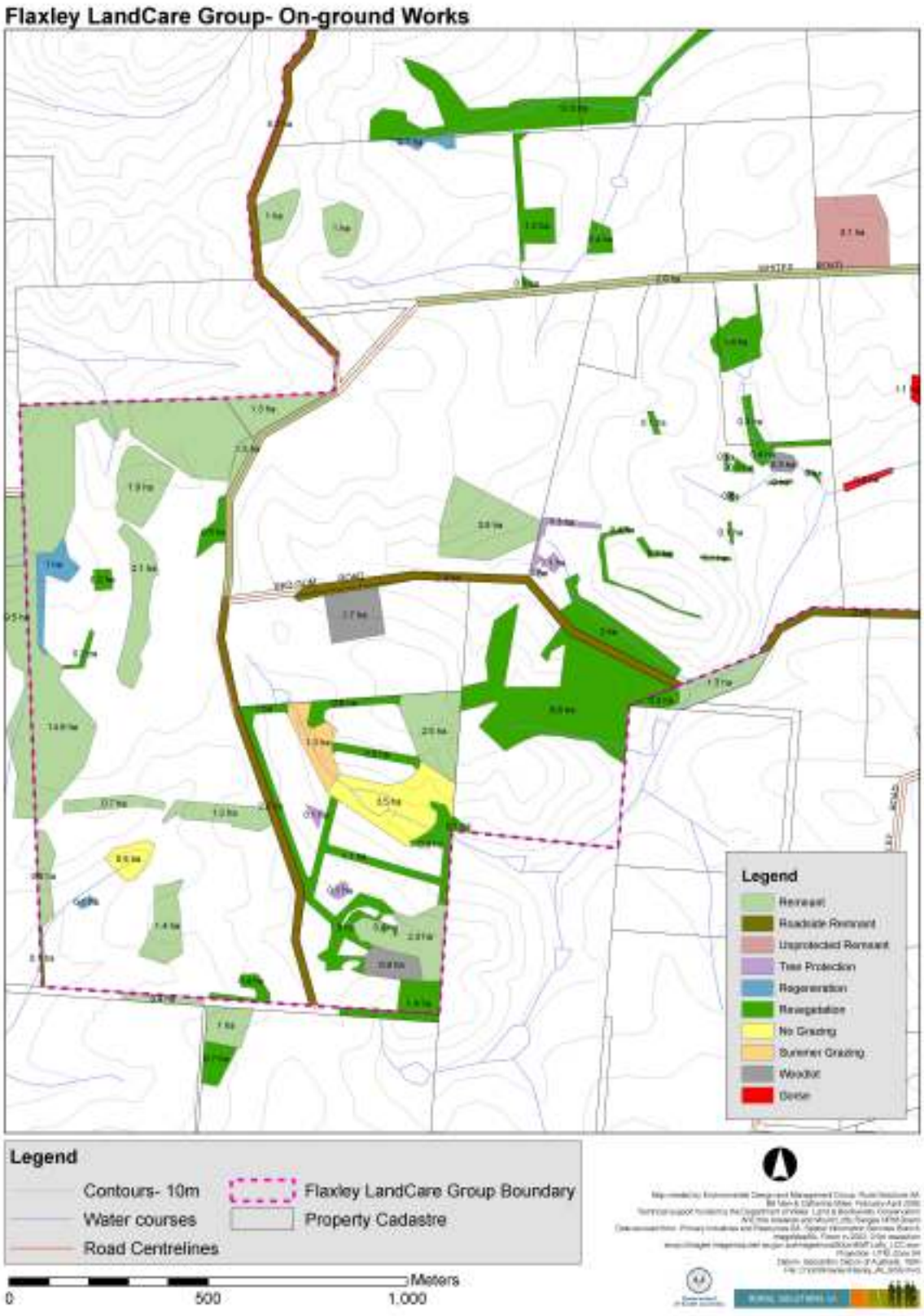
(South Eastern Area)



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5.1.2 Total area of native vegetation in Flaxley District

- 10% native vegetation cover seems to be a critical level for biodiversity, for example, in landscapes with less than 10% native vegetation cover, woodland bird species diversity declines dramatically (eg Bennet & Radford 2004).
- Landscapes with between 30-50% native vegetation are thought to hold sustainable populations of most 'pre-European' native birds and animals.
- Surface water run-off from native vegetation areas managed for conservation is clean, (in many other states, catchments producing water dammed for human consumption are not cleared).
- Native vegetation uses water that infiltrates into the soil, preventing recharge of potentially saline groundwater.
- Native vegetation binds and protects soil, preventing erosion.
- Native vegetation reduces the rate of surface water run-off, reducing flooding but prolonging flow events, and reducing water erosion.

Pre-Flaxley Landcare Group

- **Area native vegetation: 86ha, 8.6%**

In 2005

- **Area of native vegetation: 140ha, 14.1%**

Achievements

- Area of native vegetation almost doubled through revegetation and natural regeneration.
- Have exceeded the minimum threshold level of 10% native vegetation cover

Actions

- Re-establish native vegetation by encouraging natural regeneration and actively revegetating:
    - natural regeneration will be most successful adjacent to existing remnants and/or where introduced pastures have not been sown, weed control and grazing exclusion are usually required;
    - active revegetation will usually be required on soils that have been highly modified for example by introduced pasture establishment; sometimes a combination will be required.
- Site revegetation/regeneration areas to also meet other targets.
- Maintain existing remnants and regeneration areas through bushcare, and revegetation through enhancement techniques.

Target

Long term 30% native vegetation cover

Area for native vegetation re-establishment: 160ha

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5.1.3 Size of native vegetation patches

- The size of patches of native vegetation is critical for many species of birds and animals.
- Most species require a certain area of native vegetation to support them, minimum patch sizes in the order of 20-100ha are being suggested (Paton et al 2004).
- Many species, especially smaller animals, will not move long distances across open farmland, therefore they require a continuous cover of native vegetation in order to disperse and find a mate.
- Minimum patch sizes in the order of 10ha have been suggested (Watson et al 2001), however bigger is better.

Patches are areas of continuous vegetation at least 30m in width, or if less than 30 then only for short distances (so that canopies of tree cover might still touch), with areas less than 30m in width considered a separate patch.

Pre-Flaxley Landcare Group

- **mean average size of patches: 2.58ha**
- **number of patches 10ha or greater: 1**

In 2005:

- **mean average size of patches: 1.98ha** but this is mainly due to high number of small bits of revegetation, if isolated revegetation is removed from the data then average patch size increases to **3.52ha**
- **number of patches 10ha or greater: 4**

Size of patch (ha)	Pre LCG		2005		Increase (ha)
	No. patches in size class	Area (ha)	No. patches in size class	Area (ha)	
10 – 19.99	1	18[4]	4	45	27
5 – 9.99	3	21	4	28	7
2 – 4.99	10	25	11	33	8
<2	19	22	54	30	8

Achievements

- Increase in the number of patches of local native vegetation between 10-20ha from 1 to 4, more than doubling the area of native vegetation in large areas.
- The majority of revegetation (54%) has been strategic, creating buffers and corridors.

Actions

- Increase existing patch sizes through active revegetation and encouraging regeneration around the edges of existing remnants (‘buffers’), and connecting nearby remnants (‘corridors’).

[4] Note: this remnant is actually part of a larger remnant of 26ha, part of which falls outside the perimeter of the LCG

Target

Double the number of patches in 10ha or greater size class (from four to eight). Increase the proportion of vegetation in patch sizes of 10ha or greater from 33% to 66%.

Increase the mean average patch size to 5ha

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5.1.4 Fragmentation of native vegetation

- The behavioural characteristics of many animals prevents them travelling long distances across cleared land, therefore populations of animals living in isolated patches may not be able to disperse and breed with animals in other patches and are highly susceptible to local extinction.
- The distance species are willing to travel varies from several metres to thousands of kilometres, but studies of birds have shown that patches should be less than between 500m and 1km apart for most species (Platt 2002). All patches of native vegetation within the Flaxley District already satisfy this criteria so a higher level of connectedness was defined.
- Vegetated corridors between patches provide an option for species that do not like to move into the open to move between patches, but less species are likely to use a corridor the longer and/or narrower it is.
- Distance from other vegetation may also be important for pollination of plants and maintaining the genetic diversity of plants.

Connectivity is difficult to define, however, for the purposes of this report, patches of greater than 2ha were counted as not isolated from another patch of greater than two hectares if they are within 100 metres or connected by a corridor of 30m width or greater.

Pre-Flaxley Landcare Group: 8 out of 15 (53%) patches greater than 2ha not isolated within 100m radius

In 2005: 11 out of 18 (61%) patches greater than 2ha not isolated within 100m radius

Average number of nearby patches has remained as 1 (ie on average patches greater than 2ha are within 100m of one other patch of greater than 2ha.

Actions

- Site regeneration and revegetation areas to create corridors between patches, and create stepping stones between patches:
    - the priority is to create short and wide direct connections.
- Make use of existing vegetation to create larger areas and widths (eg buffer patches and revegetate adjacent to roadside vegetation).

Target

All patches managed for conservation directly connected to another patch managed for conservation by a corridor of at least 30m in width.

5.1.5 Native vegetation on each soil type

- Remnant vegetation is mostly confined to poorer agricultural soils in the Flaxley District ('shallow soils on rock' and 'Ironstone soils').
- As vegetation associations are primarily dictated by soil type in the District, clearance patterns have resulted in a predominance of Messmate Stringybark forests and woodlands being the main vegetation associations in intact condition. Other vegetation associations mainly exist along roadsides and as scattered overstorey in paddocks.
- The loss of vegetation on more productive soil types has resulted in –
    - loss of plant species and habitats that exist only on these soil types
    - loss of animal species that depend on these plants and habitats
    - loss of animal species that depend on flowering/fruiting of vegetation on these soil types at a time when vegetation on other soil types are not producing (ie late Autumn early Winter) to maintain year round food sources.
- Paton et al recommends targeting revegetation activities on disproportionately cleared soil types (ie productive soils), aiming for patch sizes of 20-100ha.
- In the Mt Lofty Ranges *Integrated Natural Resource Management Plan*, a target of establishing na

Soil Type	Total Area	Pre LCG		2005	
		Ha NV	% NV	Ha NV	% NV
Deep loamy texture contrast	457	16.9	3.7	33.4	**7.3**
Shallow to moderately deep acidic soils on rock	260	16.2	6.2	56.1	**21.6**
Ironstone soils	51	2	3.9	18.3	**35.9**
Alluvial soils	116	2.1	1.8	19.9	**15.4**

Actions

- Productive soil types and their associated vegetation associations should be a priority for revegetation and regeneration.
- Because these soil types have generally been highly modified so that most of the original vegetation (including the soil seed bank) has been removed, replicating the original vegetation communities will require a staged revegetation program, focussing on the creation of suitable microhabitats for gradual re-introduction of understorey.
- Any remnant vegetation on disproportionately cleared soil types is a priority to protect.

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Target

Conserve and manage remnants of native vegetation on highly cleared soil types and/of of conservation significance, in particular the following road reserves:

- Red Gum Road (whole length)
- Whites Road (adjacent to and across from Ian White's Scrub)
- South East corner of Quarry Road and Flaxley Road intersection.

