

**WEED CONTROL STRATEGY  
FOR LANDS MANAGED BY THE  
DEPARTMENT OF CONSERVATION AND  
LAND MANAGEMENT**

**KIMBERLEY REGION**



Western Australia Department of Conservation and Land Mangement (2005)

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### References

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1. A reserve based account of weed presence.
2. The status of weeds occurring on, and with the potential to occur on, CALM managed lands.
3. The habitat and environmental impact of Kimberley weed species.

## Acknowledgments

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Cover Page Photos (left to right):

*Cenchrus ciliaris* – Adele Island Nature Reserve

*Parkinsonia aculeata* – Parry Lagoons Nature Reserve

*Passiflora foetida* - Geikie Gorge National Park

*Jatropha gossypifolia* - Parry Lagoons Nature Reserve

*Calotropis procera* - King Leopold Range Conservation Park

(Photos: Kirsten Pearce)

## BACKGROUND

Since the first settlers arrived in Australia, weed introduction has been a persistent and serious issue. Although plant invasions do occur naturally, the frequency has increased as weeds have been introduced either accidentally or purposefully for agriculture, horticulture or garden aesthetics. Many species are now naturalized in our environment - successfully reproducing without human interference. Environmental weeds threaten natural biodiversity and ecosystem function. Weeds also impact upon environmental aesthetics and restrict our recreational pursuits.

As defined in the CALM Environmental Weed Strategy for Western Australia: “A weed is a plant that is not native to the area it occurs in and modifies adversely the environment it occupies” (CALM, 1999). As weeds have been recently introduced to Australia they lack the natural constraints (such as pathogens, climate or grazing or browsing herbivores) which would normally modify their growth and reproduction so to achieve a natural equilibrium. Weeds are typically rated according to their invasiveness, distribution and environmental impact (CALM 1999; Wainger and King, 2001; Groves, Panetta and Virtue, 2001; Thorp and Lynch, 2000).

This strategy refers to lands in the Kimberley region that are vested in the Conservation Commission of Western Australia, are held by the Executive Director or are covered by management agreements (See map XX).

The principles and components of this strategy can also be applied to proposed conservation estate (Eg. those defined in the 2015 pastoral lease renewal process) and areas covered under other conventions (Eg. Wetlands of International Importance) where a problem is identified or could be avoided by early intervention.

A large proportion of weeds proliferate in disturbed environments. Pastoral, agricultural and ornamental industries, combined with our increasing mobility (especially with the advent of the 4WD) and infrastructure demands, are causing new and existing weeds to colonise our natural landscape faster than ever before.

Environmental weed control demands long-term initiatives and resources. The requirement to undertake structured weed control programs can be overlooked because of the complexity of the task. This strategy aims to ensure there is commitment and attention to a process which threatens intrinsic values of biodiversity – ultimately our well being.

The content of this strategy is intended to facilitate the development of reserve based weed control plans. The requirement for details specific to reserves will be met in these plans. CALM district officers and rangers are encouraged to request regional assistance and liaison in all weed management planning and control.

## GUIDING DOCUMENTATION

### ☞ **The Environmental Weed Strategy of Western Australia**

This document identifies the role of CALM as “[pivotal] in achieving the necessary degree of intra and inter-agency coordination” and as “the main coordinating agency in the response to the environmental weed problem due to its statutory responsibility for protection of flora and fauna in WA” (CALM. 1999:33).

### ☞ **CALM Policy statement #14 Weeds on CALM Land**

CALM’s operational objective is “to take preventative measures to avoid the introduction and to achieve the systematic and safe control of weeds on CALM land”. Its strategic approach recommends that all regions/districts “shall survey weed infestations on CALM lands”, “record details of weed treatments undertaken” and shall “prepare and maintain a weed control management plan” from which work programs will be structured

### ☞ **The Department of CALM’s Strategic Planning and Forward Estimates Process:**

Each year the Corporate Executive agrees on priority areas for action under six identified key result areas (KRA’s). Whilst a commitment to the KRA’s remains constant from one year to the next the priorities may change. For example the list below is inclusive of the priorities for 2005-2006. This document will be updated on an annual basis to reflect this.

#### **Nature Conservation Output**

##### **KRA 2**

NC 2A – Expand and enhance invasive species control programs on all conservation reserves under Departmental management as a major focus of our conservation management ethic and proposed good neighbour policy.

NC 2B – Management of the conservation reserve system with the primary goal of maintaining and recovering biodiversity...

NC 2D – Management of 12 Wetlands of International Importance in WA...

##### **Special emphasis for 2005/6**

Increase emphasis on core management of parks and reserves including control of threatening processes (feral animals, weeds, ...)

### ☞ **Good Neighbour Policy (under development)**

3.9 “CALM views weed control as a partnership, and works wherever possible with the community, and especially neighbours to CALM managed land, to share the control burden and optimise the benefits from weed control works that are undertaken.”

## 📖 Agriculture and Related Resources Protection (ARRP) Act 1976

### Section 39 - Department to control declared plants and animals

*A Government department shall control declared plants and declared animals on and in relation to public land under its control.*

This is subject to the Agricultural Protection Board Act 1950, which overrides the ARRP Act. This 'allows CALM, in carrying out its responsibilities under the ARRP Act, to reserve the right to decide priorities and the level of control in accordance with availability of funds'.

## OPERATIONAL OBJECTIVES

- Consistent with region-wide priorities and with Departmental objectives and regulations, undertake weed control on CALM managed land in the Kimberley region.
- Protect the ecological values of the Kimberley region. Restore ecosystem diversity and manage sources of disturbance to encourage a natural resilience to weed invasion.
- Prevent the introduction of weed species into the region. Foster relations with the Department of Agriculture, Western Australia (DAWA) and AQIS to promote an interdepartmental approach to weed risk assessment, research and quarantine nominations.
- Manage weeds with indigenous, community and stakeholder support and, preferably, participation.
- In the local context, to undertake weed control based on the following principles:
  - ❑ Strategic Develop plans giving consideration to, catchment trends, fire history, visitor behaviour, vehicle access and feral fauna activity.
  - ❑ Integrated Integrate weed control programs with recreational, fire and feral animal management programs. Integrate also with control programs of landholders within the catchment area.
  - ❑ Ecological Control weed invasions in accordance with regard for environmental impact and ecosystem dynamics.
- Continue to monitor and document the status, distribution and management of weeds across CALM managed land in the Kimberley region.
- Prepare reserve-based weed control plans for all CALM managed land in the Kimberley region to facilitate the prioritisation and management process. From initial implementation at strategically nominated sites, successful models will be extrapolated across the region.

## KEY OUTCOMES

This strategy is stage one of a long-term commitment to weed control. Its primary objective is to improve the co-ordination and planning of weed control on conservation estate.

### This document:

- Defines weed species and locations across the CALM estate in the Kimberley region that should be targeted for management actions.
- Establishes criteria that prioritise resource allocations.
- Ensures a consistent and comparable approach across the region.
- Guides the development of specific weed control plans for individual conservation estate.
- Establishes criteria for site prioritisation, monitoring and evaluation.

## REGIONAL REQUIREMENTS

- Survey and document the status of weed species on CALM managed lands. Consistently patrol all reserves, including those in remote areas.
- Secure long term funding commitment for weed control to foster a sense of regional commitment and to ensure a sustained approach.
- Establish an effective and long term weed control budget plan.
- Provide training for staff (to be identified in work programs and IDAPES), community and volunteers in regionally consistent, weed control techniques, monitoring methodology, weed identification and chemical handling and safety.
- Provide staff with appropriate weed control and safety equipment to facilitate effective and safe weed control. Requirements for new equipment and equipment maintenance to be identified in works program budgets.
- Foster relations with the community and with external agencies, such as DAWA, AQIS and Ord Land and Water in order to promote understanding and involvement of weed control and the threatening processes and activities that contribute to weed spread and proliferation.

- Set seasonal weed control objectives in work programs for CALM staff. Ensure staff availability and mobilisation of equipment during the wet season prior to seed – set of weed species.
- Establish a ‘wash-down’ protocol that is applicable to CALM officers and road working crews.
- Facilitate the exchange of information between regional staff with on-site jointly operative control, monitoring and evaluation sessions.

## ENVIRONMENTAL IMPACTS OF WEED SPECIES IN NORTHERN AUSTRALIA

Northern Australia’s weed infestations are characterized by ‘broad scale single species infestations’ which are regarded as a response to our extensive, rather than intensive, land use patterns (Humphries, Groves, Mitchell, 1991). For example as the practice of intensive irrigated agriculture becomes increasingly common, it must be considered that the threat of localized multi species infestations will increase.

Appendix 3 summarizes the environmental impact of weed species that occur, or have the potential to occur, in the Kimberley region. The establishment rate and impact of weeds may exhibit some variation from site to site, dependent on variables such as soil, moisture and climate.

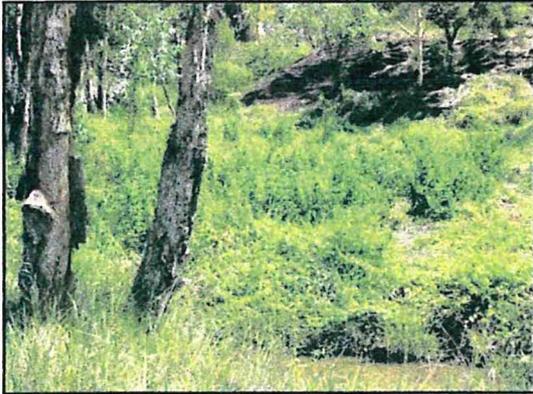
Weeds are recognised as inducing environmental change on a genetic, species and ecosystem level by means of (CALM, 1999):

- resource competition
- prevention of regeneration/seedling recruitment
- alteration of geomorphological processes
- alteration of hydrological cycles
- alteration of soil composition and nutrient status
- alteration of native flora and fauna diversity and abundance
- alteration of natural fire regimes
- causing genetic change

### **Impact by Vegetation Community** (Humphries, Groves and Mitchell, 1991).

#### Riparian and Wetland Systems

These systems are regarded as being at greatest risk based on their natural vulnerability to weed invasion and their high ecological value. The intensive activity of introduced hoofed animals, rich soils, the seed dispersal capacity of waterways, and the natural disturbance of flood events create an ideal weed habitat. A number of species identified in this strategy as being *of regional significance*, such as *Parkinsonia aculeata* and *Jatropha gossypifolia*, can be found along watercourses, floodplains and wetlands on CALM reserves including Parry Lagoon’s Nature Reserve and Purnululu National Park.



