

AZTEC RESOURCES LIMITED
KOOLAN ISLAND IRON ORE MINE AND
PORT FACILITY
SIGNIFICANT FLORA MANAGEMENT
PLAN

30TH March 2006



*Providing sustainable environmental strategies,
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1.0 ISSUE

Koolan Island is located in the Buccaneer Archipelago, 130 km north of Derby, at the northern end of the Yampi Peninsula (Figure 1-1). Aztec Resources Limited (Aztec) proposes to reopen and expand on previously mined iron ore bodies on Koolan Island bodies to access remnant ore reserves. Associated with the mining infrastructure, Aztec proposes to construct a port facility through which the ore will be exported.

Five conservation significant flora species, *Brachychiton xanthophyllus* (Priority 4), *Corymbia cadophora* subsp. *cadophora*, *Corymbia* aff. *cadophora*, *Gymnanthera cunninghamii* (Priority 3) and *Phyllanthus aridus* (Priority 3) have been identified to occur on Koolan Island (*ecologia* Environment, 2005). In addition *Eucalyptus kenneallyi* (Priority 1) potentially could occur on the island.

Previous surveys have indicated that *Phyllanthus aridus* is located within the project footprint (*ecologia* Environment, 2004a and 2006).

The objective of this management plan is to maintain the abundance, diversity, geographic distribution, conservation status and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.



Figure 1-1: Koolan Island Location

2.0 CURRENT STATUS

Koolan Island is one of the largest of the many islands comprising the Buccaneer Archipelago located in the Kimberley region of Western Australia. The Buccaneer Archipelago consists of some 800 to 1 000 rocky islands with small embayments and beaches and is extremely diverse with coral reefs, algal flats and shallow sandy banks with extensive seagrasses (CALM, 1994). This area has a tropical, sub-humid climate with an annual rainfall of about 850 mm. The 'wet' season usually occurs between December and April.

Koolan Island lies on the coastal interzone of the Northern Kimberley and Dampierland biogeographic region as described in the Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway and Cresswell 1995).

There are no World Heritage properties, National Heritage places, Ramsar wetlands, Commonwealth marine areas, Commonwealth land, or Commonwealth Heritage places, conservation reserves/parks on or immediately around Koolan Island.

Koolan Island was mined by BHP between 1965 and 1993. During this period approximately 68 million tonnes of high-grade haematite (67% Fe) ore was extracted from five pits, crushed and shipped from a wharf facility. Decommissioning of the mine in 1993 included removal (some *in situ* burial) of infrastructure associated with BHP's operations, rehabilitation of cleared areas by moonscaping, and the construction of a channel to allow sea water flooding of the Main Pit.

2.1 CLIMATE

The Buccaneer Archipelago experiences a tropical, sub-humid climate with an annual rainfall of about 850 mm. The 'Wet' season usually extends from December to April, although most rain falls in January, February and March. Little or no rain falls between May and November. The annual mean daily maximum temperature is 31.1 °C, with an annual mean daily minimum of 26.0 °C. The hottest months are November and December, whilst the coolest is July (Bureau of Meteorology 2004; based on data 1974-1992). Evaporation is low, at a daily average of 7.5 mm per year (*ecologia* Environment, 2005b).

2.2 TOPOGRAPHY AND LANDFORMS

Koolan Island has an area of 2580 hectares and is located one kilometre from the mainland. It has a Proterozoic sandstone lithology that is expressed in rugged slopes, ridges and uplands mantled with rock scree and shallow skeletal soils. The coast is steep with narrow gullies and frequent embayments, but few beaches (*ecologia* Environment, 2005b).

2.3 GEOLOGY

Koolan Island consists of a series of Lower-Proterozoic sediments of the Kimberley Group. The sediments are characterized by tight, asymmetrical folds, striking northwest-southwest, broadly along the long-axis of the island. Sandstones, quartzite with lesser phyllites and schists are the dominant geology. The folding on Koolan Island results in three major structural elements: South Syncline, Central Anticline and North Syncline.

Pentecost Sandstone forms the majority of the outcrop on the island. This formation is a thinly bedded, intercalated sequence of sandstone and siltstone with minor phyllite. The Pentecost Sandstone is underlain by Elgee Siltstone, a sequence of predominantly mudstones and shales. The Elgee Siltstone is underlain by Warton Sandstone, a unit of interbedded quartzite and siltstone.

2.4 GROUNDWATER AND SURFACE WATER

There are three broad hydrogeological provinces, which correspond to the three main structural geological elements. The central anticline separates the two fresh groundwater regions on the island: the Southern Syncline and the Northern Syncline. Depth to groundwater aquifers is on average 200 m below ground level. These aquifers experience a recharge of approximately 100,000 (Northern Syncline) and 700,000 (Southern Syncline) kL/year.

