

Wingecarribee Shire Council

Fire Management Plans

for

Mt Gibraltar Reserve

Gibbergunyah Reserve

Mt Alexandra Reserve

Appendices

July 2004

Wingecarribee Shire Council

Fire Management Plans

for

Mt Gibraltar Reserve

Gibbergunyah Reserve

Mt Alexandra Reserve

Appendices

July 2004

Prepared By

AVK Environmental Management

ABN 53 202 252 651

PO Box 230 Mittagong NSW 2575

Mobile: 041 2141955, Phone/Fax: 02) 4861 7358

and
Renaissance Forestry

ABN 53 202 252 651

PO Box 230 Mittagong NSW 2575

Mobile: 041 2141955, Phone/Fax: 02) 4861 7358

Contents

Appendix A: Management Procedures (MP)

1. Fire trail construction
2. Fire trail inspection and maintenance
3. Trail closure and rehabilitation
4. Foot track construction, inspection and maintenance
5. Construction and maintenance of static water supplies
6. Creating an Asset Protection Zone
7. Maintaining an Asset Protection Zone
8. Prescribed burning
9. Weed control before and after burning
10. Coordinating fire management activities
11. Recording wildfires
12. Recording fire management activities
13. Post-wildfire recovery

Appendix B: Fuel Load Assessment Procedure

Appendix C: Community Notification Letter

Appendix D: Plan Preparation Methodology

Appendix E: Ecological Investigation Report

Appendix F: Community Information Brochure

Appendix A

Management Procedures

MP 1 FIRE TRAIL CONSTRUCTION

Objective

To provide guidelines for construction of fire trails to ensure that they:

- are safely trafficable by Rural Fire Service vehicles (light, medium and heavy tankers)
- can be used as fire control lines for wildfire suppression and prescribed burning.

Application

This MP can be used for all fire trails constructed within, or on land adjoining, Wingecarribee Shire Council reserves for the primary or secondary purpose of providing access for Rural Fire Service vehicles.

This MP is also intended to provide reference guidelines for the up-grading and maintenance of existing trails that have been designated as fire trails, or are likely to be required for Rural Fire Service vehicle access.

This MP is not intended for trails that have unrestricted public access, or are likely to receive frequent usage.

These are general guidelines only, and may need to be varied to suit particular conditions.

Classification

The NSW Bushfire Coordinating Committee has three categories of fire trail:

- “a) **Primary Fire Trail:** This is a fire trail of strategic importance and/or is a primary feeder route to a network of secondary trails.
- b) **Secondary Fire Trail:** This is a fire trail that can be used for fire control, suppression and mitigation purposes.
- c) **Dormant Fire Trail:** This is a fire trail that has been closed but has been identified as suitable for reopening with minimal works.”

Dormant fire trails are dealt with in MP 3, Trail Closure and Rehabilitation.

Construction Guidelines

GENERAL

1. The DLWC document *Guidelines for the Planning, Construction and Maintenance of Tracks* should be used as the minimum standard for Primary and Secondary fire trails.
2. Fit the fire trail to the topography wherever possible so that alterations to the natural features will be minimised.
3. On broad-topped ridges and plateaux, locate trails at least 50 m from the break-of-slope wherever possible.
4. Avoid dead-ends wherever possible, particularly on primary fire trails.
5. Avoid areas of dense vegetation that accumulate heavy fuel loads.
6. Install suitable gates and signs to prevent unauthorised usage. Include signage to prevent gates being blocked.

PRIMARY FIRE TRAIL

1. Primary fire trails should be of formed, all weather construction.
2. Minimum trafficable width of 4 m.
3. Minimum 4 m vertical clearance to any obstructions above the trail surface.
4. Dips should have no more than a 1 in 8 (12.5%) entry and exit angle.
5. Curves with a minimum inner radius of 6 m and a minimum distance between outer and inner curves of 6 m
6. Maximum grade of 15° (1 in 4)
7. Structures such as culverts and bridges should have a load capacity of at least 20 tonnes.
8. Single lane trails should have passing bays 3 m wide by 20 m long at least every 250 m making a total road width of 6 m within the passing bay.
9. A minimum 1 m wide strip on each side of the trail should be cleared of shrubs, bushes and other undergrowth unless the trail is a component of a wider fire break. Plant species listed in the Threatened Species Conservation Act, 1995, should not be removed without a permit.
10. Average travel speed of 15 km/hr.
11. Where a dead end cannot be avoided it should be provided with a turn-around, or loop, of minimum diameter 25 m so as to allow for continuous forward motion of fire service vehicles.
12. Material used for trail construction in native bushland must be from sources free of weeds.

SECONDARY FIRE TRAIL

1. Secondary fire trails should be of formed, all weather construction.
2. Minimum trafficable width of 3.5 m.
3. Minimum 4 m vertical clearance to any obstructions above the trail surface.
4. Dips should have no more than a 1 in 8 (12.5%) entry and exit angle.
5. Curves with a minimum inner radius of 6 m and a minimum distance between outer and inner curves of 6 m
6. Maximum grade of 15° (1 in 4)
7. Structures such as culverts and bridges should have a load capacity of at least 20 tonnes. If this cannot be provided trails should be signposted as Category 7/9 Tankers only.
8. Passing bays 3 m wide by 20 m long where the terrain allows.
9. Average travel speed of 10 km/hr.
10. Where a dead end cannot be avoided it should be provided with a turn-around, or loop, of minimum diameter 25 m so as to allow for continuous forward motion of fire service vehicles. If the terrain does not allow for a loop, a turning bay 6 m wide by 8 m long should be provided, or a 'T' or 'Y' head with bays 8 m long by 4 m wide.
11. Material used for trail construction in native bushland must be from sources free of weeds.

Sources

Bushfire Coordinating Committee (2003) *Policy No. 1/03 Fire Trails*. USW Bushfire Coordinating Committee, Sydney.

Bushfire Coordinating Committee (2003) *Policy No. 1/03 Guidelines for the Classification of Fire Trails*. USW Bushfire Coordinating Committee, Sydney.

DLWC (1994) *Guidelines for the Planning, Construction and Maintenance of Tracks*. Department of Land and Water Conservation, Sydney.

NSW Rural Fire Service (2001) *Planning for Bushfire Protection, A Guide for Councils, Planners, Fire Authorities, Developers and Home Owners*. NSW Rural Fire Service, Sydney.

MP 2 FIRE TRAIL INSPECTION AND MAINTENANCE

Objective

To ensure that all designated Primary and Secondary fire trails in Wingecarribee Shire Council reserves are trafficable by Rural Fire Service vehicles at all times during the bushfire danger period, and have a low risk of erosion and sediment runoff.

Application

- This MP can be used for all designated fire trails in Council reserves.
- This MP is not intended for trails that are open to unrestricted use by the public, or are likely to receive frequent usage.

Guidelines

INSPECTION TRIGGERS

All fire trails should be inspected:

- at the beginning of the bushfire danger period (September)
- as soon as possible after heavy rainfall sufficient to cause substantial runoff
- as soon as possible after wind storms likely to have blown over trees, or brought down large branches.

A particular fire trail should be inspected and any necessary maintenance carried out following a complaint, or notification of damage, from a trail user.

INSPECTION ITEMS

The following seven items should be checked during each fire trail inspection:

1. Surface: wherever possible primary fire trails should have a smooth surface free from loose stones and rough exposed rock (except for cross banks for erosion control, and rock lined fords). A rougher surface is acceptable on secondary fire trails provided it is not likely to damage vehicles. It should be noted that a smooth surface may not be achievable on all sections of all trails without importing substantial amounts of surfacing materials.

2. **Erosion:** trails should be free of rilling or gullying caused by water flowing across or along the trail.
3. **Water on trail:** where water has been running along the trail, adequate arrangements must be made for it to be turned off the trail.
4. **Drainage:** all table drains, cross banks, fords, culverts and bridges should be functioning and free of erosion damage or blockages.
5. **Trees or branches across the trail:** fallen trees or branches should not be allowed to block trails, even where it is possible to manoeuvre a vehicle around them. They should be moved well back from the edge of the trail. Where there are heavy accumulations of fuels adjacent to trails, fallen trees and branches should be removed completely.
6. **Shrubs and bushes on the sides of the trail:** there should be no shrubs, bushes or small trees within 1 m of either side of primary fire trails. The clearing width can be reduced in areas where fuel loads are naturally relatively low, or where threatened plant species occur along the side of the trail.
7. **Gates and locks:** gates should be intact and able to be opened and closed easily, locks must be easy to open.

MAINTENANCE

Note that the use of fire trails when they are wet and soft must be minimised to reduce damage and subsequent maintenance costs.

- Where the trail surface has been damaged by water running down the trail, excessive usage etc., the trail should be regraded to ensure the trail has a smooth surface and sufficient cross-fall (preferably outfall) to shed water. Any ridges or berms along the side of the trail that could cause stormwater to run along the trail should be removed. If there is insufficient material available on the sides of the trail for repairs, import suitable material. In weed infested areas ensure that blading is done into, not out of, weed infestations.
- Material used for trail repair in areas of native bushland must be from areas free of weeds.
- Where excessive erosion has occurred, or it is not possible to provide adequate cross-fall drainage, install additional cross banks to direct water to the side of the trail.
- Remove any accumulated sediment, leaves, branches or other litter that is blocking table drains or culverts.
- Repair cross banks that have been overtopped, blocked up with sediment, or are badly rutted.

-
- Where trails have been eroded by runoff flowing across the trail, construct a concrete or rock lined ford, or divert runoff along a table drain to a culvert or a stable ford.
 - Remove shrubs, bushes and saplings as required to maintain a minimum 1 m clearance on each side of primary fire trails. Plant species listed in the Threatened Species Conservation Act, 1995, should not be removed without a permit. Cut vegetation should not be left on the side of the trail but removed from the site, or stockpiled and burnt in a clear open area.
 - Cut up and remove any trees that have fallen across fire trails. Larger branches and stumps should not be left on the side of the trail but dragged into the bush on the side of the trail, or removed from the area. Small branches should be removed from the site, or stockpiled in a clear open area and burnt. Make sure that fallen trees and branches are cut back at least 2 m from the edge of the trail.
 - Ensure that gates on fire trails are intact and locked, and that locks on gates are working smoothly.
 - Replace any trail identification signs or markers that have been damaged or removed.

DOCUMENTATION

Fire trail inspections should be recorded on the following form, and passed on to the relevant department for action:

FIRE TRAIL INSPECTION FORM

Date: _____ Trail name/number: _____

Inspected by: _____

Reason for Inspection: _____

Pre-bushfire season check on: _____

Notification from: _____

Received by: _____

On: _____

Heavy rainfall on: _____

Wind storm on: _____

CHECKLIST

ITEM	CONDITION	GRID REFERENCE	RECOMMENDED ACTION	COMPLETED ON	BY (signed)
Trail surface	<input type="radio"/> Good <input type="radio"/> Poor at				
Trail erosion	<input type="radio"/> Good <input type="radio"/> Poor at				
Trail drainage	<input type="radio"/> Good <input type="radio"/> Poor at				
Trees and branches across trail	<input type="radio"/> No <input type="radio"/> Yes at				
Trail overgrown	<input type="radio"/> No <input type="radio"/> Yes at				

MP 3 TRAIL CLOSURE AND REHABILITATION

Objective

To ensure that dormant fire trails in Wingecarribee Shire Council reserves are closed in a way that minimises adverse impacts on the environment, but ensures that they can be re-opened with minimal work if required for fire control in the future.

Application

All trails in Wingecarribee Shire Council reserves designated as dormant fire trails, and other trails not required for other management purposes.

Guidelines

GENERAL PRINCIPLES

Dormant fire trails are not maintained in a trafficable condition, however the trail surface is stabilised and retained so that the trail can be easily re-opened if required for fire suppression or management burning.

The main management consideration is to stop water running down dormant trails causing on-going soil erosion and sediment runoff.

Revegetation of dormant trails should be limited to indigenous shrubs and grasses that provide stability, but can be easily removed when the trail needs to be re-opened.

Trails not designated as fire trails, and not required for other management purposes, should be treated to allow for full regeneration of bushland.

Revegetation of closed trails should include any associated disturbed areas such as cut and fill batters and borrow pits.

DORMANT FIRE TRAILS

1. If not already in place, construct cross drains on steeper sections of dormant trails to avoid concentration of runoff and minimise erosion.
2. Cross drains should be constructed at 45 to 90 degrees to the trail with a cut that is about 0.3 m deep (measured from the upper side of the cut) and about 1 m wide, with a cross-fall of 1 % to 3 %. The spoil from the cut is to be placed on the down hill side of the cut to form a bank.

3. Cross drains should be placed at changes in slope and to take advantage of natural drainage points.
4. Spacing of cross drains is to be at least equal to the lower limits in the DLWC document *Guidelines for the Planning, Construction and Maintenance of Tracks*.
5. Deep ruts and washouts (depth of 0.2 m or more) should be filled, closed over and drained.
6. Treat any weed growth along the side of the trail.
7. Material used for trail rehabilitation must be from areas free of weeds.
8. Rake leaf litter from weed free bushland adjacent to the trail across the trail to encourage grass and shrubs to grow.
9. Inspect the dormant trail every 3 years, treat any weeds, and cut and poison any tree saplings that may have germinated on the trail. Alternatively, slash the trail every three years to control shrub and tree growth.
10. Where unauthorised usage is a problem, place suitable barriers (eg, boulders, large logs) at the entrance to the trail.

COMPLETE TRAIL CLOSURE

1. Deep ruts and washouts (depth of 0.2 m or more) should be filled, closed over and drained.
2. Construct cross drains where required to stop water running down the trail.
3. Bridges and culverts should be removed, and the trail restored to a condition where surface water will not drain directly into the watercourse. Wherever possible watercourses should be able to flow along their original courses.
4. Treat any weed growth along the side of the trail.
5. Lightly rip any sections of the trail with a hard compacted surface.
6. Rake leaf litter from weed free bushland adjacent to the trail across the trail.
7. Cut brush from adjacent bushland and lay it across the trail to provide a suitable environment for seed germination. Wherever possible use material containing seed.
8. Inspect the trail 6 months and one year after closure and treat any weed growth.

Sources

DLWC (1994) *Guidelines for the Planning, Construction and Maintenance of Tracks*. Department of Land and Water Conservation, Sydney.

NSW Bushfire Coordinating Committee (2003) *Policy No. 1/03*

Forestry Commission Tasmania (1993) *Forest Practices Code*. Forestry Commission Tasmania, Hobart.

MP 4 FOOT TRACK CONSTRUCTION, INSPECTION and MAINTENANCE

Objective

To provide foot tracks that allow for public access in Wingecarribee Shire reserves while at the same time providing control lines that can be used to contain bushfires.

Application

Foot tracks constructed through, and along the boundaries of, fire management units.

Guidelines

DESIGN AND CONSTRUCTION

Foot tracks should be designed and constructed to the standards for a Class 4 track or higher in Australian Standard 2156 –2001 *Walking Tracks*.

If possible, avoid timber boardwalks on foot tracks within, or on the boundaries of, fire management units as these may be hard to protect during management burns.

Where possible track signage should be of non-combustible materials.

INSPECTION AND MAINTENANCE PRIOR TO BURNING

In addition to any inspection and maintenance required to keep foot tracks in good condition for users, tracks to be used as fire control lines should be inspected approximately one week before a prescribed burn and the following preparation carried out where required:

- remove any fallen trees or branches lying across the track
- clear any shrubs and bushes encroaching on the track so that there is at least a 1.5 m break in the understorey canopy
- clear leaves and litter off the track to ensure a mineral earth gap at least 600 mm wide.
- repair any damaged sections of the track surface to the standards in AS 2156 - 2001.

Sources

Australian Standard 2156 – 2001 *Walking Tracks*. Standards Australia, Sydney.

MP 5 CONSTRUCTION AND MAINTENANCE OF STATIC WATER SUPPLIES

Objective

To construct and maintain static water supplies so that they continue to provide a reliable water supply to refill fire tankers, and are accessible by fire tankers at all times.

Application

Water points in Wingecarribee Shire Council reserves constructed to provide a water supply for fire management operations (includes; dams, waterholes and pools in running streams).

Guidelines

LOCATION

1. As a general rule static water supplies should be located along primary fire trails so that no point on the fire trail is more than 10 minutes drive for a heavy tanker from a water supply.
2. Waterholes can be constructed on reasonably level areas on the sides of fire trails in clayey soils with good water retention properties. Sites that receive some runoff and/or seepage should be preferred.
3. Dams can be constructed close to fire trails in drainage depressions
4. Pools can be constructed in creeks adjacent to bridges and fords. If the creek bed is on bedrock or rocky, the pool can be dug in the creek bed. For creek beds in gravels, sands, silts or clays an off stream storage should be constructed as shown in Figure 1.

CONSTRUCTION

1. Waterholes should have a minimal surface area to volume ratio. They can be more than 5 m deep and have near vertical walls - however, one side should be sloped at less than 10° to allow for people and animals to exit the pool should they fall in.
2. Static Water Supplies should have a minimum reliable capacity of 30,000 litres.
3. "Off stream" static water supplies should be constructed to the side of the stream bed and can be constructed efficiently with excavators. The storage hole should fill from the stream under normal flow and when full, the over flow from the storage hole should run back into the watercourse. Disturbance of the stream bed should be minimised. Flood flows should follow the original watercourse, not flow into the storage area.

4. Where a dam wall needs to be constructed the wall should be “keyed” at the base with clay material to provide an effective seal. The face of a dam wall should also be lined with clay to provide a seal.
5. Material dug out with excavators should be levelled off and contoured to leave a tidy and visually acceptable site.
6. Static water supplies that are not beside roads require a vehicle access track suitable for heavy tankers. A fender log or bollard should be placed to prevent vehicles accidentally backing into the water.
7. A level platform should be constructed on the edge of the waterhole or dam to provide a stable platform to locate pumps.
8. There must be a heavy tanker turning area within 50 m of the water supply. If there is no trail intersection within this distance, a cleared area will need to be provided on the side of the trail.

IDENTIFICATION SIGNS

1. For consistency with markers used on private property, all static water supplies within Council reserves should be marked with a reflective “SWS” marker available from the Rural Fire Service or the NSW Fire Brigades.
2. Markers should be placed on the side of the fire trail close to the water supply in a position clearly visible at night.
3. If the water supply is off the fire trail, a reflective red arrow and numbers should be placed beside the SWS marker to indicate the direction and distance to the static water supply.

MAINTENANCE

Check all static water supplies at the beginning of the bushfire season and:

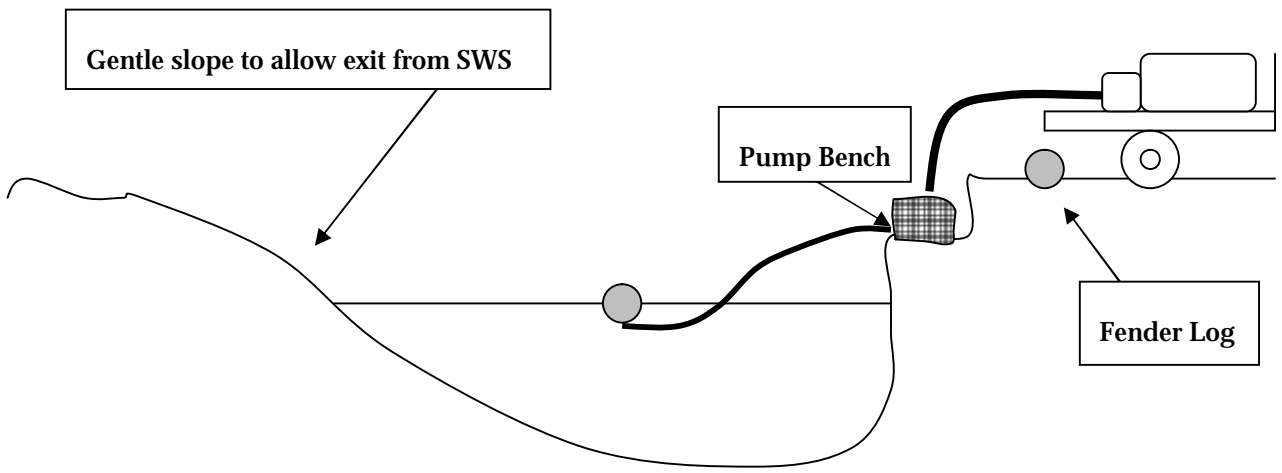
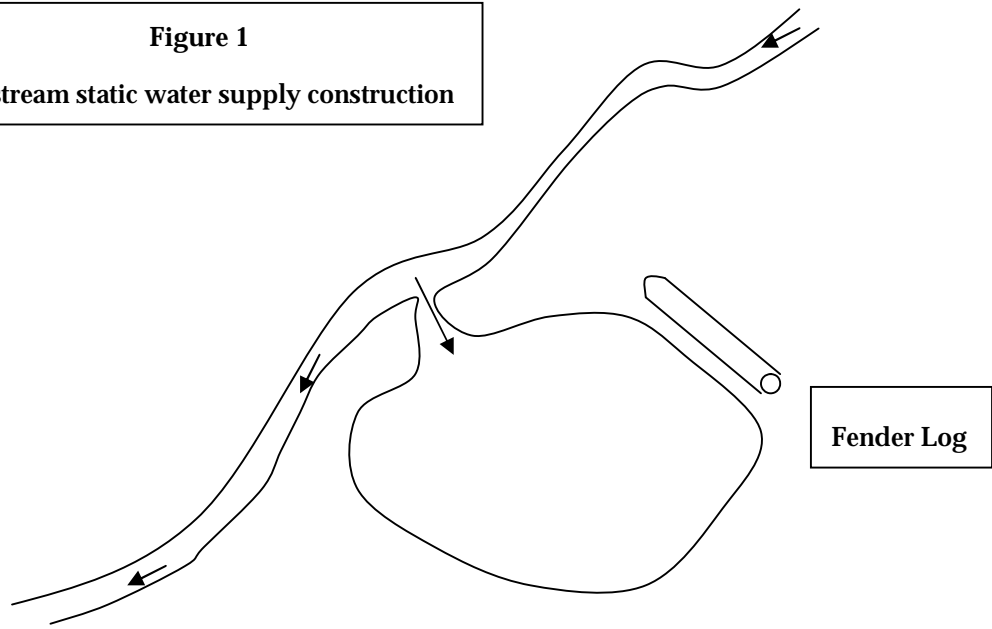
- clean out waterholes whenever sedimentation has reduced their capacity by more than 30% of the original volume
- ensure that heavy fire tankers can reverse safely to within 4 m of the static water supply
- ensure that heavy fire tankers can turn at, or close to, each static water supply.

Sources

Fogarty L. and Tucker C. (2000) *Guidelines for the Construction of Water Points for Fire Fighting*. Forestry Tasmania internal document.

Forest Practices Board (2000) *Forest Practices Code*. Forest Practices Board, Hobart, Tasmania.

Figure 1
Off stream static water supply construction



MP 6 CREATING AN ASSET PROTECTION ZONE

Objective

To establish Asset Protection Zones around built assets at risk from fire managed to reduce the bushfire hazard to a level at which there will be a significant reduction in the intensity of any wildfire as it approaches the asset at risk from fire.

An Asset Protection Zone should fulfil the following functions:

- ensure there is a reduction in fine fuel load between a bushfire hazard and any structures
- break up the continuity of fine fuel between bushland and any structures
- provide an area free of fine fuel around structures where wind-blown burning debris are unlikely to ignite spot fires during a wildfire
- minimise the risk of building ignition by radiant heat or direct flame contact during a wildfire
- provide safe access for fire fighters during a wildfire
- provide a control line for fire fighting operations
- provide a relatively safe refuge area during a wildfire.

Application

- a) Required to reduce the fire risk to dwellings, or other built assets at risk from bushfires.
- b) Can be constructed between the bushfire hazard and a single dwelling, or a group of dwellings.
- c) For existing subdivisions and developments bordering Council reserves a portion of the Asset Protection Zone may have to be established and maintained in the reserve.
- d) For new subdivisions and developments the whole of the required Asset Protection Zone should be included within the development.

NOTE: For hazard reduction works in Council reserves not covered by a fire management plan, Council will need to undertake an environmental assessment of the proposed works using the *Bushfire Environmental Assessment Code* (RFS, 2003) and issue a Bush Fire Hazard Reduction Certificate under sections 100F and 100G of the Rural Fires Act 1997.

Guidelines

An Asset Protection Zone consists of an Inner Protection Area with almost no fine fuel (not enough to carry a fire), and an Outer Protection Area with reduced fine fuel loads. Fine fuel comprises live and dead plant matter less than 6 mm in diameter. The Asset Protection Zone is measured outwards from the walls of the building towards the fire hazard.

For new developments the required widths of the Asset Protection Zone are set out in Tables 4.1 and 4.2 of the NSW Rural Fire Service publication *Planning for Bushfire Protection*. For existing developments that did not have an Asset Protection Zone included in their conditions of consent, the widths of the required Inner Protection Area are given in the *Bush Fire Environmental Assessment Code for Asset Protection and Strategic Fire Advantage Zones* (RFS, 2003). These distances apply to habitable buildings close to bushland likely to generate significant ember attack (wet and dry sclerophyll forest, shrubby woodland, heathland).

SLOPE	WIDTH
Hazard upslope (< 18°)	20 m
Hazard downslope 0° to 5°	25 m
Hazard downslope 5° to 10°	30 m
Hazard downslope 10° to 15°	40 m
Hazard downslope 15° to 18°	50 m

For fuel unlikely to generate significant ember attack (grassland, grassy woodland, rainforest) a 20 m Inner Protection Area is required irrespective of slope. For non habitable structures the Environmental Assessment Code specifies a 10 m wide Inner Protection Area.

INNER PROTECTION AREA

Establishment of an Inner Protection Area requires the removal of almost all the fine fuel on the ground surface, and isolation of any remaining fuels in the shrub layer to ensure that they are discontinuous both vertically and horizontally. Trees and shrubs can be retained or planted within the Inner Protection Area for aesthetic purposes, however trees must not overhang dwellings and there must not be a continuous vegetation cover at any level between the dwelling and the surrounding bushland. Trees and large shrubs must be pruned to remove dead branches and to ensure there is a gap of at least 2 m between the lower branches and the ground.

In general, landscaping within the Inner Protection Area should be limited to plant species of low flammability, and any accumulations of dry fine fuel must be removed before, and regularly during, the annual bushfire danger period.