*Hyptis suaveolens* and *Passiflora foetida*  
Lily Creek, Mirima National Park.  
Photos: Kirsten Pearce



*Parkinsonia aculeata*  
Parry Lagoons Nature Reserve

### Savannah Woodland

Weeds of the northern savannas are typically broad scale infestations. The common use of savannas for grazing cattle has benefited those weed species which respond favourably to disturbance. Introduced pasture species (See Appendix 1) such as *Cenchrus ciliaris* has proliferated throughout the grass layer and is gradually altering savannah ecosystem. Woody shrubs such as *Calotropis procera* and *Acacia farnesiana* are both disturbance opportunist which occupy savannah vegetation.



*Calotropis procera* – King Leopold Range Conservation Park  
Photo: Kirsten Pearce

### Rainforests

The fragmentation of sub tropical and tropical rainforests since human occupation has created a 'high edge effect', causing the combined effect of increased light, weeds and fire penetration. Introduced vines including *Passiflora foetida* (and potentially *Cryptostegia grandiflora*) pose a major threat to sites such as Point Springs Nature Reserve.

**Impact by growth type:**  
(Humphries, Groves, Mitchell 1991)

Aquatic and Semi Aquatic Weeds

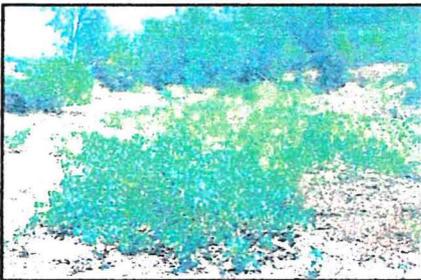
Floating weeds such as *Salvinia molesta* and *Eichhornia crassipes* are capable of rapid vegetative growth. Readily dispersed by wind and floods and avifauna, they are extremely difficult to contain or eradicate. A single outbreak of *Salvinia Molesta* at Lake Kununurra (Ramsar wetland) remains a threat despite 2 years of interdepartmental management. Rooted aquatic weeds spread more slowly, but in the long term may be more persistent. Aquatic weeds affect, water flow, light penetration, hydrological chemical and biological values, water nutrient levels and space availability.



*Salvinia molesta* in Lake Kununurra  
Photo – Allan Thomson

Herbs

Herbaceous weed species typically occupy disturbed sites, particularly where nutrient status has been enhanced. Given early peak growth periods, they out compete native species in nutrient and water consumption and are typified by high growth rates.



*Datura innoxia* at Geikie Gorge National Park.  
Photos – Kirsten Pearce



Regeneration of *Hyptis suaveolens* at King  
Leopold Range Conservation Park

### Grasses

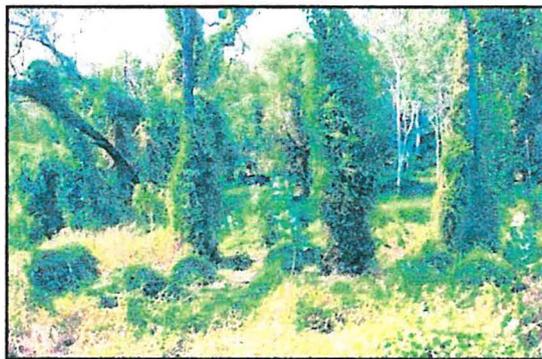
Grass species are capable of invading and altering a site rapidly. Grass weeds readily displace native ground covers and remove an essential food source for native fauna. Many species, particularly *Cenchrus ciliaris* and *Pennisetum spp.* alter fuel load characteristics, curing later in the dry season and resulting in, later, hotter and larger fires.



*Pennisetum pedicellatum* in Mirima National Park  
Photo: Kirsten Pearce

### Vines

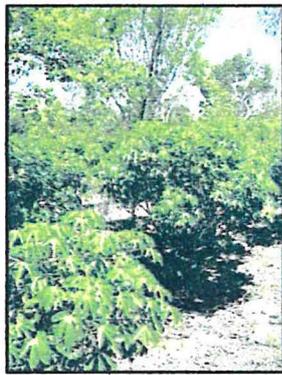
Vine weeds are vigorous and destructive growth forms, smothering and preventing the regeneration of vegetation from ground cover to canopy. Occurrences of *Passiflora foetida* are common throughout the region, most notably along the riparian zone, at sites such as Geikie Gorge National Park.



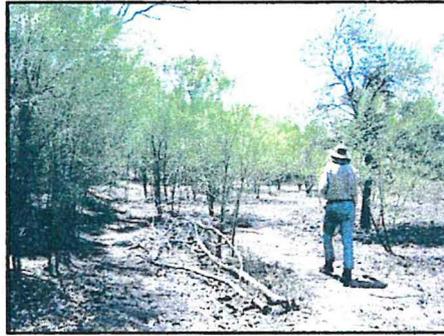
*Passiflora foetida* at Geikie Gorge National Park.  
Photo – Kirsten Pearce

### Shrubs and Trees

Shrub and tree weed species often prevent a ground level vegetation layer, leaving bare earth that is subject to erosion. They occupy a variety of habitats, from wetland, to mesic, to dry land sites; and are capable of occurring at a broad scale, at monoculture levels. Seed productivity is typically high and viability can be several years.



*Jatropha gossypifolia* at Parry Lagoons Nature Reserve  
Photo: Kirsten Pearce



*Parkinsonia aculeata*  
Photo: Kirsten Pearce

## WEEDS OF REGIONAL SIGNIFICANCE ON CONSERVATION ESTATE

### Weeds of Regional Significance – Kimberley Region

It is estimated that within the Kimberley Region there are between approximately 100 ‘naturalised alien species’ (Wheeler, 2002) to approximately 220 ‘naturalised vascular plants; of which approximately 120 are defined as environmental weeds (Keighery, unpublished). The flexible interpretation of ‘weed species’ causes considerable discrepancy in weed census results. Appendix 1 lists those species recognized to occur on conservation estate and those with the potential to occur on conservation estate. Appendix 2 lists those species which are currently recognized to occur on conservation estate, on a reserve-by-reserve basis.

Table One lists those species that are considered to constitute the greatest risk to the Kimberley Region and have been recorded on conservation estate. This list does not presume that each of these weeds should automatically be targeted for control and allocation of resources. Their significance should be considered equally with on site conditions and the principles of prioritisation and weed risk assessment.

Table 2 lists those weeds that have not been recorded on conservation estate, but are considered to pose a significant future threat. Where these species can be detected at their initial stages of establishment, they are *priorities for eradication measures*.

These species have not been further ranked in order of significance. In each weed’s respective habitat, each is capable of a significant level of environmental impact.

Both lists have been compiled with the benefit of recognized expertise; including that of CALM, AQIS and DAWA officers. The Weeds Of National Significance (WONS) and ‘Alert’ Weed listings (CRC Weed Management, 2003) and ‘Part 1 – Plant Invasions of Australian Ecosystems’ (Humphries, Groves and Mitchell, 1991) also contributed to the final lists.

<b>Weeds of regional significance observed on conservation estate</b>	
<b>Species</b>	<b>Common Name</b>
<i>Azadirachta indica</i>	Neem
<i>Calotropis procera</i>	Rubberbush
<i>Cenchrus ciliaris</i>	Buffel Grass
<i>Hyptis suaevolens</i>	Mint Weed
<i>Jatropha gossypifolia</i>	Bellyache Bush
<i>Leucaena leucocephala</i>	Leucaena
<i>Parkinsonia aculeata</i>	Parkinsonia
<i>Passiflora foetida</i>	Stinking Passion Flower
<i>Pennisetum pedicellatum</i>	Deenanth grass
<i>Prosopis spp.</i>	Mesquite
<i>Themeda quadrivalis</i>	Grader Grass
<i>Xanthium strumarium</i>	Noogoora Burr

**Table 1**

<b>Weeds of significant future threat to conservation estate</b>	
<b>Species</b>	<b>Common Name</b>
<i>Acacia nilotica</i>	Prickly Acacia
<i>Andropogon gayanus</i>	Gamba Grass
<i>Bracharia mutica</i>	Para Grass
<i>Cabomba carolina</i>	Cabomba
<i>Cryptostegia grandiflora</i>	Rubber vine
<i>Echinochloa polystachya</i>	Aleman Grass
<i>Eichhornia crassipes</i>	Water Hyacinth
<i>Hymenachne amplexicaulis</i>	Hymenachne
<i>Mimosa pigra</i>	Mimosa
<i>Pennisetum polystachion</i>	Mission grass
<i>Salvinia molesta</i>	Salvinia
<i>Martynia annua</i>	Devil's Claw

**Table 2**

## ESTABLISHING PRIORITIES FOR ACTION

In a weed control strategy preferable operational priorities are (Rejmanek, 2001; DOC,1998):

1. To prevent new weed incursions at regional, state or nation wide borders.
2. To identify and eradicate new incursions.
3. To control, contain or eradicate, existing infestations.

Early detection of weed incursions places operators on the offensive. With the exception of preventative measures, this is the most cost effective tool in weed control, offering a high probability for eradication (Rejmanek, 2001).

*Any weed identified as new to a site, which is in the initial stages of establishment should be an immediate target for the allocation of resources for an eradication program (CALM, 1999) If eradication cannot be achieved, a long term control strategy must be developed and implemented.*

Once weeds have become established, it becomes more complex to nominate priorities for action. Determining if a weed control program is *site-led* or *weed-led* is vital to create a sense of focus. This also provides a mechanism with which to justify weed control actions (Owen, 1998; CALM, 1999).

Weed – led control programs involve a species by species approach to weed control. Managing a species at the earliest possible stage of invasion is the most time and cost effective form of management with the highest probability of success.

Site-led control programs are implemented where a site is identified as having valuable ecological functions and services placed at risk by weed incursions. This approach is typically more effective when carried out as an integrated threat management plan, as often weed management alone is insufficient to restore natural vigour to a site. Sites that are recognised to be in good natural ecological condition should be emphasised for weed control to maintain their status (CALM, 1999).

### **Weed and Site Risk Assessment**

Prioritising a site or weed for control should take into consideration a variety of variables to ensure that weed control is conducted on a site that presents the highest probability for successful outcomes. These variables are: (Wainger, 2001; Thorpe, 1999; Groves, Panetta, Virtue, 2001):

- Weed abundance and
- Invasiveness.
- Environmental and social impacts.
- Practicality of control (human and financial resources & risk of re infestation)
- Cause/Source of infestation

And of the site's:

- Ecological characteristics
- Biophysical processes
- Services to community
- Risk assessment

#### Abundance

This includes both current and potential weed occurrence on a geographic scale. Potential weed range may be theorized based on, climate, land use and its existing ecological range and that which it occupies in its native home (Reichard, 2001, Groves, Pannetta, Virtue, 2001). Weeds existing on a broad scale may not be cost effective to target. Weed surveys and mapping of weed populations must be an ongoing priority in order to justify abundance based prioritisation criteria.

#### Invasiveness

A weed's "ability to establish, reproduce and disperse in an eco system" can be termed as invasiveness (Groves, Panetta, Virtue, 2001). The condition of the landscape will also affect a weed's invasive tendencies.

