2012-2017

City of Burnside

Southern Hills Face Reserves Vegetation Management Plan

Themeda Reserve, Gully & Wheal Gawler Mine Reserve, Zig Zag & Chimney Reserve, Danthonia Reserve and associated road reserves

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1. Introduction

1.1 Overview

The southern hills face reserves consist of six (6) steeply sloping reserves totalling 32ha at Mount Osmond:

- Themeda Reserve 9.1 ha
- Gully Reserve 9.7 ha
- Wheal Gawler Mine Reserve 1.8 ha
- Zig-zag Reserve 1.6 ha
- Chimney Reserve 2.2 ha
- Danthonia Reserve 7.6 ha

Associated with these reserves is approximately five (5) ha of road reserve comprising:

- Gill Terrace road reserve linking Zig-zag Reserve, Gully Reserve and Seaview Road;
- Hayward Drive verge;
- The Old Bullock track and
- Mt Osmond Road verges.

Many of the reserve boundaries are not fenced and have not been surveyed. It is important that people have a clear indication of the extent of reserve land.

> **Recommendation 1:** That poorly defined reserve boundaries are surveyed and permanently marked.

The objectives of vegetation management in these reserves relate to;

- risk management, particularly in relation to fire,
- nature conservation,
- the development of landscape aesthetics, and
- efficient and effective use of resources.

This plan proposes a vision for the vegetation structure and a proposed management regime that best balances risks and satisfies objectives.

This plan addresses management of Council controlled land only.

1.2 Previous Reports

- Management Plan – Part 1: Feasibility Study (Maguire 1994)

This sets out the legal responsibilities of the Burnside Council in regard to a number of hills face reserves, including the reserves identified in the current plan. It also assesses particular physical and environmental characteristics of the reserves, maps the vegetation and its significance and more specifically analyses the threat of

bushfire posed by each reserve group. An outline and evaluation of management options including the management strategies employed at the time of the report are also provided. Development of the management plan was in direct response to concerns associated with the risks of bushfire in the area and therefore bushfire management and assessment are priority components.

- Management Plan – Burnside Hills Face Reserves (Maguire 1995)

The Feasibility Study is a supporting document to this management plan, which is a hazard and vegetation management plan for all hills face reserves including those identified in the current plan.

The highest priority objective of the plan is to meet the Council's legislative land management responsibilities, focussing on bushfire hazard reduction and pest plant control. The plan is the basis for the current management approach to the southern hills face reserves.

It recommends a 10 metre fuel hazard reduction buffer on boundaries of residential properties and a general philosophy of replacing thick woody weed growth with an open indigenous woodland canopy in the balance of the reserve land. A number of subsidiary recommendations are also provided addressing specific issues relevant to certain reserve areas.

- Mount Osmond Reserves Action Plan (Crompton 1996)

This plan was prepared to detail the management actions required to implement the recommendations in the McGuire plan. Vegetation mapping was undertaken including identification and location of indigenous plant species. General and site recommendations are presented.

- Mount Osmond Road Vegetation Survey (Crompton 1997)

This report lists indigenous flora present on the Mt Osmond Road verges together with their location.

- City of Burnside Biodiversity Strategy (adopted by Council 2008)

Amongst other things this plan documents the biodiversity of Burnside and outlines biodiversity objectives in hills face management.

- Independent Report on the petition submitted to Burnside Council for Tree Removal at Mt Osmond (Leading Emergency Services, 2009)

This report provides a detailed assessment of fire hazard on the upper slopes of the southern hills face reserves and, inter-alia, recommends that an area out to 100 metres from dwellings on sloping ground below dwellings be maintained at a low overall fuel hazard rating with the balance of the reserves be maintained at a rating of moderate or lower. The report makes the general statement that, where land slopes uphill from residences, the standard Country Fire Service (CFS) recommendation of a 20 metre low fuel hazard zone should be maintained. The report also makes recommendations about the management of private land which will be considered in the next review of the Burnside Bushfire Prevention Plan.

Recommendation 2: That the philosophy of the Burnside Hills Face Management Plan (1996) is re-affirmed with management actions modified in response to the Leading Emergency Services report (2009).

Recommendation 3: That, as recommended by Leading Emergency Services (2009), the following fuel reduction zones are maintained: (see figure 2)

- Continue to maintain the 10 metre boundary fuel hazard reduction zone adjacent to residential properties which is presently maintained in accordance with the Hills Face Reserves Management Plan (1996).
- To a distance of 100 metre downhill from dwellings, maintain the overall fuel hazard rating at low or better.
- To a distance of 20 metre uphill from dwellings, maintain the overall fuel hazard rating of low or better.
- Maintain the balance of the reserve land to an overall fuel hazard rating of moderate or better.

1.3 Legislative Requirements

There are a number of legislative controls relevant to the management of the Burnside Hills Face reserves. These are:

1. Burnside (City) Development Plan, 1993

The Burnside (City) Development Plan is prepared pursuant to the Development Act (1993). The plan places a strong emphasis on the protection and enhancement of the City's natural environment and the protection of items and areas significant to its cultural and historical heritage.

- Development of land is limited within the Hills Face Zone and objectives for the protection and enhancement of the environment are set out.
- Bushfire danger is recognised in Development Controls and bushfire protection requirements are set out.
- MOSS (Metropolitan Open Space System) Supplementary Development Plan aims to provide an expanded system of linked open spaces in and around metropolitan Adelaide.

The main planning considerations that relate directly to how Council manages its hills face reserves are:

- Following recommendations from Leading Emergency Services, dwellings approved for construction close to a reserve boundary will force the 100 metres low fuel reduction zone further out into reserve land and increases the responsibility of Council for fire protection of the approved residence. The Department of Environment and Natural Resources recommends a minimum distance of 40 metres between reserve vegetation and housing.
- Residential developments generate stormwater runoff which, when discharged onto reserve land imposes costs to Council.

- Gardens associated with residential developments can increase fire and or weed hazard.

Recommendation 4: That Development Plans and planning approvals should aim to minimise resulting reserve management obligations to Council by ensuring that;

- houses are built as far from reserve boundaries as is practically possible;
- as much stormwater is absorbed onto the private land as is practically possible, and
- landscaping associated with residences does not include weedy or potentially hybridising species or cultivars and does not increase fire hazard.

2. Natural Resources Management Act, 2004

The NRM Act, 2004, replaces the Animal and Plant Control Act, 1986.
Defines landowner responsibilities for notification, destruction and/or control of pest declared plants on private, council and roadside land. Declared pest plants under the NRM Act for the area are:

- *Chrysanthemoides monilifera* (Boneseed)
- *Crataegus monogyna* (Hawthorn)
- *Gomphocarpus fruticosus* (Broad-leaf Cotton Bush)
- *Olea europaea* (Olive)
- *Rosa canina* (Dog Rose)
- *Rubus fruticosus* (Blackberry)

Private land holders are often reluctant to undertake weed management on their properties if weeds are also growing on council reserves and roadsides. Improved management of council land will foster acceptance of measures that encourage improved management of private land. Management of weeds on private land is not addressed in this plan.

Recommendation 5: That an information report is prepared for Council options for ensuring improved management of declared weeds and fire hazard on private land.

3. Fire and Emergency Services Act 2005

The Fire and Emergency Act was amended in 2010. District Bushfire Prevention Committees have been replaced by Bushfire Management Committees for designated bushfire management areas. Burnside is in Region 1 and the plan for this region has not been finalised. In the interim, Council administration is maintaining its commitment to the 2006 Burnside Bushfire Prevention Plan which was prepared for the former Burnside Bushfire Area.

The plan sets out the following objectives relating directly to Council's management of the reserves in the Burnside Bushfire Area:

- To inform the Council of the risk of bushfire through the District Bushfire Prevention Committee.
- To define areas of hazard and assets under threat within the City of Burnside through a detailed risk assessment.
- To identify both annual short term works and longer term strategic approaches that will assist in minimising the impact of bushfire.

The Burnside Bushfire Prevention Plan (2006) details results of a fuel assessment that was conducted in the Burnside Bushfire Area using the '*CFS Bushfire Threat Assessment Guide.* In this assessment, Leawood Gardens, Waterfall Gully, Skye and Auldana had fuel levels rated as "moderate" whereas Mount Osmond fuel loads were rated as "high".

In relation to the management of Council land, Section 105G of the Fire and Emergency Services Act 2005 states:

(1) A council that has the care, control or management of land—

(a) in the country; or

(b) in a designated urban bushfire risk area,

must take reasonable steps—

(c) to prevent or inhibit the outbreak of fire on the land; and

(d) to prevent or inhibit the spread of fire through the land; and

(e) to protect property on the land from fire; and

(f) to minimise the threat to human life from a fire on the land.

4. The Environmental Protection and Biodiversity Conservation (EPBC) Act (1999)

Is Commonwealth legislation which provides protection for listed vegetation communities. Grey Box Woodland is a listed community. It occurs as degraded patches in Danthonia and Gully Reserves but these patches lack native understorey and so it is unlikely that these areas would meet the EPBC criteria for Grey Box woodland.

5. Native Vegetation Act, 1991

The Native Vegetation Act, 1991, states that native vegetation may be cleared in certain circumstances; one being when vegetation is within 20 metres of a dwelling and the sole purpose of the clearance is to protect a dwelling or other building from the threat of fire. Approval from the Native Vegetation Council is required for any prescribed burning. A fire management plan can be submitted to the Native Vegetation Council, outlining the fire management proposed during the life of the plan.

Approval may then be granted to conduct prescribed burns in accordance with the plan. Although very degraded and dominated by weeds, the southern hills face

reserves contain some native flora and are located in an area to which the Act applies.

> **Recommendation 6:** That Council submits this plan as the basis for an application to the Native Vegetation Council for permission to undertake burning in the southern hills face reserves for the purposes of fuel hazard reduction and ground flora quality improvement.

6. Local Government Act 1999

The Local Government Act 1999 refers in Section 7(d) of Councils taking "measures to protect its area from natural and other hazards and to mitigate the effect of such hazards". Under this section, Council must take steps to mitigate the threat of bushfire.

7. Environment Protection Act 1993

Environment Protection (Burning) Policy 1994 – (pursuant to Clause 5 of Schedule 2) states that: while under most circumstances, 'fires in the open on non-domestic premises' cannot be lit without the written consent given under this clause by the Environment Protection Act or a City of Burnside officer as delegate of the Authority, under the Environment Protection (Burning) Policy, 1994 Schedule 1, Clause 4(2c)], this does not apply to "the prevention and control of bushfires". Therefore, during the period 1-31 May and 1 September - 31 October each year, permission is granted (unless the Bushfire Danger Season has been declared), for domestic premises situated in the Adelaide Hills Face Zone to burn vegetation, which cannot be disposed of by other means, for the purposes of reducing the bushfire hazard.

Burning is subject to a range of conditions including:

- Fires only to be lit between 10:00 am and 3:00 pm Monday to Saturday
- Not to be lit on Sundays or days of total fire ban
- Residents remain responsible for the fire
- Residents advise the CFS State Operations Centre prior to lighting the fire.

As seasonal conditions are very variable, to undertake an effective burning program in a year with a late seasonal break, it will often be necessary to burn in June or even July.

> **Recommendation 7:** That Council applies for permission from the EPA to undertake ecological burning and hazard reduction burning when conditions are suitable outside the Bushfire Danger Season.

8. National Parks and Wildlife Act 1972

This Act provides protection for state listed flora and fauna species. Three plant species know to occur in the reserves are listed as "rare" in South Australia.

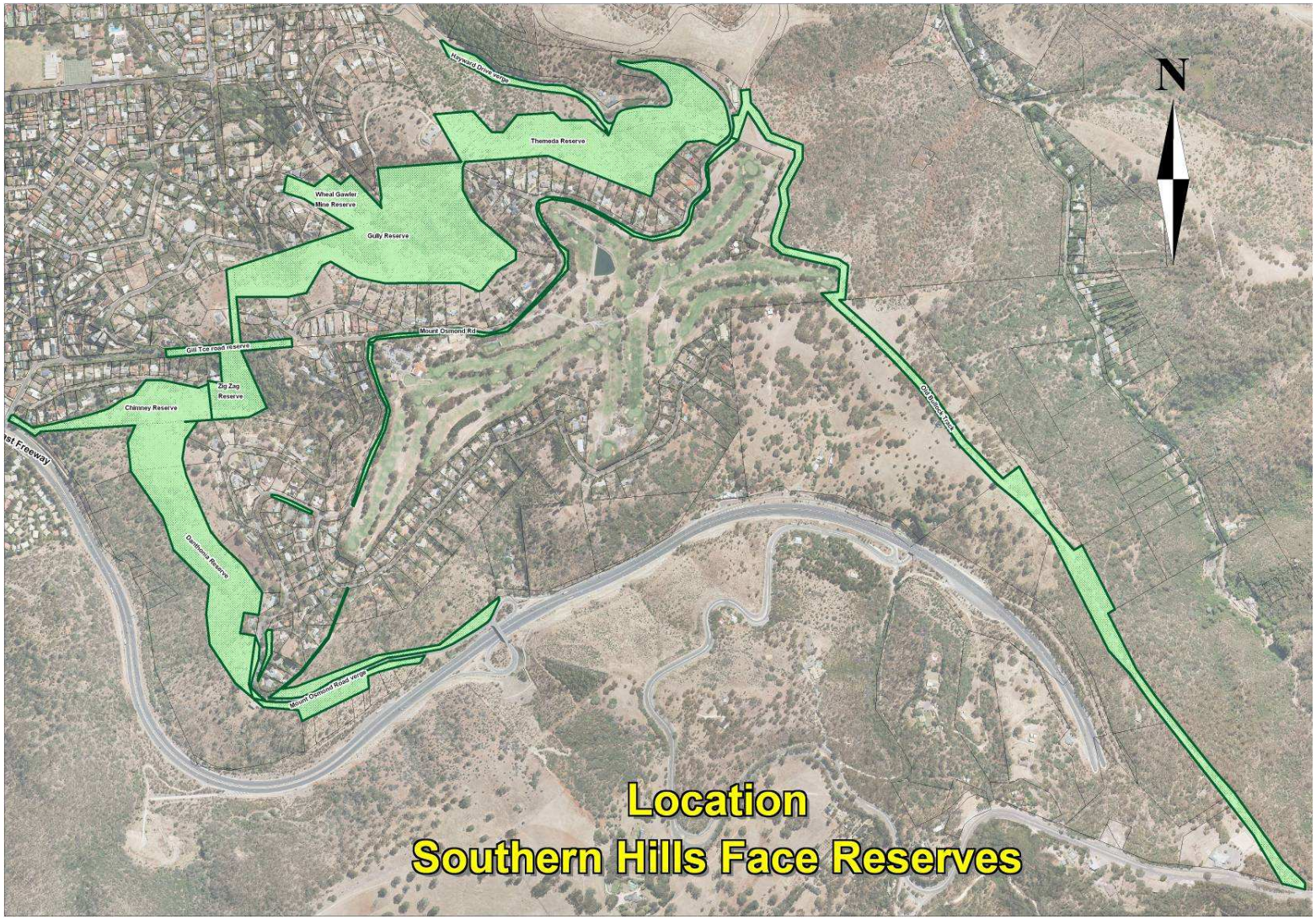

Figure 1 – Locations of southern hills face reserves

2. Risks

Land management influences the following risk factors:

- Fire
- Flooding, erosion and sedimentation
- Landslip
- Climate change
- Spread of feral introduced plants and animals
- Loss of habitat and loss of species
- Physical injury to visitors and field workers

Members of the community expect that council will manage its reserve land so that there is no risk with respect to any of these factors. But the reduction of one risk can increase the other risks and careful management is required to achieve the optimum outcome with respect to all risks.

2.1 Fire

Little is known of land management practices of the Kaurna people prior to European settlement so references here to traditional landscape management are necessarily speculative.

It appears that the southern hills face area was managed by Kaurna people by burning during suitable weather conditions and all the original vegetation types were adapted to relatively frequent low intensity fires. This burning, if frequent, tended to reduce the density of trees and shrubs in the landscape. If fire was infrequent, trees and shrubs increased in density.

It is not known how this burning was done nor do we have a clear picture of the resulting structure and composition of the vegetation. Early illustrations and photographs show an open vegetation formation in this area.

Over several years, most of the land would have had some form of burning and a mosaic landscape was formed, consisting of areas at different stages of ecological succession and tree density.

Under this management regime, fires were probably not intense. This is evidenced by the fact that the dominant *Eucalyptus leucoxylon* (SA Blue Gum) trees of the area are not tolerant of high intensity fires.

Prior to European settlement, there were no introduced species in the landscape, so burning could not encourage weeds as is the case today. Indigenous people also had no private land tenure or built assets and so there was no necessity to limit the extent of fires to exact boundaries.

It is likely that lightning would have also naturally started fires and there is no doubt that occasional very intense fires affected the stringybark forests and heaths of the higher ranges from time to time. These fires would have also

affected land in the hills face. Patches of recently burned land would have reduced the fuel loading and the severity of such wildfire. So it is likely that in the pre-European landscape, fires could have burned right through summer and, in some years, a large percentage of the landscape would have been burned by the end of the season.

It is likely that the intensity of pre-European wild-fire would have been reduced by the activity of native herbivores (mostly kangaroos) particularly in higher fertility and moister areas (mostly lower in the landscape and on floodplains).

Surviving remnants of native flora indicate that the pre-European vegetation communities of the hills face were adapted to frequent, low intensity fire. We should learn from pre-European management but the vegetation composition and the settlement patterns are now so different that burning can only now be considered to be one of a number of activities required for fire hazard management.

After European colonisation, management burning ceased. The grazing of sheep and cattle maintained a low fuel load although the effect of grazing together with the introduction of plants from Europe and South Africa led to a rapid loss of native grasses and herbage and the domination by introduced species.

With the expansion of metropolitan Adelaide, the grazed land began to be converted to residential uses from the 1960‘s onwards. Areas too steep to build on or otherwise unused, became Council reserve land and there was apparently no thought at the time to designing a hills face reserve system that is functional and manageable.

Without grazing and burning, there was explosive growth of introduced tree and shrub species that began to turn the hills face slopes into thickets of olive, pine, hawthorn and blackberry. This further increased the fire fuel loading.

The 1995 Hills Face Reserves Management Plan prepared by Michele McGuire proposed a philosophy of removing woody weeds, establishing a tree canopy to suppress ground growth and to reduce wind speeds, and developing a 10m fuel minimisation zone along reserve boundaries adjacent to private property. This has been followed since then with funds allocated annually by Council to support a contractor works program.