Re-establish native vegetation on to increase the representativeness of each soil type vegetated to 30%,

- deep loamy texture contrast soils as a priority (12.3ha required to reach 10% coverage) then alluvial soils

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5.1.6 Protection and restoration of watercourses

- Managing watercourses with stock exclusion to maintain perennial cover, and revegetation has many benefits including
    - preventing or reducing erosion of the watercourse bed and banks
    - filtering run-off from adjacent land uses, and creek water, improving water quality
    - provide habitat for both terrestrial and water dependant plants and animals
    - slowing water flows so that water stays in creeks for longer rather than rushing downstream.
- Where watercourses are eroding, protection from stock alone may not stop erosion of the watercourse bed once it has begun, although it may slow the process. The continued erosion may result in:
    - drying of the adjacent soils, and
    - transport of soil particles to downstream waterholes, causing them to fill up with soil and cover over with reed and grasses.

Pre-Flaxley Landcare Group: no watercourses protected from stock

2005: 9km out of 24km of watercourse protected from stock (however, the length protected is probably 1-2km higher as there was some mismatching of the spatial data)

Actions:

- Protect remaining watercourses.
- Monitor watercourse erosion, where bed deepening threatens and upstream site, or soil transport threatens a downstream waterhole, engineering options may be required.

Target

Fence and exclude stock from all remaining watercourses, with priority given to major channels.

Erosion controlled.

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Revegetation Methods

The methods used to revegetate the Flaxley District have changed over the years, with the following improvements being implemented:

- increase range of native species, mainly from increases in understorey species, but also use of harder to grow and collect species
- increased specificity for species indigenous to the District
- reduced range of provenance of original material to local District
- increased understanding of the role of revegetation in biodiversity conservation resulting in better siting of revegetation to link and expand remnants, more blocks and wider linear strips
- improvements in placing each species in locations for which they are most suitable
- improved spacing of plants to better replicate natural vegetation
- improved appreciation for and recognition of existing species, in particular native grasses.

Machine direct seeding has been the most common revegetation technique, especially for larger areas. Tubestock planting has been used for smaller sites and for establishing understorey. Hand direct seeding has been used by a few landholders, with particular success for establishing native grasses and *Acacia* species.

The control of perennial grassy weeds continues to be a major problem in revegetation, especially along watercourses. The most successful method of control so far being high density planting of *Acacia* species, especially in machine direct seeded sites. Other options for incorporating a broader range of species and ensuring that when the *Acacias* die off they are not replaced with grassy weeds are discussed in Appendix 2.

Natural regeneration of native grasses and groundcovers was observed in many revegetation areas, as well as secondary regeneration from plants used in the revegetation.

In addition to continuing to implement the improvements listed above, the following methods should be applied to current and future revegetation works:

- design biodiversity revegetation to mirror original plant communities to the district, see Appendix 1,
- manage older revegetation sites to enhance their biodiversity values, see Appendix 2,
- trial a broader range of methods for revegetation in riparian areas, the following are some suggestions:
    - revegetate at very high densities such as direct seeding rows at 1.5m spacing or tubestock planting at 1m spacing,

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  - incorporate sedge and rush species at the initial revegetation phase, possibly applying bushcare methods to encourage secondary regeneration,
  - establish sedges and rushes once wattle canopy is established;
- continue to use machine direct seeding on suitable sites as it is the cheapest method available, however it should be seen as a method to get a basic suite of species established, and at 3-5 years biodiversity enhancement techniques should be implemented, see Appendix 2.

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5.1.7 Conservation of Threatened Birds

- There are 43 species of birds that have been recorded in the Flaxley District with conservation significance. Many of these are birds that inhabit open woodlands (Hurren pers. com.)
- While many birds exist in the Flaxley District, species of conservation significance are generally those species with quite specific habitat requirements. Their presence can be considered an indicator of the ecological condition of the District as they often depend on a suite of other species being present (Barrett 2000).
- The following table outlines significant species occurring in the District about which habitat requirements are known.

Common Name	Ratings	Habitat requirements and other known information
Australian Reed Warbler	Declining	
Black-eared Cuckoo	MLR: R	
Brown-headed Honeyeater	Declining	Honeyeaters require food resources in Autumn (eg *Banksia marginata, Eucalyptus fasciculosa, E. leucoxylon* on good soils) (Paton et al 2004)
Brown Thornbill	Declining	Home range for pair 1-5ha, longest movement 9km (Paton et al 2004); recorded in revegetation areas including small and narrow sites from 3 years onwards, recorded breeding in 10 year old revegetation (Taws 2001)
Brown Treecreeper	Declining	Require partially open understorey with lots of standing and fallen dead wood (Birds for Biodiversity 2005).
Buff-banded Rail	Declining	
Buff-rumped Thornbill	Declining (P)	Feeds on ground among shrubs and lower parts of branches; recorded more frequently in tubestock planted areas than direct seeding where plants were wider spaced, recorded in sites 3 years old but more common in sites 10 or more years old (Taws 2001)
Crescent Honeyeater	Declining (P)	Honeyeaters require food resources in Autumn (eg *Banksia marginata, Eucalyptus fasciculosa, E. leucoxylon* on good soils) (Paton et al 2004)
Crested Shrike-tit	SA:V, MLR:V, declining	Home range for pair 5-20ha, longest movement 10km (Paton et al 2004); recorded in small number of revegetation areas over 1.5ha, 5 years or older with rough-barked trees; diet includes insects from bark curls, leaf galls, seed cases (Taws 2001)
Diamond Firetail	SA:V, MLR:V, declining	Home range for pair 2-20ha, longest movement 5km; feed on seeds of native and introduced grasses, however native grasses are preferable as they supply seed over a longer period (Paton et al 2004); observed in small number of revegetation areas 9 years or older, variety of sizes (Taws 2001)
Dusky Woodswallow	Declining	Observed in a small number of revegetation areas including small and narrow areas, older than 5 years, usually where mature trees incorporated in revegetation (Taws 2001).
Eastern Spinebill	Declining	
Fairy Martin	Declining (P)	

Common Name	Ratings	Habitat requirements and other known information
Flame Robin	SA:R, MLR U, declining	
Horsfield's Bronze-cuckoo	Declining (BFB)	
Jacky Winter	Declining	Home range for pair 10-20ha, longest movement 0km; feeding requirements probably similar to Scarlet Robin (Paton et al 2004); flies from perch into are or onto ground to pounce on insects, recorded in small number of revegetation areas older than 8 years including narrow areas, prefers open space around area for feeding (Taws 2001).
Little Grassbird	Declining (P)	
Pallid Cuckoo	Declining (BFB)	
Rainbow Bee-eater	Declining	
Red-browed Finch	Declining	
Red-rumped Parrot	Declining	Require open woodlands with abundant supply of native grasses (similar to Diamond Firetail) (Birds for Biodiversity 2005)
Restless Flycatcher	MLR:V, declining	Home range for pair 10-100ha, longest movement 2km; feeding requirements probably similar to Scarlet Robin (Paton et al 2004); recorded in small number of revegetation areas, variety of shapes, 0.5-3ha, older than 5 years (Taws 2001)
Rufous Whistler	Declining	Home range for pair 2-20ha, longest movement 10km (Paton et al 2004); feed on insects on branches, trunks, under bark and among leaves, recorded in revegetation areas from 5 years onwards but not narrow areas (Taws 2001)
Sacred Kingfisher	Declining (P)	
Scarlet Robin	Declining	Home range for pair 3-50ha, longest movement 72km; require perches of horizontal branches or fallen timber 1-4m above the ground and plenty of litter and bare ground for foraging (Paton et al 2004)
Shining Bronze-Cuckoo	SA:R, MLR:R	
Silvereye	Declining (P)	
Sittella (Tree Creeper) sp?	Declining?	
Southern Whiteface	Declining	
Tawny Frogmouth	Declining	
Tree Martin	Declining	
Varied Sittella	Declining	
Whistling Kite	Declining	
White-fronted Chat	Declining (BFB)	
White-naped Honeyeater	SA:V, MLR:V, declining	Honeyeaters require food resources in Autumn (eg *Banksia marginata, Eucalyptus fasciculosa, E. leucoxylon* on good soils) (Paton et al 2004); co-operative breeders, fragmentation may impact on social structure and breeding success (Birds for Biodiversity).

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Common Name	Ratings	Habitat requirements and other known information
White-throated Treecreeper	Declining	
White-winged Chough	Declining	
Willie Wagtail	Declining (P)	
Yellow Rumped Thorn-bill	Declining	Home range for pair 2-20ha, longest movement 37km (Paton et al 2004); insectivorous, will feed in open paddocks where shelter is nearby, commonly recorded in revegetation sites of all sizes and shapes from 3 years onwards (Taws 2001).
Yellow-faced Honeyeater	Declining (P)	Recorded using revegetation 5 or more years old, including small and narrow areas, when migrating; feeds among foliage (Taws 2001)
Yellow-tailed Black-Cockatoo	SA:V, MLR:V	Feed on *Banksia marginata* cones as wells as *Pinus* spp.
Zebra Finch	Declining	

Actions

- Implement actions to meet known habitat requirements of significant birds (see able above).
- Manage remnant vegetation and revegetation to maintain and improve the habitat value for birds and other fauna.
- Continue bird monitoring in District, expand to include regenerated and revegetated areas.

Target

Bird species of conservation significance continue to inhabit Flaxley District.

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Pest Plants, Animals and Soil-borne Diseases

Members of the Flaxley Landcare Group have undertaken both individual and coordinated weed and pest animal control programs.

5.1.8 Pest Animals

Pest animals (foxes, rabbits and hares) require constant and coordinated control programs by the Landcare Group, but re-infestation from surrounding areas will continue to occur unless broader controls are implemented.

5.1.9 Pest Plants

The following weeds pose a significant threat to natural resources in the district, (the invasive threat category to native vegetation (from Croft et al 2005) is given, where 5 is the highest threat and 1 the lowest):

Blackberry (Invasive Threat Category: 5)
No large infestations of blackberries were observed during the preparation of this report, due to vigilant control by landholders. Due to the distances over which they are transported by birds and other animals new blackberries are constantly found, especially in revegetation areas.

- Continue to monitor for and control new outbreaks of Blackberries
- maintain access ways in revegetation for easy observation and control.

Gorse (Invasive Threat Category: 4)
Some landholders have inherited large infestations of gorse but apart from these there is very little in the District.

- Control by working from the least infested areas first.

Sticky Willy / Cleavers (Invasive Threat Category: none given)
Landholders in the District have observed this annual weed rapidly increase in remnant and planted native vegetation areas, especially where introduced grasses also occur. Although it is easily killed with herbicides, spraying is not suitable in many situations because it often grows over native understorey. The small, sticky seeds are transported on animal fur and the increase in this species may be correlated to rabbit numbers.

- Control from least infested areas first, hand pull where off-target damage would be un-avoidable, spray with herbicides where safe
- control animals which may transport seeds and ensure no seed is attached to clothing when leaving areas it occurs
- work with the Eastern Mt Lofty and Murray Plains NRM Group to better understand and raise awareness about this weed.

