

Appendix 5A

Browns Oxide Project Flora Report – Egan (2005)

BROWNS OXIDE PROJECT

Flora Characterisation and Impact Assessment



Recently burnt Eucalypt savanna woodland on Browns Oxide Project Area, August 2005

Prepared for

Compass Resources NL and Enesar Consulting PL

By Judy Egan, Botanical Consultant, August 2005.

**BROWNS OXIDE PROJECT
FLORA CHARACTERISATION AND IMPACT ASSESSMENT**

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BROWNS OXIDE PROJECT

FLORA CHARACTERISATION REVIEW AND FLORA IMPACT ASSESSMENT

Summary

- Vegetation of the 175 ha of the proposed Browns Oxide Project was previously mapped and characterised as part of a broader scale study in 2002 (Metcalf 2002). The current study found a generally high level of agreement with vegetation distributions outlined by the previous study.

- Seven of the ten different vegetation communities identified by Metcalf 2002, are considered to occur within the current Browns Oxide project area. A further three localised vegetation communities have been identified and described and a further 68 species added to the combined species list.

- Approximately 45% (79 ha) of the proposed site is presently covered by Eucalypt savanna, identified by vegetation units 1, 2, 3 and 14. Approximately 25% of the project area is of significantly disturbed areas such as old pits and scrapes etc, whilst just under 20% is comprised of floodplain and drainage areas. *Acacia auriculiformis* communities occupy around 10% of the area.

- Introduced species were present in all vegetation communities with densest infestations occurring around the margins of *Acacia auriculiformis* communities, throughout a small patch of *Acacia auriculiformis*/ *Melaleuca*/ *Lophostemon* forest and throughout a degraded region of *Erythrophleum*/*Eucalypt* open forest.

- The most common and widespread introduced species is Gamba Grass (*Andropogon gayanus*) . Ongoing control of this species in particular, will be necessary to prevent its further spread and to reduce risks of wildfire on and around the mine site.

- A further 4 introduced plant species were recorded in the current survey: *Macroptilium atropurpureum* (Fabaceae) *Ipomoea triloba* (Convolvulaceae), *Grewia asiatica* (Tiliaceae), *Solanum seaforthianum* (Solanaceae). It is suggested that control of *Grewia asiatica* be undertaken promptly before it becomes firmly established.

- The *Acacia auriculiformis* community is considered to be of local and regional importance (although it is not listed under any Commonwealth or Northern Territory legislation), particularly as a source of food and habitat for native fauna. It is recommended that , if possible the Waste Dump be relocated from within this community to a less environmentally sensitive location and as much of this vegetation retained on site as possible. This

would greatly assist in preventing rapid passage of weeds to the surrounding community, assist in prevention of further river bank degradation and provide a greater buffer to a nearby AAPA recorded site.

- Threatened species: *Cycas armstrongii* is listed as Vulnerable under the Territory Parks and Wildlife Conservation Act (TPWC). However, if prior land clearing approval has already been obtained from the Northern Territory Government, no further permit is required to clear land upon which this species occurs, although efforts to minimise destruction of the species and its habitat are encouraged. It is estimated between 5900-15800 *C.armstrongii* may be present on site.

No other species of conservation significance listed under NT or Commonwealth legislation were recorded in the project area.

- Given the generally common vegetation types occurring over most of the project area and the already significantly disturbed nature of approximately 25% of the area, it is not expected that there will be a significant impact on any flora species of national or Northern Territory conservation significance as a result of the project.

- If at all possible, top soil should be removed from one location and deposited and spread at a rehabilitation site with the shortest delay, in order to maintain the soil biota. This may greatly assist the success of revegetation. If topsoil has to be stockpiled, it should be for the shortest possible time.

- Prior to revegetation, the surface should be contour ripped in order to minimise erosion by run-off and to break any hard pans derived from ongoing traffic of heavy vehicles.

- Initial stabilisation should be achieved using a blend of native (preferably perennial) grasses, with locally provenanced shrubs and trees established either at the same time or during a slightly later phase. Charles Darwin University currently has research interests in this area and it may be worthwhile exploring possible collaborative projects.

- Choices of species for revegetation will depend largely on the final landscape created and will need to be tailored to suit the different landscape forms and soils of the recreated landscape.

- Advance planning will be required as to the final landscape features, which species to plant and who/where to source them from.

- Weed control, (especially Gamba Grass) and keeping fire out of revegetated areas for at least a couple of years whilst plants establish will be of primary importance.

Part 1: Flora Characterisation Review

1.1 Introduction

This report has been prepared at the request of Compass Resources NL and Enesar Consulting PL as part of the PER associated with an application to develop the Browns Oxide Project near Batchelor in the Northern Territory. A previous vegetation assessment and mapping exercise was carried out over a much broader surrounding area of 37.5 km² in 2002 by consultant, Kristin Metcalfe (Metcalfe 2002). The current project is focussed on an area of approximately 1.75 km² (175 ha) situated approximately in the centre of the previous study region. The intention of the current exercise is primarily to update the previous body of data with respect to any changes in vegetation community boundaries, species composition and alterations in nomenclatural or legal aspects that may be relevant to the site in question.

1.2 Methodology

As Metcalfe's vegetation map was produced only 3 years prior to the current study, it was deemed unlikely that gross changes in broadscale community boundaries or species composition would have occurred in the intervening years.

Therefore, the most recent aerial photography for the area (taken in 2003 and 2004) was examined, preliminary vegetation community boundaries mapped and compared to the vegetation map prepared by Metcalfe 2002. In general, there appeared to be a high level of agreement between the two maps.

From aerial photographs, 20 potential sites covering the range of apparent communities were selected for ground truthing in order to refine the updated vegetation map.

Field work was carried out over three days in early August 2005. At each of 17 locations a full floristic inventory was conducted over a 20 x 20 m quadrat in order to classify and characterise the vegetation in accordance with standard Northern Territory vegetation survey guidelines (Brocklehurst et.al. 2004). Within the quadrat, vegetation height and structure, species composition and dominance and percentage cover were recorded for all species and all vegetation strata. However, at 3 sites, the ground cover had been extensively burnt so only a species list was compiled for the lower stratum.

A further reconnaissance of surrounding areas (whilst still remaining within the habitat) was also conducted in order to detect any other species not occurring in the quadrat area. This was considered a more time effective means of inventorying species within communities than establishing more quadrats.

At three further locations quadrats were not used for assessment purposes. One of these sites was the degraded riparian zone and two other sites had been burnt so recently that cover estimates would have been meaningless. For these sites a species list was compiled.

Any plant species not immediately recognized during fieldwork were collected and identified by the author at the Northern Territory Herbarium.

Field work was hampered by the time of year (late Dry Season when most herbaceous species have died and withered, thereby reducing the number of species present) and by the fact that much of the study area had been burnt to varying degrees over recent weeks. Nevertheless, an additional 68 species were added to Metcalfe's species list for the general region, including four new exotic species (*Ipomoea triloba* (Convolvulaceae), *Macroptilium atropurpureum* (Fabaceae), *Solanum seafortianum* (Solanaceae), *Grewia asiatica* (Tiliaceae). Appendix 1 details new species records for each vegetation community whilst Appendix 2 presents an entire combined species list, including nomenclatural corrections, for the 37.5km² of Metcalfe's study and that of the current study. Summary quadrat data is listed in Appendix 3.

1.3 Comparison of Communities in Study Area with Metcalfe 2002.

Metcalfe's 2002 study identified 10 different vegetation communities, in addition to previously mined or disturbed areas, within the 37.5 km² study region.

The current study region, being of much reduced extent, does not contain all the vegetation communities listed by Metcalfe. A total of 7 of the vegetation communities listed by Metcalfe are considered to occur within the current study area. In addition, due to the smaller scale and more focussed mapping of this exercise a further three communities have been identified within the current study area. (map 1 and Table 1)

Table 1: Vegetation Communities Within the Browns Oxide Project Area.

Map Unit	Community and Brief Description	Mean Spp. Richness 02	Approx ha within lease	% of project area
		Mean Spp. Richness 05		
1	<i>Eucalyptus phoenicea/ Corymbia bleeseri</i> open woodland, as per Metcalfe 2002	17	6.5	3.7
		33		
2	<i>Eucalyptus tetradonta/ E.miniata/ Erythrophleum chlorostachys</i> tall open forest to woodland as per Metcalfe 2002	31	1.0	0.6
		35		
3	<i>Eucalyptus tetradonta/E.miniata</i> open woodland as per Metcalfe 2002	28	67.5	38.6
		30		
5	Riparian corridor as per Metcalfe 2002	26	0.5	0.3
		27		
6	Lophostemon communities as per Metcalfe 2002	20	2.2	1.3
		18		
7	<i>Corymbia bella/Corymbia foelscheana/ Melaleuca</i> spp. Open woodland to grassland. As per Metcalfe 2002	17	31.6	18
		21		
10	<i>Acacia auriculiformis</i> communities. Woodland to open forest as per Metcalfe 2002	31	13.0	7.4
		31		
11	Disturbed areas – includes old mines, borrow pits, rehabilitated areas and recent exploration activities		41.6	23.7

12	<i>Acacia auriculiformis</i> / <i>Melaleuca dealbata</i> / <i>Lophostemon</i> forest, with exceptionally heavy weed infestation.	30 **	5.7	3.3
13	<i>Pandanus spiralis</i> woodland over <i>Imperata cylindrica</i>	12 **	1.1	0.6
14	Extensively degraded <i>Erythrophleum</i> / <i>Acacia auriculiformis</i> woodland with dense weed infestation.	23 **	4.3	2.5

** Vegetation Units 12, 13 and 14 were identified during the 2005 survey, so species richness figures for these units only reflect 2005 data.

It is considered that the vegetation community descriptions prepared by Metcalfe 2002 are still satisfactory for those map units occurring in the current study area (ie units 1 through 11 listed above). Brief descriptions follow of three further vegetation associations defined in this survey, along with a brief discussion of those species most commonly found on the disturbed areas of Unit 11.

Unit 12: *Acacia auriculiformis*/ *Melaleuca dealbata*/ *Lophostemon grandiflorus* forest with exceptionally dense weed infestation.

This community is restricted to an area of approximately 5-6 ha immediately adjacent to the East Finniss River and to the open cut trial pit.

This vegetation community is distinguished by a dense upper stratum (50-70% canopy cover) dominated by *Acacia auriculiformis*, with *Melaleuca dealbata* and *Lophostemon grandiflorus* in more or less equal proportions and a lesser representation of *Timonius timon*. Average height is 18 – 20 metres. Presence of other tree species is minimal and sporadic. The mid stratum is relatively sparse, being comprised predominantly of *Lophostemon grandiflorus* and *Acacia auriculiformis* with occasional other species such as *Flueggea virosa* and *Jasminum aemulum*.

The understorey is entirely dominated by dense introduced weed species, predominantly gamba grass (*Andropogon gayanus*), Calopo (*Calopogonium mucunoides*) and annual and perennial mission grasses (*Pennisetum spp.*). At the time of assessment much of the herbaceous material had dried and withered and some areas had been patchily burnt. Nevertheless percentage cover of attached plant material was still over 50%, with virtually all of the rest of the forest floor being covered by dense dried litter from the above species. During the growing (wet) season it is estimated that percentage cover of these weed species would be virtually 100%, forming an impenetrable mass and smothering any germinating seedlings of other species.

The more southerly outer fringes of this site retained more moisture. These areas still contained some native grasses and sedges (eg. *Ischaemum australe*), although numerous clumps of *Andropogon* were also noted, suggesting invasion is ongoing.

Unit 13: *Pandanus spiralis* woodland over *Imperata cylindrica*.

Although only occupying approximately 1 ha in drainage channels of the project area this vegetation type is characterised by a low overstorey

(approximately 6 m tall) of almost exclusively *Pandanus spiralis* with the occasional *Melaleuca dealbata* and *M. viridiflora*.