Over the last decade, Council has allocated considerable funding for the removal of woody weed vegetation from the southern hills face reserves and this has considerably reduced fuel hazard in the reserves. The removal of woody weed cover has increased the growth of grass and broadleaf weeds. The cost of cutting these areas each year is now consuming a large percentage of the “urban biodiversity” contractor allocation.

The current works program will satisfy fuel management requirements for high fire danger conditions but for extreme and catastrophic conditions, such as occurred on Ash Wednesday or on Black Saturday in Victoria, improving the vegetation management of the entire hills face reserve system is required to minimise risk.

A report from Stuart Ellis (Leading Emergency Services 2009) has recommended that Council provides for the maintenance of an overall “low” fuel hazard rating to a distance of 100 metres from dwellings situated uphill from reserve land, and, in the absence of site inspections, at least follow the CFS recommended 20 metres fuel reduction buffer from buildings along the lower boundaries of the reserves.

These fuel hazard reduction zones are mapped in figure 2, together with the existing 10 metres fuel minimisation buffer zone. It should be noted by planning staff that new house approvals have the potential to increase the area of fuel hazard reduction zone in reserves and therefore increase the cost to Council.

Fire can be used as a management tool in the southern hills face reserves because most of the native species present are grasses and geophytes (plants with underground buds) which are adapted to frequent, low intensity fires. Without burning, many of the native forbs (non-grass, herbaceous species) reduce in abundance and can be lost as grass and thatch increase. Without burning also, the native grasses reduce in abundance as annual introduced grasses build up and prevent regeneration. Burning of grassy native vegetation communities is therefore essential to maintaining biological diversity.

Stuart Ellis also highlighted the need for private landholders to manage their land for fire hazard reduction and asset protection. Addressing this issue is beyond the scope of a reserve management plan and is dealt with through the bushfire management planning process set up under the Fire and Emergency Services Act. When the Bushfire Management Plan for region 1 is adopted, it would be appropriate for Council to review how to foster good land management on private land.

The following fire management philosophy is proposed for the southern hills face reserves:

- Fire should be used as a way of reducing fire fuel loadings in defined fuel hazard reduction zones. Burning is more effective and less expensive than mowing and physical removal. Money saved can be used to undertake weed follow-up so that vegetation quality improves over time.
- Fire should be used to improve the quality and diversity of grassland areas by clearing away thatch, killing annual grasses and clearing the ground for regeneration.
- If burning is to take place during the fire season, the CFS must be involved and negotiations are needed to develop a plan for CFS involvement.
- In areas where native wildflowers are present it is preferable to burn in autumn when the plants are most dormant. As almost all of these areas are infested with annual exotic grasses, it is preferable to burn after the end of the fire season and soon after the first rains when the weed grass seeds have just germinated and vulnerable to fire.

- In all burned areas, follow-up weed control needs to be undertaken with the species controlled determined by the quality of the area burned.
- In all burned areas, indigenous sub-shrubs should be protected unless they are abundant and known to readily regenerate after fire. Known to require protection at this stage are *Astroloma humifusum* and *Pimelea curviflora.*
- In any one year, burning in the conservation land management zone will be patchy and some weed free areas will remain unburned and uncut as refuges for insects and lizards. Burning in this zone will be aimed primarily at improving and maintaining the quality and diversity of ground flora although fuel reduction will be an additional benefit.
- Council staff and contractors should be trained and equipped to undertake cool patch burning outside the fire danger season.

Recommendation 8: It is recommended that a “Standard Work Method” document is prepared for the task of area burning incorporating safety, site assessment, and protection of biodiversity.

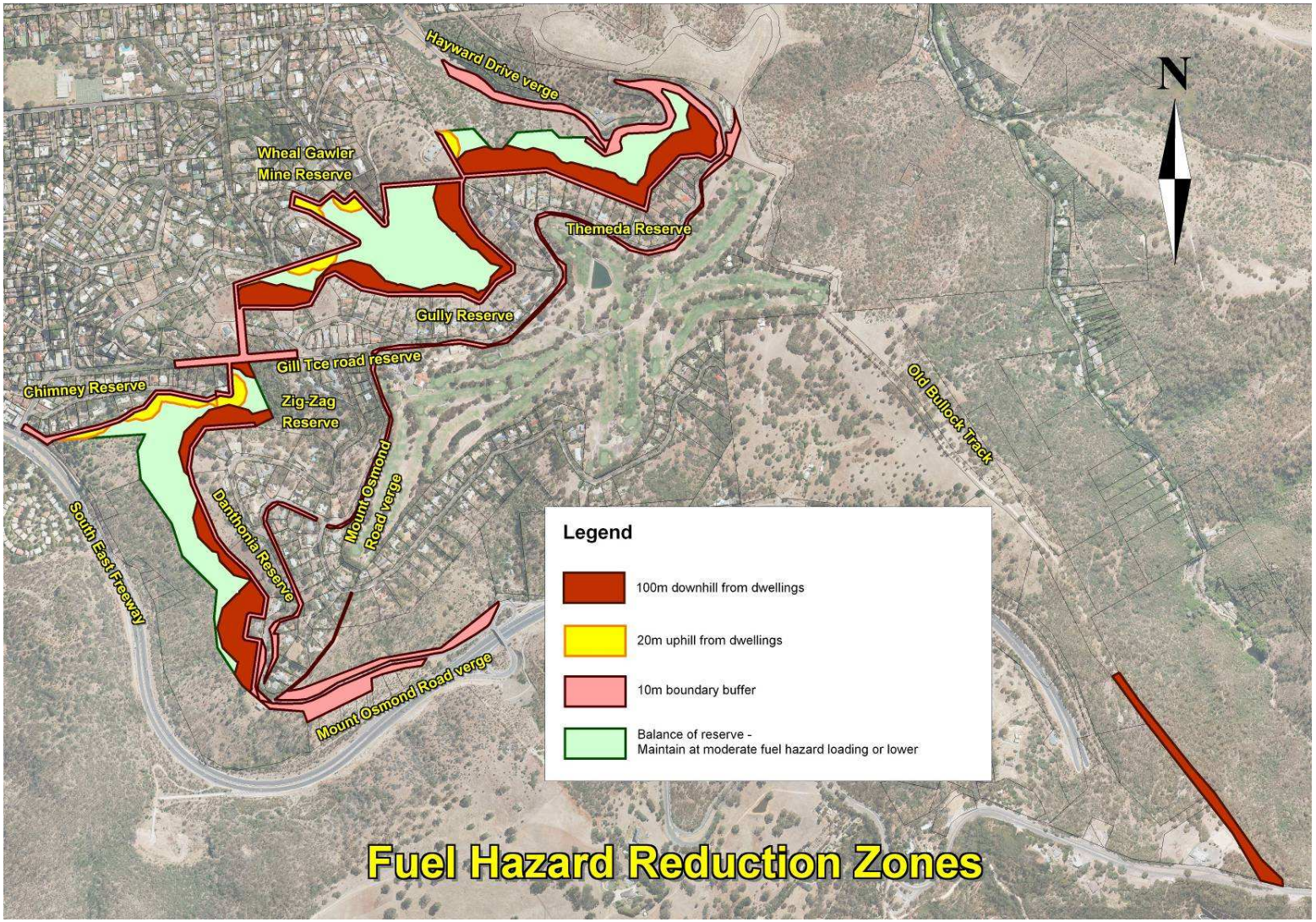

Figure 2 – proposed fire fuel hazard reduction zones.

2.2 Flooding, soil erosion, land slippage and sedimentation

Soil erosion refers to the washing of soil down-slope. In hills face reserves, this typically occurs where storm water from streets is directed onto reserves. Soil and rocks from the eroding gully will cause a nuisance or a hazard by:

- washing onto roads;
- washing into private properties;
- silting up stormwater systems;
- damaging native flora; and
- causing gullies that are difficult to manage.

The large erosion gully which is forming at Chimney Reserve is an example of the effects of uncontrolled water flowing onto a council reserve. Water directed from St Andrews Avenue has caused a deep gully to form down the slope to Jikara Drive and managing this site continues to be labour intensive.

Soil erosion can also occur when soil is bare due to fire or due to herbicide application for weed control. After Ash Wednesday 1983, the heat of the fire destroyed plant and organic matter in the top part of the soil profile and when intense rain fell, three weeks later, top soil was stripped from the hills sides causing road closures and property damage from sediment deposition. Under average fire conditions, the existence of fire tolerant native perennial grasses on slopes assists with rapid recovery after fire. Slopes covered with exotic annual grasses slopes are prone to erosion for a longer period after fire.

On a smaller scale, areas can be bared when weeds are sprayed particularly during preparation for sowing or natural regeneration of native grasses. Provided that the soil is not disturbed and there is no extra water running on to the site, the growth of moss on the soil surface is often enough to prevent erosion during the weed control phase of native grass re-establishment. Care must be taken to limit the area of bare ground and to quickly establish a temporary cover vegetation of rye-corn at sites at risk of erosion. At sites with large amounts of stormwater run-on, bales of straw, pegged along the contour can be used to spread the flow while permanent vegetative cover is established.

The key to erosion control is vegetation, particularly perennial grassy vegetation. The more water flow and the steeper the slope, the more the density of grassy vegetation is required.

Land with sparse vegetative cover will be poor at absorbing rainfall and will therefore shed water directly through surface runoff. Surface runoff can also occur if soil becomes waterlogged and cannot absorb the amount of water falling on it. Surface runoff needs to be avoided because of risk of soil erosion. Surface runoff also leads to a rapid shedding of water from the landscape and an

increase in **flooding** downstream in the catchment. The ability of the hills face areas to absorb rainfall is important for flood prevention in the suburban areas below.

The risk of surface runoff and erosion means that all land must be vegetated at all times meaning that, in dry times, some fuel will necessarily be present in the landscape.

There is an apparent conflict between the low vegetative cover needed to minimise fire hazard and the larger vegetative cover needed to minimise the risk of erosion. Good management of weeds, tree canopy and fine fuel management is needed to minimise this conflict.

It is also important to manage the discharge of water onto reserves from roads and from private developments. Managing these inflows are always labour intensive but where water flows onto reserve land at a high rate, management by vegetation alone becomes impossible and the formation of an erosion gully is inevitable.

Wherever there is surface runoff there will be particles of soil and rubbish that become suspended in the water and **sedimentation** occurs wherever the water flow slows down. Alluvial fans of sediment commonly form wherever storm water enters reserves where the land is not very steep. These alluvial fans are moist and rich in nutrients and grow rank annual growth which increases fire hazard in summer. Traditionally, Council removes sediment that reaches roads or private property because of traffic hazard or because of resident complaint. On Jikara Drive, Council has built a sediment interception structure to collect material eroding in storm water from Chimney Reserve. Council has also constructed small sediment interception structures at Danthonia Reserve and at Magill Stone Mine Reserve and has at other locations diverted stormwater flows away from reserve land. Such visually unobtrusive structures are proposed for other locations . These structures will require cleaning at most two (2) times in a year.

Parts of the hills face have some risk of **landslip**. Land slippage occurs when soil is waterlogged. This can happen after long periods of rain when more water is falling on the soil than can be absorbed and move downwards into the profile. Soil can slump down the hill and the depth of soil that moves will be determined by the strength of the bedrock below. In some areas of the hills face the underlying rock is weathered and unconsolidated shale which can also move with the topsoil when it is waterlogged.

A major landslip occurred on the southern end of Mt Osmond Road in 1997 and instability is evident along other road cuttings in the area.

Landslip risk is therefore dependent on:

- the rainfall;

- the transpiration of vegetation;
- the infiltration ability of the soil and underlying rock;
- the degree to which soil is bound together by plant roots;
- the degree of consolidation of the underlying rock;
- the degree to which the top soil is bound to the underlying rock by plant roots;
- additional stormwater flowing onto an area; and
- the presence of cuttings or excavations.

A Mt Osmond resident has suggested that the presence of buried infrastructure surrounded by sand can act as an underground conduit for stormwater which leads to landslip risk where the channelled water enters the weathered rock strata.

More information is needed to accurately quantify landslip risk in the Mt Osmond area.

> **Recommendation 9:** That council seeks to more accurately quantify the risk of landslip at Mt Osmond.

- Infiltration is greatly influenced by plant growth and accumulated organic matter in the soil.
- Binding of the topsoil is increased with fine rooted plants such as grasses and surface rooted trees such as Sheoaks.
- Binding of the topsoil to the underlying material is increased by the growth of deep rooted trees such as Eucalyptus species.
- Tree cover has a high transpiration rate which greatly reduces the incidence of waterlogging.

There is also an apparent conflict between the need for adequate vegetation to minimise risk of land slip and the desire to have minimum vegetation in the landscape during summer. As with the erosion risk management, this conflict can be managed by good vegetation management.

> **Recommendation 10:** It is recommended that a Standard Work Method document is prepared for the task of controlling erosion, landslip and sedimentation;

> **Recommendation 11:** It is recommended that, where stormwater is directed onto reserves, works are undertaken to trap sediment, spread the water flow or pipe the water to a gully or watercourse as appropriate for the situation.

2.3 Climate change

Human activity is increasing the content of greenhouse gasses in the atmosphere (particularly carbon dioxide and methane) which reduce the transparency of the atmosphere to infra-red radiation and thereby reduces the radiant loss of heat from the Earth's surface at night. This is generally considered to be causing changes to the climate.

In order to minimise the risk of adverse climate change, the need to reduce the amount of carbon dioxide entering the atmosphere is generally accepted.

One action for taking carbon dioxide (CO_2) out of the atmosphere is to establish vegetation. The amount of carbon that is permanently taken from the atmosphere is proportional to the quantity of vegetation (standing biomass) that can be maintained on a site together with any permanent increase in soil organic matter content and soil surface organic matter. It is important that vegetation is planned and developed to constitute a self-regenerating ecosystem. A plantation will eventually die or be removed and the carbon dioxide will be released back to the atmosphere. A regenerating ecosystem will grow back naturally after fire or other disturbance and so CO_2 released into the atmosphere will be reabsorbed into regenerating biomass.

Prior to European settlement, on Mt Osmond, there was a standing biomass of large trees (SA Blue Gum), small trees, shrubs, grasses and herbaceous species. A large contribution to standing biomass was the presence of logs and large diameter woody material on the ground. This had mostly been cleared and burned by the turn of the 20th century and the carbon previously contained in this vegetation was now in the atmosphere. As grazing reduced, following residential development in the 1960's, the reserves gradually were invaded by exotic woody vegetation (olive, hawthorn and Aleppo Pine) and the standing biomass increased again. As part of the fire fuel reduction program of the last decade, the standing biomass has again decreased and there has been a net release of carbon into the atmosphere.

There is, then, a conflict between fire hazard minimisation and maximising standing biomass for tying up atmospheric carbon. Council must make a contribution to the global effort in tying up atmospheric carbon but at the same time private properties must not be threatened by increasing fire hazard.

Again, good land management is essential to getting the balance right. Developing a carbon store in tree trunks and dead wood on the ground, while minimising fine fuel loading, will be part of a land management prescription for the reserves. Fine fuel is defined as fuel with a diameter of less than 6mm.

> **Recommendation 12:** It is recommended that indigenous trees in an open woodland formation are the main form in which a high biomass is

maintained without increasing fine fuel. SA Blue Gum (*Eucalyptus leucoxylon*) should be used wherever appropriate as it carries the lowest amount of bark and is therefore least likely to carry a ground fire into the crown. Logs should be left in reserves as these store carbon, provide habitat and do not contribute to fine fuel loads.

2.4 Spread of feral species and the loss of native species and habitat

The vegetation structure and composition has changed markedly since European settlement and a large number of indigenous species that occurred at that time no longer occur in the reserves. In the southern hills face reserves, native flora now occurs in weedy patches of low species diversity or as scattered individuals in weed dominated areas and a considerable amount of shelter for wildlife is provided by patches of feral plants. Land management actions aimed at altering the composition and structure of vegetation, have the potential to damage native flora, and will inevitably lead to a change in the habitat values of the reserve. Management activities must therefore be performed in a way that achieves desired reduction in feral vegetation and fuel loading while conserving indigenous flora and habitat.

Damage to flora can arise through herbicide spraying, brush-cutting and burning. Of these, the most damaging is herbicide spraying. Even if native flora is not damaged, habitat will be reduced or altered by management actions. It must be recognised that thick vegetation, leaf and bark litter, and dead tree trunks and logs all provide habitat for wildlife and management should always be of a patchy nature so as not to impact on habitat beyond the capacity of wildlife to recover.

Issues pertaining to the conservation of the native flora and fauna of Burnside are discussed in more detail in the Biodiversity Strategy.

As the hills face reserves constitute the largest area of relatively undeveloped land in Burnside, management must aim to provide habitat for the many species of wildlife that could otherwise not survive in Burnside. Loss of biodiversity is always a risk of land management activity.

Habitat consists of the following components:

- diversity of indigenous plant species and plant forms
- sufficient areas to provide support for viable populations
- linkage between areas to enable re-colonisation from unburnt areas after fire
- dead trees and course woody debris (logs and large fallen branches
- leaf litter

A list of wildlife records is presented in the City of Burnside Biodiversity Strategy. No specific wildlife survey has been commissioned for the reserves at Mt

Osmond but some recent observations reported by volunteers include Koala, Brush-tail Possum, Ring-tail Possum, Western Grey Kangaroo, Echidna, Scrub Wren, Fairy Wren, Crescent Honey-eater, Yellow-tailed Black Cockatoo and Spotted Pardalote.

Introduced animal species cause some problems in the reserves. Foxes, deer, cats and dogs all need to be managed through NRM Board and Council authorised officers.

Whereas, for complete fire safety, a landscape would need to be absolutely free of vegetation; habitat provision, erosion prevention and flood minimisation all require a vegetated landscape. For long-term habitat maintenance, a certain degree of fuel management is necessary to prevent the development of very hot fires that could kill trees and wildlife and to keep many flora species healthy and regenerating.

The first survey of vegetation of the southern hills face reserves occurred as part of the 1996 “Mt Osmond Reserves Action Plan”. No intact native vegetation was found in the reserves but rather a range of indigenous species (54 in total) surviving at sites invaded by many competitive exotic species. Five areas were identified as “Bushcare sites” where the density of native flora was greatest. Trees for Life volunteers have made a considerable effort over the years and have made a difference to these sites. More assistance from skilled field workers will be needed to enable these sites to be fully restored.