General recommendations for landscaping within an Inner Protection Area include, but are not restricted to:

- use only mown lawn, bare ground (driveways, paths etc) or non-flammable succulent ground cover plants immediately adjacent to buildings (within 2 to 5 metres)
- incorporate non-flammable structures, such as lawns, pools and tennis courts, into the Inner Protection Area
- maximum tree cover should be less than 30%, and maximum shrub cover less than 20%
- trees and shrubs should be isolated or in small clumps; avoid continuous canopies
- where tree removal is required to establish canopy breaks, remove rough-barked tree species in preference to smooth-barked species
- trees planted should be species that grow to over 2 m in height to maintain separation between the lower canopy and the ground
- trees must not be allowed to grow closer to a dwelling than their expected full height
- avoid planting trees and shrubs with rough fibrous bark, or which retain shed bark in long strips (ribbonbark)
- avoid planting trees and shrubs that retain dead material in their canopies
- avoid planting trees and shrubs that deposit large quantities of litter in a short period, particularly in spring and summer
- canopies of shrubs should not touch walls
- avoid vines on walls
- avoid brush fencing as well as continuous areas of woodchips or other flammable mulches
- use retaining walls around any terraces in preference to sloping banks as walls help reduce the impact of radiant heat
- use stone walls or solid metal fencing in preference to wooden or open fences.

OUTER PROTECTION AREA

Outer Protection Areas can be established in bushland reserves by hand thinning and clearing, mechanical slashing, or prescribed burning, either singly or in combination.

- Hand clearing is preferred in weed infested areas, in dense forest or shrubland, and where there are threatened plant species present.
- Slashing is preferred in grasslands and grassy woodlands.
- Burning may be sufficient in open grassy woodlands where there are few weeds and no fire sensitive threatened plant species.
- Remove or prune trees and shrubs as required to ensure that the vegetation (fuel) is not continuous either horizontally or vertically.
- When removing vegetation by hand to create an Outer Protection Zone in a bushland area, the order of preference for vegetation removal should be:
 1. noxious weeds
 2. other environmental weeds
 3. other introduced species (except special ornamental plantings)
 4. rough barked indigenous trees and shrubs
 5. indigenous trees and shrubs that hold dead leaves and twigs in their canopy
 6. relatively flammable sclerophyllous species.

In many urban fringe areas removal of weed species alone may be sufficient to create an Outer Protection Area.

- Retain individuals of any threatened plant species.
- Reduce fine fuel loads in Outer Protection Areas in forest and shrubland to less than 8 tonnes per hectare (fine fuels consist of live and dead plant matter less than 6 mm in diameter).
- Slash grassland areas so that fuels are below 100 mm in height.

CONSTRUCTION METHODS

The various methods that can be used to create and maintain an Asset Protection Zone are outlined in MP 7 - Maintaining an Asset Protection Zone.

Sources

RFS (2003) *Bush Fire Environmental Assessment Code for Asset Protection and Strategic Fire Advantage Zones* NSW Rural Fire Service, Sydney.

RFS (2001) *Planning for Bushfire Protection*. NSW Rural Fire Service, Sydney.

MP 7 MAINTAINING AN ASSET PROTECTION ZONE

Objectives

- To maintain Inner Protection Areas with minimal fine fuel loads, and Outer Protection Areas with fine fuel loads less than 8 tonnes per hectare in forests and shrublands, or grass fuels less than 100 mm high in grasslands.
- To maintain canopy breaks in both the tree and shrub layer between bushland and assets at risk.

Methods and Application

The methods outlined below apply to the maintenance of Asset Protection Zones around developments within and adjoining Wingecarribee Shire Council reserves.

The main methods of removing fine fuel to maintain Asset Protection Zones include:

- prescribed burning at a frequency sufficient to maintain low fine fuel loads
- slashing vegetation with a tractor mounted slasher (large areas) or mowers (small areas)
- hand cutting and raking to remove fine fuel which is then either burnt on site, mulched and composted, or removed from the site
- ploughing, or scraping off the surface vegetation mechanically
- grazing (for rural properties).

The advantages and constraints of these methods are listed in Table 1.

Table 1 - Advantages and Constraints of Fuel Reduction Techniques

METHOD	ADVANTAGES	CONSTRAINTS
Prescribed burning	<ul style="list-style-type: none"> • Relatively large (> 0.5 ha) areas can be done quickly where there are adequate control lines to contain the fire • Can be used in both forest and grassland areas • Provides training opportunities and experience for fire brigade personnel 	<ul style="list-style-type: none"> • Labour intensive • Requires special equipment (fire tanker etc.), and specially trained personnel • Limited opportunities (weather etc) to carry out burns effectively and safely • Risk of fires escaping and damaging surrounding property • Fuel loads may build up rapidly in some fuel types (as little as 2 years after burning in some vegetation types) • Burning at the frequency required to maintain low fuel loads may eliminate native shrubs and trees • Difficult to protect species of conservation value unless they can withstand frequent fire • Smoke from burning increases air pollution • May increase erosion risk on steeper areas • May encourage weed invasion • Scorched bark and foliage may be unsightly
Slashing and mowing	<ul style="list-style-type: none"> • Retains a vegetation cover to protect against soil erosion • Relatively cheap, large areas can be covered by one operator • Species of conservation value can be retained • Relatively low risk of weed invasion • No air pollution from smoke 	<ul style="list-style-type: none"> • Cannot be used on steep and/or rocky areas • Only reduces the height of fuel (unless area is raked afterwards) • Will tend to remove shrubs and replace them with grasses • May require expertise in identifying species of conservation value if present
Hand cutting and removal	<ul style="list-style-type: none"> • Can be used on difficult sites (steep, rocky or boggy) where other methods cannot be used • Species of conservation value, and ornamental and regeneration plantings can be retained • No specialised equipment required; can be carried out by individual landowners on small lots, or by volunteers in public reserves • Can be combined with weed removal • No air pollution unless cut material is burnt • Sufficient vegetation and litter cover can be retained to control erosion • Floristics of native bushland can be retained 	<ul style="list-style-type: none"> • Slow and labour intensive • Expensive for large areas unless volunteer labour is available • May require expert supervision if species of conservation value are present

METHOD	ADVANTAGES	CONSTRAINTS
Ploughing, scraping or grading	<ul style="list-style-type: none"> Quickly produces a mineral earth fire control line Relatively cheap, large areas can be covered by one operator No air pollution from smoke 	<ul style="list-style-type: none"> Cannot be used on very steep and/or rocky sites May significantly increase erosion risk May damage soil structure May contribute to the spread of plant diseases Will destroy native vegetation and encourage weed invasion Requires special equipment
Grazing	<ul style="list-style-type: none"> No air pollution from smoke Cost effective as it combines fire hazard management with other activities 	<ul style="list-style-type: none"> Not suitable for native bushland with shrubby or heathy understoreys May increase risk of soil erosion on steeper sites Stock need to be managed May encourage weed invasion, particularly in bushland areas Fencing and watering required Not suitable where rapid reduction of fuel loads is required Stock may damage plant species of conservation value Stock may be unavailable when needed

Combinations of the above methods can be used to attain specific management objectives.

INNER PROTECTION AREA

In general, the only feasible methods for maintaining Inner Protection Areas are hand clearing and raking, or mowing.

OUTER PROTECTION AREA

In general, the following applications are recommended for maintaining Outer Protection Areas:

METHOD	APPLICATION
Prescribed burning	<p>Relatively large (> 0.5 ha) areas of bushland in public reserves or larger private holdings where there are:</p> <ul style="list-style-type: none"> adequate control lines to contain the fire no species of conservation value that are fire sensitive trained personnel available to carry out the burns.
Slashing or mowing	<p>Relatively level and smooth woodland and grassland areas on private property, or in public reserves.</p>
Hand cutting and	<ul style="list-style-type: none"> Around buildings and other infrastructure at risk from fire.

METHOD	APPLICATION
removal	<ul style="list-style-type: none"> • Steep, rocky or boggy areas in public reserves. • Sites with species or plant communities of high conservation value. • Around and within ornamental and regeneration plantings.
Ploughing, scraping or grading	<ul style="list-style-type: none"> • Relatively level and smooth rural areas, or rural-bushland fringes. • In emergencies where effective fire control lines need to be installed quickly to protect assets from running wildfires.
Grazing	Rural or rural-bushland fringe areas, and larger holdings on urban fringe areas, where there is adequate fencing to contain stock and there are no plant species or communities of conservation value.

Guidelines

INSPECTION

- a) All Asset Protection Zones in Council reserves should be inspected before the beginning of the bushfire danger period, fine fuel loads and general condition assessed, and any necessary maintenance work carried out to ensure they are in a fuel reduced condition.
- b) Heavy fuel accumulations on private property adjoining Council reserves should be reported to the Rural Fire Service for action under Section 66 of the Rural Fires Act, 1997.
- c) Grassland areas will need to be inspected at least twice during the bushfire danger period, depending on weather conditions.

PRESCRIBED BURNING

Outer Protection Areas being managed by hazard reduction burning should be burnt according to MP 8 so that fine fuel loads are maintained below 8 tonnes per hectare.

SLASHING OR MOWING

- a) For Outer Protection Areas in grassland being managed by slashing or mowing, slash grasses at least at the beginning of the bushfire danger period, and when grasses are fully cured during summer. Additional slashing may be required during seasons of heavy growth.
- b) For Inner Protection Areas keep grass short, green and well watered. Cut grass should be removed by raking, or use of grass catchers.

HAND CUTTING AND REMOVAL

For Outer Protection Areas being managed by hand cutting and raking:

- Cut and remove any weed species, poison stumps if resprouting is likely.

- Prune or remove trees and shrubs to maintain vertical and horizontal fuel separations.
- Reduce ground fuels to ensure that fine fuel loads are less than 8 tonnes per hectare.
- Burn removed material in a cleared open area on site, or remove from the site.

For Inner Protection Areas being managed by hand cutting and raking:

- Remove dead trees and vegetation.
- Regularly rake and remove twigs and leaves, particularly under fences and against buildings.
- Regularly prune shrubs and trees to maintain horizontal fuel separations.
- Remove flammable debris which accumulate vertically between the underside of the tree or shrub canopy and the ground.
- Remove dead branches from trees and shrubs.
- Where possible water plants during summer to maintain a relatively high moisture content.

PLOUGHING, SCRAPING or GRADING

- a) For on-going maintenance of fire breaks, plough, scrape or grade as required to maintain a bare soil surface.
- b) If ploughing or scraping is used to construct a temporary fire control line to assist in control and suppression of a wildfire, the control line should be rehabilitated as soon as possible (preferably before machinery leaves the area) in order to control erosion and prevent weed invasion (see MP 13).

GRAZING

Where Asset Protection Zones within and adjoining Council reserves are being managed by grazing, ensure that grazing pressure is sufficient to meet the objectives of this MP, or supplement grazing with other methods of fuel reduction, such as slashing or hand cutting and removal.

DOCUMENTATION

Maintenance of any Asset Protection Zones in Council reserves should be recorded as follows:

- location and date on which the work was carried out
- method used for hazard reduction
- any particular local conditions
- width of the zone established
- who supervised the work
- name of contractor (if applicable)

- approximate cost or operator's time.

MP 8 PRESCRIBED BURNING

Objective

To burn defined areas of bushland or grassland in a safe, controlled, manner in order to achieve a management objective or objectives.

Application

Burning of relatively small areas (< 50 ha) to which a specific fire regime has been applied using low-intensity ground ignition by crews on foot.

These are general guidelines only. Each prescribed burn conducted in a Council reserve must be conducted strictly in accordance with a Prescribed Burn Plan prepared by the officer in charge of the burn and approved by the Rural Fire Service (RFS). Burns by the Rural Fire Service or NSW Fire Brigades will be carried out according to their Standard Operating Procedures.

Preamble

The Australian Fire Authorities Council's course in prescribed burning has listed the four principles of prescribed burning as:

- “Planned fire must accord with approved management plans, or in their absence must protect and maintain the priority land use.
- Planned fire must only be undertaken after the preparation of written prescriptions.
- For ecological objectives, planned fire must promote the greatest possible diversity of habitats and representation of successional (seral) stages of vegetation.
- For protection objectives, planned fire must be demonstrably effective and not result in undesirable ecological effects”.

General procedures for prescribed burning operations are set out in the Rural Fire Service's Standard Operating Procedure for Prescribed Burning.

Guidelines

There will always be a risk that prescribed burns may escape the set control lines and damage adjoining bushland or property. The level of this risk can only be fully ascertained at the time of

the burn. It is therefore imperative that no prescribed fires should be lit until the officer in charge of the burn is satisfied that the prevailing burning conditions, and available fire fighting resources, are such that the fire can be contained within the set boundaries, and will meet the prescribed outcomes for the burn.

PRESCRIBED OUTCOMES

Specific outcomes for each burn are detailed in the Fire Management Plan for each reserve.

General outcomes and precautions for all burns:

- exclusion of fire from identified fire sensitive plant communities, habitats of fire sensitive threatened flora and fauna, and riparian plant communities
- flame height less than 1.5 m wherever possible (this may not be achievable where there is a dense shrub layer).
- low intensity fire only on slopes > 18° (downslope burning)
- maintain a minimum 5 m wide unburnt buffer along intermittent watercourses, and 20 m along permanent watercourses and around permanent waterbodies (excluding farm dams) and wetlands
- no fire fighting foam used within 30 m of permanent watercourses (including wetlands) and 60 m of domestic water supplies; or near known populations of threatened plants without prior consultation with the NPWS Threatened Species Unit
- exclusion of fire from any Outer Protection Areas that are close to dwellings and are being actively managed by other means
- existing roads, tracks and natural features to be used for fire control lines wherever possible; new fire control lines to be limited to hand tool lines
- retention of fallen logs, dead trees and stumps where possible
- trees containing hollows are not to be felled unless required for safety, or to prevent the spread of the fire onto unburnt areas. Felling shall only be used as a last resort to extinguish dangerous burning trees
- no disturbance of rock outcrops; ledges and overhangs are not to be disturbed
- burn coverage greater than 80%
- fine fuel loads reduced to less than 5 tonnes per hectare overall.

PERSONNEL

The person in charge of the crew conducting any burns in Wingecarribee Shire Council reserves must have completed training to Crew Leader level in the Rural Fire Service (or equivalent), have held the position of Captain or Senior Deputy Captain in a Rural Fire Service brigade (or equivalent), and have currency in accredited courses/competencies for low intensity prescribed burning. If the burn is to be carried out near a public road, the person in charge must also have competency in managing smoke hazards over roads.

All crew members must have completed the Rural Fire Service's basic bush fire fighter course (or equivalent). All personnel involved in the burn must be attired, and provided with personal protective equipment as required by the Rural Fire Service. All personnel must comply with the relevant safety procedures in the Rural Fire Service Standard Operating Procedures.

Crew Strength

Officer in charge plus 4 crew members for smaller burns; 6 crew members required if two tankers are used on larger burns. An additional 2 crew members may be required to control traffic if smoke is likely to blow across nearby roads. Recommended minimum crew strengths in this MP can be varied at the discretion of the officer in charge of the burn.

MINIMUM RESOURCES

One Category 1 or 2 tanker; more than one tanker may be required for larger burns (decision to be made by the officer in charge prior to the burn)

- hydrant standpipe on each tanker
- 3 McLeod Tools
- axe and brush hook
- 3 drip torches + fuel
- 2 knapsack sprays (4 for units where there is limited vehicle access)
- chainsaw and fuel
- fire hoses sufficient to mop up for a distance of at least 100 m from the boundary of the burn
- instruments to measure wind speed, relative humidity and temperature
- drinking water and first aid kit
- warning signs, traffic control signs, and road barriers as required.

Recommended minimum equipment requirements in this MP can be varied at the discretion of the officer in charge of the burn.

Communications

- The crew conducting a burn must have the means to communicate with the Rural Fire Service (mobile phone, radio) at all times while the burn is under way in case back-up is required.
- Hand-held radios should be used if the area to be burnt is relatively large, and crew members will be out of sight of each other.

FUEL AND WEATHER CONDITIONS

The following fuel and weather conditions are considered to be optimal for safe, low intensity burning of dry forests and grassy woodlands:

- Fuel Moisture Content (FMC) of surface fine fuels 13% to 16%
- Fire Danger Index (FDR) - Low
- Wind Speed - < 20 km per hour in the open
- Relative Humidity - 40% to 60%
- Temperature - < 20° C

Where it is necessary to ensure that a fire will go out overnight, ensure that the forecast overnight minimum temperature will be less than 10° C, and the forecast overnight wind speed less than 5 km/h.

If there is a smoke sensitive location (schools, hospitals, residential aged care facilities, mines (including ventilation shafts) and airports) within 100 m of small fires, or 1000 m of large fires, burning should only be undertaken when the facility is closed, or the weather patterns indicate that the wind will be blowing away from it.

All non-target, wet type plant communities (riparian vegetation, rainforest) within, or adjacent to, the area being burnt should be too wet to burn.

Burning can be undertaken when weather conditions are outside these prescriptions if the officer in charge is confident (based on past experience) that the desired outcomes can be safely achieved.

PREPARATION

3 Months Prior to the Burn:

- Carry out weed treatment as required (refer to MP 9 for weed control methods).
- If there are threatened species in the unit to be burnt consult with the National Parks and Wildlife Service Threatened Species Unit for any special requirements.

2 Weeks Prior to the Burn

- If the burn is close to a main road and could cause traffic disruption, liaise with the police and, if required, the RTA to arrange for diversions and other safety measures.

Week Prior to the Burn:

- Check weather forecast to confirm if conditions are likely to be suitable for the burn. Postpone the burn if conditions are likely to be unsuitable.
- Officer in charge to inspect the area to be burnt and assess fine fuel loads, effectiveness of weed treatment, and the resources required for the burn (size and number of tankers, equipment, crew strength, hoses, communications etc.).
- Issue a Bush Fire Hazard Reduction and Management Burning Certificate in accordance with section 100F and 100G of the Rural Fires Act, 1997.
- Prepare a Prescribed Burn Plan using the current Rural Fire Service form and have it approved by the Rural Fire Service.
- Obtain a burning permit from the RFS or NSWFB if the burn is to be carried out during the bushfire danger period.
- Notify any schools, hospitals, residential aged care facilities, mines (including ventilation shafts) and airports within 100 m of small fires, or 1000 m of large fires of the intended date of the burn.
- Clear vegetation and leaf litter off tracks to be used as fire control lines, or clear new control lines along the boundary of the burn where there are no existing control lines. Ensure that there is a mineral earth barrier sufficient to stop fire burning across the control line. In grassed areas a wet line laid immediately before ignition may provide an adequate control line.
- Ensure that fire trails required for vehicle access to the area to be burnt are trafficable.
- Ensure there is access to a nearby water supply for refilling tankers if required.
- Place signs on any foot tracks or roads leading to the area to be burnt informing the public of the date of the burn.
- Inform adjoining landowners/residents of the proposed date of the burn, the reason for the burn, and public safety precautions that will be taken. Also inform residents that the burn may be postponed if weather conditions are unsuitable. Include a contact number that residents can contact for further information. For burns < 1 ha, notice should be given to all residents within 50 m of the burn. For burns > 1 ha, notice should be given to all residents within 200 m of the burn.

-
- If the area to be burnt will include an electricity transmission line easement contact the appropriate authority.

Day before the Burn

- Check weather forecast to confirm that conditions will be suitable.

On the Day of the Burn:

- Re-check weather forecast (particularly wind speed and direction) before deciding to proceed.
- Physically examine surface fuels to check that they are not too wet or too dry.
- Check that any non-target wet type vegetation within and adjoining the area being burnt is too wet to burn.
- Take weather measurements in the field (temperature, relative humidity and wind speed) and calculate a Forest Fire Danger Rating. Check that the weather parameters are within the prescriptions. If not, consider cancelling the burn.
- If conditions are suitable for the burn, notify Rural Fire Service FireCom, and the NSW Fire Brigades if the burn is in a NSW Fire Brigade District.
- Where possible, contact neighbouring landowners/residents to confirm that the burn will proceed.

Immediately Prior to Burning:

Step 1 - station a tanker at a point where hoses can reach an area suitable for a test burn; start the pump and run out a hose.

Step 2 - light a test burn in an area of typical vegetation and allow it to burn long enough to assess wind direction and likely flame height. Extinguish the test burn.

Step 3 - assess the overall conditions for the burn including; the results of the test burn, existing and predicted weather conditions, and resources available. Determine if the burn can be carried out safely and according to the prescription. Postpone the burn to later in the day, or re-schedule it if conditions are unsafe and prescribed outcomes cannot be met; otherwise proceed to Step 4.

Step 4 - check perimeter control lines and touch up as required to ensure there is a mineral earth barrier sufficient to stop fire crossing the control line. In grassed areas a wet line laid immediately before ignition may provide an adequate control line. Clear fuel away from the base of any dead standing trees close to the edge of the burn.

Step 5 - put out warning signs and set up traffic controls if required.

IGNITION TECHNIQUES

There are two main techniques for low intensity ground ignition by crews on foot; line ignition and spot ignition.

With spot ignition approximately 2/3 for the area being burnt will be burnt by relatively low intensity back and flank fires, rather than the higher intensity head fire. While this makes it easier to ensure a low fire intensity, it is also more likely that patches may remain unburnt. Depending on the spacing of the spot ignitions, this method may take longer to burn a given area than line ignition.

In line ignition approximately 5/6 of the area will be burnt by the relatively high intensity head fire, and it may be difficult to control fire intensity if fuel loads are high. However, with this method it is easier to ensure that the whole of the target area is burnt.

The spot burning technique is illustrated in Figure 1. For line ignition the lighting crew would ignite staggered lines of fire as they move through the bush, rather than regularly spaced spot fires.

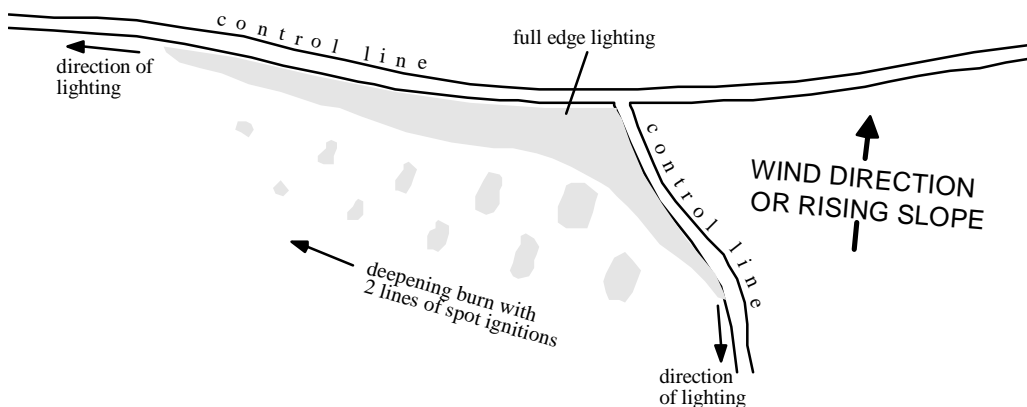


Figure 1: Spot ignition technique for low intensity ground ignition by foot

Adapted from AFAC (1996)

Within each ignition technique fire intensity and flame height can be controlled by the spacing of the ignition points or lines. For spot ignition the greater the spacing of the spots the lower the overall intensity. This is because with fewer ignition points a greater proportion of the area will be burnt by back and flank fires, and the number of junction zones will be reduced. For line ignition the closer the spacing of the lines the lower the intensity. This is because when lines are close

together (2 to 3 metres) the head fire from each line of ignition will run into the back fire from the previous line of ignition before it has had time to build up momentum and intensity.

The most appropriate ignition technique should be decided by the officer in charge at the time of the burn in order to ensure it is conducted safely. An experienced crew should be able to use a combination of both techniques to achieve the objectives of the burn. For example, in the middle of the day when fuel moisture content is relatively low, spot ignition may be required to control fire intensity, however as fuel moisture content increases in the late afternoon a switch to line ignition may be required to maintain the fire.

The general procedure to be followed during a burn is:

- position a tanker on each flank of the area to be burnt
- have at least one member of the crew watching for, and equipped to extinguish, any spot fires outside the control lines
- commence the burn at the uphill, downwind corner of the area to be burnt. Ensure that this corner is blacked out for a distance of approximately 10 m in from the apex before continuing the burn
- extend the burn along each flank in sections approximately 5 m to 10 m long while simultaneously burning the interior of the area in strips, or by a line of spot ignitions. The lighters should move in a slanted formation through the area, with the lighter on the downwind or upslope line leading the staggered crew. This ensures that none of the lighters will be threatened by fire downslope or upwind. Ensure that the burning along the perimeter is always further advanced than the interior burn. Allow each pass of the lighting crew (1 to 3 runs) to burn down before starting the next pass
- immediately after the fire has passed, wet down any wooden fence posts, large logs, and trees with burnt cavities along the perimeter of the burn to insure they are not ignited
- control the intensity of the burn, and therefore the scorch height, by varying the width of the strips burnt, or the spacing of spot fires. The wider the strip or the closer the spots, the higher the intensity of the burn. If strip or spot burning is producing a fire of too high an intensity, allow the fire to burn downslope or downwind unaided. If fire intensity is still too high, extinguish the fire
- ensure that the fire is stopped before it reaches any vegetation specifically excluded from burning

- blackout the burnt area immediately after completion of the burn, taking particular care to extinguish burning logs and hollow trees.

AFTER THE BURN

- Check the burnt area on the day following the burn and extinguish any smouldering logs, stumps, hollow trees or underground roots.
- If the burn was carried out in spring, continue periodic checks of the site for flare-ups until the next significant rain
- Record details of the burn using the procedure in MP 13
- Check for weed growth and carry out follow-up weed treatment if required (refer to MP 9 for weed treatment methods).

Sources

AFAC (1996) *Prescribed Burning 1*. Australian Fire Authorities Council and Longman, Melbourne.

Forestry Tasmania (2000) *Using Low Intensity Fire in Land Management*. Forestry Tasmania, Hobart.

RFS (1997) *Prescribed Burning Course Manual*. NSW Rural Fire Service, Sydney.

RFS (2003) *Bush Fire Environmental Assessment Code for Asset Protection and Strategic Fire Advantage Zones* NSW Rural Fire Service, Sydney.

RFS (2003) *Guidelines for Low Intensity Bushfire Hazard Reduction Burning*. NSW Rural Fire Service, Sydney.

MP 9 WEED CONTROL BEFORE AND AFTER BURNING

Objective

To use fire to assist in controlling the spread of woody and herbaceous weeds in Wingecarribee Shire reserves through:

- removing weed biomass, and reducing the amount of regrowth by destroying seed in the litter and on the soil surface; and
- removing weed debris created through bush regeneration, or other weed control activities.

Application

- a) Areas where periodic prescribed burning is used to reduce fire hazard, or manage indigenous vegetation.
- b) Areas where prescribed burning is recommended in a fire management plan as a tool to control existing weed populations.