The mid storey is sparse (5-15% cover), being dominated by juvenile *Pandanus spiralis* and *Flemingia lineata*. The introduced species *Grewia asiatica* was also present as occasional low resprouting individuals on channel margins. Likewise the lower stratum is lacking in diversity, being heavily dominated by the native grasses *Imperata cylindrica* with *Themeda triandra* and *Ischaemum australe* occurring towards the margins of the drainage channel. Members of the Cyperaceae family are sporadically present. Lack of apparent diversity in this community is likely to be at least partly attributable to the late Dry Season time of year when assessment was conducted and many more seasonally perennial or annual species may occur in the same habitat throughout the wetter times of the year.

Unit 14: Extensively degraded *Erythrophleum/Acacia auriculiformis* woodland with dense weed infestation.

This vegetation unit covers approximately 10 ha (approximately 4 ha of which are within the project area) immediately adjacent to the East Finniss River and linking to the adjacent *Acacia auriculiformis* community (Unit 10).

Unit 14 is considered to be the extensively degraded remnants of open forest akin to that of Units 2 or 3, combined with the outer intergrading margins of the adjacent *Acacia auriculiformis* community. The vegetation appears to have been extensively affected by regular hot fires, with numerous dead trunks of sizable *Acacia auriculiformis* either on the ground or still standing and *Erythrophleum chlorostachys* being the dominant remaining living tree in the upper stratum.

The area had been burnt prior to the site assessment (estimated to be approximately 4 weeks prior) and virtually no mid stratum remained. All shrub or tree species other than the emergent *Erythrophleum* trees were present only as resprouting shoots from lignotubers or rootstocks. The resprouting shrubs and trees are predominantly of species typically found in Eucalypt savanna communities (e.g., *Petalostigma quadriloculare*, *Persoonia falcata*, *Jasminum molle*) rather than those species occurring in the understory of the adjacent *Acacia auriculiformis* community.

The ground stratum had also been burnt. However, in some areas more patchily affected by the fire it was possible to determine that Gamba Grass (*Andropogon gayanus*) had been dense and likely dominant, along with Mission Grasses (*Pennisetum* spp.) and *Hyptis suaveolens*. This was also supported by the numerous large clumps of vigorously resprouting Gamba Grass in the area.

Because of the position in which this community occurs (immediately adjacent to the river and bridge crossing) it likely has a long history of disturbance and of being burnt each dry season and this is reflected in the lack of a mid stratum, the death and decay of the upper stratum and the dense infestation of exotic and weed species.

Unit 11: Previously disturbed areas, including scrapes, old pits and rehabilitated areas.

This unit is comprised of areas of various soil types and land formations, all of which have been disturbed to the extent that their current vegetation is considered to be more a product of disturbance than of natural occurrence. An upper storey still occurs in some areas, but not all. Where present it is usually patchy and sporadic with around 5% canopy cover and generally comprised of *Corymbia bella*, *Acacia auriculiformis* or remnant trees of other species. The mid-storey is mostly patchy or absent, although some areas do have *Calytrix exstipulata* and/or *Calytrix achaeta*, and occasional other species such as *Acacia holosericea* present. The lower stratum is mostly comprised of introduced species (eg. *Hyptis*, *Crotalaria goreensis*, *Pennisetum spp*, *Passiflora foetida*) and native grasses such as *Chrysopogon latifolius* and *Themeda triandra*. Some old scrapes and pits appear to become temporary wet season waterhollows and the native grass *Pseudoraphis spinescens* is common in and around these situations. Rehabilitated areas (the old Rum Jungle Mine) occur to the east of the project area and some species (eg. *Macroptilium atropurpureum*, *Calopogonium mucunoides*) appear to have migrated from the rehabilitated sections into some disturbed parts of the current project area.

1.4 Representation of Vegetation Communities Within the Browns Oxide Project Area.

In terms of area, three distinct communities dominate the Browns Oxide Lease (Table 1). Unit 3 (*Eucalyptus tetradonta/E.miniata* open woodland) covers the greatest proportion (38.6% or 79 ha) of the project area, with a further 24% or 41 ha being of significantly disturbed areas such as the old mine pits and scrapes etc. of Unit 11. Another 31 ha (18 % of the area) is comprised of *Corymbia bella/C.foeslcheana* open woodland (Unit 7) occupying seasonal floodplain and drainage areas. This community would have been more dominant over the project area had much of it not already been disturbed and therefore included under Unit 11. Intact *Acacia auriculiformis* communities (Unit 10) occupy around 7% of the project area with the remaining communities occupying relatively minor areas.

1.5 General Comparison of Status of Weeds in Vegetation Units with Report of Metcalfe 2002.

As indicated in the previous section, it was found that the vegetation mapping and vegetation community descriptions prepared by Metcalfe 2002 were generally still relevant to the area of the current study.

However, the current study did detect several exotic species in communities from which they were not recorded by Metcalfe 2002. In part this may be due to the fact that weed distributions may be patchy and different observers visit slightly different site locations. Nevertheless, it is generally accepted that, in particular, the perennial exotic grasses *Andropogon gayanus* and *Pennisetum*

polystachion have dramatically increased their area of distribution in the North-west Top End (including the Batchelor region) over recent years leading to concerns of increased risks of wildfire and loss of biodiversity (Bowman 1999, Howard 2002).

Raw data was not available to enable a quantitative comparison of weed species presence and cover values between the study of Metcalfe 2002 and this study. However, the following ‘anecdotal’ data suggest that the presence of weed species may be increasing in several of the vegetation communities concerned. In at least two communities on the proposed mine site (Unit 12 and Unit 14), exotic weed species are by far the dominant species in the ground stratum, serving to characterise the current nature of these communities.

Table 2: Comparison of Weed Species Records for Vegetation Communities

	Metcalfe 2002	Egan 2005
Unit 1	“No introduced species were recorded”	Gamba grass: - several clumps at one site
2	“Few introduced species, occurring in low densities”	Only visited 1 site of this vegetation type – gamba and mission grass both recorded.
3	“aside from introduced grasses, weeds were relatively absent”	3 of 5 sites had introduced species (<i>Hyptis</i> , <i>Passiflora</i> , <i>Pennisetum</i> , <i>Andropogon</i>). At one site gamba was common, despite site being long way from access track. <i>Grewia asiatica</i> also recorded at 1 site in this community.
5	Recorded <i>Mimosa pigra</i> , <i>Stachytarpheta</i> , <i>Hyptis</i> , <i>Andropogon</i> , <i>Leucaena</i> , amongst others	Recorded most of same spp as Metcalfe. Additionally recorded <i>Stylosanthes hamata</i> and <i>S.guianensis</i>
6	“weeds were moderately abundant”	No additions.
7	“Ten weed species occur in this habitat”	Recorded 6 of Metcalfes 10 species but over much smaller area and at unfavourable time of year. Also recorded <i>Grewia asiatica</i> .
10	“Dense weed infestations are characteristic of the fringes...”	Weed species were prevalent at most sites visited, but densest around the fringes. <i>Solanum seaforthianum</i> recorded here.
12	NA	9 out of 15 ground storey species recorded were weeds. Coverage of weed species was highly dominant.
13	NA	No weed species other than <i>Grewia asiatica</i> apparent when assessment was undertaken
14	NA	All 4 ground layer species recorded were weeds. Gamba highly dominant.

Grewia asiatica is an introduced shrub species, which has been identified as a potentially serious future weed threat (Smith 2002), having the ability to rapidly colonize and establish both by means of seed set and vegetative resprouting. This species was not recorded in any community by Metcalfe 2002 but was found to be relatively abundant at several locations in the current study, particularly in Unit 7, with 1 record from Unit 3. At one site (B12) in Unit 7, numerous seedlings and resprouting suckers were noted. This species appears to be able to tolerate fire by resprouting from basal or below ground buds in a similar manner to that of the native *Grewia retusifolia* (J.Egan pers.obs).

1.6 Vegetation Communities of Conservation Significance

As discussed by Metcalfe 2002, none of the vegetation communities in the project area are of declared conservation significance. However, Metcalfe highlights the local and regional importance of Evergreen Monsoon Vine Forest (Unit 9 - which doesn't occur within the Browns Oxide project area) and the *Acacia auriculiformis* vine thicket communities (Unit 10). These communities are generally of high plant diversity with a distinct floristic assemblage providing food and habitat for native fauna.

Within the proposed project area approximately 13 ha (or around 7.5% of the project area) is covered by relatively intact *Acacia auriculiformis* communities (Unit 10), with another 3.5 ha of already extensively degraded habitat of this general type (Unit 12). The 13ha patch of forest abuts a larger area of approx another 40ha. Although "relatively intact" the 13ha patch of forest does contain numerous weed species which are particularly dense around the margins. Clearing of this 13 ha patch of forest will undoubtedly speed the passage of weed species into the adjoining forest and reduce the available local habitat for those fauna species dependent on vine thicket communities for survival.

1.7 Plant Species of Conservation Significance

Metcalfe 2002 recorded no plant species of conservation significance occurring within the 37.5km² of the original study but did note the presence of the cycad, *Cycas armstrongii* and an orchid, *Cymbidium canaliculatum*, both of which are listed by the Territory Parks and Wildlife Conservation Act as protected wildlife, although neither are currently listed at the Commonwealth level under the EPBC Act 1999.

Cymbidium canaliculatum was not recorded within the Browns Oxide project area but *Cycas armstrongii* is common throughout the Eucalypt savanna communities. (ie. Vegetation units 1, 2, 3 and 14 of the current study). The conservation status of this species has been upgraded since Metcalfe 2002 and it is now specifically protected. *C.armstrongii* is listed in the Northern Territory as 'Vulnerable' (under IUCN criteria), and in most instances, a permit is required for their removal. However, in instances where Northern Territory

Government approval has already been obtained for land clearing, no further permit is required. Therefore, the presence of *C.armstrongii* on the project area is unlikely to have ramifications for the proposed project.

Metcalfe also questioned whether three other protected species may possibly occur within the survey area but have been undetected: namely *Habenaria elongata* (Orchidaceae), *Helicteres* sp.'Glenluckie Creek' (Sterculiaceae) and *Indigofera schultzi* (Fabaceae).

The first of these species is a seasonally perennial ground orchid and, as experienced by Metcalfe 2002, the seasonality of the current survey was not conducive to detecting such species even if they had been present.

No further distributional information has been gathered on *Helicteres* sp.'Glenluckie Creek' since 2002 and it is still only known from the three locations mentioned by Metcalfe.

Surveys to better establish the known distribution and habitat of *Indigofera schultzi* were undertaken by the author in late 2004, in collaboration with the Northern Territory Herbarium. The species appears to have an extremely limited and specific distribution with current records being located approximately 20kms northwest of Rum Jungle. It is considered unlikely that *Indigofera schultzi* would occur within the 175 ha of the Browns Oxide project area although surveys during the early-mid wet season would be the most appropriate means of verifying this.

1.8 Nomenclatural Updates

Since Metcalfe's report of 2002, a small number of taxa have undergone taxonomic revisions. Currently accepted names are listed in Appendix 2, along with the previous name used in Metcalfe's report.

Part 2: Flora Impact Assessment

2.1 Introduction

The Flora Review and Impact Assessment Brief prepared by Enesar Consulting PL indicates that the majority of the vegetation within the 175ha lease area will be cleared if the project proceeds, although there appears to be some doubt as to whether it will be necessary to clear the south eastern corner.

As outlined in the accompanying Flora Characterisation Review, the project area does not contain any species, communities or habitats currently listed as being of national significance for conservation purposes under the EPBC Act, but does contain species and vegetation types which are locally or regionally important.