The distribution of native flora in the reserves has not changed much although the incidence of some species has reduced (eg, *Stackhousia monogyna, Kennedia prostrata*) and some initially represented by one individual appear to not be there anymore (eg, *Hibbertia* species and *Parietaria debilis*)

Recommendations 13: It is recommended that the following precautions are taken in order to protect habitat during management operations:

- Management actions should only be undertaken after consideration of the effect on the native species present
- Trials are conducted to determine the burning regimes required to reduce weeds and thatch in native vegetation areas and benefit native flora.
- Council should work closely with Trees for Life and CFS in the conduct of burning trials in Bush for Life sites.
- Burning should be done to create a patchy vegetation structure with unburned areas providing refuge for wildlife (including invertebrates).
- Woody weed removal should be done thoroughly, area by area, with appropriate habitat flora established as soon as the site is ready.
- Unless constituting a safety hazard, the trunks and branches of dead trees should be retained as habitat, either as standing dead trees or as logs on the surface.

2.5 Injury to visitors and workers

Risks to visitors arise from:

- Snakes
- Bees and wasps
- Trips and falls
- Collisions between trail users
- Fire

Over the last 10 years, trails have been constructed to provide safe access for staff and contractors as well as access for recreational walkers. The trail network that has now been developed in the Mt Osmond area is well used by residents. Where trails are used for mountain bike riding there is potential for conflict between walkers and riders. The existing trail network was not designed and funded to accommodate mountain bike riding and a trails plan is needed to address trail provision and management to accommodate different trail uses.

> **Recommendation 14:** It is recommended that a recreational trails plan is prepared to guide the development and maintenance of recreation and management trails and ancillary infrastructure.

All natural and semi-natural areas will have populations of snakes and biting insects. Workers and visitors need to be made aware of these hazards through signage and training.

> **Recommendation 15**: It is recommended that bee and wasp nests in proximity to trails are removed.

> **Recommendation 16**: It is recommended that all reserves are adequately signed with hazard warnings for snakes, fire, mines, cliffs and steep slopes.

Extra risks arise to field workers from the presence of steep slopes and rocky outcrops and the use of mechanical equipment. In winter, exposed wet rocks are very slippery and in summer, dry grass, particularly if cut, is also very slippery. Any manual work on slopes is hazardous and, beyond a slope of 45° and near drop-offs, it will be necessary for field workers to use a rope and safety harness. Council Standard Work Method “Working on Slopes” contains a map of these areas.

> **Recommendation 17**: It is recommended that rope anchor points are established above steep slopes in reserves to facilitate safe management access to steep slopes.

There is a danger to visitors to reserves should a fire occur in a reserve on a day of extreme fire danger. A system is needed for restricting access to reserves on days of extreme fire danger.

> **Recommendation 18**: It is recommended that advice is sought to determine a Fire Danger Index trigger point higher than which reserves will be closed and that a SWM be prepared to document reserve closing procedure.

3. Vegetation

Previous reports detail the vegetation in the reserves. The large scale removal of woody weeds has been undertaken in recent years and the dominant vegetation has now changed in many areas.

Currently the dominant vegetation is a low, open woodland (remnant and revegetated) with some areas still dominated by a low thickets of woody weed species and areas of Aleppo Pine. The understoreys vary from herbaceous and woody weeds to weedy native grass areas. Even the best areas have large infestations of annual weed grasses and forbs.

3.1 Native Flora

The pre-European native vegetation of the hills face reserves consisted of a range of woodland and grassland types:

- Red Gum woodland
- Blue Gum woodland
- Grey Box woodland
- Manna Gum woodland
- Sheoak woodland
- Grasslands

The reserves now contain relict patches of these vegetation communities and are dominated by introduced species.

A total of 54 flora species (see Appendix 1) have been recorded from the reserves which is surprisingly high considering that the reserves have been highly modified by grazing and weed invasion. The understorey has been significantly altered with only a few areas in Themeda, Zig-zag and Danthonia Reserves containing reasonable patches of native grasses and other flora. Much of the original middle level native shrub layer has disappeared with only scattered individuals and small patches persisting. These are mainly *Acacia paradoxa* (Kangaroo Thorn), *Bursaria spinosa* (Sweet Bursaria), *Acacia pycnantha* (Golden Wattle, *Allocasuarina verticillata* (Drooping Sheoak) and *Dodonaea viscosa* (Hopbush). Remnant overstorey species are mainly confined to eucalypts,

including *Eucalyptus microcarpa* (Grey Box), *Eucalyptus leucoxylon* ssp. *leucoxylon* (SA Blue Gum), *Eucalyptus viminalis ssp. viminalis* (Manna Gum), *Eucalyptus camaldulensis* var*. camaldulensis* (Red Gum) and a few *Acacia melanoxylon* (Blackwood).

Most of the *Eucalyptus leucoxylon* in Themeda Reserve was planted in the 1990's and is not of local provenance.

There are three threatened vegetation associations in the reserves:

1. *Themeda triandra* (Kangaroo Grass) +/- *Austrodanthonia* sp. (Wallaby Grass), Tussock Grassland is considered a **Priority 2** association. It is currently poorly conserved and "very rare and endangered" in South Australia (Neagle, 1995). Under the *Provisional List of Threatened Ecosystems of South Australia*, this association is recorded as "highly modified by grazing and weed invasion and with few examples in reserves." The trend is listed as "Declining".

There are only small patches of the association found in the reserves, particularly in the Themeda Reserve. Some of the examples are in moderate condition, but most are poor with a high incidence of weed invasion. The quality of these patches appears to have diminished over the past decade most likely due to weed invasion, plant senescence and the excessive accumulation of litter within and around the tussocks.

Figure 3: Native grassland in Themeda Reserve

2. *Eucalyptus microcarpa* (Grey Box) Grassy Low Woodland is listed as **Priority 4** in Neagle (1995). It is described as poorly conserved and 'much depleted with a few large examples still remaining in South Australia, but many examples have degraded understoreys and/or are currently under

threat.' Under the *Provisional List of Threatened Ecosystems of South Australia*, this association is recorded as "Limited distribution on hills south of Adelaide. Heavily modified by urban spread and associated invasion by exotics. Only a few degraded examples exist within reserves." The trend is listed as "Declining". It is listed under the Commonwealth Environmental Protection and Biodiversity Conservation Act.

There are two remnant patches of *Eucalyptus microcarpa* (Grey Box) Low Woodland in the reserves (Danthonia & Gully reserves). Both are in very poor condition due to the weed dominance in the understorey (see Figures 12 & 18 for locations).

Figure 4: Eucalyptus microcarpa (Grey Box) Grassy Low Woodland in Danthonia Reserve

3. Drooping Sheoak *Allocasuarina verticillata* Grassy Low Woodland, is listed as Vulnerable in South Australia where it occurs on clay loams of low hills (Berkinshaw 2009). This woodland type was originally the predominant vegetation community on the steeper slopes in the southern hills face reserves. It was cleared to fuel the mining industry in the 1840's and 1850's and subsequent grazing prevented any regeneration of the trees. Remnants occur in Zig-zag and Danthonia Reserves.

Figure 5 – *Allocasuarina verticillata* Low Open Woodland, Danthonia Reserve

Recommendation 19: It is recommended that permanent ecological survey quadrats are set up for monitoring the response of flora composition to management actions and that management actions be reviewed in the light of survey results.

3.2 Exotic Flora

Past plans have documented the extent to which the woody exotics (including non-indigenous Australian species) have dominated the landscape in the hills face. In Themeda Reserve for example "almost all the woody vegetation present on the reserve at the time of the survey (August 1995) was exotic" (Crompton, 1996). Since 1995 extensive efforts have gone into removing and managing the woody weeds in the southern hills face reserves whilst also focussing on slashing the weedy understorey to reduce fuel levels and protect native species and revegetation.

Woody Weeds

The main species which have been extensively targeted are *Olea europaea* (Olive), *Pinus halepensis* (Aleppo Pine), *Crataegus sp.* (Hawthorn) and *Rubus fruticosus* (Blackberry). Many of the other species listed in Appendix 1 are not as widespread or possess a high weed potential. Species such as *Erica arborea* (Erica) was also targeted following the development of the *Mount Osmond*

Reserves Action Plan (1996) because of its high weed potential and very small distribution.

The control of woody species has been successful in many areas and follow up maintenance is ongoing to minimise reestablishment. However, there are areas in Gully and Zig-zag Reserves which still have high densities of Pines and Olives and are yet to be managed. The most weed infested areas are difficult to access.

Aleppo Pine needs to be carefully managed. (See figure 6).This species is an important food source for Yellow-tailed Black Cockatoos which are much loved by many residents. The main infestation is in Gully Reserve. It is proposed to consult with local residents to determine a defined patch to be maintained in the reserve until alternative food sources have been established. Maintaining a patch of Aleppo Pine will require the trees to be pruned to 3m above the ground and grass always cut low around them to ensure that no crown fire can develop. Scattered pines elsewhere should be removed.

In the 1980's, following the Ash Wednesday fire, many non-local Australian species were used in revegetation programs and some of these species have shown a high weed potential by self perpetuating eg. *Melaleuca armillaris* (Bracelet Honey Myrtle), *Hakea laurina* (Pincushion hakea) and *Acacia baileyana* (Cootamundra Wattle). These species have been removed whereas other species less likely to spread including *Eucalyptus citriodora.* (Lemon scented gum) and *Eucalyptus cladocalyx* (Sugar Gum) are should be contained but are a lower priority for removal.

Figure 6: Aleppo Pine in Gully Reserve

Herbaceous Weeds

Herbaceous exotic species have proliferated in recent times in all areas where woody weed control has been undertaken. Management of these species has been a low priority during the large scale woody weed control operations partly because overall density has been low and the fact that woody species were significantly contributing to high fuel loads. More recently it has become apparent that, in the absence of the dense woody cover, there has been an increase in the extent and density of herbaceous weeds. Much of this is primarily due to an increase in sunlight levels in addition to greater moisture and nutrients in the soil. The extensive spread of these species is contributing to substantial increases in fuel levels, competition and displacement of native species and overall reductions in biodiversity. The most serious of these species includes *Scabiosa atropurpurea* (Scabious), *Lathyrus tingitanus* (Tangier Pea), *Foeniculum vulgare* (Fennel), *Euphorbia terracina* (False caper), *Senecio pterophorus* (African Daisy) and *Cynara cardunculus* (Artichoke thistle). Two species that were recognised earlier as a high priority for control included *Myrsiphyllum asparagoides* (Bridal Creeper) and *Pennisetum macrourum* (Fountain grass). These have been removed but vigilance is required.

Monadenia (African Weed Orchid) occurs in the reserves, particularly at the northern end of Themeda Reserve, along the Old Bullock Track and near the southern end of Danthonia Reserve. Annual patrols have been undertaken for this species for the last 6 years. Numbers are much reduced but persistence is still required to eradicate this species from Burnside reserves.

Control of the herbaceous species in the reserves is currently recognised as one of the highest priority objectives of this plan.

Figure 7: Examples of herbaceous weed dominance on the understorey

Grassy Weeds

The main grassy weed species in the reserves include a combination of annual species eg *Avena fatua* (Wild oats) and *Ehrharta longifolia* (Veldt Grass) and perennial species eg *Dactylis glomeratus* (Cocksfoot grass), and *Piptatherum miliaceum* (Rice millet). These species are relatively widespread, and in some areas contribute significantly to ground fuel levels. As annual plants die and dry off, they accumulate on the ground along with slashed materials. Years of accumulated grassy material can form a dense 'thatch', which not only presents a high fuel level, but can also reduce native seeds from germinating (Prescott pers. comm.). Thatch can also smother the crowns of native species and cause death in prolonged wet weather. The use of fire to reduce thatch build-up is an important component of this plan.

Figure 8: Example of grassy weed dominance in the understorey

Recommendation 20: It is recommended that the following priorities are applied to weed management in reserves:

- Woody weeds will be removed, area by area, from all reserves, starting in fuel hazard reduction zones and areas of higher quality native flora.
- Herbaceous weeds will be removed, area by area, using selective herbicides and follow-up, starting in areas of higher quality native flora and fuel reduction zones.
- Perennial grass weeds will be removed by spot spraying and follow-up wherever they occur in reserves.
- Unless an appropriate selective herbicide becomes available, where annual grass weeds occur in higher quality native flora areas, control will be undertaking with a combination of fire, slashing and follow-up hand weeding.

3.3 Vegetation Mapping

Vegetation in the southern hills face reserves was first mapped in 1996. The vegetation types, condition and plant density have been re-assessed by EBS and recorded on GIS to provide a format for easy review and updating in the future. The following codes were used to assess canopy density and overall vegetation condition.

Density was measured according to canopy cover estimates using the following code:

Table 1: Canopy Cover Code

Code	Density
1	Very sparse (<10% cover)
2	Sparse (10% - 30% cover)
3	Mid dense (30% - 70% cover)
4	Dense (70% - 100% cover)

Vegetation condition was assessed according to levels of weed infestation and the proportion of native species present.

Table 2: Condition Ratings used to rate vegetation communities across the project area

Condition Rating	Overview Condition	Description
1	Largely undisturbed	No exotic species in the understorey. Close to pre-European condition.
2	Good / intact structure	Few exotic species in the understorey and very low densities of those species. High proportion of pre-European native species represented.
3	Moderate	Exotic species prominent in the understorey. Either many different species or widespread infestation throughout, however native species are still dominant.
4	Poor / Highly modified	Either high number of many exotic species or high density of few exotic species. Exotic species dominate the understorey. High levels of exotic species are inhibiting native understorey species recruitment.
5	Very Poor / residual	The understorey consists of only exotic species.
(adapted from '*Guide To Roadside Vegetation Survey Methodology for South Australia*', Stokes et al 1998)		

Distinct areas within each reserve are labelled with a number. Each number corresponds to a table in Appendix 2 showing, for that mapped area, dominant vegetation association, overall health / condition and density of canopy.

Figure 9: Themeda Reserve Vegetation

Vegetation Associations

1 El / Av LW 5-2
2 El / Av LW 4-2
3 E / Av LW 4-2
4 O I Cm LW 5-1
5 O, El, Cm, Chm LW 5-2
6 El, Av, Ap LW 3-2
7 O, Cm LW 5-2
8 El / Av LW 3-2
9 E W 5-2
10 El / Av LW 5-2
11 P / Cm W 5-3
12 El, Av, Ap LW 4-2
13 El, Av, Ap LW3-2
14 El, Av, Ap, O, Cm LW 5-2
15 El / Av LW 5-2
16 El, Av, Ap LW 5-2
17 E, El, Av LW 5-3
18 E, El, Av, A LW 5-2
19 Cm LW 5-3
20 El / Av LW 2-2
21 El, Cm, O LW 5-2
22 H 5-1
23 P, El, Cm W 5-2
24 El, Av, P, O LW 5-2
25 E, Ap, Av LW 5-1
26 El, Av, Ap, E LW 5-2
27 E OF 4-3
28 Cm, El, Av LW 5-3
29 Ev OF 2-3
30 Cm / O LW 5-3
31 E OF 2-3

Codes

W = Woodland
LW = Low Woodland
OF = Open Forest

A = Acacia sp. (Wattle)
Ap = Acacia pycnantha (Golden Wattle)
Av = Allocasuarina verticillata (Drooping Sheoak)
Chm = Chrysanthemoides monilifera (Boneseed)
Cm = Crataegus monogyna (Hawthorn)
E = Mixed Eucalyptus sp.
El = Eucalyptus leucoxylon ssp. leucoxylon (SA Blue Gum)
Ev = Eucalyptus viminalis ssp. viminalis (Manna Gum)
H = Herbaceous weed growth
O = Olea europaea (Olive)
P = Pinus sp. (Pine)

5-2 = Condition - Canopy Density

Condition
1 = Largely undisturbed
2 = Good / Intact structure
3 = Moderate
4 = Poor / Highly modified
5 = Very Poor / residual

Canopy Density
1 = Very sparse (<10% cover)
2 = Sparse (10% - 30% cover)
3 = Mid dense (30% - 70% cover)
4 = Dense (70% - 100% cover)

Figure 10. Gully and Wheal Gawler Mine Reserves vegetation

Vegetation Associations

1 E / Av LW 5-2
2 E, Hl, Ap, Ma W 4-3
3 Av, Ma, Ap, Am LW 5-2
4 E, Av, Ap LW 5-3
5 E, Av, Ap, Dv LW 5-2
6 Al, Al, C W 5-2
7 O, Ap, E, Ru, Apa, Al, Av LW 5-2
8 Cc, Af, Ap, Apa W 5-3
9 O/El LW 5-1
10 Af LW 5-1
11 O, P, Ap LW 5-2
12 Av LW 5-3
13 H 5-0
14 Av LW 5-2
15 E W 5-2
16 P, O W 5-1
17 E W 3-1
18 O W 3-1
19 P, O, E W 5-3
20 Em W 4-3
21 P W 5-4
22 El W 4-3
23 Fa, P, O, Ru W 5-3
24 P, O W 5-4
25 P, O, E, Apa, Av W 5-1
26 P, O, E W 5-2
27 Av, O LW 4-1
28 Ap LW 5-1
29 O LW 5-3
30 E, Av W 3-2
31 O, E, Ap W 5-2
32 El, Ap, Av, Am W 5-2
33 Ecl OF 4-3
34 El, Cm, O, Ap 5-1
35 El, Ap, Apa, Av W 4-2
36 E, Av OF 5-3
37 E, O, Cm, Ap, Av OF 5-3
38 E, Am, Ap, Av, Ar OF 5-3

Codes

W = Woodland
LW = Low Woodland
OF = Open Forest

Af= Agonis flexuosa (Willow Myrtle)
Al= Acacia longifolia ssp longifolia (Sallow Wattle),
Am= Acacia melanoxylon (Blackwood)
Ap = Acacia pycnantha (Golden Wattle)
Apa= Acacia paradoxa (Kangaroo Thorn)
Ar=Acacia retinodes var. retinodes (Swamp Wattle)
Av = Allocasuarina verticillata (Drooping Sheoak)
C= Acacia longifolia ssp longifolia (Sallow Wattle)
Cc= Corymbia citriodora (Lemon-scented Gum)
Dv= Dodonaea viscosa ssp. spatulata (Sticky Hop-bush)
E = Mixed Eucalyptus sp.
Ecl= Eucalyptus cladocalyx (Sugar Gum)
El = Eucalyptus leucoxylon ssp. leucoxylon (SA Blue Gum)
Fa= Fraxinus angustifolia (Desert Ash)
H = Herbaceous weed growth
Hl= Hakea laurina (Pincushion Hakea)
Ma= Melaleuca armillaris (Bracelet Honey-myrtle)
O = Olea europaea (Olive)
P = Pinus sp. (Pine)
Ru= Rubus ulmifolius var. ulmifolius (Blackberry)

5-2 = Condition - Canopy Density

Condition
1 = Largely undisturbed
2 = Good / intact structure
3 = Moderate
4 = Poor / Highly modified
5 = Very Poor / residual

Canopy Density
1 = Very sparse (<10% cover)
2 = Sparse (10% - 30% cover)
3 = Mid dense (30% - 70% cover)
4 = Dense (70% - 100% cover)

Figure 11. Zig-zag and Chimney reserves vegetation

Vegetation Associations

1Ec, O, Am CF 5-4
2Ec, O, P, Cm CF 4-4
3Fa, O, P, R OW 5-3
4Av, P OF 3-3
5O, P, Fa CF 5-4
6O, P OF 5-3
7E, Ec, Oe, Av, P W 5-2

Reserve boundary

Veg. Association boundary

Codes

W = Woodland
OW = Open Woodland
OF = Open Forest
CF = Closed Forest

Am = Acacia melanoxylon (Blackwood)
Av = Allocasuarina verticillata (Drooping Sheoak)
Cm = and Crataegus monogyna 'Hawthorn)
E = Mixed Eucalyptus sp. (Eucalypt)
Ec = Eucalyptus camaldulensis var. camaldulensis (Red Gum)
Fa = Fraxinus angustifolia (Desert Ash)
O = Olea europaea (Olive)
P = Pinus sp. (Pine)

5-2 = Condition - Canopy Density

Condition
1 = Largely undisturbed
2 = Good / intact structure
3 = Moderate
4 = Poor / Highly modified
5 = Very Poor / residual

Canopy Density
1 = Very sparse (<10% cover)
2 = Sparse (10% - 30% cover)
3 = Mid dense (30% - 70% cover)
4 = Dense (70% - 100% cover)

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Figure 12. Danthonia Reserve vegetation

4. Vegetation Management

4.1 Vision

The hills face landscape that best matches the desired management objectives will have the following features:

- Fuel hazard reduction areas defined to include;
    - the existing 10 metre boundary buffer zone adjoining residential properties maintained at low to very low overall fire fuel rating;
    - land within 100 metre downhill of dwellings maintained at low overall fire fuel rating;
    - land within 20 metre uphill from dwellings maintained at low overall fire fuel rating; and
    - the balance of reserves to have no higher than a moderate overall fire fuel rating.
- Open indigenous tree canopy with;
    - few to no trees within 20 metre of property boundaries;
    - trees within fire hazard reduction areas having their crowns lifted to greater than 2 metres; and
    - tree canopy patchy with gaps and open spaces.

