



City of Burnside

Intensive Regeneration at Waterfall Gully Reserve

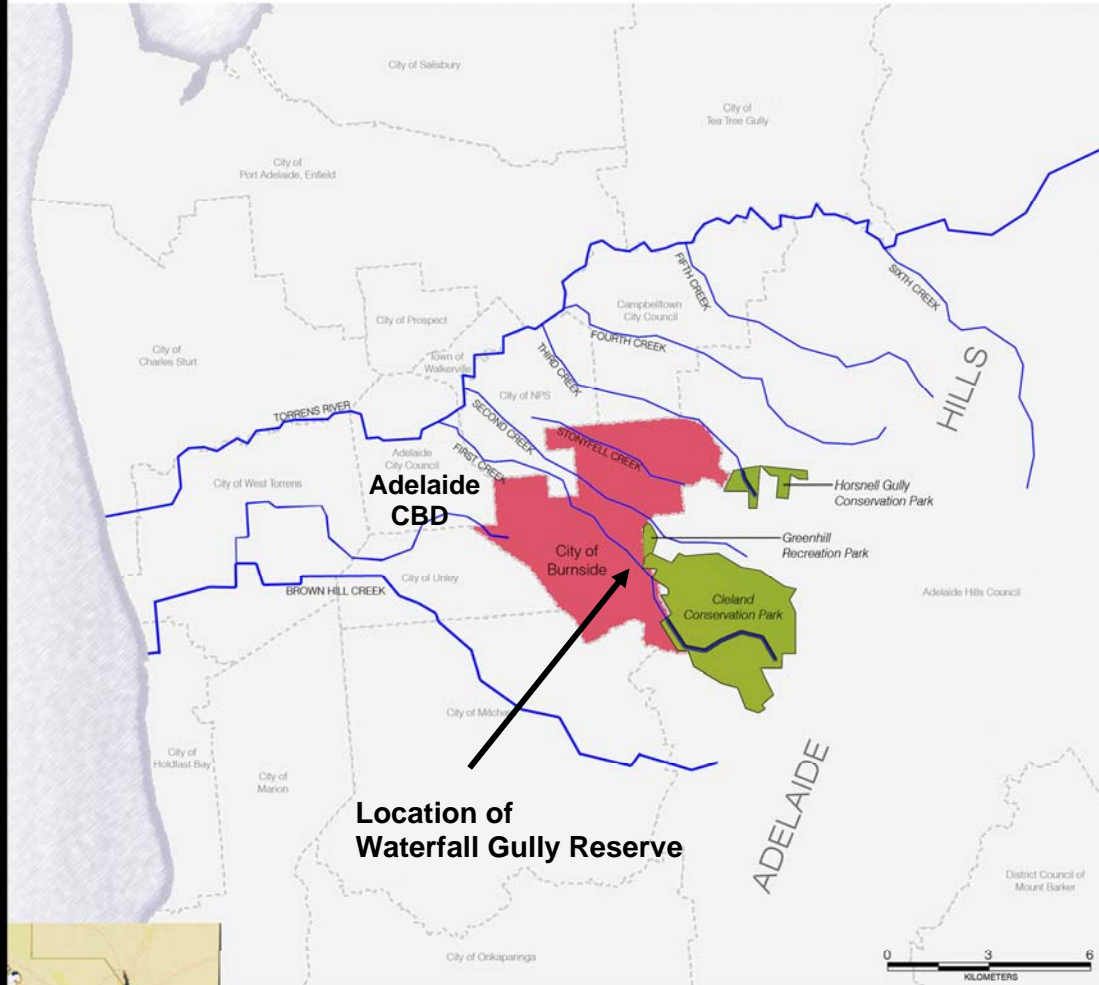
Summary

At Waterfall Gully Reserve our aim is to gradually remove all exotic flora from a very degraded 2.3ha council reserve and to replace it with a complete coverage of locally indigenous flora. Our approach is to work in small areas and expand them once they have been returned to predominantly stable native vegetation. We remove all weeds, protect all natural regeneration and introduce propagated local flora where flora does not regenerate. The restoration process relies on regular visits by a group of volunteers who remove all introduced species as they appear and protect all regeneration of indigenous species. Essential to the success of the project is the group of volunteers who are well supervised and are willing to visit the site frequently and to learn to recognise many weed and indigenous species at an early stage of growth.