#### Environmental and Social Impacts

Weed infestation can alter ecological characteristics and processes. Weeds may have a detrimental effect on human health. They can reduce the recreational and aesthetic appeal of a site and may affect the resources we rely upon, including clean drinking water, fish resources and tourism income. Environmental impact assessment of weed control actions should also be addressed. Appendix 3 summarizes the environmental impact of current and potential weed species.

#### Practicality of Control

Strategies for control should be based on available funding and human resources in both the short and long term at an appropriate scale. *"Spending decisions need to be based on reliable, replicable criteria for choosing sites... to distinguish between sites these criteria need to be based on the expected levels of both cost effectiveness and realisable benefits from a given level of treatment."* (Wagner, 2001, p.35).

An important first principle to apply is that it is more effective to target a strategically selected; less affected area or outlying population rather than aiming beyond the limits of financial and human resources. Location, stage of invasion, invasive potential, risk of re infestation, weed biology (seed production, dispersal etc) and control options must be included in assessments in order to determine levels of practicality and to maximise the possibility of successful outcomes (Groves, Pannetta, Virtue, 2001).

"It is necessary to recognize that 'natural' systems are dynamic. Irreversible alterations may have occurred, and modified systems may have become or are in the process of becoming established".

#### Cause and Source of Infestation

A large number of weeds are disturbance opportunists; occupying the habitat niche created by road works, feral animal activity, erosion, camp grounds, grazing lands or burnt areas. The identification of sites where levels of weed incursion can be attributed to disturbance or controllable dispersal mechanisms is crucial to being able

to develop an integrated management approach; where managing the cause is a key component of the plan.

#### A Common Challenge

Wetlands, riparian and mesic zones are all of high ecological value. Concurrently they often provide the greatest challenges for weed control, given high frequency of feral fauna and natural disturbance, efficient natural dispersal mechanisms, high social and recreational values and high relative nutrient status. Further consultation and survey is required at these sites to determine those that realistically can be advantaged by a weed control program. Selection of sites that can be targeted on a catchment level, and can be managed in an integrated long-term approach is essential to this prioritisation process.

It is important to acknowledge that conservation reserves in the Kimberley do not stand alone. They are part of an un fragmented landscape, so consideration needs to be given to their place in that landscape.

## PRIORITISATION OF CALM MANAGED LAND IN THE KIMBERLEY REGION

National Parks, Nature Reserves and Conservation Parks all face a variety of threatening processes. Limited financial and human resources over vast areas of often poorly accessible land has historically meant that resources have been either unavailable or stretched to a point that has resulted in unsuccessful short-term management outcomes.

It is a recommendation of this strategy that one or two reserves are selected for the development of an intensive weed control program. These then become the 'models' for the region and through this process issues and options can be defined that feed into the adaptive management cycle. A model will then be extrapolated out to other areas of conservation estate as determined by the process of prioritisation.

Reserves that will be potentially be focused on in the first instance are discussed below. The development of reserve based weed plans will help to highlight which reserves should be selected for the development of an intensive weed control program.

- The Mitchell River National Park, Laterite Conservation Park, Lawley River National Park and Camp Creek Conservation Park.

These reserves have only recently been added to the conservation estate and are within the IBRA subregion that is identified as being largely weed free. It is anticipated that there will be increased numbers of visitors to the area, along with the possible establishment of communities and potential mining exploration and other activities. Increased activity in the area, also including anticipated improved road maintenance and infrastructure development (eg ranger stations) must be recognised as escalating the risk of weed invasion and establishment into the area. At their present status, weed populations in these reserves present an achievable and practical opportunity for sustained management. The river systems, rainforest patches, and populations of native mammals all contribute to the high ecological values of the

reserves. Given the remote nature of these reserves and the limited opportunities to assess their condition, a weed management plan on these reserves would prioritize equally survey and control actions.

- Mirima National Park

Mirima National Park is a small reserve located within the Kununurra townsite boundary. Given its manageable size, history of persistent weed control and weed risk assessment it is a good candidate for an intensive weed control program in which eradication objectives could potentially be met for some species (such as *Azadirachta indica*). The majority of weeds in the park are confined to a small creek system that is readily traversed by foot. The recent focus of the Shire of Wyndham East Kimberley on *Azadirachta indica* also provides a strategic opportunity for an integrated management approach to a weed that is of growing concern in the region.

- Other sites

Priority locations can potentially be confined to sites or land systems within a reserve to target a specific weed occurrence for eradication or containment.



*Azadirachta indica* at Mirima National Park  
Photo: Kirsten Pearce

## ENVIRONMENTAL IMPACT ASSESMENT

Deciding which weed or site to prioritise in a weed management program must not only take into consideration weed impact, but also the environmental impact of control actions and the implications of weed removal.

Weed control can be a disruptive and environmentally damaging process, sometimes requiring significant vehicular, machine and human activity. Vehicles, quad bikes or machinery taken into weed-infested sites must be subject to strict wash-down procedures before and following entry. This helps to ensure that no new weeds are introduced to the site and that existing weeds are not transported beyond the site of infestation.

A number of weeds are disturbance opportunists. Control measures must minimize disturbance to the landscape. Use of heavy machinery will often promote the re-colonization of weed species at a site.

In sites dominated by weed occurrence, fauna may rely on a weed assemblage for refuge and food. At sites where weed species are responsible for the consolidation of soil, removal of these weeds could pose a high erosion risk.

Non-selective and/or residual chemicals incorrectly applied may damage native flora causing a proliferation in weed occurrence. The use of selective chemicals such as 2, 4-D, against broad leaf herbs will protect grasses, on which it has no effect. Chemicals not recommended for catchment or aquatic weed application may impact upon aquatic flora, fauna and consumable water quality.

Weeds 'controlled' with the regular application of fire may conversely have a deleterious impact on native flora and fauna. Equally, sites fenced to reduce the disturbance caused by human or feral fauna activities, such as at Point Springs Nature Reserve, require a fire management plan and ongoing monitoring of fuel levels.



Bulldozed *Calotropis procera*. Impacts such as this must be assessed for their environmental impact.

## MONITORING AND EVALUATION

The development of a consistent weed management approach for conservation estate across the Kimberley region will ensure and facilitate optimal results in management objectives.

Central to the success of survey and monitoring operations and outcomes is the confident on-ground identification seedling, juvenile and adult weed species and an understanding of weed biology and ecology.

### Monitoring

Monitoring allows for the recognition and assessment of change. Monitoring can reveal; weed biology and ecology, rate of spread, changes in weed density, new species incursions, changes in the condition of native vegetation, the status of threatening processes, environmental impact of control operations, and control success or failure. Monitoring techniques are variable and will be relative to the information required from the site. (DEH, CRC (Module 1)).

A multipurpose and simple monitoring technique is to develop photo-monitoring points. Identify and GPS reference two 'points', either existing naturally or by placing posts at chosen sites. At regular intervals, from one post, photograph the second post, maintaining a constant compass direction and photo height. Record data including; personnel, date, time, weather conditions, recent site history, treatment methods, and plant status. A simple process such as this can monitor changes including; weed density and scope, impacts on native vegetation and weed response to flood and fire events and vehicle and feral animal disturbances.

Monitoring sites can only provide useful information if they are visited consistently to build up a picture of weed behaviour and the result of control measures. Monitoring should be repeated at the same time or under similar conditions each year to prevent seasonal discrepancies from confusing the evaluation process (DEH, CRC (Module

1)). Resources and site accessibility will primarily influence the simplicity or complexity of a monitoring programme

This development of this strategy has highlighted a deficiency in weed data within remote reserves that do not have a live-in ranger or ranger station. This does not suggest a need for live in rangers, but does demand the need for regular patrols on *all* CALM managed land, even those most remote.

### **Documentation**

Documentation at each stage of planning, implementing and monitoring is *essential*. It allows the evaluation process to be justified and it provides a valuable guide for weed control across the region. The documentation of threatening processes that contribute to weed invasion will support highly desirable integrated management plans.

*Comprehensive* documented results, which can *justify* a weed control approach are more likely to attract funding. Equally, documentation that disproves a control theory will provide other officers with invaluable lessons and will prevent similar mistakes that exhaust resources and motivation.

Documentation must be:

- Available to all staff
- In a user friendly format
- Archived in a retrievable manner.

### **Evaluation**

The evaluation process requires consideration of approaches that did, or did not, work. Understanding the reason behind success or failure places operators in an advantaged in the development of future plans. Weed planning demands continual reassessment and plan modification as know-how develops and new initiatives and techniques are revealed.



Chemical control (basal bark) of *Calotropis procera* at Windjana Gorge National Park.



Chemical control (cut stump) of *Parlatansonia aculeata* at Geikie Gorge National Park



Chemical control (foliar) of *Jatropa gossypifolia* at Parry Lagoons Nature Reserve

## RESOURCE ALLOCATION

Distribution of finances must satisfy three elements:

- i. Long term financial commitment to weed control and containment at prioritised locations
- ii. Long term financial commitment to the repeat process of site survey, treatment monitoring and site evaluation
- iii. Immediate 'non specific' funding to target new weed incursions which can be eradicated.

TASK	COORDINATOR	RESOURCES	COSTS	COMPLETION DATE
Document the status and distribution of significant weed species across the conservation estate	RNCO	Vehicle GIS RIC's	\$40,000	June 2006
Develop and implement weed plans for recommended focus estate	RIC's	Work programs, vehicles, spraying equipment, chemicals, dilutants and surfactants, safety requirements.	By reserve (in excess of figures listed below)	October 2005
Continue targeted work on priority species for other estate	RIC	As above.	By reserve (eg. Derby Work Zone ~ \$35,000 (MRNP ~ \$10,000, Geikie Gorge ~ \$20,000)	On-going
Continue development of reserve based strategies			By reserve	June 2007
Continue research into the impact and control of weeds	RLNC, RNCO	CALM Research, AQIS, DAWA		Ongoing
Monitoring and documentation	RNCO, RIC's	GPS, Camera, binoculars	By reserve ~ \$	On going
CALM Officer Training	RIC's, DM, RLNC		By reserve ~ \$ 10,000	June 2007
Wet season mobilization for priority reserves	RIC's, RNCO	Quad bikes mobilization and fuel, flights into sites, chemical drops.	By reserve ~ \$ 10,000	On going

## INDIVIDUAL CONSERVATION ESTATE GUIDELINES

### PLANNING

A weed control plan will ensure that priority weeds are targeted at the right time, at the right scale, in an appropriate manner, achieving the best possible results. Plans set objectives that are measurable, achievable and justifiable, and create an operational environment that supports logical monitoring and follow-up treatments. Plans support funding allocations and direct work programs.