- Shrubs;
    - in widely-spaced groups;
    - absent within 10 metre of property boundaries;
    - sparse in the fuel hazard reduction areas; and
    - in clumps outside the fuel hazard reductions area but still consistent with a moderate or better overall fuel hazard rating.

- Ground covered with native grasses and wildflowers managed by fire and slashing to prevent fuel accumulation.

- A trails network which break the reserves into convenient management units.

Although, the fire fuel loading standards must be met, there is plenty of scope in this vision to create uplifting landscapes which residents will value highly. The open areas can be developed into diverse native grasslands with a diversity of wildflowers. These areas will be habitat for butterflies and other insects as well as small lizards and grassland birds. In the woodlands there will be a patchy shrub layer of sufficient density, particularly away from the fuel reduced zones to provide habitat for a range of small woodland bird. Paths will link areas so that all the flora and woodland types can be viewed to advantage.

4.2 Approaches

Slashing

Slashing is currently undertaken to:

- lower the potential fire hazard;
- maintain access along fire tracks;
- create fire breaks along roadsides and buffer zones; and

- promote biodiversity.

Slashing is a labour intensive exercise, particularly for those areas of difficult terrain. *It costs approximately $3000 to slash 1ha with a brush-cutter.* The amount of effort required to control the weeds is also increasing as the herbaceous weeds grow thickly in areas where woody weeds have been removed. The *District Bushfire Prevention Plan* recommends that slashing should be undertaken more than once a year, particularly if seasonal conditions favour growth throughout the year (City of Burnside, 2006). The extension of the present 10 metres boundary buffer zone to include all areas within 100 metres of a dwelling will considerably increase the labour required.

In relation to fuel reduction, an important issue worth serious consideration is removal of the litter following slashing, particularly when the weed biomass is heavy. Following slashing, a dense thatch or mulch has the potential to form on the surface.

The problems associated with high levels of litter accumulation are;

- high ground fuel levels;
- potential smothering and rotting of native plants;
- reduction in natural regeneration of indigenous flora; and
- high nutrients from litter decomposition (Eddy, 2002; Davies, 1997).

It is therefore important for future management to address litter accumulation. The practicality of manual collection over such a large area is not realistic and the steep terrain makes the use of alternative types of slashers (which distribute the defoliated materials thinly and more evenly over the surface) difficult. The practice of low intensity burning may provide an effective tool to assist in the reduction of surface fuel loads.

Figure 13: Surface accumulation of slashed materials

In addition to bushfire issues, Council's slashing program is aimed at promoting and preserving local biodiversity. Indigenous flora in the reserves is compromised by the

aggressive growth and invasion of weeds. The proliferation of grassy and herbaceous weed species in recent times is now more evident since the removal of woody exotics. In many areas small pockets of native grasses and other low growing native plants were able to persist amongst the dense canopies of the woody weeds. However, since the widespread woody weed control many of those native populations have been rapidly invaded and this is directly leading to the degradation and ultimate displacement of the native populations.

Another issue includes the progressive degradation of native grasslands through senescence. Current thinking is that some level of grass defoliation is important in the promotion of healthy native grasslands (WWF, 1999). Native grasses have the ability to tolerate slashing, however they must be allowed a period for regrowth between slashings (WWF, 1999) and this is where the timing of slashing is important. Robertson (1984) reported that over 10 years of early summer mowing/slashing resulted in large increase in density of *Themeda triandra* (Kangaroo Grass), *Austrodanthonia* spp. (Wallaby Grass) and *Austrostipa* spp. (Spear Grass) and a proportionate decrease in areas dominated by annual exotics.

The frequency of slashing is also an important factor. There is much evidence to suggest that *Themeda triandra* grasslands require some form of disturbance every 1 to 5 years to avoid senescence (depending on soils and climate) (Bush & Faithfull, 1997). In addition to frequency and timing, litter disposal and height of slash, are also important considerations with respect to biodiversity management. The height of the slash is equally important in promoting a composition and diversity of native plant species in the understorey. The height needs to be sufficient to remove biomass and to reduce seed set of exotic annual grasses, but also to allow for adequate growth and seed set of natives (WWF, 1999)

Over time, an overall reduction in the density of herbaceous and grassy weeds can be achieved through slashing prior to seed setting, (Davies, 1997; Barlow, 1998). There are, however, some problems and limitations associated with slashing. Even shallow rooted annuals usually develop new flowers and seeds after slashing, so, to have much effect, slashing will need to be done several times during the season. Slashing will not be effective at reducing deep rooted perennial weeds. (Davies, 1997).

The southern hills face reserves are generally steep and slashing is done with brush-cutters and is labour intensive and therefore very expensive. All areas that are flat enough to be cut with larger slashing equipment need to be defined and appropriate slashing equipment employed for the task.

Spraying

There is a small trial area at the southern end of Danthonia Reserve where spraying has been employed to bare an area of weed growth and native grass seed has been sown. This method has been shown to be effective if the site is visited frequently enough for 3 years of weed control to ensure that no weed sets seed on the site. Sown native grass has established well and regular patrolling will ensure that weeds do not re-establish in the area. Periodic burning of this area will maintain the area free of thatch build-up and maintain the native grass in healthy condition.
For this approach to be successful;

- the site must be patrolled frequently enough to eliminate all weeds;
- field workers must have sufficient plant recognition skill; and
- erosion from water flowing onto the site from adjacent roads and houses must be controlled.

The results at this site are encouraging and should be continued here and at other sites.

Figure 14: Trial site southern end of Danthonia Reserve – native grass established on thoroughly sprayed site with straw bales used to spread water flows during establishment.

Spraying of weeds needs to be highly selective, especially when conducted in areas containing native vegetation. Choice and dilution rates of chemicals, timing and application methods can all be varied to favour native species. (Barlow, 1998).

The use of selective herbicides for broadleaf and bulbous weed control has been used to a limited extent on hills face reserves. The main trial site for this is on the northern side of Gully Reserve where herbicides are being used to target Scabious and other broad-leaf weeds.

It will be necessary to use a combination of spraying, slashing and/or fire to achieve complete and effective removal of grassy and broadleaf weed cover over large areas.

Weed Hygiene

In order to restrict or prevent further spread of weeds already present and the introduction of new weeds into reserve sites the following procedures should be observed;

- ensure all persons on site are familiar with hygiene protocols and weed identification;
- identify and clearly mark infested and un-infested areas;
- avoid working in the infested areas other than for control reasons;
- undertake all control work before seed is set and avoid working in infested areas at high risk times when mature seed is present;
- undertake all slashing before plants are seeding;
- start all work in un-infested areas and work towards infested areas; and
- clean all machinery, equipment, footwear etc. before leaving infested areas rather than when arriving at infested areas.

Conduct hygiene thoroughly on all equipment (including footwear), machinery and vehicles that have come in contact with infested material. Be particularly vigilant on equipment with tracks or undercarriage protection.

Do not transfer soil, mulch, seed or other material without ensuring that they are free of seeds. Where material can not be left on site, ensure that all potentially infested material is disposed of correctly. Infested material should be burnt or sterilised.

Three methods can be used for cleaning weed seeds and soil from equipment and machinery:

- mechanical – brushes, brooms, crowbars and rods;
- air – compressed air; and
- Water – wash down with water from a hose or high pressure spray equipment, or even a bucket and brush. Make sure water does not run off site. Water usage should be kept to a minimum, therefore remove as much mud, soil and seeds via mechanical and air methods first.

Phytophthora

The die back fungus *Phytophthora* is present in the region. A risk assessment is required to determine appropriate actions for managing *Phytophthora* in the southern hills face reserves.

Fire

Much of Australia's flora has evolved with fire in the natural landscape and can be used as an important biodiversity management tool. The burning of native vegetation in South Australia is classed as vegetation clearance and approval from the Native Vegetation Council (NVC) is required for any prescribed burns. It is anticipated that the information contained in this management plan will assist with NVC approval of all future prescribed burns in the southern hills face reserves.

To date fire has not been used in the southern hills face reserves as a management tool but, as outlined in section 2.1, in degraded grassy vegetation such as occurs in the southern hills face reserves, fire can be used to both reduce fuel hazard and improve vegetation quality. A narrow strip up the north facing slope in Themeda Reserve is regularly burned by the CFS. It appears that this has encouraged the growth of native grasses which are now competing well with the exotic grasses. The area still contains high levels of exotic annual grass, however the native grasses are in much greater densities than surrounding areas. If prescribed burning is employed as a management tool, it is important to monitor all burned areas to track changes in vegetation composition.

As a management tool, fire can be used to;

- reduce fuel loads in the understorey;
- reduce biomass prior to revegetation tasks;
- encourage the growth and recruitment of native grasses & other species; and
- expose the ground for detailed management of regeneration.

A prescribed burn can be effective at completely reducing the understorey biomass unlike slashing which rearranges it. It may be conducted as a single management activity or periodically to stimulate growth of native species and reduce population senescence. In any case, prescribed burns should always be followed by weed control as post-fire weed response is often significant (from soil seed or edge invasion) on new bare ground (Bush & Faithfull, 1997). It will probably be necessary to combine fire with other management techniques to properly follow up prescribed burn events (ie spot spraying). Adequate resources to allow for follow-up activities must be available prior to commencement of a burn.

It will be necessary to have particular parameters in place to indicate when a fuel reduction burn may be necessary. The parameters will need to be hazard based and allow for rapid assessment of the Overall Fuel Hazard. The methodology adapted from the Victorian Overall Fuel Hazard Guide is detailed in the *Overall Fuel Hazard Guide for South Australia* (2006) and has been tailored for use in South Australian conditions. The *Overall Fuel Hazard Guide for South Australia* (2006) contains example photographs.
The Guide aims to assist with;

- defining and identifying the different components of fuel hazard;
- assessing fuel hazard levels for surface, near-surface, elevated and bark fuel; and
- integrating fuel hazards components to assess Overall Fuel Hazard (Wouters, 2006),

and should be used to;

- identify fuel hazards during fire management planning;
- identify fuel hazards before and after prescribed burning operations; and
- identify fuel hazards during fire suppression operations (Wouters, 2006).

The procedures for the use of fire need to be developed in consultation with CFS. Matters to be determined are;

- the amount of assistance possible from CFS;
- the development of Standard Work Procedures;
- staff levels, training and equipment; and
- EPA permission for less restriction on burning in cool season.

The general procedure will have the following features although refined with consultation and experience:

- In spring, grass areas can be cut and burned when dried off as part of native grass re-establishment and annual grass weed control.
- In late spring/early summer any rank weedy areas in the fuel hazard reduction zone will be burned off. This will be undertaken by the CFS.
- In autumn, patches of higher quality native grassland will be burned. The purpose is to reduce thatch and to reduce germinating weeds. This will be

done on dry days after the end of the fire danger season, after the first rains have germinated annual weed seeds. Areas will be defined with existing trails or roads as boundaries or boundaries will be created by slashing in advance and wetting down prior to ignition. Any fire sensitive plants in the burning area will be wet down prior to ignition. Fire will be started along and upper boundary and allowed to burn down hill. Staff will have knapsack sprays and a hose from a fire unit if possible.

- Any time outside the fire danger season, piles of cut or collected fine woody material will be burned. Burning sites should be selected to avoid native vegetation. This is done to some extent already and there is a Standard Work Method relating to this activity. Weeds encouraged by burning at these sites will be controlled in the following growing season.

Grazing

For more than 100 years after European settlement, the land which now comprises the southern hills face reserves was grazed, mostly by sheep.

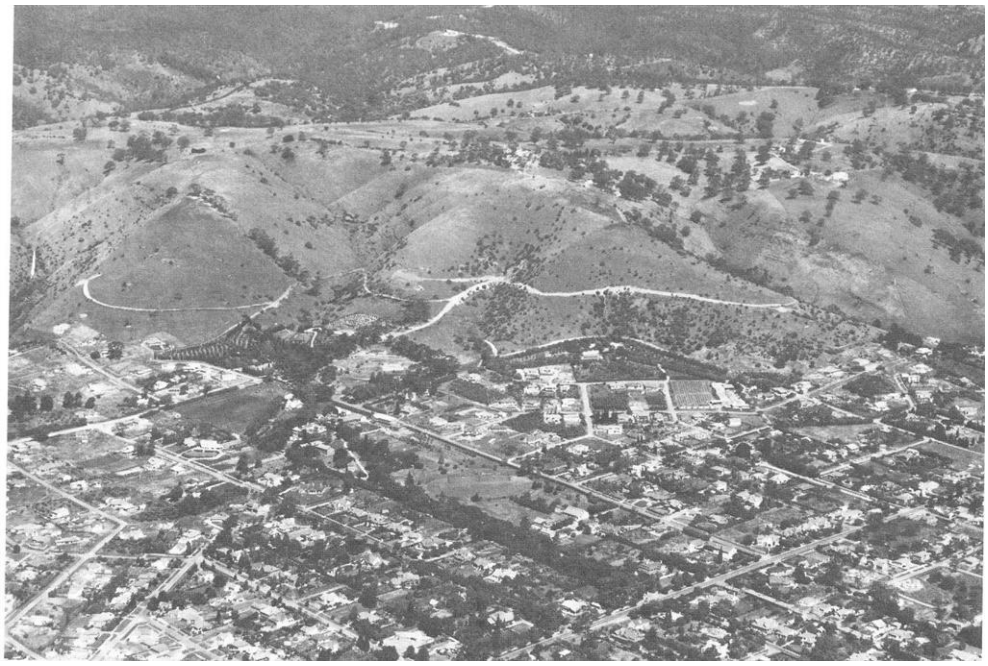

Figure 15 Mt Osmond in 1956
Landscape kept very open after more than 100 years of grazing.

As the land was subdivided in the 1960's, sheep were gradually removed with the last of the sheep taken from Chimney Reserve in the late 1990's. The cessation of grazing has led to the rapid spread of woody weeds and an increase in grass growth. No flora studies exist as a base line so it is not known what effect the cessation of grazing has had on biodiversity.

The option of grazing was not considered in detail in the preparation of this plan because;

- there is a high initial expense of fences (boundary as well as internal fences), yards and sheds;
- access for stock loading and unloading is difficult;
- grazing can have a high impact on biodiversity;
- stock can escape onto roads with the freeway presenting a particular hazard;
- proximity to urban areas greatly increases the risk of dog attack;

- livestock management requires daily attention which will be expensive whether this is done by staff or a contractor; and
- the land is very steep and difficult to manage as a livestock operation.

Grazing may be an option if proposed management actions do not adequately address fire and weed control issues at particular locations.

Tree establishment
At the end of the 19th century the land had been cleared of original tree cover and Mr GS Fowler was so worried about the potential for soil erosion on Mt Osmond that he promoted the planting of the then popular Sugar Gum (*Eucalyptus cladocalyx*) as a way of preventing erosion. Sugar Gum is not a local species and has now become weedy in Gully Reserve.

In the 1970's and 1980's, the hills face reserves were used as a location to plant trees that were surplus to requirements from the Council nursery. The species planted were mostly Australian in origin but not local to the area. Several of these have become feral and have been treated more recently as woody weeds. Plantings from this time have largely been removed from Themeda Reserve although large numbers of these plantings remain in Gully Reserve.

The first plantings intended to conform to the 1996 management plan were the widely spaced *Eucalyptus leucoxylon* in Themeda Reserve. These were planted as part of a LEAP (Federal Government Landcare and Environment Action Program) project but were not of local provenance.

With the formation of the Conservation and Land Management program at Burnside Council local plants have been propagated at the council nursery and planted in the hills face reserves. Although there have been some plantings occuring through free-lance volunteering, most of the plantings since 2000 have been aimed at establishing an open woodland structure to suppress weed growth. The numbers of trees required is quite limited and so Council has not participated in large scale tree planting projects such as National Tree Day and the One Million Trees Program.

Tree establishment will continue in appropriate locations but to comply with the recommendation to achieve low fire fuel hazard within 100m of dwellings, some thinning of trees and under-pruning will be required.