The idea behind this approach is that the path of ecological succession is more likely to lead to stable, diverse native vegetation if no exotic species are present. A zero tolerance for weeds approach sounds ambitious but is achievable for small areas. This approach is used at other council reserves in the City of Burnside where the work is done by a team of 3 conservation and land management field staff. At this site, the majority of the work is done by volunteers and demonstrates that with proper training and supervision, it is possible for volunteers to regenerate degraded areas to high quality native vegetation.

The site consists of 400 metres of creek and associated flood-plain with some associated high ground to the north east. The site is bounded by a main road to the south-west and a track along the north-east. At the up-stream end of the reserve the creek is confined to a definite channel. Further downstream, the land is low lying and the water spreads over the whole floodplain in winter. At the downstream end of the reserve there is a permanently wet *Phragmites* reed-bed.

City of Burnside Location and Context



**Location of
Waterfall Gully Reserve**



**National Parks and Wildlife
Reserves bordering the City of Burnside**





Aerial photo of Waterfall Gully Reserve showing areas worked to the end of 2008. Work has not yet started on the reed-bed area.

Waterfall Gully reserve contains a riparian ecosystem that has been substantially changed by past human use for grazing, vegetable growing and urban stormwater disposal. Past vegetation clearance, soil disturbance and watercourse degradation has resulted in a densely weed invaded vegetation. Prior to restoration work just 12 indigenous plant species remained amongst a synthetic community of mostly weed species that formed over 99% of the site's vegetation cover, resulting in displacement of native plant species, reduction of native seedbanks and impairment of regeneration processes. Without active management intervention there was no likelihood of autogenic ecosystem recovery.

Stakeholders and Budget

The project is owned and managed by the City of Burnside with some funding support from the Adelaide and Mt Lofty Ranges Natural Resource Management Board. Council input amounts to about 10 hours per month volunteer supervision and training, and funding for occasional contractor assistance with large spraying and brush-cutter jobs. More recently, a group of volunteers from Conservation Volunteers Australia have begun to provide assistance at the site for one morning every month.

Ecosystem and Impacts

Prior to European settlement, the site was a riparian wetland on the floor of a steep sided valley. Some dry steep land to the north east is included in the reserve. Using remnant wetland communities upstream in Cleland Conservation Park as a guide, the original vegetation of the wetland can be inferred to have consisted of:

- In permanently wet areas - *Phragmites australis* Reed-bed
- In the wet parts - Woolly Tea-tree (*Leptospermum lanigerum*) shrubland over Red-fruit Saw-sedge (*Gahnia sieberiana*) and many other wetland species
- In moist floodplain areas - River Red Gum (*Eucalyptus camaldulensis*) open forest over Swamp Wattle (*Acacia provincialis*) over Hop Goodenia (*Goodenia ovata*) and a range of sedges and other wetland species

On adjoining dry slopes, the woodlands consisted of *Eucalyptus camaldulensis*, *Eucalyptus leucoxyton*, *Allocasuarina verticillata*, *Acacia pycnantha* over *Dodonaea viscosa*, *Bursaria spinosa*, *Olearia ramulosa*, and a diverse range of sub-shrubs, grasses and other herbaceous species.



Cleland Conservation Park - Closest wetland vegetation in good condition.

Main species evident are *Gahnia sieberiana*, *Goodenia ovata*, *Phragmites australis* and *Leptospermun lanigerum*

The presence of permanent water attracted colonists to Waterfall Gully soon after European settlement in 1836. From the 1840's the project site was used for vegetable growing and grazing of dairy cattle and sheep. The southern side of the wetland was filled in the late 1800's to construct the present road alignment and this has been more recently upgraded. At the eastern end of the reserve, where the fill is adjacent to the creek, the creek has become incised. For the majority of the reserve the main channel of the creek is indistinct. Grazing ceased in the 1960's when Waterfall Gully was subdivided for residential use and woody weeds have subsequently expanded their range and density. Apart from a few trees planted in 1999, the reserve has essentially remained unmanaged since the 1960's.