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African Weed Orchid / Monodenia (Invasive Threat Category: none given)
Observed in remnant vegetation throughout the District but not in high densities, landholders are aware of this species and control it when they find it.

- Control from least infested areas first, removing the flower heads to prevent seed set is the highest priority, then removing the bulb.

Bridal Creeper (Invasive Threat Category: 5)
Is found within the District and at sites nearby. It can be spread across long distances by birds.

- Monitor all areas for Bridal Creeper during Winter and Spring and control if found.

Salvation Jane (Invasive Threat Category: 2)
Is found at low densities throughout the District. Although it has a low threat to native vegetation areas it can severely reduce the productivity of primary production areas.

- Control Salvation Jane through pasture management, especially grazing strategies and use of selective herbicides.

New Weeds
There is the potential for many threatening weed species found in other parts of the Mt Lofty Ranges (eg Pussytail Grass *Pentaschistis pallidus*) to spread into the Flaxley District.

- Preventing and controlling new weeds is a high priority.

Target
A reduction in the area of primary production and native vegetation areas affected by invasive weeds.

No new outbreaks of invasive weed species.

5.1.10 Soil-Borne Diseases

Phytophthera root rot has not been confirmed to occur in the Flaxley District, however it does occur in the Mt Lofty Ranges. There is some concern by members of the Landcare Group that some trees are already infected with *Phytophthora*.

- Good soil hygiene is a priority to practise when doing all activities in the District.

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Soil and Land Management

5.1.11 Soil Erosion

Except in some watercourses, no evidence of erosion of soil by water was observed, despite most soils having a high potential for erosion (PIRSA 2001). This is probably the result of good pasture management to maintain a minimum of 70% groundcover, as well as there being no cultivation of soils. Such good management should continue as eroded soil is a significant contaminant of watercourses.

Most watercourse erosion began many years ago and it was in fact an initial driver for the Flaxley Landcare Group. Once started, watercourse erosion is difficult to control as the watercourse expands to find a new balance between the size and steepness of the channel, the quantity of flows and the vegetation (or lack of vegetation) on the banks. Small scale and low cost engineering solutions may be used on minor watercourses, but on major watercourses high cost engineering is often required. Consideration of what assets are threatened by erosion should be included in decisions about erosion control.

5.1.12 Soil Acidity and Fertility

Regular soil testing and appropriate applications of lime (or dolomite) and fertiliser are necessary to maintain the production of pasture in grazing areas as most soils in the Flaxley District are susceptible to acidity and inherently low in nutrients. Pasture deterioration can result in increased weeds, toxicities to stock, lower production, increased likelihood of soil erosion, increased groundwater recharge.

Many landholders in the Flaxley Landcare Group indicated they do regularly soil test and manage nutrient and acidity accordingly.

5.1.13 Pastures

Perennial pastures are desirable for their higher productivity to the landholder, but also reduced likelihood of soil erosion, reduced groundwater recharge, slowing surface run-off, and better soil structure. Although not mapped as part of this project, most pastures in the District consist of perennial pasture species (including some native pastures) with clovers. Many landholders have re-seeded their pastures and subdivided paddocks to enable them to rotate their grazing.

5.1.14 Salinity

There are a number of small saline seeps relatively high up in the landscape throughout the District. While these pose a low threat to production, the run-off of saline water into

the Angas River is undesirable. All these small seeps have been fenced off and the surrounding areas, especially the area above, revegetated to local native species. With a change in the groundwater balance throughout the catchment, these saline seeps may never be completely eradicated, but the revegetation and natural regeneration of reeds should soak up much of the water.

The high proportion of perennial pastures and native vegetation throughout the Flaxley District will contribute to reduced recharge to the broader Angas catchment.

5.1.15 Pugging and Waterlogging

Pugging is the result of stock trampling clayey soils when they are waterlogged, which results in the soil becoming compacted. This in turn causes prevents root growth, and oxygen and water infiltration. Most pastures and native vegetation deteriorates under these conditions.

Waterlogging was observed throughout the district and the incidence of pugging is high, in terms of land area affected, pugging is the major form of land degradation in the district. To prevent pugging, susceptible soils should not have stock on them when they are wet, so these areas should be fenced to landclass. However, some properties may not have sufficient area to support their stock that is dry enough during Winter. In these cases, stock should be rotated on and off these soils to allow the pasture to recover and reduce compaction.

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6 RECOMMENDATIONS

Summary of Recommended On-ground Actions

Type	Action	Long Term Target	Short Term Target (see Appendix X)
Remnant Vegetation	Protection of all remnant vegetation on private land through fencing	11ha	
	Actively remnant vegetation for conservation using bushcare methods, giving priority to remnants: • in the best condition • of vegetation on highly cleared soil types and/or of conservation significance.	All remnant vegetation managed (86ha)	
Revegetation	Re-establish native vegetation through revegetation and regeneration	30% cover (160ha)	
	Site revegetation to increase the size of patches of remnant vegetation and existing revegetation 1. Increase number of patches greater than 10ha 2. Increase the average patch size	1. Double patches >10ha 2. Increase av. size to 5ha	
	Site revegetation to improve connectivity and reduce isolation of patches managed for conservation • Create corridors between patches managed for conservation	All patches connected by corridors at least 30m wide.	
	Revegetate soils with low proportion of remnant vegetation, with revegetation designed to mimic the composition and structure of the original vegetation association, the following ranks soils with least vegetative cover to highest 1. deep loamy texture contrast 2. alluvial soils 3. shallow soils on rock 4. ironstone soils	30% of each soil type.	10% of each soil type

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	Continue to manage revegetated areas (especially larger areas) to increase their biodiversity values	54ha total	
Fauna	Based on monitoring of birds and research of habitat requirements, carry out habitat enhancement (eg install nest boxes) as required	No loss of species	
Watercourse protection	Protect all watercourses not currently protected from grazing animals	≈14km	
	Control erosion where needed	na	
Pest Plant and Animal Control	Maintain coordinated control programs across the district for • Blackberry • Gorse • Sticky Willy/Cleavers • African Weed Orchid/Monodenia • Bridal Creeper • Foxes • Rabbits	Reduce the area affected by invasive weeds. No new outbreaks	
Land Management	Maintain perennial pastures to reduce saline recharge in catchment	Whole of district	
	Manage waterlogged soils to prevent pugging	as required	

Monitoring Recommendations

Theme	Monitor
Remnant Vegetation	Establish Bushland Condition Monitoring Sites
Revegetation	Establish Bushland Condition Monitoring sites in older revegetation areas
	Monitor impacts of habitat enhancement techniques in revegetation
	Monitor birds in revegetation areas
Fauna	Monitor overall bird populations in the district
	Keep and centrally collate records of other fauna
Watercourse protection	Monitor erosion sites
Pest Plant and Animal Control	Monitor for outbreaks of new weeds

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Recommended Research & Trials

Theme	Research / Trial
Revegetation	Trial different revegetation techniques for watercourses to reduce perennial grassy weed problems
	Trial establishment techniques of understorey species
Fauna	Research habitat requirements of fauna in the district, especially threatened and declining species.
Pest Plant and Animal Control	Trial control techniques for Sticky Willy

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APPENDIX 1: FLAXLEY PLANT ASSOCIATIONS

Identifying what was the original plant association for a highly modified site can be based on observations of the soil-type, slope and remnant trees. The distribution of different associations in the landscape is not hard and fast, and is dependant on the seasonal conditions (eg a run of wet years may result in watercourse vegetation establishing further upslope than in dry years). At the local level, vegetation associations are delineated more by changes in the dominance of different species, rather presence or absence.

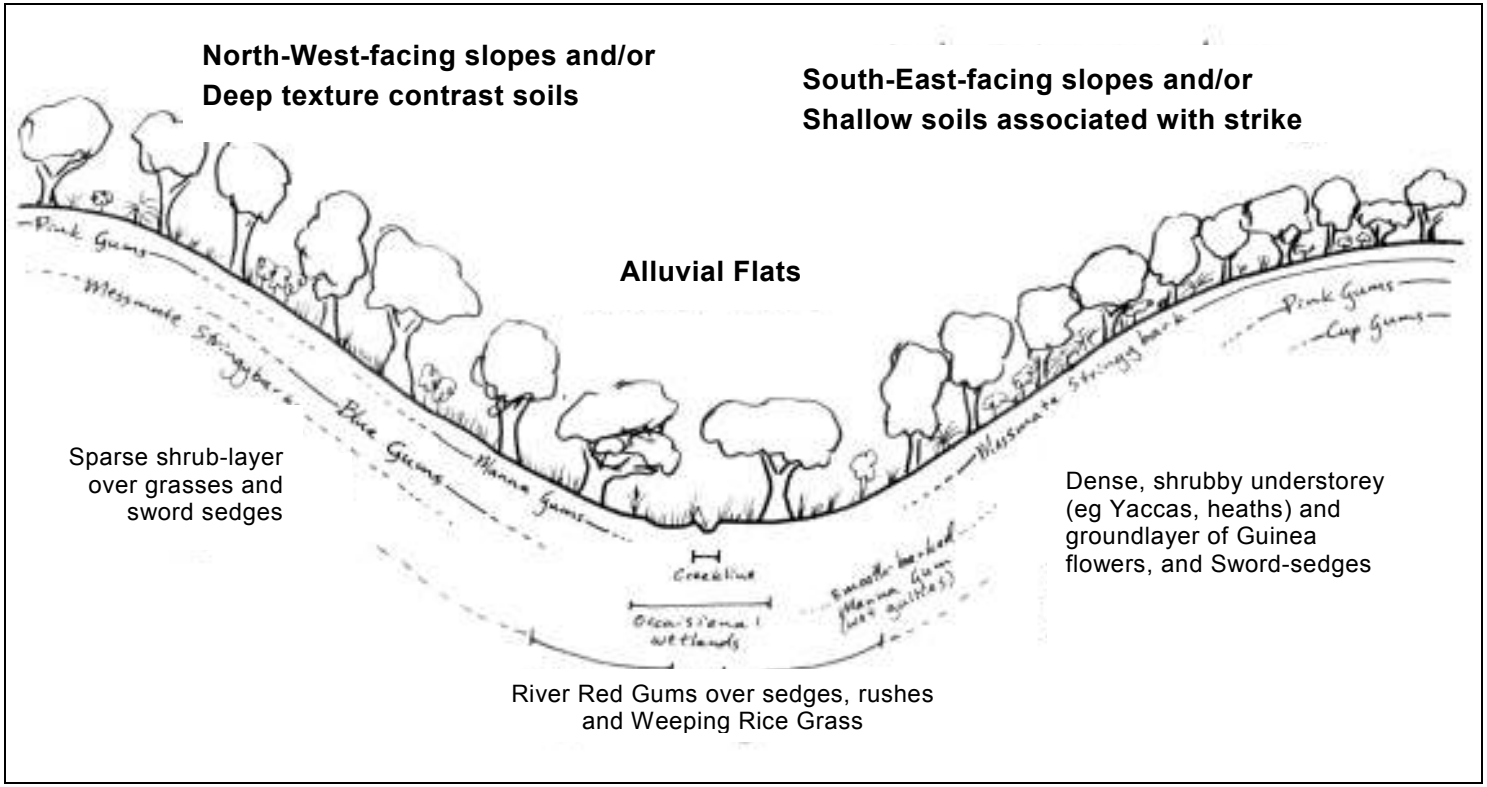

Figure 1. Distribution of original vegetation associations in the Flaxley District.