Guidelines

- Known responses to fire of introduced plants in Wingecarribee Shire Council reserves is detailed in Table 1.
- Prior to prescribed burning any mature woody weeds in the areas to be burnt should be treated to ensure infestations are root dead at the time of burning. Chemical treatment of woody weeds may involve cutting and poisoning the stump (cut-stump), tree injection, or spraying with an appropriate herbicide. Herbaceous weeds should be treated using a foliar spray. Treatment of target weeds in the Wingecarribee Shire reserves both pre- and post-fire has been detailed in Table 2.
- Herbicide treatment should be carried out at least 3 months prior to the burn to ensure that the chemical has penetrated into the root system, achieved a total kill of all tissue, and the plant has had time to desiccate prior to burning. This will maximise removal of weed biomass during the burn. Disturbance of the treated weedy sites (by mechanical means, slashing or burning) within this period may reduce the chemical's effectiveness, and regeneration from rootstock is likely to occur.

Table 1 - Response to fire of introduced species known, or considered likely to occur in Wingecarribee Shire reserves.

WEED SPECIES	WHOLE PLANT KILLED	RE-SPROUTS FROM ROOTSTOCK ¹	RE-SPROUTS FROM EPICORMIC BUDS	SEED GERMINATION LIKELY AFTER FIRE	COMMENTS
<i>Acacia baileyana</i> (Cootamundra wattle)	X			X	May resprout after cool fires
<i>Briza maxima</i> (Quaking Grass)	X			X	
<i>Briza minor</i> (Shivery Grass)	X			X	Seeds may remain viable for up to 40 years
<i>Centranthus ruber</i> (Red Valerian)		X			Seed response not known
<i>Chrysanthemoides monilifera</i> ssp. <i>monilifera</i> (Boneseed)		X		X	Resprouts if fire is not hot enough to kill plant
<i>Cirsium</i> sp. (Thistles)	X			X	
<i>Cortaderia seloana</i> (Pampas Grass)		X			
<i>Cotoneaster</i> spp. (Cotoneaster)		X			
<i>Cotoneaster</i> spp. (Cotoneaster)		X			
<i>Crataegus monogyna</i> (Hawthorn)		X		X	
<i>Crocasmia X crocosmiflora</i> (Montbretia)		X			
<i>Cytisus palmensis</i> (Tree lucerne)		X		X	
<i>Cytisus scoparius</i> (English Broom)		X		X	Seeds may remain viable up to 70 years
<i>Erica lusitanica</i> (Spanish Heath)	X	X		X	May resprout after very cool fires.
<i>Foeniculum vulgare</i> (Fennel)		X			
<i>Genista monspessulana</i> (Canary Broom)		X		X	
<i>Hedera helix</i> (English Ivy)		X			
<i>Ilex aquifolium</i> (Holly)		X			
<i>Lycium ferocissimum</i> (Boxthorn)		X		X	
<i>Nasella tricholoma</i> (Serrated Tussock)		X		X	
<i>Pinus radiata</i> (Monterey Pine)	X			X	
<i>Prunus</i> sp. (Flowering plum)		X			

WEED SPECIES	WHOLE PLANT KILLED	RE-SPROUTS FROM ROOTSTOCK ¹	RE-SPROUTS FROM EPICORMIC BUDS	SEED GERMINATION LIKELY AFTER FIRE	COMMENTS
<i>Rosa rubiginosa</i> (Briar Rose)		X			
<i>Rubus fruticosus</i> (Blackberry)		X			
<i>Salix alba</i> X <i>fragilis</i> (Crack Willow)		X			
<i>Sarothamnus scoparius</i> (English Broom)		X		X	
<i>Ulex europaeus</i> (Gorse)		X	X	X	Seeds may remain viable for up to 40 years
<i>Vinca major</i> (Periwinkle)		X			

1 Some plants may resprout after low intensity fires but will be killed by high intensity fires.

Table 2 - Recommended Treatment for Weeds

TARGET WEEDS	BEFORE BURNING					AFTER BURNING					COMMENTS
	Spot Spray	Cut Stump & Poison	Drill & Poison	Hand Pull	Other	Spot Spray	Cut Stump & Poison	Drill & Poison	Hand Pull	Other	
<i>Briza maxima</i> (Quaking Grass)	X					X					
<i>Briza minor</i> (Shivery Grass)	X					X					
<i>Centranthus ruber</i> (Red Valerian)	X					X					
<i>Chrysanthemoides monilifera ssp. monilifera</i> (Boneseed)	X	X				X			X		Preferable to have cut timber lying on ground for fuel and to avoid moving seed bearing material
<i>Cotoneaster spp.</i> (Cotoneaster)		X	X			X			X		Preferable to have cut timber lying on ground for fuel
<i>Cortaderia selloana</i> (Pampas Grass)	X					X			X		
<i>Crataegus monogyna</i> (Hawthorn)		X	X			X			X		Preferable to have cut timber lying on ground for fuel
<i>Crocosmia x Xcrocosmiiflora</i> (Montbretia)	X					X					
<i>Cytisus scoparius</i> (English Broom)	X					X			X		Preferable to have cut timber lying on ground for fuel and to avoid moving seed bearing material
<i>Erica lusitanica</i> (Spanish Heath)	X					X			X		

TARGET WEEDS	BEFORE BURNING					AFTER BURNING					COMMENTS
	Spot Spray	Cut Stump & Poison	Drill & Poison	Hand Pull	Other	Spot Spray	Cut Stump & Poison	Drill & Poison	Hand Pull	Other	
<i>Foeniculum vulgare</i> (Fennel)	X					X					
<i>Genista monspessulana</i> (Canary Broom)	X	X				X			X		Preferable to have cut timber lying on ground for fuel and to avoid moving seed bearing material
<i>Hedera helix</i> (English Ivy)	X		X			X					
<i>Ilex aquifolium</i> (Holly)		X	X			X			X		
<i>Lycium ferocissimum</i> (African Boxthorn)	X	X				X					Preferable to have cut timber lying on ground for fuel and to avoid moving seed bearing material
<i>Pinus radiata</i> (Monterey Pine)		X				X			X		
<i>Rosa rubiginosa</i> (Briar Rose)	X	X				X			X		
<i>Rubus fruticosus</i> (Blackberry)	X					X					
<i>Salix alba X fragilis</i> (Crack Willow)		X	X?			X					May be difficult to access plants for drilling
<i>Ulex europaeus</i> (Gorse)	X	X				X			X		Preferable to have cut timber lying on ground for fuel and to avoid moving seed bearing material
<i>Vinca major</i> (Periwinkle)	X	X		X		X			X		

-
- Following a prescribed burn in weed infested areas, a flush of weed seedlings can be expected. It is essential to treat weed seedlings (either manually or using a foliar spray) before indigenous plant seeds germinate. As a rule of thumb, herbaceous (and some woody) weeds germinate rapidly in high light situations, so that it may be possible to treat the flush of weeds before any native seeds germinate. However, once native seeds have germinated, control options are reduced to careful spot-spraying (using a protective cone nozzle sprayer) or hand weeding.
 - Woody weeds regenerating from rootstock must also be treated promptly. Re-cutting the stump and poisoning, drilling into the bole (junction of stem and root), or spraying new shoots when they reach approximately 0.5 m in height, is recommended.
 - Burning weed debris in situ is an economical way of disposing of large amounts of material, and may stimulate germination of indigenous plant seeds if present in the soil. Note that burning will also stimulate weed seeds to germinate and follow-up treatment will be required. Note also that a permit from the Rural Fire Service or the NSW Fire Brigades will be required for pile burns during the bushfire danger period.

The Bushfire Environmental Code (RFS 2003) states that any herbicides used must be registered by the National Registration Authority (NRA) and approved for the intended situation of use, and users must:

- strictly adhere to any directions on the label
- not risk injury to persons, property and non-target plants and animals through the use of a herbicide,
- use the herbicide in accordance with the requirements of the *Pesticides Act 1999*, the *Protection of Environment Operations Act, 1997*, and the *Noxious Weeds Act, 1993*.
- not use herbicides within 10 metres of any riparian area that contains threatened amphibian species.

Sources

Buchanan R. A. (1986) *Bush Regeneration – Recovering Australian Landscapes* Inkata Press, Melbourne.

Parsons J. M. (1995) *Australian Weed Control Handbook* Inkata Press, Melbourne.

RFS (2003) *Bush Fire Environmental Assessment Code for Asset Protection and Strategic Fire Advantage Zones* NSW Rural Fire Service, Sydney.

MP 10 COORDINATING FIRE MANAGEMENT ACTIVITIES

Objective

To assist Wingecarribee Shire Council and landowners adjoining Wingecarribee Shire reserves to achieve the objectives of the fire management plan by coordinating all fire management related activities so that their effectiveness is enhanced.

Application

All State government, local government, non-government bodies, landcare and bushcare groups, and private landowners involved in planning, controlling and executing fire management activities in and around Wingecarribee Shire reserves. Many of these agencies and groups have specific areas of responsibility and activities, however their actions can affect the programs of other groups and agencies.

Guidelines

GENERAL

- a) Ensure coordination of management activities through regular liaison and meetings, preparation and joint review of works schedules, and exchange of data/information.
- b) Ensure availability of up-to-date information to all stakeholders, including up-to-date mapping information (eg. vegetation types, recent fires, location of rare/threatened species and exclusion zones, location of weeding and/or planting sites).
- c) Coordinate site selection and timing of all proposed fire management and weed control activities.

SPECIFIC

- a) When planning prescribed burns, check the latest flora and fauna records and listings in the *Threatened Species Conservation Act, 1995*, to ensure protection/exclusion of all fire sensitive plant communities and species.

-
- b) In areas scheduled to be burnt within the next twelve (12) month period, ensure that appropriate weed control measures are carried out at least 3 months prior to burning (see MP 9 for weed control measures before and after fire).
 - c) To use fire as an inexpensive means of removing weed debris and/or reducing soil nutrients, bush regeneration crews should stockpile weeds and flammable rubbish in areas accessible to fire brigade crews, and away from natural or cultural assets.
 - d) Ensure that identified plant communities, and rare and threatened species, are managed strictly in accordance with the fire regime specified in the recovery plan for that species, if available (excepting unavoidable incidents of wildfire or arson).
 - e) If contractors are used for fire management activities within Wingecarribee Shire reserves, ensure that they are suitably qualified.
 - f) Ensure that any bush regeneration and ornamental planting in Asset Protection Zones is carried out according to the landscaping guidelines in MP 6 so as not to increase fire hazards.

COORDINATING MANAGEMENT ACTIVITIES

To help coordinate management activities in Council reserves, Council should consider holding meetings of the main stakeholders each spring and autumn. The spring meeting should be held at the beginning of the bushfire danger period to review works undertaken during autumn and winter, and coordinate activities during the fire season. The autumn meeting should be held at the commencement of the burning season in order to coordinate and integrate the various on-ground fire management activities to be undertaken over winter. In general these meetings should be held before Wingecarribee Bushfire Risk Management Committee meetings so that the committee can be advised of the proposed works.

The meetings should include the fire service whose district the reserve is in (especially local brigade captains), the reserve committee if there is one, and representatives of any groups who will be carrying out fire management, weed control or bush regeneration activities in Wingecarribee Shire reserves. The Sydney Catchment Authority should be included where works are to be undertaken in catchment areas, and Integral Energy and Transgrid should also be included if issues affecting their infrastructure will be discussed. The meetings should allow for a site inspection.

The meetings should be minuted, and an edited version of the minutes prepared that summarises management actions completed since the previous meeting, and future management actions agreed to at the meeting. The edited minutes should be circulated to all interested stakeholders.

Autumn Meeting

The autumn meeting should at least consider and resolve the following issues:

- what is the best time to carry out scheduled prescribed burns so that they cause the least disruption to other management activities (weeding, planting, general maintenance)?
- to what extent is pre- and post-fire weeding required, who will carry it out, and when?
- potential for coordination of clearing for fire hazard reduction with larger weed control programs
- what other preparation work needs to be carried out, who will do it, and when?
- are there any areas within, or adjacent to, areas to be burnt (such as new plantings) that require special protection, and what protection measures will be taken?
- is everyone aware of the identified fire exclusion zones (eg. fire sensitive plant communities or habitats)?
- have any threatened species been recently identified in the area? Are they likely to be affected by the burns proposed for the year? If so, what needs to be protected from fire (nest sites, food sources etc)? If individuals of threatened species are likely to be killed in the burns, check if a licence from the Parks and Wildlife Service is required?
- which fire trails require maintenance, who will carry it out and when?

Spring Meeting

The spring meeting should at least consider and resolve the following issues:

- what are the predictions for the coming fire season?
- if a severe fire season is predicted can any precautions be taken to minimise the fire risk?
- have all the prescribed burns and other fire management activities for the previous winter been achieved, if not, can they still be achieved?
- has maintenance of all Asset Protection Zones around assets within and adjoining Wingecarribee Shire reserves been carried out?

Sources

Conroy B. (1988) Bushfire management planning in natural areas. In proceedings of the conference - *Caring for Warringah's Bushland*. Warringah Council, Dee Why, NSW.

Ku-ring-gai Municipal Council (1991) *Fire Management Policy*. Ku-ring-gai Council, Gordon, NSW.

MP 11 RECORDING WILDFIRES

Objective

To provide a record of wildfires in Wingecarribee Shire reserves, and their effects, that can be used to revise the fire management plans for the reserves.

Application

Any wildfires in Wingecarribee Shire reserves.

Guidelines

In addition to the records kept by the Rural Fire Service, Council should record the following details of any wildfires for management planning purposes.

- location of any bulldozed fire control lines
- any assets lost on, or adjacent to, Wingecarribee Shire reserves
- any problems encountered during fire fighting operations, such as poor condition of access, inadequate water supply
- dates and extent of any post-fire weed control
- date of completion of post fire recovery (MP 13) and details of specific works carried out.

MP 12 RECORDING FIRE MANAGEMENT ACTIVITIES

Objective

To provide a record of prescribed burning and other fire management activities, that can be used to evaluate and revise reserve fire management plans.

Application

- Any prescribed burns in Wingecarribee Shire reserves.
- Construction and maintenance of fire management assets in Wingecarribee Shire reserves.

Guidelines

In general, information on fire management activities will be recorded by whoever carried out the work.

PRESCRIBED BURNS

Details of the burn should be entered in the Bushfire Risk Information Management System (BRIMS) maintained by the Rural Fire Service. In addition to the burn plan, the following details of each management burn should be recorded in the attached record sheet for management purposes:

- average scorch height (survey one to two weeks after the fire)
- any variations to the burning prescription in the fire management plan
- dates and extent of any pre- and post-burn weed control
- weed species and general density of weeds in the area burnt at the time of pre-burn weed control
- cost of the burn including weed control.

CONSTRUCTION AND MAINTENANCE OF FIRE MANAGEMENT ASSETS

This includes construction and maintenance of fire trails, Asset Protection Zones and static water supplies. Information recorded should include:

- location and date
- the nature of the work carried out and cost
- who carried out the work

- any difficulties encountered in carrying out the work.

[reserve name]: supplementary details of prescribed burns (page 1)		Fire management unit number:	Season:
Area burnt (ha):	Location:	Grid reference (centre): eastings: northing:	
Who carried out the burn: Crew strength:			
Variations to the burning prescription in the fire management plan:			
Fire effects: average scorch height(metres) Others:			
Values protected (property, human lives, rare or vulnerable wildlife etc):			
Pre-burn weed control carried out on: By:			
Weed species and general density of weeds at the time of pre-burn weed control:			
Post-burn weed control carried out on:		By:	
Other post-burn recovery activities:			
Costs: pre-fire weed treatment: prescribed burn: post-fire weed control: other costs (specify):			
Remarks (including problems encountered and recommendations, and whether objectives of the burn			

were met, and whether prescriptions were adhered to):

(continue overleaf if necessary)

Reported to TFS(date) by	Entered in GIS(date) by
--------------------------------------	-------------------------------------

[reserve name]: supplementary details of prescribed burns (page 2)	Fire management Unit number:	Season:
---	------------------------------	---------

Map of fire (show area burnt, vegetation types, location, assets protected, control lines, grid references, north point, scale, date, relative intensities of fire (crown fires, spotting, etc) crown scorch, defoliation, etc

Report compiled by:

.....(signature)

.....(date)

MP 13 POST-FIRE RECOVERY

Objectives

- To ensure public safety in areas affected by wildfire.
- To minimise the risk of damage to assets in Wingecarribee Shire Council reserves following wildfires.
- To ensure areas affected by wildfire recover as quickly as possible.

Application

Any parts of Wingecarribee Shire reserves affected by a wildfire, or by actions taken to control and suppress wildfires, such as clearing of fire control lines.

Guidelines

- a) Immediately following a wildfire in Wingecarribee Shire reserves, all fire trails and foot tracks through the burnt area should be closed to the public until they are inspected and declared safe.
- b) Inspect all foot tracks and fire trails through the burnt area for damaged trees or branches and remove any that may fall on a track or trail.
- c) Rehabilitate any control lines constructed to control the fire using the techniques in MP 3.
- d) Approximately two months after the fire, inspect the burnt area and any rehabilitated control lines for weeds. If noxious or environmental weeds are regenerating or invading, commence weed control using the procedure in MP 9.
- e) Inspect all infrastructure and facilities; repair as required.

Appendix B

Fuel Load Assessment Procedure

from

Forestry Tasmania (2000) *Using Low Intensity Fire In Land Management.*

TAKING A CLOSER LOOK AT FUELS.

Fuels are being constantly produced by trees and scrub. In the dry forests decomposition can't keep pace with production so fine fuels accumulate to more than 10 tonnes per hectare only 10 years after the last burn. Although these fine fuels may stabilise at about this amount, heavy fuels, such as branches, logs and dead roots continue to accumulate until the next fire.

Fuel Quantity

Fuels up to pencil thickness (6mm) such as dead leaves, twigs and bark are called the 'fine' fuels and are the ones that have the greatest effect on fire spread. Doubling their quantity doubles flame height and rate of spread and quadruples fire intensity and damage on each hectare. It also quadruples the area burnt in a given time. Together this means that doubling the fine fuel quantity causes **SIXTEEN TIMES** the damage.

These fine fuels occur mostly as litter on the ground or as standing scrub and their quantity can be easily assessed without having to weigh anything. Just find a typical patch and estimate the % cover of litter and scrub in a circle about 2 m diameter.

Litter Fuels

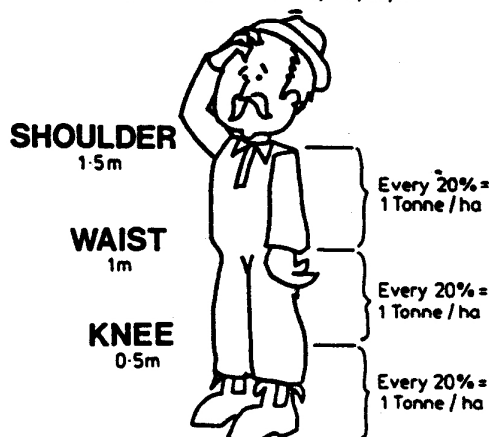
- Estimate % litter cover.
- Every 10% cover = 1 tonne/ha
e.g. 90% litter, 10% bare = 9 tonnes/ha fine fuels.



If litter 100%, every 2 cm depth = 10 tonnes/ha

Scrub Fuels

- Divide scrub into 3 layers of 0.5 m.
- Estimate the % cover for each layer.
- Every 20% = 1 tonne/ha/layer.



TOTAL FINE FUELS = LITTER + ALL 3 SCRUB LAYERS

Appendix C

Text of the Community Notification Letter

Fire Management Plans

Mount Gibraltar Reserve, Gibbergunyah Reserve, Greater Mount Alexandra Reserve

Wingecarribee Shire Council has engaged consultants AVK Environmental Management to prepare Fire Management Plans for each of the above reserves. These are the three largest bushland reserves under Council's management.

The aim of this project is to provide recommendations to minimise the fire threat to:

- life and property
- ecological diversity
- sustainability of natural systems
- cultural and aboriginal values
- threatened species

The plans are restricted to fire management on land owned or controlled by Council, but will consider impacts on and by neighbouring landowners. Where the actions of Council and neighbouring landowners can significantly affect each other, a program to co-ordinate fire management activities will be developed through a process of consultation.

Development of the plans will involve a number of tasks, which include:

Literature Review	<ul style="list-style-type: none">• Review of scientific research, legislation and other relevant literature.
Fieldwork	<ul style="list-style-type: none">• Extensive fieldwork to identify existing natural and cultural values, condition of bushland, fuel types and threats, facilities, vehicle access, water supply points, etc.
Stakeholder Consultation	<ul style="list-style-type: none">• Consultation with Wingecarribee Council officers, reserve committees, Rural Fire Service brigades that cover the reserves, relevant Government agencies, landowners adjoining the reserves, and community groups with an interest in the reserves.
Risk Assessment and Management	<ul style="list-style-type: none">• Research into fire history, fire weather patterns and bushfire behaviour.• Assessment of the adequacy of existing fire protection measures and fire brigade access.• Assessment of the risks to life, and to built, cultural and natural heritage assets within and bordering the reserves using the procedures in AS 4360 - 1999 <i>Risk Management</i>.• Identification of measures to minimise the risk of damage from bushfires including prescribed burning for hazard reduction or habitat management.• Identification and assessment of the condition of all fire management assets (eg. defensible spaces, fire breaks, fire trails, water points, refuge areas).

Bushland Management

- Identification of the optimal fire frequency thresholds of plant communities within the reserves.
- Identification and mapping of fire sensitive plant communities.
- Identification of populations of threatened plant species.
- Identification of critical habitat for threatened fauna species.
- Identification of areas at risk from soil erosion or weed invasion, and modifications to fire management activities to minimise problems.
- Identification of burning regimes aimed at ensuring the long term viability of plant communities within the reserves.

USING FIRE

The fire management plans will recognise the potential use of fire as a management tool to:

reduce fire hazard to protect assets from wildfires

maintain plant communities and individual species of conservation value within the reserves that require fire in order to ensure their long-term viability

assist in the removal of weeds within the reserves and the regeneration of degraded bushland.

INVOLVING THE COMMUNITY

The local community and stakeholder groups will have several opportunities to discuss issues and concerns with the consultants and comment on the fire management plans. You can:

1. attend one of the following 'walk and talk' meetings at each reserve
 - 14th June, 9.30 am, meet at the corner of Merranie and Colo Street, Welby
 - 14th June, 1.30 pm, meet at the corner of Badgery and Carlton St, Willow Vale
 - 15th June, 9.30 am, meet at the corner of Duke St and Oxley Drive, Mittagong
 - 15th June, 1.30 pm, meet at the entrance to Gibbergunyah Reserve near Country Club, Boronia Street, Bowral
 - 21st June, 9.30 am, meet at the corner of Cliff and Soma Streets, Bowral
 - 21st June, 1.30 pm, meet at Lake Alexandra, Mittagong, (at the large picnic shelter)
2. provide written comments on the attached Comments Sheet and post it to: Attention Michelle Bond, Wingecarribee Shire Council, PO Box 141, Moss Vale NSW 2576
3. provide written comments on the draft Fire Management Plans when they go on public exhibition in the middle of the year
4. make direct contact with the principal consultant, Axel von Krusenstierna, on 041 2141955 or email avkem@optusnet.com.au

Thank you for your interest in the project.

Appendix D

Fire Management Plan Preparation Methodology for Use When Reviewing Plans

1 Implementation Audit

Any prior fire management plans for the reserve should be audited. The objective of the audit is to identify any areas where there have been problems in implementing the previous fire management plan for the reserve, so that improvements can be made to ensure effective implementation.

2 Legal and Policy Framework

To provide a framework for the fire management plan clearly set out the legal and policy framework for fire management planning and include:

- Council policies and strategies, existing reserve management plans
- State legislation, regulations and guidelines
- other relevant standards and guidelines.

The sections of all legislation, regulations, policies and guidelines relevant to fire management in the reserve should be quoted or summarised in the plan.

3 Bushfire Risks

Each plan should include an up to date fire history (wildfires and management burns) and an analysis of past fire regimes (frequency, intensity, area and season). Causes of wildfires should be determined from an analysis of available records and discussions with Rural Fire Service personnel and local residents. All recorded wildfires, whether originating within the reserve or on adjacent property, should be considered. The analysis of wildfire causes and location should be used to determine methods to reduce the risks of wildfires either by reducing ignitions or improving access for fire fighting.

As part of the fire risk assessment, average fuel loads in the different vegetation communities within the reserve should be determined. As management planning does not require a precise measurement, visual estimations using an acceptable technique should be used.

3.1 Assets at Risk from Fire

Assets potentially at risk from fire in and bordering the reserves are to be identified and mapped in the plans including:

- infrastructure
- dwellings

- items of natural and cultural heritage value, particularly threatened flora and fauna.
- drinking water storages
- scenic panoramas
- bush regeneration and landscape plantings.

Special note must be made of any assets, such as chemical stores, likely to be a hazard for fire fighters during a bushfire.

Appropriate fire protection measures are to be included for infrastructure, buildings, and other assets within and surrounding the reserve that may be at risk from fires within the reserve.

The location of existing Asset Protection Zones around assets in and surrounding the reserve is to be shown on the asset map.

Vegetation Mapping

The boundaries of existing plant communities in the reserve is to be checked against any recent mapping, and in the field. The overall aim of the vegetation mapping review is to ensure that fire dependent vegetation is identified and managed appropriately, and fire sensitive communities are protected.

For the purposes of fire management planning it is sufficient to map plant communities on the basis of similar fire management requirements under the following categories:

- wet sclerophyll and mixed forests
- shrubby dry sclerophyll forest
- heathy dry sclerophyll forests
- grassy dry sclerophyll forests & woodland
- non eucalypt forests/woodlands
- grassland
- wetland and riparian vegetation.

Plant communities of regional, State and national conservation value are to be recorded and mapped in the plan.

Threatened Species.

Threatened species information is to be collated from current published and anecdotal sources, including the National Parks and Wildlife Service, database, to ensure recent updates are incorporated into the plans.

Known populations of threatened plant species, and critical habitat for threatened fauna are to be shown on the “assets” map for the reserve. Fire management of threatened species must follow the recommendations in any Recovery Plans for the species within the reserve.

In general fire management plans should aim to preserve existing fauna habitats within the reserve, except where there is a need to increase a particular habitat type to ensure the long-term viability of populations of a threatened species. Where critical habitat elements for threatened fauna species can be identified, the plans are to recommend measures to reduce the risk of damage by fire (eg protection of known nest trees).

Each fire management plan should include a table listing all threatened flora and fauna known to occur in the reserve along with known information on their fire ecology.

Built and Cultural Heritage Assets

Each reserve fire management plan is to identify built and cultural heritage assets within and adjoining each reserve, and to include a risk assessment in accordance with Australian Standard 4360: 1999 *Risk Management* in order to prioritise management activities.