The level of detail to be included in the plans is dependant on the extent of readily available information. If there is data lacking then this should be acknowledged in the plan.

### OUTLINE OF WEED CONTROL PLAN FOR INDIVIDUAL ESTATE

#### Background:

- Estate name
- Size (ha)
- Landscape features
- Vegetation
- Past and current use
- Cultural Significance
- Stakeholders
- Access

#### Weed Profile (In table format)

Weeds Recorded on Site	Potential Weeds
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#### Weed Status (In table Format)

Species	Location	Impact	Past control	Notes (including response to disturbance, dispersal and infestation issues)
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**Strategic Priorities for Action** (In table Format)

Priority (high/low/moderate)	Objective	Strategy	Action	Responsibility
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**Species by Species Priorities for Action** (In table Format)

Priority (high/moderate/low)	Species	location	Objective	Actions	Notes
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**Weed Control** (In table Format)

Species	Legal Status	Source	Recommended Control	On/off label
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**Environmental Impact Assessment**

- Potential impact of control work.

**Monitoring and Evaluation**

- Locations where monitoring has not been undertaken
- Cost approximations for the short and long term
- Time frames
- Documentation style
- Standard/uniform documentation style
- Record keeping custodianship

## **Resource Requirements**

Resource nomination must be considered with realistic consideration of resource availability and work programs design.

### Consider:

- Staff availability
- Budget for short and long term
- Training requirements
- Materials, equipment, vehicle costs and maintenance
- Safety procedures – regulation storage, personal protective equipment and first aid
- Aerial photos
- GIS expertise
- Public education
- Documentation
- Monitoring
- Wet season mobilization (for priority sites)

### **Signed off by**

- Regional Manger
- Regional Leader Nature Conservation
- District Manager

# CASE STUDY

## MIRIMA NATIONAL PARK

Allan Thomson, District Conservation Officer, East Kimberley District, CALM Kununurra  
Kirsten Pearce, Nature Conservation Officer, Kimberley Region, CALM

### Notes:

- This document relates only to weed control for conservation purposes, not for visitor services activities.
- Survey is defined as searching for weeds, both on new areas and previously treated areas.
- Monitoring is defined as measuring impacts of weeds.

**Name:** Mirima National Park

**Size:** 2068 hectares

### **Landscape Features**

- Eroding Devonian sandstone plateau surrounded by Quaternary sandplain.
- The eroding plateau has created a 'fractured gully' landscape incorporating sandstone 'hillocks' which are a feature of the park with their distinctive multicoloured horizontal sedimentary bedding.
- The plateau, hillocks and gullies are part of the Weaber Land System and the sandplain part of the Cockatoo Land System.
- Lily creek cuts through the centre of the park, supporting pools of permanent water. Permanent water can be found at 'Bull', 'Middle' and 'Top' Springs on the edge of the plateau. Other creeks within the park are seasonal.
- Drainage across the sand plain is poor. During the wet season much of the sand plain becomes boggy.

### **Vegetation**

- The plateau has savannah of sparse trees and shrubs over a virtually pure *Triodia sp.* grass layer.
- The gullies and creeks support a diverse variety of trees, shrubs, grasses and herbs.
- The sand plain supports savannah woodland over mixed grasses; predominantly *Triodia sp.* and *Sorghum sp.*

### **Past and current use**

- Prior to National Park vesting in 1968, sites such as creeks and springs were used for recreation.
- Cattle and donkeys also used the water points in the past.
- Today the park occurs entirely within the gazetted boundaries of Kununurra, only 2km from the centre of town.
- The park is frequently visited by locals and visitors to Kununurra.
- No camping is permitted. Infrastructure and tourist visitation is concentrated around the bitumised entrance road. Structures include, a toilet, day shelters, short walk trails, picnic tables and interpretation panels.

- Primary activity in the park include, walking, picnicking, bird watching and photography. Over the wet season locals frequent the permanent springs.

### Cultural significance

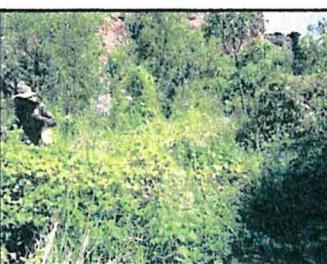
- Mirima National Park is of cultural significance to the Mirriuwung Gajjorong Traditional Owners. Ceremonial activities still occur within the park.

### WEED PROFILE

Weeds Recorded on site	Weeds with potential to exist on site
<i>Hyptis suaevolens</i>	<i>Pennisetum polystachion</i>
<i>Passiflora foetida</i>	<i>Bidens bipinnata</i>
<i>Macroptilium atropurpureum</i>	<i>Aerva javanica</i>
<i>Azadirachta indica</i>	<i>Gomphrena celosiodes</i>
<i>Hibiscus sabdariffa</i>	<i>Chloris inflata</i>
<i>Pennisetum pedicellatum</i>	<i>Euphorbia hirta</i>
<i>Lantana sp.</i>	<i>Echinochloa colona</i>
<i>Leuceana leucocephala</i>	<i>Andropogon gayanus</i>
<i>Calotropis procera</i>	<i>Aerva javanica</i>
<i>Merremia spp.</i>	
<i>Bidens pilosa</i>	
<i>Cenchrus ciliaris</i>	



*Hyptis suaevolens* and seedlings



*Passiflora foetida*



*Azadirachta indica*



*Pennisetum pedicellatum*

## KNOWN WEEDS IN MIRIMA NATIONAL PARK

### Impact and past control actions

SPECIES	LOCATION	IMPACT	PAST CONTROL	NOTES
<i>Azadirachta indica</i>	Common in Lily Creek, western and southern side of park on sand plain and fractured gullies	Competes with native shrubs and trees, especially those in riparian areas	Lily Creek, visitor area and entrance road grubbed and sprayed	Seed spread by frugivores. Constant reinfestation from Kununurra town site Community initiative to remove from Kununurra
<i>Bidens pilosa</i>	Lily Creek (entire length) visitor areas	Competes with native herbs, can form monoculture, especially in riparian and damp areas can form monocultures on wet season herb fields.	Grubbed & sprayed.	Easily spread, can complete a life cycle in 4-6 weeks.
<i>Calotropis procera</i>	Uncommon, sparsely distributed on sand plain and fractured gullies	Low environmental impact	Individuals grubbed	Favours disturbed areas e.g. annual fire, grazing. Removal of disturbance achieved eradication at Point Springs NR. 'fluffy' seeds spread over vast distances by wind.
<i>Cenchrus ciliaris</i>	Lily Creek and visitor areas	Nuisance to visitors Negligible environmental impact	Sprayed & grubbed in visitor areas	Easily spread by burrs, favours disturbed sites (fires and grazing)
<i>Hibiscus sabdariffa</i>	Uncommon, occasionally on sand plain	Negligible environmental impact	None	
<i>Hyptis suaveolens</i>	Lily Creek (entire length) and end car park	Can form monocultures in riparian and wet areas	Grubbed and sprayed in Lily Creek and visitor areas.	Annual to perennial. Seed burr easily spread. Can germinate and set seed in only four weeks. Multiple germination when moisture available. 3-4 year seed viability. Reinfestation from townsite. Disturbance opportunist
<i>Lantana camara</i>	End carpark (boab)	Displaces shrubs	Single plant removed	One off occurrence. Single specimen also found on Kelly's Knob
<i>Leuceana leucocephala</i>		Displaces vegetation, especially in riparian zone. massive seedling recruitment.		
<i>Macroptilium atropurpureum</i>	Lily Creek and end car park	Smothering vine that can dominate site	Sprayed, but control in Lily Creek ineffective	
<i>Merremia aegyptia</i>	Entrance road	Displace natives and alters flammability	Grubbed and sprayed	Continual reinfestation from town site
<i>Passiflora foetida</i>	Lily Creek, end car park, moist areas	Smothering vine that can totally dominate sites, particularly riparian areas	Some grubbing and spraying	Widespread, continual reinfestation from birds. Responds well to natural flood events.
<i>Pennisetum pedicellatum</i>	Lily Creek, end car park entrance road	Displace native grasses and alters natural fire behaviour	Spraying?	

Mirima National Park is well surveyed. Most of the park has been visited by staff in the past 15 years. See Figure 1

Weed locations are shown on Figures 2 and 3.

## STRATEGIC PRIORITIES FOR ACTION

Priority = high, moderate, low

<b>PRIORITY</b>	<b>OBJECTIVE</b>	<b>STRATEGY</b>	<b>ACTION</b>	<b>RESPONSIBILITY</b>
High	Evaluate weed control actions to date in Mirima	Prepare Weed Control Strategy and evaluate past control to strategy	Write Strategy Meet to evaluate report	Strategy– District Conservation Officer (DCO) & Regional Nature Conservation Officer (RNCO) Meeting - above plus Regional Leader Nature Conservation (RLNC) .
High	Readily accessible records of weed control operations	Electronic Database	Create Access data base and instruct relevant staff on its use	DCO to modify and train nominated others
High	Minimise impact of weeds in Mirima National Park	Use Strategy to prioritise works and create works program	Undertake control operations	DCO
High	Evaluate efficacy of weed control strategy	Monitoring Program to feed into adaptive management	Implement monitoring program and annually evaluate Mirima Weed Control Strategy	DCO RNCO RLNC

**SPECIES BY SPECIES PRIORITIES FOR ACTION**

	<b>SPECIES</b>	<b>LOCATION</b>	<b>OBJECTIVE</b>	<b>ACTION</b>	<b>NOTES</b>
Moderate	<i>Azadirachta indica</i>	Western and southern edges on sand plain and in fractured gullies	Minimise impact	Annual grubbing or herbicide application. Survey and monitor Community education with Ord Land and Water	Constant reinfestation from trees in Kununurra townsite. Utilise community volunteers
High	<i>Bidens pilosa</i>	Lily Creek Walk trails	Minimise Impact	Survey and treat when soil is moist- at least once a month from November to May. Monitor	Constant reinfestation from external sources
Low	<i>Calotropis procera</i>	Sandplain Visitor areas Fractured gullies	Remove	Grubb or herbicide as part of other operations	
Low	<i>Cenchrus ciliaris</i>	Walk trails Visitor areas Lily Creek	Remove	Apply herbicide as part of higher priority operations	
Low	<i>Hibiscus sabdariffa</i>	Sandplain Fractured gullies	Remove	Remove during other operations	
High	<i>Hyptis suaveolens</i>	Lily Creek End carpark	Eradicate on upper creek. Control on lower creek	Survey and treat when soil is moist, at least once a month from November to May Monitor	Constant reinfestation from external sources
Moderate	<i>Lantana camara</i>	End car park	Monitor	Inspect site at least once per year	Under large boab adjacent to shade shelter, end carpark
Low	<i>Leuceana leucocephala</i>				
High	<i>Macroptilium atropurpureum</i>	Lily Creek End car park roundabout	Eradicate	Grub and spray Monitor	Resistant to Glyphosate, trial other herbicides
High	<i>Merremia aegyptia</i>	Entrance Road	Eradicate	Spray Monitor	Spot infection
Moderate	<i>Passiflora foetida</i>	Lily Creek	Ameliorate smothering effects	Grub and spray as part of other operations	
High	<i>Pennisetum pedicellatum</i>	Lily Creek Entrance road	Eradicate	Spray Monitor	Small area Field id only near

## WEED CONTROL

NB For use of a chemical that is not registered for a particular weed, an application must be made for species/site registration.