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Figure 1 demonstrates the rough distribution of plant associations in the Flaxley District, and indicates the gradual changes in canopy species with changes in slope.

The following section is a guide to the revegetation species for the major plant associations found in the district.

North to West-Facing and/or Deep Texture Contrast Soils

Structure: Woodlands, open middlestorey, grassy understorey

Reference Sites: Red Gum Rd, White's Rd adjacent to Ian White's remnant vegetation, southeast corner of Quarry and Flaxley Roads intersection.

Overstorey: dominated by Pink Gums (*Eucalyptus fasciculosa*) on the upper slopes, grading into Blue Gums (*E. leucoxylon ssp. leucoxylon*) then Rough-barked Manna Gums (*E. viminalis ssp. cygnetensis*) towards the lower slopes. Messmate Stringybarks (*E.* obliqua) may occur occasionally throughout, and River Red Gums (*E. camaldulensis*) would be likely to extend up the lower slopes in some areas. At maturity, the overstorey trees would have occurred on average 15-30 apart. Sheoaks may form a dense 'sub-canopy' in some areas especially among the Pink and Blue Gums.

Middlestorey: open areas interspersed with patches of dense vegetation (eg 5-20 plants).

Groundlayer: dominated by native grasses (*Microlaena stipoides, Austrodanthonia* spp. and *Austrostipa* spp.) and sword sedges (*Lepidosperma* sp.), scattered Guinea flowers (*Hibbertia spp.*) and many lilies, orchids and annual daisies in Spring. Leaf litter a minor component of the groundlayer (eg <5%).

Revegetation Issues

- Where native grasses cannot be established readily at the first revegetation phase, high densities of short lived colonising species such as Golden Wattles (*Acacia pycnantha*) should be used to suppress grassy weeds. This will initially result in high levels of leaf litter and shade. As the wattles mature and die, native grasses should be planted before weeds re-colonise the site.
- The initial density of overstorey species may be much higher than the final density, especially where direct seeding is used. After 5-10 years trees may be thinned by chain-sawing and poisoning the stump, some trees should be left un-poisoned to replicate a second wave of growth. Trees with multiple trunks or strong side branches should be selected for retaining.

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Phase One Revegetation Species (Pink, Blue and Manna Gum Woodlands)

Note: this is a guide only, numbers are based on the assumption there is no remnant vegetation on the site.

Predominant position: U=upper slope, L = lower slopes, A = all over

Scientific Name	Common Name	No./ha	Position
Overstorey		**50-150**	
Eucalyptus fasciculosa	Pink Gum	50-100	U
Eucalyptus leucoxylon ssp. leucoxylon	SA Blue Gum	50-100	A
Eucalyptus viminalis ssp. cygnetensis	Rough-bark Manna Gum	50-100	L
Colonisers		**300-600**	
Acacia melanoxylon	Blackwood	10-25	L
Acacia myrtifolia var.	Myrtle Wattle	50-100	U
Acacia paradoxa	Kangaroo Thorn	25-50	A
Acacia pycnantha	Golden Wattle	100-300	A
Acacia retinodes var. retinodes (swamp form)	Swamp Wattle	100-300	L
Dodonaea viscosa ssp. spatulata	Sticky Hop-bush	50-100	A
Olearia ramulosa	Twiggy Daisy-bush	100-200	A
Senecio quadridentatus	Cotton Groundsel	25-50	A
Middlestorey/Sub-canopy		**100-300**	
Allocasuarina muelleriana ssp. muelleriana	Common Oak-bush	10-25	U
Allocasuarina verticillata	Drooping Sheoak	50-100	A
Banksia marginata	Silver Banksia	25-50	A
Bursaria spinosa	Sweet Bursaria	50-100	A
Daviesia leptophylla	Narrow-leaf Bitter-pea	25-50	A
Daviesia ulicifolia	Gorse Bitter-pea	10-25	A
Exocarpos cupressiformis	Native Cherry	10	A
Hakea rostrata	Beaked Hakea	10-25	A
Leptospermum continentale	Prickly Tea-tree	10-25	L
Leptospermum myrsinoides	Heath Tea-tree	50-100	U
Pultenaea daphnoides	Large-leaf Bush Pea	10-25	A
Pultenaea largiflorens	Twiggy Bush-pea	25-50	A

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Ground layer (Pink, Blue and Manna Gum Woodlands)

As many of these species should be planted as possible, therefore no numbers are given, however an indication of the dominance is given by H = high, M = medium and L= low. Many ground layer species will be difficult to establish unless there has been very good weed control, sometimes it is better to wait until the third year or more before establishing these species (ie establishment phase two).

Scientific Name	Common Name	Est method	No.	Est. Phase
Acaena echinata	Sheep's Burr	S	L	1 or 2
Billardiera cymosa	Sweet Apple-berry	C, S	L	
Danthonia sp.	Wallaby-grass	S	H	1 or 2
Dianella revoluta var. revoluta	Black-anther Flax-lily	S, D	L	1 or 2
Grevillea lavandulacea var. lavandulacea	Spider-flower	C, S	L	1 or 2
Hibbertia exutiacies	Prickly Guinea-flower	C, S	L	2
Hibbertia sericea var. sericea	Silky Guinea-flower	C, S	L	2
Kennedia prostrata	Scarlet Runner	S, D	L	1 or 2
Lomandra densiflora	Soft Tussock Mat-rush	S, D	L	2
Lomandra micrantha ssp. micrantha	Small-flower Mat-rush	S, D	L	2
Lomandra multiflora ssp. dura	Hard Mat-rush	S, D	L	2
Lomandra nana	Small Mat-rush	S, D	L	2
Microlaena stipoides var. stipoides	Weeping Rice-grass	S	H	1 or 2
Neurachne alopecuroidea	Fox-tail Mulga-grass	S	L	1 or 2
Platylobium obtusangulum	Holly Flat-pea	S	L	2
Poa sp.	Tussock-grass	S	L	1 or 2
Pultenaea pedunculata	Matted Bush-pea	S, C	L	2
Scaevola albida var. albida	Pale Fanflower	C	L	2
Stipa sp.	Spear-grass	S	M	1 or 2
Tetratheca pilosa ssp. pilosa	Hairy Pink-bells	C	L	2
Themeda triandra	Kangaroo Grass	S	M	1 or 2

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South to East-Facing and/or Shallow Soils

Structure: Open forest, dense heath middlestorey.

Reference Sites: most remnant vegetation in district, especially along Hack Range Road.

Overstorey: dominated by Messmate Stringybarks (*Eucalyptus obliqua*), with Pink Gums (*E. fasciculosa*) and occasional Cup Gums (*E. cosmophylla*) on the ridge-tops. Smooth-barked Manna Gums (*E. viminalis ssp. viminalis*) occurs mainly in wet gullies. At maturity, the overstorey trees would have occurred on average 5-20m apart.

Middlestorey: dense middlestorey, especially of Epacridaceae and Yaccas (*Xanthorrhoea semiplana*)

Groundlayer: dominated by small heathy bushes (eg *Hibbertia spp*) and sword sedges (*Lepidosperma* sp.), and many lilies, orchids and annual daisies in Spring. Native grasses a minor component compared with the previous association. Leaf litter an obvious component of the groundlayer (eg <10-20%).

Revegetation Issues

- Re-establishment of this plant community is not a priority except for buffers and corridors as it is well-represented in the area.
- Many of the middle and understorey species are difficult to propagate.
- High densities of short lived colonising species such as Golden Wattles (*Acacia pycnantha*) should be used to suppress grassy weeds and provide leaf litter and shade. As sheltered areas develop, groundlayer species should be introduced..

Phase One Revegetation Species (Stringy Bark Forests)

Note: this is a guide only, numbers are based on the assumption there is no remnant vegetation on the site.

Position: U=upper slope only, L = Lower slopes only, A = all over, G, = gullies

Scientific Name	**Common Name**	**No./ha**	**Position**
Overstorey		**100-200**	
Eucalyptus fasciculosa	Pink Gum	50-150	U
Eucalyptus cosmophylla	Cup Gum	25-50	U
Eucalyptus obliqua	Messmate Stringy-bark	100-200	A
Eucalyptus viminalis ssp. viminalis	Smooth-barked Manna Gum	25-50	G
Colonisers		**300-600**	
Acacia melanoxylon	Blackwood	25-50	L
Acacia myrtifolia var.	Myrtle Wattle	100-200	U
Acacia paradoxa	Kangaroo Thorn	10-25	A

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Acacia pycnantha	Golden Wattle	50-300	A
Acacia retinodes var. retinodes (swamp form)	Swamp Wattle	50-100	L
Dodonaea viscosa ssp. spatulata	Sticky Hop-bush	25-50	A
Olearia ramulosa	Twiggy Daisy-bush	100-200	A
Senecio quadridentatus	Cotton Groundsel	25-50	A
Middlestorey/Sub-canopy		**300-500**	
Allocasuarina muelleriana ssp. muelleriana	Common Oak-bush	25-100	U
Allocasuarina verticillata	Drooping Sheoak	10-25	A
Banksia marginata	Silver Banksia	25-50	A
Bursaria spinosa	Sweet Bursaria	25-50	A
Daviesia leptophylla	Narrow-leaf Bitter-pea	25-50	A
Daviesia ulicifolia	Gorse Bitter-pea	25-50	A
Exocarpos cupressiformis	Native Cherry	10	A
Hakea carinata	Hakea	10-25	
Hakea rostrata	Beaked Hakea	10-25	A
Leptospermum continentale	Prickly Tea-tree	10-25	L
Leptospermum myrsinoides	Heath Tea-tree	50-100	U
Pultenaea daphnoides	Large-leaf Bush Pea	50-100	A
Pultenaea largiflorens	Twiggy Bush-pea	25-50	A
Xanthorrhoea semiplana	Yacca	50-100	A

Ground layer (Stringy Bark Forests)

As many of these species should be planted as possible, therefore no numbers are given, however an indication of the dominance is given by H = high, M = medium and L= low. Many ground layer species will be difficult to establish unless there has been very good weed control, sometimes it is better to wait until the third year or more before establishing these species

Scientific Name	**Common Name**	**Est method**	**No.**	**Est. Phase**
Danthonia sp.	Wallaby-grass	S	L	1 or 2
Microlaena stipoides var. stipoides	Weeping Rice-grass	S	M	1 or 2
Stipa sp.	Spear-grass	S	L	1 or 2
Acaena echinata	Sheep's Burr	S	L	1 or 2
Dianella revoluta var. revoluta	Black-anther Flax-lily	S, D	L	1 or 2
Grevillea lavandulacea var. lavandulacea	Spider-flower	C, S	L	1 or 2
Hibbertia exutiacies	Prickly Guinea-flower	C, S	M	2
Hibbertia sericea var. sericea	Silky Guinea-flower	C, S	H	2
Kennedia prostrata	Scarlet Runner	S, D	L	1 or 2

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Isopogon ceratophyllus	Horny Cone-bush	S	L	2
Lomandra densiflora	Soft Tussock Mat-rush	S, D	L	2
Lomandra micrantha ssp. micrantha	Small-flower Mat-rush	S, D	L	2
Lomandra multiflora ssp. dura	Hard Mat-rush	S, D	L	2
Lomandra nana	Small Mat-rush	S, D	L	2
Platylobium obtusangulum	Holly Flat-pea	S	H	2
Poa sp.	Tussock-grass	S	L	1 or 2
Scaevola albida var. albida	Pale Fanflower	C	L	2
Tetratheca pilosa ssp. pilosa	Hairy Pink-bells	C	M	2

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Creeklines, Wetlands and other Alluvial Soils

Structure: Woodlands, shrublands and/or sedgelands

Reference Sites: No examples of remnant vegetation in good condition observed on these soil types within the Flaxley district. Some wetlands have regenerated well on private properties where they have been fenced from stock.