Risk Identification

Apart from fire, some fire management activities, such as construction of control lines to contain wildfires, and maintenance of fire breaks and defensible spaces, are potential risks to some assets. For example, Aboriginal artefact scatters are not affected by low intensity fire, but could be badly damaged by fire management activities such as bulldozing fire control lines to contain wildfires.

Risk Analysis

Three sources of risk should be considered; wildfire, prescribed burning, and fire management activities, such as maintenance of fire trails.

The risk analysis should include the likelihood of the three sources of risk occurring (where there is sufficient data available), their potential consequences, and the likelihood of those consequences occurring with the control measures currently in place. This will separate the minor acceptable risks from the major risks.

The extent and likely effectiveness of existing fire management measures in each reserve is to be assessed, including:

- access for fire fighters
- fire suppression including response times, access and water supply
- fire protection measures in place around built assets.

The standard for assessing the adequacy of existing fire protection measures for built assets is the Rural Fire Service document *Bush Fire Environmental Assessment Code for Asset Protection and Strategic Fire Advantage Zone*.

Due to the complexities of fire occurrence and behaviour the risk assessment will have to be qualitative and utilise a scoring system to rank assets in terms of their relative risk.

Fine fuel loads in the different vegetation communities in the reserves are to be determined using the visual estimation procedure such as that in the Tasmania Fire Service and Forestry Tasmania publication *Guidelines for Fuel Reduction Burning under Dry Forests*.

Risk Treatment

Options for treating identified risks are to be developed including:

- Reducing the likelihood of occurrence, such as by reducing deliberate lighting of fires through better policing and public awareness, improving fire detection, hazard reduction, improving fire suppression by maintaining fire trails and fire breaks.
- Reducing the consequences such as by improving the resistance of built assets to fire, and implementing recovery measures after fire.

Risk treatment options are to be assessed to determine which have the optimal benefit in terms of risk reduction and cost.

4 Fire Management Issues and Constraints

Each plan is to identify and outline the major fire management issues in the reserve, (such as protection of threatened species, surrounding urban areas etc.) and also any constraints that need to be taken into account when planning fire management activities. These should include the need to ensure the fire management plan is compatible with any general management plans for the reserve, Council policies, and on-site conditions.

Management Responsibilities

Each plan is to include a list of agencies and organizations responsible for infrastructure and activities carried out in the reserves that are relevant to fire management.

Maintenance of Fire Management Assets

Fire management assets in the reserve are to be checked to determine their condition and the need for any maintenance, including:

- fire brigade vehicular access points

-
- public roads and fire trails
 - fire breaks and refuge areas
 - Asset Protection Zones
 - existing and potential water points within and near the reserve.

The overall requirements for fire service vehicle access in the reserve is to be reviewed including:

- identification of trails that need to be upgraded
- fire trails that can be closed if not required for other management purposes
- new fire trails to improve access or replace existing trails
- an inspection and maintenance schedule for fire trails.

In particular, the fire trail network is to be reviewed with the emphasis on providing effective perimeter access where possible. The routes of any recommended new trails should be mapped and appropriate rehabilitation techniques provided for any trails that can be closed. Fire trails in the reserve should be classified according to current Rural Fire Service policy.

Weed Management

Fire management plans should include strategies and activities to ensure that they improve existing weed problems. Fire can be an effective tool for weed management but can also exacerbate weed problems if management burning and weed control are not coordinated. Fire management plans should focus on noxious weeds but also include management of environmental weeds. The reserve fire management plans should provide for coordination of management burning and weed control in infested areas.

The weed assessment is to rely primarily on existing information, but should also include incidental observations while carrying out the field work for the reserve fire management plans. Prescribed burning procedures are to include a requirement that each burning unit be checked for weeds prior to burning, and at least major infestations are treated prior to burning and after the burn.

Soil Erosion

Areas of existing or potential soil erosion that could be affected by wildfires or fire management activities are to be identified. Recommended fire management activities in these areas are to be modified to ensure that fire management will not exacerbate existing problems. Where possible fire regimes that will reduce existing risks should be prescribed.

Community Consultation

The fire management plan should include extensive consultation with landowners surrounding the reserve, and other stakeholders including community groups with an interest in the reserve, the Rural Fire Service and any other government agencies that have responsibility for infrastructure or management in the reserve.

5 Fire Management Objectives

The fire management plan should include clearly stated management objectives that address all the fire management issues identified in the reserve. Management actions should then be developed to achieve each of the management objectives.

6 Plan Implementation

Habitat Management Burning

A burning regime (fire frequency, season and intensity) is to be prescribed for each of the plant communities within the reserve that are known to require relatively frequent fire to maintain their structure and floristics. These regimes aim to ensure the long-term viability of these plant communities, and should be based on the latest available information on the fire ecology of these communities, and any species of particular conservation value known to occur within those communities.

Burning Units

The reserve is to be divided into fire management units that are optimal for implementing the fuel and habitat management activities determined by the risk assessment process. These should be divided into units where burning is primarily for hazard reduction (strategic hazard management units) and those where burning is primarily for ecosystem management (ecosystem management units). These units facilitate application of the fire hazard management techniques (burning, mechanical or manual fuel removal) that are most appropriate to the location of the unit, and the vegetation that it contains. In areas where prescribed burning is the most appropriate means of reducing fire hazard, the units permit the implementation of a mosaic burning pattern, and optimisation of the fire regime for each vegetation type. Areas of vegetation considered to require management burning for hazard reduction and/or ecosystem management are to be selected on the following basis:

- the unit contains vegetation with similar fire regime requirements to maintain long-term viability of the vegetation types. Areas of fire sensitive vegetation where fire should be

excluded are to be identified. Plant communities that have optimal fire frequencies longer than the plan period are to be identified and excluded from the burning program. This will ensure that appropriate fire regimes can be applied to plant communities that require management burning, and fire sensitive communities can be protected.

- Wherever possible units are to be bounded by roads, fire trails, walking tracks or natural features that can be used as fire control lines. This will reduce the time required to prepare for the burn and reduce the risk of the burn escaping.
- Unit boundaries are to correspond with existing property and management boundaries wherever possible.
- Each unit should be small enough to be burnt in one day using ground ignition.

Burning units should be extended to cover adjoining areas of bushland where this will supplement and strengthen fire management measures in the reserve, or provide the most practical boundaries for fire management planning and suppression. Such extensions should only be made with the agreement of the neighbouring landowner.

Burning Schedule and Prescriptions

For each fire management unit considered to require management burning, the plan should include a burning schedule to meet the fire management objectives of the plan. Burn scheduling should have some flexibility to allow for excessively wet or dry years when it may not be possible to carry out scheduled management burns, and also to introduce some variability into the schedule.

Burning prescriptions are to cover:

- vegetation type and fuel loads
- fire frequency and intensity
- sequencing of burns
- desired outcomes
- weather conditions
- associated bushland management works such as weed control
- environment protection during and after burns

Procedures for planning management burns and recording the outcomes should be based on current Rural Fire Service procedures, and must ensure that all relevant safety and environmental issues are taken into account, and the details of the burn required for on-going planning are recorded.

The fire management plan should have an in-built flexibility to allow new information on the fire ecology of flora and fauna species and plant communities within the reserves to be incorporated into the plan.

Although one of the aims of a fire management plan is to reduce the incidence and severity of unplanned fires within a reserve, these will inevitably occur. Therefore the plan must include a procedure for varying prescribed burning regimes to incorporate the occurrence of wildfires so that the objectives of the plan can still be achieved.

Community Education and Awareness

Community education and awareness is important for the successful implementation of a fire management plan. In particular, the cooperation of neighbouring landowners is required for effective fire management. This is best accomplished by community consultation during preparation of the plan, and an information and education program during the operation of the plan. The plan should include recommendations for involving and educating adjoining landowners as to their role in fire management, and the role of fire in the natural environment. These could include preparation of brochures with information presented in straightforward terms.

Community Response

Public submissions on a draft fire management plan should be collated into a Schedule of Submissions. This will involve categorisation of issues, identification of where the issue is addressed in the management plan, a summary of the issues, the planning team's response and the action taken. This information should be documented in the form of a table.

This technique will provide a readily referenced way of sourcing information by Council and the community. Minutes from particular meetings with stakeholders may also be reproduced as deemed necessary.

Recording, Monitoring and Evaluation

Each fire management plan is to include monitoring activities to assess the effectiveness and impacts of management burning and other fire management activities. Performance indicators are to be set for all recommended management actions in the reserve fire management plans. This will allow the plans to be audited, and the information gained used to improve the existing, or future fire management plans.

Personnel Safety and Training

The fire management plan should clearly state minimum levels of training and safety equipment for persons carrying out management burning in the reserve. Also included should be a procedure to ensure effective coordination of fire management activities amongst the various stakeholders.

Appendix E

Ecological Investigation Report

ECOLOGICAL INVESTIGATION

**STRATEGIC BUSHFIRE
MANAGEMENT PLAN FOR
MOUNT GIBRALTAR RESERVE,
GIBBERGUNYAH RESERVE AND
MOUNT ALEXANDRA RESERVE**

a report prepared by

**KEVIN MILLS & ASSOCIATES
ECOLOGICAL AND ENVIRONMENTAL CONSULTANTS**

November 2003

03/53

**ECOLOGICAL INVESTIGATION
STRATEGIC BUSHFIRE MANAGEMENT PLAN FOR
MOUNT GIBRALTAR RESERVE, GIBBERGUNYAH RESERVE AND
MOUNT ALEXANDRA RESERVE**

a report prepared by

KEVIN MILLS & ASSOCIATES
ECOLOGICAL AND ENVIRONMENTAL CONSULTANTS
114 NORTH CURRAMORE ROAD
JAMBEROO NSW 2533
ABN 346 816 238 93

for

WINGECARRIBEE SHIRE COUNCIL
PO BOX 141
MOSS VALE NSW 2577

November 2003
03/53

**ECOLOGICAL INVESTIGATION
STRATEGIC BUSHFIRE MANAGEMENT PLAN FOR
MOUNT GIBRALTAR RESERVE, GIBBERGUNYAH RESERVE
AND MOUNT ALEXANDRA RESERVE**

CONTENTS

PART 1:	INTRODUCTION.....	1
1.1	BACKGROUND.....	1
1.2	PURPOSE OF THE REPORT.....	1
1.3	STUDY BRIEF.....	2
1.4	THE STUDY AREAS.....	2
1.5	STUDY METHODS.....	6
PART 2:	MOUNT GIBRALTAR RESERVE.....	7
2.1	VEGETATION: MOUNT GIBRALTAR.....	7
2.2	FAUNA AND HABITATS: MOUNT GIBRALTAR.....	8
2.3	SIGNIFICANT FEATURES: MOUNT GIBRALTAR.....	8
PART 3:	GIBBERGUNYAH RESERVE.....	10
3.1	VEGETATION: GIBBERGUNYAH.....	10
3.2	FAUNA AND HABITATS: GIBBERGUNYAH.....	10
3.3	SIGNIFICANT FEATURES: GIBBERGUNYAH.....	11
PART 4:	MOUNT ALEXANDRA RESERVE.....	12
4.1	VEGETATION: MOUNT ALEXANDRA.....	12
4.2	FAUNA AND HABITATS: MOUNT ALEXANDRA.....	13
4.3	SIGNIFICANT FEATURES: MOUNT ALEXANDRA.....	13
PART 5:	ENVIRONMENTAL MANAGEMENT.....	16
5.1	IDENTIFYING KEY ISSUES.....	16
5.2	VEGETATION TYPES.....	16
5.3	SIGNIFICANT PLANT SPECIES.....	16
5.4	SIGNIFICANT FAUNA SPECIES.....	16
5.5	HIGH FREQUENCY FIRE AS A KEY THREATENING PROCESS.....	22
5.6	RECOMMENDATIONS FOR BUSHFIRE MANAGEMENT.....	22
PART 6:	REFERENCES AND BIBLIOGRAPHY.....	25
PART 7:	APPENDICES.....	27
7.1	FINAL DETERMINATION FOR MOUNT GIBRALTAR FOREST.....	27
7.2	FLORA LISTS FOR THE RESERVES.....	30
7.3	FAUNA LISTS FOR THE RESERVES.....	55

TABLES

2.1 Vegetation Communities in Mount Gibraltar Reserve.....7
3.1 Vegetation Communities in Gibbergunyah Reserve.....10
4.1 Vegetation Communities in Mount Alexandra Reserve.....12
5.1 Conservation Significance of Vegetation Communities in the
Mittagong Reserves.....17
5.2 Comparison between Vegetation Classification Schemes.....19
5.3 Plant Species of Conservation Importance.....20
5.4 Fauna Species of Conservation Importance21
5.5 Fire Management Requirements of Vegetation Communities.....24

FIGURES

1. Location of the Bushland Reservesafter p.2
2. Vegetation Map: Mount Gibraltar Reserveafter p.7
3. Vegetation Map: Gibbergunyah Reserve.....after p.10
4. Vegetation Map: Mount Alexandra Reserve.....after p.12

ECOLOGICAL INVESTIGATION STRATEGIC BUSHFIRE MANAGEMENT PLAN FOR MOUNT GIBRALTAR RESERVE, GIBBERGUNYAH RESERVE AND MOUNT ALEXANDRA RESERVE

PART 1: INTRODUCTION

1.1 BACKGROUND

Wingecarribee Shire Council is responsible for the management of fire and fire risk within natural areas within the Shire managed by Council. Fire is an essential component in the maintenance of ecological diversity in the natural environment. Council has the dual responsibility of combining the conservation of these natural areas with the protection of life and property, both of adjoining residents and recreational users.

Council is developing a Fire Management Strategy that outlines its fire management policies and describes best management practices in a number of relevant areas including firebreak and fire trail construction and maintenance, management burning, co-ordinating weed control and monitoring. One of the primary recommendations of the Strategy is the preparation of specific fire management plans for large bushland areas.

Fire Management Plans for bushland areas should determine areas of high fire hazard, recommend appropriate hazard abatement programs and identify necessary fire management works, whilst providing for the protection of the natural and cultural values of the area.

Council requires a Fire Management Plan that is a working document, detailing management actions through the identification and mapping of appropriate burn compartments and fuel management zones, the timetabling of burn programs, the construction and maintenance of firebreaks and fire trails, and the incorporation of work management actions.

This study is concerned with three Council bushland reserves in the Mittagong – Bowral area; namely Mount Gibraltar Reserve, Gibbergunyah Reserve and Mount Alexandra Reserve.

1.2 PURPOSE OF THE REPORT

The aim of the Consultancy is to prepare a Fire Management Plan for Mount Gibraltar, Gibbergunyah and Mount Alexandra Reserves that:

- (a) Provides recommendations for maintenance and operational procedures that will minimise fire threat to:
 - Life and property;
 - Ecological diversity;
 - The sustainability of natural systems;
 - Cultural and Aboriginal values; and
 - Threatened Species.
- (b) Provides Council with recommendations on policy and best management practice for development of Fire Hazard Management Strategies.

This report forms the ecological investigation component of the Fire Management Plan.

1.3 STUDY BRIEF

The Bushland Management section of the study brief prepared by Council included the following objectives:

- Identify the threat from fire to habitat values and ecological diversity within the subject area.
- Assess the impact of fire management programs on the long term protection of biodiversity and in particular rare or threatened species.
- Identify and isolate areas that pose an environmental risk, for instance soil erosion or weed invasion, due to the proposed fire management actions.

The following tasks were identified by Kevin Mills & Associates to meet the objectives for this project.

1. Review all relevant ecological information on the reserves; this will include liaison with the Council and bushfire brigades, assessing published material and NPWS databases, and discussion with people involved in the reserves.
2. Undertake field inspections to:
 - Prepare a vegetation map for each reserve, based on recognised methods of identifying vegetation community types;
 - Verify, if possible, occurrences of rare or threatened plant species and vegetation communities in the reserves; and
 - Prepare a general description of the flora and fauna in the reserves.
3. Liaise with the bushfire consultant to develop a suitable approach to bushfire management in the reserves.
4. Prepare a report containing the results of the above investigations; a description of all rare and threatened species and communities, the vegetation maps, photographs and other maps as may be deemed relevant, and a bushfire management protocol to protect the conservation values of the reserves.

1.4 THE STUDY AREAS

The study area covers three bushland reserves under the control of Wingecarribee Shire Council in the Mittagong - Bowral area; these are summarised below. The location of the reserves is shown on Figure 1.

RESERVE PROFILE

NAME:	Mount Gibraltar Reserve
AREA:	120 hectares
MANAGER:	Wingecarribee Shire Council
1:25,000 MAP SHEET:	Mittagong 8929-2-S
LOCALITY:	Located on the northern edge of Bowral, covering Mount Gibraltar and its southern flank.
APPROXIMATE DIMENSIONS:	Approximately two kilometres by 500 metres.
ALTITUDE:	730 metres to 863 metres above sea level.
GEOLOGY:	Mainly on Mount Gibraltar Syenite, with Hawkesbury Sandstone to the east and some Wianamatta Group shale to the west.
RAINFALL:	Average of 949 mm per year at Bowral.
CATCHMENT(S):	Gibbergunyah Creek and Chinamans Creek, then the Nattai River. Southern section drains to Mittagong Creek and the Wingecarribee River.
ACCESS:	Off Oxley Drive and Scenic Road, the latter bisecting the reserve.
BIO-REGION:	Sydney Basin Bio-Region.
BOTANICAL SUBDIVISION:	On the boundary of the Central Coast Subdivision and the Central Tablelands Subdivision.
CLOSEST RESERVE(S):	Gibbergunyah Reserve (Wingecarribee Shire Council), one kilometre to the west.
MAJOR NATURAL FEATURES:	Mount Gibraltar is the highest peak in the district (863 metres), offering extensive views over the region. A tall forest, developed over most of the reserve, is unique in the region. This is in stark contrast to the lower forest in the eastern part of the reserve growing on the Hawkesbury Sandstone. A distinctive shrubby vegetation occurs on the broad rock surfaces on the summit.

RESERVE PROFILE

NAME:	Gibbergunyah Reserve
AREA:	186 hectares
MANAGER:	Wingecarribee Shire Council
1:25,000 MAP SHEET:	Mittagong 8929-2-S
LOCALITY:	One kilometre south of Welby and two kilometres north-west of Bowral.
APPROXIMATE DIMENSIONS:	Approximately 1.5 kilometres by 1.5 kilometres.
ALTITUDE:	660 metres to 803 metres above sea level.
GEOLOGY:	Hawkesbury Sandstone; one small area shows signs of Shale (Wianamatta Group) influence.
RAINFALL:	Average of 949 mm per year at Bowral.
CATCHMENT(S):	Nattai River, mostly via Gibbergunyah Creek, with a small area draining to the west and Nattai Creek.
ACCESS:	Off Howards Lane, just west of Welby.
BIO-REGION:	Sydney Basin Bio-Region.
BOTANICAL SUBDIVISION:	On the boundary of Central Coast Subdivision and the Central Tablelands Subdivision.
CLOSEST RESERVE(S):	Mount Gibraltar Reserve (Wingecarribee Shire Council) one kilometre to the east; Mount Alexandra Reserve, one kilometre to the north.
MAJOR NATURAL FEATURES:	The reserve covers the ridges and slopes around Ninety Acre Hill, at the northern end of the Mittagong Range. The reserve contains an extensive stand of good quality forest. Most of the upper catchment of Gibbergunyah Creek is within the reserve.

RESERVE PROFILE

NAME:	Greater Mount Alexandra Reserve
AREA:	2,300 hectares
MANAGER:	Wingecarribee Shire Council
1:25,000 MAP SHEET:	Mittagong 8929-2-S
LOCALITY:	Covers the Nattai River valley to the north of Mittagong and Welby.
APPROXIMATE DIMENSIONS:	Approximately seven kilometres north to south, and by about 1.5 to six kilometres east to west.
ALTITUDE:	430 metres to 780 metres above sea level.
GEOLOGY:	Hawkesbury Sandstone.
RAINFALL:	Average 922 mm per year at Mittagong.
CATCHMENT(S):	The whole area drains to the Nattai River, that bisects the reserve. The major creeks are Drapers, Kells, Sheepwash and Nattai.
ACCESS:	Access is available from several points. In the south, access is off the old Hume Highway near Welby and Morris Road, off Kells Creek Road and Wombeyan Caves Road. Public access is also from the Mount Alexandra area, immediately to the north of Mittagong. Access from the east and north is only available off fire trails that are gated; these are located off Drapers Road and Colo Road.
BIO-REGION:	Sydney Basin Bio-Region.
BOTANICAL SUBDIVISION:	Central Coast Subdivision, close to Central Tablelands Subdivision boundary.
CLOSEST RESERVE(S):	Gibbergunyah Reserve (Wingecarribee Shire Council) one kilometre to the south, and Nattai National Park and Bargo State Conservation Area, (NPWS), both about one kilometre to the north.
MAJOR NATURAL FEATURES:	The reserve covers an extensive part of the upper catchment of the Nattai River, including the gorge and the land immediately northwest of Mittagong. Mount Alexandra, on the edge of Mittagong, is within the reserve.

1.5 STUDY METHODS

The study methods involved both field investigations and the gathering and analysis of existing ecological and other information on the reserves. Essentially, the survey methods can be summarised as:

- a. Identify and review existing information;
- b. Critically assess the existing information;
- c. Undertake field inspections of the reserves;
- d. Collate all existing information on each reserve, including that gathered during the field inspections;
- e. Prepare vegetation maps of each reserve, based on field inspections and existing maps where appropriate;
- f. Identify critical information/issues related to bushfire management that require addressing in the final report; and
- g. Prepare a report based on the above.

* * * * *

PART 2: MOUNT GIBRALTAR RESERVE

2.1 VEGETATION: MOUNT GIBRALTAR

The vegetation communities within the Mount Gibraltar Reserve were identified in the field and a vegetation community map was prepared using a colour aerial photograph covering the reserve and the adjacent land. This map is provided at Figure 2. The identified vegetation communities are summarised in Table 2.1.

TABLE 2.1
VEGETATION COMMUNITIES IN MOUNT GIBRALTAR RESERVE

No.	Name (Code)	Key Species	Occurrence
1	Brown Barrel Tall Forest (FAS-TOF)	<i>Eucalyptus fastigata</i>	Covers most of the southern part of the reserve, on deep syenite soils.
2	Gully Gum Forest/Forest (SMI-ELA)	<i>Eucalyptus smithii</i> <i>Eucalyptus elata</i> <i>Eucalyptus globoidea</i>	Covering an extensive Tall area on the syenite soils across the northern part of the reserve.
2a	River Peppermint Tall Forest (SMI-ELA)	<i>Eucalyptus elata</i> <i>Eucalyptus smithii</i>	Along the gully of Chinamans Creek, particularly on the flat in the northeast.
3	Manna Gum Tall Forest (VIM-TOF)	<i>Eucalyptus viminalis</i>	On the lower western edge of the reserve.
4	Peppermint Forest (PIP-SMI)	<i>Eucalyptus piperita</i>	On rather dry slopes of syenite along the western part of the reserve.
5	Peppermint - Silvertop Ash Silvertop Ash Forest (PIP-SIE)	<i>Eucalyptus piperita</i> <i>Eucalyptus sieberi</i>	On the Hawkesbury Sandstone in the north-eastern part of the reserve.
6	Silvertop Ash - Stringybark Forest (SIE-AGG)	<i>Eucalyptus sieberi</i> <i>Eucalyptus agglomerata</i>	On an exposed Hawkesbury Sandstone Ridge on the far north-eastern edge of the reserve.
7	Red Gum Woodland (TER-WLD)	<i>Eucalyptus tereticornis</i>	Mainly on the lowest north-western corner of the reserve, near the railway.

TABLE 2.1 cont...
VEGETATION COMMUNITIES IN MOUNT GIBRALTAR RESERVE

No.	Name	Key Species	Occurrence
8	Wattle Forest/Woodland/ Shrubland (ACA-WLD)	<i>Acacia mearnsii</i> <i>Eucalyptus tereticornis</i> <i>Eucalyptus smithii</i> <i>Leptospermum brevipes</i>	On the summit of Mount Gibraltar, covering the exposed rock surfaces.

A plant list for the Mount Gibraltar Reserve has been compiled by Jane Lemann. This list forms the basis of the flora list for the reserve provided in this report at Appendix 7.2. Some additional species have been added during the current investigation, particularly those found on the sandstone section of the reserve. The list is quite comprehensive and the majority of the species in the reserve have probably been identified; a total of 229 native species and 69 exotic species are listed.

2.2 FAUNA AND HABITATS: MOUNT GIBRALTAR

The habitats in the Mount Gibraltar Reserve consist mainly of open forest and tall open forest, with some woodland and open areas on the rock surfaces. The western part of the reserve contains large outcrops of the syenite rock, including some tall cliffs, while the eastern section contains small outcrops of sandstone. The upper section of Chinamans Creek in the east provides a small amount of riparian habitat. A major feature of the reserve is the tall forest, found in the southern half of the reserve and on the flats in the far north-eastern corner.

A fauna list for the Mount Gibraltar Reserve is presented in Appendix 7.3. This list has been compiled from all sources, including observations made during the current investigation. This is only a preliminary lists of the species occurring in the reserve, as no systematic surveys have been undertaken.

2.3 SIGNIFICANT FEATURES: MOUNT GIBRALTAR

Significant conservation features are listed under the *Threatened Species Conservation Act 1995 (TSC Act)* as threatened species, populations and communities. Species and communities may also be of local or regional conservation importance. Those significant species and communities occurring in Mount Gibraltar Reserve are discussed below. The relationship between these species and communities and bushfire management are discussed in Section 5.

Mount Gibraltar Forest

Mount Gibraltar Forest is listed as an endangered ecological community under the *TSC Act*; the Final Determination to list this community is provided in Appendix 7.1. As the determination states "Mount Gibraltar Forest includes vegetation ranging from open-forest to woodland and scrub depending on aspect, soil conditions and previous clearing and disturbance." The community occurs on "clay soils derived from a microsyenite volcanic intrusion associated with Mount Gibraltar".

The following vegetation communities identified in this report form part of the Mount Gibraltar Forest endangered ecological community.

- Brown Barrel Forest
- Gully Gum Tall Forest/Forest
- Manna Gum Tall Forest
- Peppermint Forest
- Red Gum Woodland

- Wattle Forest/Woodland/Shrubland

The Scientific Committee notes in the Final Determination that "inappropriate fire regimes" may threaten the community; consideration is given to this issue in Section 5.

Threatened Flora

No species of threatened flora is known to occur in the reserve. One species of regional significance occurs in the reserve, this is *Leptospermum brevipes* (*Myrtaceae*). This shrub is considered to be "rare on [the] Central Tablelands" (Benson & McDougall 1998). *Leptospermum brevipes* is quite common on the summit of Mount Gibraltar, growing on shallow soils over broad rock surfaces.