Species in Mirima	Source	control method	On or off label
<i>Azadirachta indica</i>	Scott Goodson (DOE) Allan Thomson (CALM)	Access (triclopyr + picloram): diesel (1:60) basal bark, 1m of trunk (360°). 50 - 80% Roundup (Glyphosphate) – Cut stump.	
<i>Bidens pilos</i>	Allan Thomson (CALM)	1% Roundup:water + 0.3% wetting agent. Or, hand pull.	On Roundup is registered for use on 'broadleaf herbs'.
<i>Calotropis procera</i>	DAWA Declared Plant Control Handbook.	Access:Diesel 1:60 (cut stump or basal bark) Grazon (triclopyr + picloram):Water 1:200 (foliar,seedlings) Tordon (picloram + 2,4-D):water 1:50 (cut stump seedlings only) Dig out small plants.	on
<i>Hyptis suaevolens</i>	A. Thomson (CALM) and Andrew. Mitchell (AQIS)	2,4-D:water <1:100, + 1% wetting agent. Use fine mist spray and 'waft' over plant. Hand pull	
<i>Leuceana leucocephala</i>	QLD Government Natural Resources and Mines	Access:Diesel 1;60 (cut stump or basal bark)	on
<i>Macroptilium atropurpureum</i>		? glyphosphate	
<i>Passiflora foetida</i>	Rod O'Donnell (CALM)	? glyphosphate (foliar), pull by by tap root.	
<i>Pennisetum sp.</i>	Kristine Brooks (CDU, NT) and A Thomson (CALM)	glyphosphate:water 1:100 + 0.2% wetting agent. Spray before seeding (approx March) (proven effective on <i>P. polystachion</i> )	Off
<i>Merremia spp.</i>	A Thomson (CALM)	Roundup:water (1:100) + 0.3% wetting agent.	
<b>Potential weeds</b>			
<i>Aerva javanica</i>	Rod O'Donnell (CALM)	Hand grub and burn (including seed bank beneath), Glyphosphate (%) and burn (to remove seed bank)	
<i>Andropogon gayanus</i>		Glyphosphate:water 1:100 + wetting agent when plant actively growing. Use 2:100 if plant is stressed.	
<i>Bidens bipinnata</i>		?glyphosphate	
<i>Echinochloa colona</i>		?glyphosphate	
<i>Euphorbia hirta</i>		?glyphosphate	
<i>Gomphrena celosiodes</i>		?glyphosphate	

## ENVIRONMENTAL IMPACT ASSESSMENT

Specific weed control operations should be assessed as to any negative impact on the conservation values of Mirima National Park before commencement.

Items to consider include

- Erosion – will removal of weed cover expose soil to erosion, especially in Lily Creek
- Non-target species – misidentification, specificity of herbicide, residual properties, application rates.
- Pollution of watercourses – careful, specific use of herbicide or alternately grub near watercourses
- Spread of weed seed – ensure operations do not themselves spread seed

## MONITORING AND EVALUATION PROGRAM

Procedures should be developed whereby the efficacy of weed control operations in Mirima National Park can be assessed.

To facilitate this:

- The existing database should be modified to become include a user friendly “form”.
- Every weed control activity should be entered in this database, (including a GPS location).
- Staff need to be made aware of the database and instruction given on its relatively simple use.
- Flexfields need to be created and used identifying weed control operations in Mirima National Park.
- A monitoring program established to determine rate of weed spread, and the effectiveness of chemical and manual weed control. This may initially be achieved with annual photographic monitoring points at strategic sites along Lilly Creek and walk trails.
- Annual survey program. This should be considered for late the wet season when weeds have had the opportunity to germinate and new infestations can be identified early in the establishment phase. Many weeds will also flower and fruit following rain events, improving the opportunities for accurate species identification.
- Maintain records of *local* fruiting and flowering periods and of seedling habit (to improve opportunities for successful monitoring).

Weed control operations in Mirima have mostly finished by the end of the Wet season, which coincides with the annual budget preparation cycle. A report of previous works should be prepared, noting especially what outcomes were achieved by those works. The report should be reviewed by the Regional Leader, Nature Conservation and staff involved in the works. Outcomes, strategies and operations should be reviewed and where necessary modified.

## RESOURCE REQUIREMENTS

ACTION	DAYS	STAFF	VEHICLE	MATERIALS
Modify Database	2	DCO & RLNC		
Control Activities	Unknown until priorities have been set			
Monitoring	Unknown until methodology developed and priorities set			
Evaluate efficacy of strategy	1	DCO NCO RLNC		

Days allocated to chemical control = ?? = \$\$\$ by RIC and NCO.....

Chemicals + diesel + wetting agent \$7000/yr

Training \$5000 for first 2 years

Library \$200/year

Equipment maintenance \$1,500/yr

First Aid and Safety gear \$200/yr

Volunteer costs (food, safety gear, spray units) (relative to project size)

Spray units and maintenance \$500/yr

Quad Bike \$?? / 3 years

Aerial photos and mapping expertise \$1000 year 1

Wet season mobilization of equipment and persons: n/a

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**SIGNED OFF BY:**

**Ranger In Charge:**

**District Manager:**

**Regional Leader Nature Conservation:**

**Regional Manager:**

# MIRIMA NATIONAL PARK WEED AND SURVEY LOCATION MAPS

Maps produced by Allan Thomson

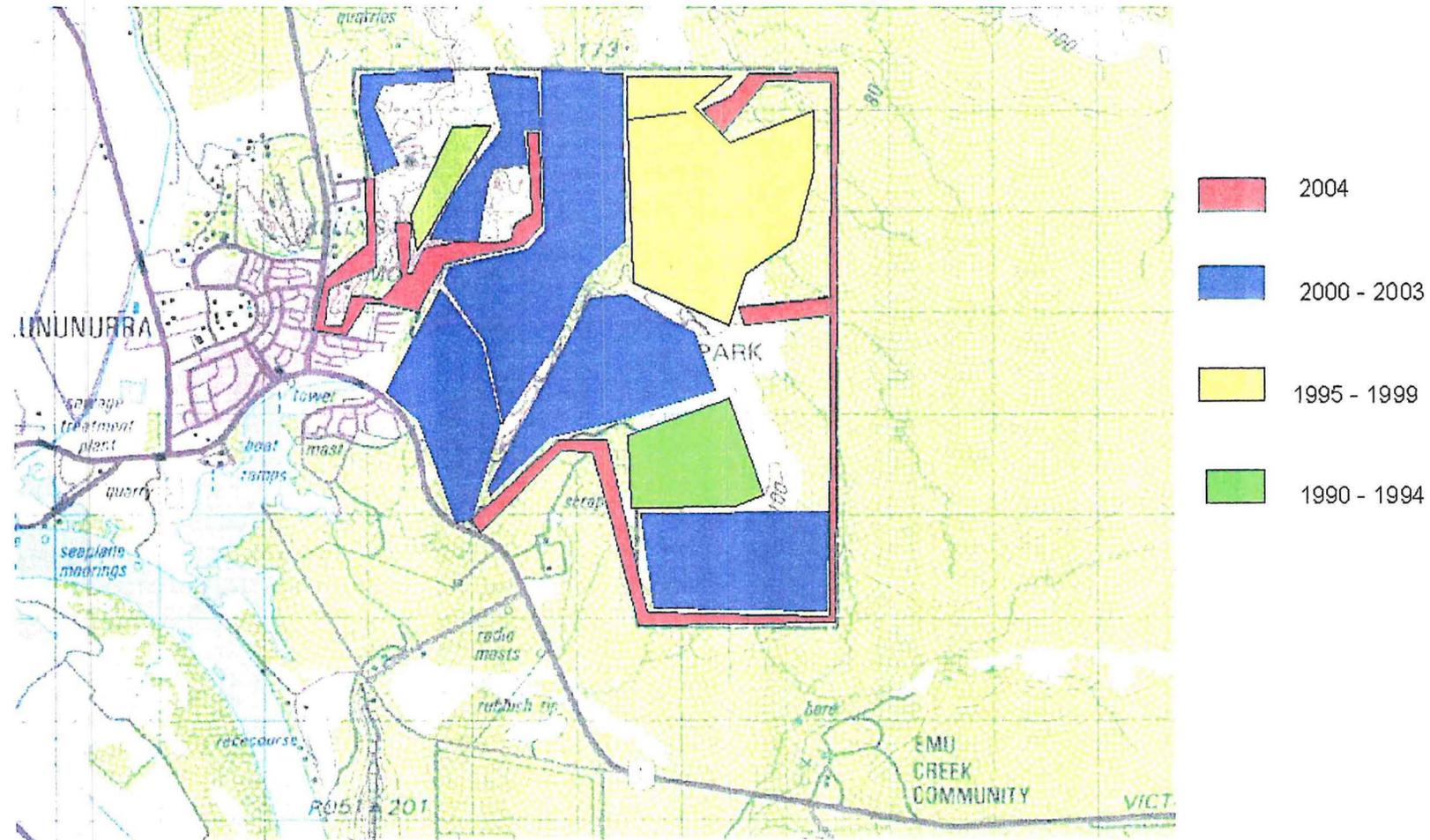
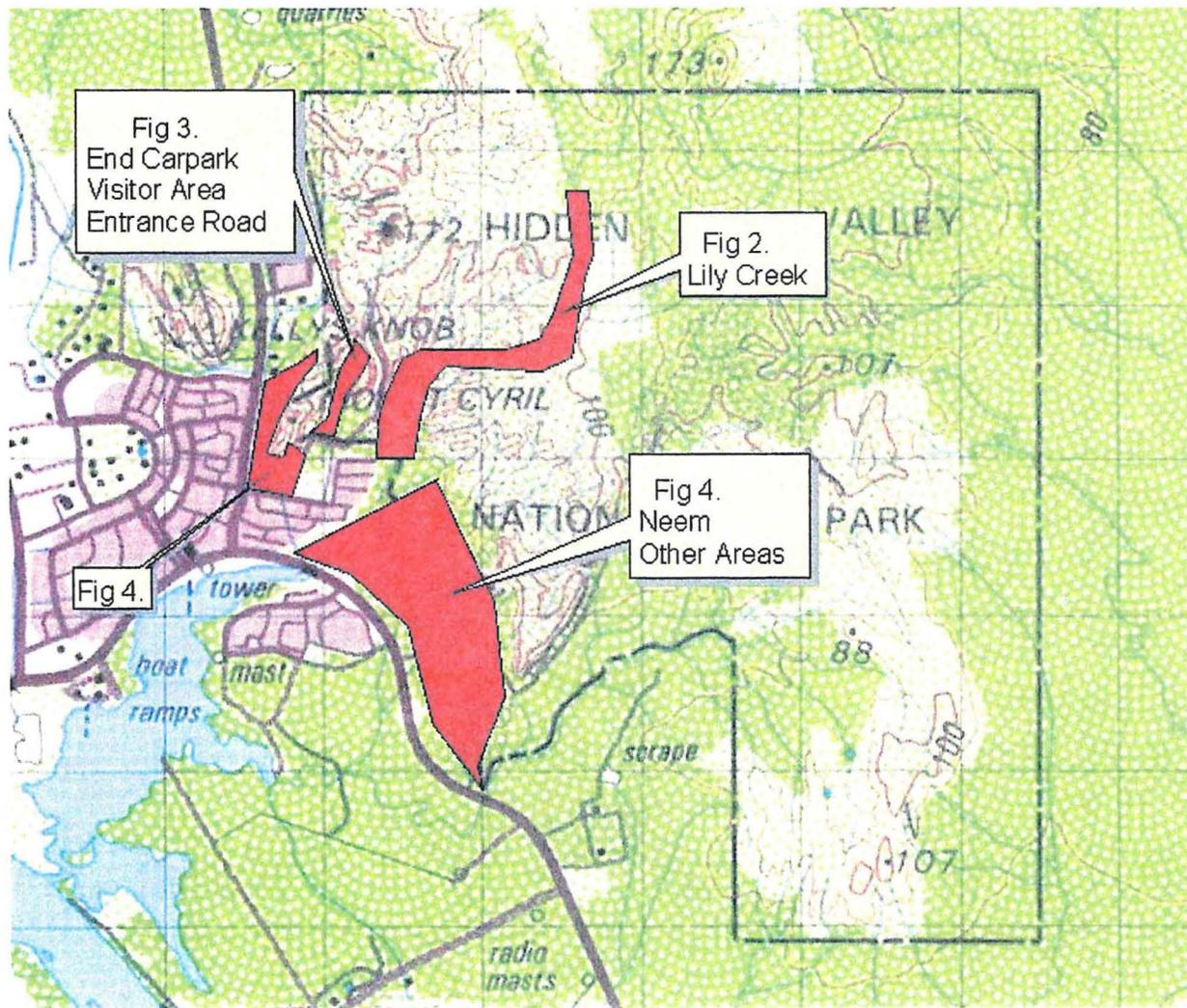