The Southern Syncline aquifer can be subdivided into two zones: the interland zone (or water supply area) and the orebody zone. The orebody aquifer is on the southern limb of the Southern Syncline and has been exposed in the Main Pit. This aquifer was originally only in hydraulic connection with the sea along strike to the west, however, excavation and push-back of the hanging wall has resulted in hydraulic connection with the sea through the wall. The orebody aquifer remains hydraulically isolated from the water supply aquifer by a low permeability Pentecost Formation and an indurated zone at the base of the orebody.

There are no known permanent surface waterbodies on Koolan Island, although ephemeral pools and streams are present during and immediately after the wet season.

2.5 FLORA AND VEGETATION

Koolan Island is located in the Fitzgerald Botanical District, which is predominantly comprised of savannah woodland over hummock grasses, typical of the sub-humid tropical sandstone flora that is widespread across northern Australia (Beard, 1979). The tree layer is dominated by *Eucalyptus* species and the grass layer by *Triodia* species. Patches of rainforest occur in moist areas and there is a fringing of mangroves in areas where silt has accumulated. Much of the island has been affected by a number of introduced weed species. No EPBC listed flora have been recorded on Koolan Island.

The vegetation of Koolan Island has been mapped into nine different communities (*ecologia* Environment, 2005b):

1. open woodland;
2. very open woodland;
3. *Eucalyptus miniata* woodland along stony ridges;
4. *Eucalyptus miniata* / *Corymbia cadophora* woodland along moderate gullies;
5. *Callitris intratropica* forest;
6. vine forest;
7. mangroves;
8. previously disturbed areas; and
9. beaches.

The majority of the island is vegetated by open woodland in which *Eucalyptus miniata* occurs as a taller canopy, with the lower bloodwoods *Corymbia confertiflora* and *Corymbia*

cadophora subsp. *cadophora* occurring at variable densities below with a mixed herb ground cover.

Very small areas of rainforest or vine thickets occur in limited locations. Rainforest and vine thickets intergrade into *Callitris intratropica* forest at the bases of several deep gullies. The *Callitris intratropica* forest is restricted to the more deeply incised gullies and often occurs in sporadic stands.

Mangroves occur extensively at the intertidal zone but are largely restricted to narrow strips of vegetation, with only a few of the larger inlets supporting substantive areas. There are twelve small beaches that predominantly occur adjacent to mangrove communities but with some mobile sands. The overstorey consists of scattered shrubs and the rest of the complex is mainly comprised of grasses and creepers.

Areas previously disturbed during BHP's mining on the island consist of rehabilitated areas of open to moderately dense *Acacia* dominated shrublands and non-rehabilitated areas consisting of a variable overstorey with predominantly introduced shrubs, herbs and grasses. Both types of disturbed areas consist of vegetation communities that are not typical of the local vegetation communities across the island and that of the Kimberley region.

A number of exotic plant species were introduced and are now abundant across the island, as a result of previous mining operations. Weed surveys have been conducted on Koolan Island by in 1993, 2004 and 2005 from which 60 taxa of weed species has been estimated to occur on the island (Keighery *et al.*, 1995; *ecologia* Environment 2004a, and 2005b). Many of the introduced species have been collected at the old settlement site and were former garden and ornamental plants that were planted during periods of occupation prior to 1993. Some of these species include Century Plant (**Agave Americana*), Common Mango (**Mangifera indica*), Wild Tamarind (**Leucaena leucocephala* subsp. *Leucocephala*), **Gliricidia sepium* and **Delonix regia*. The most widespread and common introduced species observed during the *ecologia* Environment surveys were **Malvastrum americanum*, **Melinis repens*, **Passiflora foetida* var. *hispida*, **Robinia pseudoacacia*, **Stylosanthes scabra* and **Clitoria ternatea*. The weed species of greatest environmental concern identified are Stinking Passionflower (**Passiflora foetida* var. *hispida*), Bellyache Bush (**Jatropha gossypifolia*), Rubber Vine (**Cryptostegia madagascariensis*), and Candle Bush (**Senna alata*).

2.6 SIGNIFICANT FLORA

2.6.1 *Brachychiton xanthophyllus* (Priority 2)

Brachychiton xanthophyllus is a shrub or tree that grows to 12 m high, and can be recognised by its shallowly, or obscurely palmate, three-lobed leaves (Wheeler *et al.*, 1992). The inflorescence is pink, growing in heads of 10 to 20 flowers, predominantly on old wood. It flowers from May to December, and fruits from May onwards (Wheeler *et al.*, 1992).