4.3 Principles

Management actions need to take into account the composition and the structure of the vegetation being managed:

- Areas that are all exotic species (with scattered native grass and colonising species) can be cut or burned as often as is needed for fire hazard reduction purposes without damage to native flora:
- Any native sub-shrub individuals should be protected from fire during burning, (*Astroloma, Pimelea, Vittadinia*):
- Young trees in appropriate locations should be protected during prescribed burns:
- Areas containing native grass, but no non-grass native species, can be burned up to once a year. Trial burns should be conducted to determine the effect on

weed populations - after the first rain in autumn when weed seeds have germinated or cut in spring before annuals set seed and burn when cut material is dry enough to burn. This form of management will probably of most use in the 10m fuel reduced buffer zone adjacent to property boundaries:

- Areas where deciduous species of non-grass herbaceous native flora is present, (ie species that survive summer underground as tubers or rhizomes) can be burned in autumn before the emergence of the native flora:
- Patches should be left unburned as a refuge for insects and native flora species:
- When thinning and pruning trees and shrubs, and when collecting dead fallen branches and twigs, make small piles of material and burn outside the fire danger season:
- Leave dead trunks for habitat after cutting off the smaller dead branches:
- Glyphosate herbicide is to be used only for spot spraying particular weeds or for area spraying as the first step in the long and intensive process of converting weed vegetation to native vegetation:
- Broadleaf specific herbicides are to be used to control broad leaf and bulbous weeds but all native plants other than grasses must be located and protected:
- Herbicides are only to be used where adequate follow-up is assured:
- With the exception of small refuge areas and very steep, inaccessible places, all unburned areas in the fuel reduction zones will be slashed prior to the bushfire danger season:
- Due to site steepness, most of the area will necessarily be slashed with a brush-cutter but to save labour, sufficiently flat areas need to be defined and appropriate equipment acquired to cut these areas more quickly:

In all cases, the need to protect sub-shrubs from fire is due to local rarity and it would be desirable to burn close to remnants individuals in the hope that some regeneration might result.

It is expected that burning will result in an improvement in vegetation condition but monitoring will be required to assess the effects of burning and all burned sites will need to be thoroughly patrolled for weed germination.

With past management emphasising fuel hazard reduction, detailed vegetation management has not been undertaken in the southern hills face reserves apart from some voluntary work by Trees for Life volunteers at Bush for Life sites.

A well planned burning regime will reduce the amount of grass cutting necessary and free resources to undertake vegetation restoration in reserves.

Vegetation restoration occurs in three phases:

1. Removal of major weeds and developing appropriate canopy:

   This has been the major management focus in the reserves for the last 10 years. Most major weed infestations are dealt with but some remain and there is still a lot of follow-up to do. Most of the replacement native canopy has now been established:

2. Basic management of canopy and ground flora:

   As the canopy develops, trees will need to be thinned and pruned to develop the desired canopy form. The canopy in the fuel hazard reduction zone will have no branches below head height, no fine dead branches and twigs on the

ground, trees single or in small groups with large gaps in the canopy. Dead wood will need to be managed with fine material collected and burned. In this context, fine fuel is defined as plant material 6mm in diameter or less. Ground flora management has to date been limited to brush-cutting in the 10m boundary buffer initiated after the Maguire report (1995) and extending this into the reserves, particularly along walking trails in areas of tree planting. This work will need to be extended to all the fuel hazard reduction zones proposed by Leading Emergency Services (2009). Learning to use fire to manage the ground vegetation is a major recommendation of this plan:

3. Improving the composition of ground flora:

   Gradually over many years, defined areas need to be managed intensively to, as near as possible, eliminate weeds. This will require some trial work but will be based on the methods that have been shown to be successful at urban biodiversity sites in Burnside. The first area where an attempt at vegetation conversion is being made is at the southern end of Danthonia Reserve. Results are promising, with problems arising from a mismatch between site requirements for small and timely work inputs and contractors' requirements for infrequent large jobs. The development of a hills face vegetation CALM field team will overcome this problem.

4.4 Actions

The management actions required to achieve the landscape vision (section 3.4) will have the following components:

- Woody weeds should be treated and followed up throughout the reserve system on a staged basis to minimise disruption to native birds. Primary clearance is not to take place when birds are nesting:
- Dead twiggy material removed from the ground and to a height of 2m, concentrating on material 6mm diameter of less (fine fuel):
- Dead material should be burned at weedy locations where native grass patches will not be affected:
- Indigenous tree canopy species, selected to match the physical environment, should be established as woody weeds removed:
- Trees crown lifted within 100m of dwellings that are uphill from reserves and within 20m of dwellings that are downhill from reserves:
- Introduced perennial grasses should be spot sprayed throughout reserve system and followed up:
- Broad leaf herbaceous weeds should be sprayed throughout the reserve system with selective herbicide and followed up:
- Indigenous shrubs should be planted in well spaced groups well away from property boundaries – very sparse in fuel hazard reduction areas and consistent with a moderate overall fuel hazard rating or better outside the fuel reduction areas:
- Highest quality native grassland areas should be carefully weeded or spot sprayed by staff or trained volunteers:
- Introduced grasses should be eliminated on an area by area basis and replacement by native herbage (bite and hold strategy):
- 10m boundary buffer zones should cut with brush-cutter or burned as appropriate in spring and in early summer, native broad-leaf plants should be avoided:

- An Autumn patch burning regime should be established to ensure that all areas get burned approx once in 4 or 5 years in the defined fuel reduction areas:
- Trails should be maintained to ensure cross fall, battering, and grass on side should be cut 3 times per year or sprayed with herbicide where appropriate to reduce the cutting requirement:
- Trails should be constructed in locations required for management:
- Sediment entering reserves in storm water should be trapped and removed:
- Appropriate vegetation should be developed in areas of storm water flow:
- Diverse native vegetation should be developed outside the fuel reduced zones provided that the overall fire fuel standard is met.

Recommendation 21: It is recommended that the principles and practices of vegetation management outlined in sections 4.1 to 4.4 are incorporated into Standard Work Method documentation for land management tasks.

4.5 Rubbish Dumping

Rubbish dumping is a minor but important issue in the reserves. Dumped rubbish smothers native flora, adds nutrients, adds weeds and increases fire hazard. Rubbish should be removed carefully without damaging native flora.

Littering is generally associated with car parking. It takes the form of fast food packaging and dog waste in black plastic bags. Visitation will be addressed in the proposed Burnside Recreational Trails Plan, consideration will be given to the issues associated with car parking including litter.

Recommendation 22: It is recommended that council informs adjoining landholders of the weed, conservation and bushfire issues associated with dumping rubbish and, in particular, garden waste.

5. Specific Management Issues

Issues discussed in this section are those which relate specifically to particular reserves. General vegetation management philosophy and practice are discussed in section 4.

5.1 Themeda Reserve

Figure 16: General view of Themeda Reserve from eastern end.
Infestation of Scabious in the foreground.

Remnant Vegetation

The main remnant overstorey and midstorey species are scattered *Eucalyptus leucoxylon* ssp. *leucoxylon* (SA Blue Gum) on the upper parts of the north facing slopes, *Eucalyptus viminalis* ssp. *viminalis* (Manna Gum) in a small area of south facing slope (map area 29) and scattered *Acacia pycnantha* (Golden Wattle). Most of the native vegetation in Themeda Reserve was lost or severely modified over years of grazing followed by heavy weed infestation. Moderately sized patches of degraded native grassland, dominated by Kangaroo Grass (*Themeda triandra*), still persist along the north facing slopes particularly towards the western end, however these are becoming more degraded as weeds proliferate and older native grass plants senesce. At present, the areas of *Themeda* have a lot of accumulated dead material and a burning regime needs to be implemented to improve the quality of these grassland areas. The summer active growth habit of Themeda will have a particular fire suppressing effect when it regrows after burning. Other species still persisting in the reserve include *Convolvulus erubescens* (Australian Bindweed), *Lomandra densiflora* (Pointed Mat-rush), *Goodenia albiflora* (White Goodenia),

Gonocarpus tetragynus (Small-leaf Raspwort), *Stackhousia monogyna* (Creamy Candles) and *Vittadinia cuneata* (New Holland Daisy).
Map area 3 is a Bush for Life site managed largely by volunteers from Trees for Life. This is Themeda grassland in reasonable condition with a range of non-grass herbaceous indigenous species present. Map area 13 contains the largest and least weedy patch of Danthonia grassland on the reserve and it appears that frequent burning by the CFS has assisted the survival and regeneration of the native grass species.

Revegetation
Plantings in Themeda Reserve began in the early 1990s with SA Blue Gum (*Eucalyptus leucoxylon*) of unknown provenance. The growth form, flower and fruit characteristics of this form differ from the indigenous form. To avoid cross pollination with local indigenous SA Blue Gum, these should be gradually removed from the reserve and replaced with the local form of the species. Since the Mt Osmond Reserves Action Plan in 1996, all plantings have been of local provenance and have occurred mainly in the eastern end of the reserve to replace areas of hawthorn that have been removed.

Woody Weeds
Removal of exotic woody weeds has been effective with most of the areas now controlled. There are however, a few areas still infested with Olive and Hawthorn, mainly at the eastern end of the reserve and in the steeper gullies which are almost inaccessible (map areas 5,11,31,30,22,28). Scattered Olive, Pine and Hawthorn trees also persist having either resprouted from cut bases, or plants which are yet to be treated.

Broad Leaf Weeds
In absence of the woody weeds exotic broad leaf species are proliferating. Not only is this creating high fuel levels it is also increasing competition for remnant native species, and reducing the capacity for natural regeneration for all native species, particularly native grasses and low growing species.

These species are currently being controlled in certain areas through slashing but it is mainly confined to the 10m fuel reduced buffer zone identified by Maguire (1995). Slashed weeds are also accumulating on the ground and thereby creating a thick overlying thatch which has the potential to limit natural regeneration and produce high fuel levels.

The African Weed Orchid (*Monodenia bracteata*) occurs at the eastern end of this reserve (map areas 26 and 28). For several years, contractors have been engaged to search and destroy this weed. It is not too late for this weed to be kept from establishing in Burnside.

Grassy Weeds
In many areas of Themeda Reserve exotic grass species are increasing following the removal of woody weeds.

Slashing is currently the primary control technique to limit the biomass of exotic grasses. With careful execution and knowledge of native species, contractors are in most cases avoiding native non-grass species by slashing around the individuals. One of the main disadvantages of slashing is the accumulation of plant material on

the ground surface which has the potential to inhibit seedling recruitment and even smother and kill plants (Eddy, 2002). Decomposition is often very slow in dry climates and the development of a smothering thatch often incorporates grass biomass from multiple seasons of growth. The thatch can also produce high fuel levels although fire does not spread as fast through fuel lying on the ground as it does through standing fuel. Slashing can also spread weeds such as *Pentaschistis* sp (False Hairgrass) and *Hyparrhenia hirta* (Coolatai Grass). Both of these species have appeared on the reserve and have been removed.
Vegetation Area 13 is regularly burned and this has encouraged the growth of *Austrodanthonia* sp. (Wallaby Grass) coupled with a marked decrease in the growth of *Avena* sp. (Wild Oats).

Bush for Life sites

There is one Bush for Life site on Themeda Reserve which is located on the upper slopes in the western end of the reserve. It is an area relatively rich in native grasses and wildflower species. There is a need for council staff and contractors to work more closely with the volunteers so that everyone's work has the most effect.

Residential Boundaries - encroachments

An adjoining landholder located on the southern boundary of the reserve has fenced part of the reserve into their property. This was done in 2002 and still has not been resolved. A clear procedure and responsibility needs to be defined for dealing with private encroachments into reserves and the fence should be placed on the correct alignment.

Access

There is adequate vehicle access but, as an aid to management, additional pedestrian trails need to be constructed for access into the reserve. One is needed along the northern boundary and a loop is needed in the eastern end of the reserve below Hayward Drive.

Recommendation 23: It is recommended that, in relation to Themeda Reserve;

- management trails are constructed along the northern boundary and below Hayward Drive;
- the use of fire is investigated to create the 10m very low fuel boundary buffer in late spring;
- complete primary clearance of woody weeds is undertaken in the eastern end of the reserve and from gullies;
- non–indigenous SA Blue Gum and Sugar Gum are phased out over a number of years;
- African Weed Orchid and any other threatening weeds are eliminated from the reserve; and
- the encroachment issue is resolved.

5.2 Gully & Wheal Gawler Mine Reserves

Figure 17: Gully & Wheal Gawler Mine Reserve from western end.

Remnant Vegetation

The majority of the native vegetation within Gully & Wheal Gawler Mine Reserves was lost or severely modified during decades of grazing, wood-cutting and subsequent weed invasion.

Remnant vegetation includes a small isolated patch of *Eucalyptus microcarpa* (Grey Box) grassy Woodland (map area 20), small remnant patches of *Allocasuarina verticillata* (Drooping Sheoak) (map area 12) and a small patch of *Eucalyptus leucoxylon* ssp *leucoxylon* (South Australia Blue Gum) in map area 22. Both these areas are degraded by weeds in the understorey.

There are also scattered individual specimens of *Acacia melanoxylon* (Blackwood), *Eucalyptus leucoxylon* ssp. *leucoxylon* (SA Blue Gum), *Acacia pycnantha* (Golden Wattle) and *Bursaria spinosa* (Sweet Bursaria). *Austrodanthonia* sp. (Wallaby Grass) was found dominating small areas on the south-western slopes and also small patches of *Poa* sp (Tussock grass). Other native grassy areas include *Themeda triandra* (Kangaroo Grass) and *Austrostipa* sp. (Spear Grass) and *Paspalidium jubiflorum* (Warrego Summer Grass) on the north-western facing slopes. *Enneapogon nigricans* (Black-head Grass) is widespread in the reserve and it occurs in a particularly good patch in map area 17, above the fire track at the western end of the reserve.

The most diverse indigenous ground cover vegetation occurs near the upper adit in the Wheal Gawler Mine Reserve. Species include *Goodenia albiflora*, *Goodenia pinnatifida, Calostemma purpurea* and *Wahlenbergia sp*. (map area 27).

Relics of two threatened plant communities occur in Gully Reserve. A small patch of *Eucalyptus microcarpa* (Grey Box) Grassy Woodland is located at map area 20. This patch is highly degraded due to a high level of weed invasion in the understorey and being completely surrounded by dense woody weeds. There is a small area of *Allocasuarina verticillata* (Drooping Sheoak) woodland (map area 12) and scattered relicts of this woodland in map area 14.

Figure 18: Remnant Drooping Sheoak (*Allocasuarina verticillata*) in Gully Reserve

Revegetation

Many areas have been planted with a variety of local species (Table 4 in Appendix 1 for full list).

The most obvious vegetation component in the reserve is the stand of Sugar Gum (*Eucalyptus cladocalyx*) at the western end of the reserve (map area 36). The trees in this stand have sown themselves from the original trees planted along the reserve boundary in the 1890's. Other plantings occurred in the 1980's and these are mainly non-local native species including Platypus Gum (*Eucalyptus platypus*), Spotted Gum (*Corymbia maculata*), Bracelet Honeymyrtle (*Melaleuca armillaris*) and Pin Cushion Hakea (*Hakea laurina*), (map area 2). These species are self-propagating and becoming weedy.

Revegetation with the local species *Hakea carinata* has been aimed at providing a food source for Yellow-tailed Black Cockatoos as Aleppo Pine is gradually removed from the reserve.

Over a period of 9 years, one volunteer has cleared woody weeds and propagated and established replacement vegetation in map area 35. Some other weedy areas have been planted thickly with *Acacia pycnantha* (Golden Wattle) and *Allocasuarina verticillata* (Drooping Sheoak) to provide competition for weeds. Planting density is determined by the density of weeds, quality of native flora present and distance from residential properties. The effect of planting density on vegetation composition needs to be monitored. To maintain a low fire hazard rating as recommended by Leading Emergency Services (2009), this approach should only be used outside the 100m buffer zone.

Figure 19: Revegetation in Gully Reserve – Drooping Sheoak suppressing weeds

There is some revegetation in map area 1 that has occurred inside the fuel hazard reduction zone. This patch of shrubs needs to be thinned in the future to maintain a low fire hazard.

This reserve is the largest in the southern hills face area and has considerable areas that are further than 100m from houses. This offers plenty of scope for habitat development and for the creation of attractive local landscapes. The waterfall and hanging rock features have been recognised as having particular potential. The presence of field staff members responsible for landscape development will improve the quality of the landscapes over time.

Woody Weeds

Woody weeds have been removed on a large scale from many parts of the reserve. There is still follow-up to do in these areas but the density of woody weedy is markedly less than it was at the time of the first management plan. Some woody weed areas at the following locations will need careful management:

- creek line below the waterfall – map area 24
    - This is an important refuge for small native birds and must be restored gradually to ensure that habitat is maintained and improved for these birds.
- stand of Aleppo Pine on the north facing slope – map area 10
    - This is an important food source for Yellow-tailed Black Cockatoos. An area of these trees needs to be retained until adequate alternative food sources are available in the reserve.
- stand of Sugar Gum in the north western part of the reserve – map area 36
    - This species is not native to the area and is gradually spreading over the reserve. The existing stand needs to be contained and managed.
- plantings of non-local Australian species below the fire track on the northern part of the reserve – map area 2
    - Weedy shrub species should be removed (Acacia iteaphylla, Hakea laurina). Non-weedy Australian tree species should be contained and managed.

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Past work on woody weeds has left piles of dead olive and other material that makes management difficult and constitutes a fire hazard. As this reserve is not accessible to a chipper, ongoing management must provide for the regular collection and burning of fine woody debris.

Access

Gully Reserve has one vehicular access at Mountainview Place, from where the maintained fire track accesses the upper eastern and southern slopes along the length of the reserve. There is no access at the southern end of the fire track and another access point is required.

More trails are required for management access. Highest priority is a trail through the southern part to where the reserve connects to Sunnyside Road at the golf course pumping station. Extra access in the northern part of the reserve would also be useful.

Bush for Life sites

There is one Bush for Life site in Gully Reserve. It is located on the north facing slope above the waterfall (western end of map area 5). This area does not have the species diversity that it had 10 years ago and highlights the need for using burning as a management tool and for working more closely with volunteers. Work is now being focussed on capitalising on a small wild fire (May 2011) to follow up all weeds regrowing at the site.

The area above the upper adit in Wheal Gawler Mine reserve requires good management and contractors alone have not achieved the potential of this area.

Volunteers working closely with staff and contractors could achieve considerably more at this site.

Storm water and sedimentation

Water discharged from the drain in Mountainview Place, deposits sediment and is forming an alluvial fan. The resulting rank grass growth requires cutting several times a year but as the surrounding area is very weedy, the removal of sediment at this site is a low priority.