Threatened and Rare Fauna

The only record of threatened species for the reserve appears to be the Grey-headed Flying-fox *Pteropus poliocephalus*, which

Grey-headed Flying-fox *Pteropus poliocephalus*

Status: Vulnerable under the *TSC Act*

Habitat: Forests and woodlands, wherever flowers or fruits can be found; forms large camps in rainforest. Visits introduced trees in orchards and gardens.

Critical Habitat Components: Flowering eucalypts and other trees, rainforest gullies for camps.

Local Records: This bat is listed for the reserve, and is probably an occasional summer visitor to the forests in the reserve when eucalypts are flowering.

Threatened cave-dwelling bats such as the Large Bentwing-bat *Miniopterus schreibersii* may use the high cliffs in the reserve for roosting. There are several records of Koalas around Bowral and with several key feed trees within the reserve, the Koala may visit from time to time.

Greater Glider *Petauroides volans*

Status: Species of special concern.

Habitat: Forest and tall forests, usually containing large, old trees.

Critical Habitat Components: Large trees with large enough hollows for denning.

Local Records: Present and probably common throughout the taller forests in the reserve.

Fauna Habitat

The tall forest in the reserve is unique in the region and supports a wide range of fauna species, some of which are uncommon elsewhere. In particular, tree hollow-using species such as arboreal mammals and some birds, find good habitat in the larger trees in this forest.

* * * * *

PART 3: GIBBERGUNYAH RESERVE

3.1 VEGETATION: GIBBERGUNYAH

The vegetation communities within the Gibbergunyah Reserve were identified in the field and a vegetation community map was prepared using a colour aerial photograph covering the reserve and the adjacent land. The identified vegetation communities are summarised in Table 3.1. The distribution of the vegetation communities within the Gibbergunyah Reserve is shown on Figure 3.

TABLE 3.1
VEGETATION COMMUNITIES IN GIBBERGUNYAH RESERVE

No.	Name (Code)	Key Species	Occurrence
1	Peppermint - Gully Gum Tall Forest (PIP-SMI)	<i>Eucalyptus piperita</i> <i>Eucalyptus smithii</i>	In the deep gullies of Gibbergunyah Creek.
2	Peppermint - Silvertop Ash Forest (PIP-SIE)	<i>Eucalyptus piperita</i> <i>Eucalyptus sieberi</i>	On the ridges and slopes over most of the reserve.
3	Grey Gum - Stringybark Forest (PUN-AGG)	<i>Eucalyptus punctata</i> <i>Eucalyptus agglomerata</i> <i>Allocasuarina littoralis</i>	On dry, north-facing slopes in the northern part of the reserve.
4	Shale Forest (PIP-GLB)	<i>Eucalyptus piperita</i> <i>Eucalyptus globoidea</i>	On a small area on a ridgetop in the northern-central part of the reserve.

There is no comprehensive plant list for Gibbergunyah Reserve. A plant species list was compiled during the current investigation; this was added to a small amount of existing information. This list, provided at Appendix 7.2, is by no means a comprehensive list for the reserve; a total of 100 native species and three exotic species are listed.

3.2 FAUNA AND HABITATS: GIBBERGUNYAH

The reserve contains a relatively extensive stand of good quality open forest in a natural condition. Much of the reserve contains habitat features important for threatened fauna species; see below. Large trees with hollows are fairly common, with well developed tall forest in the main gullies (Community 1).

A fauna list for the Gibbergunyah Reserve is presented in Appendix 7.3. This list has been compiled from all sources, including observations made during the current investigation. This is only a preliminary list of the species occurring in the reserve, as no systematic surveys have been undertaken.

3.3 SIGNIFICANT FEATURES: GIBBERGUNYAH

Natural Forest

Although not listed as an endangered community, the forest in the reserve provides a reasonably large area of good quality forest habitat for flora and fauna. The species composition of the forest on the area influenced by shale (Community 4) is of local value.

Threatened Flora

There are no species of threatened flora known from the Gibbergunyah Reserve.

Threatened and Rare Fauna

Three species of threatened forest fauna are known in the reserve; these are the Powerful Owl, Glossy Black-Cockatoo and the Yellow-bellied Glider. These species and their habitats are summarised below.

Powerful Owl *Ninox strenua*

Status: Vulnerable under the *TSC Act*.

Habitat: Forest, particularly tall forest containing large trees.

Critical Habitat Components: Large, hollow-bearing trees for nesting; good populations of arboreal mammals required for food; thick foliated trees for roosting.

Local Records: The Reserve Management Committee reports the presence of the Powerful Owl in the reserve; the habitat is certainly ideal. There are several other records for the general Wingecarribee area.

Glossy Black-Cockatoo *Calyptorhynchus lathami*

Status: Vulnerable under the *TSC Act*.

Habitat: Forest and woodland, where mature stands of Black She-oak *Allocasuarina littoralis* occur.

Critical Habitat Components: Mature stands of *Allocasuarina littoralis* holding good quantities of cones; large, old trees with hollows for breeding.

Local Records: The distinctive chewed casuarina cones were found in several places on the northern part of the reserve, in the Grey Gum - Stringybark Forest.

Yellow-bellied Glider *Petaurus australis*

Status: Vulnerable under the *TSC Act*.

Habitat: Mainly tall open forest and open forest, where their favoured food trees are present. In the Wingecarribee Shire, this is mainly the tree Grey Gum *Eucalyptus punctata*.

Critical Habitat Components: Old, large trees with hollows for denning; favoured food trees for foraging.

Local Records: The distinctive feeding scars of this glider were observed on several *Eucalyptus punctata* trees in the northern part of the reserve. The species inhabits much of the sandstone country west and north of Mittagong, wherever *Eucalyptus punctata* occurs.

Greater Glider *Petauroides volans*

Status: Species of special concern.

Habitat: Forest and tall forests, usually containing large, old trees.

Critical Habitat Components: Large trees with large enough hollows for denning.

Local Records: Present and probably common throughout the gully forests in the reserve, mainly vegetation Community 1.

* * * * *

PART 4: GREATER MOUNT ALEXANDRA RESERVE

4.1 VEGETATION: MOUNT ALEXANDRA

The vegetation communities within the Greater Mount Alexandra Reserve were identified in the field and a vegetation community map was prepared using a colour aerial photograph covering the reserve and the adjacent land. This map is provided at Figure 4. The identified vegetation communities are summarised in Table 4.1. Note that Community 6 – Riparian Scrub is very narrow and has not been mapped.

**TABLE 4.1
VEGETATION COMMUNITIES IN MOUNT ALEXANDRA RESERVE**

No.	Name (Code)	Key Species	Occurrence
1	Peppermint Tall Forest (PIP-SMI)	<i>Eucalyptus piperita</i> <i>Eucalyptus radiata</i> <i>Eucalyptus smithii</i>	In the deep gullies of Nattai River gorges, extending onto adjacent protected slopes.
2	Mixed Peppermint Forest (PIP-PUN)	<i>Eucalyptus piperita</i> <i>Eucalyptus punctata</i> <i>Eucalyptus sieberi</i> <i>Eucalyptus agglomerata</i>	Extensive across the plateaux and dry slopes throughout the reserve.
3	Grey Gum - White Stringybark Forest (PUN-GLB)	<i>Eucalyptus punctata</i> <i>Eucalyptus globoidea</i>	Small area of shale soil west of Welby.
4	Mixed Scribbly Gum Forest (SCL-SIE)	<i>Eucalyptus sclerophylla</i> <i>Eucalyptus sieberi</i> <i>Eucalyptus agglomerata</i> <i>Banksia serrata</i>	Widespread on plateaux.
5	Scribbly Gum Heathy Woodland (SCL-MAN)	<i>Eucalyptus sclerophylla</i> <i>Eucalyptus mannifera</i>	Rocky sites between Colo Vale and Welby.
6	Tea Tree Shrubland (Swamp Shrubland) (LEP-SHR)	<i>Leptospermum juniperinum</i> <i>Gleichenia dicarpa</i>	Restricted to a gully to the west of Colo Vale.
7	Riparian (Simple) Rainforest (CER-WRF)	<i>Ceratopetalum apetalum</i>	Along the fringes of the main watercourses in the area, most notably the upper Nattai River.

There is no comprehensive plant list for the Greater Mount Alexandra Reserve. A plant species list was compiled during the current investigation and species lists were obtained from a few other sources. This list, provided at Appendix 7.2, is by no means a comprehensive list for the reserve; a total of 242 native species and 17 exotic species are listed.

4.2 FAUNA AND HABITATS: GREATER MOUNT ALEXANDRA RESERVE

Mount Alexandra contains a large area of generally undisturbed natural forest, with some areas of woodland. The reserve is a major local habitat for forest-dwelling fauna and forest flora. The other major habitat components are the extensive cliffines and the riparian habitats along the Nattai River and its main tributaries.

4.3 SIGNIFICANT FEATURES: GREATER MOUNT ALEXANDRA RESERVE

Natural Forest/Habitats

Mount Alexandra Reserve covers a large area of forest habitat, almost all of which is in a relatively natural condition. The tall valley forest and associated riparian habitats are important for local fauna, both in terms of their intrinsic habitat value as well as their role in providing a habitat corridor for forest species. The reserve as a whole provides a significant habitat link, in terms of its size and location between the NPWS reserves of the lower Blue Mountains and the bushland around Mittagong, including Council's two other reserves, and the water catchment land further to the east.

Threatened, Rare and Locally Significant Flora

The following plant species known to occur in Mount Alexandra Reserve are either threatened, rare or have local/regional conservation significance.

Persoonia glaucescens

Status: Endangered under the *TSC Act*.

Habitat: Woodland to open woodland on sandstone.

Local Records: Quite common in the Scribbly Gum Heathy Woodland community near Welby, also near Drapers Road.

Eucalyptus apiculata

Status: ROTAP species – coded 3RC-.

Habitat: Edges of cliffs and rock outcrops on sandstone.

Local Records: On rocky ground in the Scribbly Gum Heathy Woodland community north of Welby; possibly on other cliffines.

Lissanthe sapida

Status: ROTAP species – coded 3RCa.

Habitat: Forest on sandstone, often on rocky ground.

Local Records: Reported to occur above the tunnel along the Box Vale railway in the far south of the reserve.

Eucalyptus oreades

Status: Locally significant, at species southern limit of distribution.

Habitat: Tall forest on moist sites in gullies. Benson and McDougal (1998) note that this eucalypt, unlike most others, is severely affected by fire.

Local Records: In the gorge of the upper section of the Nattai River north of Welby.

Persoonia mollis subsp. *revoluta*

Status: Endemic to the region, ROTAP species – coded ZR.

Habitat: Woodland and open woodland on sandy soils.

Local Records: Occasional in woodland near the Box Vale Walking Track.

Threatened and Rare Fauna

Three species of threatened forest fauna are known in the reserve; these are the Powerful Owl, Glossy Black-Cockatoo and the Yellow-bellied Glider. These species and their habitats are summarised below.

Glossy Black-Cockatoo *Calyptorhynchus lathami*

Status: Vulnerable under the *TSC Act*.

Habitat: Forest and woodland, where mature stands of Black She-oak *Allocasuarina littoralis* occur.

Critical Habitat Components: Mature stands of *Allocasuarina littoralis* holding good quantities of cones; large, old trees with hollows for breeding.

Local Records: The distinctive chewed casuarina cones were found in various places throughout the reserve.

Yellow-bellied Glider *Petaurus australis*

Status: Vulnerable under the *TSC Act*.

Habitat: Mainly tall open forest and open forest, where their favoured food trees are present. In the Wingecarribee Shire, this is mainly the tree Grey Gum *Eucalyptus punctata*.

Critical Habitat Components: Old, large trees with hollows for denning; favoured food trees for foraging.

Local Records: The distinctive feeding scars of this glider were observed on several *Eucalyptus punctata* trees in the reserve, notably along the far northern edge of the reserve. The species inhabits much of the sandstone country west and north of Mittagong, wherever *Eucalyptus punctata* occurs.

Squirrel Glider *Petaurus norfolcensis*

Status: Vulnerable under the *TSC Act*.

Habitat: Many types of forest and woodland.

Critical Habitat Components: Hollow-bearing trees for denning, trees providing flowering and sap resources.

Local Records: Whelan (1983) reported the glider near Mittagong, but did not list the far more common Sugar Glider; there may be some doubt about the record.

Brown Treecreeper *Climacteris picumnus*

Status: Vulnerable under the *TSC Act*.

Habitat: Woodland with a fairly open understorey, mostly a species of west of the dividing range.

Critical Habitat Components: Good quality woodland, fallen timber.

Local Records: This species appears on a list of birds for the reserve; its origin is unknown. Chafer et. al. (1999) note the Brown Treecreeper occurs "in open forests, woodlands and semi-cleared land well west of the Hume Highway [in the Wingecarribee region]". Its presence in this reserve is questionable.

Platypus *Ornithorhynchus anatinus*

Status: Species of special concern (Grant 1991).

Habitat: Pools in moderately sized to large watercourses.

Critical Habitat Components: Unpolluted rivers and creeks, including the absence of excessive sedimentation.

Local Records: Known to inhabit the Nattai River.

Greater Glider *Petauroides volans*

Status: Species of special concern.

Habitat: Forest and tall forests, usually containing large, old trees.

Critical Habitat Components: Large trees with large enough hollows for denning.

Local Records: Present and probably common throughout the gully forests in the reserve, mainly vegetation Community 1.

Peregrine Falcon *Falco peregrinus*

Status: Species of special concern

Habitat: Wide range of foraging habitats, nests on cliffs.

Critical Habitat Components: Undisturbed cliffs needed for nesting.

Local Records: Probably thinly distributed throughout the region; recorded in the reserve.

Vegetation Communities

Tea Tree Shrubland (Swamp Shrubland)

This community is rare in the area, although such sandstone swamps are common in the Blue Mountains and on the eastern side of the water catchment land. This small swamp is threatened by inappropriate fire regimes and use of off-road vehicles.

Riparian (Simple) Rainforest

A fairly simple rainforest dominated by Coachwood *Ceratopetalum apetalum* that occurs along the upper Nattai River, as a narrow stand along the base of the valley. Rainforest is quite rare in this part of the region. Generally occurs in locations protected from fire as fire is likely to kill it.

* * * * *

PART 5: ENVIRONMENTAL MANAGEMENT

5.1 IDENTIFYING KEY ISSUES

The following key issues surrounding bushfire management and the conservation of the ecological environment have been identified. These are based on the conservation values identified in Sections 2.3, 3.3 and 4.3. The following section discusses each of the issues and Section 5.6 provides recommendations for conservation management as it relates to bushfire management.

The aim of bushfire management, in regard to the conservation of the natural environment, should:

- maintain existing populations of threatened, rare and locally significant plant species;
- maintain existing populations of threatened, rare and locally significant fauna species;
- maintain the integrity of all stands of endangered, and regionally and locally significant vegetation types; and
- minimise the general impact of bushfire management activities on the natural environment of the reserves, including the location and use of fire tracks and the use of hazard reduction activities.

5.2 VEGETATION TYPES

The conservation importance of the vegetation communities identified within each of the three reserves is summarised in Table 5.1. The value of the communities on a state and regional/local level is documented. The most important communities are those that are listed as endangered ecological communities under the *Threatened Species Conservation Act 1995*.

For comparative purposes, the equivalent communities in this study and the Wingecarribee Biodiversity Study are tabulated in Table 5.2.

5.3 SIGNIFICANT PLANT SPECIES

The species of threatened and rare flora are summarised in Table 5.3. The table provides information on the locality of the species, its known or conservation status, its occurrence and the likely response to fire and management of each species.

5.4 SIGNIFICANT FAUNA SPECIES

The species of threatened and rare fauna are summarised in Table 5.4. The table provides information on the locality of the species, its known or conservation status, its occurrence and the likely response to fire and management of each species.

Table 5.1 Conservation Significance of Vegetation Communities in the Mittagong Reserves				
Vegetation Community	Reservation Status	Equivalent Mapped Community	State Conservation Status	Regional Conservation Status
Mount Gibraltar Reserve				
Mount Gibraltar Tall Forest	Not adequately reserved.	Brown Barrel Forest Gully Gum Tall Forest/Forest Manna Gum Forest Peppermint Forest Red Gum Forest Wattle Forest/Woodland/Shrubland	Endangered ecological community	Endangered ecological Community
Sandstone Forest	Probably adequately reserved.	Peppermint-Silvertop Ash Forest Silvertop Ash-Stringybark Forest	Widespread and common in the Sydney Basin	Common in water catchments and lower Blue Mountains reserves
Gibbergunyah Reserve				
Tall valley forest	Possibly not well reserved	Peppermint-Gully Gum Tall Forest	Widespread in Sydney Basin	Moderately high, generally only in narrow occurrence along gullies
Sandstone Forest	Probably adequately reserved.	Peppermint-Silvertop Ash Forest Grey Gum-Stringybark Forest	Widespread and common in the Sydney Basin	Common in water catchments and lower Blue Mountains reserves
Shale Forest	Probably not well reserved	Shale Forest	Not significant	Of local interest only
Greater Mount Alexandra Reserve				
Tall valley forest	Possibly not well reserved	Peppermint Tall Forest	Widespread in Sydney Basin	Moderately high, generally only in narrow occurrence along gullies
Sandstone Forest	Probably adequately reserved.	Mixed Peppermint Forest Grey Gum-Stringybark Forest	Widespread and common in the Sydney Basin	Common in water catchments and lower Blue

		Nixed Scribbly Gum Forest		Mountains reserves
--	--	----------------------------------	--	---------------------------

Table 5.1 cont... Conservation Significance of Vegetation Communities in the Mittagong Reserves				
Vegetation Community	Reservation Status	Equivalent Mapped Community	State Conservation Status	Regional Conservation Status
Mount Alexandra Reserve cont...				
Sandstone woodland	Probably adequately reserved.	Scribbly Gum Heathy Woodland	Widespread and common in the Sydney Basin.	Common in water catchments and lower Blue Mountains reserves.
Sandstone swamp	Possibly adequately reserved	Tea Tree Shrubland (Swamp Shrubland)	Widespread but localised in the Sydney Basin to wetter areas.	High, because of its rarity in this locality.
Coachwood Rainforest	Probably well reserved in water catchments.	Riparian (Simple) Rainforest	Widespread but localised in the Sydney Basin to gorges.	High, because of its rarity in this locality.

Table 5.2 Comparison between Vegetation Classification Schemes	
Kevin Mills & Associates (2003)	Biodiversity Study
Brown Barrel Tall Forest (FAS-TOF)	Mt Gibraltar Forest
Gully Gum Tall Forest/Forest (SMI-ELA)	Moist Gully Gum Forest
River Peppermint Tall Forest (SML-ELA)	Moist Gully Gum Forest
Manna Gum Tall Forest (VIM-TOF)	-
Peppermint Forest (PIP-SMI)	Tall Open Gully Forest
Peppermint - Silvertop Ash Forest (PIP-SIE)	Mittagong Sandstone
Silvertop Ash - Stringybark Forest (SIE-AGG)	Woodland Sandstone
Mixed Peppermint Forest (PIP-PUN)	Woodland Sandstone
Red Gum Woodland (TER-WLD)	-
Wattle Forest/Woodland/Shrubland (ACA-WLD)	-
Grey Gum – White Stringybark Forest (PUN-GLB)	Wingecarribee Woodland
Mixed Scribbly Gum Forest (SCL-SIE)	Bundanoon Sandstone Woodland
Scribbly Gum Heathy Woodland (SCL-MAN)	Wingecarribee Mallee
Grey Gum – Stringybark Forest (PUN-AGG)	Sydney Sandstone Gully Forest
Tea Tree Shrubland (LEP-SHR)	Upland Swamps: Tea Tree Thicket
Riparian Rainforest (CER-WRF)	Warm Temperate Rainforest
Shale Forest (PIP-GLB)	Southern Highlands Shale Woodland (?)

Table 5.3

Plant Species of Conservation Importance

Flora Species (Habit)	Conservation Status	Occurrence	Response to Fire and Management
Mount Gibraltar Reserve			
<i>Leptospermum brevipes</i> (shrub to 3m)	Regionally rare	Summit of Mt Gibraltar.	Older plants probably survive fire and re-sprout; young plants may be killed. Frequent fires could remove populations. Time between fires should allow for seed set.
Gibbergunyah Reserve			
No significant species known			
Mount Alexandra Reserve			
<i>Persoonia glaucescens</i> (shrub to 2m)	Vulnerable	Eastern and southern parts of Mt Alexandra Reserve, in Scribbly Gum Woodland.	Probably killed by fires. Time between fires should allow for seed set.
<i>Lissanthe sapida</i> (small shrub)	ROTAP	Reported from above tunnel on Box Vale railway line.	Probably killed by fire. Time between fires should allow for seed set.
<i>Eucalyptus apiculata</i> (mallee to over 4m)	ROTAP	Eastern and southern parts of Mt Alexandra Reserve, along edges of gorges.	Mallees re-sprout from lignotuber after fire. Time between fires should allow for seed set.
<i>Eucalyptus oreades</i> (tree to over 20m)	Local importance	In the gorges of the Nattai River.	Reported to be very susceptible to being killed by fire.
<i>Eucalyptus dendromorpha</i> (mallee to tree)	Local importance	On the rim of the Nattai Gorge in some places.	Trees re-sprout from lignotuber after fire. Time between fires should allow for seed set.
<i>Persoonia mollis</i> subsp. <i>revoluta</i> (prostrate shrub)	ROTAP	Occasional along the Box Vale Walking Track.	Probably killed by fire.

Table 5.4 Fauna Species of Conservation Importance			
Fauna Species	Conservation Status	Occurrence	Response to Fire and Management
Gibbergunyah Reserve			
Glossy Black-Cockatoo	Vulnerable	Northern part of reserve, with <i>Allocasuarina littoralis</i> .	Old stands of casuarinas can be killed by fire. Frequent fires probably do not allow establishment of new stands of this tree.
Yellow-bellied Glider	Vulnerable	Northern part of reserve, with <i>Eucalyptus punctata</i> .	Frequent fires may change character of forest in a negative way for species or its food trees.
Powerful Owl	Vulnerable	Forests; status unclear.	Frequent fires may change character of forest in a negative way for species or its prey.
Greater Glider	Species of concern	Forests.	Frequent fires may change character of forest in a negative way for species or its food trees.
Mount Gibraltar Reserve			
Grey-headed Flying-fox	Vulnerable	Unknown; probably uncommon summer visitor.	Impact of fires unknown.
Greater Glider	Species of concern	Widespread in forests.	Frequent fires may change character of forest in a negative way for species or its food trees.
Mount Alexandra Reserve			Frequent fires may change character of forest in a negative way for species or its food trees.
Glossy Black-Cockatoo	Vulnerable	Widespread; wherever <i>Allocasuarina littoralis</i> occurs.	Old stands of casuarinas can be killed by fire. Frequent fires probably do not allow establishment of new stands of this tree.
Yellow-bellied Glider	Vulnerable	Widespread in <i>Eucalyptus punctata</i> forests.	
Platypus	Species of concern	Nattai River.	Fires and fire track construction/maintenance may cause sedimentation of watercourses that fill pools.
Greater Glider	Species of concern	Widespread in forests	Frequent fires may change character of forest in a negative way for species or its food trees.
Brown Treecreeper	Vulnerable	Unknown; record unconfirmed.	Unknown response to fire. As species prefers an open understorey, fire could be beneficial.
Peregrine Falcon	Species of concern	Unknown; clifflines, reserve generally.	Unlikely to be seriously affected by fire.
Squirrel Glider	Vulnerable	Reported to the west of Mittagong.	Frequent fires may change character of forest in a negative way for species or its food trees.

5.5 HIGH FREQUENCY FIRE AS A KEY THREATENING PROCESS

The NSW Scientific Committee (2001) has listed 'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' as a "key threatening process" under the NSW *Threatened Species Conservation Act 1995*, see Appendix 7.4. A key threatening process is specified on Schedule 3 to the Act. Under the Act, a threatening process is eligible to be listed as a key threatening process if it:

- "adversely affects 2 or more threatened species, populations or ecological communities, or
- could cause species, populations or ecological communities that are not threatened to become threatened."

Consideration needs to be given to the ecological requirements of the communities and constituent species in developing hazard reduction burns. The key consideration is to avoid a high frequency regime in the one location.

5.6 RECOMMENDATIONS FOR BUSHFIRE MANAGEMENT

The following recommendations are made to improve the management of bushfire in terms of the impact on the natural environment of the three Mittagong reserve.

General

(i) Bushfire should be managed with the dual purpose of protection of life and property and minimising the adverse impact on the natural environment.

(ii) The fire management requirements for each of the identified vegetation communities within the reserves is summarised in Table 5.4. Consideration should be give to these requirements when preparing hazard reduction burning within the reserves.

(iii) The plethora of vehicle tracks in some parts of the reserves, particularly Mount Alexandra, should be rationalised. Those not required for fire management should be closed and rehabilitated. Tracks should be gated where necessary.

(iv) The reserves should be appropriately sign-posted, providing basic information about the reserve, management authority, the importance of the area and contact details.

Mount Gibraltar Reserve

(v) Public vehicle access along the fire tracks should be closed. Those tracks not needed for fire management purposes should be completely closed off and rehabilitated.

(vi) The shrubland community on the rocky summit should be a no-burn area. Adequate fire protection for the facilities located there can, we believe, be gained by removing dead wattles and other fuel around the towers and buildings by hand.

(vii) Weed control should be an important reserve management objective, to assist in bushfire hazard reduction as well as for the health of the forest.

Gibbergunyah Reserve

(viii) The Grey Gum - Stringybark forest across the northern part of the reserve (Community 3) should generally be a no burn area, or at most burn in small parcels, to retain the stands of casuarinas there that are used as food trees by the threatened Glossy Black-Cockatoos.

(ix) The tall moist gully forest (Peppermint – Gully Gum Forest, Community 1) should be a no burn area.

(x) The small area of shale forest remnant is of local interest and should be a no burn area.

(xi) Avoiding control burns in the above communities still leaves most of the reserve available for hazard reduction burning. Hazard reduction should be aimed at strategic burns, the whole reserve should not be burnt all at once.

Mount Alexandra Reserve

(xii) The small area of swamp shrubland west of Colo Vale should be a no burn area.

(xiii) In general, the tall gully forest and, in particular, the riparian zones around the main watercourses, should be no burn areas.

(xiv) Consideration should be given to the ecological requirements of the rare and threatened plant species occurring in the Scribbly Gum Woodland west of Welby when developing plans for hazard reduction burns.

(xv) Vehicle tracks should be closed off, at least to the public, to the north of Welby, west of the Mount Alexandra summit, and near the swamp community west of Colo Vale.

(xvi) Weed control is needed in the section of the reserve north of Welby. Here, weeds are prolific near the old rubbish tip and to some extent along the creeks.

