King Leopold Range Conservation Park (KLRCP)
Draft Weed Control Plan

Date: February 2006
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1. Background

King Leopold Range Conservation Park features a variety of landforms including rugged terrain with an elevation of up to 959m, steep valleys, rocky cliffs, dolorite, sandstone and alluvial plains.

Size: 392 100 ha

Vegetation

- Eucalyptus low open woodland with hummock grass understorey
- Eucalyptus woodland with tussock grass understorey
- Mixed open woodland over tussock grassland
- Sparsely wooded mixes species low woodland over sparse *Plectrachne/Triodia* hummock grassland on limestone
- Closed tussock grassland sparsely wooded
- Tussock grassland

Land Systems

- Precipice
- Looingnin
- Richenda
- Pigeon
- Amy
- O'Donnell
- Cowendyne
- Glenroy
- Burramundi
- Lubbock
- Forrest
- Rose
- Clifton

(North Kimberley Land Systems)

- Buldiva
- Napier
- Barton
- Kennedy
- Isdell

Past Use

- Traditional land use
- Grazing

2. Strategic Priorities for Action

Objective	Action	Time frame	Responsibility	Priority H=High M=Moderate L=Low
Build on experience	Evaluate weed control actions to date	Feb 06	RNC Officer NC Officer Senior Ranger	H
Weed control plan for KLRCP	Finalise weed control plan with maps and rolling works program	Apr 06	RNC Officer NC Officer Senior Ranger	H
Good record keeping and data accessibility	Cooperate in development of standardised record keeping and database. Training in use of database and access of data.	ongoing	RNC Officer RLNCO NC Officers Senior Ranger All Park staff	H
A certified and well prepared work team	Identify gaps in training, materials and equipment. Support and train staff in control methods, record keeping and monitoring and evaluation.	ongoing	Senior Ranger RLNCO RNC Officer NC Officers	H
Develop and implement works programs	Develop and implement works programs to control weeds in KLRCP	ongoing	Senior Ranger	H
Eradicate new, recent and low density incursions	Identify and implement achievable eradication projects	ongoing	Senior Ranger All Park staff RNC Officer NC Officers	H
Prevent entry and further spread of weeds in KLRCP	Control weeds in adjacent off reserves areas. Remove weeds from all visitor access areas to prevent weed spread within and among Parks. Control access to locations where visitors present a high risk of weed dispersal, including interpretation where appropriate. Assist in efforts to remove cattle from areas adjacent to national park to prevent spread of weeds by cattle.	ongoing	Senior Ranger All Park staff RNC Officer NC Officers	H
Education and Awareness for Park visitors	Establish a notice board dedicated to enhance weed awareness among visitors, focusing on how they can help. Include tour operators to enhance education and awareness.	ongoing	Senior Ranger All Park staff	M

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Objective	Action	Time frame	Responsibility	Priority H=High M=Moderate L=Low
Cooperate with all stakeholders in weed control.	Work in cooperation with TOs, mining companies and their contractors and tour operators.	ongoing	Senior Ranger All Park staff	M
Expand areas surveyed for weeds.	Survey all visitor areas within KLRCP. Work towards a complete survey of the park.	ongoing	RNC Officer NC Officers Senior Ranger All Park staff	H
Monitoring and evaluation of weed status, control activities and effectiveness	Revisit and monitor control sites and high risk invasion sites. Increase knowledge on weed status and effectiveness of control methodologies. Annual review of weed control plan.	ongoing	RNC Officer RLNCO NC Officers Senior Ranger All Park staff	H
Facilitate weed identification on Park.	Develop park specific field guide for weed identification.		RNC Officer Senior Ranger All Park staff	M
Confirm current status of old flora base records.	Utilise Flora Base resource to determine collection locations		Park Rangers NC Officer	L