Recommendation 24: It is recommended that, in relation to Gully and Wheal Gawler Mine Reserves;

- vehicular access to the southern end of Gully Reserve is negotiated;
- a access trail is constructed at the southern end of the reserve to link the fire track with Sunnyside Road;
- volunteers are recruited to improve flora conservation work at map area 28; and
- a sediment trap is constructed at the stormwater outfall at Mountainview Place

5.3 Zig-Zag & Chimney Reserves

Figure 20: Zig-Zag Reserve looking south.

Note existing fuel reduced buffer zone below properties on the ridge.

Remnant Vegetation

The main remnant indigenous overstorey and midstorey species are *Eucalyptus camaldulensis* (River Red Gum) (map areas 1 & 2), *Acacia melanoxylon* (Blackwood) (map area 1), *Allocasuarina verticillata* (Drooping Sheoak) (map area 4) and a few *Eucalyptus leucoxylon* ssp *leucoxylon* (Blue Gum) (map areas 5 & 6) (Figure 11). Chimney Reserve contains large areas of native grass (mostly *Austrodanthonia, Aristida* and *Austrostipa*) of various species with some non-grass herbaceous species, mainly *Convolvulus erubescens* associated with it.

Austrodanthonia sp. (Wallaby Grass) was found dominating small areas on the eastern end of Zig-Zag Reserve and also small patches of *Poa* sp. (Tussock grass).

Small areas of *Themeda triandra* (Kangaroo Grass) and *Danthonia* sp. (Wallaby Grass) are found in Zig-Zag Reserve, however they are severely infested with exotic grasses, particularly *Avena* sp. (Wild Oats).

A small patch of *Rubus parvifolius* (Native Raspberry), which is rated Uncommon for South Australia, and *Austrodanthonia* sp. (Wallaby Grass) are currently being managed by a volunteer as a Bush for Life Site. A small population of *Goodenia pinnatifida* (Cut-leaf Goodenia), rated Uncommon in South Australia is located amongst remnant *Eucalyptus leucoxylon* ssp. *leucoxylon* (Blue Gum).

Map area 4 contains the greatest diversity of native flora and the work already done at this site should be followed up.

Revegetation

During the 1980's some tree planting took place in map area 7. The plantings are now mature but are not local species. Those which are spreading or are known to be invasive should be gradually phased out as the appropriate local woodland flora develops.

Following the removal of woody weeds, map area 4 and 5 have been replanted (2001) mostly with Drooping Sheoak. Intensive weed control is required in these areas to prevent invasion of herbaceous weeds until an open canopy of Drooping Sheoak is developed.

The vegetation communities to be restored in the reserve include:
Allocasuarina verticillata (Drooping Sheoak) Low Open Grassy Woodlands on north facing slopes
Eucalyptus microcarpa (Grey Box) Open Forest (Southern end of map area 7)
Eucalyptus camaldulensis (River Red Gum) / *Acacia melanoxylon* (Blackwood) Open Forest on south facing slopes and valley floor.

Woody Weeds

Due to difficulty of access, woody weed management has not been as extensive in Zig-Zag and Chimney reserves as in Themeda, Gully and Wheal Gawler Reserves. The most common species dominating the reserve are *Olea europaea* (Olive), *Pinus halepensis* (Aleppo Pine) and *Crataegus monogyna* (Hawthorn). The western end of Chimney has been revegetated with non-local Eucalypt species which are now the co-dominant species with Aleppo Pine.
Until now, map areas 4 & 5 are the only sites which have been managed for woody weeds. Any further woody weed control needs to be accompanied with a stringent follow-up control program to address the herbaceous weed growth which invade rapidly following removal of the woody weeds. Unless these activities are adequately resourced to accommodate follow-up control works, then it is preferable to delay any further work until resources become available.

Broad Leaf Weeds

As woody weeds are removed, broad leaf weeds are beginning to invade Areas 4 & 5. Native species such as *Lomandra* sp and *Vittadinia* sp. are at risk of being smothered by the prolific invasion of the dominating herbaceous species (*Euphorbia terracina* (False Caper), *Solanum mauritianum* (Tobacco Bush), *Lactuca serriola* (Prickly Lettuce) and *Sisymbrium officinale* (Mustard Weed). At present there is only a small amount of control works being conducted within the reserves.

At present the 10m boundary buffer zone identified in Maguire (1995) in Management Zone 3 is not being managed to maintain a low fuel hazard rating.

Grassy Weeds

The dominant grass species in the reserves is *Avena* sp. (Wild Oats). This species is particularly evident in Chimney Reserve which was the last reserve to have grazing removed (1997). At present, management of grassy weeds in Zig-Zag and Chimney Reserves is limited to cutting the 10m boundary fuel minimised buffer zone.

Access
Currently there is no vehicle access to Zig-Zag Reserve. There is an old track from Gill Terrace that passes through 4 private properties before entering Zig-Zag Reserve where there is an area suitable for a vehicle turn-around. For this track to be useful for management, negotiation with private property holders will be needed. The turn-around area would also need to be cleared and suitably prepared for vehicle use.

At the western end of Chimney Reserve is a common access road to several properties. Discussions are needed with the residents to negotiate the use of this roadway to access the lower part of the reserve.

More trails are needed for management access in the reserves. These are:

- a link from the end of Jikara Drive to meet the existing trail;
- a link from western end of Chimney Reserve to Danthonia reserve; and
- a link from Danthonia Reserve down to Jikara Drive.

A safety barrier or a mesh cover should be constructed at the old mine pit.

Bush for Life sites
One Bush for Life site is located at the western end of Zig-Zag Reserve and was initiated to manage and protect a small patch of *Rubus parvifolius* (Native Raspberry), which is rated Uncommon for South Australia. Native grasses such as *Austrodanthonia* sp. (Wallaby Grass) are also growing under a canopy of *Eucalyptus camaldulensis* (River Red Gum).

Residential Boundaries
At present, one residential property has a garden on part of Zig-zag reserve. As this area is the only access to the reserve from Jikara Drive, it is important that this access be maintained.

Recommendation 25: It is recommended that, in relation to Zig-Zag and Chimney Reserve;

- vehicular access is negotiated to Zig-Zag Reserve from Gill Terrace and to Chimney Reserve from the freeway end;
- an access trail is constructed to link from the end of Jikara Drive to meet the existing trail;
- interpretative signage is provided at the mine chimney; and
- a permanent barrier or mesh cover is constructed at the mine exploratory pit in Chimney Reserve.

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5.4 Danthonia Reserve

Figure 21: Danthonia Reserve from the western end

Remnant Vegetation

Remnant vegetation includes a patch of *Eucalyptus microcarpa* (Grey Box) Grassy Woodland (map area 11). Grey Box woodland is a nationally threatened vegetation community although the patch in this reserve has virtually no native understorey. There are several small remnant patches of *Allocasuarina verticillata* (Drooping Sheoak) and areas of *Eucalyptus camaldulensis* (River Red Gum) Open Forest in the lower and southern parts of the reserve. The understorey in these areas is highly modified by weed invasion.

There are also scattered individual *Eucalyptus leucoxylon* ssp. *leucoxylon* (SA Blue gum), *Acacia pycnantha* (Golden Wattle), *Acacia melanoxylon* (Blackwood) and *Bursaria spinosa* (Sweet Bursaria).

Good examples of *Aristida behriana* (Brush Wire-grass), *Austrodanthonia* sp. (Wallaby Grass), *Enneapogon nigricans* (Black-head Grass) and other native species occur at the Bush for Life site at northern end of the reserve (zone 2).

Figure 22: Remnant vegetation in Danthonia Reserve

Revegetation

Several areas have been planted with local tree species. These areas are those where woody weeds have been removed and contain no native tree cover.

Figure 23: Revegetation in Danthonia Reserve

Woody Weeds

There has been considerable weed removal effort conducted in the reserve within the past decade. A follow up program needs to be implemented to restrict the re-colonisation by Olives.

Several areas on the south facing slope (drainage lines) are still dominated by Olive and are difficult to access. The continued removal of woody weeds from the reserve will require adequate resources to follow-up and to manage the herbaceous weeds which respond vigorously in the absence of woody exotics.
There are a few planted English Oak (*Quercus robur*) trees in the reserves. These are of value to some residents and are not weedy and so should be contained and managed.

Broad Leaf Weeds
The dominant herbaceous species include *Senecio pterophorus* (African Daisy), *Foeniculum vulgare* (Fennel), *Sisymbrium officinale* (Mustard Weed), *Lathyrus tingitanus* (Tangier Pea) and *Plantago lanceolata* (Ribwort). *Hypericum* (St John's Wort) has a limited distribution and is a priority for eradication.

Access
There is currently no vehicle access into Danthonia Reserve. The only pedestrian access is from Mt Osmond Road at the southern end and through Zig-Zag to access the northern section. Field workers are currently using the vacant block, for access but as building is about to commence at this location, access for management to Danthonia Reserve will be a particular problem. The existing forms of access are not satisfactory as field workers are required to carry tools and equipment considerable distances on walking trails. This is a significant health and safety issue.

Trails in the reserve need to be upgraded to permit the operation of a motorised wheel barrow. This will require a 1m path width. This will entail the realignment of the existing trail, which in parts is too steep and encroaches on private land, and the construction of a new trail along the southern boundary.

Acquisition of state government or private land to the south of the reserve should be considered to improve access from the car-park at the bottom of Chimney Reserve.

Bush for Life Sites
There is one Bush for Life site on Danthonia Reserve which is located on the northern end of the reserve. It was established to manage and protect the remnant Sheoaks, and patches of native grasses and associated understorey species. It contains good stands of *Themeda* and *Aristida* as well as some non-grass herbaceous species – *Convolvulus, Goodenia, Vittadinia*.

Recommendation 25: It is recommended that, in relation to Danthonia Reserve;

- land acquisition is investigated to enable the construction of a vehicular access to the reserve;
- trails are constructed to provide access to the southern parts of the reserve and through Chimney Reserve to Gill Terrace;
- stormwater and sediment flowing onto the reserve from Mt Osmond Road are stabilised; and
- re-establishment of native grass and other flora continues from the area already commenced at the southern end of the reserve throughout the upper parts of the reserve.

5.5 Hayward Drive verge

Until 2007, this road reserve was essentially unmanaged apart from spraying and brush-cutting along the guard rail. Since 2007, the following work has taken place;

- clearance of woody weeds from about 50% of the area;
- construction of an access trail along the length of the reserve just below the adjoining property boundary;
- installation of trail markers; and
- regular spraying and brush-cutting along the trail.

Although the site is very degraded there several important remnant indigenous species present including:

Bursaria spinosa
Cullen australasicum
Myoporum viscosum
Lomandra densiflora
Themeda triandra
Austrodanthonia sp
Austrostipa sp

Following up the woody weed regrowth is critical and it would be appropriate to continue primary woody weed clearance at the site. Work is also required to maintain the trail, to develop a low overall fuel hazard rating and to conserve and extend indigenous flora at the site.

On the verge there are good patches of *Enneapogon* which is a summer active and low growing native grass. Early verge spraying will minimise damage to this species.

There is an old mine adit at the western end of the site. This should be cleared of woody weeds, made accessible, made safe and an interpretive sign erected.

Recommendation 26: It is recommended that, in relation to the Hayward Drive road reserve;

- woody weed removal is completed;
- woody weed work is followed up;
- weeds and rubbish are removed from adit pit;
- the adit pit is accessible and furnished with an interpretive sign;
- as weeds are removed, the stormwater detention basin is developed with flora associated with ephemeral wetlands; and
- spraying is timed to minimise damage to *Enneapogon.*

5.6 Gill Terrace road reserve

The Gill Terrace road reserve connects Gill Terrace with Seawiew Road and with Gully Reserve. Most of the woody weeds have now been removed from the site and follow-up is needed. An access trail has been constructed.
In the lower part of the reserve there is a track leading from Gill Terrace through the road reserve and then into the rear of private allotments. This part of the reserve still contains a large amount of woody weed growth and, and as it is close to dwellings needs to be cleaned out.

The indigenous species of note in the reserve is *Rumex brownii* (native dock).

There is a significant stormwater outfall on the reserve which has caused erosion and slumping on the side of the SA Water easement track. This needs to be addressed with piping the water away from the reserve and towards the watercourse in the adjoining private land.

Recommendation 27: It is recommended that, in relation to the Gill Terrace Road Reserve;

- primary woody weed removal is completed;
- woody weed work is followed up; and
- the stormwater outfall is stabilised.

5.7 Mt Osmond Road verges

Flora on the verges of Mt Osmond Road was surveyed on 1997 and some degraded patches of native flora were noted. Much of this flora was at a site towards the southern end of the road which was subject to a landslip soon after the survey was done a much of this flora was lost.

The main feature is the remnant native trees, namely SA Blue Gum (*Eucalyptus leucoxylon*), River Red Gum (Eucalyptus camaldulensis), and Drooping Sheoak (Allocasuarina verticillata). There is also some Native Cherry (*Exoparpos cupressiformis*) in the southern part of the road reserve. This species is locally rare and few are known in Burnside. Understorey is sparse with scattered *Scaevola albida, Lomanda glauca, Kennedia prostrata* and a good patch of *Themeda triandra* (Kangaroo Grass).

No conservation or restoration work has ever been conducted on the Mt Osmond Road verges due to lack of resources. Management has consisted of yearly slashing for fuel hazard reduction purposes and contractors are generally aware of the presence of the indigenous flora. Woody weeds have been cleared for fire hazard reduction purposes from the wide verge area at the southern end and feral *Acacia saligna* has been removed from adjacent to the golf course. Work will be required over the next few years to do the needed follow-up work.

The main woody weeds on the verge are Olive and Hawthorn. There is also the unusual occurrence of the garden plant *Buddleia* as a weed in this area and a prominent grass weed is tall wheat grass (*Thinopyrum elongatum*) near the golf

course. The African Weed Orchid (*Monadenia*) also occurs towards the southern end of the road reserve and in the drainage reserve that links with Gleneagles Road. There is a patch of thick Kikuyu growing where water drains from the golf course.

A walking trail has been constructed along the verge but resources need to be allocated for it to be properly managed. When it is overgrown, people still walk on the road.

Recommendation 28: It is recommended that, in relation to the Mt Osmond Road verge;

- all woody weeds are removed and appropriate canopy density established;
- major herbaceous weeds are treated namely *Gazania, Thrinopyrum* and *Centranthus;*
- areas of native flora are marked and managed;
- the sides of the walking trail are regularly cut;
- the provision of an access trail along the wide southern section of the verge is investigated; and
- restoration work is commenced in the native flora areas.

5.8 Old Bullock Track verges

The verges of the Old Bullock Track contain important remnant native flora areas which include species that occur nowhere else in Burnside and do not occur on land adjoining which has had a history of grazing.

So far, a considerable effort has gone into removal of major weeds from the reserve but no detailed flora conservation work has been undertaken.

The main threat to flora conservation is the development of informal bike trails through the vegetation on the verges. Fences were erected in 2000 to deter cyclists but these were soon cut.

The property holder at the southern end of the road has fenced off part of the road reserve and for a while grazed it heavily with sheep. The flora in this area was particularly diverse and the flora has not recovered.

Damage to native flora is also being done in this area by feral and escaped deer.

The African Weed Orchid (*Monadenia*) occurs in the reserve and regular patrols have been undertaken to eradicate it.

Recommendation 29: It is recommended that, in relation to the Old Bullock Track;

- the encroachment at the southern end of the reserve be rectified;
- regular patrols for *Monadenia* be maintained;
- volunteers be sought who could support the efforts of council in restoring the better quality vegetation areas of the reserve;
- investigate ways of maintaining bicycle traffic on the existing road surface;
- a flora survey is conducted of the Old Bullock Track; and
- feral deer are eradicated.

6. Implementation

6.1 Management Actions

This management plan reflects current management philosophy with the following additions:

- Fuel reduction zone (FRZ) is proposed to be expanded to ensure an overall low fuel hazard rating is maintained within 100 metre of dwellings above reserve land.
- It is proposed to increase the use of fire as a management tool.
- It is recommended that hills face reserves field team be established in order to more effectively use the resources available.

With the present level of resourcing the following management will take place:

- Existing 10 metre buffer zones will be maintained (fire prevention budget):
- Woody weeds will be removed from the reserves over a 10 year period (weeds budget):
- Appropriate tree canopy will be established over a 5 year period (urban biodiversity budget):
- Walking trail network will gradually be extended over a 10 year period at which point the existing annual allocation will all be required for maintenance. (walking trail budget with voluntary help):
- Perennial weed grasses eliminated in 20 years (urban biodiversity budget):
- Broad leaf herbaceous weeds eliminated in 20 years (urban biodiversity budget):
- Follow-up of major weeds across all reserves (urban biodiversity budget):
- Selected areas will be well managed for biodiversity (urban biodiversity budget with voluntary help):
- Sediment traps established and managed (project funding and urban biodiversity budget).

With present levels of resourcing the following will not be done except on a very small and inadequate scale:

- Autumn burning and slashing of 100 metre fuel reduction zone to maintain a low overall fuel hazard rating:
- Crown lifting trees and managing fine twiggy fuels in the 100 metre fuel hazard reduction zone:
- Careful weed control in best areas of native grassland:
- Replacement of introduced grass with native grasses and herbage:
- Establishing an autumn patch burning regime:
- Best practice conservation work on native flora remnants.

The effect of this is that the present level of management of vegetation in the hills face will continue with some gradual improvement in some areas over time. The development of tree canopy over time will suppress ground growth to some extent but the ground growth will always be a problem in the absence of resourcing for early summer grass cutting and autumn burning. The absence of crown lifting and twiggy fuel management will mean that the potential to minimise crown fires will not be realised.

6.2 Summary of additional labour required

The main area of additional cost arising from this plan is the proposed implementation of the recommendation, from the LES report, to set up a fuel hazard reduction zone out to 100 metre from dwellings upslope from reserves and 20 metre from dwellings which are downslope from reserve land. The LES report also recommends that the balance of the reserve land beyond the FRZ be managed to achieve a moderate or better overall fuel loading at all times.

The main additional work needed to achieve the recommended fuel loadings are;

- setting up and maintaining recommended FRZ;
- woody weed treatment in presently untreated areas;
- pruning, thinning trees;
- collecting and burning fallen foliage which contributes to fine fuel;
- grass cutting; and
- patch burning.

Maintaining the fuel hazard ratings recommended by LES will require ongoing canopy management. The appropriate tree canopy and shrub density will need to be achieved by thinning and pruning all trees (not just new plantings referred to in the petition).