Prior to work commencing at the reserve in late 2005, the native vegetation on the site had been reduced to:

- 5 original *Eucalyptus camaldulensis*
- 5 *Eucalyptus camaldulensis* planted in 1999
- 4 *Allocasuarina verticillata* planted in 1999
- Approximately 1000m² of *Phragmites australis* at the downstream end of the reserve
- 3 *Lomandra densiflora*
- 1 *Carex breviculmis*
- Approximately 50 tussocks of *Austrodanthonia racemosa*
- 1 small patch of *Achaena echinata*
- 3 small patches of *Microlaena stipoides*
- Approximately 50m² of *Typha domingensis*
- Approximately 10m of creek bank fringed with *Lobelia alata* and *Isolepis cernua*
- One low-lying area, away from the main channel, with *Carex fascicularis* and *Juncus subsecundus*

In 2005, the introduced flora which dominated the site consisted mostly of:

Trees: *Salix babylonica*, *Salix x rubens*, *Fraxinus angustifolia*, *Ficus carica*, *Olea europea*, *Crataegus monogyna* and *Pinus radiata*

Other woody weeds: *Rhamnus alternifolius*, *Rubus ulmifolius*, *Senecio mikanioides*, *Senecio pterophorus*, *Hedera helix*, *Vinca major*.

Herbaceous perennials: *Asparagus asparagoides*, *Zantedeschia aethiopicum*, *Piptatherium miliaceum*, *Pennisetum clandestinum*, *Arundo donax*, *Cyperus involucratus*, *Poa annua*, *Ehrharta erecta* and many others.

Restoration goals and Planning

The long-term aim is to regenerate a weed-free native vegetation cover over the whole reserve. Examples of riparian vegetation and wetlands in Cleland Conservation Park, 5 to 10km upstream are used as a guide but quality examples of the pre-European vegetation of the adjoining slopes no longer exist locally. Remnant native flora scattered across the adjoining hills provides clues to the original structure and composition.

It is unlikely that the site will eventually truly replicate original native vegetation communities because:

- We don't know exactly what the site looked like prior to the 1840's
- Not all the species that do not regenerate naturally can be propagated and re-introduced
- The course of ecological succession may lead naturally to a different structure and composition
- The water and fire regimes at the site are unlikely to be as they were in the 1830's

Vegetation work at this reserve is an on-going process funded from Councils yearly reserve management budgets. It is not a project with a definite completion date.

Project implementation

The general strategy for developing native vegetation at the reserve is to:

- Define an area to be worked
- Search for and mark any indigenous plants present
- Stem inject tree weed species
- Use brushcutter with "Wakka"® blade to knock down all shrub weeds, blackberry etc
- Spray herbaceous weeds
- Allow woody weeds to regrow and spray regrowth
- Continually look for natural regeneration and mark if necessary with canes
- Frequently follow-up weed regrowth by hand and by spot spraying
- Propagate local species, particularly those that do not naturally regenerate, and plant into bare areas.
- When the worked area is manageable, expand the area downstream.
- Continue to patrol all previously worked areas

Brush-cutting is done by a contractor. A Wakka® blade is used where woody material is present because this cuts the material into smaller pieces that lie flat on the ground. When the weeds regrow, the initial spray is done by a contractor using trichlopyr and glyphosate. Future follow-up spot sprays are done by the supervisor using glyphosate. Killing tree weeds is done by a contractor.

The tree weeds Hawthorn, Olive, Ash, Fig and Pine are all killed as part of the initial area clearance using a stem injection method. The main contractor uses drill and fill. The CVA group uses the frill and fill method. Not all the willows are treated initially as they provide some shade for the regenerating site but are gradually phased out over time. Tree weeds near the road need to be removed or pruned back. Ash trees are all treated early because, if allowed to seed, they germinate and grow prolifically.

Pruning or felling tree weeds near the road is done by either council staff or a contractor. The constant search for native plants among the regenerating weeds is done by the supervisor. These are marked with canes and shown to the volunteers at the next session.

The greatest time input is undertaken by the volunteers of whom there about 6 or 8 regular participants. The volunteers meet most Wednesday mornings at the site. They comb over the established areas for weeds and intensively work the new areas, removing all germinating weeds from around regenerating natives.



Volunteer Bryan Milligan finding weeds amongst regenerating native flora



Natural regeneration on sprayed out soil

The key to success is the willingness of the volunteers to learn to recognise plants at an early growth stage. The supervisor introduces the volunteers to different weeds each time as well as reinforcing the species already introduced. The supervisor also looks

over areas weeded to find species that have not been recognised as weeds and checks the pile of weeded plants at the end of each session to check that no native plants have been removed. Native wetland plants accidentally removed are always planted back into mud near the creek. Dry-land plants that are accidentally removed are placed immediately in water and at the end of the session are potted at the council nursery for later return to the site.