3. Rolling Works Program Guidelines

Month	Action	Location	Priority H=High M=Moderate L=Low

4. Weed Profile

Weeds recorded/observed on site by CALM staff		
LATIN NAME	**COMMON NAME**	**OCCURRANCE**
Achyranthes aspera	Kimberley Tick Weed	
Aloe barbadensis	Aloe Vera	
Alternanthera pungens	Khaki Weed	
Calotropis procera	Rubber Bush	
Cassia fistula	Golden Shower	
Cenchrus biflorus	Gallon's Curse	
Cenchrus ciliaris	Buffel Grass	
Cenchrus echinatus	Mosman River Grass	
Clitoria ternata	Darwin Pea	
Colocasia esculenta	Taro	
Hibiscus sabdariffa	Rosella	
Hyptis suaevolens	Mint Weed	
Leuceana leucocephala	Leuceana	
Macroptilium atropurpureum	Purple Bean, Siratro	
Passiflora foetida	Passionfruit vine	
Sida acuta	Spiny Headed Sida	
Tamarindus indics	Tamarind	

Potential weeds (not limited to these species.)	
LATIN NAME	**COMMON NAME**
Aerva javanica	Kapok Bush
Acacia farnesiana	Prickly Acacia
Cenchrus ciliaris	Buffel Grass
Cenchrus echinatus	Mosman River Grass
Chloris inflata	Purple Top Chloris
Merremia aegyptia/dissecta	Hairy Merremia
Parkinsonia aculeata	Parkinsonia
Pennisetum pedicellatum	Deenanth Grass
Stylosanthes sp.	Stylo
Themeda quadrivalvis	Grader Grass
Tribulus terrestris	Caltrop

5. Past and Current Control Actions

Species	Location	Past & Current control techniques	Notes (including response to disturbance, dispersal and infestation issues.
Achyeranthes aspera	Riparian areas, tracks and trails.	Glyphosphate, grubbing, burning dead plants to reduce seed bank	Should be cleared from all path areas to prevent distribution by tourists within park and to other locations. Control cattle access.
Aloe barbadensis	Milliwindie Waterfall	No control	Possibly no longer present. May have been eradicated in recent fire events.
Alternanthera pungens	Car parks, grassed areas.	Grubbing, Glyphosphate, burning dead plants to reduce seed bank (douse with kero)	Should be cleared from all path areas to prevent distribution by tourists within park and to other locations.
Calotropis procera	Savanna grassland and riparian zone	Cut stump and basal bark Access:diesel Foliar spray of suckering plants with Glyphospate	Very hardy species, occurring in degraded and disturbed areas. Ideally controlled by reducing/removing disturbance where realistic. Glyphosphate application unsuccessful. Basal Bark with Access largely successful if applied according to label.
Cassia fistula	Silent Grove Campground / ranger station	Cut stump	Described by Smith (2002) as 'a weed of concern'. Removal a priority based on current limited distribution
Cenchrus biflorus		Grubb and hand pull, dry, then burn	Likely to be spread by bovine and human activity.
Cenchrus ciliaris	Savanna grassland, riparian areas	No control	Is favoured by fire and grazing. Widespread. Alice Springs and Airlie Isl are undertaking control programs.
Clitoria ternata		Find tap root and remove by hand	Possibly has the potential to become more severe – sleeper weed – or will be held in check by *P. foetida* (weed).
Colocasia esculenta	Mt Hart (second creek?) and Barker Pool.	Spraying with Glyphosphate (Taffy)	Re-grows from corms vigorously from slashing or mechanical control. Need to remove all in one round. Remove all tubers or will re-sprout. See 7.2

Species	Location	Past & Current control techniques	**Notes** (including response to disturbance, dispersal and infestation issues.
Hibiscus sabdariffa		Wrap in plastic and pull plant, burn.	
Hyptis suaveolens	Silent Grove campsite, edges of walk trails, Bell Gorge track	Glyphosphate, slashing, burning, grubbing	Capable of germinating and setting seed in ~4 weeks.
Leuceana leucocephala	Milliwindie Waterfall – creek tributary.	No control	Requires further survey – extent of infestation unknown, likely to occur entirely down river of current location, based on mass fruiting from trees on creek banks. Does not appear to rely on disturbance to take hold.
Macroptilium atropurpureum			Potential to become more severe. Town site infestation indicative of potential. DAWA expressed interest in introducing another *Macroptilium sp.* as a fodder legume.
Passiflora foetida	Wide spread	Find tap root and remove.	No further control methods have been seriously investigated. Hand removal trials at Windjana and TC NP in Oct 05 to be monitored. Requires early detection and on-going follow up measures.
Sida acuta	Silent grove camping and Rangers area.	Spraying and grubbing	Bio controls available – The Calligrapha beetle is bred at Frank Wise Research Institute in Knx
Tamarindus inducs	Milliwindi Waterfall	None	Specimen believed to have been planted. Recorded by Tim Willing. Unknown if there has been any successful recruitment.