Maintaining the fuel hazard ratings recommended will also require additional slashing, twice a year in the fuel hazard reduction zone, which represents an additional 8ha of slashing, and once per year in about 15ha of reserve land. This work is labour intensive because land is steep and brush-cutters are used.

Burning will require training and people to do the work.

Recommendation 30: It is recommended that the resources available for hills face management are used to develop a permanent land management field team with sufficient funds available for the engagement of contractors particularly at times of peak labour requirements in late spring and early summer.

7. Recommendations

These actions are recommended in the body of the report but are brought together for clarity. It is recommended that:

From **1. Introduction**

1. Poorly defined reserve boundaries are surveyed and permanently marked.

2. The philosophy of the Burnside Hills Face Management Plan (1996) is re-affirmed with management actions modified in response to the Leading Emergency Services report (2009).

3. The following fuel reduction zones are maintained as recommended by Ellis (2009); (see figure 2)

- Continue to maintain the 10 metre boundary fuel hazard reduction zone adjacent to residential properties which is presently maintained in accordance with the Hills Face Reserves Management Plan (1996)
- To a distance of 100 metre downhill from dwellings, maintain the overall fuel hazard rating at low or better.
- To a distance of 20 metre uphill from dwellings, maintain the overall fuel hazard rating of low or better.
- Maintain the balance of the reserve land to an overall fuel hazard rating of moderate or better.

4. Development plans and planning approvals aim to minimise resulting reserve management obligations to council by ensuring that:

- houses are built as far from reserve boundaries as is practically possible,
- as much stormwater is absorbed onto the private land as is practically possible, and
- landscaping associated with residences do not include weedy or potentially hybridising species or cultivars and does not increase fire hazard.

5. An information report is prepared for Council presenting options for ensuring improved management of declared weeds and fire hazard on private land.

6. Council submits this plan as the basis for an application to the Native Vegetation Council for permission to undertake burning in the southern hills face reserves for the purposes of fuel hazard reduction and ground flora quality improvement.

7. Council applies for permission from the EPA to undertake ecological burning and hazard reduction burning when conditions are suitable outside the Bushfire Danger Season.

From **2. Risks**

8. A “Standard Work Method” document is prepared for the task of area burning incorporating safety, site assessment, protection of biodiversity.

9. Council seeks to more accurately quantify the risk of landslip at Mt Osmond.

10. A “Standard Work Method” document is prepared for the task of controlling erosion, landslip and sedimentation;

11. Where stormwater is directed onto reserves, works are undertaken to trap sediment, spread the water flow or pipe the water to a gully or watercourse as appropriate for the situation.

12. Indigenous trees in an open woodland formation are the main form in which a high biomass is maintained without increasing fine fuel. SA Blue Gum (*Eucalyptus leucoxylon*) should be used wherever appropriate as it carries the lowest amount of

bark and is therefore least likely to carry a ground fire into the crown. Logs should be left in reserves as these store carbon, provide habitat and do not contribute to fine fuel loads.

13. The following precautions are taken in order to protect habitat during management operations:

- Management actions should only be undertaken after consideration of the effect on the native species present
- Trials are conducted to determine the burning regimes required to reduce weeds and thatch in native vegetation areas and benefit native flora.
- Council should work closely with Trees for Life and CFS in the conduct of burning trials in Bush for Life sites.
- Burning should be done to create a patchy vegetation structure with unburned areas providing refuge for wildlife (including invertebrates).
- Woody weed removal should be done thoroughly, area by area, with appropriate habitat flora established as soon as the site is ready.
- Unless constituting a safety hazard, the trunks and branches of dead trees should be retained as habitat, either as standing dead trees or as logs on the surface.

14. A recreational trails plan is prepared to guide the development and maintenance of recreation and management trails and ancillary infrastructure.

15. Bee and wasp nests in proximity to trails are removed.

16. All reserves are adequately signed with hazard warnings for snakes, fire, mines, cliffs and steep slopes.

17. Rope anchor points are established above steep slopes in reserves to facilitate safe management access to steep slopes.

18. Advice is sought to determine a Fire Danger Index trigger point higher than which reserves will be closed and that a SWM be prepared to document reserve closing procedure.

From **3. Vegetation**

19. Permanent ecological survey quadrats are set up for monitoring the response of flora composition to management actions and that management actions be reviewed in the light of survey results.

20. The following priorities are applied to weed management in reserves:

- Woody weeds will be removed, area by area, from all reserves, starting in fuel hazard reduction zones and areas of higher quality native flora.
- Herbaceous weeds will be removed, area by area, using selective herbicides and follow-up, starting in areas of higher quality native flora and fuel reduction zones.
- Perennial grass weeds will be removed by spot spraying and follow-up wherever they occur in reserves.

- Unless an appropriate selective herbicide becomes available, where annual grass weeds occur in higher quality native flora areas, control will be undertaking with a combination of fire, slashing and follow-up hand weeding.

From **4. Vegetation management**

21. The principles and practices of vegetation management outlined in sections 4.1 to 4.4 are incorporated into Standard Work Method documentation for land management tasks.

22. Council informs adjoining landholders of the weed, conservation and bushfire issues associated with dumping rubbish and, in particular, garden waste.

From **5. Specific management issues**

23. In relation to Themeda Reserve;
- management trails are constructed along the northern boundary and below Hayward Drive;
- the use of fire is investigated to create the 10m very low fuel boundary buffer in late spring;
- complete primary clearance of woody weeds is undertaken in the eastern end of the reserve and from gullies;
- non–indigenous SA Blue Gum and Sugar Gum are phased out over a number of years;
- African Weed Orchid and any other threatening weeds are eliminated from the reserve; and
- the encroachment issue be resolved.

24. In relation to Gully and Wheal Gawler Mine Reserves;
- vehicular access to the southern end of Gully Reserve is negotiated;
- a trail is constructed at the southern end of the reserve to link with Sunnyside Road;
- volunteers are recruited to improve flora conservation work at map area 28; and
- a sediment trap is constructed at the stormwater outfall at Mountainview Place.

25. In relation to Danthonia Reserve;
- land acquisition is investigated to enable the construction of a vehicular access to the reserve;
- trails are constructed to provide access to the southern parts of the reserve and through Chimney Reserve to Gill Terrace;
- stormwater and sediment flowing onto the reserve from Mt Osmond Road are stabilised;
- re-establishment of native grass and other flora continues from the area already commenced at the southern end of the reserve throughout the upper parts of the reserve; and
- the few resident planted English Oak trees are retained.

26. In relation to the Hayward Drive road reserve;
- woody weed removal is completed;

- woody weed work is followed up;
- weeds and rubbish are removed from adit pit;
- The adit pit is accessible and furnished with an interpretive sign;
- as weeds are removed develop the stormwater detention basin with flora associated with ephemeral wetlands; and
- spraying is timed to minimise damage to *Enneapogon.*

27. iI relation to the Gill Terrace Road Reserve;
- woody weed removal is completed;
- woody weed work is followed up; and
- the stormwater outfall is stabilised.

28. In relation to the Mt Osmond Road verge;
- all woody weeds are removed and appropriate canopy density established;
- major herbaceous weeds are treated namely *Gazania, Thrinopyrum* and *Centranthus;*
- areas of native flora are marked and managed;
- the sides of the walking trail are regularly cut;
- the provision of a trail link along the southern section of the reserve is investigated; and
- restoration work is commenced in the areas of remnant native flora.

29. In relation to the Old Bullock Track;
- the encroachment at the southern end of the reserve is rectified;
- regular patrols for Monadenia are maintained;
- volunteers are sought who could support the efforts of council in restoring the better quality vegetation areas of the reserve;
- ways of maintaining bicycle traffic on the existing road surface are investigated;
- a flora survey is conducted of the Old Bullock Track; and
- feral deer are eradicated.

From **6. Implementation**

30. The resources available for hills face management are used to develop a permanent land management field team with sufficient funds available for the engagement of contractors particularly at times of peak labour requirements in late spring and early summer.

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1 Appendices

Appendix 1: Vegetation Species Lists recorded on City of Burnside Southern Hills Face Reserves

List compiled from: *Mt Osmond Reserves Action Plan (1996)*

Table 3: Flora species recorded in City of Burnside Mt Osmond Reserves

Native Flora species								
Scientific Name	**Common Name**	**Reserve**				**Conservation Ratings**		
		Them	**Gully**	**ZZ**	**Danth**	**AUS**	**SA**	**SL**
Acacia melanoxylon	Blackwood							
Acacia paradoxa	Kangaroo Thorn	+						
Acaena echinata	Sheeps Burr		+		+			
Acacia pycnantha	Golden Wattle	+	+		+			
Allocasuarina verticillata	Drooping Sheoak	+	+	+	+			
Aristida behriana	Brushwire grass			+	+			U
Arthropodium strictum	Vanilla Lily	+	+	+	+			
Austrodanthonia sp.	Wallaby Grass	+	+	+	+			
Austrostipa sp.	Spear Grass	+	+	+	+			
Bulbine bulbosa	Bulbine Lily	+	+					
Bursaria spinosa	Sweet Bursaria		+					
Calostemma purpureum	Purple bells	+	+					
Carex breviculmis	Short-stem Sedge		+					
Chamaesyce drummondii	Caustic weed							
Cheilanthes austrotenuifolia	Rock Fern	+	+	+	+			
Cheilanthes distans	Bristly Cloak Fern	+	+					R

Convolvulus erubescens	Australian Bindweed	+	+	+	+			
Cullen australasicum	Tall Scurf-pea		+					R
Dichondra repens	Kidney Weed							
Dodonaea viscosa	Sticky Hop Bush							
Einadia nutans	Climbing Saltbush		+					
Enneapogon nigricans	Blackhead Grass		+	+	+			
Eucalyptus camaldulensis ssp. *camaldulensis*	River red Gum			+	+			
Eucalyptus leucoxylon ssp. *leucoxylon*	SA Blue Gum	+	+	+	+			
Eucalyptus microcarpa	Grey Box	+	+		+			U
Eucalyptus viminalis ssp *viminalis*	Manna Gum		+				R	R
Geranium retrorsum	Common Cranesbill	+	+	+	+			
Glycine rubiginosa	Twining Glycine	+	+		+			
Gonocarpus elatus	Hill Raspwort	+		+	+			
Gonocarpus tetragynus	Small-leaf Raspwort	+						
Goodenia albiflora	White Goodenia	+	+	+	+			U
Goodenia pinnatifida	Cut-leaf Goodenia	+		+	+			U
Hakea carinata	Erect Hakea							
Hibbertia sp.	Guinea-flower			+				
Kennedia prostrata	Running Postman			+				
Lomandra densiflora	Pointed Mat-rush	+	+	+	+			
Lomandra nana	Pale Mat-rush		+		+			
Lysiana exocarpi	Harlequin Mistletoe		+					
Lythrum hyssopifolia	Purple Loosestrife							
Malva behriana	Native Hollyhock	+	+					U
Oxalis perennans	Native Sorrel	+			+			
Pimelea curviflora var. *sericea*	Curved Riceflower	+						
Pleurosorus rutifolius	Blanket Fern	+	+	+	+			U
Poa labillardieri	Tussock Grass		+		+			
Ptilotus spathulatus f. spathulatus	Pussy-tails	+						R

Rubus parvifolius	Small-leaved Raspberry							U
Rumex brownii	Native Dock							
Scaevola albida	Fan-flower	+						
Setaria jubiflora	Warrego Summer-grass		+					K
Stackhousia monogyna	Creamy candles	+	+					
Themeda triandra	Kangaroo Grass	+	+	+	+			
Vittadinia blackii	Narrow-leaf New Holland Daisy		+					R
Vittadinia cuneata	New Holland Daisy	+	+	+	+			
Wurmbea dioica	Early Nancy	+						
Wahlenbergia luteola	Native Bluebell	+	+					

Non-local native woody species

Scientific name	**Common Name**	**Reserve**			
		Them	**Gully**	**ZZ/CH**	**Danth**
Acacia baileyana	Cootamundra Wattle	+			
Acacia iteaphylla	Flinders Ranges	+			
Acacia longifolia	Sallow wattle	+			
Acacia podalyriifolia	Mt. Morgan Wattle	+			
Acacia pravissima	Ovens Wattle	+			
Acacia saligna	Golden Wreath Wattle	+			
Acacia sp.	Wattle				
Agonis flexuosa	Willow myrtle		+		
Albizzia lophantha	Cape Leeuwin Wattle		+		
Callistemon linearis	Bottlebrush		+		
Casuarina cunninghamiana	River Oak			+	
Eucalyptus botryoides	Bangalay	+			

Eucalyptus citriodora	Lemon scented gum	+	+	+	
Eucalyptus cladocalyx	Sugar Gum	+	+		
Eucalyptus ficifolia	W.A. Flowering Gum		+		
Eucalyptus leucoxylon ssp. *megalocarpa*	Large fruited S.A. Blue Gum	+		+	
Eucalyptus maculata	Spotted Gum		+	+	
Eucalyptus sp.	Gum	+	+	+	
Eucalyptus spathulata	Swamp Mallet			+	
Hakea laurina	Pincushion hakea		+		
Melaleuca armillaris	Bracelet Honey Myrtle		+		
Melaleuca gibbosa					
Melaleuca lanceolata	Dry land Tea tree		+		
Melaleuca linariifolia			+		

Exotic woody species

Scientific Name	Common Name	Reserve			
		Them	Gully	ZZ	Danth
Asclepias rotundifolia	Cotton bush	+	+		+
Chrysanthemoides monilifera	Boneseed	+			
Crataegus species	Hawthorn	+	+	+	+
Erica arborea	Tree Heath				
Fraxinus oxycarpa	Desert Ash		+	+	
Genista monspessulana	Montpellier Broom		+		+
Melia azedarach	White Cedar		+		
Olea europaea	Olive	+	+	+	+
Pinus halepensis	Aleppo Pine	+	+	+	+
Pinus radiata	Monterey Pine		+		
Quercus robur	English Oak				+
Rhamnus alaternus	Buckthorn	+	+	+	+
Rosa canina	Dog Rose	+	+	+	+
Rubus ulmifolius var. *ulmifolius*	Blackberry		+	+	+
Senecio pterophorus	African Daisy	+	+	+	+

Exotic herbaceous & Grass plant species

Scientific Name	Common Name	Reserve			
		Them	Gully	ZZ	Danth
Arctotheca arvensis	Pimpernel	+	+	+	+
Arctotheca calendula	Capeweed	+	+	+	+
Asphodelus fistulosus	Onion weed		+		
Avena fatua	Wild oats	+	+	+	+
Briza maxima	Quaking grass	+	+	+	
Briza minor	Small Quaking grass	+	+	+	+
Bromus diandrus	Jabbers	+	+	+	+
Cynara cardunculus	Artichoke thistle	+			
Cynosurus echinatus	Dogs tail grass	+	+	+	+
Dactylis glomeratus	Cocksfoot grass	+	+	+	+
Echium piantagineum	Salvation Jane	+	+	+	+
Ehrharta longiflora	Annual veldt grass	+	+	+	+
Euphorbia terracina	False caper	+	+	+	+
Foeniculum vulgare	Fennel	+	+	+	+
Gomphocarpus fruticosus	Broad Leaf Cotton Bush	+	+	+	+
Holcas lanatus	Yorkshire Fog	+	+	+	+
Hypericum perforatum	St. Johns wort	+	+	+	+
Hypochaeris radicata	Deep-rooted cats-ear	+	+	+	+
Lactuca serriola	Prickly Lettuce	+	+	+	+
Lathyrus tingitanus	Tangier Pea	+	+	+	+
Misopates oronteum	Lesser snapdragon	+			
Myrsiphyllum asparagoides	Bridal Creeper				+
Nicotiana glauca	Tree Tobacco				+
Oxalis pes-caprae	Soursob	+	+		
Pennisetum clandestinum	Kikuyu	+			

Pennisetum macrourum	Fountain grass				+
Piptatherum miliaceum	Rice millet	+	+	+	+
Phalaris aquatica	Phalaris	+	+		+
Plantago lanceolata	Ribgrass	+	+	+	+
Poa annua	Winter grass	+	+	+	+
Polygonurn aviculare	Wire weed	+	+	+	+
Rapistrum rugosum	Short-fruit Radish	+	+		
Romulea rosea	Guilford grass	+	+	+	+
Rumex sp	Dock	+	+	+	+
Salvia verbeneca	Wild sage	+	+	+	
Scabiosa atropurpurea	Scabious	+	+	+	+
Sisymbrium officinale	Wild Mustard	+	+	+	+
Solanum mauritianum	Tobacco Bush	+			
Solanum nigrum	Blackberry nightshade	+	+	+	+
Sonchus oleraceus	Sow-thistle	+	+	+	+
Stellaria media	Chickweed	+	+	+	+
Trifolium angustifolium	Narrow-leaf clover	+	+	+	+
Verbascum virgatum	Mullein		+		+
Vulpia sp	Silver grass	+	+	+	+

Them = Themeda Reserve
ZZ = Zig Zag & Chimney Reserves
Gully = Gully & Wheal Gawler Mine Reserve
Danth = Danthonia Reserve

CONSERVATION STATUS CODES

X = Extinct/Presumed extinct: not located despite thorough searching of all known and likely habitats; known to have been eliminated by the loss of localised population(s); or not recorded for more than 50 years from an area where substantial habitat modification has occurred.
E = Endangered: rare and in danger of becoming extinct in the wild.
T = Threatened: likely to be either Endangered or Vulnerable but insufficient data for a more precise assessment.
V = Vulnerable: rare and at risk from potential threats or long term threats which could cause the species to become endangered in the future.
K = Uncertain: likely to be either Threatened or Rare but insufficient data for a more precise assessment.
R = Rare: has a low overall frequency of occurrence (may be locally common with a very restricted distribution or may be scattered sparsely over a wider area). Not currently exposed to significant threats, but warrants monitoring and protective measures to prevent reduction of population sizes.
U = Uncommon: less common species of interest but not rare enough to warrant special protective measures.
N = Not of particular significance/Common. (Also indicated by a blank entry.)