Overstorey: dominated by River Red Gums (*Eucalytpus camaldulensis*), except in highly boggy soils where there would probably have been no tree layer. Occasional Rough and Smooth-barked Manna Gums (*E. viminalis ssp.*) may have occurred on the margins. At maturity, the overstorey trees would have occurred on average 20m or more apart, but they have a tendency to regenerate densely.

Middlestorey: likely to have been sparse but with occasional dense thickets of Woolly Tea-trees (*Leptospermum lanigerum*) in very wet soils, and Blackwoods (*Acacia melanoxylon*), Silver Banksias (*Banksia marginata*) and Prickly Tea-trees (*L. continentale*) on better drained soils.

Groundlayer: dominated by reeds, rushes and sedges and a high proportion of Weeping Rice-grass (*Microlaena stipoides*) except in boggy soils.

Revegetation Issues

- High levels of perennial grassy weeds (eg Paspalum, Kikuyu, Fog Grass and Phalaris) can become dominant where revegetation is carried out in these areas. As well as competing with the revegetation these present a high fire risk when they dry off. Dense planting of wattles, sedges and rushes, grazing or slashing may be required.
- Reeds, rushes and sedges have not generally been included in revegetation to date. Their use should be trialled to determine how to better use them for weed competition. Most are prolific reproducers and 'bushcare' methods may be used to aid their spread.
- Some rushes can become weeds of pastures (in particular some medium sized *Juncus* species), so where the adjacent use is for pasture, rush species in revegetation should be carefully selected.
- Bogs, or perched wetlands, have been found to regenerate naturally with little active revegetation required except to re-introduce some shrub species.
- The initial density of overstorey species may be much higher than the final density, especially where direct seeding is used. After 5-10 years trees may be thinned by chain-sawing and poisoning the stump, some trees should be left un-poisoned to replicate a second wave of growth. Trees with multiple trunks or strong side branches should be selected for retaining.

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- Over time, revegetation on waterlogged soils may result in the soils becoming drier, so that there may be a shift in the species that regenerate.

Phase One Revegetation Species

Note: this is a guide only, numbers are based on the assumption there is no remnant vegetation on the site.

Predominant position: V = Very wet, A = all over except where very wet, D = drier margins/top of creek banks/well-drained alluvial soils, M = margins of fast flowing, rocky watercourses

Scientific Name	Common Name	No./ha	Position
Overstorey		**50-150**	
Eucalyptus camaldulensis	River Red Gum	50-150	A
Eucalyptus viminalis ssp. viminalis	Smooth-bark Manna Gum	10-25	D
Eucalyptus viminalis ssp. cygnetensis	Rough-bark Manna Gum	10-25	D
Colonisers		**300-600**	
Acacia melanoxylon	Blackwood	25-50	A
Acacia paradoxa	Kangaroo Thorn	10-25	D
Acacia pycnantha	Golden Wattle	100-200	D
Acacia retinodes var. retinodes (swamp form)	Swamp Wattle	200-400	A
Dodonaea viscosa ssp. spatulata	Sticky Hop-bush	50-100	A
Olearia ramulosa	Twiggy Daisy-bush	25-50	D
Middlestorey/Sub-canopy		**100-300**	
Allocasuarina verticillata	Drooping Sheoak	10-25	D
Banksia marginata	Silver Banksia	10-25	D
Bursaria spinosa	Sweet Bursaria	50-100	D
Hakea rostrata	Beaked Hakea	10-25	D
Leptospermum continentale	Prickly Tea-tree	50-150	A
Leptospermum lanigerum	Heath Tea-tree	50-150	V
*Goodenia ovata**	Hop Goodenia	25-50	A
*Melaleuca decussata**	Totem Poles	10-25	A
*Callistemon sieberi**	River Bottlebrush	10-25	M

* denotes species no-longer naturally occurring in the Flaxley area but very likely to have in the past.

Ground layer

As many of these species should be planted as possible, therefore no numbers are given, however an indication of the dominance is given by H = high, M = medium and L= low. Many sedge and rush species may already be present and/or regenerate naturally. Some ground layer species can be difficult to establish unless there has been very good weed control, sometimes it is better to wait until the third year or more before establishing these species (ie establishment phase two).

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Scientific Name	Common Name	Est method	No.	Est. Phase
Acaena nova-zelandiea	Sheep's Burr	S	L	1 or 2
Carex tereticaulis	Tall Sedge	S, D	L	1 or 2
Carex inversa ssp. inversa	Knob Sedge	S, D	L	2
Danthonia sp.	Wallaby-grass	S	L	2
Eleocharis gracilis, E. acuta	Spike Rush	S, D	M	1 or 2
Hibbertia sericea var. sericea	Silky Guinea-flower	C, S	L	2
Juncus kraussii[5]	Sea Rush	S, D	L	1 or 2
Juncus pallidus	Pale Rush	S, D	M	1 or 2
Juncus sarophorus	Rush	S, D	L	1 or 2
Juncus subsecundus	Finger Rush	S, D	H	1 or 2
Luzula meridionalis	Common Wood-rush	S, D	L	
Microlaena stipoides var. stipoides	Weeping Rice-grass	S	H	2
Poa sp.	Tussock-grass	S	L	2
Schoenoplectus validus	River Club-rush	S, D	M	1 or 2
Stipa sp.	Spear-grass	S	L	1 or 2
Themeda triandra	Kangaroo Grass	S	L	1 or 2

Note: some *Danthonia, Stipa* and *Poa* species naturally occur in wetter areas but most prefer drier sites. When collecting, concentrate on collecting from similar sites, identification to species level is not critical provided you are confident it is not a weed.

[5] Saline sites

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APPENDIX 2: ENHANCING THE BIODIVERSITY VALUE OF OLDER REVEGETATION

There are now many revegetation sites within the Flaxley district that are at least five years old. The following section outlines different techniques to improve the biodiversity benefits of these sites.

Supplementary Planting

After five to ten years the initial revegetation species form canopies, microclimates develop, leaf litter builds up, recycling of nutrients begins and other natural process occur. The site is then ready for establishing those species that require protection from exposure, good weed control and a degree of natural process occurring (listed in as phase 2 revegetation species).

Little weed control will be required as planting sites should be selected where weed levels are already low. For those species for which little seed can be found or can only be propagated from cuttings, tubestock establishment will be required. For those species where large quantities of seed are available (eg grasses, daisies and some lilies) hand direct seeding can be used. This can be done either by seeding in 'spots' as previously outlined, or by seeding lines between direct seeding rows. Lightly raking the ground before and after seeding will help seed come into contact with the soil. For winter growing species this should be done in Autumn, around the time of the opening rains, while summer growing species should be sown in spring while the ground is still moist but starting to warm. Take not of what level of shade the species naturally occur in, some native grass species would be unlikely to grow between dense direct seeding.

Many direct seeded sites contain a limited range of middle storey species because they are not suitable for establishment by this method (eg *Banksias* and *Hakeas*). Species such as this that are listed on the phase one list can be planted into older sites.

It is also important to maintain "waves" of new growth across a developing site. Therefore the establishment phase can be on-going until well beyond the end of the funding cycle or project life.

Controlling Perennial Grassy Weeds

in some sites, non-native perennial grasses may still be the dominant ground-layer several years after revegetation, especially along watercourses and/or where the initial revegetation did not establish very densely. Management of the grass will depend on the objectives for the site:

- If the objective for the site is to recreate the original native vegetation association, then weed replacement should be carried out.

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- If the objective is for the area to protect a watercourse, provide a shelterbelt or for amenity, then either leaving the site alone, careful crash-grazing[6] or slashing could be used.

Where removal of weeds is carried out, bushcare-type methods should be applied whereby weeds are controlled in the least weedy areas first and pushed outwards. Areas should be re-planted with an appropriate competitive native species however, instead of waiting for natural regeneration to take place. Some highly competitive species include:

- Wattles *Acacia spp.*
- Sticky Hop-bush *Dodonaea viscosa ssp. spatulata*
- Pale Rush *Juncus pallidus*
- Sheoaks *Allocasuarina spp.*
- Running Postman *Kennedia prostrata.*

Tree Thinning

Many older revegetation sites (especially those direct seeded), and areas where some natural regeneration of Eucalypts has taken place, have much higher tree densities than occur in remnant bushland. For woodland ecosystems, the two main 'problems' with this are

1) the trees all grow tall and straight, lacking substantial side branches, and
2) there are a lack of 'open spaces' within the revegetation.

Horizontal low perches are important for native birds which specialise in watching for insects on the ground, such as Hooded Robins. Native grasses (which require open spaces for light) supply a source of food for birds which specialise in eating grass seeds, such as Diamond Finches and Red-rumped Parrots. Reptiles and insects move around to feed and breed in spaces between native grass tussocks (A. Prescott pers. com.)

Canopy species, mainly Eucalypts, can be selectively thinned to average spacings of at least ten metres, but up to 40m (provided there are other native species within the 'gap') taking care to conserve any trees that have strong lateral branches or multiple trunks. Thinned trees should have their stumps poisoned to prevent re-growth. Where there are few trees with lateral branches, coppicing (ie cutting down the tree without poisoning to encourage regrowth) can be used to create multi-stemmed trees, this also replicates 'waves' of new growth. Coppiced trees are, however, more prone to falling over so this should not be done near fencelines, buildings or other assets.

Many sites have also been sown with 'generic' local mixes, so thinning can also be used to remove those species that are no longer considered appropriate for the type of plant community that is being created, however this is probably less critical than the overall structure. In general wattles will not need to be thinned as they are short-lived (except

[6] Note that some revegetation funding agreements do not allow sites to be grazed.

Acacia melanoxylon) and also provide a role in weed suppression, sometimes though they may suppress the growth of other species such as Sheoaks where the germinate close–by.

The thinned trees and any other fallen trees should be left where they fall unless they are considered to pose a fire risk. The logs will provide food for insects and the animals which feed on them as they decay, as well as hollows for lizards.