The species is endemic to the Kimberley region, being recorded only from vine thickets on the Bougainville Peninsula, Fenelon Island and the Mitchell Plateau (Wheeler *et al.*, 1992). Two individuals of this species have been identified from two locations at Koolan (*ecologia* Environment, 2004a and 2006). Both collections have been verified by a taxonomist specialising in the family Sterculiaceae, Gordon Guymer (Queensland Herbarium).

Four other species from the genus *Brachychiton* are present on Koolan Island, one of which, *Brachychiton viscidulus*, closely resembles the general leaf morphology of *B. xanthophyllus*. *B. viscidulus* is known to be widespread on the island.

2.6.2 *Corymbia* species

Corymbia cadophora subsp. *cadophora* is a straggly, often gnarled, straggly mallee tree that can grow to 8 m high (Brooker and Kleinig, 2004; Coleman, 1997). It has two distinct flowering morphs, which are creamy white in the west of the distribution, and red in the east (Brooker and Kleinig, 2004). It is distinguishable by its distinctive bloodwood-style bark and urn-shaped nuts.

This species widespread and common on Koolan Island, occurring on hillcrests, hill tops, ridges, outcrops and gully slopes and floors (*ecologia* Environment, 2004a).

Corymbia aff. *cadophora* is a distinct taxon from other subspecies of *Corymbia cadophora* collected on Koolan Island (*ecologia* Environment, 2005). *Corymbia* aff. *cadophora* is distinguished from the typical *Corymbia cadophora* by a number of characteristics, mostly associated with its flowers and fruit structure.

A single individual of this taxon was recorded at the old settlement site on Koolan Island during the W.A Museum survey (Keighery *et al.*, 1995). Extensive surveying by *ecologia* Environment has not been able to locate this individual or any others on the island. Although not currently of Priority status *Corymbia* aff. *cadophora* has been identified as potentially subject to listing in the future.

2.6.3 *Eucalyptus kenneallyi* (Priority 1)

Eucalyptus kenneallyi is one of a group of small, smooth, powdery-barked *Eucalypts* and very little is known of its biology (Brooker and Kleinig, 2004).

This species is endemic to the Kimberley region and has been recorded on Storr Island. It has not been recorded by *ecologia* Environment in previous flora surveys.

2.6.4 *Gymnanthera cunninghamii* (Priority 3)

Gymnanthera cunninghamii is an erect shrub that grows 1 – 2 m high with tubular, cream, yellow and green, 5 part flowers (Paczkowska, 1996a; Wheeler *et al.*, 1992). *G. cunninghamii* is known from several collections in the Pilbara region, but is not known from the Kimberley region. In the *ecologia* Environment 2004 flora survey this species was identified at one location on Koolan Island.

2.6.5 *Phyllanthus aridus* (Priority 3)

Phyllanthus aridus is an erect, much-branched shrub that grows to 0.5 m high (Paczkowska, 1996b; Wheeler *et al.*, 1992). It is characterised by small, inconspicuous cream and green coloured, male and female flowers. It flowers and fruits from March to August.

The species is often found on sandstones, occurring from the King Edward River and Cockburn Range southwards to Camballin. It is also found on Augustus and Koolan Islands, and may represent a bioregional endemic. *P. aridus* is widespread on Koolan Island.



Plate 2-1: *Corymbia cadophora*.



Plate 2-1: *Phyllanthus aridus*.

3.0 POTENTIAL IMPACTS

3.1 LAND DISTURBANCE

Approximately 540 ha will be cleared for the entire project, of which 45% is previously disturbed vegetation. The potential impacts arising from land disturbance include:

- Loss of individuals
- Loss of habitat;
- Soil erosion;
- Weed invasion and establishment through out-competition with native flora; and
- Habitat fragmentation.

3.2 INTRODUCED FLORA

Weed species are introduced flora species that establish themselves in natural ecosystems and modify natural processes that often results in the decline of the invaded community (CALM, 1999). A number of weed species are already established on Koolan Island, and with the exception of Stinking Passionflower (*Passiflora foetida* var. *hispidula*), most species are isolated to the location of the old settlement. Several of these species, however, are highly invasive species and may infest surrounding vegetation and colonise new areas that they are transported to.

The impacts of weed species on of conservation-significant flora species include:

- Resource competition (i.e. space, water and nutrients);
- Prevention of seedling recruitment;
- Changes in soil nutrient status;
- Alteration of fire regime; and
- Genetic changes.