Figure 1 – Locations surveyed and years surveyed – Mirima National Park.



**Figure 2 – Map Index, Mirima National park**

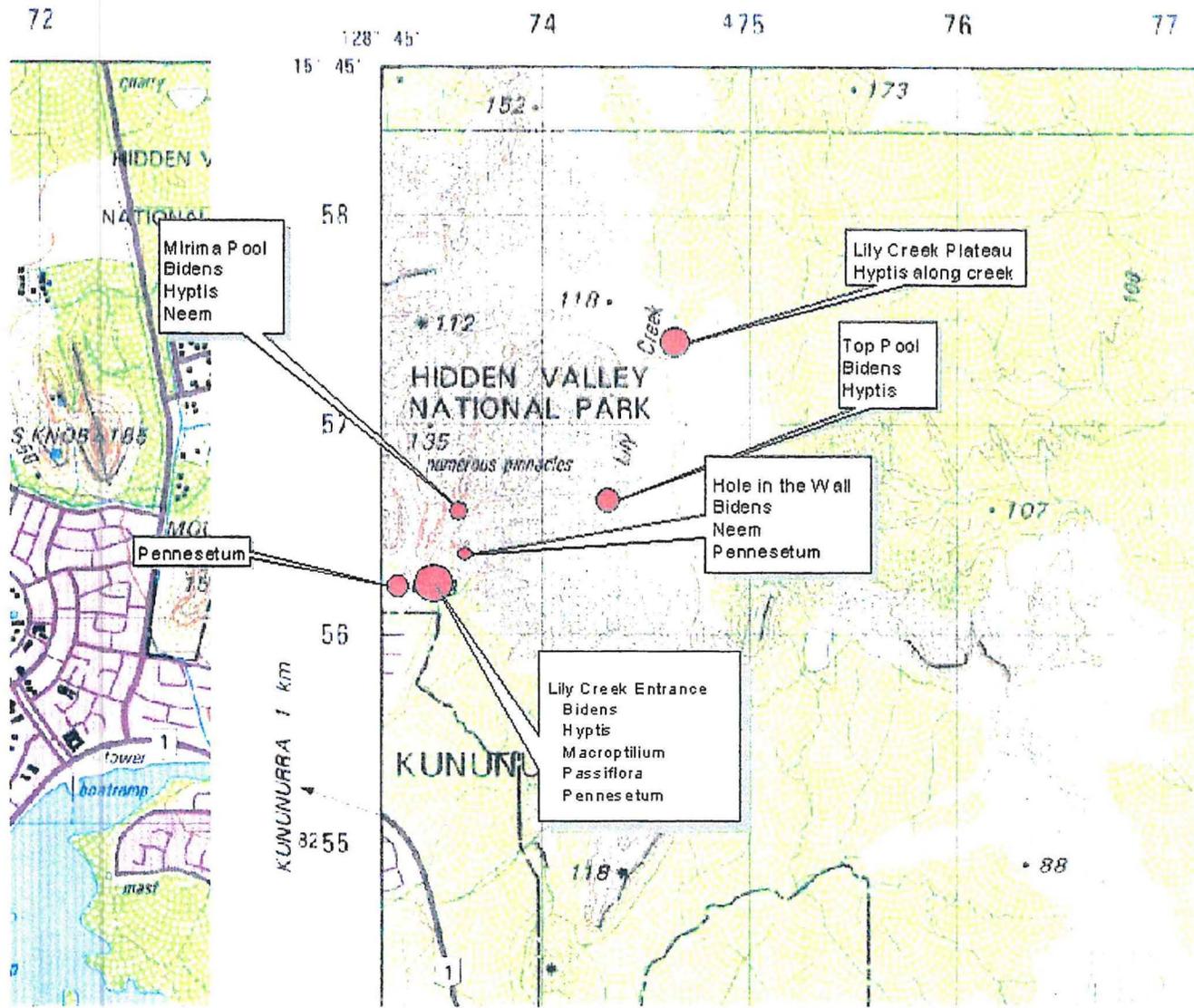
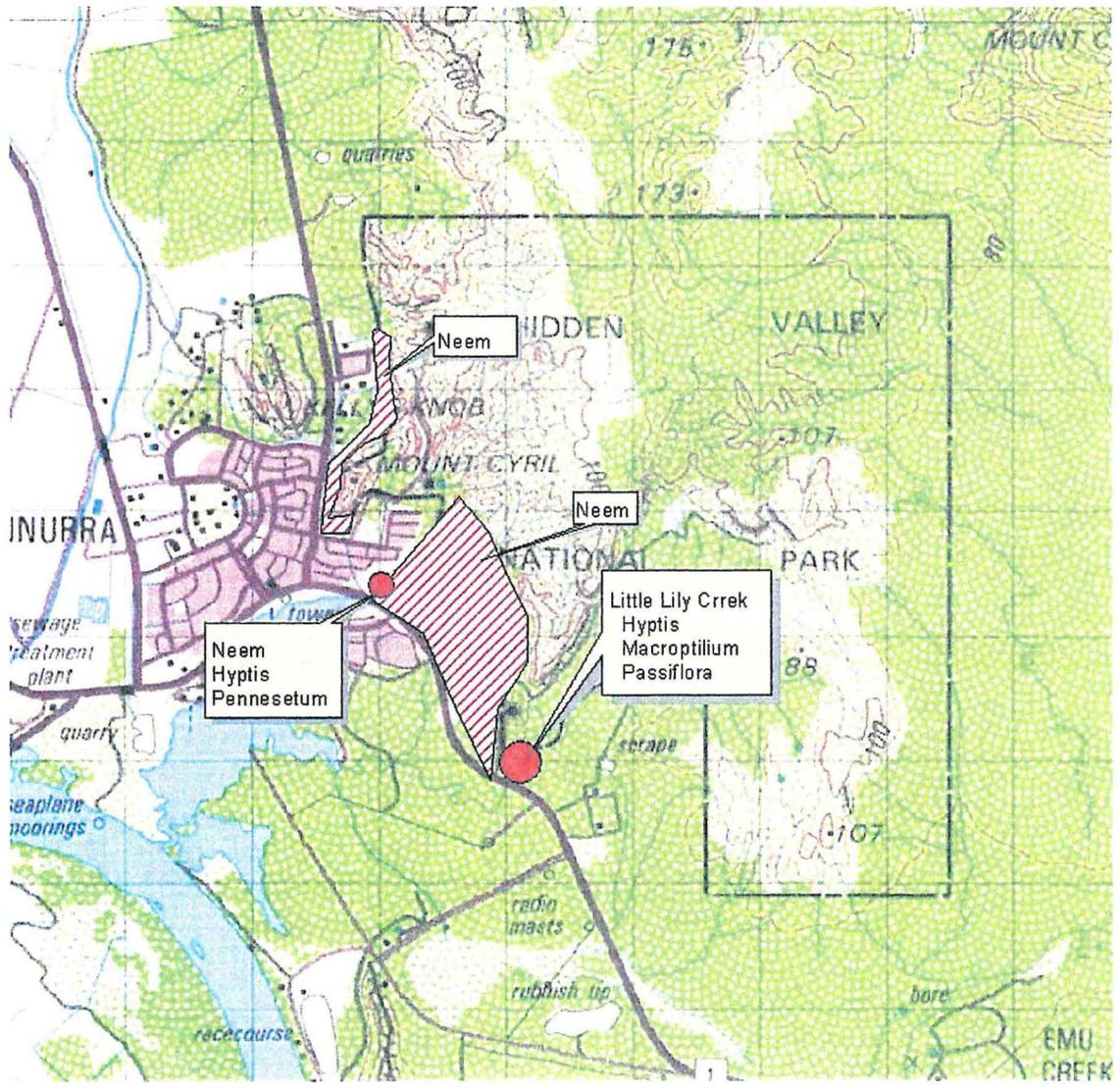
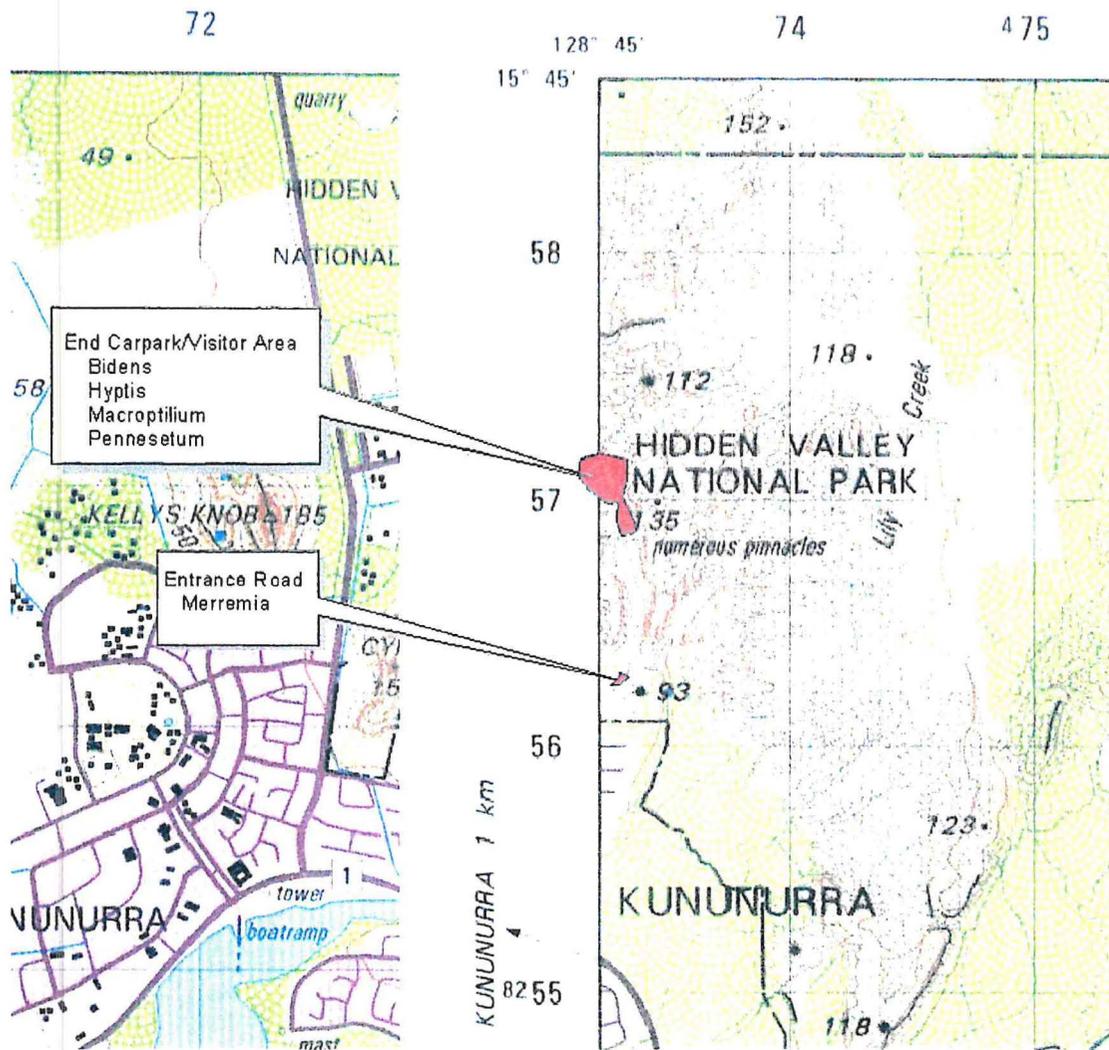