Volunteers also propagate plants and plant them at the site. Most plantings are done on the higher ground where natural regeneration is slow or does not happen. Mostly tree species are planted with ground-flora species only introduced when weed control has been done thoroughly.

Every attempt is made to make the process minimum disturbance although it is unavoidable that some trampling takes place with so many volunteers working at once. Volunteers also have limited plant knowledge so it is unavoidable that some regenerating natives are lost through trampling and through mistaken identity. However, with constant reinforcing and by keeping the volunteers happy with a good morning tea, the volunteers are gradually learning and improving the speed and accuracy of their work.

Progress to Date

So far approximately 2000m² of the floodplain has been worked to point where regular patrols are easily keeping the area in weed free condition. A further 1000m² of floodplain has just been cleared and has been sprayed for the first time. On the high ground on the other side of the creek, about 1000m² has been treated for woody weeds and the ground weeds have been sprayed out after finding and marking the native grasses and other species.

On a technical level, the greatest achievement has been the minimal damage done to natural regeneration during weed removal activities and the high quality of the resulting ground cover. Regeneration includes locally rare species notably *Haloragis brownii* (Rare for SA). The high degree of weed removal has created an environment suitable for the introduction of other rare wetland flora. The Program Coordinator of the Threatened Plant Action Group, Tim Jury, has offered assistance with this.

At a local community level, a major achievement has been the development of a group of volunteers who understand the need to remove weeds and the roles of natural regeneration and planting in vegetation development.

The site follows the philosophy of pursuing vegetation quality rather than quantity. This philosophy is appropriate to urban and peri-urban areas where sites available for habitat development are small and where urban residents demand that their aesthetic sensibilities are not offended. This approach has been used in the City of Burnside for developing urban biodiversity sites since 1999 and the standards applied to this work can be seen on the website. The Waterfall Gully Reserve site along with a smaller site further down First Creek at Tusmore Park, are the first sites where this approach has been attempted with volunteers.

It is important that this approach be used for other volunteer managed sites to ensure that these sites develop into local native vegetation rather than into tree and shrub plantations over weeds. Whilst there has been some interest from other councils and

agencies, there is little evidence that the approach is catching on. Limiting the adoption of this approach are:

- Lack of plant recognition and identification skills in supervisors and contractors
- Lack of understanding of the thoroughness and persistence required to eliminate weeds
- Lack of understanding of the primacy of weed elimination in native vegetation development.

There are several advantages for land managers in working with volunteers to develop quality small sites in very degraded areas:

- Managers do not have to find new areas of land each year for event tree planting
- The cost of maintaining weedy tree plantations is avoided
- With good site management, volunteers can plant smaller growing species at the site in subsequent years
- There is plenty for volunteers to do at each visit
- Volunteers who learn about a site become committed to it



Looking downstream



Looking upstream

Picture pair taken from the downstream end of worked area 20 November 2008



September 2006



November 2008

Picture pair showing regeneration at the site in 2 years



north of creek



south of creek

Picture pair - weeds on one side of the creek, worked area on the other

Monitoring and research links

It is only after seeing the surprising amount of regeneration at the site that we began to do some formal monitoring. Initially this was limited to species lists of local plants and weeds but more recently we have set a simple monitoring procedure which includes:

- photo-points,
- recording the vegetation and canopy cover in a set of 6, 1m² quadrats,
- recording wildlife observed along a set transect in a pre-determined time

A site like Waterfall Gully Reserve offers considerable scope for ongoing research projects for TAFE and university. As yet no partnerships have been formed.

We have had initial discussions with the Threatened Plant Action Group to use the Waterfall Gully site as re-introduction site for threatened wetland species that occur upstream.

Lessons learned

Work at Waterfall Gully Reserve has demonstrated the amount of natural regeneration that is possible on flood-plain sites that are so degraded that few native species are evident. From a site dominated by blackberry and Kikuyu, so far 66 indigenous species have been recorded as naturally regenerating on the site following weed removal.

We have shown that volunteers with little or no prior knowledge can do quality weed removal work in complex sites although several site management issues remain unresolved.

One native species which was previously rarely seen in the City of Burnside is the native colonising species *Sigesbeckia orientalis*. This has regenerated in such profusion that it appears to smother other species. One of the volunteers has decided to remove *Sigesbeckia* in one area and this area appears to support a greater range of regenerating flora. Evidence will be gathered on this issue by setting up matched pairs of quadrats in a new area and monitoring the development of vegetation with and without *Sigesbeckia*.