6. Species by Species Priorities for Action

Species	Impact	Objective	Actions	Priority H=High M=Moderate L=Low
Achyranthes aspera	Out-competes native species. Nuisance burrs limit access.	Minimise impact	Trial chemical control and late wet season hand removal. Remove cattle.	M-H
Aloe barbadensis	Unknown	Remove	Identify if still present. If so, remove by grubbing.	L
Alternanthera pungens	Nuisance burrs	Minimise impact	Isolate infestation areas from visitors. Grub, apply chemicals or burn.	M
Calotropis procera	Out-competes native species. Creates dense thickets in riparian zones. Aesthetically unappealing.	Minimise impact	Identify achievable control locations (considering environmental impact of chemicals). Apply chemical when soil moisture low to nil. Remove source of disturbance – cattle and pigs.	H
Cassia fistula	sleeper weed?	Remove	Cut stump chemical application and replace with native trees.	H
Cenchrus biflorus	Nuisance burrs. Out-competes native grasses. Responds well to fire and increases fuel loads.	Minimise impact	Remove cattle. Identify extent of occurrence and most susceptible habitat. Control with chemical application or grubbing. Burn plant trash containing burs.	M
Cenchrus ciliaris	Out-competes native grasses – limits food availability for granivorous birds. Inhibits seedling recruitment. Increases fire fuel load and intensity	Minimise impact	Research existing programmes. Any large scale control to be ameliorated with native grass and other ground cover revegetation.	M
Clitoria ternata	Smothers native plants.	Minimise impact	Remove according to practicality.	M
Colocasia esculenta	Out-competes riparian and aquatic species. Can form monoculture.	Remove	Remove population. Use wick wiper application over water to prevent contamination. Hand removal requires total tuber removal. Revegetate site of heavy infestation.	H
Hibiscus sabdariffa	Unknown. Doesn't appear to be high impact weed.	Monitor	Opportunistic removal.	L

Species	Impact	Objective	Actions	**Priority** H=High M=Moderate L=Low
Hyptis suaevolens	Aggressive pan-tropical weed out-competing native species	Minimise impact	Employ a *regular* spray program on actively growing plants. Avoid slashing or burning. Investigate revegetation with native ground covers/grasses to inhibit re-establishment. Quarantine infested areas.	H
Leuceana leucocephala	Forms dense thickets in riparian zone, out-competing native plants. Seed set and recruitment massive and rapid.	Minimise impact	Identify extent of infestation. Eradication probably already impractical. Will require on-going chemical control. Identify most appropriate periods to apply chemicals. Prevent seed set.	H
Macroptilium atropurpureum	Smothers native species.	Minimise impact	Remove initially from isolated sites. Identify practicality of eradication	M-H
Passiflora foetida	Smothers all vegetation layers. Extremely vigorous.	Minimise impact	Investigate control options. Use volunteers for hand removal. Eradicate all isolated populations, especially those in permanently moist areas.	H
Sida acuta	Out-competes native species and potential to form monocultures.	Minimise impact	Determine if infestation is sufficient to apply for bio control. If not, continue to minimise impact.	H
Tamarindus indics	Unknown.	Eradicate	Remove tree and investigate whether there are any 'offspring'.	M