(Carr et al., 1992; Humphries et al., 1993; Csurhes and Edwards, 1998).

Weed species may impact on the biodiversity by impacting on the genetic diversity, species diversity, and ecosystem diversity (CALM, 1999). Weed species may reduce the viability and robustness of populations of conservation-significant flora species, resulting in impacts to the genetic diversity of the population (CALM, 1999). The composition of the flora community may also be impacted by weed species through competitive recruitment, which often results in a simplified species assemblage (Adair, 1995; CALM, 1999).

3.3 INTRODUCED FAUNA

A number of feral animals occur on the mainland and have the potential to colonise Koolan Island. Introduced fauna species that establish themselves in natural ecosystems have the potential to impact on flora species resulting in the decline of the invaded flora community. A number of introduced fauna species have previously been recorded on Koolan Island, most of which there are no recent records of (*ecologia* Environment, 2004b, McKenzie *et al.*, 1995). Reintroduction of feral species or introduction of other feral species has the potential to significantly impact on the floral biodiversity on Koolan Island.

The impacts of introduced herbivorous fauna species include:

- Resource competition (i.e. space, water and food);
- Prevention of seedling recruitment;
- Alteration and damage to vegetation structure and composition;
- Soil erosion;
- Damage to watercourses; and
- Genetic changes.

3.4 WATER

Groundwater will be abstracted for dewatering activities and potable water supply and the construction of project infrastructure and waste dumps will modify existing surface water flow regimes. Groundwater abstraction and alteration of surface water flow regimes may impact on conservation-significant flora species by:

- Alteration of floral community structure and individual plant deaths from a reduction in the availability of surface water and groundwater water resources.

3.5 DUST

Dust will be produced by earthmoving activities and the operation of some project facilities, such as the crushing and screening plant. Dust pollution may impact on conservation-significant flora species by causing:

- Deposition of dust on individual plants restricting transpiration and photosynthesis, resulting in death; and
- Habitat modification due to the death of individuals.

3.6 FIRE

Project activities may result in accidental fires. Fire will impact on conservation-significant flora species by causing:

- Removal of individuals or populations; and
- Disturbed areas that are prone to invasion by introduced flora species.

3.7 HYDROCARBONS AND CHEMICALS

Hydrocarbons and chemicals will be stored, used and transported within the project area. The potential impacts to conservation-significant flora species are:

- Contamination of soil, ground and surface water and vegetation from spillage.

3.8 WASTE

A minor landfill will be established to manage the disposal of putrescible and inert wastes. The potential impacts on conservation-significant flora species are:

- Contamination of ground and surface water;
- Habitat degradation.

4.0 ENVIRONMENTAL OBJECTIVE AND PERFORMANCE INDICATORS

Table 4-1: Environmental objectives identified by Ministerial Statement 000715.

Number	Environmental Objective	Performance Indicator
1	Maintain the abundance, geographic distribution, conservation status and productivity of conservation-significant flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	<ul style="list-style-type: none"> No significant long term change to the abundance of conservation-significant flora species. No change to the geographic distribution of conservation-significant flora species. No change to the conservation status of conservation-significant flora species on Koolan Island.

5.0 MANAGEMENT STRATEGY

Table 5-1: Management strategies for identified environmental objectives.

Objective #	Aspect	Management Strategy
	Conservation-significant flora presence	<ul style="list-style-type: none"> Prior to ground-disturbing activities conduct a pre-clearance survey for conservation-significant flora species. Maintain a map that identifies the location of conservation-significant flora species on the island and within the project area, which includes the date, approximate number and type of each conservation-significant flora species at each identified location. Demarcate populations of identified conservation-significant flora located within and directly adjacent to the project area. All sightings of conservation-significant flora will be reported to the Environmental Superintendent and recorded in the Rare Flora Register.
	Planning	<ul style="list-style-type: none"> Where populations of significant flora are identified in the project area alternative clearing and mine plans will be evaluated and modified where practicable.
	Land disturbance	<ul style="list-style-type: none"> Disturbance to natural vegetation will be minimised.