Burning

The rehabilitation of revegetation areas may, at some time in the future, look to the use of fire to promote regeneration of local vegetation types. Fire can act as a quick boost to the movement of an ecosystem, producing new vigour and subsequent seed-set within a number of species. However there is little information available on the use and effects of fire in revegetation areas. Fire may can also promote some weed species, particularly woody weeds, so follow-up is essential. Any use of burning in revegetation should only be carried out at a small scale on a trial basis. Where possible photo points should be established within these burnt areas and a monitoring program developed.

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APPENDIX 3: LIST OF PLANT SPECIES RECORDED IN THE FLAXLEY DISTRICT

Note: this list includes species recorded outside of the mapped Landcare/Group area, from Bradstreet/Whittaker remnants, and DEH records for remnants immediately adjacent to Hack Range Road.

NPWSA Conservation Status

E Endangered: rare and in danger of becoming extinct
V Vulnerable: rare and at risk from potential threats in the long term
R Rare: having a low overall frequency, confined to a restricted range or scattered sparsely over a wider area

SA Regional Conservation Status

X Presumed extinct: not recorded for more than 50 years
E Endangered: rare and in danger of becoming extinct
V Vulnerable: rare and at risk from potential threats in the long term
T Threatened: rare and likely to become either endangered or vulnerable
R Rare: having a low overall frequency, confined to a restricted range or scattered sparsely over a wider area
K Uncertain: either threatened or rare but insufficient data for a more precise assessment
U Uncommon: less common species but not rare
N Not of particular significance
Q Not yet assessed but flagged as being of possible significance

Scientific Name	Common Name	NPWSA	SL
Acacia melanoxylon	Blackwood		
Acacia myrtifolia var. myrtifolia	Myrtle Wattle		
Acacia paradoxa	Kangaroo Thorn		
Acacia pycnantha	Golden Wattle		
Acacia retinodes var. retinodes (hill form)	Wirilda		
Acaena agnipila var.	Downy Sheep's Burr		U
Acaena echinata var.	Sheep's Burr		
Acianthus caudatus var.	Mayfly Orchid		
Acianthus pusillus	Mosquito Orchid		
Acrotriche serrulata	Cushion Ground-berry		
Adiantum aethiopicum	Common Maiden-hair		
Agrostis avenacea var. avenacea	Common Blown-grass		
Allocasuarina muelleriana ssp. muelleriana	Common Oak-bush		
Allocasuarina striata	Stalked Oak-bush		
Allocasuarina verticillata	Drooping Sheoak		
Amphipogon strictus var. setifer	Spreading Grey-beard Grass		
Amyema miquelii	Box Mistletoe		
Aphanes australiana	Australian Piert		R
Aphelia pumilio	Dwarf Aphelia		N

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Scientific Name	Common Name	NPWSA	SL
Aristida behriana	Brush Wire-grass		U
Arthropodium fimbriatum	Nodding Vanilla-lily		
Arthropodium strictum	Common Vanilla-lily		
Astroloma humifusum	Cranberry Heath		
Banksia marginata	Silver Banksia		
Banksia ornata	Desert Banksia		
Billardiera bignoniacea	Orange Bell-climber		U
Billardiera cymosa	Sweet Apple-berry		
Billardiera versicolor	Yellow-flower Apple-berry		R
Bossiaea prostrata	Creeping Bossiaea		
Brunonia australis	Blue Pincushion		
Bulbine bulbosa	Bulbine-lily		
Burchardia umbellata	Milkmaids		
Bursaria spinosa	Sweet Bursaria		
Caesia calliantha	Blue Grass-lily		
Caladenia carnea var. carnea	Pink Fingers		
Caladenia dilatata complex	Green-comb Spider-orchid		
Caladenia prolata	Shy Caladenia		R
Caladenia sp.	Spider-orchid		
Caladenia tentaculata	King Spider-orchid		
Calochilus robertsonii	Purplish Beard-orchid		N
Carex breviculmis	Short-stem Sedge		
Carex inversa var.	Knob Sedge		
Carex inversa var. inversa	Knob Sedge	R	R
Carex tereticaulis	Rush Sedge		
Cassytha glabella forma dispar	Slender Dodder-laurel		
Cassytha melantha	Coarse Dodder-laurel		
Cassytha pubescens	Downy Dodder-laurel		
Centrolepis aristata	Pointed Centrolepis		
Centrolepis strigosa	Hairy Centrolepis		
Chamaescilla corymbosa var. corymbosa	Blue Squill		
Chara contraria var. behriana	Algae		
Cheilanthes austrotenuifolia	Annual Rock-fern		
Cheilanthes sieberi ssp. sieberi	Narrow Rock-fern		R
Cheiranthera alternifolia	Hand-flower		
Chenopodium pumilio	Clammy Goosefoot		
Chrysocephalum apiculatum	Common Everlasting		

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Scientific Name	Common Name	NPWSA	SL
Chrysocephalum baxteri	White Everlasting		
Clematis microphylla	Old Man's Beard		
Comesperma calymega	Blue-spike Milkwort		
Convolvulus erubescens	Australian Bindweed		
Convolvulus remotus	Grassy Bindweed		
Corybas dilatatus	Common Helmet-orchid		
Corybas incurvus	Slaty Helmet-orchid		U
Corybas sp.	Helmet-orchid		
Cotula australis	Common Cotula		
Craspedia glauca	Billy-buttons		
Craspedia sp.			
Crassula closiana	Stalked Crassula		N
Crassula colorata var. acuminata	Dense Crassula		
Crassula decumbens var. decumbens	Spreading Crassula		
Crassula peduncularis	Purple Crassula	R	R
Crassula sieberiana ssp. tetramera	Australian Stonecrop		
Cryptostylis subulata	Moose Orchid	V	E
Cynoglossum suaveolens	Sweet Hound's-tongue		U
Cyperus tenellus	Tiny Flat-sedge		
Cyrtostylis reniformis	Small Gnat-orchid		
Danthonia caespitosa	Common Wallaby-grass		
Danthonia duttoniana	Brown-back Wallaby-grass	R	R
Danthonia geniculata	Kneed Wallaby-grass		
Danthonia laevis	Smooth Wallaby-grass	R	R
Danthonia linkii var. fulva	Leafy Wallaby-grass		U
Danthonia pilosa var.	Velvet Wallaby-grass		
Danthonia pilosa var. pilosa	Velvet Wallaby-grass		
Danthonia racemosa var. racemosa	Slender Wallaby-grass		
Danthonia setacea var. setacea	Small-flower Wallaby-grass		
Danthonia sp.	Wallaby-grass		
Daucus glochidiatus	Native Carrot		
Daviesia leptophylla	Narrow-leaf Bitter-pea		
Daviesia ulicifolia ssp.			
Daviesia ulicifolia ssp. incarnata			
Deyeuxia quadriseta	Reed Bent-grass		
Dianella brevicaulis/revoluta var.	Black-anther Flax-lily		
Dianella longifolia var. grandis	Pale Flax-lily	R	V

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Scientific Name	Common Name	NPWSA	SL
Dianella revoluta var. revoluta	Black-anther Flax-lily		
Dichelachne crinita	Long-hair Plume-grass		
Dichelachne micrantha	Short-hair Plume-grass		Q
Dichondra repens	Kidney Weed		
Dillwynia hispida	Red Parrot-pea		
Dipodium roseum	Pink Hyacinth Orchid		
Diuris aff. corymbosa	Wallflower Donkey-orchid		
Diuris pardina	Spotted Donkey-orchid		
Dodonaea viscosa ssp. spatulata	Sticky Hop-bush		
Drosera auriculata	Tall Sundew		
Drosera glanduligera	Scarlet Sundew		
Drosera macrantha ssp. planchonii	Climbing Sundew		
Drosera peltata	Pale Sundew		
Drosera whittakeri ssp. whittakeri			
Eleocharis acuta	Common Spike-rush		
Elymus scabrus var. scabrus	Native Wheat-grass		
Enneapogon nigricans	Black-head Grass		
Epacris impressa	Common Heath		
Epilobium billardierianum ssp. x intermedium	Variable Willow-herb		N
Epilobium hirtigerum	Hairy Willow-herb		
Eriochilus cucullatus	Parson's Bands		
Eucalyptus camaldulensis var. camaldulensis	River Red Gum		
Eucalyptus cosmophylla	Cup Gum		
Eucalyptus fasciculosa	Pink Gum		
Eucalyptus leucoxylon ssp. leucoxylon	South Australian Blue Gum		
Eucalyptus obliqua	Messmate Stringybark		
Eucalyptus viminalis ssp. cygnetensis	Rough-bark Manna Gum		
Eucalyptus viminalis ssp. viminalis	Manna Gum	R	R
Euchiton gymnocephalus	Creeping Cudweed		
Euchiton involucratus	Star Cudweed		
Euchiton sphaericus	Annual Cudweed		
Exocarpos cupressiformis	Native Cherry		
Galium migrans	Loose Bedstraw		
Genoplesium rufum	Red Midge-orchid		N
Genoplesium sp.	Midge Orchid		
Geranium retrorsum	Grassland Geranium		
Geranium solanderi var. solanderi	Austral Geranium		N

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Scientific Name	Common Name	NPWSA	SL
Glossodia major	Purple Cockatoo		
Glyceria australis	Australian Sweet-grass		R
Gonocarpus elatus	Hill Raspwort		
Gonocarpus mezianus	Broad-leaf Raspwort		
Gonocarpus tetragynus	Small-leaf Raspwort		
Goodenia blackiana	Native Primrose		
Goodenia geniculata	Bent Goodenia		
Goodenia sp.	Goodenia		
Grevillea lavandulacea var. lavandulacea	Spider-flower		
Hakea carinata	Erect Hakea		
Hakea rostrata	Beaked Hakea		
Haloragis heterophylla	Variable Raspwort		U
Hardenbergia violacea	Native Lilac		
Helichrysum scorpioides	Button Everlasting		
Hibbertia exutiacies	Prickly Guinea-flower		
Hibbertia incana			N
Hibbertia riparia	Guinea-flower		
Hibbertia sericea var. sericea	Silky Guinea-flower		
Hyalosperma demissum	Dwarf Sunray		
Hybanthus floribundus ssp. floribundus	Shrub Violet		
Hydrocotyle callicarpa	Tiny Pennywort		
Hydrocotyle foveolata	Yellow Pennywort		
Hypericum gramineum	Small St John's Wort		
Hypoxis vaginata var. vaginata	Yellow Star		N
Isolepis cernua	Nodding Club-rush		
Isolepis marginata	Little Club-rush		
Isolepis nodosa	Knobby Club-rush		
Isopogon ceratophyllus	Horny Cone-bush		
Juncus amabilis		V	V
Juncus bufonius	Toad Rush		
Juncus flavidus	Yellow Rush		R
Juncus holoschoenus	Joint-leaf Rush		
Juncus pallidus	Pale Rush		
Juncus subsecundus	Finger Rush		
Kennedia prostrata	Scarlet Runner		
Lasiopetalum sp.	Velvet-bush		
Laxmannia orientalis	Dwarf Wire-lily		