2.2 Significant Species

In terms of species, *Cycas armstrongii* is the only species encountered during the current study which is listed for specific environmental protection under the Territory Parks and Wildlife Conservation Act. Endemic to the Northern Territory, *Cycas armstrongii* is limited to the NW Top End (ie. around the Darwin region, Cobourg Peninsular and the Tiwi Islands). (Figure. 1)

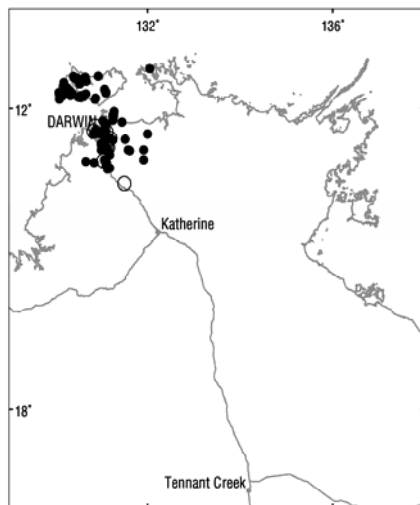


Figure 1. Distribution of *Cycas armstrongii* in the Northern Territory.

Source: Threatened Wildlife of the Northern Territory Information Sheet. Parks & Wildlife Service of the Northern Territory 2003

Cycas armstrongii is represented in a number of conservation reserves including Berry Springs Nature Park, Blackmore River Conservation Reserve, Holmes Jungle Nature Park, Howard Springs Nature Park, Howard Springs Hunting Reserve, Manton Dam Recreation Area and the nearby Litchfield National Park.

Although presently considered locally abundant this species is listed as Vulnerable under IUCN criteria, as used under the TPWC Act, largely due to projected population decline through land clearing and the effects of intense regular fires, particularly those fuelled by the dense exotic perennial grasses *Andropogon gayanus* (Gamba grass) and *Pennisetum polystachion* (Mission

grass) (Kerrigan et.al 2002). A draft Management Plan for Cycads in the Northern Territory has been prepared (PWCNT 2003) but not yet finalised.

The habitat in which this species occurs on the Browns Oxide Lease is generally defined by the Eucalypt savanna Vegetation Units 1,2,3 and 14, covering approximately 79 ha or 45% of the total 175 ha of the project area.

Distribution and density of *Cycas armstrongii* is variable across the Eucalypt savanna. As a very rough guide to population densities in the project area, the number of *Cycas armstrongii* individuals was counted in each of the 20m x 20m quadrats (ie.400m²) located at the eight sites in Eucalypt savanna habitats. Number of cycads/quadrat ranged between 3 and 8, with a mean value of 5 per 400m².

This suggests a density ranging from 75/ha to 200/ha with a mean density of around 130/ha., although it must be borne in mind that the sample size is small and these figures are unlikely to be statistically rigorous (Table 3).

Table 3: Calculated Number of *Cycas armstrongii* over project area

	No.Cycads/quadrat	Calculated No./ha	Calc.No. over Lease
Minimum	3	75	5925
Mean	5	134	10586
Maximum	8	200	15800

Clearing of the entire area of Eucalypt woodland over the project area therefore has the potential to remove somewhere between 5900 and 15800 individuals from the regional population, with the figure likely being around 10500.

Should the southeastern portion of the mine lease not be cleared (ie.Unit 1 and adjacent parts of Unit 3 on Map 1), the amount of cleared habitat likely to contain *Cycas armstrongii* would be reduced by around 22ha to approx 57 ha. This could decrease the number of individuals lost to the regional population by between 1650 and 4400 (ie. Total number of individuals lost would likely be between 4275 and 11400).

The preliminary site layout plan indicates that the small area of Eucalypt savanna to the west of the abandoned railway line does not contain any infrastructure and perhaps this area can be left uncleared.

If the area covered by the Tailings Dam or other infrastructures can be reduced in any way, it may also be possible to leave more of the Eucalypt savanna on the lease intact and thereby reduce the number of *C.armstrongii* affected.

2.3 Significant Habitats and Communities

No habitat or vegetation communities listed as significant under the EPBC or TPWC Acts are present within the project area.

However, the *Acacia auriculiformis* vegetation unit (Unit 10) is considered the most regionally or locally important vegetation community to occur within the 175 ha lease, due to its more restricted distribution than Eucalypt savanna communities, and its role in providing habitat and resources for native fauna.

Complete clearing of the project area will remove around 13 ha of this vegetation type, leaving approximately 40 ha to the north and northeast. Aside from the loss of habitat and food resources for native fauna,, the primary concern with clearing of this vegetation unit on the lease is the increased access it will create for the passage and spread of weed species into the remainder of the forest patch and the consequent altered fire dynamics , as outlined below.

The southeastern edge of this vegetation unit , (where it grades in to Unit 14) has been extensively infiltrated by Gamba grass (*Andropogon gayanus*), Mission grass (*Pennisetum polystachion*) , *Hyptis suaveolens* and *Senna obtusifolia*.

Gamba grass and Mission grass both form extremely dense clumps with growth 3-4m high and capable of supplying massive fuel loads (eg. Gamba grass up to 20T/ha (Barrow 1995) and Mission grass up to 27T/ha (Panton 1993)). The huge fuel load of Gamba Grass can create fires up to 8 times as intense as those in native grasses (Rossiter et.al 2003) often resulting in tree mortality and altered vegetation structure. Therefore infiltration of the *Acacia auriculiformis* woodlands (or any other native woodlands or forests) by these invasive grasses not only displaces native ground cover and shrub species but also creates a situation where the woodland is highly susceptible to mortality from fire. Both species are prolific seeders with dispersal primarily by means of wind or by accidental transport in soil carried on vehicles and equipment etc. Germination and establishment of Gamba Grass appears to be enhanced by site and canopy disturbance (Setterfield et.al 2005). At present, Gamba and Mission grass appear to be restricted to the margins of the *Acacia auriculiformis* community and their penetration into the community is likely held in check by lack of soil disturbance and an intact canopy cover. Removal of the 13ha of *Acacia auriculiformis* woodland would create a new woodland margin with disturbed canopy cover and extensively disturbed soil, providing ideal conditions for the spread of these species.

The preliminary site layout plan indicates a waste dump being sited at the northeast corner of the mineral lease, immediately adjacent to the river and within the *Acacia auriculiformis* community. Geologist on site (John Earthrowl) indicated the waste likely to be deposited in this dump would be sand and rock. It is suggested that the waste dump be removed from this particular location and relocated in a less ecologically and environmentally sensitive part of the lease or possibly the material could be incorporated in to the tailings dam wall.

At present the Gamba and Mission Grass infestations appear to be restricted to the margins of the *Acacia auriculiformis* community and prevention of their further spread into that community would still be feasible with efficient and ongoing control. Removal of the waste dump from the currently proposed location may obviate the need to clear much or all of the 13ha of the *Acacia auriculiformis* community within the project area, thereby helping to prevent the rapid spread of weeds in to the remainder of the community.

Retention of this vegetation on lease, combined with targeted herbicide application to eliminate the current weed infestation in this area (with particular focus on preventing its further spread by targeting newly established plants) would be strongly recommended.

Retention of this vegetation and relocation of the waste dump would also create less disturbance immediately adjacent to the river, with likely implications for a reduction in erosion and run-off. In addition an aboriginal sacred site is apparently located very close to the proposed waste dump location and its removal to another part of the project area would likely be regarded favourably by the aboriginal community.

2.4 Weed species

A total of 33 species of introduced plants have been recorded from the combined data of Metcalfe's 2002 study and the current project.

Of those species recorded during the current study, those listed in Table 4 are considered to pose the most significant threats and will require effective and ongoing intervention or management to prevent their further spread. Control of these and other Class B noxious weeds is required under the Northern Territory Weed Management Act 2001

In particular, control of Gamba Grass and Mission Grass will be essential in order to reduce the fire risk on and around the project area. As outlined in the previous section, these species supply massive fuel loads which create exceptionally hot and intense fires. Both these species are capable of resprouting rapidly and vigorously after fire (J.Egan pers.obs).

Of the other species listed in Table 4, *Grewia asiatica* is also able to withstand fire by resprouting from a woody rootstock. *Senna obtusifolia* and *Calopogonium mucunoides* are annual species which die and dry off in the dry season unless growing in a permanently moist situation. Most of the other species listed are shortlived perennials (or longlived in the case of *Mimosa*) which may resprout from low buds after an early season 'cool' burn or patchy burn, but which are generally killed by hotter fires.

Table 4: Significant weed species on project area

Scientific name	Common name
<i>Andropogon gayanus</i>	Gamba Grass
<i>Pennisetum polystachion</i>	Mission Grass. Class B noxious weed
<i>Hyptis suaveolens</i>	Horehound. Class B noxious weed.
<i>Sida acuta, Sida cordifolia</i>	Class B noxious weeds
<i>Mimosa pigra</i>	Class B, Weed of National Significance
<i>Senna obtusifolia</i>	Sicklepod. Class B noxious weed
<i>Stachytarpheta spp</i>	Snakeweeds. Class B noxious weeds
<i>Calopogonium mucunoides</i>	Calopo
<i>Grewia asiatica</i>	Phalsa

Andropogon gayanus

Of the above species, Gamba Grass is likely to pose the greatest threat of spreading over the mine site and into adjacent woodlands and forests, as outlined in the previous section. Gamba Grass is capable of spreading into undisturbed bushland (Setterfield et.al 2005) but its easiest and most rapid mode of spread is along roads and cleared corridors. Clearing of the project area will create several kilometres of ‘coastline’ which Gamba will be able to quickly colonize and then spread into neighbouring properties – monitoring and control of the ‘coastline’ will be of prime importance in controlling this weed.

Gamba Grass Distribution

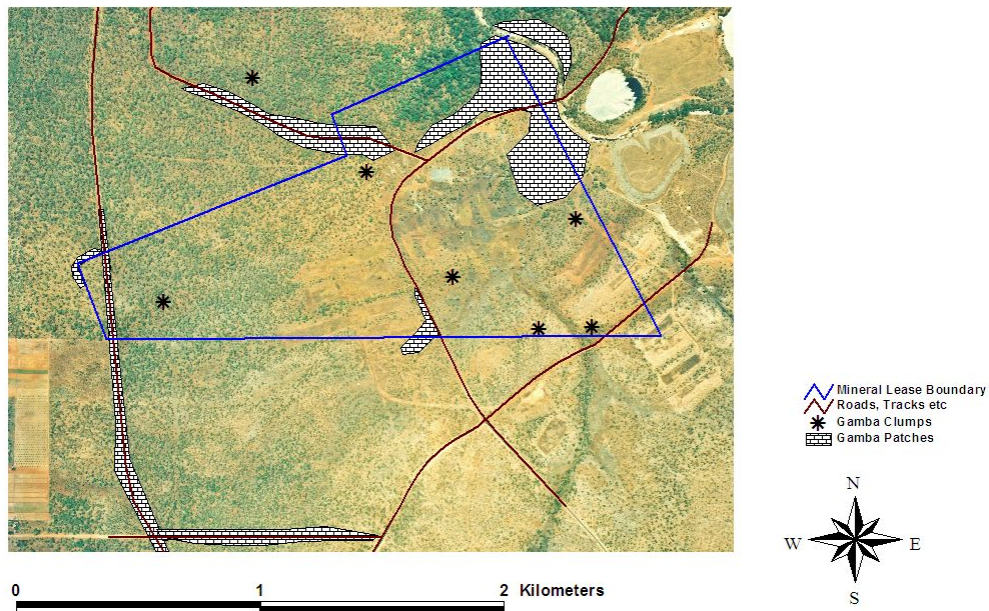


Figure 2 : Major Gamba Grass Infestations on Browns Oxide Lease, 2005

Figure 2 presents a broad overview of the locations of the most dense infestations of Gamba grass on and around the project area. This study was

not intended to be an exhaustive mapping exercise for Gamba grass and these distributions were derived in the course of general fieldwork. Therefore, further large infestations may also occur in the area. It must also be borne in mind that much of the project area had been burnt in recent weeks so the extent of infestation is likely to have been substantially underestimated. In addition to the main patches delineated, scattered clumps were found at various locations over the lease and these are likely to be only a very small proportion of clumps which may already exist throughout the project area. As a rough calculation derived from the mapping exercise, it is estimated at least 20ha (around 11%) of the project area is currently affected by moderately dense to dense Gamba infestation.

