



Vegetation Management Plan Rainforest Way



Ballina Shire Council image, 2003

June, 2004

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ACKNOWLEDGMENTS

EnviTE would like to acknowledge the contribution of James Brideson (Natural Resource Extension Officer) of Ballina Shire Council. All photographs in this report, unless otherwise credited, were taken by Andy Erskine.

SUMMARY

The Rainforest Way Vegetation Management Plan has been compiled for the newly formed Rainforest Way Landcare group. The group applied for and succeeded in acquiring an Envirofund grant from the Natural Heritage Trust (NHT). A plan of management was required by council for management and insurance purposes. The study area of approximately 2.5 hectares is found on the south western slopes of the Pacific Pines Estate branching off North Creek Rd., Lennox Head. It is considered that this area could be enhanced to conform to the designated purpose of providing public amenity. This vision could be achieved by carrying out systematic weed control and vegetation restoration of the endemic vegetation type ie Littoral Rainforest (LRF). The original vegetation has undergone major disturbance with the pre-existing LRF being cleared. LRF regrowth appears on the road reserve and a few isolated copses of trees exist within the study site.

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1. Introduction

The study area of approximately 2.5 hectares is found on the western slopes of the Pacific Pines Estate off North Creek Rd., Lennox Head. The site is bounded to the north and east by homes, to the south by a road reserve and rural dwelling and to the south west by a wetland.

The Rainforest Way Vegetation Management Plan has come about as a result of the newly formed Rainforest Way Landcare Group who applied for and succeeded in acquiring an Envirofund grant from the Natural Heritage Trust. Ballina Shire Council require a management plan for management and insurance purposes.

This area (Lot 126 DP 828137, Lot 51 DP 805289) is part of the Pacific Pines Estate that was rezoned on 31 March, 1989 from 1(d) Rural (Urban Investigation) to 2(b)Village Area, as part of Amendment No. 2 to the Ballina Local Environmental Plan, 1987.

The soils are red Krasnozem (Ferosols) of volcanic origin appearing thin or compacted on the upper slopes and stony and wet on the lower portions. The original vegetation has undergone major disturbance with the pre-existing littoral rainforest (LRF) being cleared. LRF regrowth appears on the road reserve and a few isolated copses of trees exist within the study site. Plantings of eucalypts and related sclerophyll species have been established by the developer in the upper portions of the site. Where canopy trees are not present weeds dominate; the dominant weeds being Lantana (*Lantana camara*) and Red Natal Grass (*Melinis repens*).

It is considered that this area could be enhanced to conform to the designated purpose of providing public amenity. This could be achieved by carrying out systematic weed control and vegetation restoration of the endemic vegetation type ie LRF.

The benefits of this work would be;

- Greater accessibility for residents and their children to a natural self perpetuating ecosystem.
- A reduction of wind blown irritants from weed species such as Stinking Roger.
- Improved visual amenity which will be reflected in real estate value.
- Reduced fire risk to homes.
- Increased habitat value for local fauna.
- An opportunity for residents to form bonds through shared stewardship of the reserve.

Aims and Objectives

The **aim** of this Vegetation Management Plan is to provide strategies, actions and a works schedule to restore the structure, function, integrity and dynamics of the native vegetation communities at Rainforest Way and to provide an assessment of the status of vegetation found at the site. In addition practical guidelines will be included for individuals or groups engaged in remediation and rehabilitation works aimed at restoring the native vegetation community.

The **objectives** of the Vegetation Management Plan and its recommended works are:

- to assess the condition and regeneration potential of native vegetation,
- to provide information on weed species, weed control and restoration techniques,
- to identify and assess threats that are contributing to the degradation of vegetation communities,
- to make recommendations for the sequential restoration of the vegetation communities,
- to recommend methods that ensure soil stability and increase resistance to erosion,
- to strengthen the existing vegetation through the planting of local native species in areas where natural regeneration is least likely to occur (ie. highly disturbed, physically compacted and isolated areas),
- to increase public awareness of the importance of native vegetation and encourage local stewardship for the area,

The plan provides practical guidelines to those involved in restoration, to:

- ~ enhance the resilience and regenerative capacity of the current native vegetation,
- ~ reduce the potential for exotic plants, which can displace endemic species, to become established,
- ~ provide a suitable habitat for local and migratory native fauna,
- ~ improve the general amenity for local residents and visitors (aesthetic, recreational and educational).

2. SITE DESCRIPTION

2.1. Location

The study site is located on the NSW north east coast approximately 2 kms south west of central Lennox Head (see **Figure 1**). The area of approximately 2.5 hectares is located on the south western slopes of the Lennox Pines Estate off North Creek Rd., Lennox Head. The site is bounded to the north and east by homes, to the south by a road reserve and rural dwelling and to the south west by a wetland.

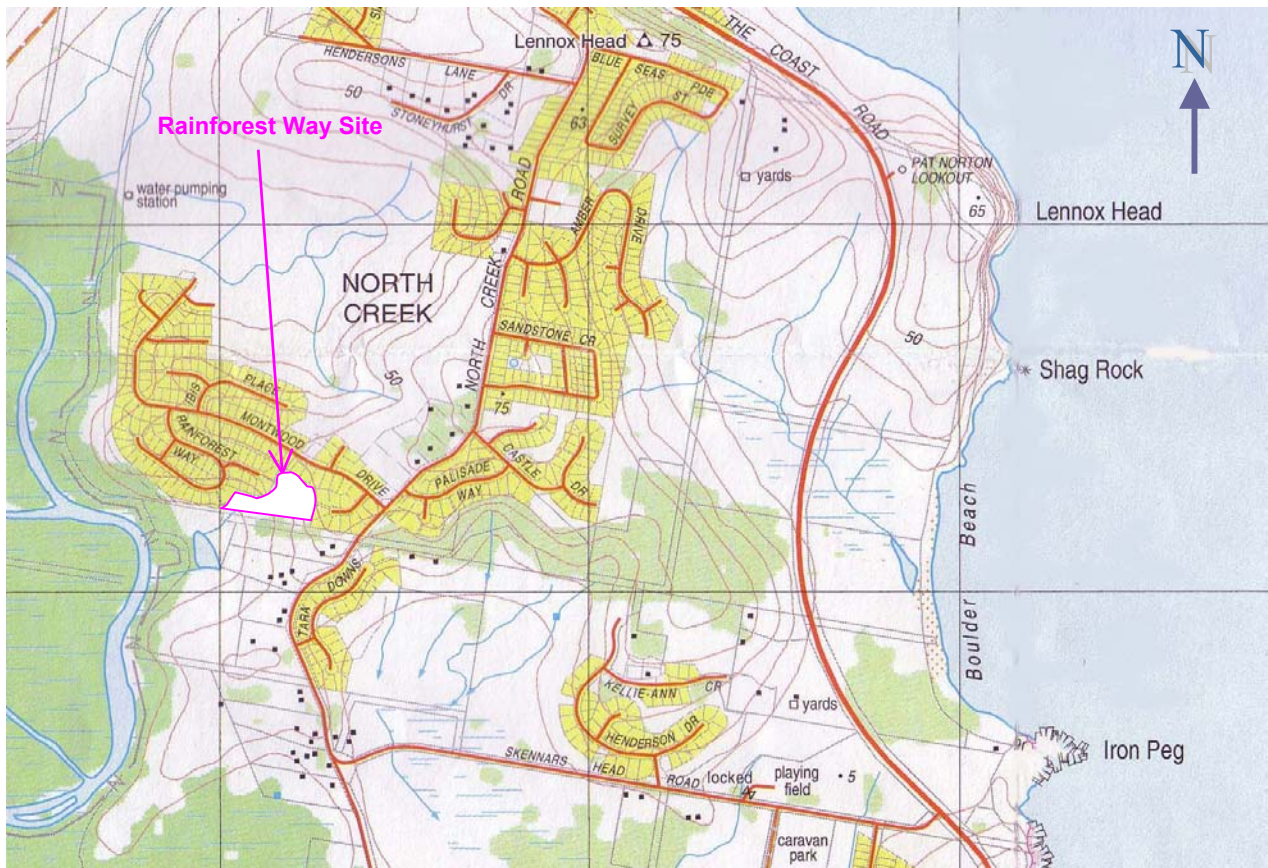


Figure 1: A map of the Rainforest Way site showing proximity to geographical landmarks. (base map extract - Land and Property Information NSW, Ballina 9640-03N, 1:25000 Orthophoto)

2.2. Geomorphology

The study sites consist of a single soil/geology type according to Morand, 1996. This landscape type carries the classification *bg* Bangalow

Soils are moderately deep to deep (100>200cm) well drained Krasnozems and brownish red Krasnozems. These soils are generally strongly acidic, moderately erodible soils with high aluminium toxicity potential. Localised stony, shallow and waterlogged soils occur.

Mass movement, generally shallow slumping along drainage lines, is common in many locations. The geology in this area is known as Lamington Volcanics.

2.3. Climate

North eastern NSW experiences a temperate to subtropical climate due to its geographic location. Average rainfall fluctuates between 1600 and 1700 millimetres per year, with the highest falls in summer (see Figure 3), November to April. (Anderson, A. 1999). Frosts are generally absent in the immediate coastal strip.

The prevailing wind is from the south east, however strong winds from the north are experienced in the spring and summer.

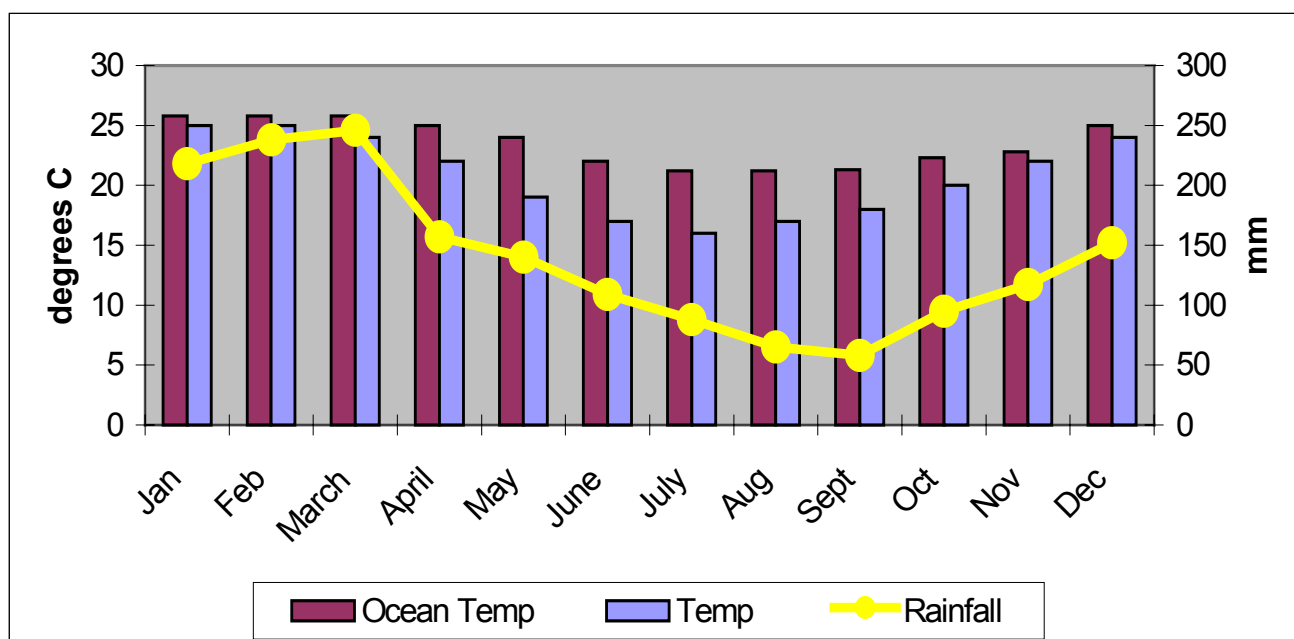


Figure 2: Climate graph of the Tweed coast showing ocean temperature, rainfall and air temperature (data source: Tweed and Coolangatta Tourism Incorporated, 2000 & Tweed Council web site)

2.4. Land Tenure

The land is Zoned 2 (b)- Residential Village Area, under the Ballina Local Environmental Plan (1987, 2004 edition).

A. The primary objectives are:

- a. to regulate the subdivision and use of land to permit a wide range of urban purposes; and
- b. to allow detailed provision to be made, by means of a development control plan, to set aside specific areas within the zone for varying housing densities, commercial and special uses and other urban and tourist facility purposes.

B. The secondary objectives are to allow a variety of housing types and designs and to encourage greater visual amenity by requiring site landscaping.

C. The exception of these objectives is to permit development of land within the zone for public works and services, outside the parameters specified in the primary objectives.

The area was shown as open space in the original development control policy adopted by Council on 25 May, 1989. These lots were subsequently dedicated to Council and are classified as "Community Land" and categorised as "General Community Use" under the Local Government Act. The land is subject to the Principal Generic Plan of Management for Community Land. The land is currently designated "O1 - Open Space" under Development Control Plan No. 1 - Urban Land.

To the west and south west are two areas listed as 7 (a) Environmental Protection – Wetlands. Any works undertaken on the Rainforest Way site would need to consider likely effects on flora and fauna found in the wetlands and the impact of clearing on the wetland environment. Natural drainage patterns direct water flows towards the area designated as a wetland.

3. SITE ASSESSMENT

3.1 Methods

Field flora surveys were conducted in May, 2004 and flora species identified using a variety of guides. Lists of the flora species that were recorded, both native and introduced, appear in **Appendices 1&2**.

A fauna study was not undertaken for this report. Birds in particular are an accurate indicator of vegetation change, species diversity increases as habitat requirements are met. The compilation of a fauna species list is another effective way of monitoring the success of a remnant vegetation project.

3.2 Original Vegetation

Littoral rainforest (LRF) is described by Williams *et al.* (1984), as being “not really a structural sub-form (of rainforest) but a distinctive series of communities found close to the sea either on nutrient-enriched deep sands or on soil derived from slates, basalt etc; mostly combining characteristics of sub-tropical rainforest (STRF) and dry rainforest (DRF); often with a wind-sheared upper tree canopy; with an abundance of blunt-leaved tree species tolerant of some salt-spray; and generally of distinctive species composition. A strip of littoral rainforest is thought to have extended along almost the entire coast from south of Ballina to Tweed Heads (**Figure 3**), Floyd, 1990.