* * * * *

Fire Management Class	Identified Plant Communities	Vegetation Structure	Fire Impacts and Fire Management Aims
Mount Gibraltar Reserve	Brown Barrel Tall Forest Manna Gum Forest	Tall forest with a rather open understorey, weedy in some places.	Do not burn whole area at once. Reduce weed cover by hand removal, etc., not burning.
	Gully Gum Tall Forest/Forest Peppermint Forest Red Gum Woodland	Tall forest to forest, very variable shrubby to grassy understorey.	Do not burn whole area at once.
	Peppermint-Silvertop Ash Forest Silvertop Ash-Stringybark Forest	Heathy to shrubby understorey, rocky in places.	
	Wattle Forest/Woodland/ Shrubland	Variable, dense shrubs and small trees, rock surfaces common.	Avoid burning, recovery possibly slow on shallow, dry soils. Significant shrub <i>Leptospermum brevipes</i> present.
Gibbergunyah Reserve	Peppermint-Gully Gum Tall Forest	Tall forest, generally in moist gully, rather open understorey.	Do not burn.
	Peppermint-Silvertop Ash Forest	Forest with a shrubby understorey.	Maintain fire interval of minimum of 5-9 years. Burn strategically.
	Grey Gum-Stringybark Forest	Dry forest, often with dense tree casuarinas.	Burning regime must maintain stands of casuarinas for Glossy Black-Cockatoo. Do not burn all at once.
	Shale Forest	Forest similar to surrounding forest.	Do not burn.
	Mount Alexandra Reserve	Peppermint Tall Forest	Tall forest
	Mixed Peppermint Forest Grey Gum-Stringybark Forest Mixed Scribbly Gum Forest	Forest	Maintain fire interval of minimum of 5-9 years. Burn strategically.
	Scribbly Gum Heathy Woodland	Woodland-Open Woodland with heathy understorey.	Burning regime to maintain threatened and rare plants in this community.
	Tea Tree Shrubland Riparian Scrub	Shrubland, with wetland components.	Do not burn.

PART 6: REFERENCES AND BIBLIOGRAPHY

- Anon. (undated). Wingecarribee Bushland Assessment Project – Gibbergunyah Reserve.
- Anon. (undated). Bushland Assessment - Mount Alexandra Reserve.
- Anon. (undated). Mount Alexandra Reserve and its Vegetation.
- Anon. (2002). Mount Gibraltar Reserve Flora List. June.
- Benson, D. & McDougall, L. (1998). Ecology of Sydney plant species. *Cunninghamia* (5)4: 809-983.
- Fisher, M., Ryan, K. & Lembit, R. (1995). The natural vegetation of the Burragorang 1:100 000 map sheet. *Cunninghamia* 4(2): 143-215.
- Grant, T.R. (1991). The biology and management of the Platypus (*Ornithorhynchus anatinus*) in NSW. NSW National Parks & Wildlife Service, Hurstville.
- IBOC (1992). Bird Records for the start of the Boxvale Track. Illawarra Bird Observers Club.
- Kevin Mills & Associates Pty Limited (1989). Flora and Fauna Survey and Assessment, Proposed Quarry Extension, Portion 155, Parish of Jellore, Welby, New South Wales. Prepared for Welby Sandstone Quarries Pty Limited, November.
- Kevin Mills & Associates Pty Limited (1995). Flora and Fauna Study, Environmental Impact Statement, Mittagong Regional Sewerage Scheme. Prepared for Rust PPK Pty Ltd and Department of Public Works & Services, July.
- Kevin Mills & Associates Pty Limited (1997). Flora and Fauna Study, Environmental Impact Statement, Mittagong Regional Sewerage Scheme, Shire of Wingecarribee. Prepared for Rust PPK Pty Ltd and Department of Public Works & Services, May.
- Lemann, J. (1994). Assessment of Major Flora on Mount Gibraltar. Including Weed Infestation.
- New South Wales (1995). *Threatened Species Conservation Act 1995*. NSW Government Printer, Sydney.
- New South Wales Scientific Committee (2001). Final Determination to list the Mount Gibraltar Forest in the Sydney Basin Bioregion. The Committee, Hurstville, March.
- Sonter, C. (1985). List of Bird Species for Mt Alexandra and adjacent area, June.
- Stone, G.J. (1995). Mount Alexandra Reserve Mittagong NSW - Vegetation Communities. July.
- Stone, G.J. (1996). Dynamics of Silvertop Ash – Peppermint – Stringybark Woodland Communities in Mount Alexandra Reserve, Mittagong, NSW. Prepared for the Mount Alexandra Reserve Management Committee, February.
- Stone, G.J. (1998). *Vegetation Communities of Mount Alexandra Reserve Extensions, Mittagong, NSW*. Prepared for the Mount Alexandra Reserve Management Committee, December.
- Tait, I. (1996). Literature Review of Faunal Studies in the Mount Alexandra Region, February.
- Tait, I. (1996). Fauna Survey of Mt Alexandra Part 1. Prepared for the Mt Alexandra Reserve Management Committee, June.

Whelan, R.J. (1983). Faunal Survey, Freeway No. 5 – South Western Freeway, Aylmerton to Hoddles Crossroads. Prepared for Department of Main Roads.

Wingecarribee Shire Council (1996). Wingecarribee Bushland Assessment and Conservation Network Project. Report on Stage One. January - December 1996. The Council, Moss Vale.

* * * * *

APPENDIX 7.1

FINAL DETERMINATION FOR MOUNT GIBRALTAR FOREST

**NSW Scientific Committee
Final determination**

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list the Mount Gibraltar Forest in the Sydney Basin Bioregion, as an ENDANGERED ECOLOGICAL COMMUNITY on Part 3 of Schedule 1 of the Act. Listing of Endangered Ecological Communities is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. Mount Gibraltar Forest in the Sydney Basin Bioregion is the name given to the plant community characterised by the species assemblage listed in 2 below. All sites are within the Sydney Basin Bioregion. The community is described in Fisher, Ryan & Lembit (1995).

2. Mount Gibraltar Forest is characterised by the following assemblage:

<i>Acacia melanoxylon</i>	<i>Adiantum aethiopicum</i>
<i>Blechnum cartilagineum</i>	<i>Cyathea australis</i>
<i>Cymbopogon refractus</i>	<i>Dianella caerulea</i>
<i>Dichondra repens</i>	<i>Doodia aspera</i>
<i>Eucalyptus fastigata</i>	<i>Eucalyptus piperita</i>
<i>Eucalyptus radiata</i>	<i>Eucalyptus smithii</i>
<i>Eucalyptus viminalis</i>	<i>Eustrephus latifolius</i>
<i>Exocarpos cupressiformis</i>	<i>Hedycarya angustifolia</i>
<i>Leptospermum brevipes</i>	<i>Leptospermum polygalifolium</i>
<i>Leucopogon lanceolatus</i>	<i>Lomandra longifolia</i>
<i>Melaleuca hypericifolia</i>	<i>Notelaea venosa</i>
<i>Oreomyrrhis eriopoda</i>	<i>Pittosporum undulatum</i>
<i>Polyscias sambucifolia</i>	<i>Pteridium esculentum</i>
<i>Senecio linearis</i>	<i>Stypandra glauca</i>
<i>Themeda australis</i>	<i>Tylophora barbata</i>

3. The total species list of the flora and fauna of the community is considerably larger than that given in 2 (above), with many species present in only one or two sites or in very small quantity. The community includes invertebrates, many of which are poorly known, as well as vertebrates. In any particular site not all of the assemblage listed above may be present. At any one time, seeds of some plant species may only be present in the soil seed bank with no above-ground individuals present. Invertebrate species may be restricted to soils or canopy trees and shrubs, for example. The species composition of the site will be influenced by the size of the site and by its recent disturbance history. The number of species and the above-ground composition of species will change with time since fire, and may also change in response to changes in fire frequency.

4. Mount Gibraltar Forest includes vegetation ranging from open-forest to woodland and scrub depending on aspect, soil conditions and previous clearing and disturbance. Typical trees include *Eucalyptus radiata*, *Eucalyptus piperita* and *Eucalyptus smithii*, on the upper slopes, and *Eucalyptus radiata*, *Eucalyptus piperita*, *Eucalyptus fastigata* and *Eucalyptus viminalis* on the deeper soils on the southern side.

5. Understorey species in the open-forest are predominantly herbaceous and grassy and include *Stypandra glauca*, *Dianella caerulea*, *Dichondra repens*, *Themeda australis*, *Blechnum cartilagineum*, *Adiantum aethiopicum*, *Tylophora barbata*, *Oreomyrrhis eriopoda*, *Cymbopogon refractus*, *Senecio linearis*, *Polyscias sambucifolia*, *Exocarpos cupressiformis*, *Leucopogon lanceolatus* and *Lomandra longifolia*. The tall forest is dominated by ferns such as *Blechnum cartilagineum*, *Doodia aspera*, *Pteridium esculentum*, and twiners such as *Eustrephus latifolius* and *Tylophora barbata*. There may be small patches of rainforest species such as *Acacia melanoxylon*, *Hedycarya angustifolia*, *Notelaea venosa*, *Pittosporum undulatum* and *Cyathia australis*. Scrub with *Melaleuca hypericifolia*, *Leptospermum brevipes* and *Leptospermum polygalifolium* may occur on exfoliating rock on exposed sites.

6. Mount Gibraltar Forest is found on clay soils derived from a microsyenite volcanic intrusion associated with Mount Gibraltar near Bowral, but may also have occurred on nearby mountains such as Mount Jellore, Mount Flora, Mount Misery and Cockatoo Hill depending on the extent of microsyenite. It is referred to in Fisher, Ryan & Lembit (1995).

7. Mount Gibraltar Forest is or has been known to occur in the Wingecarribee Local Government Area, but may occur elsewhere in the Sydney Basin Bioregion.

8. Disturbed Mount Gibraltar Forest remnants are considered to form part of the community including where the vegetation would respond to assisted natural regeneration, such as where the natural soil and associated seedbank is still at least partially intact.

9. Mount Gibraltar Forest has been cleared for agriculture and rural development. Remnants are mostly small isolated pockets.

10. Mount Gibraltar Forest has not been reported from any NPWS reserves.

11. Much of the remaining area of Mount Gibraltar Forest is largely isolated from other areas of bushland. Ongoing threats to the remnants include exotic weed invasion such as *Hedera*, *Lonicera*, *Ilex*, *Berberis*, *Pyracantha* and *Genista*, pressure from adjacent urban development (including dogs, cats, rubbish dumping, noise, trampling and vehicles), inappropriate fire regimes and disturbances associated with communication tower infrastructure (including clearing, movement of machinery, weed introduction, dumping of rubbish).

12. In view of the restricted distribution of this community, the ongoing threats to the remnants and its inadequate representation within conservation reserves, the Scientific Committee is of the opinion that Mount Gibraltar Forest in the Sydney Basin Bioregion is likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate and that the community is eligible for listing as an endangered ecological community.

Proposed Gazettal date: 16/03/01
Exhibition period: 16/03/01 – 20/04/01

References

Fisher, M., Ryan, K. & Lembit, R. (1995) The natural vegetation of the Burratorang 1:100 000 map sheet. *Cunninghamia* 4(2): 143-215.

APPENDIX 7.2

FLORA LISTS FOR THE MITTAGONG RESERVES

The following lists have been prepared using all available sources of information. Most species have been included without question; a few have been deleted, as they are clearly incorrect. The list includes many species added by Kevin Mills & Associates during inspections in July and August 2003. Because of a lack of detailed field studies, these lists should be regarded as preliminary and certainly not comprehensive; most work has been done on Mount Gibraltar Reserve.

All introduced plants (weeds) are indicated by an asterisk (*).

A. PLANT LIST FOR MOUNT GIBRALTAR RESERVE

PTERIDOPHYTE (Ferns)

ADIANTACEAE

Adiantum aethiopicum L.

ASPLENIACEAE

Asplenium flabellifolium Cav.

BLECHNACEAE

Blechnum ambiguum (Presl) Kaulf. ex C. Chr.

Blechnum cartilagineum Sw.

Blechnum nudum (Labill.) Mett. ex Luerssen

Doodia aspera R. Br.

Doodia maxima J. Smith

CYATHEACEAE

Cyathea australis (R. Br.) Domin

DAVALLIACEAE

**Nephrolepis cordifolia* (L.) Presl

DENNSTAEDTIACEAE

Pteridium esculentum (Forster f.) Cockayne

DICKSONIACEAE

Calochlaena dubia (R. Br.) M. Turner & R. White

POLYPODIACEAE

Pyrrhosia rupestris (R. Br.) Ching

SINOPTERIDACEAE

Cheilanthes distans (R. Br.) Mett.

Cheilanthes sieberi Kunze

***Pellaea falcata* (R. Br.) Fee**

GYMNOSPERMAE (Conifers)

CUPRESSACEAE

**Juniperus* sp.

PINACEAE

**Pinus radiata* D. Don

ANGIOSPERMAE (Flowering Plants)

ALLIACEAE

**Nothoscordum borbonicum* Kunth

AMARANTHACEAE

**Amaranthus viridis* L.

AMARYLLIDACEAE

**Agapanthus orientalis*

ANTHERICACEAE

Thysanotus juncifolius (Salisb.) J. H. Willis & Court

Thysanotus tuberosus R. Br.

Tricoryne simplex R. Br.

APIACEAE

Actinotus helianthi Labill.

Centella asiatica (L.) Urban

Daucus glochidiatus (Labill.) Fischer, C. Meyer & Ave-Lall.

Hydrocotyle geraniifolia F. Muell.

Hydrocotyle laxiflora DC.

Hydrocotyle peduncularis R. Br. ex A. Rich.

Oreomyrrhis eriopoda (DC.) Hook. f.

Platysace lanceolata (Labill.) Druce

APOCYNACEAE

**Mandevilla laxa* (Ruiz Lopez & Pavon) Woodson

**Vinca major* L.

AQUIFOLIACEAE

**Ilex aquifolium* L.

ARACEAE

Gymnostachys anceps R. Br.

ARALIACEAE

**Hedera helix* L.

Polyscias sambucifolia (Sieber ex DC.) Harms

ASCLEPIADACEAE

Marsdenia rostrata R. Br.
Marsdenia suaveolens R. Br.
Tylophora barbata R. Br.

ASPARAGACEAE

**Myrsiphyllum asparagoides* (L.) Willd.
**Protasparagus densiflorus* (Kunth) Oberm.

ASTERACEAE

Arrhenechthites mixta (A. Rich.) Belcher
**Bidens pilosa* L.
Brachycome multifida DC.
Brachycome scapiformis DC.
Bracteantha bracteata (Vent.) Anderberg & Haegi
Cassinia aculeata (Labill.) R. Br.
Cassinia quinquefaria R. Br.
**Chrysanthemoides monilifera* (L.) Norlindh
**Cichorium intybus* L.
**Cirsium vulgare* (Savi) Ten.
**Conyza candensis* (L.)
Craspedia sp.
**Delairea odorata* Lem.
Helichrysum calvertianum F. Muell.
Helichrysum elatum Cunn. ex DC.
Helichrysum leucopsidium DC.
Helichrysum scorpioides Labill.
**Hypochaeris radicata* L.
Lagenifera stipitata (Labill.) Druce
Olearia microphylla (Vent.) Maiden & E. Betche
Olearia viscidula (F. Muell.) Benth.
Onopordum acanthium L.
Ozothamnus diosmifolius (Vent.) DC.
Podolepis jaceoides (Sims) Voss
Senecio lautus Forster f. ex Willd. subsp. *dissectifolius* Ali.
Senecio linearifolius A. Rich.
**Senecio madagascariensis* Poiret
Sigesbeckia orientalis L.
**Silybum marianum* (L.) Gaertner
**Sonchus oleraceus* L.
**Taraxacum officinale* Weber

BERBERIDACEAE

**Berberis* sp.

BIGNONIACEAE

Pandorea pandorana (Andrews) Steenis

BRASSICACEAE

**Lunaria annua* L.

BUDDLEJACEAE

**Buddleja davidii* Franchet

CAMPANULACEAE

Wahlenbergia gracilis (Forster f.) Schrader

Wahlenbergia stricta (R. Br.) Sweet

CAPRIFOLIACEAE

**Lonicera japonica* Thunb.

CARYOPHYLLACEAE

Stellaria flaccida Hook.

**Stellaria media* Villars

Stellaria pungens Brongn.

CASUARINACEAE

Allocasuarina littoralis (Salisb.) L. Johnson

CHENOPODIACEAE

Einadia hastata (R. Br.) A. J. Scott

Einadia trigonus (Roemer & Schultes) Paul G. Wilson

COMMELINACEAE

**Tradescantia albiflora* Kunth

CONVOLVULACEAE

Calystegia marginata R. Br.

Dichondra repens Forster & Forster f.

CRASSULACEAE

Crassula sieberana (Schultes & Schultes f.) Druce

CUNONIACEAE

Aphanopetalum resinosum Endl.

CYPERACEAE

**Cyperus congestus* Vahl

Gahnia sp.

Lepidosperma filiforme Labill.

Lepidosperma laterale R. Br.

Schoenus melanostachys R. Br.

DILLENACEAE

Hibbertia empetrifolia (DC.) Hoogl

Hibbertia scandens (Willd.) Gilg
Hibbertia serpyllifolia R. Br. ex DC.

ELAEOCARPACEAE

Elaeocarpus reticulatus Smith

EPACRIDACEAE

Brachyloma daphnoides (Smith) Benth.
Epacris microphylla R. Br.
Leucopogon ericoides (Smith) R. Br.
Leucopogon lanceolatus (Smith) R. Br.

EUPHORBIACEAE

Amperea xiphoclada (Sieber ex Sprengel) Druce
Breynia oblongifolia Muell. Arg.
**Euphorbia pepplus* L.
Phyllanthus hirtellus F. Muell. ex Muell. Arg.
Poranthera microphylla Brongn.

FABACEAE

CAESALPINIOIDEAE (subfamily)

**Cytisus scoparius* (L.) Link
**Genista monspessulana* (L.) L. Johnson
**Ulex europaeus* L.

FABOIDEAE (subfamily)

Aotus ericoides (Vent.) Don
Bossiaea obcordata (Vent.) Druce
Daviesia ulicifolia Andrews
Desmodium varians (Labill.) Endl.
Dillwynia ramosissima Benth.
Dillwynia retorta (Wendl.) Druce
Glycine clandestina Wendl.
Goodia lotifolia Salisb.
Hardenbergia violacea (Schneev.) Stearn
Indigofera australis Willd.
Oxylobium ilicifolium (Andr.) Domin
Pultenaea blakelyi J. Thompson
**Vicia* sp.

FUMARIACEAE

**Fumaria muralis* Sonder ex Koch

IRADACEAE

**Crocsmia x crocosmiiflora* Lemoine ex Morren) N. E. Br.
**Freesia* spp.

MIMOSOIDEAE (subfamily)

***Acacia falciformis* DC.**

***Acacia fimbriata* Cunn. ex Don**

***Acacia longifolia* (Andrews) Willd.**

***Acacia mearnsii* De Wild.**

***Acacia melanoxylon* R. Br.**

***Acacia penninervis* Sieber ex DC.**

***Acacia rubida* Cunn.**

***Acacia stricta* (Andrews) Willd.**

***Acacia terminalis* (Salisb.) J. F. Macbr.**

***Acacia ulicifolia* (Salisb.) Court**

GERANIACEAE

***Geranium potentilloides* L'Her. ex DC.**

***Geranium solanderi* Carolin**

***Pelargonium inodorum* Willd.**

GOODENIACEAE

***Cooperhooia barbata* (R. Br.) Carolin**

***Goodenia hederacea* Smith**

***Goodenia hederacea* Smith**

***Goodenia ovata* Smith**

***Scaevola ramosissima* (Smith) K. Krause**

HYPOXIDACEAE

***Hypoxis hygrometrica* Labill.**

IRIDACEAE

***Patersonia glabrata* R. Br.**

***Patersonia longifolia* R. Br.**

***Patersonia sericea* R. Br. ex Ker**

LAMIACEAE

***Ajuga australis* R. Br. s. lat.**

***Plectranthus parviflorus* Willd.**

***Prostanthera hirtula* F. Muell. ex Benth.**

LAURACEAE

***Cassytha pubescens* R. Br.**

PHORMIACEAE

***Stypantra glauca* R. Br.**

LOBELIACEAE

***Isotoma axillaris* Lindley**

***Pratia purpurascens* (R. Br.) F. Wimmer**

LOGANIACEAE

Logania albiflora (Andrews) Druce

Mitrasacme polymorpha R. Br.

LOMANDRACEAE

Lomandra filiformis (Thunb.) Britten

Lomandra glauca (R. Br.) Ewart

Lomandra longifolia Labill.

Lomandra multiflora (R. Br.) J. Britt.

Lomandra obliqua (Thunb.) J. F. Macbr.

LORANTHACEAE

Amyema pendulum (Sieber ex Sprengel) Tieghem

Dendrophthae vitellina (F. Muell.) Tieghem

MALVACEAE

**Modiola caroliniana* (L.) G. Don

MENISPERMACEAE

Sarcopetalum harveyanum F. Muell.

MONIMIACEAE

Hedycarya angustifolia Cunn.

MYRSINACEAE

Rapanea howittiana Mez

MYRTACEAE

Calytrix tetragona Labill.

Eucalyptus agglomerata Maiden

Eucalyptus amplifolia Naudin

Eucalyptus cypellocarpa L. Johnson

Eucalyptus dalrympleana Maiden

Eucalyptus elata Dehnh.

Eucalyptus fastigata Deane & Maiden

Eucalyptus globoidea Blakely

Eucalyptus obliqua L'Her.

Eucalyptus piperita Smith

Eucalyptus punctata DC.

Eucalyptus radiata Sieber ex DC.

Eucalyptus sieberi L. Johnson

Eucalyptus smithii R. Baker

Eucalyptus tereticornis Smith

Eucalyptus viminalis Labill.

Kunzea parvifolia Schauer

Leptospermum brevipes F. Muell

Leptospermum juniperinum Smith

Leptospermum polygalifolium Salisb.
Leptospermum trinervium (Smith) J. Thompson
Melaleuca hypericifolia Smith
Melaleuca linariifolia Smith

OLEACEAE

**Ligustrum lucidum* Aiton
**Ligustrum sinense* Lour.
Notelaea venosa F. Muell.
**Olea europaea* L. subsp. *africana* Miller

ORCHIDACEAE

Acianthus fornicatus R. Br.
Dendrobium speciosum Sm.
Dipodium punctatum (Sm.) R. Br.
Diuris sulphurea R. Br.
Microtis sp.
Pterostylis concinna R. Br.
Pterostylis grandiflora R. Br.
Pterostylis longifolia R. Br.
Pterostylis nutans R. Br.
Pterostylis pedunculata R. Br.
Pterostylis truncata Fitzg.

PASSIFLORACEAE

Passiflora cinnabarina Lindley
**Passiflora mollissima* (Kunth) L. Bailey

PHILESIACEAE

Eustrephus latifolius R. Br.
Geitonoplesium cymosum (R. Br.) A. Cunn. ex Hook.

PHORMIACEAE

Dianella caerulea var. *producta* Sims
Dianella longifolia R. Br.
Dianella revoluta R. Br.

PHYTOLACCACEAE

**Phytolacca octandra* L.

PITTOSPORACEAE

Billardiera scandens Smith
Bursaria spinosa Cav.
Pittosporum undulatum Vent.

PLANTAGINACEAE

Plantago gaudichaudi Barneoud

**Plantago lanceolata* L.

POACEAE

**Briza maxima* L.

Cymbopogon refractus (R.Br.) A. Camus

Cynodon dactylon (L.) Pers.

**Dactylis glomerata* L.

Danthonia sp.

Echinopogon caespitosus C. E. Hubb.

Echinopogon ovatus (G. Forst.) P. Beauv.

**Ehrharta erecta* Lam.

Entolasia marginata (R. Br.) Hughes

Entolasia stricta (R. Br.) Hughes

Eragrostis sp.

**Holcus lanatus* L.

Imperata cylindrica P. Beauv. var. *major* (Nees) C. E. Hubb.

Microlaena stipoides (Labill.) R. Br.

**Paspalum dilatatum* Poir.

**Pennisetum clandestinum* Hochst. ex Chiov.

**Phalaris* sp.

Poa labillardieri Steud.

Poa sieberiana Spreng.

**Sporobolus indicus* (L.) R. Br.

**Stenotaphrum secundatum* (Walter) Kuntze

Stipa rudis Spreng.

Themeda australis (R. Br.) Stapf

POLYGALACEAE

Comesperma defoliatum F. Muell.

Comesperma volubile Labill.

POLYGONACEAE

**Acetosa sagittata* Thunb.) L. Johnson & B. Briggs

PORTULACACEAE

Calandrinia calyptata Hook. f.

PRIMULACEAE

**Anagallis arvensis* L.

PROTEACEAE

Banksia serrata L. f.

Banksia spinulosa Smith

Conospermum tenuifolium R. Br.

Hakea dactyloides (Gaertner) Cav.

Lomatia ilicifolia R. Br.

Lomatia silaifolia (Smith) R. Br.

Persoonia laurina Pers.
Persoonia levis (Cav.) Domin
Persoonia linearis Andrews

RANUNCULACEAE

Clematis aristata R. Br. ex DC.
Clematis glycinoides DC.
Ranunculus lappaceus Smith
Ranunculus plebeius R. Br. ex DC.

RESTIONACEAE

Restio fastigiatus R. Br.

RHAMNACEAE

Pomaderris aspera Sieber ex DC.
Pomaderris lanigera (Andrews) Sims

ROSACEAE

Acaena novae-zelandiae Kirk
**Cotoneaster glaucophyllus* Franchet
**Crataegus monogyna* Jacq.
**Photinia serratifolia* (Desf.) Kalkman
**Prunus laurocerasus* L.
**Prunus lusitanica* L.
**Pyracantha angustifolia* (Franchet) C. Schneider
**Rubus fruticosus* sp. agg.
Rubus hillii F. Muell.
Rubus parvifolius L.

RUBIACEAE

Asperula conferta Hook f.
**Galium aparine* L.
Opercularia hispida Sprengel
Pomax umbellata (Gaertner) Sol. ex A. Rich.

RUTACEAE

Zieria smithii Jackson

SANTALACEAE

Choretrum candollei F. Muell.
Exocarpos cupressiformis Labill.
Leptomeria acida R. Br.
Omphacomeria acerba (R. Br.) A. DC.