Pennisetum polystachion.

Mission grass was most abundant throughout vegetation units 12 and 14 with several largish stands (ie.c.20 - 30m diameter) noted in woodland off of Whites Road. Again, estimation of actual coverage was compromised by having been burnt recently.

Hyptis and Stachytarpheta spp.

Hyptis suaveolens and *Stachytarpheta spp.* were observed throughout the project area with the most dense infestations being noted along the margins of the *Acacia auriculiformis* community (Unit 10). This apparent distribution may however be misleading - some of these margins had not yet been burnt and numerous remnants of singed and burnt *Hyptis* plants were also noted on Unit 14 as well as in several of the Eucalypt savanna plots of Units 2 and 3.

Sida spp.

Within the project area, *Sida acuta* and *Sida cordifolia* were not very obvious. *Sida acuta* was recorded in Unit 10 and Unit 12 but it was not abundant at time of assessment and *Sida cordifolia* was only noted along the Rum Jungle roadside. The apparent lack of these species may or may not be due to the very dry seasonal conditions when they tend to lose much of their leaf cover, or to their having been burnt off .

Mimosa pigra

Scattered plants of *Mimosa pigra* were discovered along the main East Finniss River channel downstream of the mine site and some larger patches approx 6m across and 4m high were noted growing amongst the understorey of Unit 10 (*Acacia auriculiformis* community). It would be prudent to bring these infestations under control whilst they are still localised.

Senna obtusifolia

Senna obtusifolia was recorded on the outskirts of Units 12 and 14, and had been burnt. Nevertheless it had obviously been extremely dense when alive. As an annual plant, this species will undoubtedly regenerate from the soil seed bank in the forthcoming wet season.

Calopogonium mucunoides

Calopo (*Calopogonium mucunoides*) did not appear to be widespread at time of survey, only being recorded from Units 10 and 12. However, in these

Acacia auriculiformis communities it was locally abundant and dense, apparently favouring these situations of retained soil moisture throughout the dry season. This twining species can form an impenetrable tangle over the forest floor and shrub layers, preventing growth or recruitment of other species (J.Egan pers.obs.) It was likely introduced to this area in the mid 1980's as one of the species used for revegetation of the nearby Rum Jungle Mine (Taylor et.al 2003).

Grewia asiatica

Grewia asiatica had not previously been reported from this region by Metcalfe 2002, but was found at several locations across the project area. It is mentioned here primarily because it appears to be in the early stages of establishment and prompt intervention at this stage may prevent its further spread. As outlined under the Flora Characterisation Review, the species has become established around Daly River in the NT, around Cooktown in Qld and is being eradicated in Kununurra WA (Smith 2002).

2.5 Rehabilitation and revegetation

To date, rehabilitation and revegetation activities on mine sites in the Top End have achieved limited success (eg.Office of the Supervising Scientist 2004). Decommissioning of the nearby Rum Jungle Uranium Mine in the 1970's caused numerous environmental problems, the legacy of which is still present today (Jeffree 2001, Pidsley 2002). Mine site rehabilitation in the tropical wet-dry seasonal climate of Australia poses particular difficulties and challenges and is an evolving sphere of expertise with no 'recipe' yet to follow.

The Browns Oxide Notice of Intent (NOI) of December 2004, indicates that top soil will be stockpiled for use in rehabilitation and that rehabilitation will be progressive throughout the life of the mine.

The use of topsoil for rehabilitation is certainly recommended, although it must be borne in mind that longterm stockpiling of topsoils may lead to an almost complete elimination of the native soil bacteria and mycorrhizal fungi necessary for many Top End native plants (Corbett 1999; Reddell and Milnes 1992).

Ideally, top soil should be re-spread as soon after its removal as possible in order to preserve the soil biota of bacteria and fungi (Lloyd et.al 2002). Therefore, careful planning to coordinate the removal of top soil from one area with its prompt deposition and spreading in another area is recommended.

If topsoil does have to be stockpiled in large amounts for periods of time, it is recommended that it be spread out in the storage area as much as possible to permit aeration and to maximise contact with underlying soils which may help to maintain or replenish the soil biota, rather than dumped in huge piles. Re-inoculation of stored soil with native micro-organisms may be a possible option (Tommerup et.al 2002). Weed infestation of stored topsoil will be almost inevitable and will need to be controlled or prevented so that weed species are not introduced straight into the area undergoing rehabilitation, thereby making revegetation a more difficult task.

Prior to revegetation it is recommended that the surface be contour ripped in order to minimise erosion by run-off and to break any hard pans created by frequent heavy traffic, and stabilised with a blend of native perennial grass, shrub and tree species selected for suitability to the eventual topography and soil conditions. Unlike many parts of Australia, *Acacia* species are generally no longer regarded as suitable pioneer vegetation in Top End conditions as their rapid growth and flammability tend to create an Acacia-fire cycle which slows development of a longer term sustainable community (Setterfield et.al. 1993). Research into native species suitable for minesite rehabilitation is currently underway at Charles Darwin University and perhaps some joint collaboration in research could be investigated which would benefit both parties.

Depending on the seasonal timing of revegetation activities, it may be preferable to establish a stabilising grass cover prior to establishing shrub and tree species. Shrub and tree species used for revegetation would ideally be locally provenanced to maintain the genetic integrity of the surrounding woodlands. In most situations a combination of broadcast seeding and planting of seedling plants is employed. Planning will need to establish where, when and who will supply the seeds and/or plants (ie. setting up of a small nursery or subcontracting/purchasing from an outside supplier). Final choice of species will depend largely on final contouring of the area and selecting those species most suitable for the recreated landscape (eg. Lower lying areas around the pit may be suitable for establishing artificial wetlands, whilst areas contoured to rocky mounds will be suitable for a very different suite of species, maybe similar to that occurring in Vegetation Unit 1).

For at least the first couple of years after planting it will be necessary to try to exclude fire from the area in order that seedlings may become sufficiently established to withstand being burnt.

Weed control will need to be effective and ongoing with Gamba Grass and Mission Grass in particular needing to be kept from establishing in revegetated areas.

2.6 Items to include in a conceptual Weed Management Plan(WMP)

- Wash down units for vehicles and any other equipment moving on or off the mine site (particularly earthmoving equipment).
- Define a regular surveillance programme to monitor and control spread of weeds along and from boundaries of the project area, especially after clearing.
- Include weed control and monitoring as an ongoing regular duty of one or more staff members.
- target spread of Gamba grass, particularly its potential spread into the adjacent *Acacia auriculiformis* community to the north
- target *Grewia asiatica* before it becomes firmly established.

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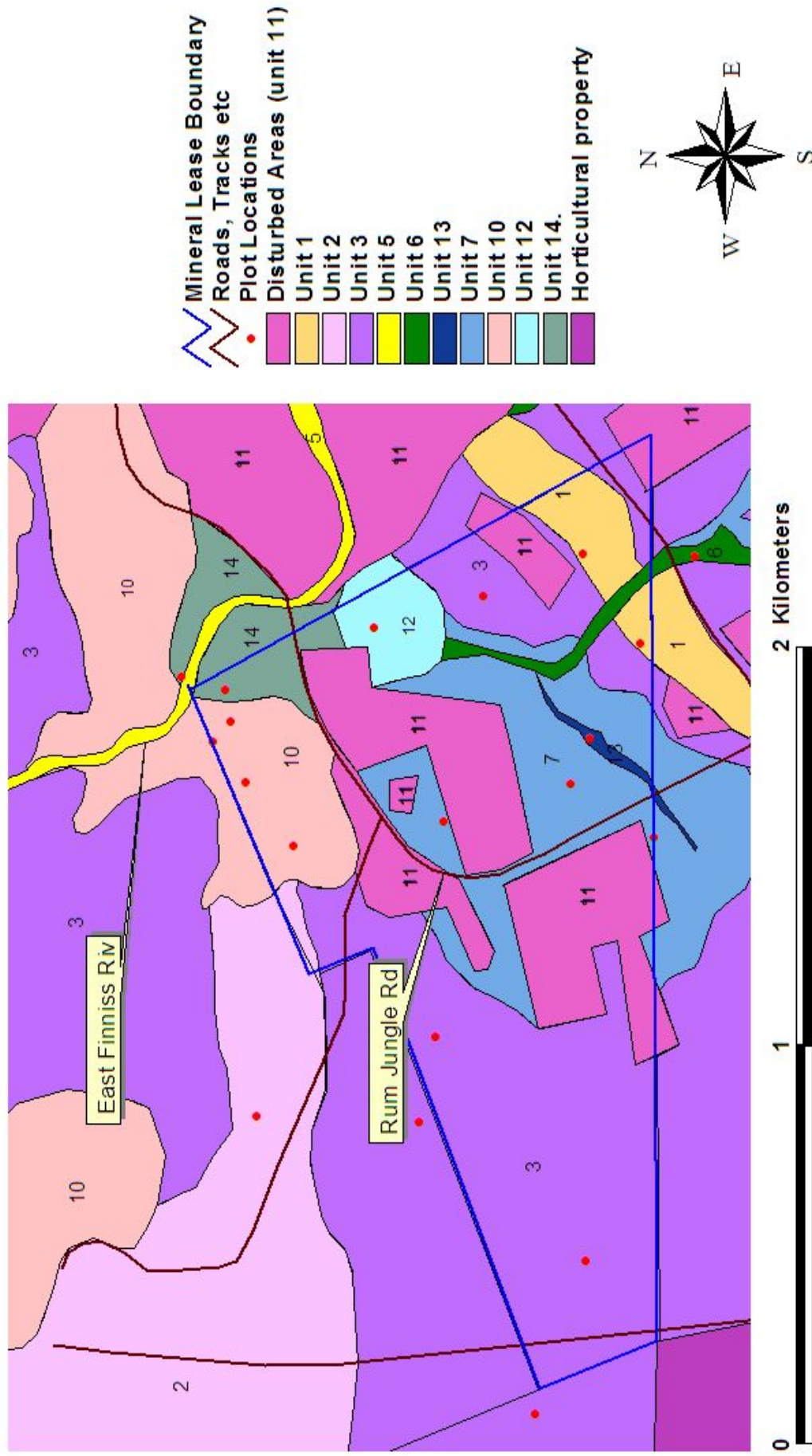
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Browns Oxide Vegetation Map



APPENDIX 1

Additions to Species Lists for Each Vegetation Unit in Project Area

The following table presents additional species encountered in each vegetation community during field work of 2005. For complete listings of plant species associated with each vegetation unit, see Appendix 1 of Metcalfe 2002 in collaboration with these additions

Species	Family
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Unit 1: *Eucalyptus phoenicea*/*Corymbia bleeseri* open woodland

31 species recorded by Metcalfe 2002. Further 29 species recorded 2005.
Total 60 species

Mid stratum

<i>Acacia gonocarpa</i>	Mimosaceae
<i>Acacia latescens</i>	Mimosaceae
<i>Brachychiton diversifolius</i>	Sterculiaceae
<i>Brachychiton megaphyllus</i>	Sterculiaceae
<i>Breynia cernua</i>	Euphorbiaceae
<i>Capparis umbonata</i>	Capparaceae
<i>Cochlospermum fraseri</i>	Bixaceae
<i>Erythrophleum chlorostachys</i>	Caesalpiniaceae
<i>Flemingia sp.sericea</i>	Fabaceae
<i>Gardenia megasperma</i>	Rubiaceae
<i>Hakea arborescens</i>	Proteaceae
<i>Planchonia careya</i>	Lecythidaceae
<i>Terminalia carpentariae</i>	Combretaceae

Lower stratum

<i>Andropogon gayanus</i>	Poaceae
<i>Bonamia media</i>	Convolvulaceae
<i>Cymbopogon bombycinus</i>	Poaceae
<i>Distichostemon hispidulus</i>	Sapindaceae
<i>Eriachne sulcata</i>	Poaceae
<i>Eriachne obtusa</i>	Poaceae
<i>Evolvulus alsinoides</i>	Convolvulaceae
<i>Gomphrena canescens</i>	Amaranthaceae
<i>Goodenia armstrongiana</i>	Goodeniaceae
<i>Polycarpaea corymbosa</i>	Amaranthaceae
<i>Polycarpaea longiflora</i>	Amaranthaceae
<i>Ptilotus distans</i>	Amaranthaceae
<i>Sorghum intrans</i>	Poaceae
<i>Stemodia lythrifolia</i>	Scrophulariaceae
<i>Trachymene didiscoides</i>	Apiaceae
<i>Triodia bitextura</i>	Poaceae

**Unit 2: Eucalyptus tetrodonta/E.miniata/Erythrophleum chlorostachys
- tall open forest to woodland**

63 species recorded by Metcalfe 2002. Further 13 species recorded in 2005.
Total 76 species.