The Lennox Pines Estate (developed during the 1990's) would have been part of a much larger littoral rainforest that extended from the due east, to the wet lands bounding the west of Rainforest Way. Remnants of this vegetation type persist throughout the red soils of Lennox Head with substantial areas seen at Boulders Beach (SEPP26 site 38), the Newton property directly opposite (SEPP26 site 37) and at Tara Downs and Gradwell Estate, all of which would once have been linked to the area now occupied by the Lennox Pines Estate.

The remnants we now see in this region are almost all regrowth (Landmark. 1999) with only an occasional individual tree or tiny patch surviving the fervour to clear land inspired by the Robertson Land Act of 1862. Land has been selected and cleared for farming since the 1870's in the Upper North Creek area (Wilson, 2000).

Aerial photography from 1958 shows much of the landscape denuded of forest, regrowth has increased considerably since then (Landmark. 1999), demonstrating the resilience of littoral rainforest. The greatest risks to these remnants now consist of illegal clearing, weed competition, fire and inappropriate use.

The Rainforest Way flora list (**Appendix 1**), should be referred to when deciding on appropriate species for planting taking into consideration the species adaptation to this soil type, aspect and other climatic parameters.

3.3 Littoral Rainforest as a listed Endangered Ecological Community

The Scientific Committee, established by the Threatened Species Conservation Act 1995, has made a Final Determination to list Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions as an ENDANGERED ECOLOGICAL COMMUNITY in Part 3 of Schedule 1 of the Act

The Scientific Committee has found that:

Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions is generally a closed forest, the structure and composition of which is strongly influenced by proximity to the ocean. The plant species in this ecological community are predominantly rainforest species with evergreen mesic or coriaceous leaves. Several species have compound leaves, and vines may be a major component of the canopy. These features differentiate littoral rainforest from sclerophyll forest or scrub, but while the canopy is dominated by rainforest species, scattered emergent individuals of sclerophyll species, such as *Angophora costata*, *Banksia integrifolia*, *Eucalyptus botryoides* and *E. tereticornis* occur in many stands. Littoral Rainforest in NSW is found at locations along the entire NSW Coast in the NSW North Coast Bioregion, Sydney Basin Bioregion and South East Corner Bioregion. The areas mapped for inclusion in State Environmental Planning Policy 26 Littoral Rainforest are examples of the Littoral Rainforest ecological communities, but the mapping for SEPP 26 is not exhaustive and stands of the Littoral Rainforest ecological community occur at locations not mapped under SEPP 26. Some stands may be regrowth or in the process of regenerating.

Littoral Rainforest occurs on both sand dunes and on soils derived from underlying rocks (McKinley *et al.* 1999 cited Adam, 2004). Stands on headlands exposed to strong wind action may take the form of dense windpruned thickets (for example the Bunga Head Rainforest illustrated by Keith & Bedward, 1999, cited Adam, 2004), or MU5 Littoral Windshear Thicket in NPWS 2002). In more sheltered sites, and in hind dunes, the community is generally taller, although still with wind pruning on the windward side of stands. Floristically there is a high degree of similarity between stands on different substrates. Most stands of Littoral Rainforest occur within 2 km of the sea, but may occasionally be found further inland, but within reach of maritime influence.

The species composition of a site will be influenced by the size of the site, recent rainfall or drought condition and by its disturbance (including fire) history. The community also includes micro-organisms, fungi, cryptogamic plants and a diverse fauna, both vertebrate and invertebrate. These components of the community are poorly documented but the assemblage in individual stands will depend on geographic location, size of stand, degree of exposure, history of disturbance and, if previously disturbed, stage of regeneration (Adam, 2004).

According to Adam (2004) Threatened species and populations for which Littoral Rainforest is known or likely habitat include:

FLORA

Acronychia littoralis

Cryptocarya foetida

Archidendron hendersonii

Macadamia tetraphylla

Cynanchum elegans

Hicksbeachia pinnatifolia

Fontainea oraria

Syzygium moorei

Senna acclinis

Xylosma terrae-reginae

Syzygium paniculatum

FAUNA

Amaurornis olivaceus

Bush-hen

Coracina lineata

Barred Cuckoo-shrike

Lichenostomus faciogularis

Mangrove Honeyeater

Monarchia leucotis

White-eared Monarch

Ninox strenua

Powerful Owl

Pandion haliaetus

Osprey

Ptilinopus magnificus

Wompoo Fruit-dove

Ptilinopus regina

Rose-crowned Fruit-dove

Ptilinopus superbus

Superb Fruit-dove

Tyto tenebricosa

Sooty Owl

Dasyurus maculatus

Spotted-tailed Quoll

Kerivoula papuensis

Golden-tipped Bat

Mormopterus beccarii

Beccari's Freetail-bat

Mormopterus norfolkensis

Eastern Freetail-bat

Myotis adversus

Large-footed Myotis

Nyctimene robinsoni

Eastern Tube-nosed Bat

Potorous tridactylus

Long-nosed Potoroo

Pteropus alecto

Black Flying Fox

Pteropus poliocephalus

Grey-headed Flying Fox

Syconycteris australis

Eastern Blossom Bat

Thylogale stigmarica

Red-legged Pademelon

Coeranoscincus reticulatus

Three-toed Snake-tooth Skink

Hoplocephalus bitorquatus

Pale-headed Snake

Thersites mitchellae

Mitchell's Rainforest Snail

Rainforest Way Vegetation Management Plan

Most of the species included in this list are found at only some sites, or vary in occurrence and abundance.

Littoral Rainforest occurs in numerous, small stands and in total comprises less than 1% of the total area of rainforest in NSW. The largest known stand occurs in Iluka Nature Reserve, which is approximately 136 ha. Many, but not all, stands of Littoral Rainforest have been included in mapping for State Environmental Planning Policy 26 Littoral Rainforest, but degradation of the ecological community is still occurring.

Threats include loss of canopy integrity arising from salt and wind damage as a result of clearing or damage to stand margins; clearing of understorey (including for firewood collection); grazing and physical disturbance of understorey including by feral deer; inappropriate collection of a range of plant species (including, but not restricted to, epiphytes); fire, particularly fire incursion along boundaries; visitor disturbance including soil compaction, soil disturbance, erosion from foot, cycle, trail bike and 4 wheel drive tracks, introduction of pathogens, and disturbance from creation of new planned and unplanned tracks; increased visitation and resulting increased demand for and use of, visitor facilities such as walking tracks, viewing platforms, toilet blocks, picnic areas etc; dumping of garden waste causing weed infestation; car and other rubbish dumping. Loss of fauna due to predation by feral animals, road kill, loss of habitat and feeding resources, disturbance from human visitation (faunal elements are essential to the ecological functioning of littoral rainforest and loss, or reduction, in pollinators and seed dispersal agents will adversely affect long term vegetation health); fragmentation resulting in loss of connectivity and possibly reduced genetic exchange between populations. For stands not protected by State Environmental Planning Policy 26, clearing and development remains a possibility. (Adam 1987, 1992; Floyd 1990; Mills 1996 cited Adam, 2004).

In view of the above the Scientific Committee is of the opinion that Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions 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 (Adam, 2004).

3.4 Implications of working in a Threatened Community

In view of the changed status of Littoral Rainforest bush regenerators may consider applying for a 132C license under the National Parks and Wildlife Act. This license is issued where the NPWS considers that the proposed work is for conservation purposes. More information and a checklist for bush regeneration activities can be found in **Appendix 9**.

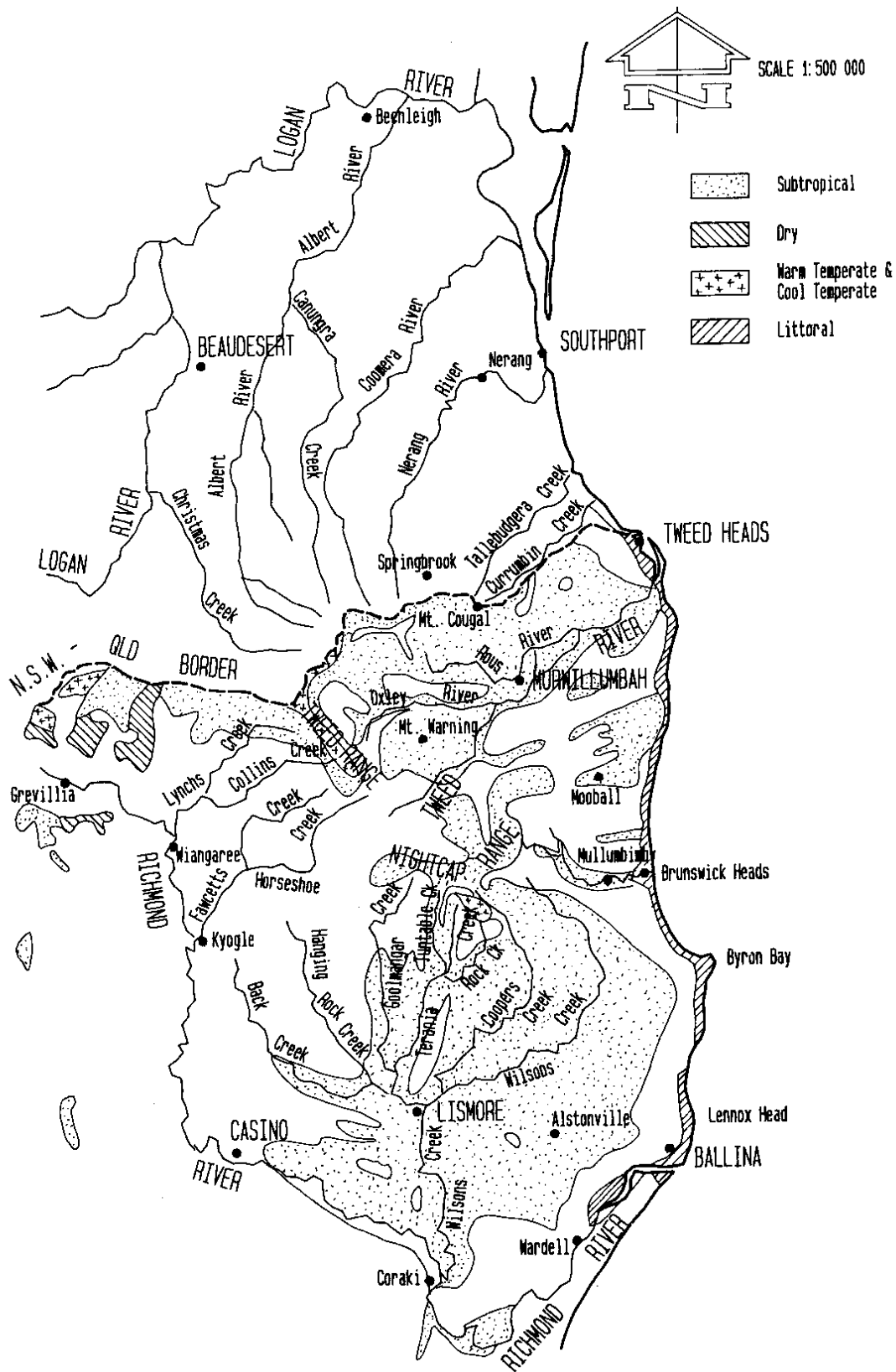


Figure 3: Pre existing vegetation communities of northern NSW. A strip of littoral rainforest is thought to have extended along the entire coast from south of Ballina to Tweed Heads. source: Floyd, 1990

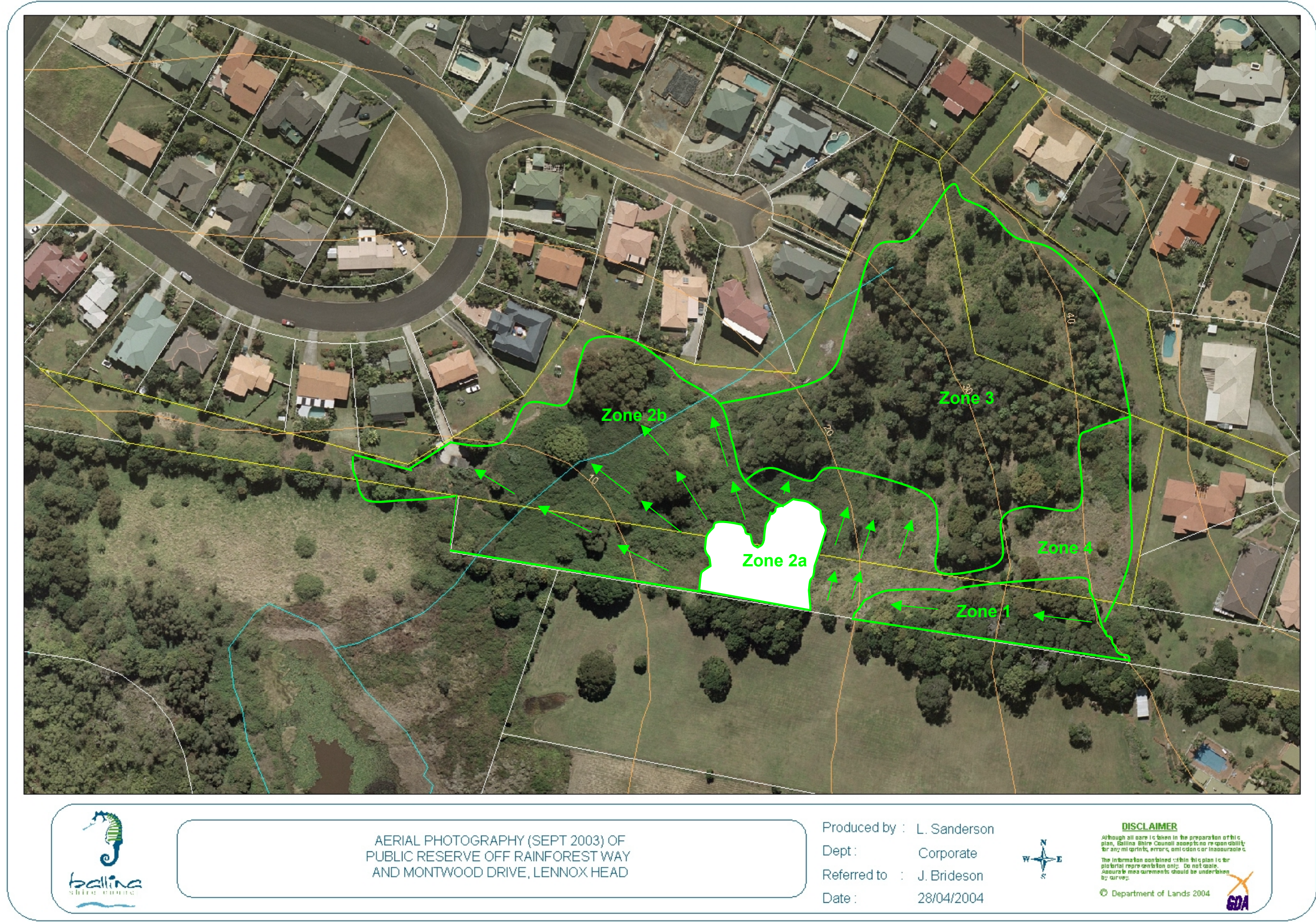


Figure 4: Map of the study site showing work sites and their associated zone numbers. (base mapping - Ballina Shire Council, 2003). Worksite areas, in green, illustrated by Julie Reid (EnvITE NSW).