Objective #	Aspect	Management Strategy
		<ul style="list-style-type: none"> • Prior to disturbance of identified conservation-significant flora species within the approved mining footprint CALM will be informed of the number of individuals and proportion of total known population to be cleared. • A Vegetation Disturbance Permit will be completed and authorised prior to clearing activities. • Conservation management and weed hygiene zones will be clearly marked and sign posted. • No unauthorised entry will be allowed into conservation management and weed hygiene zones. • No unauthorised off-track driving. • Conduct progressive rehabilitation to minimise the time between disturbance and rehabilitation. • Local provenance seed will be used for rehabilitation.
	Introduced flora and fauna	<ul style="list-style-type: none"> • Invasion prevention and control of introduced flora and fauna species will be managed as per the Quarantine Management Plan (<i>ecologia</i> Environment, 2006).
	Water	<ul style="list-style-type: none"> • Groundwater will be managed as per the Water Management Plan (Aquaterra, 2006a). • Surface water will be managed as per the Stormwater Management Plan - Overall Site Area (Aquaterra, 2006b) and the Stormwater Management Plan - Plant Site Area (Aquaterra, 2006c).
	Dust	<ul style="list-style-type: none"> • Dust generation from project activities will be minimised by engineering controls and use of dust suppression measures, such as water trucks, sprinklers and deluge sprays. • Vehicle speed will be restricted on cleared tracks.
	Fire	<ul style="list-style-type: none"> • Equip hydrocarbon and chemical storage facilities, light vehicles, mobile plant and fixed plant with approved fire extinguishers. • Obtain a hot works permit for work that has the potential to create ignition sources. • Make available adequate fire suppression equipment for hot works within 3 m of vegetation. • An emergency response team will be available.
	Hydrocarbons and chemicals	<ul style="list-style-type: none"> • Hydrocarbons and chemicals will be stored, used, transported and disposed of in accordance with Dangerous Goods Regulations, Australian Standards and DoCEP guidelines. • Spills will be immediately cleaned up and contaminated material appropriately disposed of.
	Waste	<ul style="list-style-type: none"> • Inert and putrescible waste will be disposed of in a licensed landfill facility on the island. • Hazardous waste will be removed from the island and disposed of by a licensed contractor.

Objective #	Aspect	Management Strategy
	Contracts	<ul style="list-style-type: none"> • Land disturbance requirements will be included in contracts with all earthmoving and land clearing contactors.
	Training	<ul style="list-style-type: none"> • Training on the identification, location and reporting of conservation-significant flora species will be included in the environmental induction and environmental awareness sessions (toolbox training presentations). • Training on land clearing procedures will be included in the environmental induction and environmental awareness • A conservation-significant flora identification guide will be made available to personnel. • Personnel will be trained in the use of fire extinguishing equipment and fire prevention measures in work areas.

6.0 MONITORING

Prior to ground-disturbing activities a pre-clearance flora survey shall be conducted to identify the presence of conservation-significant flora species. The results of pre-clearance surveys will be valid for a period of 12 months.

Annual monitoring surveys of identified populations of conservation-significant species within the project area will be conducted for a period of three years. Monitoring surveys will be decreased to every two years if no adverse impacts to populations from the project are identified.

7.0 CONTINGENCIES

In the event that monitoring demonstrates that project activities are having an adverse impact on identified conservation-significant flora, CALM will be consulted and contingency measures determined and implemented.

8.0 STAKEHOLDER CONSULTATION

Aztec has identified key stakeholders and engaged them throughout the Environmental Impact Assessment process. Stakeholders involved in project discussions comprise of regulatory agencies, conservation groups and local interest groups (Table 8-1).

Since May 2004, Aztec has maintained on-going consultation with stakeholder groups. This includes project briefing sessions, circulation of reports and documents for comments, updates on project developments and a visit to Koolan Island. The issues raised through consultations are addressed in the Environmental Referral Document (ERD) submitted to the EPA.

Table 8-1: Key stakeholder groups in the Koolan Island Iron Ore Mine and Port Facility Project.

Regulatory Stakeholders	Non-regulatory Stakeholders
DoE (EPA Service Unit)	Environs Kimberley
DoE (North West Region)	Greens (MLC)
DoE (Land and Water Quality Branch)	Marine and Coastal Community Network
CALM (Perth)	Conservation Council of Western Australia
CALM (North West Region)	Kimberley Land Council
DIA (Perth)	Broome Botanical Society
DIA (North West Region)	Kimberley Environ Horticulture
Department of Fisheries	Wildflower Society
Shire of Derby and West Kimberley	

9.0 AUDITING

The Environmental Management System will be internally audited annually by an experienced Environmental Auditor.

10.0 REVIEW AND REVISION

This plan will be reviewed every 2 years by environmental personnel, unless ongoing monitoring indicates that project activities are having an adverse effect on identified conservation-significant flora.

11.0 REPORTING

The Annual Environmental Report (AER) will provide a detailed summary on the current status of conservation-significant species on Koolan Island.

12.0 KEY MANAGEMENT ACTIONS TABLE

Refer to the Project Audit Programme.

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