Upper stratum

Gardenia megasperma Rubiaceae

Mid stratum

Pachygone ovata Menispermaceae

Petalostigma quadriloculare Euphorbiaceae

Flemingia sp.sericea Fabaceae

Lower stratum

Cyanthillium cinerea Asteraceae

Dactyloctenium radulans Poaceae

Jasminum molle Oleaceae

Mitrasacme connata Loganiaceae

Murdannia graminea Commelinaceae

Pachynema dilatatum Dilleniaceae

Panicum mindanaense Poaceae

Pseudopogonatherum contortum Poaceae

Schizachyrium sp. Poaceae

Unit 3: Eucalyptus tetrodonta/ E.miniata open woodland

66 species recorded by Metcalfe 2002. Further 42 species recorded 2002. Total
110 species

Upper stratum

Alstonia actinophylla Apocynaceae

Buchanania obovata Anacardiaceae

Grevillea pteridifolia Proteaceae

Xanthostemon paradoxus Myrtaceae

Mid stratum

Acacia dimidiata Mimosaceae

Acacia latescens Mimosaceae

Acacia oncinocarpa Mimosaceae

Brachychiton diversifolius Sterculiaceae

Capparis umbonata Capparaceae

Croton arnhemicus Euphorbiaceae

Denhamia obscura Celastraceae

Flemingia sp.sericea Fabaceae

Browns Oxide Project – Appendix 1 – Additional Species Per Vegetation Unit

<i>Grewia asiatica</i>	Tiliaceae
<i>Grewia retusifolia</i>	Tiliaceae
<i>Petalostigma quadriloculare</i>	Euphorbiaceae
<i>Pogonolobus reticulatus</i>	Rubiaceae
<i>Syzygium eucalyptoides</i> <i>ssp. bleeseri</i>	Myrtaceae
<i>Wrightia saligna</i>	Apocynaceae

Lower stratum

<i>Aristida latifolia</i>	Poaceae
<i>Bulbostylis barbata</i>	Cyperaceae
<i>Chrysopogon latifolius</i>	Poaceae
<i>Crotalaria goreensis</i>	Fabaceae
<i>Eriachne obtusa</i>	Poaceae
<i>Eriachne trisetata</i>	Poaceae
<i>Fimbristylis xyridis</i>	Cyperaceae
<i>Gomphrena canescens</i>	Amaranthaceae
<i>Heliotropium ventricosum</i>	Boraginaceae
<i>Hyptis suaveolens</i>	Lamiaceae
<i>Indigofera linifolia</i>	Fabaceae
<i>Mitrasacme latiflora</i>	Loganiaceae
<i>Passiflora foetida</i>	Passifloraceae
<i>Pennisetum pedicellatum</i>	Poaceae
<i>Polygala sp.</i>	Polygalaceae
<i>Pseudopogonatherum contortum</i>	Poaceae
<i>Ptilotus distans</i>	Amaranthaceae
<i>Sauropus glaucus</i>	Euphorbiaceae
<i>Sorghum intrans</i>	Poaceae
<i>Stemodia lythrifolia</i>	Scrophulariaceae
<i>Trianthema sp.</i>	Aizoaceae
<i>Triodia bitextura</i>	Poaceae
<i>Tylophora flexuosa</i>	Asclepiadaceae
<i>Waltheria indica</i>	Sterculiaceae

Unit 5: Riparian corridor

99 species recorded by Metcalfe 2002. Further 5 species recorded 2005. Total 104 species.

Mid stratum

<i>Exocarpos latifolius</i>	Santalaceae
<i>Capparis sepiaria</i>	Capparaceae

Lower stratum

<i>Physalis angulata</i>	Solanaceae
<i>Stylosanthes guianensis</i>	Fabaceae
<i>Stylosanthes hamata</i>	Fabaceae

Unit 6: Lophostemon communities

35 species recorded by Metcalfe 2002. Further 12 species recorded 2005. Total 47 species.

Lower stratum

<i>Ammania baccifera</i>	Lythraceae
<i>Bacopa floribunda</i>	Scrophulariaceae
<i>Cyperus difformis</i>	Cyperaceae
<i>Cyperus haspan</i>	Cyperaceae
<i>Elytrophorus spicatus</i>	Poaceae
<i>Eragrostis fallax</i>	Poaceae
<i>Eragrostis leporina</i>	Poaceae
<i>Eriocaulon sp.</i>	Eriocaulaceae
<i>Glinus oppositifolius</i>	Molluginaceae
<i>Ludwigia adscendens</i>	Onagraceae
<i>Paspalum scrobiculatum</i>	Poaceae
<i>Pseudoraphis spinescens</i>	Poaceae

Unit 7: *Corymbia bella*/ *Corymbia foelscheana*/ *Melaleuca* spp. Open woodland

51 species recorded by Metcalfe 2002. Further 26 species recorded 2005. Total 77 species.

Upper stratum

<i>Buchanania obovata</i>	Anacardiaceae
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Mid stratum

<i>Acacia difficilis</i>	Mimosaceae
<i>Acacia pallidifolia</i>	Mimosaceae
<i>Ampelocissus frutescens</i>	Vitaceae
<i>Brachychiton megaphyllus</i>	Sterculiaceae
<i>Erythrina vespertilio</i>	Fabaceae
<i>Flemingia lineata</i>	Fabaceae
<i>Flemingia sp.sericea</i>	Fabaceae
<i>Ficus aculeata</i>	Moraceae
<i>Grewia asiatica</i>	Tiliaceae
<i>Hakea arborescens</i>	Proteaceae
<i>Planchonia careya</i>	Lecythidaceae
<i>Pogonolobus reticulatus</i>	Rubiaceae

Lower stratum

<i>Boerhavia sp.</i>	Nyctaginaceae
<i>Chrysopogon fallax</i>	Poaceae
<i>Flemingia trifoliastrum</i>	Fabaceae
<i>Goodenia armstrongiana</i>	Goodeniaceae
<i>Imperata cylindrica</i>	Poaceae

<i>Indigofera linifolia</i>	Fabaceae
<i>Indigofera trita</i>	Fabaceae
<i>Merremia quinata</i>	Convolvulaceae
<i>Rhynchosia minima</i>	Fabaceae
<i>Sebastiania chamaelea</i>	Euphorbiaceae
<i>Trichodesma zeylanica</i>	Boraginaceae
<i>Tylophora flexuosa</i>	Asclepiadaceae
<i>Vigna lanceolata</i>	Fabaceae

Unit 10: *Acacia auriculiformis* communities - woodland to open forest.

89 species recorded by Metcalfe 2002. Further 31 species recorded 2005. Total 120 species.

Upper stratum

<i>Antiaris toxicaria</i>	Moraceae
<i>Artocarpus glaucus</i>	Moraceae
<i>Carallia brachiata</i>	Rubiaceae
<i>Glochidion sumatranum</i>	Euphorbiaceae
<i>Lophostemon grandiflorus</i>	Myrtaceae
<i>Lophostemon lactifluus</i>	Myrtaceae
<i>Maranthes corymbosa</i>	Chrysobalanaceae
<i>Melaleuca leucadendra</i>	Myrtaceae
<i>Syzygium nervosum</i>	Myrtaceae
<i>Vitex acuminata</i>	Verbenaceae

Mid stratum

<i>Aidia racemosa</i>	Rubiaceae
<i>Barringtonia acutangula</i>	Lecythidaceae
<i>Clerodendrum costatum</i>	Verbenaceae
<i>Ficus scobina</i>	Moraceae
<i>Grewia mesomischa</i>	Tiliaceae
<i>Mallotus philippensis</i>	Euphorbiaceae
<i>Melaleuca cajuputi</i>	Myrtaceae
<i>Melaleuca dealbata</i>	Myrtaceae
<i>Mimosa pigra</i>	Mimosaceae
<i>Pachygone ovata</i>	Menispermaceae
<i>Solanum seforthianum</i>	Solanaceae

Lower stratum

<i>Achyranthes aspera</i>	Amaranthaceae
<i>Adenia floribunda</i>	Passifloraceae
<i>Ageratum conyzoides</i>	Asteraceae
<i>Aristida macroclada</i> <i>ssp. macroclada</i>	Poaceae
<i>Eriachne trisetata</i>	Poaceae

<i>Flagellaria indica</i>	Flagellariaceae
<i>Ludwigia octovalvis</i>	Onagraceae
<i>Ludwigia perennis</i>	Onagraceae
<i>Panicum mindanaense</i>	Poaceae
<i>Pseudoraphis spinescens</i>	Poaceae

Unit 12: Acacia auriculiformis/ Melaleuca dealbata/ Lophostemon grandiflorus forest.

Newly identified map unit. 30 species recorded

Upper stratum

<i>Acacia auriculiformis</i>	Mimosaceae
<i>Corymbia bella</i>	Myrtaceae
<i>Lophostemon grandiflorus</i>	Myrtaceae
<i>Lophostemon lactifluus</i>	Myrtaceae
<i>Melaleuca dealbata</i>	Myrtaceae
<i>Pandanus spiralis</i>	Pandanaceae
<i>Syzygium nervosum</i>	Myrtaceae
<i>Syzygium suborbiculare</i>	Myrtaceae
<i>Timonius timon</i>	Rubiaceae

Mid stratum

<i>Acacia auriculiformis</i>	Mimosaceae
<i>Capparis sepiaria</i>	Capparaceae
<i>Flueggea virosa</i>	Euphorbiaceae
<i>Jasminum aemulum</i>	Oleaceae
<i>Lophostemon grandiflorus</i>	Myrtaceae
<i>Planchonia careya</i>	Lecythidaceae
<i>Strychnos lucida</i>	Loganiaceae

Lower stratum

<i>Andropogon gayanus</i>	Poaceae
<i>Calopogonium mucunoides</i>	Fabaceae
<i>Flagellaria indica</i>	Flagellariaceae
<i>Gymnanthera oblonga</i>	Asclepiadaceae
<i>Hyptis suaveolens</i>	Lamiaceae
<i>Imperata cylindrica</i>	Poaceae
<i>Ipomoea triloba</i>	Convolvulaceae
<i>Ludwigia octovalvis</i>	Onagraceae
<i>Passiflora foetida</i>	Passifloraceae
<i>Pennisetum polystachion</i>	Poaceae
<i>Pennisetum pedicellatum</i>	Poaceae
<i>Pseudoraphis spinescens</i>	Poaceae
<i>Scleria ligulata</i>	Cyperaceae
<i>Sida acuta</i>	Malvaceae
<i>Stachytarpheta cayennensis</i>	Verbenaceae
<i>Tylophora flexuosa</i>	Asclepiadaceae

Unit 13: Pandanus spiralis over Imperata cylindrica - drainage channel

Newly identified unit. 12 species.