4 RECOMMENDATIONS

Condition rating.

1= Weed dominated, native trees absent or dead.

2 = Weed dominated with a few emergent native trees and shrubs.

3 = Structure of forest or original vegetation type with heavy weed infestation leading to rapid decline.

4 = Structure of forest or original vegetation type with heavy weed but some natural regeneration.

5 = Structure of original vegetation type with a number of stratus, healthy but threatened by encroaching weeds.

6 = Vegetation in good order, sporadic weeds.

7 = Forest or system self sustaining, needs no assistance

Zone No Vegetation description	Condition rating (1-7)	Recommendations	Priority	Work performed by
Zone 1. Road Reserve (southern boundary of site). Disjointed Littoral Rainforest remnants consisting of regrowth approximately 40 years old. Good diversity is evident with the threatened species <i>Macadamia tetraphylla</i> (Plate 3) well represented. Dominant species <i>Guioa semiglauc</i> . Significant numbers of native seedlings are present (Plate 1). The understorey has few weeds, those present consist mainly of <i>Ochna</i> (<i>Ochna serrulata</i>), Umbrella Tree (<i>Schefflera actinophylla</i>) (Plate 2) and Cocos Palm (<i>Syagrus romanzoffianum</i>). There is good natural regeneration potential.	5	<ul style="list-style-type: none"> Communicate with neighbouring property “Montana” to enlist their cooperation. Begin work from top of hill to the east (Figure 4), in company of an experienced bush regenerator who can teach volunteers weed ID and appropriate treatments. Confine actions initially to this strip below canopy. When a large area of Lantana is encountered cut a track (about 2m wide) down Montana boundary to access the next clump of trees (Zone 2). Overspray a band of Lantana to the north of this track with Glyphosate @ 1:100 approximately 5m wide, when dead knock or trample and repeat spray for another band. Watch for expected germination of natives, remove weed seedlings when recognizable. Repeat the process heading north-west about every 3 months or as regeneration dictates. 	High High High Medium	Rainforest Way Landcare Group (RWLC) + Ballina Shire Council (BSC) RWLC + EnviTE Bush Regenerator RWLC RWLC or contractors



Plate 1: Significant numbers of seedlings are evident in the understorey of Zone 1 this indicates there is a good potential for natural regeneration.



Plate 2: The closed canopy provided by the remnants in Zone 1 ensures there are few weeds in the understorey. *Ochna serrulata* (weed) can be seen in the right, foreground.



Plate 3: *Macadamia tetraphylla* is a threatened species that is well represented in Zone 1. Threats to this species include risk of local extinction due to low numbers and the invasion of habitat by introduced weeds.

Zone No Vegetation description	Condition rating (1-7)	Recommendations	Priority	Work performed by
Zone 2. Road Reserve 2nd Remnant. A small LRF remnant separated from the eastern remnant by a wall of Lantana (Plate 4). The remnant is dominated by a medium sized Strangler Fig (Plate 5) that attracts fauna. Native animals using this tree assist in the regeneration process by introducing seed from outlying areas. There is a high diversity of local species beneath this tree with little serious weed problem (Plate 6). It is considered that these two remnants have the potential to expand naturally if weed control works are carried out.	6	<ul style="list-style-type: none"> Begin work beneath the canopy with the assistance of an experienced bush regenerator who can teach volunteers weed identification and appropriate control techniques. When the area beneath the canopy is treated move through the Lantana creating a corridor 10m wide to link to another isolated fig to the north, treat the area beneath fig. Expand the working area from this fig, cutting Lantana to include other nearby native trees. There are many native seedlings beneath the Lantana so take care when cutting and treating Lantana. Continue this process heading to the north-west in a broadening arc towards the pump station (Figure 4). Treat other weeds such as Camphor Laurel (<i>Cinnamomum camphora</i>) and Senna (<i>Senna sp.</i>) as encountered using the methods described in the Appendix 5 of this report. Ascertain the pace of the work from observations of the speed of regeneration in the initial treated areas and the ability of the group to perform follow-up maintenance on these areas. Areas that show no sign of natural regeneration after 6 months will require planting. Pioneer and secondary species should be selected from amongst the LRF species that are already present at the site (Appendix 1). 	High High High Medium	RWLC + EnviTE Bush Regenerator RWLC RWLC RWLC



Plate 4: A wall of lantana separating remnants. Looking from the Fig to Zone 3.



Plate 5: The Fig (*Ficus rubiginosa*) in Zone 2a provides habitat for native fauna assisting the regeneration process.



Plate 6: A high diversity of local species is present beneath the Fig.

Zone No Vegetation description	Condition rating (1-7)	Recommendations	Priority	Work performed by
Zone 3. Planted Eucalypt area (Plate 7). This zone has been planted by the developer prior to handing the reserve over to the community. As well as Eucalypts; Coast Banksia (<i>Banksia integrifolia</i>), Brush Box (<i>Lophostemon confertus</i>) (Plate 9) and White Bottlebrush (<i>Callistemon salignus</i>) have been planted. While these species do occur on the North Coast they would not usually be found on this soil type. Their presence in close proximity to houses increases the potential fire risk of the site (Plate 8). Some natural regeneration of rainforest species is occurring beneath the established canopy as well as the weeds Camphor Laurel, Lantana and Senna.	4	<ul style="list-style-type: none"> These trees are well established and the canopy provided is creating conditions favouring native groundcovers over weed species. Retain these trees but consider removal of low limbs (under 3m) to reduce the risk of fire. Retain injected trees (e.g. Camphor laurel) to act as bird and fruit-bat perch. Camphor laurel should be stem injected (see Appendix 4) and allowed to decay in situ. Smaller weeds such as juvenile Camphor Laurel, Senna, Umbrella tree and Lantana should be treated using cut, scrape and paint methodology as outlined in the Appendix 4 of this report. A thirty metre hazard reduction zone should be maintained between this flammable vegetation and homes (see Appendix 8). Rainforest vegetation is considered to have low flammability. 	Medium Medium Medium Medium	RWLC Contractor employed by RWLC RWLC RWLC and residents at risk



Plate 7: Looking east into Zone 3 the edge of the eucalypt planted area. Note the *Pinus elliottii* (weed) on the right.



Plate 8: The north eastern edge of the site showing proximity of vegetation to property fences.



Plate 9: An extensive stand of non endemic species planted by the developer. Brush Box to the left and Flooded Gum to the right of the photo.

Zone No	Vegetation description	Condition rating (1-7)	Recommendations	Priority	Work performed by
Zone 4.	Area dominated by exotic grasses in the south-eastern corner of the reserve (Plate 10). Topsoil has been lost from this area due to scraping or sheet erosion. The area is dominated by the exotics Red Natal Grass (<i>Melinis repens</i>) (Plate 11), Kikuyu (<i>Pennisetum clandestinum</i>) and annual weeds such as Fleabane and Ragweed. Some random natural regeneration of native pioneer species is seen. The options for this zone are to revegetate the area by planting littoral rainforest species or to landscape the area for passive recreation incorporating complimentary plant selection, a formal path and mown areas. The question of who would maintain this second option must be addressed before proceeding. Residents of adjacent homes may feel their security is compromised by increased activity .	2	<ul style="list-style-type: none"> • Communicate with residents living at the upper section of the site to evaluate their vision for the area and the level of assistance they may provide. • Work on this zone will require a high degree of commitment and a long period of follow-up, otherwise it will again revert to weeds perhaps more invasive than those currently present. • If it is decided to plant out the site, species employed should be fast growing pioneer and secondary species such as Sally Wattle (<i>Acacia melanoxylon</i>), Macaranga (<i>Macaranga tanarius</i>), Sweet Pittosporum (<i>Pittosporum undulatum</i>), White Kamala (<i>Mallotus discolor</i>) and Red Bean (<i>Dysoxylum muelleri</i>). The site should be mechanically ripped prior to planting. • If it is decided to landscape this area the Landcare Groups financial support from Envirofund will probably not be able to be used (dependant on the detail in the application). If this is the case funding should be sought from Council under Section 94. Developer Contributions. Council would also need to commit to mowing and general maintenance. 	High Medium Low	RWLC RWLC



Plate 10: View from the south eastern corner of Zone 4.

Plate 11: Grasses dominate Zone 4. The pink flowering grass in the background is Red Natal Grass (*Melinis repens*).



4.1 Vegetation Management Issues

- The opportunity for natural regeneration to occur on the site is currently restricted due to competition from weeds and a scarcity of seed dispersing trees. This necessitates weed control and, in some areas, planting of suitable native rainforest species.
- The sites will require ongoing maintenance.
- Vegetation in zones 1 and 2 has the potential for self regeneration. Plantings where deemed necessary should reflect the nature of these regenerating areas.

4.2 General Vegetation Management Recommendations

- Encourage support and keep local residents informed through public information campaign.
- Action identified to remediate zones should be undertaken systematically. Treat weeds as they are encountered using the methods described in **Appendix 4 & 5**. Once an area is treated, workers can move onto the next. It is good practice to recheck worked areas prior to commencing work at a new site. This ensures weed regrowth and other problems can be addressed immediately and follow-up maintenance is reduced.
- Maintain previously worked areas by spraying or hand weeding. Avoid creating piles of woody material as these are troublesome later, it is better to cut material and scatter. As this vegetative matter breaks down it will add to the soil organic matter content.
- When planning work at a new site consider what resources will be available for follow-up treatments. If a team is available to carry out work, confine their activities to an area that can be treated thoroughly or maintenance may become unmanageable. Discuss these limits and desired objectives openly with the team as well as the team supervisor to establish a clear picture of what needs to be undertaken; this will lead to greater mutual satisfaction as well as a more effective primary treatment.
- It is recognised that the volunteer time Landcarers have available for projects is limited. Activities should be satisfying and systematic and should include monitoring the effectiveness of treatments, and coordination of the available labour market programs and funding that are available.
- Seed of desirable species should be collected when available. Contact EnviTE to take delivery of this seed for propagation on a cost recovery basis. Alternatively a member of the group may have an interest in plant propagation.
- The introduction of species that would not naturally occur on this site is not recommended. This can be detrimental to the ecological functions of the vegetation community. Recommended local native species for plantings are detailed in **Appendix 1**.

4.3 Natural Regeneration

Adherence to the recommendations should result in the following sequence of recovery. If this sequence of events is not apparent, regeneration activities and the techniques used may need to be modified or improved.

1. Sprayed areas of weeds will yellow and die, which will open up spaces for existing native vegetation to expand and for plantings to be undertaken. Dead material should be broken up by stamping or chopping to facilitate breakdown.
2. Green trash, that has been evenly chopped and left on the ground, will break down and form a moisture retentive mulch (weeds should not be piled). Aerial vines, that have been severed and left in trees, will deteriorate, so that light penetration is slowly increased allowing plants beneath

to acclimatise to increased levels of light and salt. Don't pull vines or plant material, such as Morning Glory (*Ipomoea sp.*) or Passionfruit (*Passiflora sp.*), from trees. Cut at head height to allow maintenance access and allow the plant biomass to break down insitu.

3. Plantings are most successful in late summer and should be protected by tree guards. Ideally plant on the leeward side of vegetative barriers or, of organic waste that has been retained. As the canopy develops there will be a decrease in light penetration to the understory, germination of weeds in these areas will be retarded.

4.4 Lantana Control

Lantana is a highly invasive weed familiar to those residing on the north coast of NSW. According to Buchanan (1999) the weed occurs along the east coast from Cape York to Ulladulla on the south coast of NSW. It invades paddocks, wet and dry sclerophyll forests and rainforests in the coastal areas. The plant grows best with an annual rainfall of greater than 750mm and can grow at altitudes of up to 1300m. The limiting factors are cold, particularly frost, and decreased rainfall.

In rainforests and in wet sclerophyll forests with dense understoreys, the canes become vine-like and can climb over 20 m up the trees. Layering is one means it can spread locally (Buchanan, 1999).

The control of an individual lantana is quite easy. The most difficult part is to hack into the centre of the plant without being torn to shreds by the hooked prickles. Having achieved this feat all that regenerators in temperate regions need to do is to take out the crown the base of the plant and the start of the root system and lift the sections of stem that have layered. In warmer areas the shallow coarsely branched root system can regenerate very quickly and apparently more of the root system needs to be removed. In dense thickets, herbicide may be the only option. For Roundup®, a concentration of 1:100 sprayed in summer is recommended. Be careful about spraying lantana grows rapidly in a moist summer (ideal spraying conditions), but in those periodic droughts, the plant ceases to grow and it also sheds an enormous number of leaves. These are not good conditions for spraying and the plant may well regrow (Buchanan, 1999).

Cut lantana stems act as an effective mulch and assist in the retention of soil moisture and the suppression of weeds. This practice is best undertaken when moisture is at a minimum as cut stems may reshoot.

4.5 Revegetation of Littoral Rainforest areas.

The methods recommended in this plan are based on previous experience in Littoral Rainforest communities at nearby Broken Head. In that project we found little need to plant as our activities stimulated the remnant seedbank into germinating, when weed species were excluded. Pioneer (see Stage 2 below) plants secured the site improving conditions for the slower growing secondary and mature phase species. Floyd (1989) describes this succession as typically occurring in 4 stages.