7. Species Characteristics

Species recorded and with potential to occur	**Type**	**Life Cycle**	**Flowering / Fruiting** (not necessarily local conditions)	**Dispersal**
Achyeranthes aspera	Herb/shrub	annual or perennial	March-August	Adheres, water
Aloe barbadensis	Herb (fleshy)	perennial		Vegetative
Alternanthera pungens	Herb	annual or perennial	December-May	Adheres, water
Calotropis procera	Shrub/small tree	perennial	April-August	Wind, water
Cassia fistula	Tree	perennial	December-January	
Cenchrus biflorus	Grass	annual	November-May	Adheres, water
Cenchrus ciliaris	Grass	perennial	November-May	Adheres, water
Cenchrus echinatus	Grass	annual or perennial	November-May	Adheres, water
Clitoria ternata	Vine	perennial	April- June	Wind, water
Colocasia esculenta	Semi aquatic/aquatic	perennial	Infrequent	Vegetative
Hibiscus sabdariffa	Shrub/herb	annual	May- June	Bird and animal faeces
Hyptis suaveolens	Shrub/herb	annual	March-August or when moist	Adheres, water
Leuceana leucocephala	Small tree	perennial	Throughout the year	Stock, wind, water
Macroptilium atropurpureum	Vine	perennial	March-July	Seed and stolons
Passiflora foetida	Vine	perennial	February-August	Bird and animal faeces
Sida acuta	Small shrub/herb	annual or perennial	April-Sept	Adheres
Tamarindus indicus	Tree	perennial	December-January	Birds?
Aerva javanica	Shrub	perennial	February-October	Wind, water
Acacia farnesiana	Shrub/small tree	perennial	May-November	Stock, wind, water
Chloris inflata	Grass	annual	April (when moist)	Wind, water
Merremia aegyptia/dissecta	Vine	perennial	May-June	Shattering capsules
Parkinsonia aculeata	Shrub/tree	perennial	May-August	Stock, wind, water
Pennisetum pedicellatum	Grass	annual	May-July	Wind, adheres, water
Stylosanthes sp.	Herb/shrub	perennial	April-December	Machinery, stock feed
Themeda quadrivalvis	Grass	annual or perennial	April	Transported, machinery
Tribulus sp. (terrestris?)	Herb	annual or biannual	February-August	Adheres, water

8. Control Methods

This list is not to be considered exhaustive, nor is the chemical status to be considered static. **Ongoing research is required to update and maintain this list.**

ALWAYS REFER TO THE PROCUCT LABEL AND MATERIAL SAFETY DATA SHEET (MSDS) BEFORE PURCHASING AND USING HERBICIDES.

MSDS and Product labels contain information essential information on chemical behaviour in the environment and guide in the environmentally and personally safe application of herbicide products. NOTE: some chemicals will not be appropriate, under any circumstances, for application on CALM managed lands.

Species	Source	Recommended Control	Plant Status Recommended spraying conditions	On/off* label
Acacia farnesiana	Dow Agro Sciences	Access: Diesel 1:60	Basal Bark on stems up to 5cm. Cut Stump for stems larger than this	On (Acacia spp.)
	Dow Agro Sciences	Starane: Water 3L/100L	Basal Bark on stems up to 5cm diameter.	On
Achyranthes aspera				
Althernanthera pungens	Summit Agro	2,4-D625: water 1.1-2.2L/ha	Spray as seedlings	Off in WA
Amaranthus viridis				
Calotropis procera	DAWA 2002	Access:Diesel. 1:60	Cut Stump or Basal Bark on larger trees	On?
	DAWA 2002	Tordon: water 1:50	Seedlings and small trees actively growing.	On?
	DAWA 2002	Grazon: water 1:200	Foliar spray to seedlings and small trees	On?
Cassia fistula	Suggestion: UN-TRIALED	Access: Diesel 1:60	Cut stump or basal bark	Off
Cenchrus biflorus		1% Glyphosphate + surfactant + ph buffer	Be aware that this is *Non Selective*	On
Cenchrus echinatus		1% Glyphosphate + surfactant + ph buffer	Be aware that this is *Non Selective*	On
Chloris inflata		1% Glyphosphate + surfactant + ph buffer	Be aware that this is *Non Selective*	On
Clitoria ternata	Suggestion UN-TRIALED.	2% 2.4-D: water + wetting agent	Foliar spray	Off