Upper stratum

<i>Pandanus spiralis</i>	Pandanaceae
<i>Melaleuca dealbata</i>	Myrtaceae
<i>Melaleuca viridiflora</i>	Myrtaceae

Mid stratum

<i>Antidesma ghaesembila</i>	Euphorbiaceae
<i>Flemingia lineata</i>	Fabaceae
<i>Pandanus spiralis</i>	Pandanaceae
<i>Grewia asiatica</i>	Tiliaceae

Lower stratum

<i>Imperata cylindrica</i>	Poaceae
<i>Ischaemum australe</i>	Poaceae
<i>Cyperus haspan</i>	Cyperaceae
<i>Panicum sp.</i>	Poaceae
<i>Fimbristylis dichotoma</i>	Cyperaceae
<i>Rhynchospora sp.</i>	Cyperaceae
<i>Themeda triandra</i>	Poaceae

Unit 14: Extensively degraded Acaia auriculiformis/ Erythrophleum chlorostachys woodland

Newly identified unit. Extensively affected by frequent fires and invasion of weeds.
23 species

Upper stratum

<i>Acacia auriculiformis</i>	Mimosaceae
<i>Erythrophleum chlorostachys</i>	Caesalpiniaceae
<i>Eucalyptus tetradonta</i>	Myrtaceae

Mid stratum

<i>Acacia difficilis</i>	Mimosaceae
<i>Alphitonia excelsa</i>	Rhamnaceae
<i>Brachychiton diversifolius</i>	Sterculiaceae
<i>Breynia cernua</i>	Euphorbiaceae
<i>Buchanania obovata</i>	Anacardiaceae
<i>Clerodendrum floribundum</i>	Verbenaceae
<i>Cycas armstrongii</i>	Cycadaceae
<i>Denhamia obscura</i>	Celastraceae
<i>Flemingia sp.sericea</i>	Fabaceae
<i>Flueggea virosa</i>	Euphorbiaceae
<i>Jasminum molle</i>	Oleaceae

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<i>Livistona humilis</i>	Arecaceae
<i>Persoonia falcata</i>	Proteaceae
<i>Petalostigma quadriloculare</i>	Euphorbiaceae
<i>Planchonia careya</i>	Lecythidaceae
<i>Syzygium suborbiculare</i>	Myrtaceae

Lower stratum

<i>Andropogon gayanus</i>	Poaceae
<i>Hyptis suaveolens</i>	Lamiaceae
<i>Passiflora foetida</i>	Passifloraceae
<i>Pennisetum polystachion</i>	Poaceae

APPENDIX 2

**Combined Species List for All Vegetation Communities -
Metcalf 2002 and Egan 2005**

i = introduced/ exotic species

E = species endemic to the Northern Territory

A or B = noxious weed class A and/or B (Smith 1995)

WONS = Weed of National Significance

Y = Species added to list as result of 2005 project

Family	Genus and species	Previous name(if any)	Code	2005 Record
Acanthaceae	Andrographis paniculata		i	
Acanthaceae	Hygrophia angustifolia			
Acanthaceae	Hypoestes floribunda			
Acanthaceae	Nelsonia campestris			
Acanthaceae	Staurogyne leptocaulis			
Agavaceae	Pleomele angustifolia			
Aizoaceae	Trianthema sp.			Y
Amaranthaceae	Achyranthes aspera			Y
Amaranthaceae	Gomphrena canescens		E	Y
Amaranthaceae	Ptilotus distans			Y
Anacardiaceae	Buchanania obovata			
Anacardiaceae	Mangifera indica		i	
Annonaceae	Miliusa traceyi			
Annonaceae	Polyalthia australis			
Apiaceae	Trachymene didiscoides			Y
Apocynaceae	Alstonia actinophylla			
Apocynaceae	Parsonsia velutina			
Apocynaceae	Wrightia pubescens			
Apocynaceae	Wrightia saligna			Y
Araceae	Amorphophallus galbra			
Araceae	Colocasia esculenta			
Arecaceae	Carpentaria acuminata		E	
Arecaceae	Livistona humilis		E	
Asclepiadaceae	Asclepiadaceae sp.			
Asclepiadaceae	Gymnanthera oblonga			
Asclepiadaceae	Marsdenia velutina			
Asclepiadaceae	Tylophora flexuosa			Y
Asteraceae	Ageratum conyzoides		i	
Asteraceae	Bidens bipinnata		i	
Asteraceae	Cyanthillium cinereum	doubtful if introduced (cf.Metcalf)		
Asteraceae	Eclipta sp. Gove	doubtful if introduced (cf.Metcalf)		
Asteraceae	Elephantopus scaber			
Bignoniaceae	Dolichandrone filiformis			
Bigoniaceae	Tecoma stans		i	
Bixaceae	Cochlospermum fraseri			
Boraginaceae	Heliotropium ventricosum			Y
Boraginaceae	Trichodesma zeylanica			Y
Burseraceae	Canarium australanum			

Browns Oxide Project – Appendix 2 – Entire Combined Species List

Caesalpiniaceae	Erythrophloem chlorostachys			
Caesalpiniaceae	Senna obtusifolia	Cassia obtusifolia	i, B	
Capparaceae	Capparis sepiaria			
Capparaceae	Capparis umbonata			Y
Capparaceae	Cleome viscosa			
Caryophyllaceae	Polycarpaea corymbosa			Y
Caryophyllaceae	Polycarpaea longiflora			Y
Celastraceae	Denhamia obscura			
Chrysobalanaceae	Maranthes corymbosa			
Clusiaceae	Calophyllum sil			
Clusiaceae	Calophyllum soulatri			
Combretaceae	Terminalia carpentariae			
Combretaceae	Terminalia ferdinandana			
Combretaceae	Terminalia grandifolia			
Combretaceae	Terminalia microcarpa			
Commelinaceae	Cartonema spicatum			
Commelinaceae	Murdannia graminea			Y
Convolvulaceae	Bonamia media			Y
Convolvulaceae	Evolvulus alsinoides			Y
Convolvulaceae	Ipomoea graminea			
Convolvulaceae	Ipomoea sp.			
Convolvulaceae	Ipomoea triloba		i	Y
Convolvulaceae	Merremia hederacea			
Convolvulaceae	Merremia quinata			Y
Cycadaceae	Cycas armstrongii		E	
Cyperaceae	Bulbostylis barbata			Y
Cyperaceae	Cyperus aquatilis			
Cyperaceae	Cyperus difformis			Y
Cyperaceae	Cyperus haspan			
Cyperaceae	Eleocharis geniculata			
Cyperaceae	Fimbristylis dichotoma			
Cyperaceae	Fimbristylis littoralis			
Cyperaceae	Fimbristylis pauciflora			
Cyperaceae	Fimbristylis sp.			
Cyperaceae	Fimbristylis xyridis			Y
Cyperaceae	Fuirena ciliaris			
Cyperaceae	Rhynchospora sp.			
Cyperaceae	Scleria ligulata			Y
Dilleniaceae	Hibbertia sp.			
Dilleniaceae	Pachynema complanatum			
Dilleniaceae	Pachynema dilatatum		E	
Dilleniaceae	Pachynema sp.			
Dioscoreaceae	Dioscorea bulbifera			
Droseraceae	Drosera indica			
Ebenaceae	Diospyros calycantha			
Elaeocarpaceae	Elaeocarpus arnhemicus			
Eriocaulaceae	Eriocaulon sp.			Y
Euphorbiaceae	Antidesma ghaesembila			
Euphorbiaceae	Breynia cernua	not endemic (cf. Metcalfe 02)		
Euphorbiaceae	Bridelia tomentosa	not endemic (cf. Metcalfe 02)		
Euphorbiaceae	Croton argyratus			
Euphorbiaceae	Croton arnhemicus			Y

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Euphorbiaceae	Drypetes deplanchei			
Euphorbiaceae	Flueggea virosa			
Euphorbiaceae	Glochidion sumatranum			Y
Euphorbiaceae	Mallotus philippensis			
Euphorbiaceae	Petalostigma pubescens			
Euphorbiaceae	Petalostigma quadriloculare			
Euphorbiaceae	Sauropus glaucus			
Euphorbiaceae	Sebastiania chamaelea			Y
Fabaceae	Abrus precatorius			
Fabaceae	Calopogonium mucunoides		i	
Fabaceae	Centrosema molle		i	
Fabaceae	Crotalaria goreensis		i	
Fabaceae	Crotalaria medicaginea			
Fabaceae	Erythrina vespertilio			
Fabaceae	Flemingia lineata			
Fabaceae	Flemingia sp.sericea		E	Y
Fabaceae	Flemingia trifoliastrum			
Fabaceae	Galactia tenuiflora			
Fabaceae	Indigofera linifolia			Y
Fabaceae	Indigofera trita			Y
Fabaceae	Macroptilium atropurpureum		i	
Fabaceae	Pongamia pinnata			
Fabaceae	Pycnospora lutescens			
Fabaceae	Rhynchosia minima			Y
Fabaceae	Stylosanthes guianensis		i	
Fabaceae	Stylosanthes hamata		i	
Fabaceae	Vigna lanceolata			Y
Flacourtiaceae	Flacourtia territorialis		E	
Flagellariaceae	Flagellaria indica			
Gentianaceae	Canscora diffusa			
Goodeniaceae	Goodenia armstrongiana			
Hemionitidaceae	Pityrogramma colomelanos		i	
Hydrocharitaceae	Blyxa aubertii			
Lamiaceae	Basilicum polystachion			
Lamiaceae	Hyptis suaveolens		i, B	
Lauraceae	Litsea glutinosa			
Lecythydaceae	Barringtonia acutangula			
Lecythydaceae	Planchonia careya			
Leeaceae	Leea indica			
Liliaceae	Protoasparagus racemosus			
Loganiaceae	Mitrasacme connata			Y
Loganiaceae	Mitrasacme latiflora		E	Y
Loganiaceae	Strychnos lucida			
Lythraceae	Ammania baccifera			
Malvaceae	Hibiscus meraukensis			
Malvaceae	Hibiscus sabdariffa		i	
Malvaceae	Sida acuta		i, B	
Malvaceae	Sida cordifolia		i, B	
Malvaceae	Urena lobata			
Meliaceae	Owenia vernicosa			
Meliaceae	Vavaea australiana			
Menispermaceae	Pachygone ovata			Y

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Menispermaceae	Stephania japonica			
Menispermaceae	Tinospora smilacina			
Menyanthaceae	Nymphoides indica			
Mimosaceae	Acacia auriculiformis			
Mimosaceae	Acacia difficilis			
Mimosaceae	Acacia dimidiata			Y
Mimosaceae	Acacia gonocarpa			Y
Mimosaceae	Acacia holosericea			
Mimosaceae	Acacia lamprocarpa	A.aulacocarpa		
Mimosaceae	Acacia latescens			Y
Mimosaceae	Acacia mountfordiae			
Mimosaceae	Acacia oncinocarpa		E	
Mimosaceae	Acacia pallidifolia			Y
Mimosaceae	Acacia sp.			
Mimosaceae	Leucaena leucocephala		i	
Mimosaceae	Mimosa pigra		i, A/B, WONS	
Molluginaceae	Glinus oppositifolius			Y
Moraceae	Antiaris toxicaria			Y
Moraceae	Artocarpus glaucus			Y
Moraceae	Ficus aculeata	Ficus opposita		
Moraceae	Ficus hispida			
Moraceae	Ficus platypoda			
Moraceae	Ficus racemosa			
Moraceae	Ficus scobina			Y
Myristicaceae	Myristica insipida			
Myrsinaceae	Embelai curvinervia			
Myrtaceae	Calytris exstipulata			
Myrtaceae	Calytrix achaeta			
Myrtaceae	Corymbia bella	Eucalyptus papuana		
Myrtaceae	Corymbia bleeseri			
Myrtaceae	Corymbia confertiflora	Eucalyptus confertiflora		
Myrtaceae	Corymbia grandifolia			
Myrtaceae	Corymbia polycarpa			
Myrtaceae	Corymbia polysciada	Eucalyptus clavigera	E	
Myrtaceae	Eucalyptus miniata			
Myrtaceae	Eucalyptus phoenicea			
Myrtaceae	Eucalyptus sp.			
Myrtaceae	Eucalyptus tectifera			
Myrtaceae	Eucalyptus tetradonta			
Myrtaceae	Leptospermum madidum	Leptospermum longifolium		
Myrtaceae	Lophostemon grandiflorus			
Myrtaceae	Lophostemon lactifluus			
Myrtaceae	Melaleuca cajuputi			
Myrtaceae	Melaleuca dealbata			
Myrtaceae	Melaleuca leucadendra			
Myrtaceae	Melaleuca viridiflora			
Myrtaceae	Syzygium armstrongii			
Myrtaceae	Syzygium eucalyptoides ssp.bleeseri			
Myrtaceae	Syzygium minutiliflorum		E	
Myrtaceae	Syzygium nervosum			
Myrtaceae	Syzygium suborbiculare			