- Stage 1: Herbs and soft-wooded shrubs, lifespan 0-2 years. Likely to include Farmers Friends (*Bidens pilosa*), Fleabane (*Conyza albida*), Stinking Roger (*Tagetes minuta*) and Paddys Lucerne (*Sida rhombifolia*). These species, while generally regarded as weeds, can actually help in conditioning the site through breaking a compacted soil profile and increasing microbiological activity.
- Stage 2: Secondary shrubs or pioneers, soft-wooded, lifespan 2-15 years. These may reach a height of 4-8 m, shading out Stage 1 species, which they resemble in the production of a large number of effectively dispersed seeds with long viability and intolerance to shade. Likely species include Wild Tobacco (*Solanum mauritianum*), Bleeding Heart (*Omolanthus populifolius*), Poison Peach (*Trema aspera*), Corkwood (*Duboisia myoperoides*), Macaranga (*Macaranga tanarius*) and Lantana (*Lantana camara*). These pioneers effectively attract frugivorous birds that will introduce and disperse a variety of seed throughout the site. Lantana should be prevented from recolonising but the other species should be tolerated until they are succeeded by stage 3 succession. Exceptions to this are when a weed species such as Wild Tobacco is growing close to and in immediate competition with a more desirable species. Shade established by these species will begin to exclude stage 1 regrowth.
- Stage 3: Short-lived trees, early secondary trees. Lifespan 15-50 years. These may reach 10-25m and are capable of very fast growth. The seeds have very long viability, are well dispersed by birds or wind and are intolerant of shade. They take over from the pioneer species of stage 2. Species that are likely to arise include Guoia (*Guoia semiglauc*), Native Guava (*Rhodomyrtus psidioides*), Celery Wood (*Polyscias elegans*) and Brown Kurrajong (*Commersonia bartramia*). Stage 4 seedlings should begin to occur amongst the understorey of stage 3.
- Stage 4: Mature stage, long-lived trees more than 100 years lifespan. These trees (where not sheared by wind) are capable of reaching 20-35 m in height and are typically slow growing and shade tolerant. They seed irregularly, and seed often has a short viability of a few weeks only. Typical littoral trees of this phase are Tuckeroo (*Cupaniopsis anacardioides*), 3-veined Laurel (*Cryptocarya triplinervis*), Yellow Pear-fruit (*Mischocarpus pyriiformis*), and Riberry (*Syzygium leuhmannii*).

Those undertaking this project should be prepared for a process of up to 10 years before the recommended works become self-sustaining. Maintenance of each area as it is initially “opened up” will be intense as the seed bank is stimulated, this decreases significantly as a succession of desirable plants establish on the site.

4.5.1 Methods of stimulating natural regeneration

- Removal of competitive weeds and grasses (carried out and maintained prior to the growing season).
- Light soil disturbance such as the pulling up of lantana roots (not on slopes) to stimulate dormant seed. Heavily compacted soils may respond to a higher degree of disturbance such as running a rotary hoe through the area.
- Foot traffic and regeneration activity around the roots of some species will encourage suckering. eg. Native Guava (*Rhodomyrtus psioides*).
- Retention of injected trees (e.g. Camphor laurel) to act as bird and fruit-bat perch.
- Provision of water assists frugivores in regurgitation of seed. In areas of high potential it may be worth lining some natural depressions with plastic to retain rain and create water holes. This source of water could also be handy when planting trees.
- Bark mulche and chopped up weed mass will stimulate micro-organisms and mycorrhizal fungi that may be required to overcome germination inhibitors.
- Intensive maintenance through the early part of the project to deplete the weed seed store.
- Retain some fruiting weeds such as Wild Tobacco to entice frugivores to the site.

5 OTHER ISSUES

5.1. Fauna

Snakes, ticks, ants, mosquitoes and chiggers (the larval mites that cause “scrub itch”) can potentially cause discomfort, disease and serious illness. The best way to avoid complications is to minimise the risk of bites. Always wear protective clothing i.e. long sleeves and trousers tucked into sturdy boots, socks and a hat. Apply repellent (particularly one containing pyrethrins / DEET / triclosan antiseptics) to skin and clothing, and always take repellent and a comprehensive first aid kit into the field. (Lignocaine gel can give localised relief from bites). Ticks should be killed before removal, as the shock of physical removal can stimulate them to release more of the toxin into their host.

A detailed up to date fauna list should be compiled to be able to implement an effective rehabilitation plan that is complimentary to the requirements of fauna species in the area. Quantitative data is required that will record the abundance of the species of fauna sighted

Black-necked Storks, a threatened species, frequent swamps, mangroves and mudflats. The wetland to the south of the study site has the potential to provide habitat for the stork. Conservation actions would include the retention and protection of native vegetation adjoining wetlands especially tall trees both dead and living.

Birds of open areas such as the Currawong and Magpie will decrease in numbers as vegetation regenerates and canopies close. Birds such as Rose-crowned Fruit Dove have specific habitat requirements like closed forests and fleshy fruit bearing trees. A variety of vegetation communities are essential to maximise habitat availability.

Extension and enhancement of the littoral rainforest would provide habitat for threatened fruit eating species such as the Superb Fruit-dove (*Ptilinopus superbus*) and Rose-crowned Fruit-dove (*Ptilinopus regina*). Threatened nectar eating fauna that would benefit from habitat extension of all vegetation types include the Regent Honeyeater (*Xanthomyza phrygia*) and Common Blossom-bat (*Syconycteris australis*). The Grey-headed Flying Fox (*Pteropus poliocephalus*) and the Black Flying-fox (*Pteropus alecto*) survive on a diet of fruit and nectar and aid the spread of seeds and pollination of native flowers. The presence of these vulnerable species will aid natural regeneration.



An Eastern Blue –Tongued lizard (*Tiliqua scincoides*) is found in a variety of habitats. The lizard is a diurnal (day time), ground-dwelling lizard, it feeds on a variety of insects, snails, carrion and wildflowers, native fruits and berries. The lizard shelters at night in hollow logs, ground debris etc (Cogger, 1994).

5.2 Rubbish Dumping

Dumping of rubbish and garden waste is a problem in most natural areas. It is also one of the main ways that exotic plants are introduced into the vegetation remnants. Explanatory signage and personal communication with anyone observed dumping may discourage the practice. Always remove rubbish that is found at work sites.

Articles relating to natural regeneration and the impact of garden waste on the environment (including specific invasive plants) should be submitted for publications in local newspapers and newsletters if applicable.

5.3 Fire

When undertaking bush regeneration works in proximity to dwellings, consideration needs to be given to the potential threat of bushfire. The Asset Protection Zone (APZ) designed to provide a buffer zone between vegetation and dwellings is essential when planning work. The standard APZ zone is 30m from the base of the house. This is the required distance for Bush Fire Vegetation Category 2. According to Brideson *pers com* (2004), planting can occur in the APZ as long as there is not a continuous canopy.

A specific list of recommendations with variations for fire protection follows:

*Lot 51 DP805209: for the dwellings facing downslope approx 10-15 degrees, (particularly 11,13 and 8 The Crest and 11-15 Montwood Drive) an asset protection zone (APZ) of 40meters.

*Lot 126 DP 828137: for the dwellings facing downslope such as 17 Montwood an APZ of 40 meters would be appropriate. For the houses 4-8 Clement Place with an approximate slope of 5-10 degrees downslope, an APZ of at least 30meters is required. From 27 to 35 Rainforest Way with a slope approx 0-5 degrees an APZ of 25meters would be appropriate.

All APZs should be measured from the base of the dwellings and comply with the document "Guidelines for Asset Protection Zones" (**Appendix 8**) or section 4.2.2b Inner Protection Areas of Planning for Bushfire Protection 2001 (both can be found at www.rfs.nsw.gov.au). Most APZs are partially in place on the private land side and the residual portion would be required to extend into the reserves.

When installing the Zones, the Landcare group should be guided by the following pattern of clearing:

- * Removal of noxious and environmental weeds first
- * Removal of highly flammable species next
- * Removal of trees and shrubs less than 3 meters in height
- * Removal of significant native species last.

(Laurence, 2004)

5.4 General Management Recommendations

- Rainforest Way Landcare Group and Ballina Shire Council should continue to apply for assistance from organisations such as EnviTE, Conservation Volunteers Australia and/or Green Corps. However, care should be taken to allocate tasks to volunteers that are appropriate to the participant's level of skill.
- Frequent liaison with Ballina Shire Council should also be maintained so that Council management and staff are familiar with the progress of works at Rainforest Way and to enable the provision of council assistance where possible. Matters to be considered include improved communication regarding action to be taken such as lopping, spraying etc
- A brochure or flyer circulated to residents and the local schools may encourage increased volunteer participation. Information could also be disseminated to assist identification and discourage the planting of environmental weeds in local gardens.
- Training should be made available for Landcare Group members and community in the best practise environmental weed control and techniques for facilitating natural regeneration. Richmond Landcare Inc. provides regular training for Landcare groups undertaking bush regeneration works.
- Making contact with Richmond Landcare Inc. will facilitate access to specialised weed eradication tools and equipment.

5.4 Monitoring

It is important to monitor the project with “before and after” photographs. This provides a record of progress that will prove useful when applying for further funding. Photographs help to identify successful regeneration techniques, as well as providing a base for comparison to reassure volunteers that their work has been effective. The ongoing impact of rehabilitation works is best monitored when specific photo points are established during the initial stages of the project and these photo points should be repeatedly used.

Photo points should be identified with a permanent marker (on an easily located stake or picket) and images taken at the same site from the same direction. This can be established by referring to past photographs prior to undertaking another shoot. Photographic records should be collected at least seasonally (i.e. three to six monthly) and after major events, such as intensive plantings, storms or fires. Ensure all photos are labeled with the date and site details.

Records of working bees including; attendance, activities undertaken, weather constraints, successes and failures etc. are also invaluable monitoring tools. An example of a work record sheet is included as **Appendix 7**.

Another important aspect of monitoring is maintaining species lists. The flora and weed lists in this plan (**Appendices 1 and 2**) should be continually updated as new species are identified. It is also useful to establish a fauna species list for the site, particularly as the site has the potential to provide habitat for threatened species. The Northern Rivers Wildlife Carers Inc. and the Department of Environment and Conservation can assist with the compilation of fauna lists by naming fauna that is known to frequent the area.

6. CONCLUSION

The Rainforest Way site contains limited ecological diversity but with ongoing regeneration work the recommended restoration project can enhance and increase the biodiversity of the study area. If degradation is halted and ongoing regeneration is continued, a valuable scientific and educational resource will be reestablished. There are many reasons for doing this work, including conservation of native plant species and forest type, improved habitat for wildlife thus increasing biodiversity, reduction of erosional processes, and general public amenity.

This will be a long-term process, involving intensive weed control and some replanting in the early stages, followed by less intense but regular monitoring and follow up treatment on a permanent basis. Environmental restoration can be very satisfying and the community/team interaction is renowned for forming long, trusting associations between individuals.

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8. RECOMMENDED RESOURCES

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APPENDIX 1: Native Plant Species List (May, 2004)

* = Likely to have been planted.

Trees and Shrubs

Zones of occurrence

Family	Scientific name	Common name	1.	2a.	2b.	3.	4.
Mimosaceae	<i>Acacia melanoxylon</i>	Sally Wattle	*	*	*	*	
Mimosaceae	<i>Acacia sophorae</i>	Coastal Wattle	*			*	
Myrtaceae	<i>Acmena hemilampra</i>	Broad-leaved Lilly Pilly		*			
Arecaceae	<i>Archontophoenix cunninghamiana</i>	Bangalow Palm		*			
Sapindaceae	<i>Arytera divaricata</i>	Coogera		*			
Proteaceae	<i>Banksia integrifolia</i>	Coast Banksia	*	*	*	*	*
Euphorbiaceae	<i>Breynia oblongifolia</i>	Breynia	*	*		*	
Myrtaceae	<i>Callistemon salignus</i> *	White Bottlebrush				*	
Verbenaceae	<i>Clerodendrum floribundum</i>	Smooth Clerodendrum		*			
Agavaceae	<i>Cordyline stricta</i>	Narrow-Leaved Palm Lily	*				
Lauraceae	<i>Cryptocarya triplinervis</i>	Three-Veined Laurel	*	*			
Sapindaceae	<i>Cupaniopsis anacardioides</i>	Tuckeroo	*	*	*	*	
Meliaceae	<i>Dysoxylum fraserianum</i>	Rosewood		*			
Myrtaceae	<i>Eucalyptus grandis</i>	Flooded Gum				*	
Myrtaceae	<i>Eucalyptus robusta</i>	Swamp Mahogany			*	*	
Myrtaceae	<i>Eucalyptus siderophloia</i>	Ironbark			*	*	
Santalaceae	<i>Exocarpos latifolius</i>	Broad-Leaved Ballart		*			
Moraceae	<i>Ficus rubiginosa</i>	Rusty Fig		*			
Moraceae	<i>Ficus watkinsiana</i>	Strangler Fig		*			
Rutaceae	<i>Flindersia schottiana</i>	Cudgerie		*			
Euphorbiaceae	<i>Glochidion sumatranum</i>	Umbrella Cheese Tree	*	*	*		
Sapindaceae	<i>Guioa semiglauc</i>	Guioa	*	*		*	
Celastraceae	<i>Hedraianthera porphyropetala</i>	Hedraianthera	*	*			
Sapindaceae	<i>Jagera pseudorhus</i>	Foambark	*	*			
Myrtaceae	<i>Lophostemon confertus</i> *	Brush Box			*	*	
Proteaceae	<i>Macadamia tetraphylla</i>	Macadamia	*	*			

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Trees and Shrubs

Zones of occurrence

Family	Scientific name	Common name	1.	2a.	2b.	3.	4.
Euphorbiaceae	<i>Macaranga tanarius</i>	Macaranga	*	*	*		
Euphorbiaceae	<i>Mallotus discolor</i>	White Kamala	*	*			
Euphorbiaceae	<i>Mallotus philippensis</i>	Red Kamala	*	*	*	*	
Sapindaceae	<i>Mischocarpus pyriformis</i>	Yellow Pear-Fruit	*				
Lauraceae	<i>Neolitsea australiensis</i>	Green Bolly Gum		*		*	
Oleaceae	<i>Olea paniculata</i>	Native Olive		*			
Pittosporaceae	<i>Pittosporum undulatum</i>	Sweet Pittosporum	*		*	*	*
Rubiaceae	<i>Psychotria loniceroides</i>	Hairy Psychotria		*			
Myrsinaceae	<i>Rapanea howittiana</i>	Brush Muttonwood	*				
Myrsinaceae	<i>Rapanea variabilis</i>	Variable Muttonwood	*				
Meliaceae	<i>Synoum glandulosum</i>	Scentless Rosewood	*				
Myrtaceae	<i>Syzygium leuhmanii</i>	Riberry		*			
Thymeliaceae	<i>Wikstroemia indica</i>	Bushmans Bootlace	*		*	*	*
Monimiaceae	<i>Wilkiea austroqueenslandica</i>	Smooth Wilkiea	*	*			