Species	Source	Recommended Control	Plant Status Recommended spraying conditions	On/off* label
Colocasia esulenta	EWAN Brochure	50% metsulfuron (.05g/L) +glyphosphate:water then…	Cut leaf stalk close to corm and paint. Do not cut when plant is exuding maximum sap, sap may push out chemical. (Late Dry best?).	Off
		Follow up with: 2%glyphosphate+.05g/L metsulfuron +2mL Pulse	Foliar spray any leaves emerging subsequent to treatment above. Subsequent to this physically remove emerging plants – entire corm.	Off
	Suggestion UN-TRIALED	Metsulfuron + glyphosphate: Water + sulfactant	Apply with wick wipers	Off
Hyptis suaveolens	QLD Dept Primary Industries 1977	2% 2,4-D		Off (QLD only?
	East Kimb. NCO	0.2% 2,4-D + surfactant.		
		Grub single plants		
Leuceana leucocephala	Dow Agro Sciences	Access: Diesel 1:60,	Basal Bark on stems up to 5cm. Cut Stump for stems larger than this.	On
Macroptilium atropurpureum	Summit Agro	2,4-D 625: water. 1.8L/ha	Foliar application	Off (NSW, QLD, TAS)
Parkinsonia aculeata	Dow AgroSciences DAWA, 2002	Access: Diesel 1:60,	Basal Bark on stems up to 5cm. Cut Stump for stems larger than this. DO NOT try to mix with water	On
	Dow AgroScience P. aculeata manual.	Grazon DS:water 350mL/100L + Uptake Spraying Oil.	Under 2m only. Foliar – whilst actively growing. Apply liberally, avoid when fruiting.	On
	DAWA, 2002	Garlon 600:diesel 1:60	When actively growing. Basal Bark application. May require follow up. Mix for same day use only.	On?
	DAWA, 2002	Velpar:water 35mL/10L	Do not spray in dry conditions and avoid fruiting periods. Foliar application.	On?
Passiflora foetida	Dow Agro Sciences	Starane: Water 450mL:100L	Established plants and regrowth.	On
		Pull roots where possible		

Species	Source	Recommended Control	Plant Status Recommended spraying conditions	On/off* label
Sida sp	Dow Agro Science DAWA 2002	Starane:Water 1000mL/100L	Seedlings, juveniles, flowering	On
Tamarindus indicus	Suggestion UN-TRIALED	Access:Diesel 1:60	Cut Stump or Basal Bark	
Tribulus terrestris	Dow Agro Sciences	Starane:Water 500mL/100L + 'Uptake' Spraying Oil.	Seedlings and up to 30cm diameter.	Off (QLD, NSW only)
	Nufarm	Roundup 360:water 90mL/15L	Be aware that this is *Non Selective*	On
	Summit Agro	2,4-D 625, 1.1L/ha	Foliar application	

*Anybody wishing to use chemicals which have not been registered for specific weed use is required to apply for the appropriate permit through the respective chemical company.

9. Environmental Impact Assessment

Weed survey and control operations must be mindful of potentially detrimental environmental impacts which occur as a result of these actions.
The following issues must be taken into consideration during the planning process. Impacts must be defined as manageable and therefore acceptable, or non acceptable. The management of the former must be determined and planning put in place prior to the outset of any field operations.

POTENTIAL IMPACT	POTENTIAL CAUSE	SUGGESTED MANAGEMENT
Erosion	Removal of weed cover exposes soil and un-consolidates soil.	Undertake weed control in manageable areas. Avoid large scale weed remove immediately prior to the wet season when winds and rain will exacerbate erosion. Where possible use selective herbicide.
Damage to non target species	Inappropriate herbicide selection. Nature of herbicide (residual, non selective, volatile, soil and aquatic half life, mobility etc) not understood.	Read herbicide label and MSDS carefully. Understand the terminology and the implications. Eg, do not apply highly mobile chemicals in the wet season. Understand soil type environmental which will effect the herbicide reaction. Also be aware of 'at risk' fauna species (terrestrial & aquatic).
Pollution of water courses	Inappropriate herbicide selection or herbicide applied at an inappropriate time.	Read herbicide label and MSDS carefully. Understand the terminology and the implications. Eg, do not apply highly mobile chemicals in the wet season. Do not apply water toxic chemicals near water. Be aware of wind direction, rain forecasts, chemical drift and volatility.
Spread of weed	Inadequate clean down efforts and/or facilities after weed control work.	Awareness. Know of all weeds in control area, even those which are not target weeds. Wear gaiters to limit burrs attaching to socks. Check vehicle for seeds before moving into and out of control area. Burn weed waste on site where realistic. Cover weed waste completely before transporting.
Visual amenity non favourable	Dead and dying vegetation, flagging tap, chemical dye…	Provide visitor interpretation. Explain, what, why and anticipated outcome – and how they can help.
Disturbance to habitat	Vehicle activity, chemical dispersal, general human activity.	Try to be aware of the sensitivity of area which is being entered. If it is known significant flora or fauna habitat, walk into site and as much as possible 'tread-softly'. Determine if your impact will be greater than that of the weed.
Encouraging weed recruitment and destruction of native habitat.	Fire as a weed control tool. In some instances, fire at an inappropriate intensity will promote weed recruitment and germination.	Apply fire as a control tool (in the case of woody weeds this typically requires intense heat generation) only where long term damage to native flora and fauna will be negligible. Understand the level of fire intensity required to create desired outcome and the on ground conditions which will achieve this.
Encouraging weed recruitment (2)	Hand removal of weeds/grubbing turning soil over and creating seed bed. Slashing or canopy reduction.	Recognize the possible outcome and factor follow up into works programme until recruitment has ceased. Such an option has limited merit at the end of the dry season, where access during the wet season may prevent follow up.