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Myrtaceae	Xanthostemon paradoxus			
Nyctaginaceae	Boerhavia sp.			Y
Nymphaeaceae	Nymphaea violacea			
Oleaceae	Jasminum aemulum			
Oleaceae	Jasminum molle			Y
Onagraceae	Ludwigia adscendens			Y
Onagraceae	Ludwigia hyssopifolia			
Onagraceae	Ludwigia octovalvis			
Onagraceae	Ludwigia perennis			Y
Opiliaceae	Opilia amentacea			
Orchidaceae	Cymbidium canaliculatum			
Pandanaceae	Pandanus aquaticus			
Pandanaceae	Pandanus spiralis			
Passifloraceae	Adenia heterophylla			
Passifloraceae	Passiflora foetida		i	
Pittosporaceae	Pittosporum sp.			
Poaceae	Andropogon gayanus		i	
Poaceae	Aristida latifolia			Y
Poaceae	Aristida macroclada ssp. macroclada			Y
Poaceae	Bambusa arnhemica		E	
Poaceae	Bothriochloa bladonii ssp. bladonii			
Poaceae	Chrysopogon fallax			Y
Poaceae	Chrysopogon latifolius			
Poaceae	Cymbopogon bombycinus			Y
Poaceae	Dactyloctenium radulans			Y
Poaceae	Digitaria ciliaris			
Poaceae	Echinochloa colona		i	
Poaceae	Ectrosia leporina			
Poaceae	Elytrophorus spicatus			Y
Poaceae	Eragrostis fallax			Y
Poaceae	Eriachne avenacea			
Poaceae	Eriachne burkittii			
Poaceae	Eriachne obtusa			Y
Poaceae	Eriachne sp.			
Poaceae	Eriachne stipacea			
Poaceae	Eriachne sulcata			
Poaceae	Eriachne trisetata			
Poaceae	Heteropogon contortus			
Poaceae	Imperata cylindrica			Y
Poaceae	Ischaemum australe			
Poaceae	Melinis repens		i	
Poaceae	Panicum mindanaense			Y
Poaceae	Panicum sp.			
Poaceae	Paspalum scrobiculatum			Y
Poaceae	Paspalum sp.			
Poaceae	Pennisetum pedicellatum		i, B	
Poaceae	Pennisetum polystachion		i, B	
Poaceae	Phragmites vallatoria			
Poaceae	Pseudopogonatherum contortum			Y
Poaceae	Pseudopogonatherum sp.			
Poaceae	Pseudoraphis spinescens			

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Poaceae	Sorghum intrans			
Poaceae	Sorghum sp.			
Poaceae	Sorghum stipoideum			
Poaceae	Sporobolus pyramidalis			
Poaceae	Themeda quadrivalvis		B	
Poaceae	Themeda triandra			
Poaceae	Triodia bitextura			Y
Poaceae	Urochloa maxima	Panicum maximum		
Poaceae	Urochloa mutica		i	
Poaceae	Urochloa subquadriflora		i	
Poaceae	Poaceae sp.			
Poaceae	Schizachyrium sp.			Y
Polygalaceae	Polygala sp.			Y
Polygonaceae	Persicaria attenuata			
Polygonaceae	Persicaria barbata			
Polypodiaceae	Microsorium grossum			
Proteaceae	Grevillea decurrens	not endemic (cf. Metcalfe 02)		
Proteaceae	Grevillea dryandrii			
Proteaceae	Grevillea pteridifolia			
Proteaceae	Hakea arborescens			
Proteaceae	Persoonia falcata			
Proteaceae	Stenocarpus cunninghamii			
Rhamnaceae	Alphitonia excelsa			
Rhizophoraceae	Carallia brachiata			
Rubiaceae	Aida racemosa			Y
Rubiaceae	Cyclophyllum schultzei	Canthium schultzei	E	
Rubiaceae	Gardenia megasperma			
Rubiaceae	Ixora timorensis	Ixora klanderiana		
Rubiaceae	Nauclea orientalis			
Rubiaceae	Pogonolobus reticulatus			
Rubiaceae	Spermacoce sp.	Borreria sp.		
Rubiaceae	Timonius timon			
Rutaceae	Glycosmis trifoliata			
Rutaceae	Melicope elleryana			
Rutaceae	Micromelum minutum			
Santalaceae	Exocarpus latifolius			
Sapindaceae	Allophylus cobbe			
Sapindaceae	Cardiospermum halicacabum			
Sapindaceae	Cupaniopsis anacardioides			
Sapindaceae	Distichostemon hispidulus			
Sapindaceae	Ganophyllum falcatum			
Sapotaceae	Pouteria sericea			
Scrophulariaceae	Bacopa floribunda			Y
Scrophulariaceae	Buchnera ramosissima			
Scrophulariaceae	Buchnera sp.			
Scrophulariaceae	Lymnophila fragrans			
Scrophulariaceae	Stemodia lythrifolia			
Smilacaceae	Smilax australis			
Solanaceae	Physalis angulata	Physalis minima		
Solanaceae	Solanum seaforthianum		i	Y
Sterculiaceae	Brachychiton diversifolius			
Sterculiaceae	Brachychiton megaphyllum		E	

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Sterculiaceae	Helicteres hirsuta			
Sterculiaceae	Helicteres isora			
Sterculiaceae	Sterculia holtzei		E	
Sterculiaceae	Sterculia quadrifida			
Sterculiaceae	Waltheria indica			
Tiliaceae	Grewia asiatica		i	Y
Tiliaceae	Grewia mesomischa			Y
Tiliaceae	Grewia retusifolia			
Ulmaceae	Celtis philippensis			
Ulmaceae	Trema tomentosa			
Verbenaceae	Clerodendrum costatum			Y
Verbenaceae	Clerodendrum floribundum			
Verbenaceae	Gmelina schlechteri			
Verbenaceae	Stachytarpheta cayennensis		i, B	
Verbenaceae	Stachytarpheta jamaicensis		i, B	
Verbenaceae	Vitex acuminata			Y
Vitaceae	Ampelocissus acetosa			
Vitaceae	Ampelocissus frutescens		E	Y
Vitaceae	Cayratia trifolia			

APPENDIX 3 **Summary Quadrat Data from 2005 Survey**

SITE	Easting	Northing	Veg. Unit
B1	716720	8563230	10
Upper Stratum Cover %:	12	Average Height Upper:	20m
Mid Stratum Cover %	20	Average Height Mid:	2.5m
Lower Stratum Cover %	100	Average Height Lower:	1m
Main Species Upper		% cover	
Acacia auriculiformis		10	
Alstonia actinophylla		1	
Melaleuca dealbata		1	
Main Species Mid			
Acacia auriculiformis		10	
Lophostemon grandiflorus		5	
Canarium australianum		1	
Cupaniopsis anacardioides		1	
Ficus scobina		1	
Pandanus spiralis		1	
Other Species Mid: (outside quadrat)		Flagellaria indica, Lophostemon lactifluus.	
Main Species Lower			
Pennisetum polystachion		30	
Andropogon gayanus		20	
Pseudoraphis spinescens		20	
Passiflora foetida		10	

Browns Oxide Project – Appendix 3 – Summary Quadrat Data

Senna obtusifolia	10
Ageratum conyzoides	5
Urena lobata	5
Hyptis suaveolens	1
Stephania japonica	1
Ipomoea nil, Ludwigia perennis, Tylophora flexuosa	

Other Species Lower:
(outside quadrat)

Notes
Margin of Acacia auriculiformis community. Heavy infestation of weeds. Site been burnt repeatedly

SITE	Easting	Northing	Veg. Unit
B2	716668	8563276	10
Upper Stratum Cover %:	40	Average Height Upper:	22m
Mid Stratum Cover %	40	Average Height Mid:	14m
Lower Stratum Cover %	70	Average Height Lower:	0.5m
		% cover	
Main Species Upper:	Acacia auriculiformis	20	
	Alstonia actinophylla	10	
	Lophostemon lactifluus	5	
	Pandanus spiralis	5	
Main Species Mid:	Acacia auriculiformis	10	
	Mallotus philippensis	10	
	Denhamia obscura	5	

Browns Oxide Project – Appendix 3 – Summary Quadrat Data

Flagellaria indica	5
Micromelum minutum	5
Barringtonia acutangula	1
Carallia bracteata	1
Melaleuca cajuputi	1
Melaleuca dealbata	1
Pachygone ovata	1

Other Species Mid:
(outside of quadrat)
Aida racemosa, Cupaniopsis anacardioides, Ficus racemosa, Flueggea virosa, Litsea glutinosa, Mimosa pigra, Timonius timon.

Main Species Lower:

Calopogonium mucunoides	40
Pseudoraphis spinescens	10
Hyptis suaveolens	5
Pennisetum polystachion	5
Stachytarpheta cayennensis	5
Senna obtusifolia	5
Ageratum conyzoides	1
Passiflora foetida	1
Sida acuta, Ludwigia octovalvis, Urena lobata	

Other Species Lower:

Notes:
Acacia auriculiformis tending to 'vine-thicket'. Invasion of exotics especially Calopo. Mimosa clumps in vicinity

Browns Oxide Project – Appendix 3 – Summary Quadrat Data

SITE	Easting	Northing	Veg. Unit
B3	716411	8563054	10
Upper Stratum Cover %:	55	Average Height Upper:	24m
Mid Stratum Cover %	50	Average Height Mid:	3m
Lower Stratum Cover %	30	Average Height Lower:	0.7m
Main Species Upper:		% cover	
Erythrophleum chlorostachys		15	
Alstonia actinophylla		10	
Lophostemon grandiflorus		10	
Micromelum minutum		10	
Acacia auriculiformis		5	
Artocarpus glaucus		1	
Drypetes deplanchei		1	
Polyalthia australis		1	
Syzygium suborbiculare		1	
Other Species Upper: (outside quadrat)			
Antiaris toxicaria, Canarium australianum, Corymbia bella, Ficus virens, Ganophyllum falcatum, Maranthes corymbosa, Vitex acuminata.			
Main Species Mid:			
Micromelum minutum		15	
Cupaniopsis anacardioides		10	
Trema tomentosa		10	
Mallotus phillipensis		5	
Opilia amentacea		5	
Breynia cernua		1	

Browns Oxide Project – Appendix 3 – Summary Quadrat Data

Capparis sepiaria	1
Erythrophleum chlorostachys	1
Grewia mesomischa	1
Plumbago zeylanica	1
Other Species Mid: (outside quadrat)	
Cycas armstrongii, Exocarpos latifolia, Ficus scobina, Jasminum aemulum, Solanum seafortianum, Strychnos lucida.	
Main Species Lower:	
Hyptis suaveolens	20
Stachytarpheta sp.	5
Sida acuta	5
Adenia floribunda	1
Eriachne trisetata	1
Pennisetum polystachion	1
Stephania japonica	1
Other Species Lower: (outside quadrat)	
Aristida macroclada ssp.macroclada, Hypoestes floribunda, Panicum mindanaense.	