Grasses and Groundcovers

Zones of occurrence

Family	Scientific name	Common name	1.	2a.	2b.	3.	4.
Adiantaceae	<i>Adiantum hispidulum</i>	Rough Maidenhair Fern	*	*		*	
Apiaceae	<i>Centella asiatica</i>	Gotu Kola	*	*		*	
Commelinaceae	<i>Commelina cyanea</i>	Native Wandering Jew	*	*			
Aspidiaceae	<i>Lastreopsis marginans</i>	Glossy Shield Fern				*	
Poaceae	<i>Oplismenus aemulis</i>	Basket Grass	*	*			
Dennstaedtiaceae	<i>Pteridium esculentum</i>	Bracken Fern				*	*
Poaceae	<i>Themeda triandra</i>	Kangaroo Grass	*			*	*
Violaceae	<i>Viola hederaceae</i>	Native Violet	*	*		*	

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Climbers

Zones of occurrence

Family	Scientific name	Common name	1.	2a.	2b.	3.	4.
Aristolochiaceae	<i>Aristolochia praevenosa</i>	Aristolochia		*			
Vitaceae	<i>Cissus antarctica</i>	Water Vine	*	*	*		
Fabaceae	<i>Derris involuta</i>	Native Derris	*			*	
Philesiaceae	<i>Geitonoplesium cymosum</i>	Scrambling Lily	*				
Dilleniaceae	<i>Hibbertia scandens</i>	Twining Guinea Flower		*			
Moraceae	<i>Maclura cochinchinensis</i>	Cockspur		*		*	
Passifloraceae	<i>Passiflora herbertiana</i>	Native Passionfruit		*			
Smilacaceae	<i>Smilax australis</i>	Native Sarsaparilla	*	*	*	*	*

APPENDIX 2: Weed Species List

Family	Scientific name	Common name	1.	2a.	2b.	3.	4.
Asteraceae	<i>Ageratina adenophora</i>	Crofton Weed			*	*	*
Asteraceae	<i>Ageratina riparia</i>	Mist Weed	*		*	*	*
Asteraceae	<i>Ambrosia artemisiifolia</i>	Rag Weed			*	*	*
Arecaceae	<i>Arecastrum romanzoffianum</i>	Cocos Palm	*	*		*	
Asparagaceae	<i>Asparagus aethiopicus</i>	Ground Asparagus	*				
Asteraceae	<i>Bidens pilosa</i>	Farmers Friends			*	*	*
Asteraceae	<i>Chrysanthemoides monilifera</i> ssp. <i>rotundata</i>	Bitou Bush				*	
Lauraceae	<i>Cinnamomum camphora</i>	Camphor Laurel	*	*	*	*	*
Myrtaceae	<i>Eucalyptus torrelliana</i>	Cadagi	*				
Myrtaceae	<i>Eugenia uniflora</i>	Surinam Cherry		*			
Convolvulaceae	<i>Ipomoea cairica</i>	Coastal Morning Glory	*	*	*	*	
Verbenaceae	<i>Lantana camara</i>	Lantana	*			*	*
Fabaceae	<i>Macroptilium atropurpureum</i>	Seratro			*		*
Poaceae	<i>Melinis repens</i>	Red Natal Grass	*			*	*
Rutaceae	<i>Murraya paniculata</i>	Murraya	*	*			
Ochnaceae	<i>Ochna serrulata</i>	Mickey Mouse Bush	*	*		*	
Passifloraceae	<i>Passiflora suberosa</i>	Corky Passionfruit	*				
Passifloraceae	<i>Passiflora subpeltata</i>	White Passionfruit	*	*			
Poaceae	<i>Pennisetum clandestinum</i>	Kikuyu				*	*
Pinaceae	<i>Pinus elliottii</i>	Slash Pine				*	
Myrtaceae	<i>Psidium guajava</i>	Guava	*		*	*	
Rosaceae	<i>Rhaphiolepis umbellata</i>	Indian Hawthorn	*				
Euphorbiaceae	<i>Ricinus communis</i>	Castor Oil Plant			*	*	
Araliaceae	<i>Schefflera actinophylla</i>	Umbrella Tree	*	*	*	*	
Caesalpinaceae	<i>Senna pendula</i> var. <i>glabrata</i>	Easter Senna	*	*	*	*	*
Solanaceae	<i>Solanum mauritanium</i>	Wild Tobacco	*		*	*	

APPENDIX 3: Weed Profiles

TREES AND SHRUBS

Araliaceae

Schefflera actinophylla

Umbrella Tree

Native of North Queensland and naturalized in coastal districts of northern NSW. A tree to ten metres high, often multi-stemmed and sometimes epiphytic on rainforest trees (Harden, 1992), making removal difficult. Birds disperse its red fruit. Adventitious roots form readily from stem segments that remain in contact with the ground.

Areaceae

Syagrus romanzoffianum

Cocos Palm

Native of Brazil. A tall palm growing to 12 metres. Its fleshy fruit is dispersed by birds, rodents and water. Fruit is also eaten and dispersed by flying foxes (Eby and Palmer, 1988). It is becoming a serious pest in Currie Park and Rotary Park, Lismore, NSW.

Asteraceae

Chrysanthemoides monilifera subsp. *rotundata*

Bitou Bush

Native of South Africa. An erect, shallow-rooted, densely branched perennial shrub up to three metres high (Auld and Medd, 1992). It grows on sand dunes and forest margins near beaches and poses a serious threat to native sand dune vegetation (Harden, 1992). These plants can invade and overwhelm all plant communities on the coastal system, growing in the open or in the shade of other plants. Up to 48,000 seeds per plant can be produced with a viability of up to seven years. Fruits are attractive to birds (Buchanan, 1989). There is increasing evidence that long-term domination of coastal frontal dunes by Bitou Bush leads to instability and increased erosion (Stanley et. al., 1989). It is a declared W3 noxious weed (i.e. must be prevented from spreading and its numbers reduced).

Euphorbiaceae

Ricinus communis

Castor Oil Plant

Native of Asia and Africa. A large perennial shrub up to 3 metres high. It has burr-like fruits containing 3 seeds which are dispersed by the exploding fruit as it ripens. Its seeds are toxic to stock and humans. It is abundant along creek banks and creek beds (Auld and Medd 1992).

Fabaceae

Senna pendula var. *glabrata*

Winter Senna

Native of South America. A spreading shrub to three metres high, it does not produce root nodules and is widely naturalized in coastal areas (Harden, 1991.). It produces a large number of seeds, which appear to have a long viability, possibly for years. Can regenerate from cut material in moist conditions.

Lauraceae

Cinnamomum camphora

Camphor Laurel

Native of China and Japan. A large tree of spreading habit that can grow to approximately 25-30 metres. It has abundant seed production, effective dispersal mechanism, mainly by birds, and some seed dormancy. It is a hardy, long-living competitive tree which can also reproduce rapidly by suckering to form single species stands. Camphor Laurel prefers deep, well-drained red soil but will grow well on alluvial soil; it cannot, however, tolerate prolonged flooding (Firth, 1992, p.69). It is extensively naturalized in coastal areas on the North Coast of NSW (Harden, 1990). It is a declared W4(d) noxious weed (i.e. must not be sold, propagated or knowingly distributed and must be fully and continuously suppressed and destroyed).

Myrtaceae

Eugenia uniflora

Surinam Cherry/Brazilian Cherry

Native of Brazil. A broad, compact shrub with deep green, glossy foliage with rich wine-coloured new growth. Crushed leaves have a pungent, agreeable odour. Fruit is 2.5 cm. in diameter, deep crimson, fleshy and readily dispersed by birds (Popenoe, 1974).

Eucalyptus torrelliana

Cadaghi

Tall fast growing eucalypt found north of Townsville. Trees cross pollinate with endemic species creating hybrids.

Psidium guajava

Guava

A shrub or small tree up to 6 metres high (Harden, 1991). Its fleshy berries are attractive to birds which disperse the seed. It is resistant to glyphosate.

Ochnaceae

Ochna serrulata

Mickey Mouse Bush

Shrub two to three metres high. Leaves oblong to narrow elliptic, margins toothed. Ovoid drupes, five to eight millimetres long, black and embedded on a swollen red receptacle. The shrub is often cultivated. Native of South Africa

Pinaceae

Pinus elliottii

Slash Pine

A tall tree with ascending branches high on the trunk; the bark is reddish, shedding in thin scales. The tree is native to SE USA to Central America and the West Indies. (Harden, 1990–1993). Needle like leaves create a thick sterile layer beneath the tree.

Roseaceae

Rhaphiolepos indica

Indian Hawthorn

A native of Asia. An evergreen shrub which can grow to 1-1.5 metres, it flowers in spring and bears a bluish drupe-like pome which is dispersed by birds (Harden, 1990).

Rutaceae

Murraya paniculata

Murraya/Orange Jessamine

Native of India and Melanesia. A bushy shrub or small tree to 4 metres high. The red shiny berries are dispersed by birds and this plant is already naturalising in dry and subtropical rainforest on alluvial soil.

Solanaceae

Solanum mauritianum

Wild Tobacco

A shrub or small tree up to 4 metres high, widely naturalized in rainforest regrowth (Harden, 1992, 359). Its fruit are dispersed by birds. In areas of higher light levels it can form thick stands displacing native species by competing for water, space and nutrients.

Verbenaceae

Lantana camara

Lantana

Native of tropical South America. A scrambling shrub that often forms dense thickets (Harden, 1992, p.614) and can climb over 20 metres into trees. It grows best on well-drained, fertile soils including nutrient-enriched sands, roots also develop on branches which contact the ground, aiding its spread. It produces abundant seed, which is effectively dispersed by birds. According to Richard Lamb of Sydney University, when Lantana is present, particularly in sclerophyll communities, litter fall and nutrient turnover is altered, populations of native seeds are depleted, new seedlings are suppressed, soil structure is altered and micro-climate is changed, and some nutrients may be mobilized and lost to neighboring communities and others accumulated in unnatural amounts. These changed conditions seem to further favour Lantana and other weeds over native species (Buchanan, 1999) and in many forest areas can block secondary succession. It is a declared W3 noxious weed (i.e. must be prevented from spreading and its numbers reduced).

VINES AND SCRAMBLERS

Asparagaceae

Asparagus aethiopicus

Ground Asparagus

Native of South Africa. A shrub with sprawling stems up to two metres long, it is extensively naturalized in coastal districts and is a serious weed of bushland (Harden, 1993). It will form a total ground cover thereby preventing any germination of native species and inhibiting those that are present. It is a prolific seeder, making eradication difficult.



Convolvulaceae

Ipomoea cairica

Coastal Morning Glory

Native of tropical Africa and Asia. A vine that can smother trees and whose stolons can penetrate and establish several metres into native vegetation. It produces viable seed and is observed to be adapted to a range of soils, from sand to swampy areas, and can establish in relatively undisturbed rainforest and rainforest ecotones.

Fabaceae

Macroptilium atropurpureum

Siratro

Decumbent or climbing perennial, stems two to three metres long, pubescent. Leaves three-foliolate two to seven centimetres long, lower surface densely whitish pubescent. Pods linear, four to ten centimetres long, pubescent. Native of Central and North America (Harden, 1991).

Passifloraceae

Passiflora. suberosa

Corky Passionfruit

Native of S. America. A slender vine with corky stems occasionally naturalized in disturbed rainforest in warmer areas (Harden, 1990). Its foliage cover inhibits photosynthesis of supporting plants, which can also be damaged by its weight. Its seed is dispersed by birds and animals.

Passiflora subpeltata

White Passionflower

Native of Brazil. A climber which is a widespread weed along the coast on margins of rainforest and moist gullies (Harden, 1990). Its foliage cover inhibits photosynthesis of supporting plants, which can also be damaged by its weight. Its seed is dispersed by birds and animals.

HERBS, FERNS AND GRASSES

Asteraceae

Ageratina adenophora

Crofton Weed

Native of Mexico. Erect, perennial, branched herb up to 1-2 metres high, growing in disturbed moist sites on fertile soils (Harden, 1992). Its seeds are dispersed mainly by wind, it can form a dense cover inhibiting and sometimes preventing natural native regeneration. A declared Category 3 noxious weed in the Far North Coast of N.S.W. (W3 - weed must be prevented from spreading and its numbers and distribution reduced).

Ageratina riparia

Mistflower

Native of Mexico. Erect, perennial, sometimes decumbent herb, 0.3-1 metres high. Grows in disturbed damp sites, often in or near rainforests (Harden, 1992). Its seeds are dispersed mainly by wind, and vegetative fragments can carry downstream. It can form a dense cover, inhibiting and sometimes preventing natural native regeneration. A declared Category 3 noxious weed in the Far North Coast of N.S.W. (see *a. adenophora*).

Ambrosia artemisiifolia

Ragweed

Native of N. America. An annual herb to 2 metres high, a weed of roadsides and wastelands (Harden, 1992).

Bidens pilosa

Farmers Friends

One of four similar species occurring in NSW and native of the Americas. The plant is an erect annual herb that produces dark slender seeds with barbed spines. Farmers Friends, also known as Cobbler's Pegs, are weeds of disturbed areas, roadsides and wastelands. The seeds cling to clothing. (Auld and Medd, 1999)

Poaceae

Melinis repens

Red Natal Grass

A native of South America the grass is a perennial or annual with erect slender stems up to 1m high. Flowers are a panicle of silvery white to pink or purple silky, hairy spikelet. *M. repens* is a widespread roadside and railway embankment weed, particularly in coastal NSW and Qld. (Auld & Medd, 1999)

Pennisetum clandestinum

Kikuyu

A native of Africa. A creeping perennial grass with very long, robust stolons and rhizomes forming a mat. Kikuyu is used widely as a lawn grass and is a common pasture grass in coastal subtropical Australia.