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Scientific Name	Common Name	NPWSA	SL
Lepidosperma carphoides	Black Rapier-sedge		
Lepidosperma concavum	Spreading Sword-sedge		N
Lepidosperma curtisiae	Little Sword-sedge		N
Lepidosperma semiteres	Wire Rapier-sedge		
Lepidosperma viscidum	Sticky Sword-sedge		
Leptoceras menziesii	Hare Orchid		N
Leptorhynchos squamatus	Scaly Buttons		
Leptospermum continentale	Prickly Tea-tree		
Leptospermum lanigerum	Silky Tea-tree		U
Leptospermum myrsinoides	Heath Tea-tree		
Leucopogon virgatus	Common Beard-heath		
Levenhookia dubia	Hairy Stylewort		
Levenhookia pusilla	Tiny Stylewort		
Lissanthe strigosa	Peach Heath		
Lobelia gibbosa	Tall Lobelia		
Lomandra densiflora	Soft Tussock Mat-rush		
Lomandra fibrata	Mount Lofty Mat-rush		N
Lomandra micrantha ssp. micrantha	Small-flower Mat-rush		
Lomandra micrantha ssp. tuberculata	Small-flower Mat-rush		
Lomandra multiflora ssp. dura	Hard Mat-rush		
Lomandra nana	Small Mat-rush		N
Lomandra sororia	Sword Mat-rush		U
Luzula densiflora	Dense Wood-rush		R
Luzula meridionalis	Common Wood-rush		
Luzula sp.	Wood-rush		
Lythrum hyssopifolia	Lesser Loosestrife		
Microlaena stipoides var. stipoides	Weeping Rice-grass		N
Microseris lanceolata	Yam Daisy		
Microtis arenaria	Notched Onion-orchid		
Microtis frutetorum			
Millotia tenuifolia var. tenuifolia	Soft Millotia		
Neurachne alopecuroidea	Fox-tail Mulga-grass		
Neurachne sp.	Mulga-grass		
Nitella sp.	Algae		
Olearia ramulosa	Twiggy Daisy-bush		
Opercularia ovata	Broad-leaf Stinkweed		U
Opercularia turpis	Twiggy Stinkweed		

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Scientific Name	Common Name	NPWSA	SL
Opercularia varia	Variable Stinkweed		
Orthoceras strictum	Horned Orchid		R
Ottelia ovalifolia	Swamp Lily	R	R
Oxalis perennans	Native Sorrel		
Persicaria prostrata	Creeping Knotweed		U
Persoonia juniperina	Prickly Geebung		U
Phyllangium divergens	Wiry Mitrewort		
Pimelea humilis	Low Riceflower		
Pimelea linifolia ssp. linifolia	Slender Riceflower		
Pimelea octophylla	Woolly Riceflower		
Pimelea phylicoides	Heath Riceflower		
Plantago gaudichaudii	Narrow-leaf Plantain		R
Platylobium obtusangulum	Holly Flat-pea		
Poa clelandii	Matted Tussock-grass		
Poa crassicaudex	Thick-stem Tussock-grass		
Poa labillardieri var. labillardieri	Common Tussock-grass		
Poranthera microphylla	Small Poranthera		
Potamogeton ochreatus	Blunt Pondweed	R	T
Prasophyllum fitzgeraldii	Fitzgerald's Leek-orchid		R
Prasophyllum occultans	Hidden Leek-orchid	R	E
Prasophyllum sp.	Leek-orchid		
Pseudognaphalium luteoalbum	Jersey Cudweed		
Pteridium esculentum	Bracken Fern		
Pterostylis curta	Blunt Greenhood	R	R
Pterostylis longifolia	Tall Greenhood		
Pterostylis nana	Dwarf Greenhood		
Pterostylis nutans	Nodding Greenhood		
Pterostylis pedunculata	Maroon-hood		
Pterostylis sanguinea	Blood Greenhood		
Pultenaea daphnoides	Large-leaf Bush Pea		
Pultenaea largiflorens	Twiggy Bush-pea		
Pultenaea pedunculata	Matted Bush-pea		
Pyrorchis nigricans	Black Fire-orchid		
Ranunculus sessiliflorus var.	Annual Buttercup		
Rumex brownii	Slender Dock		
Rutidosis multiflora	Small Wrinklewort		
Scaevola albida var. albida	Pale Fanflower		

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Scientific Name	Common Name	NPWSA	SL
Schoenus apogon	Common Bog-rush		
Sebaea ovata	Yellow Sebaea		
Senecio glossanthus	Annual Groundsel		
Senecio picridioides	Purple-leaf Groundsel		
Senecio quadridentatus	Cotton Groundsel		
Senecio tenuiflorus	Woodland Groundsel		
Stackhousia aspericocca ssp. "Cylindrical inflorescence"(W.R.Barker 1418)	Bushy Candles		
Stackhousia aspericocca ssp. "One-sided inflorescence"(W.R.Barker 697)	One-sided Candles		
Stackhousia sp.	Candles		
Stipa densiflora	Fox-tail Spear-grass	R	R
Stipa elegantissima	Feather Spear-grass		U
Stipa flavescens	Coast Spear-grass		
Stipa mollis	Soft Spear-grass		
Stipa nodosa	Tall Spear-grass		
Stipa pubinodis	Long-shaft Spear-grass		U
Stipa scabra ssp.	Rough Spear-grass		
Stipa semibarbata	Fibrous Spear-grass		
Stipa sp.	Spear-grass		
Stuartina muelleri	Spoon Cudweed		
Stylidium graminifolium	Grass Trigger-plant		
Tetratheca pilosa ssp. pilosa	Hairy Pink-bells		
Thelymitra antennifera	Lemon Sun-orchid		
Thelymitra grandiflora	Great Sun-orchid		U
Thelymitra ixioides	Spotted Sun-orchid		
Thelymitra juncifolia	Spotted Sun-orchid		N
Thelymitra nuda	Scented Sun-orchid		
Thelymitra pauciflora	Slender Sun-orchid		
Thelymitra rubra	Salmon Sun-orchid		
Thelymitra sp.	Sun-orchid		
Themeda triandra	Kangaroo Grass		
Thysanotus patersonii	Twining Fringe-lily		
Tricoryne elatior	Yellow Rush-lily		
Triglochin procerum	Water-ribbons		U
Triglochin striatum	Streaked Arrowgrass		N
Typha sp.	Bulrush		

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Scientific Name	Common Name	NPWSA	SL
Viola cleistogamoides	Shy Violet		U
Viola hederacea	Ivy-leaf Violet		R
Viola sieberiana	Tiny Violet		
Vittadinia sp.	New Holland Daisy		
Wahlenbergia communis	Tufted Bluebell		
Wahlenbergia gracilenta	Annual Bluebell		
Wahlenbergia luteola	Yellow-wash Bluebell		
Wahlenbergia multicaulis	Tadgell's Bluebell		U
Wahlenbergia stricta ssp. stricta	Tall Bluebell		
Wurmbea dioica ssp. dioica	Early Nancy		
Xanthorrhoea semiplana ssp. semiplana	Yacca		
Xanthosia pusilla	Hairy Xanthosia		

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APPENDIX 4: BIRDS OBSERVED IN FLAXLEY DISTRICT

Ratings are:

Declining – listed as declining in the Mt Lofty Ranges by DEH 2003, or by another source as indicated in brackets: (P) Paton et al 2004, or (BFB) from Birds for Biodiversity
SA: - South Australian conservation rating
MLR:_ - Mt Lofty Ranges regional conservation rating
E – endangered, V – vulnerable, R – rare, D – declining, U – uncommon, I - introduced

DEH threatened species records supplied by A. Hurren (DEH)
White records are supplied to Bird Atlas of Australia??, numbers refer to number of sightings over 32 surveys since November 1998
Coldrey records ✓ indicates occaisional sightings, ✓✓ indicates frequent sightings

Common Name	Scientific Name	Pearce	White wattle paddock	White back scrub	Coldrey	DEH Threat. Spp. record	Rating
*Blackbird	*Tardus merula*		2		✓✓		I
*European Goldfinch	*Carduelis chloris*	✓	2	5	✓		I
*House Sparrow	*Passer domesticus*	✓					I
*Common Starling	*Sturnus vulgaris*			20	✓		I
Australian Magpie	*Gymnorhina tibecen*	✓	24	29	✓✓		
Australian Raven	*Corvus tasmanicus*				✓✓		
Australian Reed Warbler	*Acrocephalus australis*					✓	D
Australian Wood Duck	*Chenonetta jubata*			2	✓✓		
Black Cormorant	*Phalacrocoryx carbo*				✓✓		
Black-eared Cuckoo	*Chrysococcyx osculans*				✓		MLR:R
Black-faced Cuckoo Shrike	*Coracina novahollandiae*		4	5	✓✓		
Black-shouldered Kite	*Elanus axillaris*		3				
Black Swan	*Cygnus atratus*	✓					
Boobook Owl	*Ninox novaeseelandiae*				✓		
Brown-headed Honeyeater	*Melithreptus brevirostris*		3	2	✓		D
Brown Thornbill	*Acanthiza pusilla*					✓	D
Brown Treecreeper	*Climacteris picumnus*				✓✓	✓	D
Buff-banded Rail	*Gallirallus philippensis*					✓	D
Buff-rumped Thornbill	*Acanthiza reguloides*		11	17		✓	D (P)
Crescent Honeyeater	*Phylidonyris pyrrhoptera*			1	✓	✓	D (P)
Crested Pigeon	*Ocyphaps (Geophaps) lophotes*	✓			✓		
Crested Shrike-tit	*Falcunculus frontatus*					✓	SA:V, MLR:V, D

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Common Name	Scientific Name	Pearce	White wattle paddock	White back scrub	Coldrey	DEH Threat. Spp. record	Rating
Crimson (Adelaide) Rosella	*Platycercus elegans (adelaidae)*	✓	30	32	✓✓		
Diamond Firetail	*Stagonopleura guttata*					✓	SA:V, MLR:V, D
Dusky Woodswallow	*Artamus cyanopterus*					✓	D
Eastern Spinebill	*Acanthorhynchus tenuirostris*	✓	4	2	✓✓	✓	D
Elegant Parrot	*Neophema elegans*					✓	
Fairy Martin	*Petrochelidon ariel*					✓	D (P)
Fan-tailed Cuckoo	*Cacomantis flabelliformis*					✓	
Flame Robin	*Petroica phoenicea*				✓	✓	SA:R, MLR:U, D
Galah	*Eolaphus (Cacatua) roseicapila*	✓	7	17	✓✓		
Golden Whistler	*Pachycephala pectoralis*		5	8	✓		
Goshawk	*Accipiter* sp.		1	1			
Grey Currawong	*Strepera versicolor*			2	✓✓		
Grey Fantail	*Rhipidura fuliginosa*	✓	16	28	✓✓		
Grey Shrike-Thrush	*Colluricincla harmonica*	✓	7	14	✓✓		
Grey Teal	*Anas gracilis*	✓			✓		
Hard Head Duck	*Athya australis*	✓					
Hoary-headed Grebe	*Poliocephalus poliocephalus*	✓					
Horsfield's Bronze-cuckoo	*Chrysococcyx basalis*					✓	D (BFB)
Jacky Winter	*Microeca fascinans*					✓	D
Laughing Kookaburra	*Dacelo novaeguinea*	✓	8	10	✓✓		
Little Grassbird	*Megalurus gramineus*					✓	D (P)
Little Grebe	*?*				✓✓		
Little Pied Cormorant	*Phalacrocoryx melanoleucas*				✓✓		
Little Raven	*Corvus bennetti*		2	14			
Magpie Lark	*Grallina cyanoleuca*	✓		1	✓✓		
Masked Lapwing	*Venellus miles*	✓		1			
Mistletoe bird	*Dicaeum hirundinaceum*		1	2			
Musk Lorikeet	*Glossopsitta concinna*		4	11			
New Holland Honeyeater	*Phylidonyris novahollandiae*	✓	1		✓✓		
Noisy Miner	*Manorina melanocephala*				✓[7]		
Pacific Black Duck	*Anas superciliosa*	✓	2				
Pallid Cuckoo	*Cuculus pallidus*					✓	D (BFB)