Figure 3 – Lily Creek



**Figure 4 – Neem and Other Areas**



**Figure 5 – End carpark, visitor area and entrance road**

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Personal Communication

Derek Goddard – Department of Agriculture WA, Kununurra (December 2004)

Noel Wilson – Department of Agriculture WA, Kununurra (December 2004 and January 2005)

Allan Thompson – Department of CALM, Conservation officer Kununurra (December 2004)

Gordon Graham – Department of CALM, Regional Nature Conservation Leader (November to January 2004/5)

Andrew Mitchell – Australian Quarantine Inspection Service, Darwin (December and January 2004/5)

## APPENDIX 1

Exiting and potential weeds on conservation estate						
Weed Species	Common Name	Declared In WA	WONS***	of Regional Significance	Future Threats**	Introduced Pasture Species
<i>Acacia nilotica</i>	Prickly Acacia	P1/2	Yes	Yes	Yes	Yes
<i>Acacia farnesiana</i>	Mimosa Bush					
<i>Acanthospermum hispidum</i>		Prohibited				
<i>Achyranthes aspera</i>	Chaff Flower					
<i>Althernanthera pungens</i>	Khaki Burr					
<i>Amaranthus viridis</i>	Green Amaranth					
<i>Antigonon leptopus</i>	Coral Vine					
<i>Aerva javanica</i>	Kapok Bush					
<i>Andropogon gayanus</i> *	Gamba Grass			Yes	Yes	Yes
<i>Annona glabra</i>	Pond Apple	Prohibited	Yes			
<i>Azadirachta indica</i>	Neem			Yes	Yes	
<i>Barleria prionitis</i>	Porcupine Flower		(Alert)		Yes	
<i>Bidens bipinnata</i>	Cobbles Peg					
<i>Bidens pilosa</i>	Cobblers Peg					
<i>Brachiaria mutica</i>	Mission Grass			Yes	Yes	Yes
<i>Cabomba caroliniana</i>	Cabomba	P1/2	Yes	Yes	Yes	
<i>Calotropis procera</i>	Rubber bush			Yes		
<i>Cardiospermum halicacabum</i>	Small Balloon Creeper					
<i>Cassia fistula</i>	Golden Shower Tree					
<i>Cenchrus biflorus</i>	Gallon's Curse					
<i>Cenchrus ciliaris</i>	Buffel Grass			Yes		Yes
<i>Cenchrus echinatus</i>	Mossman river Grass	Prohibited				
<i>Cenchrus setiger</i>	Birdwood Grass					
<i>Chloris infata</i>	Purple Top Chloris					
<i>Citrullus colocynthis</i>	Pie Melon					
<i>Citrullus lanatus</i>	Pie Melon					
<i>Clitoria ternata</i>	Butterfly Pea					
<i>Cryptostegia grandiflora</i>	Rubber Vine	P1/2	Yes	Yes	Yes	
<i>Datura innoxia</i>	Downy Thornapple					
<i>Echinochloa colona</i>	Awnless Barnyard grass					
<i>Echinochloa polystachya</i>	Aleman Grass			Yes	Yes	Yes
<i>Eichhornia crassipes</i>	Water Hyacinth	P1/2		Yes	Yes	
<i>Euphorbia hirta</i>	Asthma Plant					
<i>Grewia asiatica</i>	Phassa					
<i>Heliotropium indicum</i>						
<i>Hibiscus sabdariffa</i>	Rosella					
<i>Hymenache amplixicaulis</i>	Hymenachne		Yes	Yes	Yes	Yes
<i>Hyptis capitata?</i>		Prohibited				
<i>Hyptis suaveolens</i>	Mint Bush	Prohibited		Yes		
<i>Jatropha gossypifolia</i>	Bellyache Bush	P1/3		Yes		
<i>Lantana spp.</i>	Lantana		Yes			
<i>Leucaena leucocephala</i>	Leuceana	Prohibited		Yes		Yes
<i>Limnocharis flava</i>	Yellow Burrhead	Prohibited				
<i>Macroptilium atropurpureum</i>	Siratro					
<i>Martynia annua</i>	Devil's Claw	P1/2		Yes		
<i>Merremia aegyptia</i>	Hairy Merremia					
<i>Merremia dissecta</i>						
<i>Mimosa pigra</i>	Giant Sensitive Plant	P1	Yes	Yes	Yes	
<i>Parkinsonia aculeata</i>	Parkinsonia	P1/4	Yes	Yes		
<i>Parthenium hysterophorus</i>	Parthenium Weed	P1	Yes	?	Yes	
<i>Passiflora foetida</i>	Passionfruit vine			Yes		
<i>Pennisetum polystachion</i>	Mission Grass	Prohibited		Yes	Yes	Yes
<i>Pennisetum pedicellatum</i>	Deenarth Grass			Yes		
<i>Physalis minima</i>	Wild Goosberry					
<i>Prosopis spp.</i>	Mesquite	P1/2	Yes	Yes		Yes
<i>Salvinia molesta</i>	Salvinia	P1/2	Yes	Yes	Yes	
<i>Senna obtusifolia</i>	Sicklepod Senna	P1/2				
<i>Sida acuta</i>	Spinyhead Sida	P1				
<i>Stylosanthes spp.</i>	Stylo					Yes
<i>Tamarix aphylla</i>	Athel Pine	Prohibited	Yes			
<i>Themeda quadrivalvis</i>	Grader Grass	Prohibited		Yes		
<i>Thunbergia grandiflora</i>	Blue Trumpet Vine	Prohibited				
<i>Thunbergia laurifolia</i>	Laurel Clock Vine		(Alert)			
<i>Tribulus terrestris</i>	Caltrop					
<i>Xanthium strumarium</i>	Noogoora Burr	P4*		Yes		
<i>Ziziphus mauritiana</i>	Chinee Apple	P1/P5*				

\* Declared only in Broome, Derby West Kimberley, Halls Creek and Wyndham East Kimberley  
\*\* These species are weeds which have the potential to establish in the Kimberley region on conservation estate.  
\*\*\* Weeds of National Significance (WONS) and ALERT weeds (potential threats) were nominated by researchers and scientists to foster an Australia-wide, focused approach to weed control.

P1 Prevention of trade, sale or m  
P2 Plants to be eradicated from the state  
P4 Plants that should be prevented from spreading from that area of the state  
P5 Infestations on public lands should be controlled.

This table was compiled with the assistance of: N Wilson (AgWA Kununurra) and A Mitchell (AQIS)  
Smith, 2002; Humpries, Groves and Mitchell, 1991; Wilson, N.; Mitchell, A., Goddard, D., pers comm. WONS and ALERT lists  
www.weeds.org.au, www.agric.wa.gov.au.