APPENDIX 4: Weed Treatment Methods

1. **“Cut-scrape-paint”**: this method applies to all woody shrubs, trees and some vines.

- (a) Cut plant low to the ground at an angle.
- (b) Apply Glyphosate immediately at the rate of 1 part Glyphosate: 1.5 parts water, with a paintbrush approximately 1.5 centimetres wide.
- (c) Scrape sides lightly to reveal green tissue and apply the herbicide to the scraped area.
- (d) Take care that the brush is not contaminated with soil.

Note: all seed that has high viability and longevity, e.g. *Senna* spp. and other members of the Fabaceae family, or plants with a high invasive potential, such as *Schefflera actinophylla*, must be removed from the parent and either composted on site or removed from the site.

2. **“Gouge-paint”**: this method applies to those plant species that have a fleshy root system, such as rhizomes or large bulbs. It is particularly appropriate for the treatment of *Asparagus* spp. (*Asparagus*).

- (a) Gouge out sections of the fleshy base with a knife (if using on *Asparagus*, first cut the stems at shoulder height and also at the base).
- (b) Apply 1 part Glyphosate: 1.5 parts water immediately, with a paint brush approximately 1.5 centimetres wide.

3. **“Stem Injection”**: this method applies to all woody trees and shrubs with a diameter of about six to ten centimetres or greater.

- (a) With a tomahawk, make a cut the width of the blade, at a slight angle, into the trunk. **Note:** it is important not to make cuts too deep.
- (b) Apply herbicide immediately into the cut using a tree-injecting device (if using Glyphosate, apply at the rate of 1 part Glyphosate: 1.5 parts water).
- (c) Repeat this procedure in a brickwork pattern around the circumference of the tree, as close to the ground as possible. Where the presence of a crotch angle makes this difficult, make a cut above it. **Note:** two rows of cuts will be sufficient for trees with trunks of six to ten centimetres; larger trunk diameters will need correspondingly more.
- (d) Treat all visible lateral roots as per (a).

4. **“Scrape-ditch-paint”**: this method is applicable to many species of vines where it is desirable to treat the vines intact, particularly those with aerial tubers such as *Anredera corifolia* (Madeira Vine) or those which will propagate from segments, e.g. *Delairia odorata* (Cape Ivy).

- (a) Scrape the stem tissue on one side of the stem only for at least 20-30 centimetres if possible. **Note:** on Madeira Vine, it is necessary to scrape heavily. Scrape as many sections of the stem as possible.
- (b) Apply undiluted Glyphosate with a paintbrush.
- (c) On stems that are thicker or horizontal, make a ditch into the stem with a knife and apply herbicide. Tubers and side roots should be treated the same way. **Note:** care must be taken not to sever the stem.

5. **“Spraying”**: this is carried out using a 15 litre backpack spray unit with a modified spray nozzle that gives a solid spray pattern. Glyphosate is the main herbicide used with the addition of a marker dye. For plants that show some

resistance (e.g. Madeira Vine) or where growing conditions are not optimal, an acidifying agent, LI700®, is added. Metsulfuron can also be used for resistant species and grasses. It should be used with a surfactant, such as Agral®.

Note: where both Glyphosate and Metsulfuron are recommended for a species, it may be possible to use a commercially available compound of these two herbicides. This approach is currently under trial and is not suitable for operators unskilled in precision spraying

Note: dilution rates for Glyphosate and Metsulfuron are in accordance with the manufacturer's recommendations and any variation requires a permit from the National Registration Authority.

Dilution Rates (Glyphosate: water):

- Plants with more or less succulent leaves, e.g. *Tradescantia fluminensis*, *Anredera cordifolia* (autumn to winter is the suggested time for spraying these plants), *Chlorophytum* spp. etc.
1 part Glyphosate: 50 parts water + LI700® 0.5%
- *Lantana camara*
1 part Glyphosate: 100 parts water
- Other soft-leaved plants, annuals and grasses
1 part Glyphosate: 100 parts water
- *Chrysanthemoides monilifera* subsp. *rotundata*
1 part Glyphosate: 150 parts water to 1 part Glyphosate: 400 parts water

Dilution Rates (Metsulfuron: water):

- 1.5g Metsulfuron: 10 litres water + 20 millilitres Agral®: 10 litres water

6. **“Overspray”:** this method is applicable to large, dense infestations of such plants as *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush) and *Lantana camara* (Lantana), where it is desirable to leave the dead plants intact to prevent erosion and over-exposure of large areas, protect native seedlings from predators such as wallabies, and avoid trampling by humans.

- (a) Spray over the top of the infestation, using a weak solution of Glyphosate.
Note: any native plants that may be under the weed will be protected by the foliage cover of the weed.
- (b) Leave the sprayed plants intact so that native seedlings can establish under the shelter provided.

Note: Lantana – 1 part Glyphosate: 100 parts water

Bitou Bush – 1 part Glyphosate: 150 parts water to 1 part Glyphosate: 400 parts water

Alternatively: weeds can be cut and flattened with bush-hooks or loppers and the subsequent regrowth sprayed with Glyphosate.

Note: in many cases it is preferable to overspray wherever practicable as this will cause less erosion and trampling of suppressed native plants, such as ferns and seedlings. However, handwork will be necessary to “cut-scrape-paint” any unsprayed Bitou Bush or Lantana that surrounds native plants.

7. **“Crowning”:** this method is applicable to weeds which have their growing points below the surface of the ground (corms, bulbs, rhizomes, clumped or fibrous root systems, etc. e.g. *Asparagus* spp., *Chlorophytum comosum* and grasses).

- (a) Grasp the leaves or stems and hold them tightly so that the base of the plant is visible. Plants with sharp leaves or stems should be cut back first.
- (b) Insert the knife close to the base of the plant at a slight angle, with the tip well under the root system.

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- (c) Cut through the roots close to the base. Depending on the size of the plant, two or more cuts may be needed to sever all the roots.
- (d) Remove the plant. Make sure that the base of the plant where the roots begin is completely removed.

Source: Adapted from Joseph, R., 2001. *Course Notes from Certificate II in Bushland Regeneration*. TAFE, Wollongbar.

APPENDIX 5: Specific treatment methods for the weeds.

Note: Ratios for Application of Herbicide

Dilution ratios for application of a mix of herbicide (Glyphosate based such as Round Up®) and water are provided. For example, 1:50 means that one part by volume of herbicide is mixed with fifty parts by volume of water. All cut, scrap and paint at 1:1.5 refers to Glyphosate.

For some weeds a combination of Glyphosate and Metsulfuron is recommended, however a permit will be required for this off label usage.

Protec® and other similar products are added in some treatments to assist the transfer of the herbicide through the surface tissue – particularly plants with waxy leaves, such as Camphor Laurel, Madeira Vine and Wandering Jew.

For more detail on control method techniques refer to specific treatment methods for weeds below

Trees and Shrubs

Scientific Name	Common Name	Control Method
<i>Baccharis halimifolia</i>	Groundsel	Cut, scrape and paint 1:1 glyphosate
<i>Chrysanthemoides monilifera</i> spp. <i>Rotundata</i>	Bitou Bush	Hand pull young seedlings and hang up, cut & paint 1:1.5 small plants. Over spray mature plants if no risk to native seedlings, glyphosate 1:200
<i>Cinnamomum camphora</i>	Camphor Laurel	Cut, scrape and paint 1:1 glyphosate
<i>Lantana camara</i>	Lantana	Lop and cut, scrape and paint base 1:1.5 . Spray regrowth glyphosate 1:100 + Protec®
<i>Leptospermum laevigatum</i>	Coast Tea Tree	Cut close to the ground and bag seed.
<i>Ochna serrulata</i>	Ochna	Cut, scrape and paint 1:1.5 . Spray seedlings glyphosate 1:50 + Protec® Difficult to pull will regrow from broken root. Paint stem on larger specimens with neat glyphosate to a height of 50 cm
<i>Schefflera actinophylla</i>	Umbrella Tree	Hand pull seedlings and bag. Cut, scrape and paint or stem inject 1:1.5 . Cut sections, can regrow if left on the ground
<i>Senna pendula</i> var. <i>glabrata</i>	Winter Senna	Hand pull young plants or spray seedlings glyphosate 1:50 + Protec® Cut, scrape and paint 1:1.5 . Stem inject large specimens 1:1.5 , bag seeds

Vines and Scramblers

<i>Anredera cordifolia</i>	Madeira Vine	Scrape as much stem as possible (on one side) and paint with 100% glyphosate, tubers: scrape/gouge and paint (100%); spray ground infestations 1:50 + Protec® . Bag tubers. Do not cut the stem.
<i>Gloriosa superba</i>	Glory Lily	Difficult to control, spray foliage glyphosate (1:50 + Protec® + mef sulfuron (1 gram: 10L) in spring when plants are small – September/October. Follow-up required.
<i>Ipomoea cairica</i>	Coastal Morning Glory	Hand pull, cut scrape and paint 1:1.5 . Roll up vines, spray glyphosate 1:100 + Protec®
<i>Ipomoea indica</i>	Blue Morning Glory	Hand pull, cut scrape and paint 1:1.5 . Roll up vines, spray glyphosate 1:100 + Protec®
<i>Macroptilium atropurpureum</i>	Siratro	Cut, scrape and paint 1:1 glyphosate or spray 1:50 Protec
<i>Oenothera drummondii</i>	Beach Primrose	Hand remove or spray glyphosate 1:100

Herbs, Ferns and Grasses

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Scientific Name	Common Name	Control Method
<i>Asparagus aethiopicus</i>	Ground Asparagus	Crown out small infestations or spray Metsulfuron 1.5g/10L with Protec® 20ml/10L
<i>Chloris gayana</i>	Rhodes Grass	Spray glyphosate 1:100 or if amongst desirable grasses apply glyphosate at 1:1 with weed wand
<i>Conyza albida</i>	Fleabane	Spray glyphosate 1:100 , or handpull, bag seed
<i>Euphorbia cyathophora</i>	Painted Spurge	Spray glyphosate 1:100 + Protec® . Hand pull
<i>Gloriosa superba</i>	Glory Lily	Difficult to control, spray foliage <i>glyphosate</i> (1:50 + Protec® + mefsulfuron (1 gram: 10L) in spring when plants are small – September/October. Follow-up required.
<i>Melinis minutiflora</i>	Mollasses Grass	Spray glyphosate 1:100 or if amongst desirable grasses apply glyphosate at 1:1 with weed wand
<i>Melinis repens</i>	Red Natal Grass	Spray glyphosate 1:100 or if amongst desirable grasses apply glyphosate at 1:1 with weed wand
<i>Richardia brasiliensis</i>	Brazil Weed	

A permit will be required for off label usage of these chemicals. Protec® should be used as per manufacturer's instructions.

Note: Unless otherwise stated the herbicide recommended for the techniques described above is Glyphosate e.g. Roundup®. Protec® should be used as per manufacturer's instructions. An off label permit is required from the National Registration Authority for any combination of herbicides or for rates not described on the product labels.

APPENDIX 6: List of tools and equipment required

Non-consumables

- Plastic or steel boxes for equipment storage
- Leather pouches with belts to secure secateurs and knives
- Felco® secateurs (no.5)
- Victorinox® boning knives with non-slip handles
- Sandvik® loppers (no.16)
- Large bow saw
- Small pruning saws
- Poison pots, stands, and paintbrushes
- Goggles for mixing and applying herbicide
- Tomahawk
- Tree injection unit
- Sharpening stone
- Post hole shovels for tree planting
- Hoses
- Wheel barrow
- Chemical measuring container
- Rubber gloves for measuring and applying herbicide
- Gardening gloves
- 15 litre backpack spray unit with Rega® nozzle
- Fertilizer (or other large) sacks for weed and tuber removal
- Black builders' plastic for composting
- Native plant and weed identification manuals
- Hand lens
- Camera
- First aid kit
- Tarp for laying tools out on when the ground is wet (various other uses i.e. erecting sunshade, rain protection etc.)

Consumables

- Aerosol oil for tool maintenance (WD40® or Inox®)
- Tree fertilizer tablets (Agriform®)
- Diary/ journal
- Work record sheets (see Appendix 9)
- Flagging tape
- Photographic film
- Glyphosate (Roundup®)
- Protec® - acidifier
- Metsulfuron (Brushoff® or Brush Killer®)
- Agral® – surfactant
- Spray marker dye
- Fencing material – timber posts, pig wire, shade cloth
- Trees for planting
- Water crystals or wetting agent
- Tree guards and/or wallaby repellent spray
- Stakes or star pickets for photo points

APPENDIX 7: Regeneration Record Sheet

REGENERATION RECORD SHEET

Zone:	Date:
-------	-------

Personnel/Volunteers:	Hours Worked:
-----------------------	---------------

Weather Conditions (temperature, prevailing wind, cloud cover etc.):
--

Work Completed (work zone – use map on reverse, methods trialed, comments on previous works, monitoring, followup or reminders etc.):

Weeds Treated	Methods Used	Chemical & Application Rate

Chemical	Vol. Used (ml)	Chemical	Vol. Used (ml)

Payment/Funding	Cheque No.	Invoice No.

Observations (flora, fauna, fruiting, flowering etc.):
--

Accidents/Incidents/Near Misses:

APPENDIX 8: Guidelines for Asset Protection Zones

NSW RURAL FIRE SERVICE *...for our community*

GUIDELINES for Asset Protection Zones

- **WHAT IS AN ASSET PROTECTION ZONE?**
- **WHERE CAN I PUT AN APZ?**
- **WHAT WILL THE APZ DO?**
- **COMPONENTS OF AN APZ**
- **RECOGNISING A BUSH FIRE HAZARD**
- **WHAT APPROVALS ARE REQUIRED FOR CONSTRUCTING AN APZ?**
- **ASSET PROTECTION ZONE WIDTHS**
- **MANAGING BUSH FIRE FUEL TO REDUCE BUSH FIRE HAZARDS**
- **LANDSCAPING AND BUSH FIRE HAZARD REDUCTION**
- **HOW CAN I FIND OUT MORE?**

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INTRODUCTION

Bush fires are a natural and periodic event in the Australian bush. Many Australian plants and animals have adapted to fire over thousands of years and require fire as part of their life cycle. However, development adjacent to bushland areas has increased the risk of fire impacting on people and their assets. Fire management needs to strike a balance between the protection of life and property and the maintenance of ecological processes and systems.