SAPINDACEAE

Dodonaea multijuga G. Don
Dodonaea viscosa Jacq. subsp. *angustissima* (DC.) J. West

SCROPHULARIACEAE

****Verbascum thapsus* L.**

***Veronica plebeia* R. Br.**

SMILACACEAE

***Smilax australis* R. Br.**

***Smilax glycyphylla* Sm.**

SOLANACEAE

****Physalis peruviana* L.**

***Solanum aviculare* Forster f.**

***Solanum cinereum* R. Br.**

****Solanum nigrum* L.**

***Solanum opacum* A. Braun & Bouche**

***Solanum prinophyllum* Dunal**

****Solanum pseudocapsicum* L.**

***Solanum vescum* F. Muell**

STACKHOUSIACEAE

***Stackhousia monogyna* Labill.**

THYMELAEACEAE

***Pimelea linifolia* Smith**

TREMANDRACEAE

***Tetradlea thymifolia* Smith**

ULMACEAE

***Trema aspera* (Brongn.) Blume**

URTICACEAE

***Urtica incisa* Poiret**

UVULARIACEAE

***Schelhamera undulata* R. Br.**

VERBENIACEAE

****Verbena bonariensis* L.**

VIOLACEAE

***Viola betonicifolia* Smith**

***Viola hederacea* Labill.**

XANTHORRHOEACEAE

***Xanthorrhoea resinifera* (Sol. ex Kite) E. C. Nelson & D. L. Bedford**

* * * * *

B. PLANT LIST FOR GIBBERGUNYAH RESERVE

PTERIDOPHYTA (Ferns)

BLECHNACEAE

Blechnum cartilagineum Sw.

CYATHEACEAE

Cyathea australis (R. Br.) Domin

DENNSTAEDTIACEAE

Pteridium esculentum (Forster f.) Cockayne

DICKSONIACEAE

Calochlaena dubia (R. Br.) M. Turner & R. White

SINOPTERIDACEAE

Cheilanthes sieberi Kunze

ANGIOSPERMAE (Flowering Plants)

APIACEAE

Actinotus helianthi Labill.

Hydrocotyle laxiflora DC.

Platysace lanceolata (Labill.) Druce

ARALIACEAE

Polyscias sambucifolia (Sieber ex DC.) Harms (pinnate form)

ASCLEPIADACEAE

Tylophora barbata R. Br.

ASTERACEAE

Bracteantha bracteata (Vent.) Anderberg & Haegi

Cassinia aculeata (Labill.) R. Br.

Cassinia sp.

Helichrysum elatum Cunn. ex DC.

Helichrysum leucopsidium DC.

**Hypochaeris radicata* L.

Lagenifera stipitata (Labill.) Druce

Olearia erubescens (Sieber ex DC.) Dippel

Olearia microphylla (Vent.) Maiden & E. Betche

Olearia viscidula (F. Muell.) Benth.

CASUARINACEAE

Allocasuarina littoralis (Salisb.) L. Johnson

CLUSIACEAE

Hypericum gramineum Forster f.

CONVOLVULACEAE

Dichondra repens Forster & Forster f.

CYPERACEAE

Gahnia sp.

Lepidosperma filiforme Labill.

Lepidosperma laterale R. Br.

DILLENACEAE

Hibbertia empetrifolia (DC.) Hoogl

ELAEOCARPACEAE

Elaeocarpus reticulatus Smith

EPACRIDACEAE

Leucopogon lanceolatus (Smith) R. Br.

EUPHORBIACEAE

Amperea xiphoclada (Sieber ex Sprengel) Druce

Phyllanthus hirtellus F. Muell. ex Muell. Arg.

Poranthera microphylla Brongn.

FABACEAE

FABOIDEAE (subfamily)

Bossiaea obcordata (Vent.) Druce

Daviesia corymbosa Smith

Hardenbergia violacea (Schneev.) Stearn

Indigofera australis Willd.

Oxylobium ilicifolium (Andr.) Domin

MIMOSOIDEAE (subfamily)

Acacia falciformis DC.

Acacia longifolia (Andrews) Willd.

Acacia mearnsii De Wild.

Acacia obtusifolia Cunn.

Acacia suaveolens (Smith) Willd.

Acacia terminalis (Salisb.) J. F. Macbr.

Acacia ulicifolia (Salisb.) Court

GOODENIACEAE

Goodenia hederacea Smith

Goodenia ovata Smith

Scaevola ramosissima (Smith) K. Krause

HALORAGACEAE

***Gonocarpus teucrioides* DC.**

IRIDACEAE

***Patersonia glabrata* R. Br.**

***Patersonia sericea* R. Br. ex Ker**

LAURACEAE

***Cassytha pubescens* R. Br.**

LOBELIACEAE

***Pratia purpurascens* (R. Br.) E. Wimmer**

LOMANDRACEAE

***Lomandra filiformis* (Thunb.) Britten**

***Lomandra longifolia* Labill.**

***Lomandra multiflora* (R. Br.) J. Britt.**

***Lomandra obliqua* (Thunb.) J. F. Macbr.**

LORANTHACEAE

***Amyema congener* (Sieber ex Schultes & J. H. Schultes) Tieghem**

MYRTACEAE

***Acmena smithii* (Poiret) Merr. & Perry**

***Eucalyptus agglomerata* Maiden**

***Eucalyptus globoidea* Blakely**

***Eucalyptus piperita* Smith**

***Eucalyptus punctata* DC.**

***Eucalyptus radiata* Sieber ex DC.**

***Eucalyptus sieberi* L. Johnson**

***Eucalyptus smithii* R. Baker**

***Leptospermum polygalifolium* Salisb.**

***Leptospermum trinervium* (Smith) J. Thompson**

OLEACEAE

***Notelaea venosa* F. Muell.**

ORCHIDACEAE

***Pterostylis* sp. (1)**

***Pterostylis* sp. (2)**

PHORMIACEAE

***Dianella caerulea* Sims**

***Dianella revoluta* R. Br.**

***Stypandra glauca* R. Br.**

PITTOSPORACEAE

Billardiera scandens Smith
Pittosporum undulatum Vent.

POACEAE

Entolasia stricta (R. Br.) Hughes
Poa sieberiana Spreng.
Poa sp. (small)
Stipa sp.

PRIMULACEAE

**Anagallis arvensis* L.

PROTEACEAE

Banksia serrata L. f.
Banksia spinulosa Smith
Hakea dactyloides (Gaertner) Cav.
Lomatia silaifolia (Smith) R. Br.
Persoonia levis (Cav.) Domin
Persoonia linearis Andrews
Xylomelum pyriforme (Gaertner) Knight

RANUNCULACEAE

Clematis aristata R. Br. ex DC.

RHAMNACEAE

Pomaderris lanigera (Andrews) Sims

ROSACEAE

**Rubus fruticosos* sp. agg.

RUBIACEAE

Pomax umbellata (Gaertner) Sol. ex A. Rich.

SANTALACEAE

Exocarpos cupressiformis Labill.
Exocarpos strictus R. Br.
Omphacomeria acerba (R. Br.) A. DC.

SAPINDACEAE

Dodonaea triquetra Wendl.

SCROPHULARIACEAE

Veronica calycina R. Br.

SMILACACEAE

Smilax australis R. Br.
Smilax glyciophylla Sm.

STYLIDIACEAE

***Stylidium laricifolium* Rich.**

THYMELAEACEAE

***Pimelea linifolia* Smith**

TREMANDRACEAE

***Tetratheca thymifolia* Smith**

UVULARIACEAE

***Schelhammera undulata* R. Br.**

VIOLACEAE

***Viola betonicifolia* Smith**

* * * * *

PTERIDOPHYTA (Ferns)

ADIANTACEAE

Adiantum aethiopicum L.

ASPLENIACEAE

Asplenium flabellifolium Cav.

BLECHNACEAE

Blechnum ambiguum (Presl) Kaulf. ex C. Chr.

Blechnum cartilagineum Sw.

Blechnum minus (R. Br.) Ettingsh.

Blechnum nudum (Labill.) Mett. ex Luerssen

Blechnum patersonii (R. Br.) Mett.

CYATHEACEAE

Cyathea australis (R. Br.) Domin

DENNSTAEDTIACEAE

Pteridium esculentum (Forster f.) Cockayne

DICKSONIACEAE

Calochlaena dubia (R. Br.) M. Turner & R. White

DRYOPTERIDACEAE

Lastreopsis acuminata (Houlston) Morton

GLEICHENIACEAE

Gleichenia dicarpa R. Br.

Gleichenia microphylla R. Br.

Sticherus flabellatus (R. Br.) St. John

HYMENOPHYLLACEAE

Hymenophyllum cupressiforme Labill.

LINDSAEACEAE

Lindsaea microphylla Sw.

LYCOPODIACEAE

Lycopodium laterale R. Br.

OSMUNDACEAE

Todea barbara (L.) T. Moore

POLYPODIACEAE

Microsorium pustulatum (G. Forst.) Copel.
Pyrrosia rupestris (R. Br.) Ching

PTERIDACEAE

Pteris tremula R. Br.

SINOPTERIDACEAE

Pellaea falcata (R. Br.) Fee

GYMNOSPERMAE (Conifers)

PINACEAE

**Pinus radiata* D. Don

ANGIOSPERMAE (Flowering Plants)

APIACEAE

Actinotus helianthi Labill.

Hydrotyle laxiflora DC.

Platysace ericoides (Sieber ex Sprengel) Norman

Platysace lanceolata (Labill.) Druce

Platysace linearifolia (Cav.) Norman

ARALIACEAE

Astrotricha latifolia Benth.

Astrotricha longifolia Benth.

Polyscias sambucifolia (Sieber ex DC.) Harms

ASCLEPIADACEAE

Marsdenia suaveolens R. Br.

Tylophora barbata R. Br.

ASTERACEAE

Arrhenechthites mixta (A. Rich.) Belcher

Cassinia aculeata (Labill.) R. Br.

Cassinia longifolia R. Br.

Cassinia quinquefaria R. Br.

Cassinia uncata Cunn. ex DC.

**Cirsium vulgare* (Savi) Ten.

**Gnaphalium americanum* Miller

Helichrysum elatum Cunn. ex DC.

Helichrysum scorpioides Labill.

**Hypochaeris radicata* L.

Lagenifera stipitata (Labill.) Druce

Olearia erubescens (Sieber ex DC.) Dippel

Olearia microphylla (Vent.) Maiden & E. Bettle

Olearia phlogopappa (Labill.) DC.

Olearia viscidula (F. Muell.) Benth.

Ozothamnus diosmifolius (Vent.) DC.

Senecio linearifolius A. Rich.

**Sonchus oleraceus* L.

BAURACEAE

Bauera rubioides Andrews

BRASSICACEAE

**Rorippa nasturtium-aquaticum* (L.) Hayek

CAPRIFOLIACEAE

**Lonicera japonica* Thunb.

CARYOPHYLLACEAE

**Cerastium fontanum* Baumg

Stellaria flaccida Hook.

CASUARINACEAE

Allocasuarina littoralis (Salisb.) L. Johnson

Allocasuarina nana (Sieber ex Spreng.) L. Johnson

CONVOLVULACEAE

Dichondra repens Forster & Forster f.

CRASSULACEAE

Crassula sieberana (Schultes & Schultes f.) Druce

CUNONIACEAE

Callicoma serratifolia Andrews

Ceratopetalum apetalum D. Don

CYPERACEAE

Carex appressa R. Br.

Caustis flexuosa R. Br.

Gahnia sieberana Kunth

Lepidosperma filiforme Labill.

Lepidosperma laterale R. Br.

Lepidosperma limicola N.A. Wakef.

Lepidosperma urophorum N.A. Wakef.

DILLENACEAE

Hibbertia empetrifolia (DC.) Hoogl

Hibbertia obtusifolia DC.

ELAEOCARPACEAE

Elaeocarpus reticulatus Smith

EPACRIDACEAE

Brachyloma daphnoides (Smith) Benth.

Dracophyllum secundum R. Br.
Epacris calvertiana F. Muell.
Epacris microphylla R. Br.
Epacris obtusifolia Smith
Epacris pulchella Cav.
Leucopogon lanceolatus (Smith) R. Br.
Leucopogon setiger R. Br.
Lissanthe sapida R. Br.
Monotoca scoparia (Smith) R. Br.
Sprengelia incarnata Smith

ESCALLONIACEAE

Quintinia sieberi A. DC.

EUPHORBIACEAE

Amperea xiphoclada (Sieber ex Sprengel) Druce
Breynia oblongifolia Muell. Arg.
Phyllanthus gasstroemii Muell. Arg.
Poranthera corymbosa Brongn.
Poranthera ericifolia Rudge

FABACEAE

FABOIDEAE (subfamily)

Bossiaea obcordata (Vent.) Druce
Bossiaea rhombifolia Sieber ex DC.
Daviesia mimosoides R. Br.
Dillwynia ramosissima Benth.
Dillwynia retorta (Wendl.) Druce
**Genista monspessulana* (L.) L. Johnson
Gompholobium grandiflorum Smith
Hardenbergia violacea (Schneev.) Stearn
Hovea longifolia R. Br.
Indigofera australis Willd.
Kennedia rubicunda (Schneev.) Vent.
Mirbelia platylobioides (DC.) J. Thompson
Mirbelia rubiifolia (Andr.) G. Don
Oxylobium arborescens R. Br.
Oxylobium ilicifolium (Andr.) Domin
Platylobium formosum Smith
Pultenaea daphnoides Wendl.
Pultenaea villosa Willd.
**Ulex europaeus* L.

MIMOSOIDEAE (subfamily)

Acacia elata Cunn. ex Benth.
Acacia elongata Sieber ex DC.
Acacia falciformis DC.

Acacia floribunda (Vent.) Willd.
Acacia longifolia (Andrews) Willd.
Acacia mearnsii De Wild.
Acacia myrtifolia (Smith) Willd.
Acacia obtusifolia Cunn.
Acacia penninervis Sieber ex DC.
Acacia rubida Cunn.
Acacia suaveolens (Smith) Willd.
Acacia terminalis (Salisb.) J. F. Macbr.
Acacia ulicifolia (Salisb.) Court

GOODENIACEAE

Dampiera purpurea R. Br.
Goodenia hederacea Smith
Goodenia ovata Smith
Scaevola ramosissima (Smith) K. Krause

HALORAGACEAE

Gonocarpus teucrioides DC.

IRIDACEAE

Patersonia glabrata R. Br.
Patersonia sericea R. Br. ex Ker

LAMIACEAE

Prostanthera lasianthos Labill.
Prostanthera rugosa Cunn. ex Benth.
Prostanthera violacea R. Br.

LAURACEAE

Cassytha pubescens R. Br.

LOBELIACEAE

Pratia purpurascens (R. Br.) E. Wimmer

LOGANIACEAE

Logania albiflora (Andrews) Druce

LOMANDRACEAE

Lomandra confertifolia (F. M. Bailey) Fahn
Lomandra filiformis (Thunb.) Britten
Lomandra longifolia Labill.
Lomandra multiflora (R. Br.) J. Britt.
Lomandra obliqua (Thunb.) J. F. Macbr.

LORANTHACEAE

Amyema pendulum (Sieber ex Sprengel) Tieghem

MONIMIACEAE

Hedycarya angustifolia Cunn.

MORACEAE

Ficus coronata Spin.

MYRTACEAE

Angophora costata (Gaertner) Britten

Baeckea linifolia Rudge

Callistemon citrinus (Curtis) Skeels

Eucalyptus agglomerata Maiden

Eucalyptus apiculata R. Baker & H. G. Smith

Eucalyptus cypellocarpa L. Johnson

Eucalyptus dendromorpha (Blakely) L. Johnson & Blaxell

Eucalyptus dives Schauer

Eucalyptus elata Dehnh.

Eucalyptus fastigata Deane & Maiden

Eucalyptus globoidea Blakely

Eucalyptus gummifera (Sol. ex Gaertner) Hochr.

Eucalyptus imitans L. Johnson & K. Hill

Eucalyptus mannifera Mudie

Eucalyptus oreades R. Baker

Eucalyptus piperita Smith

Eucalyptus punctata DC.

Eucalyptus radiata Sieber ex DC.

Eucalyptus sclerophylla (Blakely) L. Johnson & Blaxell

Eucalyptus sieberi L. Johnson

Eucalyptus smithii R. Baker

Eucalyptus viminalis Labill.

Kunzea ambigua (Smith) Druce

Leptospermum arachnoides Gaertner

Leptospermum juniperinum Smith

Leptospermum lanigera (Aiton) Smith

Leptospermum morrisonii J. Thompson

Leptospermum polygalifolium Salisb.

Leptospermum trinervium (Smith) J. Thompson

Melaleuca linariifolia Smith

Tristaniopsis collina Peter G. Wilson & Waterhouse

OLEACEAE

Ligustrum sinense Lour.

Notelaea venosa F. Muell.

ORCHIDACEAE

Acianthus fornicatus R. Br.

Caladenia carnea R. Br.

Dendrobium speciosum Sm.
Diuris sulphurea R. Br.
Liparis reflexa (R. Br.) Lindl.
Pterostylis longifolia R. Br.
Pterostylis nutans R. Br.
Thelymitra ixioides Sw.

PHILESIACEAE

Eustrephus latifolius R. Br.

PHORMIACEAE

Dianella caerulea Sims
Dianella revoluta R. Br.
Stypandra glauca R. Br.

PITTOSPORACEAE

Billardiera scandens Smith
Bursaria spinosa Cav.

PLANTAGINACEAE

**Plantago lanceolata* L.

POACEAE

Danthonia longifolia R. Br.
Entolasia stricta (R. Br.) Hughes
Microlaena stipoides (Labill.) R. Br.
**Paspalum dilatatum* Poir.
**Poa annua* L.
Poa labillardieri Steud.
Poa sieberiana Spreng.
**Sporobolus indicus* (L.) R. Br.
Stipa pubescens R. Br.
Themeda australis (R. Br.) Stapf

PROTEACEAE

Banksia marginata Cav.
Banksia paludosa R. Br.
Banksia serrata L. f.
Banksia spinulosa Smith
Grevillea arenaria R. Br.
Grevillea baueri R. Br.
Grevillea sericea (Smith) R. Br.
Grevillea triternata R. Br.
Hakea dactyloides (Gaertner) Cav.
Hakea salicifolia (Vent.) B. L. Burtt.
Hakea sericea Schrader
Hakea teretifolia (Salisb.) Britten

***Isopogon anemonifolius* Knight**
***Isopogon anethifolius* (Salisb.) Knight**
***Lambertia formosa* Smith**
***Lomatia ilicifolia* R. Br.**
***Lomatia myricoides* (Gaertner f.) Domin**
***Lomatia silaifolia* (Smith) R. Br.**
***Persoonia glaucescens* Sieber ex Sprengel**
***Persoonia lanceolata* Andrews**
***Persoonia laurina* Pers.**
***Persoonia levis* (Cav.) Domin**
***Persoonia linearis* Andrews**
***Persoonia mollis* R. Br.**
Persoonia mollis* R. Br. subsp. *revoluta
***Petrophile pedunculata* R. Br.**
***Petrophile sessilis* Sieber ex Schult. & Schult. f.**
***Telopea speciosissima* (Smith) R. Br.**
***Xylomelum pyriforme* (Gaertner) Knight**

RANUNCULACEAE

***Clematis aristata* R. Br. ex DC.**

RESTIONACEAE

***Empodisma minus* (Hook. f.) L. A. S. Johnson & D. F. Cutler**

RHAMNACEAE

***Pomaderris aspera* Sieber ex DC.**
***Pomaderris discolor* (Vent.) Poir.**
***Pomaderris andromedifolia* Cunn.**
***Pomaderris lanigera* (Andrews) Sims**
***Pomaderris ligustrina* Sieber ex DC.**

ROSACEAE

****Rubus* sp.**

RUTACEAE

***Boronia anemonifolia* Cunn.**
***Boronia ledifolia* (Vent.) J. Gay**
***Boronia microphylla* Sieber ex Spreng.**
***Eriostemon myoporoides* DC.**
***Eriostemon scaber* Paxton**

SALICACEAE

****Salix babylonica* L.**

SANTALACEAE

***Choretrum candollei* F. Muell.**
***Exocarpos cupressiformis* Labill.**

Leptomeria acida R. Br.
Omphacomeria acerba (R. Br.) A. DC.

SAPINDACEAE

Dodonaea multijuga G. Don
Dodonaea triquetra Wendl.

SMILACACEAE

Smilax australis R. Br.
Smilax glyciophylla Sm.

STERCULIACEAE

Lasiopetalum ferrugineum Smith

STYLIDIACEAE

Stylidium graminifolium Sw. ex Willd.
Stylidium laricifolium Rich.

THYMELAEACEAE

Pimelea linifolia Smith

TREMANDRACEAE

Tetratheca thymifolia Smith

TYPHACEAE

Typha orientalis C. Presl.

UVULARIACEAE

Schelhammera undulata R. Br.

VIOLACEAE

Hybanthus monopetalus (Schultes) Domin
Viola hederacea Labill.

XANTHORRHOEACEAE

Xanthorrhoea resinifera (Sol. ex Kite) E. C. Nelson & D. L. Bedford

* * * *

APPENDIX 7.3

FAUNA LISTS FOR THE MITTAGONG RESERVES

The following lists have been prepared using all available sources of information. Most species have been included without question, although a few records considered erroneous have been excluded. The list includes some records collected by Kevin Mills & Associates during visits in July and August 2003. The fauna of Mount Alexandra, at least the southern-most part, and Mount Gibraltar are well documented, while Gibbergunyah is not well known. All lists should be regarded as preliminary only.

All introduced animals are indicated by an asterisk (*).

A. FAUNA LIST FOR MOUNT GIBRALTAR RESERVE

Mammals

Brown Antechinus	<i>Antechinus stuartii</i>
Bush Rat	<i>Rattus fuscipes</i>
Feral Cat*	<i>Felis catus</i>
Chocolate Wattled Bat	<i>Chalinolobus morio</i>
Common Brushtail Possum	<i>Trichosurus vulpecula</i>
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>
Common Wallaroo	<i>Macropus robustus</i>
Common Wombat	<i>Vombatus ursinus</i>
Fox*	<i>Vulpes vulpes</i>
Feral Goat*	<i>Capra hircus</i>
Greater Glider	<i>Petauroides volans</i>
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>
Rabbit*	<i>Oryctolagus cuniculus</i>
Short-beaked Echidna	<i>Tachyglossus aculeatus</i>
Sugar Glider	<i>Petaurus breviceps</i>
Swamp Wallaby	<i>Wallabia bicolor</i>

Birds

Australian King-Parrot	<i>Alisterus scapularis</i>
Australian Magpie	<i>Gymnorhina tibicen</i>
Australian Raven	<i>Corvus coronoides</i>
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>
Black-faced Monarch	<i>Monarcha melanopsis</i>
Black-shouldered Kite	<i>Elanus axillaris</i>
Brown Gerygone	<i>Gerygone mouki</i>
Brown Goshawk	<i>Accipiter fasciatus</i>
Brown Thornbill	<i>Acanthiza pusilla</i>
Brush Cuckoo	<i>Cacomantis varilosus</i>
Chestnut-rumped Heathwren	<i>Hylacola pyrrhopygia</i>

Common Blackbird*
Common Bronzewing
Common Koel
Crescent Honeyeater
Crested Pigeon
Crested Shrike-tit
Crimson Rosella
Dollarbird
Dusky Woodswallow
Eastern Rosella
Eastern Spinebill
Eastern Whipbird
Eastern Yellow Robin
Fan-tailed Cuckoo
Flame Robin
Galah
Gang-gang Cockatoo
Golden Whistler
Grey Butcherbird
Grey Fantail
Grey Shrike-thrush
Jacky Winter
Laughing Kookaburra
Leaden Flycatcher
Lewin's Honeyeater
Magpie-lark
Mistletoebird
New Holland Honeyeater
Pallid Cuckoo
Pied Currawong
Pilotbird
Red Wattlebird
Red-browed Finch
Rose Robin
Rufous Fantail
Rufous Whistler
Sacred Kingfisher
Satin Bowerbird
Satin Flycatcher
Scarlet Robin
Shining Bronze-Cuckoo
Silvereye
Southern Boobook
Spotted Pardalote
Striated Pardalote
Striated Thornbill
Sulphur-crested Cockatoo

Turdus merula
Phaps chalcoptera
Eudynamys scolopacea
Phylidonyris pyrrhoptera
Ocyphaps lophotes
Falcunculus frontatus
Platycercus elegans
Eurystomus orientalis
Artamus cyanopterus
Platycercus eximius
Acanthorhynchus tenuirostris
Psophodes olivaceus
Eopsaltria australis
Cacomantis flabelliformis
Petroica phoenicea
Cacatua roseicapilla
Callocephalon fimbriatum
Pachycephala pectoralis
Cracticus torquatus
Rhipidura fuliginosa
Colluricincla harmonica
Microeca fascinans
Dacelo novaeguineae
Myiagra rubecula
Meliphaga lewinii
Grallina cyanoleuca
Dicaeum hirundinaceum
Phylidonyris novaehollandiae
Cuculus pallidus
Strepera graculina
Pycnoptilus floccosus
Anthochaera carunculata
Neochmia temporalis
Petroica rosea
Rhipidura rufifrons
Pachycephala rufiventris
Todiramphus sanctus
Ptilonorhynchus violaceus
Myiagra cyanoleuca
Petroica multicolor
Chrysococcyx lucidus
Zosterops lateralis
Ninox novaeseelandiae
Pardalotus punctatus
Pardalotus striatus
Acanthiza lineata
Cacatua galerita

Superb Fairy-wren
Tawny Frogmouth
Topknot Pigeon
Tree Martin
Varied Sittella
Variegated Fairy-wren
Wedge-tailed Eagle
Welcome Swallow
White-browed Scrubwren
White-eared Honeyeater
White-naped Honeyeater
White-throated Treecreeper
Wonga Pigeon
Yellow-faced Honeyeater
Yellow-rumped Thornbill
Yellow-tailed Black-Cockatoo

Malurus cyaneus
Podargus strigoides
Lopholaimus antarcticus
Hirundo nigricans
Daphoenositta chrysoptera
Malurus lamberti
Aquila audax
Hirundo neoxena
Sericornis frontalis
Lichenostomus leucotis
Melithreptus lunatus
Cormobates leucophaeus
Leucosarcia melanoleuca
Lichenostomus chrysops
Acanthiza chrysorrhoa
Calyptorhynchus funereus

Reptiles

Black Rock Skink
Copperhead
Copper-tailed Skink
Eastern Brown Snake
Eastern Small-eyed Snake
Eastern Water Skink
Red-bellied Black Snake

Egernia saxatilis
Austrelaps superbus
Ctenotus taeniolatus
Pseudonaja textilis
Rhinoplocephalus nigrescens
Eulamprus quoyii
Pseudechis porphyriacus

Frogs

Common Eastern Froglet

Crinia signifera

B. FAUNA LIST FOR GIBBERGUNYAH RESERVE

Mammals

Common Brushtail Possum	<i>Trichosurus vulpecula</i>
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>
Common Wombat	<i>Vombatus ursinus</i>
Eastern Grey Kangaroo	<i>Macropus giganteus</i>
Greater Glider	<i>Petauroides volans</i>
Short-beaked Echidna	<i>Tachyglossus aculeatus</i>
Swamp Wallaby	<i>Wallabia bicolor</i>
Yellow-bellied Glider	<i>Petaurus australis</i>