[7] first seen recently

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Common Name	Scientific Name	Pearce	White wattle paddock	White back scrub	Coldrey	DEH Threat. Spp. record	Rating
Peregrine Falcon	*Falco peregrinus*					✓	SA:R, MLR:R
Pink-eared Duck	*Malacorhynchus membranaceus*	✓					
Rainbow Bee-eater	*Merops ornatus*					✓	D
Rainbow Lorikeet	*Trichoglossus haematodus*		6	8	✓		
Red Wattlebird	*Anthochaera caranculata*	✓	19	23	✓✓		
Red-browed Finch (/Firetail)	*Neochima temporalis*	✓		1	✓✓	✓	D
Red-capped Robin	*Petroica goodenovii*				✓		
Red-rumped Parrot	*Psephotus haematonotus*					✓	D
Restless Flycatcher	*Myiagra inquieta*					✓	MLR:V, D
Rufous Whistler	*Pachycephala rufiventris*				✓	✓	D
Sacred Kingfisher	*Todiramphus sanctus*					✓	D (P)
Scarlet Robin	*Petroica multicolor*	✓	1	1	✓	✓	D
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*					✓	SA:R, MLR:R
Silvereye	*Zosterops lateralis*	✓	1	5		✓	D (P)
Southern Whiteface	*Aphelocephala leucopsis*					✓	D
Spotted Pardalote	*Pardalotus punctatus*		1	4			
Striated Thornbill	*Acanthiza lineata*		22	28		✓	*
Straw-necked Ibis	*Threskiornis spinicollis*				✓		
Striated Pardalote	*Pardalotus striatus*			27			
Stubble Quail	*Coturnix pectoralis*				✓✓		
Sulphur Crested Cockatoo	*Cacatua galerita*	✓			✓		
Superb Fairy Wren	*Malurus cyaneus*	✓	2	4	✓✓		
Tawny Frogmouth	*Podargus strigoides*				✓	✓	D
Thornbill species	*Acanthiza sp.*				✓✓[8]		
Tree Creeper	*Sittella* sp.	✓			?		D?
Tree Martin	*Petrochelidon nigricans*					✓	D
Varied Sittella	*Daphoenositta chrysoptera*			1		✓	D
Wedge-tailed Eagle	*Aquila audax*	✓			✓✓		
Welcome Swallow	*Hirundo neoxena*	✓		2	✓✓		
Whistling Kite	*Haliastur sphenurus*					✓	D
White-faced Heron	*Egretta (ardea) novahollandiae*	✓(B)			✓✓		
White-fronted Chat	*Epthianura albifrons*					✓	D (BFB)
White-naped Honeyeater	*Melithreptus lunatus*		7	22	✓✓	✓	SA:V, MLR:V, D

[8] several unidentified species oberved

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Common Name	Scientific Name	Pearce	White wattle paddock	White back scrub	Coldrey	DEH Threat. Spp. record	Rating
White-plumed Honey-eater	*Lichenostomus penicillatus*				✓		
White-throated Treecreeper	*Cormobates leucophaeus*		4	26		✓	D
White-winged Chough	*Corcorax melanorhamphos*					✓	D
Willie Wagtail	*Rhipidura leucophrys*	✓	2	1	✓		D (P)
Wood Duck		✓			✓✓		
Yellow Rumped Thorn-bill	*Acanthiza chrysorrhoa*	?				✓	D
Yellow-faced Honeyeater	*Lichenostomus chrysops*		7	20		✓	D
Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*	✓		1	✓✓	✓	SA:V, MLR:V
Zebra Finch	*Taeniopygia guttata*					✓	D

Additionally, Reed warblers were heard by T. Vale in swamps on A. Kebbell's property as well as other species already recorded in the district.

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APPENDIX 5: BATTUNGA SWAMPS SURVEY

Scientific Name	Common Name	Site 1	Site 2	Site 3	Site 4	Site 5
Acaena novae-zealandiae	Bidgee-widgee	✓				
Carex tereticaulis	Sedge					✓
Centrolepsis aristata	Pointed Centrolepsis	✓				
Cyperus tenallus	Tiny Flat-sedge	✓				
Eleocharis acuta	Common Spike-rush	✓	✓		✓	
Eleocharis gracilis	Slender Spike-rush	✓	✓	✓	✓	✓
Epilobium hirtigerum	Hairy Willow-herb	✓		✓	✓	
Epilobium billardieranum	Showy Epilobium	✓	✓	✓		
Isolepis hookeriana	A Club-rush	✓				
Isolepis inundata	Swamp Club-rush	✓				
Juncus bufonius	Toad Rush	✓	?		✓	
Juncus caespiticius	Grassy Rush	✓			✓	
Juncus kraussii	Sea Rush		✓			
Juncus pallidus	Pale Rush	✓	✓	✓		
Juncus sarophorus	Rush			✓		
Juncus sp.5			?✓			✓
Lobelia alata		✓				
Lythrum hyssopifolia	Lesser loose-strife	✓				
Microlaena stipoides	Weeping Rice-grass	✓				
Schoenoplectus validus	River Club-rush	✓				
Schoenus apogon	Common Bog-rush	✓				
Triglochin striatum	Streaked Arrowgrass	✓			✓	
Typha domingensis	Bulrush	✓	✓		✓	✓
Revegetation regen						
Acacia retinodes	Swamp wattle	✓		✓		
Leptospermum continentale	Prickly Tea-tree	✓	✓			
Leptospermum lanigerum	Woolly Tea-tree	✓	✓			
Acacia melanoxylon	Blackwood	?	✓			
Wetland Weeds						
*Tragopogon porrifolius**	Salsify					
Polypogon	Annual Beard-grass					

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Scientific Name	Common Name	Site 1	Site 2	Site 3	Site 4	Site 5
*monspeliensis**						
*Cotula coronopifolia**	Waterbuttons		✓			
*Rorripa natsturtium-aquaticum**	Watercress					
*Vellereophyton dealbatum**	White Cudweed	✓	✓	✓	✓	
*Hypochoeris sp.**	Flatweed / Catsear			✓		
*Centarium erythraea**	Common Centaury	✓			✓	
*Aster subulatus**					✓	
*Juncus articulatus**	Jointed Rush	✓				
*Juncus effusus**	Soft Rush				✓	

Site 1: Wetland at upstream end of most south-west watercourse
Site 2: Wetland at upstream end of watercourse to the north and east of Site 1
Site 3: Downstream of Site 2
Site 4: Wetland below fenced off remnant (north-east of Site 2)
Site 5: Downstream of Site 4

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APPENDIX 6: SHORT TERM ACTION PLAN

Following the preparation of the draft of the plan and review by members of the Landcare Group, a workshop was held to identify on-ground and monitoring activities for the next three years.

Remnant Vegetation Management	
Red Gum Rd	• Recently became a Bush For Life Site. • Finalise management plan and implement. • To become a focus for volunteer management by Landcare Group in addition to work of adjacent landholders. • Important site due to soil type, plant communities present and connectivity between a remnant vegetation block and revegetation areas.
White's Rd (124 & 119)	• Continue management to conserve area of bush in good condition.
East End White's Rd	• Weed control to push weed front outwards. • Small area of remnant vegetation on roadside adjacent to scrub block, important site to due plant community present and soil type.
Middle section White's Rd	• Managed by adjacent landholders.
Reserve Cnr Quarry and Greenhills Rds	• Monitor to ensure no deterioration.
Other road reserves	• Monitor to ensure no deterioration.
Private Properties	• On-going management of protected remnant vegetation by landholders. • Several sites subject to Bush Bids funding assessments. • Approach owners of remaining unprotected remnants to discuss protection measures.

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Revegetation Areas	
Farnhill and Skinner	• 5ha revegetation in total • Links and buffers remnant vegetation and revegetation areas => a consolidated block of native vegetation of approximately 20ha (not including corridors).
Kebbell	1. 4ha watercourse revegetation (Western Flat Creek) 2. 3ha watercourse revegetation (Angas tributary), joined to older area of revegetation creating patch of approximately 10ha
Kuchel	• 1.5ha consolidation along Angas => patch 2.5ha
Cooper	1. 2.5ha revegetation adjacent to Whittaker's and own remnant vegetation 2. Revegetate watercourse (2ha+?)
Metfan	1. 1ha revegetation linking two older areas of revegetation. 2. Habitat enhancement in older area of revegetation
Coldrey	• 1ha revegetate corridors and understorey establishment
White	• 5ha watercourse revegetation

Watercourses and Waterlogging	
Coldrey	• New fencing system to allow summer grazing
White, Kebell, Cooper, Kuchel, Metfan	• Revegetate watercourses (see above)

Training	
Bush For Life	• Planned for June.
Bushland Condition Monitoring	• Some time 2006, probably latter half. • Will guide management of some remnant and revegetation areas.
Bird monitoring workshop	• 2007, need to identify training and funding source, initially approach LAP

Monitoring	
Birds	• Continue existing monitoring • Following bird monitoring training, establish additional monitoring sites, including both remnant and revegetation areas.
Mammals	• Annual anecdotal reporting (add to AGM agenda?)
Salinity	• Informal monitoring of salt affected areas: are they spreading or decreasing?
Tree health	• Consider following Bushland Condition Monitoring training.

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8 APPENDIX 7 LOCAL WEED PRIORITISATION FOR REMNANT AND REVEGETATION AREAS

At the workshop discussed in Appendix 6, an exercise to prioritise the local threat of weeds to remnant and revegetation areas was undertaken. It is intended that this list assist landholders to prioritise which weeds they put their effort towards controlling on their properties.

Threat to Remnant Vegetation		
High	**Medium**	**Low**
Gorse	Broom	Briza
Blackberry	African Daisy	Other annual grasses
Pentaschistas	Ivy	Perennial pasture grasses
Sticky Willy / Cleavers	Cocksfoot	Wireweed
Monodenia		Pines
Bridal Creeper		Willows
		Poplars
		Soursobs

Threat to Revegetation		
High	**Medium**	**Low**
Kikuyu	Thistles	Annual grasses
Couch	Dock	Nightshade
Phalaris	Salvation Jane	Capeweed
Paspalum	Wireweed	Geranium
Pentaschistas	Other perennial grasses	English Dandelion
Sticky Willy		Sorrel
Blackberries		Soursob
Bridal Creeper		

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