In Australia, bush fires are inevitable and an essential aspect of the Australian landscape. However, the impact on property and life can be mitigated with responsible preparation and management of bush fire hazards. This is the responsibility of all land managers, as well as communities and individuals taking responsibility for their own fire safety.

The level of protection for life or whether or not a house or other assets survive a bush fire ultimately depends on the landowner and their level of preparedness against bush fire attack.

This guideline provides advice to private landowners to assist them in creating and maintaining an Asset Protection Zone (APZ) for residential buildings and other personal assets.

WHAT IS AN ASSET PROTECTION ZONE?

An Asset Protection Zone (APZ) is an area surrounding an asset, managed to reduce bush fire fuels to a level that will minimise the impact of fire on that asset. The APZ serves as a buffer zone between an asset and the bush fire hazard. The primary purpose of the APZ is to ensure that a progressive reduction of bush fire fuels occurs between the bush fire hazard and any habitable structures within the development.

WHERE CAN I PUT AN APZ?

An APZ is located between your house and the bush fire hazard. An APZ may only be implemented on land with the land owners written consent. You cannot undertake any clearing of vegetation on a neighbours property, including National Park estate, Crown land or land under the management of your local council. The APZ should be located wholly within your land. If you believe that the land adjacent to your property is a bushfire hazard and may require clearing to create an APZ, you can lodge a complaint with the RFS your complaint be investigated and appropriate action will be taken if required.

WHAT WILL THE APZ DO?

An APZ, if designed correctly and maintained regularly, will reduce the likelihood of:

Ember attack on the asset;

Damage to the built asset (eg. a house) from intense radiant heat;

A ground fire burning up to the walls of the house and setting fire to the house

The APZ should provide a safe point for firefighters and home owners to defend their property.

Within this area, bush fire fuels that could become a part of the fire should be minimised. When considering the level of clearing required, you need to keep in mind that the aim of the APZ is to ensure that fuels are discontinuous, that is, the vegetation does not provide a path for the transfer of fire to the asset from the surface to the tree canopy or through the canopy.

RECOGNISING A BUSH FIRE HAZARD

Recognising that a bush fire hazard exists is the first step in developing an APZ for a property.

Generally, the more flammable and dense the vegetation, the greater the hazard will be. A large area of continuous vegetation on sloping land may also increase the potential bush fire hazard.

The amount and structure of vegetation around a house will influence the severity of damage from a bush fire.

Basically, the higher the available fuel loading the more intense a fire will be.

Isolated areas of vegetation

Isolated areas of vegetation generally may not be considered an insignificant bush fire hazard, as they are not large enough to produce fire of an intensity that will threaten dwellings.

This includes the following vegetation:

Bushland areas of less than 1 hectare (100 metres x 100 metres) that are more than 100 metres from a high hazard area;

Strips of vegetation less than 20 metres wide e.g. road and river corridors;

Vegetation not mapped on your local council's Bush Fire Prone Land Map.

If you are not sure whether or not there is a bush fire hazard in or around your property, contact your local NSW Rural Fire Service District Office for further details.

Isolated areas of vegetation may not be considered a significant bush fire hazard

CAUSE OF DAMAGE FROM BUSH FIRE

Houses can be ignited during bush fires by any of the following ways:

a) Wind

The wind during a bush fire can be extremely strong. This may throw debris and branches of the trees that are too close causing damage to buildings (especially windows & roofs). This will create openings and make the structure more prone to ember attack.

b) Embers

Embers (sparks) are the main cause of houses catching alight during bush fires. Extreme fire weather days are accompanied by strong to gale force winds, which carry burning debris. Embers gain entry to houses through broken windows or gaps in and around walls or roof cladding and ignite the contents. Embers can also lodge between and ignite horizontal timber decking, guttering, steps and windowsills. They can be blown up against and ignite timber used for supports, floor joists, posts and steps.

c) Radiation

Radiant heat can crack windows, allowing embers to enter. Radiant heat also preheats the buildings and contents, increasing the risk of ignition by embers and flame. In severe situations this may cause such things as curtains and fabric furnishings to burst into flames.

d) Flame contact

A significant risk to an asset is from ignition of vegetation growing directly against a dwelling, in turn igniting the dwelling through those areas described above.

People may also be adversely affected by smoke generated by bush fires, particularly in sensitive locations such as schools, nursing homes and hospitals.

WHAT APPROVALS ARE REQUIRED FOR CONSTRUCTING AN APZ?

If you intend to undertake bush fire hazard reduction works to create or maintain an APZ you must gain the written consent of the land owner/ manager. You cannot undertake any clearing of a neighbour's land without their agreement (this includes NPWS, councils etc.). All works must be undertaken wholly within the boundary of the affected property.

If you are constructing an APZ for a new dwelling you will need to comply with the requirements in *Planning for Bushfire Protection 2001*. Any approvals required will have to be obtained as part of the Development Application process. *Planning for Bushfire Protection 2001* outlines the distance requirements for APZs around new dwellings including the requirements for an Inner and Outer Protection Area.

If you wish to create or maintain an APZ for an existing structure you may be required to obtain a Bush Fire Hazard Reduction Certificate or other environmental approval. The RFS offers a free environmental assessment and certificate issuing service. Contact the Fire Mitigation Officer at your local RFS Fire Control Centre to determine if you can use this approval process.

If you intend to use fire to remove the bush fire hazard from your property you may also need to obtain a fire safety Permit through the RFS or NSW Fire Brigades. The RFS document *Before You Light That Fire* explains when a permit is required.

ASSET PROTECTION ZONE WIDTHS

The practical extent of APZs depends on the type of vegetation and slope of the land. Fires are more intense when they run uphill therefore, if the fuel is downslope of the house the distance of the APZ from the asset will need to be greater than if it is upslope of the asset.

Calculating an APZ

The RFS Bush Fire Environmental Assessment Code allows for a maximum distance of clearing based on likely environmental impact. These distances (below) are based on the most common vegetation type found in NSW and are specifically for the stream lined assessment process required for the issue of a Bush Fire Hazard Reduction Certificate.

a) Residential Dwellings

Bush Fire Environmental Assessment Code distances for APZ (distances are measured from the wall of the dwelling towards the hazard);

b) Other Buildings

APZs protecting other buildings and infrastructure such as farm sheds can be up to 10 metres.

flat ground is safer than steep slope

bottom of a slope top of a slope

Gentle slopes are safer than steep slopes

The bottom of a slope is safer than the top of a slope

House siting-new and existing homes

Slope Distance

Hazard upslope (<18°) 20 metres

Hazard downslope 0°-5° 25 metres

Hazard downslope 5°-10° 30 metres

Hazard downslope 10°-15° 40 metres

Hazard downslope 15°-18° 50 metres

MANAGING BUSH FIRE FUEL TO REDUCE BUSH FIRE HAZARDS

The intensity of bush fires can be greatly reduced where there is little to no available fuel for burning. In order to manage bush fire fuels you can reduce, remove or change the state of the fuel through several means. Reduction of fuel does not have to be as drastic as removing all vegetation. Environmentally this would be disastrous and often trees and plants can provide you with some bush fire protection from strong winds, intense heat and flying embers by filtering embers and changing wind patterns.

Bush fire fuels can be managed by:

a) Removal or pruning of trees, shrubs and understorey

The management of existing vegetation involves both selective fuel reduction (removal, thinning and pruning) and the retention of vegetation. Vegetation can act as a windbreak and radiant heat barrier.

The majority of leaves and ground cover should be removed from the surface. Valuable native trees and shrubs should be retained as clumps or islands and should retain a covering of at least 20% of the area.

The pattern of cleaning should involve:

- Removing noxious and environmental weeds first;
- Removing highly flammable species such as species within the genus *Melaleuca* and *Leptospermum*.
- Removal of trees and shrubs less than 3 metres in height.
- Removal of significant native species last.

Refer to the landscaping section in this document for more detailed information.

b) Raking or manual removal of fine fuels

Ground fuels such as fallen leaves, twigs and barks should be removed on a regular basis. The most flammable fuel is dry vegetation, sticks and other debris less than 6mm in diameter.

c) Mowing of grass

Grass needs to be kept short.

d) Slashing and trittering

Slashing and trittering are economical methods of fuel reduction in an APZ. For slashing or trittering to be effective, the cut material must be removed or allowed to rot down well before summer starts. Slashing and mowing may leave grass in rows thus increasing fuel in some places. Trittering or turbo mowing also mulches the vegetation leaving the fuel where it is cut. Ensure you remove the clippings and dispose of them in a green waste bin where available or compost on site (it is illegal and dangerous to dump clippings in the bush).

When correctly applied, this method has the advantage of inhibiting the growth of weeds. Weeds should be completely removed, as they tend to be extremely flammable as well as growing and spreading at a fast rate.

e) Ploughing and grading

Ploughing and grading can produce effective firebreaks, however, these areas may need constant maintenance. Loose soil from ploughed or graded ground may erode in steep areas, particularly where there is high rainfall and strong winds.

Ground fuels such as fallen leaves, twigs and barks should be removed on a regular basis.

f) Burning (hazard reduction burning)

Burning off (or hazard reduction burning) is a method of removing unwanted ground litter and bush fire hazards through the use of fire. Controlled burning or prescribed burning of vegetation is more often used by land management agencies for strategic bush fire management. Before any vegetation is burned within an APZ, the type of fire should be determined i.e. is it a pile burn or is it a burn of an area of bushland (prescribed burn). The type of burn may determine the types of conditions to be imposed as part of any environmental approval.

Any hazard reduction burning, including pile burns, must be planned carefully and carried out with extreme caution under correct weather conditions. Otherwise there is a real danger that the burn will get out of control. More bush fires result from escaped burning off work than from any other single cause. Planning for the use of fire must therefore ensure that it is effective and environmentally sound. During the planning phase for a prescribed burn, there are many considerations such as smoke management, scorch height, frequency of burning and cut off points for the fire. For further information refer to the document entitled *Guidelines for Low Intensity Hazard Reduction Burning* (produced by the NSWRFES).

g) Pile Burning

In some cases you may use pile burning to remove material that has been cleared in creating or maintaining an APZ. In areas where smoke regulations control burning in the open you will need to obtain a Bush Fire Hazard Reduction Certificate or written approval from Council to undertake the burning. In these areas you will need to justify why you cannot remove the material through the normal garbage collection system. For further information refer to the document *Guideline for Pile Burning*.

LANDSCAPING AND BUSH FIRE HAZARD REDUCTION

Your home and garden can blend with the natural environment and be landscaped for fire protection at the same time.

To produce a garden that protects your home, it is necessary to plan the layout of the garden and to give consideration to features such as fire resistant plants, barriers and windbreaks.

Layout of gardens in an APZ

The following advice is recommended when creating and maintaining garden that is part of an APZ:

Ensure that vegetation does not provide a path for the transfer of fire to the house;

Remove all noxious weeds. Local councils can provide a list of noxious weeds for their local government area and information on control options for different types of weeds. Refer to Appendix A for a list of weeds 'prohibited for sale' in Sydney.

Separate tree crowns by at least 2 metres so that the canopy is not continuous; and do not permit a canopy to overhang to within 5 metres of the dwelling.

Plant or clear vegetation into clumps rather than continuous rows;

Prune low branches 2 metres from the ground to prevent a ground fire from spreading into trees;

Locate vegetation far enough away so that plants will not ignite the house by direct flame contact or radiant heat emission;

Plant and maintain short green grass around the house as this will slow the fire and reduce fire intensity or provide non flammable pathways directly around the curtilage of the dwelling;

Gardens should not directly abutt the dwelling. Where this does occur gardens should contain non-flammable plants and any mulch should be well watered;

Do not erect brush type fencing and do not plant "pencil pine" type trees, which are highly flammable.

Removal of other materials

Woodpiles, wooden sheds, combustible material, storage areas, large areas/quantities of garden mulch, stacked flammable building materials etc should be stored away from the house. These areas should preferably be located in a designated cleared location with no direct contact with bush fire hazard vegetation.

Other protective features

You can also take advantage of existing or proposed protective features such as fire trails, gravel paths, rows of trees, dams, creeks, swimming pools, tennis courts and vegetable gardens as part of the property's APZ.

Fire resistant plants

While the design of the garden is important, so too is the type of plant species selected. No plant is fireproof, however, many plants have features that minimise the extent to which they contribute to the spread of bush fires.

Given the right conditions, all plants will burn. Low to moderate fires scorch or burn plants, while severe bush fires cause more damage. In extreme circumstances, high-intensity fires can incinerate most plants and spread the fire further into the property bush fire protection area.

Fire resistant plants, which are hard to burn, have the following features:

High moisture content

High levels of salt

Low volatile oil content of leaves

Smooth barks without "ribbons" hanging from branches or trunks.

If possible, water plants during summer to maintain leaf moisture content. The higher the moisture content of the leaves, the less likely the plants are to ignite. Native plants from the local area are less likely to suffer from drought and these should be used in preference to introduced species.

Trees with loose, fibrous or stringy bark should be avoided in the APZ. These trees can easily ignite and encourage the ground fire to spread up to and then through the crown of the trees. Wind can carry burning bark, especially loose, flaky or ribbon bark, away to start new fires. When deciding which trees to plant in the APZ, it is recommended that you use trees that have smooth bark and are planted so that the final tree height and crown width complies with recommended separation distances.

A combination of fire resistant plants and shrubs planted on your property will assist in reducing the spread of fire during bush fire incidents. As mentioned earlier, when choosing fire resistant plants, be sure not to introduce noxious or environmental weed species into your garden that can cause greater long-term environmental damage.

Rainforest Way Vegetation Management Plan

For further information on appropriate plant species for your locality, contact your local council, plant nurseries or plant societies.

Barriers

You can stop many embers (sparks) and slow down a bush fire by creating barriers around your assets. Barriers may include stone, masonry walls and earth mounds or other non-combustible fencing. Such barriers will help protect assets from possible attack of burning embers, heat radiation and direct flame contact.

Wind breaks

Rows of trees provide a more than useful windbreak, trapping embers and flying debris, which would otherwise reach the house.

Plant fire resistance trees to provide a shield from the fire front

Tree crowns will rarely carry fire without a significant fuel loading on the ground providing supporting fuel & heat.