Birds

Australian King-Parrot	<i>Alisterus scapularis</i>
Australian Magpie	<i>Gymnorhina tibicen</i>
Brown Quail	<i>Coturnix ypsilophora</i>
Collared Sparrowhawk	<i>Accipiter cirrhocephalus</i>
Common Koel	<i>Eudynamys scolopacea</i>
Crimson Rosella	<i>Platycercus elegans</i>
Eastern Rosella	<i>Platycercus eximius</i>
Eastern Whipbird	<i>Psophodes olivaceus</i>
Galah	<i>Cacatua roseicapilla</i>
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>
Grey Shrike-thrush	<i>Colluricincla harmonica</i>
Laughing Kookaburra	<i>Dacelo novaeguineae</i>
Little Lorikeet	<i>Glossopsitta pusilla</i>
Peregrine Falcon	<i>Falco peregrinus</i>
Pied Currawong	<i>Strepera graculina</i>
Powerful Owl	<i>Ninox strenua</i>
Red Wattlebird	<i>Anthochaera carunculata</i>
Satin Bowerbird	<i>Ptilonorhynchus violaceus</i>
Spotted Pardalote	<i>Pardalotus punctatus</i>
Striated Thornbill	<i>Acanthiza lineata</i>
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>
Superb Fairy-wren	<i>Malurus cyaneus</i>
White-throated Treecreeper	<i>Cormobates leucophaeus</i>
Yellow-faced Honeyeater	<i>Lichenostomus Chrysops</i>
Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>

Reptiles

Black Rock Skink	<i>Egernia saxatilis</i>
Copperhead	<i>Austrelaps superbus</i>
Eastern Blue-tongued Lizard	<i>Tiliqua scincoides</i>
Eastern Brown Snake	<i>Pseudonaja textilis</i>
Jacky Lizard	<i>Amphibolurus muricatus</i>

C. FAUNA LIST FOR GREATER MOUNT ALEXANDRA RESERVE

Mammals

Black Rat*	<i>Rattus rattus</i>
Brown Antechinus	<i>Antechinus stuartii</i>
Bush Rat	<i>Rattus fuscipes</i>
Feral Cat*	<i>Felis catus</i>
Common Brushtail Possum	<i>Trichosurus vulpecula</i>
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>
Common Wallaroo	<i>Macropus robustus</i>
Common Wombat	<i>Vombatus ursinus</i>
Feral Dog*	<i>Canis lupus</i>
Fox*	<i>Vulpes vulpes</i>
Greater Glider	<i>Petauroides volans</i>
House Mouse*	<i>Mus musculus</i>
Platypus	<i>Ornithorhynchus anatinus</i>
Red-necked Wallaby	<i>Macropus rufogriseus</i>
Short-beaked Echidna	<i>Tachyglossus aculeatus</i>
Squirrel Glider	<i>Petaurus norfolcensis</i> (Whelan 1983)
Swamp Wallaby	<i>Wallabia bicolor</i>
Yellow-bellied Glider	<i>Petaurus australis</i>

Birds

Australasian Grebe	<i>Tachybaptus novaehollandiae</i>
Australian King-Parrot	<i>Alisterus scapularis</i>
Australian Magpie	<i>Gymnorhina tibicen</i>
Australian Raven	<i>Corvus coronoides</i>
Australian White Ibis	<i>Threskiornis molucca</i>
Australian Wood Duck	<i>Chenonetta jubata</i>
Azure Kingfisher	<i>Alcedo azurea</i>
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>
Brown Gerygone	<i>Gerygone mouki</i>
Brown Goshawk	<i>Accipiter fasciatus</i>
Brown Thornbill	<i>Acanthiza pusilla</i>
Brown Treecreeper	<i>Climacteris picumnus</i>
Brown-headed Honeyeater	<i>Melithreptus brevirostris</i>
Brush Bronzewing	<i>Phaps elegans</i>
Buff-rumped Thornbill	<i>Acanthiza reguloides</i>
Cattle Egret	<i>Ardea ibis</i>
Clamorous Reed-Warbler	<i>Acrocephalus stentoreus</i>
Collared Sparrowhawk	<i>Accipiter cirrhocephalus</i>
Common Bronzewing	<i>Phaps chalcoptera</i>
Common Myna*	<i>Acridotheres tristis</i>
Common Starling*	<i>Sturnus vulgaris</i>
Crested Shrike-tit	<i>Falcunculus frontatus</i>
Crimson Rosella	<i>Platycercus elegans</i>
Dollarbird	<i>Eurystomus orientalis</i>

Double-barred Finch
Dusky Moorhen
Dusky Woodswallow
Eastern Rosella
Eastern Spinebill
Eastern Whipbird
Eastern Yellow Robin
Eurasian Coot
European Goldfinch*
Fairy Martin
Fan-tailed Cuckoo
Galah
Gang-gang Cockatoo
Glossy Black-Cockatoo
Golden Whistler
Great Cormorant
Grey Butcherbird
Grey Currawong
Grey Fantail
Grey Shrike-thrush
Grey Teal
Hardhead
Laughing Kookaburra
Leaden Flycatcher
Little Black Cormorant
Little Eagle
Little Pied Cormorant
Little Wattlebird
Magpie-lark
Mallard*
Masked Lapwing
Mistletoebird
Musk Duck
Nankeen Kestrel
Nankeen Night Heron
New Holland Honeyeater
Noisy Miner
Olive-backed Oriole
Pacific Black Duck
Painted Button-quail
Pallid Cuckoo
Peregrine Falcon
Pied Currawong
Pilotbird
Purple Swamphen
Red Wattlebird
Red-browed Finch

Taeniopygia bichenovii
Gallinula tenebrosa
Artamus cyanopterus
Platycercus eximius
Acanthorhynchus tenuirostris
Psophodes olivaceus
Eopsaltria australis
Fulica atra
Carduelis carduelis
Hirundo ariel
Cacomantis flabelliformis
Cacatua roseicapilla
Callocephalon fimbriatum
Calyptorhynchus lathami
Pachycephala pectoralis
Phalacrocorax carbo
Cracticus torquatus
Strepera versicolor
Rhipidura fuliginosa
Colluricincla harmonica
Anas gracilis
Aythya australis
Dacelo novaeguineae
Myiagra rubecula
Phalacrocorax sulcirostris
Hieraaetus morphnoides
Phalacrocorax melanoleucos
Anthochaera chrysoptera
Grallina cyanoleuca
Anas platyrhynchos
Vanellus miles
Dicaeum hirundinaceum
Biziura lobata
Falco cenchroides
Nycticorax caledonicus
Phylidonyris novaehollandiae
Manorina melanocephala
Oriolus sagittatus
Anas superciliosa
Turnix varia
Cuculus pallidus
Falco peregrinus
Strepera graculina
Pycnoptilus floccosus
Porphyrio porphyrio
Anthochaera carunculata
Neochmia temporalis

Red-browed Treecreeper
Richard's Pipit
Rockwarbler
Rose Robin
Rufous Fantail
Rufous Whistler
Sacred Kingfisher
Satin Bowerbird
Scarlet Robin
Shining Bronze-Cuckoo
Silvereye
Spotted Pardalote
Spotted Quail-thrush
Striated Pardalote
Striated Thornbill
Stubble Quail
Sulphur-crested Cockatoo
Superb Fairy-wren
Superb Lyrebird
Tawny Frogmouth
Tree Martin
Varied Sittella
Wedge-tailed Eagle
Welcome Swallow
White-browed Scrubwren
White-eared Honeyeater
White-faced Heron
White-throated Gerygone
White-throated Treecreeper
White-winged Chough
Willie Wagtail
Yellow Thornbill
Yellow-faced Honeyeater
Yellow-rumped Thornbill
Yellow-tailed Black-Cockatoo
Zebra Finch

Climacteris erythroptus
Anthus novaeseelandiae
Origma solitaria
Petroica rosea
Rhipidura rufifrons
Pachycephala rufiventris
Todiramphus sanctus
Ptilonorhynchus violaceus
Petroica multicolor
Chrysococcyx lucidus
Zosterops lateralis
Pardalotus punctatus
Cinclosoma punctatum
Pardalotus striatus
Acanthiza lineata
Coturnix pectoralis
Cacatua galerita
Malurus cyaneus
Menura novaehollandiae
Podargus strigoides
Hirundo nigricans
Daphoenositta chrysoptera
Aquila audax
Hirundo neoxena
Sericornis frontalis
Lichenostomus leucotis
Egretta novaehollandiae
Gerygone olivacea
Cormobates leucophaeus
Corcorax melanorhamphos
Rhipidura leucophrys
Acanthiza nana
Lichenostomus chrysops
Acanthiza chrysorrhoa
Calyptorhynchus funereus
Taeniopygia guttata

Reptiles

Copper-tailed Skink
Cunningham's Skink
Delicate Skink
Diamond Python
Eastern Blue-tongued Lizard
Eastern Brown Snake
Eastern Tiger Snake
Eastern Water Dragon
Eastern Water Skink

Ctenotus taeniolatus
Egernia cunninghami
Lampropholis delicata
Morelia spilota
Tiliqua scincoides
Pseudonaja textilis
Notechis scutatus
Physignathus lesueurii
Eulamprus quoyii

Grass Skink
Jacky Lizard
Lesueur's Velvet Gecko
Mountain Dragon
Red-bellied Black Snake
Red-throated Skink
Southern Leaf-Tailed Gecko
Wall Lizard

Lampropholis guichenoti
Amphibolurus muricatus
Oedura lesueurii
Tympanocryptis diemensis
Pseudechis porphyriacus
Pseudemoia platynota
Phyllurus platurus
Cryptoblepharus virgatus

Frogs

Bleating Tree Frog
Blue Mountains Tree Frog
Brown-striped Frog
Common Eastern Froglet
Lesueur's Frog

Litoria dentata
Litoria citropa
Limnodynastes peronii
Crinia signifera
Litoria lesueuri

APPENDIX 7.4

ECOLOGICAL CONSEQUENCES OF HIGH FREQUENCY FIRES KEY THREATENING PROCESS

NSW Scientific Committee Final Determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to support a proposal to list 'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' as a **KEY THREATENING PROCESS** on Schedule 3 of the Act. Listing of Key Threatening Processes is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. Plants and animals have a range of mechanisms to survive individual fires. The long-term survival of plants and animals over repeated fires is dependent upon two key features: i) the ability of species to maintain life cycle processes; and, ii) the maintenance of vegetation structure over time as habitat for animal species. Where fires occur very close together in time (high frequency fire) both these key features can be disrupted.

2. High frequency fire is defined as two or more successive fires close enough together in time to interfere with or limit the ability of plants or animals to recruit new individuals into a population, or for plants to build-up a seedbank sufficient in size to maintain the population through the next fire. Sustained high frequency fire will consequently lead to a loss of plant species, a reduction in vegetation structure and a corresponding loss of animal species. While most communities are likely to have some tolerance to two fires at a high frequency (one short inter-fire interval), what must be avoided is a sustained sequence of such closely spaced fires. Other components of the fire regime (e.g., infrequent fire) may also be a threat in some circumstances, but this determination deals specifically with high frequency fire.

3. The threat of high frequency fire will occur in all fire-prone habitats in New South Wales, although the likelihood of occurrence of high frequency fire is currently greatest in coastal and tableland habitats and in urban areas. No one time limit can be used as an acceptable time between fires for the maintenance of biodiversity across the State of New South Wales; i.e., it is not possible to say all fire intervals should be greater than say 5 years across New South Wales. This is because in different parts of the State the timing of critical life history processes will be different. The specific frequency of fire that will be detrimental to a species or community will vary from place to place, depending upon the survival mechanisms that the species or community exhibit, and local

conditions. The number of fires over any set time period that will constitute a detrimental high fire frequency will therefore be location and community specific.

4. High frequency fire and inappropriate fire regimes (which largely equates to too high a fire frequency) have been identified as threats to a number of species and communities listed on Schedule 1 or 2 of the Threatened Species Conservation Act, including:

Ecological Communities

- Ben Halls Gap National Park Sphagnum Moss Cool Temperate Rainforest
- Duffys Forest
- Eastern Suburbs Banksia Scrub
- Kurnell Dune Forest
- O'Hares Creek Shale Forest
- Pittwater Spotted Gum Forest
- Other listed endangered ecological communities, including Cumberland Plain Woodland, Sydney Turpentine Ironbark Forest, Blue Gum High Forest, Elderslie Banksia Scrub Forest, Genowlan Point Allocasuarina nana heathland, Sydney Coastal River-flat Forest, Shale/Sandstone Transition Forest and Cooks River Clay Plain Scrub Forest are all likely to suffer a loss of species if subject to repeated high frequency fires, based on current knowledge of the response of species to fire in the Sydney Region.

Plants

- *Acacia bynoeana*
- *Acacia courtii*
- *Acacia macnuttiana*
- *Acacia pubifolia*
- *Acacia ruppii*
- *Acrophyllum australe*
- *Almaleea cambagei*
- *Apatophyllum constablei*
- *Asterolasia elegans*
- *Boronia granitica*
- *Boronia repandra*
- *Calitris oblonga*
- *Cynanchum elegans*
- *Darwinia biflora*
- *Elaeocarpus williamsianus*
- *Epacris hamiltonii*
- *Eucalyptus nicholii*
- *Grevillea banyabba*
- *Grevillea beadleana*

- *Grevillea caleyi* *Grevillea mollis*
- *Grevillea rivularis*
- *Grevillea scortechinii* ssp. *sarmentosa*
- *Grevillea shiressii*
- *Haloragodendron lucasii*
- *Homaranthus lunatus*
- *Lasiopetalum joyceae*
- *Leptospermum thompsonii*
- *Melichrus hirsutus*
- *Phaius australis*
- *Phaius tancarvilliae*
- *Phebalium glandulosum* ssp. *eglandulosum*
- *Phebalium lachnaeoides*
- *Pimelea spicata*
- *Pterostylis gibbosa*
- *Pultenaea* sp. *Olinda*
- *Styphelia perileuca*
- *Swainsona plagiotropis*
- *Velleia perfoliata*
- *Zieria involucrata*

Birds

- *Calyptorhynchus lathami* (Glossy Black-Cockatoo)
- *Dasyornis brachypterus* (Eastern Bristlebird)
- *Leipoa ocellata* (Mallee Fowl)
- *Pezoporus wallicus* (Ground Parrot)

Mammals

- *Aepyprymnus rufescens* (Rufous Bettong)
- *Dasyurus maculatus* (Spotted-tailed Quoll)
- *Dasyurus viverrinus* (Eastern Quoll)
- *Isoodon obesulus* (Southern Brown Bandicoot)
- *Macropus dorsalis* (Black-striped Wallaby)
- *Macropus parma* (Parma Wallaby)
- *Ningauai yvonneae* (Southern Ningauai)
- *Petaurus norfolcensis* (Squirrel Glider)
- *Potorous tridactylus* (Long-nosed Potoroo)
- *Potorous longipes* (Long-footed Potoroo)

5. A number of plant species now considered to be nationally rare (Briggs & Leigh 1996 – Rare or Threatened Australian Plants, CSIRO, Canberra) have been identified as being threatened by high fire frequency. For these species, which have restricted distributions, losses of additional sites are likely to lead to the species becoming threatened. Such species include:

- *Acacia brunioides* ssp. *granitica*
- *Acacia latisepala*
- *Babingtonia odontocalyx*
- *Boronia serrulata*
- *Darwinia diminuta*
- *Darwinia glaucophylla*

- ***Darwinia procera***
- ***Dodonaea hirsuta***
- ***Eucalyptus burgessiana***
- ***Eucalyptus rupicola***
- ***Eucalyptus luehmanniana***
- ***Grevillea longifolia***
- ***Hakea macrorrhyncha***
- ***Melaleuca deanii***
- ***Phebalium ambiens***
- ***Philotheca myoporoides* ssp. *epilosa***

6. Populations of certain common plant and animal species could become threatened by high frequency fire. Some examples of mammals include:

- ***Acrobates pygmaeus*** (Feathertail Glider)
- ***Antechinus flavipes*** (Yellow-footed Antechinus)
- ***Antechinus swainsonii*** (Dusky Antechinus)
- ***Cercartetus nanus*** (Eastern Pygmy Possum)
- ***Isoodon macrourus*** (Northern Brown Bandicoot)
- ***Perameles nasuta*** (Long-nosed Bandicoot)
- ***Pseudocheirus peregrinus*** (Common Ringtail Possum)
- ***Petaurus breviceps*** (Sugar Glider)
- ***Pseudomys novaehollandiae*** (New Holland Mouse)

7. Listing of 'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' will be of significant conservation value as it will trigger consideration of this key threatening process in the environmental assessment process. Development of a threat abatement plan in New South Wales for the threat of high fire frequency is both desirable and achievable. Such a plan would allow the incorporation of conservation guidelines with respect to high frequency fire, where known, to be incorporated into fire plans of management and risk plans as well as the development of monitoring programs to assist in identifying detrimental high fire frequencies.

8. In view of 4, 5 and 6 above the Scientific Committee is of the opinion that 'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' adversely affects two or more threatened species or ecological communities and it could cause species that are not threatened to become threatened.

Proposed Gazettal date: 24/3/00
Exhibition period: 24/3/00 – 28/4/00

Appendix F

Community Information Brochure

(text only)

Protecting Your Property from Bushfires

This brochure is designed to give residents in Wingecarribee Shire relevant information about protecting their property from bushfires, and what to do in the event of a bushfire.

Protecting Your Property

There are four ways that a bushfire can damage your home:

1. through direct flame contact
2. through the heat radiated from the fire front which can ignite materials on or around your home, or shatter window glass
3. through wind-blown burning embers that can ignite material around your home, or enter your home through any unprotected openings
4. through the strong winds that can be generated by high intensity fires.

A well maintained dwelling with a well maintained Asset Protection Zone has a good chance of surviving a major bushfire.

What is an Asset Protection Zone?

An Asset Protection Zone is a buffer zone between your house and surrounding bushland where there is not enough fine fuel to carry a fire. The Asset Protection Zone should prevent flames from a bushfire reaching your home, and reduce the level of radiant heat from a bushfire to a level where it will not ignite materials on your dwelling or shatter windows.

In general a well managed garden with scattered trees and shrubs, mown and well watered lawn, and scattered flower beds will provide an adequate Asset Protection Zone. However, a few important points should be noted:

- Trees and shrubs should be isolated or in small clumps so they do not provide a continuous area of fuel between bushland and your home. As a general rule tree canopy cover should be less than 30%, and maximum shrub canopy cover less than 20%.
- Only use mown lawn, bare ground (driveways, paths etc) or non-flammable succulent ground cover plants immediately adjacent to buildings (within 2 to 5 metres).
- Canopies of trees and shrubs should not touch walls or overhang your house.
- Avoid planting trees and shrubs with rough fibrous bark, or which retain shed bark in long strips (ribbonbark), and avoid planting trees and shrubs that retain dead material in their canopies

- Avoid planting shrubs under trees, and avoid vines on walls and pergolas.
- Avoid brush fencing as well as continuous areas of woodchips or other flammable mulches. Any mulches within 5 m of your house should be non combustible (pebble or gravel)
- locate any combustible materials, such as woodpiles, flammable fuel stores etc., away from buildings.

Wingecarribee Shire Council has a list of trees, shrubs and groundcover plants of relatively low flammability that are recommended for planting in Asset Protection Zones.

How to establish an Asset Protection Zone

Width

New dwellings in bushfire prone areas will have an Asset Protection Zone specified as a condition of consent. This will include the width of the Asset Protection Zone.

For existing homes the Rural Fire Service recommends the following widths for the Asset Protection Zone:

SLOPE	WIDTH
Hazard upslope (< 18°)	20 m
Hazard downslope 0° to 5°	25 m
Hazard downslope 5° to 10°	30 m
Hazard downslope 10° to 15°	40 m
Hazard downslope 15° to 18°	50 m

These distances apply to dwellings close to bushland likely to generate significant ember attack (open forest, shrubby woodland, heathland). Where the surrounding vegetation is unlikely to generate significant ember attack (grassland, grassy woodland, rainforest) a 20 m Asset Protection Zone is required irrespective of slope.

The width of the Asset Protection Zone is measured outwards from the walls of your house.

Clearing

If you need to clear bushland to establish your Asset Protection Zone you must first obtain a Bush Fire Hazard Reduction Certificate from the Rural Fire Service. Application forms can be obtained from the Rural Fire Service website www.bushfire.nsw.gov.au or from the Rural Fire Service control centre in Priestly Street, Mittagong. Prior to issuing the certificate the Rural Fire Service will conduct an environmental impact assessment of your proposed clearing using the **Bush Fire Environmental Assessment Code**. Copies of the code are also available on the Rural Fire Service website.

If you cannot clear your Asset Protection Zone yourself, Council can provide a list of contractors who can do the clearing for you.

If you are not able to clear a full Asset Protection Zone on your own property, and are concerned about the bushfire risk from bushland on a neighbouring property, you should first approach your neighbour with your concerns and seek their assistance in reducing the hazard on their land. All landowners and occupiers have a legal obligation under the Rural Fires Act, 1997, to “take the notified steps (if any) and any other practicable steps to prevent the occurrence of bush fires on, and to minimise the danger of the spread of bush fires on or from, that land.”

If your neighbour does not cooperate you can lodge a complaint with the Rural Fire Service. Forms are available from the Rural Fire Service website, or the control centre in Priestly Street, Mittagong. Following receipt of your complaint, the Rural Fire Service will investigate the issue and, if required, issue a notice to your neighbour to reduce the hazard. If your neighbour does not comply with the notice, the Rural Fire Service has the power to do the required hazard reduction.

Disposing of Cleared Vegetation

Your Bushfire Hazard Reduction Certificate will generally specify how the clearing required for hazard reduction on your land can be undertaken (mechanical, burning etc.). If you clear your Asset Protection Zone by hand or by machine, you will need to dispose of the cleared vegetation. You have a number of options for disposing of vegetation cleared to establish or maintain an Asset Protection Zone:

- transporting the material to Council’s green waste depot at the Resource Recovery Centre, Berrima Road, Moss Vale
- mulching and composting the material on your property
- burning the material on your property.

Council does not permit burning of vegetation on properties zoned Residential 2b (medium density residential) or less than 4000 m² in Balaclava, Bowral, Braemar, Burradoo, East Bowral, Mittagong, Moss Vale, Welby and Willow Vale, in order to control air pollution. In other areas pile burning of cleared vegetation is allowed, although you will need to obtain a burning permit from the Rural Fire Service or the NSW Fire Brigades if you intend to burn during the bushfire danger period (usually 1 October to 31 March but may be extended in dry years).

Pile burns must be conducted in accordance with the conditions on a permit and/or in accordance with the Rural Fire Service document *Guidelines for Pile Burning* available from the Rural Fire Service website, or the Fire Control Centre in Priestly Street, Mittagong. If you are unsure about

your ability to control your pile burn contact your local Rural Fire Service brigade. They will generally be happy to assist for a small donation.

Water Supply

If you live in an area that does not have town water, or if the water pressure is poor, you should keep a supply of water for fire fighting. This can be used by yourself or fire fighters to protect your home. A static water supply of around 10,000 litres is sufficient for the average family home. The supply can be stored in a tank, a pool, or even a dam if it is within 60 m of the house. Whatever storage is used it must be dedicated and maintained for fire fighting only, and be accessible by fire brigade vehicles.

The static water supply can be combined with a domestic water supply by placing the outlet for the domestic supply far enough above the base of the tank to ensure that 10,000 litres remains in the bottom of the tank at all times. An additional outlet will be required for fire brigade use.

In order to access the static water supply, fire brigade vehicles need to be able to reverse to within 4 m of the storage, or an outlet connected to the storage. It will therefore be an advantage to locate the storage, or the outlet, close to your driveway. The outlet for fire fighting use should be provided with a 65 mm Storz outlet with a gate or ball valve. Underground tanks should have an access hole of minimum 200 mm diameter. If the supply is stored above ground, the tank, supports and fittings should be non combustible, or provided with a masonry or metal shield against radiant heat. If the water for fire fighting is piped from the storage tank to an outlet, the pipe will need to be at least an 80 mm metal pipe as suction would be used to extract the water.

If you install a static water supply obtain a static water supply marker (SWS) from the Rural Fire Service, or the NSW Fire Brigades, and fix it to post or pole at the entrance to your property so that the fire brigades will know that water for fire fighting is available.

As the electricity supply may fail during a bushfire, it is recommended that you purchase a portable petrol or diesel powered fire pump with sufficient hose to reach the furthest corner of your house from your static water supply.

In high bushfire risk areas a sprinkler system could provide valuable additional protection for your home and should be considered. The sprinkler system should at least cover the roof of your home but could be extended to cover the walls and surrounding garden as well. Guidelines for constructing sprinkler systems are available on the Rural Fire Service website. It should be noted that sprinklers are an active protection measure that are only effective if somebody activates them as a fire approaches the dwelling. To be effective a sprinkler system for bushfire protection needs to be able to run for a minimum of 2 hours from a stored water supply on site. The additional

water storage needed to supply a sprinkler system will depend on the system installed. In addition, any sprinkler system installed for bushfire protection must be able to operate independently of the electricity supply, as this could also fail during a major bushfire. If a sprinkler system is installed, it should be tested each year at the beginning of the bushfire season to ensure it is operating properly.

Access for Fire Fighters

If your house is more than about 50 m from a public road it will greatly assist fire fighters if they can drive a heavy tanker up to your house. To do this your driveway should meet the following specifications:

- a minimum cleared width of 3.5 m (preferably 4 m), wider at bends.
- no dense undergrowth within 1 m of either side of the driveway
- a minimum 4 m clearance from the driveway to any overhanging obstructions such as gateways, trees, and powerlines
- a turning area sufficient to turn an 8 m long vehicle close to your house. The end of the turning bay is an ideal location for your static water supply for fire fighting.

If you are not sure if your driveway is accessible, contact the Rural Fire Service and arrange for a site inspection

Building Maintenance

A well maintained house will have a better chance of surviving a bushfire. In particular:

- ensure gutters are regularly cleaned; gutter guards can help but should be of a non combustible material
- seal gaps and holes that could allow burning embers to enter the roof space, or under your house.
- If your house has a suspended floor that is not fully enclosed, make sure there are no combustible materials stored under your house and consider enclosing any portions that are less than 600 mm above ground level with a non combustible material or a metal wire mesh with an opening of less than 2 mm.
- If your house has timber cladding make sure it is regularly painted.
- Fit metal wire fly screen to opening windows, particularly windows you leave open when you go out.