APPENDIX 3

WEED SPECIES	ENVIRONMENTAL IMPACT OF WEED SPECIES	WEED HABITAT
<i>Alopecurus pratensis</i>	Readily forms vast sward thickets. Outcompetes native species and converting grass land to shrub land. Below sward by cattle, road trains and flood events	Mitchell Grass downs, on natural or man-made water courses
<i>Alopecurus pratensis</i>	Occurs in varying densities. Capable of creating sward unpenetrable thickets, outcompeting native species	Disturbance opportunist of overgrazed rangelands
<i>Alopecurus pratensis</i>	Outcompetes native species. Loose, large seed bank	Disturbed sites, sun loving
<i>Achyrocline satureioides</i>	Flowers heads probably and dispersal area of seed upon dispersal agents (people, animals, vehicles) at earliest contact. Forms monocultures which exclude any movement	Open forests, riparian riparian zone and disturbed sites
<i>Albertynia purpurina</i>	Nuisance weed of growing concern, outcompetes grasses and cereals - thus readily dispersed to new sites	Dry areas in disturbed situations
<i>Amorpha canescens</i>	Invades primarily on agricultural pursuits	Disturbed sites
<i>Arundo donax</i>	Aggressive vine weed, forms dense thickets and outcompetes native species. Tolerant to flood conditions and salt water. Threat to Melaleuca wetlands and mangroves	Fresh and brackish swamps, creeks and rivers, coastal (rainforest and roadkills) (GLD NT)
<i>Arundo donax</i>	Capable of choking out native vegetation and occupying large areas	Sites with high water table, such as edges of Lake Kununurra
<i>Avena javanica</i>	Early coloniser of disturbed sites, mass producer of wind dispersed seed (chaff) which can cause plants to occur in hard to access locations. Serotinity of impact debatable	An alkaline soil specialist at disturbed sites such as roadkills
<i>Andropogon distans</i>	Capable of altering natural fire regimes and causing very hot fires. Altered fire regimes and outcompetes of native species can cause an alteration in natural vegetation assemblages	Typically sites with over 500mm of rainfall. Potential habitat in the east and west North Kimberley area
<i>Azadirachta indica</i>	Potential for serious, widespread occurrence in Kimberley. Capable of outcompeting native species. Seeds spread readily by birds	Appears to have varied tolerances. Often occurs under trees (as dispersed by birds)
<i>Bambusa nana</i>	Highly invasive, forming dense thickets, a particular risk to riparian zone	Wetlands, open woodlands, disturbed sites (roadkills and overgrazed rangelands) (in WA)
<i>Bambusa nana</i>	Nuisance weed, which should be controlled where possible	D-mulch areas, riparian zone, riparian zone
<i>Bidens pilosa</i>	Outcompetes native vegetation, destroys water bird breeding habitat, chokes streams - forms dense mats and traps soil causing infl of wetland	Disturbed riparian areas and wetlands
<i>Bidens pilosa</i>	A major aquatic weed capable of choking out water ways. Stagnates and deteriorates water quality	semi aquatic in wetlands and shallow streams. Grows in water 2m deep and on dry land
<i>Calophila procera</i>	Aesthetically unattractive. Regarded by some as having reached maximum levels in East Kimberley. Concern for continued establishment, especially in coastal vegetation	Submerged aquatic, rooted to substrate or fine floating. Slow and slow moving water ways
<i>Cardiospermum halimifolium</i>	Generally minor	Disturbance opportunist of overgrazing and roadkills. Habitat variable
<i>Cardiospermum halimifolium</i>	Woodch virus of moderate impact	Flood plains
<i>Conyza bonariensis</i>	Nuisance weed, seeds readily attaching to objects of dispersal. Can infest compounds thus should be controlled to prevent further dispersal	Riparian and river margins
<i>Conyza bonariensis</i>	Outcompetes native vegetation systems and having a dramatic effect on natural fire regimes and thus natural vegetation composition and native fauna resources in mesic areas. Pasture species occupying large areas	Disturbance opportunist in dry areas. Widespread on river systems
<i>Conyza bonariensis</i>	Nuisance weed, seeds readily attaching to objects of dispersal. Can infest compounds, thus should be controlled to prevent further dispersal	moist areas and flood plains, also in semi and landlocked (not desert)
<i>Conyza bonariensis</i>	Outcompetes native species	Widespread on river systems, generally occupying habitat with higher water occurrence than that of C. bonariensis
<i>Conyza bonariensis</i>	Widespread, aggressively outcompetes native species (note: slashing or grazing recorded as ineffective control)	water courses
<i>Conyza bonariensis</i>	Rapid invader. Toxic	disturbed areas (roadkills), river banks
<i>Crotalaria retusa</i>	Capable of choking out native vegetation and occupying large areas. Biopersistent, more widespread	coastal in N.G.D., included rangelands, woodland and disturbed rainforest
<i>Crotalaria retusa</i>	Smotherer from ground layer to canopy (to 40m). Destroys riparian vegetation and native animal habitat. Provides habitat for feral animals. Blocks water way access, monoculture forming	rangelands, roadkills, disturbed water courses
<i>Crotalaria retusa</i>	Aggressive, forming monoculture	
<i>Crotalaria retusa</i>	A serious weed of agriculture. Displaces native grasses	
<i>Crotalaria retusa</i>	Outcompetes native vegetation, destroys water bird breeding habitat, chokes streams - forms dense mats and traps soil causing infl of wetland. Considered more serious than <i>Brachiaria distachya</i>	semi aquatic, in wetland water to 2m deep and on dry land
<i>Crotalaria retusa</i>	Capable of choking out native vegetation and occupying large areas. Biopersistent, more widespread	Flooding aquatic. High nutrient levels, standing surface water
<i>Crotalaria retusa</i>	Generally regarded as a low weed. Potential for serious impact minimal	Riparian areas
<i>Crotalaria retusa</i>	Forms dense thickets. Resistant to fire and drought	Venerable riparian, vine thicket, woodlands, coastal
<i>Crotalaria retusa</i>	Potential for invasion in isolated areas. Capable of forming dense thickets along waterways	Widespread in disturbed riparian areas
<i>Crotalaria retusa</i>	Capable of choking out native vegetation	Generally sites disturbed by stock, creeklines
<i>Crotalaria retusa</i>	Capable of choking out wetlands and modify estuary by forming dense mats and trapping silt. Potentially a very serious weed in the Kimberley	semi aquatic. In wetlands and streams and water up to 2m deep and on dry land
<i>Crotalaria retusa</i>	Widespread, monoculture forming, outcompetes native species, removing native fauna habitat	Disturbance opportunist. Often near creeks, rivers etc
<i>Crotalaria retusa</i>	Outcompetes native species, especially along water ways. Proving difficult to remove	Semi and disturbed areas and water ways
<i>Crotalaria retusa</i>	Forms dense thickets and is capable of outcompeting native species. Not indicating very invasive tendencies in Kimberley region	
<i>Crotalaria retusa</i>	Forms dense thickets out competes native species. Produces large amounts of seed. Potential threat to rangelands and riparian areas	coastal margins, wetlands, riparian sites (disturbed and undisturbed) waste sites
<i>Crotalaria retusa</i>	Chokes out native vegetation	emergent aquatic. Still fresh water, wetlands swamps, slow moving waterways, irrigation channels (GLD)
<i>Crotalaria retusa</i>	Widespread in Kimberley. Capable of smothering all vegetation layers	Disturbance opportunist, however not found in areas with livestock
<i>Crotalaria retusa</i>	Monoculture forming. Outcompetes native species	riparian zone (Lake Kununurra)
<i>Crotalaria retusa</i>	Capable of choking out native vegetation and overgrowing waterways. Regarded as more invasive than <i>Marattia dissecta</i>	
<i>Crotalaria retusa</i>	Widespread around Broome and Kununurra. Capable of choking out native vegetation and overgrowing waterways. Difficult to control when widespread	roadkills, swamps, water courses and wetlands
<i>Crotalaria retusa</i>	Forms vast monocultures, high seed production. Outcompetes native species and destroys water bird habitat. Leaves bare earth/mud where removed	open wetlands and riparian vegetation associations
<i>Crotalaria retusa</i>	Forms dense thickets out competes native species especially in riparian zones and on flood plains. Produces large amounts of seed. Threatens water bird habitat	Disturbed sites (overgrazed rangelands) woodlands, grasslands
<i>Crotalaria retusa</i>	Leaves seed bank, releases chemicals which inhibit growth of other plants. Four weeks from germination to seed. Toxic	Most invasive in riparian zone
<i>Crotalaria retusa</i>	Forms dense monocultures smothering native species from ground level to canopy. Seeds spread by birds	dry forests and woodlands, roadkills
<i>Crotalaria retusa</i>	Forms dense monocultures, outcompetes native species. Alters natural fire regimes, causing very hot fires (which promote its growth). Changes natural vegetation assemblages	Disturbance opportunist
<i>Crotalaria retusa</i>	Impact regarded as negligible	Varied soil tolerance, prefers heavier soils such as black soil plains. Riparian zone and Mitchell Grasslands
<i>Crotalaria retusa</i>	Forms vigorous dense thickets, out competing native species. High seed production. Threat to rangelands	stationary and slow moving water with good nutrient status
<i>Crotalaria retusa</i>	Readily invades open water (can double population in 6 to 10 days). Capable of altering aquatic ecosystems - chokes out waterways, reduces oxygen levels which causes death of native aquatic flora and fauna	Disturbance specialist, particularly flood plains and rivers & lakes
<i>Crotalaria retusa</i>	High tolerance for various germination conditions. Capable of occurring in dense habitats, competes with native species	Disturbance opportunist
<i>Crotalaria retusa</i>	Widespread	
<i>Crotalaria retusa</i>	Forms dense populations, concentrates salts, can alter river flow patterns and cause erosion. Changes natural vegetation composition	inland waterways, grasslands, woodlands, disturbed sites (roadkills and overgrazed rangelands)
<i>Crotalaria retusa</i>	Currents isolated distribution in Kimberley. Outcompetes native grassland species and alters entire grassland ecosystem. Burns hot and re-colonises quickly	Typically exposed by earth moving machinery. Initial populations thus generally road kills
<i>Crotalaria retusa</i>	Threat to riparian zone thickets, riparian riparian zone, riparian zone and on flood plains. Produces large amounts of seed. Threatens water bird habitat	wetlands, woodlands, vine thickets and riparian rainforest. Disturbed sites (NT, QLD)
<i>Crotalaria retusa</i>	Smotherer from ground layer to canopy (to 40m). Destroys riparian vegetation and native animal habitat. Provides habitat for feral animals. Blocks water way access, monoculture forming	Disturbance opportunist
<i>Crotalaria retusa</i>	Widespread on Fitzroy, Nicholson and Ord Rivers. Sites commonly in riparian zone. Chokes out waterways and wet areas	Flood plains and creeks
<i>Crotalaria retusa</i>	Capable of forming impenetrable thickets, outcompetes native species	Associated with sites near water

This table was compiled with the assistance of Noel Wilson (DAWA) and Andrew Mitchell (AQIS)  
 Humphries, Groves and Mitchell, 1991, Smith, 2002, Wheeler, 1992, Hussey, Kalgheery, G.J., Cousins, R.D., Dodd, J., Lloyd, B.G., 1997  
 Navis, S, 2004  
 Not all weeds represented on this table currently occur in the Kimberley region, however they have been represented if they have the potential to do so