10. Monitoring and Evaluation

Monitor for:

- Weed prevalence and distribution
- Outcomes/level of success of control measures
- Rate of weed establishment and recruitment
- Weed invasion at weed free sites.

Regular monitoring will be integrated into the works programme to determine the effectiveness of chemical and manual weed control. This may be achieved with monitoring areas using digital photographs and a monitoring checklist at strategic sites.

Annual survey program will be carried out in late wet/early dry season when weeds are identifiably by fruits or flowers and when weeds have had the opportunity to germinate and new infestations can be identified early in the establishment phase.

Record keeping

To facilitate 'useful' outcomes, general *survey* work should record (at minimum) the following information:

- Date
- Location and GPS reading and extent of survey
- Species name
- Extent of infestation (approximate number of plants or area in ha)
- Density
- Status of plants (eg. healthy, sick, dormant, flowering, fruiting, juvenile, mature etc)
- General habitat (eg. riparian, woodland, outcrop etc) and condition (dry, wet)
- Photo record with site information board (site No and date)

Control work (eg, spraying, grubbing, slashing, burning), in addition to the above, should also record (at minimum) the following information:

- Control conditions (humid, dry, windy, soil status etc…)
- Time of day
- Where relevant: Chemical dilution, application method
- Where relevant: Slashing height, burning conditions, grubbing technology.

11. Resource Requirements for weed related projects.

Requirement	Frequency	Estimated cost per event or financial year	No. staff involved
Chemcert Training	Once	(depends if training undertaken in Perth or NW)	All field staff not currently with update qualifications
Mapping/GPS/database training	Biennial	(depends if training undertaken in Perth or NW)	All field staff
Hand spray units (chapin and Hardi) + replacement parts.	Initial outlay (each subsequent year)	$1000 ($250)	~ 6
Vehicle mounted spray units	Annual	$400	~ 6
Chemical	Annual	$1500	~ 6
PPE + first aid	Annual	$400	~ 6
Purpose built chemical storage shed at Silent Grove	Once	$7000	~ 6
Volunteer co-ordination and set up	Annual	$1500	~ 3
Weed interpretation and education	Annual	$1000	~ 2
Equipment (GPS, Cameras etc)	Every 3 years.	$1000	3
Vehicle and quad bike maintenance and fuel	Annual	?	~ 6
Dedicated staff hours	Monthly	XXX hours @ $XXX/hr = $XXX	~ 5
Data base set-up	Once	Regional Cost	n/a
Herbarium set up	Once	$500	~ 6
Wet season mobilization/helicopters	Annual	$2500	~ 6
Cattle surveys and co-ordination of muster	Annual	$2500	~ 3
Aerial photography for mapping (?)	Once every 5 years	?	~ 2

'staff' is inclusive of trainee rangers.

Total cost year 1 (2005/2006 Financial Year): $

Costs annually thereafter: $

Signed off by

- Regional Manger .....

Date .....

- Regional Leader Nature Conservation .....

Date .....

- District Manager .....

Date .....