In an open area, the regenerating flora appeared to suffer in the full summer sun compared to flora that was near or under the canopy of an existing willow tree. It is beyond the labour available to set up quadrats large enough and numerous enough to test directly the effect of different canopy management approaches on natural regeneration. We have decided at this stage to thin the willow canopy to 50% in the first instance and gradually phase them out as the *Eucalyptus camaldulensis* canopy develops. We intend to test the effect of shade in regeneration by setting up a series of 1m² quadrats in a sunny area and covering these with different shade densities.

Another un-resolved issue is the amount of planting to do. On the dry ground we need to plant as complete a suite of species as possible but on the floodplain, where natural regeneration has been prolific, we are planting mainly the species that dominate wetlands upstream but which have not regenerated at our site. The most obvious of these is Woolly Tea-tree, *Leptospermum lanigerum*. If we can propagate other species that occur upstream, we will introduce these as well. One such species is *Hydrocotyle laxiflora*.

Further Reading

Crompton, A. (2008). Revegetation – the Role of Quality Small Sites, *Australasian Plant Conservation*, vol 17, no. 1, pp 12-13

Contact Information

For information about this or other project sites in the City of Burnside and about joining the Burnside Biodiversity Volunteers, contact:

Andrew Crompton

Group Team Leader, Conservation and Land Management

City of Burnside

Phone: (08) 8366 4267

Email: acrompton@burnside.sa.gov.au

Indigenous Species found in Waterfall Gully Reserve (volunteer restoration site)

Naturally occurring

Acacia melanoxylon	Blackwood
Acacia myrtifolia	Myrtle-leaf Wattle
Acacia provincialis	Swamp Wattle
Acacia pycnantha	Golden Wattle
Acaena novae-zeylandii	Bidgee-widgee
Atriplex suberecta	Lagoon Saltbush
(?)Acrotriche fasciculiflora	Pink Ground Berry
Billardiera bignoniacea	
Carex appressa	Tall Sedge
Carex fascicularis	Tassel Sedge
Centipeda crateriformis	Sneeze Weed
Centrolepis strigosa	Hairy Centrolepis
Chenopodium pumilio	Clammy Goosefoot
Chloris truncata	Windmill Grass
Clematis microphylla	Old Mans Beard
Convolvulus erubescens	Australian Bindweed
Cotula australis	Common Cotula
Cyperus vaginatus	a Flat Sedge
Deyeuxia quadriseta	Reed Bent-grass
Dichelachne sp	
Dichondra repens	Kidney Weed
Dodonaea viscosa	Sticky Hop Bush
Epilobium billardieranum	Native Willow Herb
Eucalyptus camaldulensis	River red Gum
Euchiton gymnocephalus	a Cudweed
Euchiton involucratus	Star Cudweed
Gahnia seiberiana	Red-fruit Saw-sedge
Geranium retrorsum	Native Geranium
Glyceria australis	Australian Sweet Grass
Gonocarpus elatus	Hill Raspwort
Gonocarpus meizianus	a Raspwort
Goodenia amplexans	Clasping Goodenia
Goodenia ovata	Hop Goodenia
Gratiola peruviana	Brooklime
Halorgis brownii	Swamp Raspwort
Hydrocotyle species	a Pennywort
Isolepis cernua	Nodding Club-rush
Isolepis marginata	Little Club-rush
Ixodia achilleoides	Hills Daisy
Juncus bufonius	Toad Rush
Juncus planifolius	Broad-leaved Rush
Juncus subsecundus	Finger Rush
Lachnagrostis filiformis	Blown Grass
Lobelia alata	Native Lobelia
Logania saxatilis	Rock Logania
Lythrum hyssopifolia	Purple Loosestrife
Microlaena stipoides	Weeping Rice Grass
Myosotis sp	Forget-me-not
Olearia ramulosa	Twiggy Daisy-bush
Oxalis perennans	Native Oxalis

Pelargonium australe
Persicaria decipiens
Pimelea linifolia
Poa labillardieri
Portulaca oleracea
Prunella vulgaris
Psuedognaphalium luteo-album
Putenaea daphnoides
Ranunculus sessiliflorus
Senecio glomeratus
Senecio minimus
Senecio quadrangulata
Sigesbeckia orientalis
Solanum laciniatum
Typha domingensis
Wahlenbergia gracilentia