By reducing the wind speed, a row of trees also slows the rate of spread of a bush fire and a dense foliage traps radiant heat, lowering bush fire intensity.

To be effective a windbreak should

Be located on the side of the property from which extreme fire weather normally approaches.

In NSW this is typically the northwest aspect.

Be of sufficient length (generally 100 metres minimum length if possible)

Be located at a distance of 1 to 3 times the height of fully grown trees if possible;

Use smooth barked eucalyptus or deciduous trees;

Allow 50-60% of the wind to pass through.

Windbreaks should be located towards the outer edge of the APZ.

Ground fuel should be reduced around the windbreak so as to prevent any approaching bush fire from climbing into the crowns of the trees and spreading further.

HOW CAN I FIND OUT MORE?

If you require any further information please contact:

- your local NSW Rural Fire Service District Office; or
- call the NSW RFS Education Line 1 800 654 443 (Monday to Friday, 9am to 5pm), or
- the NSW RFS website at www.rfs.nsw.gov.au.

**Produced by the NSW Rural Fire Service, Locked Mail Bag 17,
GRANVILLE, NSW 2142. Ph 02 9684 4411**

www.rfs.nsw.gov.au

Printed on 100% recycled paper using soy ink.



Appendix 9: Checklist For Bush Regeneration Activities In The Habitat Of Threatened Species, Endangered Populations And Endangered Ecological Communities

Background

Threatened species, endangered populations and endangered ecological communities are protected in NSW under the *Threatened Species Conservation Act 1995* (TSC Act).

It is an offence to “harm” or “pick” threatened species, populations or ecological communities, or cause “damage” to critical habitat or the habitat of threatened species, populations or ecological communities¹.

“Harm” refers to native fauna, and is defined as to: hunt, shoot, poison, net, snare, spear, pursue, capture, trap, injure, or kill.
 “Pick” refers to native flora, and is defined as to: gather, pluck, cut, pull up, destroy, poison, take, dig up, remove or injure the plant or any part of the plant.
 “Damage” is not defined but the common dictionary definition would apply.

It is a defence to a prosecution if the action was:

- authorised in accordance with a Section 120 licence or a Section 132C licence under the *National Parks and Wildlife Act* or a licence granted under Section 91 of the TSC Act (flora and ecological communities);
- authorised in accordance with a development consent under the *Environmental Planning & Assessment Act 1979*; or
- authorised by or under the Rural Fires Act 1997, or the State Emergency and Rescue Management Act 1989.

Bush regeneration activities

Areas where bush regeneration is undertaken are often the habitat of threatened species or may be an endangered ecological community (e.g. Lowland Rainforest on Floodplain). It is understood that the intention of bush regeneration activities is to have a positive impact, however, there is a chance that these activities may adversely impact on threatened species, populations or ecological communities. This may occur where:

- a species (flora or fauna) is not known to exist on the site (e.g. cryptic species such as orchids);

- a species may be accidentally harmed or picked (e.g. by spray drift or accidental cutting).
- a species may be misidentified and is thought to be either an exotic or common native species and therefore may be removed or damaged;
- the requirements of the species, including habitat structure and components, may be temporarily adversely impacted (e.g. maintaining microclimatic conditions, connecting or sheltering habitat for fauna);

Licensing

Those undertaking bush regeneration activities may consider applying for a Section 132C licence under the NPW Act.

A Section 132C licence is issued where the NPWS considers that the proposed work is for conservation purposes.

License Conditions

Generally, licences are issued on an annual basis; however, shorter or longer term licences are also issued where appropriate.

The NPWS may prohibit, condition, or limit bush regeneration works in some areas where it may affect research plots. Other licence conditions may be applied after consideration of population estimates, age structure, viability and health of the population or individuals.

The Bush Regeneration Checklist

The intention of the checklist is to ensure that bush regeneration activities will **not** have a significant impact on threatened species, populations or ecological communities and their habitats. Applicants should consider attaching this standard checklist to any Section 132C licence application to assist the NPWS in assessing the significance of the proposed activity. The NPWS will assume the applicant is prepared to adhere to the guidelines in the checklist where they form part of the licence application. Detail of any proposed work additional or contrary to that described in the checklist must be provided. The NPWS then assesses the likely significance of the impact of the proposal² using the information provided in the licence application.

For the purposes of the checklist, bush regeneration is considered as all types of habitat restoration activities that include such activities as manual weed removal.

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herbicide use, temporary damage to, or removal of native plants, planting, track work or maintenance and habitat removal or modification.

Threatened Species are listed under two schedules on the Threatened Species Conservation Act: Schedule 1 includes Endangered Species, Endangered Populations and Endangered Ecological Communities and Schedule 2 includes Vulnerable species. The Threatened Species Conservation Act Schedules are maintained by the NSW Scientific Committee. The

most recent versions of these schedules may be obtained on the NPWS Web Site:
www.nationalparks.nsw.gov.au.

A Species Impact Statement must be prepared where a proposed activity is assessed as likely to have a significant impact on threatened species, populations or ecological communities.

The Wildlife Atlas is the NPWS statewide flora and fauna database.

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NPWS Checklist For Bush Regeneration Activities:

Please Note:

- 1) The checklist is provided to facilitate licence applications and to draw attention to NPWS issues of concern.
- 2) There is no requirement to use the checklist when applying for a licence. You may alternatively choose to provide details of your project and an explanation of how you will ensure there will not be a significant impact on threatened species, their habitat or on endangered ecological communities.
- 3) If you provide a negative answer using the checklist this does not necessarily mean your application will be unsuccessful. You will however need to provide a satisfactory explanation as to why you do not wish to comply with the guideline and how you will ensure there is unlikely to be a significant impact on threatened species, their habitat or on endangered ecological communities.
- 4) You may wish your licence application to cover the collection of Voucher Herbarium Specimens and Plant Material for Identification. Guidelines to cover those activities are also attached.

Management Planning:	yes	no	more info attached
The proposed activities will be in accordance with a management plan or site plan (map). <i>Please attach the plan or relevant sections of the plan or strategy to the licence application.</i>	√		
The project has been discussed with the relevant Landcare coordinator. <i>If not, provide details of any other professional advice you have sought, e.g. from a qualified bush regenerator.</i>	√		
A NPWS Wildlife Atlas database search of a 5km radius of the site has been undertaken to identify threatened flora/fauna species known or likely to occur on the site. <i>The Wildlife Atlas is accessible on the NPWS Web Site www.nationalparks.nsw.gov.au.</i>	√		
Prior to commencing any works on site, a permit or permission will be obtained from the relevant landowner(s) or land manager(s).	√		
Training and supervision:			
All workers carrying out bush regeneration and associated works will be supervised by a trained and experienced co-ordinator who has completed a recognised bush regeneration course (e.g. the Certificate of Bushland Regeneration) or a minimum of 2 years bush regeneration experience. <i>If 'yes', please provide below the name and qualifications of the co-ordinator.</i> Name: Qualifications/experience:.....	√		
Other members of the group that have bush regeneration training or experience. Name: Qualifications/experience: Name: Qualifications/experience:..... Name: Qualifications/experience:..... Name: Qualifications/experience:..... Name: Qualifications/experience:.....			
All activities by workers will be regularly checked and approved by the co-ordinator.	√		
All workers will be informed of any threatened species or endangered ecological communities in the area or which may occur in the area and the potential impacts of activities on these species/communities. <i>e.g. vines on the edge of a littoral rainforest remnant may protect the remnant from salt-bearing winds.</i>	√		

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	yes	no	more info attached
All workers have adequate weed and native plant identification skills. <i>i.e. all workers can identify and differentiate between weeds and native plants that occur on the site.</i>	√		
Workers will be familiar with the identifying features of threatened flora that are known or likely to occur in the project area. Where threatened species known from the area are similar to weed species, the distinguishing features between these will be understood prior to commencing the work.	√		
Access to sites			
All vehicular access to sites will be restricted to formed roads.	√		
Unnecessary damage to sites will be avoided. <i>e.g. avoid working in wet weather to lessen soil compaction.</i>	√		
Impacts on flora:			
Prior to any works being undertaken, the presence or absence of threatened flora will be determined by a thorough walking search of the area.	√		
All threatened flora will be tagged with highly visible flagging tape before work commences. If a number of individuals occur in a clump, that area should be marked out with flagging tape.	√		
Cutting or damaging of threatened flora will be avoided.	√		
All plants will be positively identified before they are removed (pulled, cut, poisoned etc).	√		
Weed removal within 2m of a threatened species will be undertaken by hand.	√		
To reduce the possibility of introducing plant diseases and weeds the following measures will be applied: 1. Secateurs will be sharp and cleaned with methylated spirits. 2. Footwear will be cleaned of loose soil and preferably treated with bleach between sites.	√		
Impacts on fauna:			
All workers will be aware of any threatened fauna that are known or likely to occur on site, and the potential impacts of the proposed activities on those species.	√		
The habitat and refuge potential of weeds and rubbish will be considered prior to removal. <i>e.g. Lantana can provide cover for threatened fauna such as the Bush-hen. Dead Lantana and poisoned Camphor Laurels should, where possible, be left in situ.</i>	√		
Weeds will be removed gradually in areas where an infestation is extensive. <i>Ideally, 50% of weeds that may provide habitat should be left until native plant species have re-established and provide alternative refuge.</i>	√		
Disturbance to, and removal of rocks, logs and other potential refuge sites will be avoided.	√		
A herbicide registered for use near waterways will be used within 5m of waterways.	√		
Herbicide spraying will be prohibited within 5 metres from watercourses where threatened frogs are known or likely to occur and within a 10m radius of records of threatened frogs.	√		
A buffer of 1m along other watercourses will be maintained in which no herbicide will be sprayed.	√		

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Care will be taken to minimise disturbance to shy or cryptic species. <i>e.g. the Marbled Frogmouth roosts in vine 'curtains'.</i>	√		
Care will be taken to minimise disturbance to the leaf litter layer.	√		
Reconstruction through revegetation: <i>This section does not address propagation or planting of threatened species – this activity would need to be separately addressed.</i>			
Seed collection or cuttings will be from species, populations or ecological communities other than those listed as threatened (unless licensed by NPWS).	√		
Prior to collecting any seed or cuttings permission will be obtained from the relevant landholder or manager of the site. <i>e.g. a licence is required to collect native plants on National Parks estate.</i>	√		
	yes	no	more info attached
Seed collection from any one species will be limited to less than 10% of the available crop at that site.	√		
Seed collection from any individual plant will be limited to less than 10% of the available crop.	√		
If your seed source is used by other seed collectors, has consideration been given to minimising any cumulative impacts to the source plants? <i>Some individual plants are known as a reliable seed source and their seed is collected extensively. This may result in – (i) a reduction in genetic diversity; (ii) an impediment to the individual's natural ability to regenerate.</i>	√		
When collecting propagation material from a wild population, collection will be random from as many individuals as possible across the population to ensure a representative range of genetic material is collected. Collectors will avoid selection of propagation material on the basis of physical attributes. <i>e.g. tallest, most attractive, greatest amount of seed or flowers.</i>	√		
Plantings will be sourced from stock of local provenance.*	√		
Propagated plants will be used only at the subject site. <i>i.e. excess material will only be used at other sites if it meets the provenance criteria.</i>	√		
A buffer of 5 metres will be maintained around all threatened plant specimens. Planting will only be undertaken outside this buffer. <i>This requirement is intended to protect the roots of the threatened plant from damage, introduction of disease or impacts of herbicide.</i>	√		
Care will be taken to ensure that mulch does not introduce weeds or impede natural regeneration at the site.	√		
Care will be taken to ensure that weeds and/or phytophthora are not introduced to a site from any plantings.	√		
Consideration will be given to the possible impacts of plantings on the ecological requirements of threatened species at the site <i>e.g. reduced light, competition, etc.</i>	√		
Species will be planted within their natural habitat and range. Plantings will be guided by the plants' local habitat preferences. <i>e.g. the species used for plantings along watercourses should be those that naturally occur in that habitat in your local area.</i>	√		

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Herbicide use: <i>A permit from the National Registration Authority for Agricultural and Veterinary Chemicals PO Box E240, Kingston ACT 2604 may be required for herbicide use that is not consistent with conditions specified on the label.</i>	Yes	No	
A buffer of 2m will be maintained around all threatened plant specimens. Herbicide use will only be undertaken outside this buffer.	√		
Herbicide use will cease where there are any signs of threatened species being affected by herbicide. <i>e.g. browning off, wilting, deformed growth.</i>	√		
All herbicide spray operators will be capable of undertaking precise and effective weed control.	√		
Spray will be directed away from threatened flora.	√		
Herbicide will only be sprayed in suitable weather conditions when the impact of spray drift (windy) or run-off (wet) on threatened flora is minimised.	√		
Marker dyes <i>e.g. 'white field marker'</i> will be mixed with herbicide before use. <i>Marker dye enables the worker to see where the spray is landing.</i>	√		
Reporting and data records:			
Any new records of threatened species will be provided within three months to NPWS. These records will be in a format appropriate for entry into the Wildlife Atlas, once identification of a threatened species is confirmed by a recognised authority. <i>Wildlife Atlas cards available on request.</i>	√		

*Local provenance species should be regarded as those species propagated from material that has been collected from a natural wild population as close as possible to a site. For example, within the local catchment – which may be based on a local creek.

Please sign below, keep a copy for your records and attach all original pages of checklist, and any additional information, to your application form.

I, the undersigned, agree that the proposed bush regeneration activities are in accordance with all items checked above, additional information attached and the licence application form.

Name (please print) Signature Date

Further reading:

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Acknowledgements

These guidelines have been developed by Dianne Brown, Annette McKinley and Maria Matthes of the Threatened Species Unit, Conservation Programs and Planning Division, National Parks and Wildlife Service, Northern Directorate, with assistance from the following people: Hank Bower (Byron Shire Council), Sue Bower, Conservation Ecologists Association, Mike Delaney (Envite), R. John Hunter (NPWS), Bob Jarman (Landcare), Rosemary Joseph (NPWS), Lisa King (Envite), Stephanie Lymburner (Australian Association of Bush Regenerators), Tein McDonald (Australian Association of Bush Regenerators), Kate McKenzie (Landcare), Julie Mousley (Landcare), John Ross, Maurizio Rossetto (Royal Botanic Gardens, Sydney), Barbara Stewart, Lisa Wellman (NPWS), Carolyn Woods (Landcare)