Table 4: Species used in revegetation programs

Planted native species					
Common Name	**Scientific Name**	**Reserve**			
		Them	**Gully**	**ZZ**	**Danth**
Acacia melanoxylon	Blackwood		+		+
Acacia paradoxa	Kangaroo Thorn	+	+		+
Acacia pycnantha	Golden Wattle	+	+		+
Acacia retinodes	Swamp Wattle		+		
Allocasuarina verticillata	Drooping Sheoak	+	+	+	+
Bursaria spinosa	Sweet Bursaria	+	+		+
Dodonaea viscosa	Hopbush	+	+		+
Eucalyptus leucoxylon	South Australian Bluegum	+	+		+
Eucalyptus microcarpa	Grey Box		+		
Eucalyptus viminalis	Manna Gum		+		
Hakea carinata	Erect Hakea		+		

Appendix 2: Reserve site information

Table 5: mapped vegetation areas (Refer to maps – figures 8,9,10 and 11)

Themeda Reserve

Area #	vegetation description	Cond (1-5)*	Canopy Density (1- 4)**	Comments BFL = Bush for Life site R = Existing Revegetation WW = Woody weed management	Management Options PB=Prescribed Burn S = Slash Sp = Spray * WW = Woody Weed control F = Follow up Woody Weed control
20	*Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*)*, *Allocasuarina verticillata* (Drooping Sheoak) Low Woodland	2	2	WW, R	S/PB/Sp
29	*Eucalyptus viminalis* ssp. *viminalis* (Manna Gum) Open Forest	2	3		S
31	*Eucalyptus* sp. (Eucalypt) Open Forest	2	3		S
6	*Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*)*, *Allocasuarina verticillata* (Drooping Sheoak), *Acacia pycnantha* (Golden Wattle) Low Woodland	3	2	WW, R	S
8	*Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*) / Allocasuarina verticillata* (Drooping Sheoak) Low Woodland	3	2	WW, R	S/PB/Sp
13	*Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*)*, *Allocasuarina verticillata* (Drooping Sheoak), *Acacia pycnantha* (Golden Wattle) Low Woodland	3	2	WW, R	S/PB/Sp
2	*Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*) / Allocasuarina verticillata* (Drooping Sheoak) Low Woodland	4	2	R	S (track) S/PB/Sp (slopes)
3	Mixed *Eucalyptus* sp. (Eucalypt) / *Allocasuarina verticillata* (Drooping Sheoak) Low Woodland	4	2	WW, R	S/PB/Sp
12	*Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*)*, *Allocasuarina verticillata* (Drooping Sheoak), *Acacia pycnantha* (Golden Wattle) Low Woodland	4	2	WW, R	S/PB /Sp
27	*Eucalyptus* sp. (Eucalypt) Open Forest	4	3	WW, R	S
1	*Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*) / Allocasuarina verticillata* (Drooping Sheoak) Low Woodland	5	2	WW, R	S
4	*Olea europaea* (Olive) / *Crataegus monogyna* (Hawthorn) Low Woodland	5	1	WW	F/S
5	*Olea europaea* (Olive), *Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*)*, *Crataegus monogyna* (Hawthorn), *Chrysanthemoides monilifera* (Boneseed) Low Woodland	5	2	WW	F/S/PB/Sp
7	*Olea europaea* (Olive), *Crataegus monogyna* (Hawthorn) Low Woodland	5	2		WW/S
9	Mixed *Eucalyptus* sp. (Eucalypt)	5	2	WW	S
10	*Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*) / Allocasuarina verticillata* (Drooping Sheoak) Low Woodland	5	2	WW, R	S/PB/Sp

11	*Pinus* sp. (Pine), *Crataegus monogyna* (Hawthorn) Woodland	5	3		WW
14	*Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*)*, *Allocasuarina verticillata* (Drooping Sheoak), *Acacia pycnantha* (Golden Wattle), *Olea europaea* (Olive) and *Crataegus monogyna* (Hawthorn) Low Woodland	5	2	WW, R	F/S
15	*Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*)/ Allocasuarina verticillata* (Drooping Sheoak) Low Woodland	5	2	WW, R	S/PB/Sp
16	*Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*)*, *Allocasuarina verticillata* (Drooping Sheoak), *Acacia pycnantha* (Golden Wattle) Low Woodland	5	2	WW, R	S/Sp
17	Mixed *Eucalyptus* sp. (Eucalypt), *Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*)*, *Allocasuarina verticillata* (Drooping Sheoak) Low Woodland	5	3	WW, R	S/Sp
18	Mixed *Eucalyptus* sp. (Eucalypt), *Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*)*, *Allocasuarina verticillata* (Drooping Sheoak), mixed *Acacia* sp. (Wattle) Low Woodland	5	2	WW, R	S/Sp
19	*Crataegus monogyna* (Hawthorn) Low Woodland	5	3	WW	F/S
21	*Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*)*, *Crataegus monogyna* (Hawthorn) and *Olea europaea* (Olive) Low Woodland	5	2	WW, R	WW/F/S/PB/Sp
22	Herbaceous weed growth	5	1	WW	S/PB/Sp
23	*Pinus* sp. (Pine), *Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*)* and *Crataegus monogyna* (Hawthorn) Woodland	5	2	WW, R	F/WW/S/Sp
24	*Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*)*, *Allocasuarina verticillata* (Drooping Sheoak), *Pinus* sp. (Pine) and *Olea europaea* (Olive) Low Woodland	5	2	WW, R	F/S/PB/Sp
25	*Eucalyptus* sp. (Eucalypt), *Acacia pycnantha* (Golden Wattle) and *Allocasuarina verticillata* (Drooping Sheoak) Low Woodland	5	1	WW, R	S/Sp
26	*Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*)*, *Allocasuarina verticillata* (Drooping Sheoak), *Acacia pycnantha* (Golden Wattle) and *Eucalyptus* sp. (Eucalypt) Low Woodland	5	2	WW, R	S/Sp
28	*Crataegus monogyna* (Hawthorn), *Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*)* and *Allocasuarina verticillata* (Drooping Sheoak) Low Woodland	5	3	WW, R	F/S/Sp
30	*Crataegus monogyna* (Hawthorn) / *Olea europaea* (Olive) Low Woodland	5	3		WW/S

Gully & Wheal Gawler Mine Reserves

Area #	vegetation description	Cond (1-5)*	Canopy Density (1- 4)**	Comments BFL = Bush for Life site R = Existing Revegetation WW = Woody weed management	Management Options PB=Prescribed Burn S = Slash Sp = Spray * WW = Woody Weed control F = Follow up Woody Weed control
17	*Eucalyptus* sp. (Eucalypt) Woodland	3	1	WW	S/Sp
18	*Olea europaea* (Olive) Woodland	3	1	WW	F/S/Sp
30	*Eucalyptus* sp. (Eucalypt) / *Allocasuarina verticillata* (Drooping Sheoak) Woodland	3	2		S/Sp
2	*Eucalyptus* sp. (Eucalypt), *Hakea laurina* (Pin-cushion Hakea), *Acacia pycnantha* (Golden Wattle) and *Melaleuca armillaris* (Bracelet Honey-myrtle) Woodland	4	3	WW, R	WW/S
20	*Eucalyptus microcarpa* (Grey Box) Woodland	4	3	WW	S/PB/Sp
22	*Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*)* Woodland	4	3		S/PB/Sp
27	*Allocasuarina verticillata* (Drooping Sheoak) / *Olea europaea* (Olive) Low Woodland	4	1	WW	F/S/Sp
33	*Eucalyptus cladocalyx* (Sugar Gum) sp. (Eucalypt) Open Forest	4	3		WW/S/Sp
35	*Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*)*, *Acacia pycnantha* (Golden Wattle), *Acacia paradoxa* (Kangaroo Thorn) and *Allocasuarina verticillata* (Drooping Sheoak) Woodland	4	2	WW, R	S/PB/Sp
1	*Eucalyptus* sp. (Eucalypt) / *Allocasuarina verticillata* (Drooping Sheoak) Woodland over *Hakea carinata* (Erect Hakea)	5	2	WW, R	S
3	*Allocasuarina verticillata* (Drooping Sheoak), *Melaleuca armillaris* (Bracelet Honey-myrtle), *Acacia pycnantha* (Golden Wattle) and *Acacia melanoxylon* (Blackwood) Low Woodland	5	2	WW, R	WW/S
4	*Eucalyptus* sp. (Eucalypt), *Allocasuarina verticillata* (Drooping Sheoak) and *Acacia pycnantha* (Golden Wattle) Low Woodland	5	3	WW, R	S/PB/Sp
5	*Eucalyptus* sp. (Eucalypt), *Allocasuarina verticillata* (Drooping Sheoak), *Acacia pycnantha* (Golden Wattle) and *Dodonaea viscosa* ssp. *spatulata* (Sticky Hop-bush) Low Woodland	5	2	WW, R	S/Sp
6	*Agonis flexuosa* (Willow Myrtle), *Acacia longifolia* ssp *longifolia* (Sallow Wattle), *Callistemon* sp. (Bottle Brush) Low Woodland	5	2	WW	WW/S/Sp
7	*Olea europaea* (Olive), *Acacia pycnantha* (Golden Wattle), *Eucalyptus* sp. (Eucalypt), *Rubus ulmifolius* var. *ulmifolius* (Blackberry), *Acacia paradoxa* (Kangaroo Thorn), *Acacia longifolia* ssp *longifolia* (Sallow Wattle) and *Allocasuarina verticillata* (Drooping Sheoak) Low Woodland	5	2	WW	WW/F/S/Sp
8	*Corymbia citriodora* (Lemon-scented Gum), *Agonis flexuosa* (Willow Myrtle), *Acacia*	5	3	WW, R	WW/F/S/Sp

	pycnantha (Golden Wattle), *Acacia paradoxa* (Kangaroo Thorn) Woodland				
9	*Olea europaea* (Olive) / *Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*)* Low Woodland	5	3		WW/S/Sp
10	*Agonis flexuosa* (Willow Myrtle) Low Woodland	5	1	WW	WW/S/Sp
11	*Olea europaea* (Olive), *Pinus* sp. (Pine) and *Acacia pycnantha* (Golden Wattle) Low Woodland	5	2	WW	F/S/PB/Sp
12	*Allocasuarina verticillata* (Drooping Sheoak) Low Woodland	5	3		S
13	Exotic herbaceous and grassy understorey	5	-	WW	S/Sp
14	*Allocasuarina verticillata* (Drooping Sheoak), *Acacia pycnantha* (Golden Wattle), *Dodonaea viscosa* ssp *spatulata* (Sticky Hop-bush) Low Woodland	5	2	WW, R	S/PB/Sp
15	*Eucalyptus* sp. (Eucalypt) Woodland	5	2	WW	S/Sp
16	*Pinus* sp. (Pine) and *Olea europaea* (Olive) Woodland	5	1	WW	F/S/Sp
19	*Pinus* sp. (Pine), *Olea europaea* (Olive) and *Eucalyptus* sp. (Eucalypt) Woodland	5	3		WW/S/Sp
21	*Pinus* sp. (Pine) Woodland	5	4		WW/S/Sp
23	*Fraxinus angustifolia* (Desert Ash), *Pinus* sp. (Pine) and *Olea europaea* (Olive) Woodland over *Rubus ulmifolius* var*. ulmifolius* (Blackberry)	5	3		WW/S/Sp
24	*Pinus* sp. (Pine) and *Olea europaea* (Olive) Woodland over *Rubus ulmifolius* var*. ulmifolius* (Blackberry)	5	4		WW/S
25	*Pinus* sp. (Pine) and *Olea europaea* (Olive), *Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*)*, *Acacia paradoxa* (Kangaroo Thorn) and *Allocasuarina verticillata* (Drooping Sheoak) Woodland	5	1	WW, R	F/S/Sp
26	*Pinus* sp. (Pine), *Olea europaea* (Olive) and *Eucalyptus* sp. (Eucalypt) Woodland	5	2		WW/S
28	*Acacia pycnantha* (Golden Wattle) Low Woodland	5	1		S/Sp
29	*Olea europaea* (Olive) Low Woodland	5	3		WW/S/Sp
31	*Olea europaea* (Olive), *Eucalyptus* sp. (Eucalypt) and *Acacia pycnantha* (Golden Wattle) Woodland	5	2	WW, R	F/S/Sp
32	*Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*)*, *Acacia pycnantha* (Golden Wattle), *Allocasuarina verticillata* (Drooping Sheoak) and *Acacia melanoxylon* (Blackwood) Woodland	5	2	WW, R	S/Sp
34	*Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*)*, *Crataegus monogyna* (Hawthorn), *Olea europaea* (Olive) and *Acacia pycnantha* (Golden Wattle) Open Woodland	5	1	WW	F/S/Sp
36	*Eucalyptus* sp. (Eucalypt) / *Allocasuarina verticillata* (Drooping Sheoak) Open Forest	5	3		WW/S/Sp
37	*Eucalyptus* sp. (Eucalypt), *Olea europaea* (Olive), *Crataegus monogyna* (Hawthorn), *Acacia pycnantha* (Golden Wattle) and *Allocasuarina verticillata* (Drooping Sheoak) Open Forest	5	3	WW, R	F/PB/S/Sp
38	*Eucalyptus* sp. (Eucalypt), *Acacia melanoxylon* (Blackwood), *Acacia pycnantha* (Golden Wattle), *Allocasuarina verticillata* (Drooping Sheoak) and *Acacia retinodes* var*. retinodes* (Swamp Wattle) Open Forest	5	3	WW, R	PB/S/Sp

Chimney & Zig-zag Reserve

Area #	vegetation description	Cond (1-5)*	Canopy Density (1- 4)**	Comments BFL = Bush for Life site R = Existing Revegetation WW = Woody weed management	Management Options PB=Prescribed Burn S = Slash Sp = Spray * WW = Woody Weed control F = Follow up Woody Weed control
4	*Allocasuarina verticillata* (Drooping Sheoak) / *Pinus* sp. (Pine) Open Woodland	3	3	WW, R	F/S/PB/Sp
2	*Eucalyptus camaldulensis* var. *camaldulensis* (Red Gum), *Olea europaea* (Olive), *Pinus* sp. (Pine) and *Crataegus monogyna* (Hawthorn) Closed Forest	4	4		WW/S/PB/Sp
1	*Eucalyptus camaldulensis* var. *camaldulensis* (Red Gum), *Olea europaea* (Olive) and *Acacia melanoxylon* (Blackwood) Closed Forest	5	4		WW/S/PB/Sp
3	*Fraxinus angustifolia* (Desert Ash), *Olea europaea* (Olive), *Pinus* sp. (Pine) and *Rhamnaceae* sp. Low Open Woodland.	5	3		WW/S/PB/Sp
5	*Olea europaea* (Olive), *Pinus* sp. (Pine) and *Fraxinus angustifolia* (Desert Ash) Closed Forest	5	4	WW	F/S/Sp
6	*Olea europaea* (Olive) / *Pinus* sp. (Pine) Open Forest	5	3	WW	WW/F/S/Sp
7	Mixed *Eucalyptus* sp. (Eucalypt), *Eucalyptus camaldulensis* var. *camaldulensis* (Red Gum), *Olea europaea* (Olive), *Allocasuarina verticillata* (Drooping Sheoak) and *Pinus* sp. (Pine) Woodland	5	2	R	WW/ S/PB/Sp

Danthonia Reserve

Area #	vegetation description	Cond (1-5)*	Canopy Density (1- 4)**	Comments BFL = Bush for Life site R = Existing Revegetation WW = Woody weed management	Management Options PB=Prescribed Burn S = Slash Sp = Spray * WW = Woody Weed control F = Follow up Woody Weed control
11	*Allocasuarina verticillata* (Drooping Sheoak) / *Acacia pycnantha* (Golden Wattle) Low Woodland	3	2	WW, R	S/Sp
12	*Allocasuarina verticillata* (Drooping Sheoak) Low Woodland	3	2		S/Sp
1	*Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*)* / *Allocasuarina verticillata* (Drooping Sheoak) Woodland	4	2	R	S/PB/Sp
2	*Allocasuarina verticillata* (Drooping Sheoak) Low Woodland	4	2		S/PB/Sp
4	*Allocasuarina verticillata* (Drooping Sheoak) / *Acacia pycnantha* (Golden Wattle) Woodland	4	4	WW, R	S/Sp
5	*Eucalyptus camaldulensis* var*. camaldulensis* (Red Gum), *Acacia pycnantha* (Golden Wattle), *Allocasuarina verticillata* (Drooping Sheoak) and *Eucalyptus leucoxylon ssp. leucoxylon (*SA Blue Gum*)* Woodland	4	2	WW, R	PB/S/Sp
6	*Eucalyptus camaldulensis* var*. camaldulensis* (Red Gum), *Olea europaea* (Olive), *Allocasuarina verticillata* (Drooping Sheoak) and *Eucalyptus leucoxylon ssp. leucoxylon (SA Blue Gum)* Open Forest	4	3		WW/S/Sp
8	*Allocasuarina verticillata* (Drooping Sheoak), *Olea europaea* (Olive), *Eucalyptus camaldulensis* var*. camaldulensis* (Red Gum) and *Acacia pycnantha* (Golden Wattle) Open Forest	4	3		WW/S/Sp
3	*Olea europaea* (Olive), *Pinus* sp. (Pine), *Acacia pycnantha* (Golden Wattle), *Allocasuarina verticillata* (Drooping Sheoak) Woodland	5	2	WW, R	F/S/PB/Sp
7	*Olea europaea* (Olive) Low Woodland	5	3	WW	F/S/Sp
9	*Eucalyptus microcarpa* (Grey Box), *Allocasuarina verticillata* (Drooping Sheoak) and *Acacia pycnantha* (Golden Wattle) and *Eucalyptus camaldulensis* var*. camaldulensis* (Red Gum) Open Forest	5	3		S/PB/Sp
10	*Eucalyptus microcarpa* (Grey Box) Open Forest	5	3		S/PB/Sp

**Code	Density
1	Very sparse (<10% cover)
2	Sparse (10% - 30% cover)
3	Mid dense (30% - 70% cover)
4	Dense (70% - 100% cover)

*Cond. Rating	Overview Condition	Description
1	Largely undisturbed	No exotic species in the understorey. Close to pre-European condition.
2	Good / intact structure	Few exotic species in the understorey and very low densities of those species. High proportion of pre-European native species represented.
3	Moderate	Exotic species prominent in the understorey. Either many different species or widespread infestation throughout, however native species are still dominant.
4	Poor / Highly modified	Either high number of many exotic species or high density of few exotic species. Exotic species dominate the understorey. High levels of exotic species are inhibiting native understorey species recruitment.
5	Very Poor / residual	The understorey consists of only exotic species.
(adapted from '*Guide To Roadside Vegetation Survey Methodology for South Australia*', Stokes et al 1998).		

Appendix 3

Illustrations of fire management concepts

LOW overall fire fuel hazard

MODERATE overall fire fuel hazard

Photographs from CFS website

High quality native woodland –
Low overall fire fuel hazard

Belair National Park

High quality native grassland - Low overall fire fuel hazard
- managed by patch burning after the first rains in autumn.

Hamilton, Victoria

Low intensity area burn after the first rains in autumn
- for removing thatch and to control annual grass weeds.
Staff and contractors can safely undertake burns like this.

Private property, Adelaide Hills