(66 species)

Native Pelargonium
Slender Knotweed

Tussock Grass
Munyeroo
Self-heal
a Cudweed
Large-leaved Bush-pea
Annual Buttercup

Shrubby fireweed

Indian Weed
Cut-leaf Kangaroo Apple
Bulrush
Annual Bluebell

Planted

Acacia melanoxydon
Acacia pycnantha
Allocasuarina verticillata
Austrodanthonia species
Austrostipa species
Cullen australasicum
Dodonaea viscosa
Eucalyptus camaldulensis
Goodenia ovata
Leptospermum continentale
Leptospermum lanigerum
Rubus parvifolius
Rumex brownii
Samolus repens

Blackwood
Golden Wattle
Drooping Sheoak
Wallaby Grass
Spear Grass
Scurf Pea
Sticky Hop Bush
River red Gum
Hop Goodenia
Prickly Tea-tree
Woolly Tea-tree
Small-leaf Raspberry
Native Dock
Austral Brooklime

Weeds at Waterfall Gully Reserve – volunteer site

Araceae species	
Allium triquetrum	Three-corner Garlic
Acacia saligna	Golden Wreath Wattle
Albizzia lophantha	Cape Lewin Wattle
Alocasia sp	Elephants ears
Anagallis arvensis	Red Pimpernel
Argeratina adenofera	Crofton Weed
Arundo donax	Giant Weed
Asparagus asparagoides	Bridal Creeper
Carduus pycnocephalus	a thistle
Centarium erythraea	
Chasmanthe floribunda	Aunt Eliza
Cymbalaria muralis	Kenilworth Ivy
Cyperus alterniflorus	Umbrella sedge
Digitaria ciliaris	Crab Grass
Dipogon lignosus	Lavatory Creeper
Echinochloa crus-galli	Barnyard Grass
Epilobium ciliatum	weed Epilobium
Erharta erecta	Millet Veldt Grass
Erharta longiflora	Annual Veldt Grass
Erigeron bonariensis	Fleebane
Erigeron karvinscianus	Seaside daisy
Euphorbia maculata	Eyebane
Euphorbia peplus	Petty Spurge
Foeniculum vulgare	Fennel
Ficus carica	Fig
Fraxinus rotundifolia	Ash
Fumaria sp	Fumitory
Galium aperine	Cleavers
Gladiolus undulata	Wild Gladiolus
Gnaphalium spicatum	a weed cudweed
Hedera helix	Ivy
Holchus lanatus	Yorkshire Fog Grass
Hybiscus trionum	Bladder Ketmia
Hypericum perforatum	St Johns Wort
Hypochoeris radicata	Cats Ear
Ipomoea sp	Morning Glory
Juncus articulatus	Jointed Rush
Juncus capitatus	Capitate Rush
Panicum miliaceum	Millet
Pennesetum clandestinum	Kikuyu
Lathyrus tingitanus	Tangier Pea
Lobelia garden type	
Lolium rigidum	Annual Rye Grass
Lobularia maritima	Sweet Allysum
Medicago polymorpha	Medic
Mimulus moschatus	Musk Monkey-flower
Oxalis latifolia	
Oxalis pes-caprae	Soursob
Oxalis purpurea	One o'clock
Piptatherum miliaceum	Rice Millet
Plantago lanceolata	Ribgrass

Plantago major	Greater Plantain
Poa annua	Winter Grass
Polycarpon tetraphyllum	Allseed
Polygonum aviculare	Wire Weed
Ranunculus repens	Creeping Buttercup
Rhamnus alaternus	Buckthorn
Rorippa nasturtium-aquaticum	Water Cress
Rubus Canadensis	Thornless blackberry
Rubus fruticosus	Blackberry
Rumex conglomerates	Dock
Romulea rosea	Guildford Grass
Senecio mikanioides	Cape Ivy
Senecio pterophorus	African Daisy
Sagina apetala	Pearlwort
Salvia verbenaca	Wild Sage
Setaria verticillata	Love Grass
Solanum nigrum	Black Nightshade
Sonchus oleraceus	Sow Thistle
Trifolium arvense	Hares-foot Clover
Trifolium subterraneum	Sub Clover
Salix babylonica	Weeping Willow
Zantedeschia aethiopicum	Arum Lily

74 species of weed

[More biodiversity highlights in the City of Burnside](#)