SITE	Easting	Northing	Veg. Unit
B4	715726	8563168	2
Upper Stratum Cover %:	30	Average Height Upper:	20m
Mid Stratum Cover %	45	Average Height Mid:	4m
Lower Stratum Cover %	70	Average Height Lower:	0.6m
Main Species Upper:		% cover	
Eucalyptus miniata		15	
Canarium australianum		5	

Browns Oxide Project – Appendix 3 – Summary Quadrat Data

Eucalyptus tetradonta	5	
Erythrophleum chlorostachys	5	
Alstonia actinophylla	1	
Gardenia megasperma	1	
Livistona humilis	1	
Main Species Mid:		
Flueggea virosa	20	
Cycas armstrongii	5	5 individuals
Eucalyptus miniata	5	
Erythrophleum chlorostachys	5	
Flemingia sp.sericea	5	
Canarium australianum	1	
Gardenia megasperma	1	
Livistona humilis	1	
Pachygone ovata	1	
Petalostigma quadriloculare	1	
Planchonia careya	1	
Other Species Mid: (outside quadrat)		
Denhamia obscura, Jasminum molle, Persoonia falcata, Syzygium suborbiculare, Trema tomentosa.		
Main Species Lower:		
Panicum mindanaense	35	
Eriachne trisetata	10	
Pennisetum polystachion	10	
Andropogon gayanus	5	
Chrysopogon latifolius	1	
Cyanthillium cinerea	1	
Dioscorea bulbifera	1	

Browns Oxide Project – Appendix 3 – Summary Quadrat Data

Heteropogon contortus	1
Murdannia graminea	1
Pseudopogonatherum contortum	1
Passiflora foetida	1
Spermacoce sp.	1
Schizachyrium sp.	1
Pther Species Lower: (outside quadrat)	
Dactyloctenium radulans, Distichostemon hispidulus, Mitrasacme connata, Pachynema dilatatum.	

Notes: Eucalyptus miniata tall woodland, mostly intact though Pennisetum and Andropogon are establishing.

SITE	Easting	Northing	Veg. Unit
B5	716471	8562664	7
Upper Stratum Cover %:	20	Average Height Upper:	18m
Mid Stratum Cover %	20	Average Height Mid:	1m
Lower Stratum Cover %	70	Average Height Lower:	0.7m
Main Species Upper:		% cover	
Corymbia bella		15	
Corymbia foelscheana		5	
Ficus aculeata		1	
Buchanania obovata		1	
Main Species Mid:			
Corymbia bella		5	
Erythrina vespertilio		5	
Grewia asiatica		5	

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Acacia difficilis	1
Ampelocissus frutescens	1
Corymbia foelscheana	1
Brachychiton diversifolius	1
Brachychiton megaphyllus	1
Planchonia careya	1

Other Species Mid:
(outside quadrat)

Grewia retusifolia, Tylophora flexuosa,

Main Species Lower:

Chrysopogon fallax	40
Themeda triandra	15
Heteropogon contortus	5
Pennisetum polystachion	5
Calopogonium mucunoides	1
Crotalaria goreensis	1
Merremia quinata	1
Passiflora foetida	1
Trichodesma zeylanica	1
Vigna lanceolata	<1

SITE	Easting	Northing	Veg. Unit
B6	715924	8562678	3
Upper Stratum Cover %:	35	Average Height Upper:	20m
Mid Stratum Cover %	25	Average Height Mid:	2.5m
Lower Stratum Cover %	nil (burnt)	Average Height Lower:	NA

Browns Oxide Project – Appendix 3 – Summary Quadrat Data

	% cover
Main Species Upper:	
Erythrophleum chlorostachys	20
Eucalyptus miniata	10
Eucalyptus tetradonta	5
Xanthostemon paradoxus	1
Main Species Mid:	
Livistona humilis	5
Cycas armstrongii	5
Planchonia careya	5
Acacia dimidiata	1
Acacia latescens	1
Buchanania obovata	1
Croton arnhemicus	1
Eucalyptus miniata	1
Gardeniamegasperma	1
Persoonia falcata	1
Petalostigma quadriloculare	1
Other Species Mid: (outside quadrat)	
Denhamia obscura, Flemingia sp.sericea, Pandanus spiralis, Tylophora flexuosa.	
Main Species Lower:	
Chrysopogon latifolius, Eriachne triseta, Flemingia trifoliastrum, Hyptis suaveolens, Pachynema dilatatum, Passiflora foetida, Pennisetum pedicellatum, Pseudopogonatherum contortum, Stermodia lythrifolia, Waltheria indica.	
Notes:	
Site burnt c.3 weeks prior to assessment. Ground cover virtually nil - species list only	

Browns Oxide Project – Appendix 3 – Summary Quadrat Data

SITE	Easting	Northing	Veg. Unit
B7	715712	8562734	3
Upper Stratum Cover %:	35	Average Height Upper:	18m
Mid Stratum Cover %	40	Average Height Mid:	2.5m
Lower Stratum Cover %	nil (burnt)	Average Height Lower:	NA
Main Species Upper:		% cover	
	Erythrophleum chlorostachys	20	
	Eucalyptus miniata	15	
	Buchanania obovata	1	
	Alstonia actinophylla	1	
Main Species Mid:			
	Eucalyptus miniata	15	
	Cycas armstrongii	5	3 individuals
	Grevillea decurrens	5	
	Livistona humilis	5	
	Petalostigma pubescens	5	
	Planchonia careya	5	
	Acacia difficilis	1	
	Acacia dimidiata	1	
	Buchanania obovata	1	
	Erythrophleum chlorostachys	1	
	Flemingia sp.sericea	1	
	Gardenia megasperma	1	
	Persoonia falcata	1	
	Petalostigma quadriloculare	1	

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Main Species Lower:

Chrysopogon latifolius, Distichostemon hispidulus, Eriachne obtusa, Flemingia trifoliatrum, Goodenia armstrongiana, Pachynema dilatatum, Ptilotus distans, Sauroopus glaucus, Stemodia lythrifolia.

Notes:

Site burnt c.3 weeks prior to assessment. Ground cover virtually nil - species list only

SITE	Easting	Northing	Veg. Unit
B8	714985	8562420	3

Upper Stratum Cover %:

30

Average Height Upper:

20m

Mid Stratum Cover %

40

Average Height Mid:

2.5m

Lower Stratum Cover %

70

Average Height Lower:

0.7m

% cover

Main Species Upper:

Eucalyptus miniata
 Eucalyptus tetradonta
 Erythrophleum chlorostachys
 Grevillea pteridifolia
 Xanthostemon paradoxus

15
 10
 5
 1
 1

Main Species Mid:

Acacia oncinocarpa
 Cycas armstrongii
 Eucalyptus miniata
 Livistona humilis
 Petalostigma quadriloculare
 Planchonia careya

10
 5
 5
 5
 5
 5

6 individuals

Browns Oxide Project – Appendix 3 – Summary Quadrat Data

Brachychiton megaphyllus	1
Buchanania obovata	1
Grevillea decurrens	1
Owenia vernicosa	1
Xanthostemon paradoxus	1

Other Species Mid:
(outside quadrat)

Brachychiton diversifolius, Persoonia falcata, Terminalia grandiflora

Main Species Lower:

Triodia bitextura	30
Pseudopogonatherum contortum	20
Eriachne obtusa	15
Andropogon gayanus	1
Aristida latifolia	1
Chrysopogon latifolius	1
Cartonema spicatum	1
Pachynema dilatatum	1
Schizachyrium sp.	1
Stemodia lythrifolia	1
Bulbostylis barbata	<1
Fimbristylis xyridis	<1
Gomphrena canescens	<1
Heliotropium ventricosum	<1
Indigofera linifolia	<1
Polygala sp.	<1
Spermacoce sp.	<1
Trianthema sp.	<1

Browns Oxide Project – Appendix 3 – Summary Quadrat Data

SITE	Easting	Northing	Veg. Unit
B9	717036	8562559	3
Upper Stratum Cover %:	30	Average Height Upper:	20m
Mid Stratum Cover %	30	Average Height Mid:	2.5m
Lower Stratum Cover %	30	Average Height Lower:	0.5m
Main Species Upper:		% cover	
Eucalyptus miniata		10	
Erythrophleum chlorostachys		10	
Eucalyptus tetradonta		5	
Corymbia foelscheana		5	
Corymbia bleeseri		1	
Main Species Mid:			7 individuals
Cycas armstrongii		5	
Buchanania obovata		5	
Grewia asiatica		5	
Livistona humilis		5	
Planchonia careya		5	
Pogonolobus reticulatus		5	
Acacia difficilis		1	
Brachychiton megaphyllus		1	
Petalostigma quadriloculare		1	
Syzygium eucalyptoides ssp.bleeseri		1	
Other Species Mid: (outside quadrat)			
Acacia dimidiata, Brachychiton diversifolius, Capparis umbonata, Clerodendrum floribundum, Corymbia polysciada, Pandanus spiralis.			

Browns Oxide Project – Appendix 3 – Summary Quadrat Data

Eucalyptus miniata	5
Flemingia sp.sericea	5
Grewia retusifolia	5
Pogonolobus reticulatus	5
Planchonia careya	5
Persoonia falcata	5
Acacia dimidiata	1
Buchanania obovata	1
Erythrophleum chlorostachys	1
Ficus aculeata	1
Livistona humilis	1
Pandanus spiralis	1

Other Species Mid: (outside quadrat)
 Brachychiton diversifolius, Corymbia confertiflora, Denhamia obscura, Gardenia megasperma, Wrightia saligna.

Main Species Lower:

Andropogon gayanus	25
Hyptis suaveolens	5
Cyanthillium cinerea	1
Flemingia trifoliastrum	1
Goodenia armstrongiana	1
Mitrasacme latiflora	1
Pachynema dilatatum	1
Sauropus glaucus	1
Trachymene didiscoides	1

Notes:

Site recently burnt - Andropogon (Gamba grass) vigorously resprouting.

Browns Oxide Project – Appendix 3 – Summary Quadrat Data

SITE	Easting	Northing	Veg. Unit
B11	716833	8563358	5

Site encompasses the degraded and recently burnt riparian corridor of the East Finniss River. Quadrat assessment not used. Species list only

Upper Stratum:

Acacia auriculiformis (mostly burnt and/or dead/dying), Canarium australianum, Corymbia bella, Carallia brachiata, Erythrophleum chlorostachys, Lophostemon lactifluus, Pandanus spiralis.

Mid Stratum:

Acacia holosericea, Barringtonia acutangula, Capparis sepiaria, Exocarpus latifolius, Leucaena leucocephala, Mimosa pigra, Opilia amentacea.

Lower Stratum:

Andropogon gayanus (dense, dominant), Calopogonium mucunoides (dense), Pennisetum polystachion (dense, dominant), Cleome viscosa, Flagellaria indica, Hyptis suaveolens, Physalis angulata, Phragmites vallatoria, Pityrogramma calomelanos, Pseudoraphis spinescens, Stachytarpheta cayennensis, Senna obtusifolia

Browns Oxide Project – Appendix 3 – Summary Quadrat Data

SITE	Easting	Northing	Veg. Unit
B12	716428	8562108	7
Upper Stratum Cover %:	15	Average Height Upper:	18m
Mid Stratum Cover %	35	Average Height Mid:	1m
Lower Stratum Cover %	30	Average Height Lower:	1m
		% cover	
Main Species Upper:			
	Corymbia bella	10	
	Corymbia polycarpa	5	
	Erythrina vespertilio	1	
Other Species Upper: (outside quadrat)	Pandanus spiralis, Lophostemon lactifluus		
Main Species Mid:			
	Buchanania obovata	5	
	Hakea arborescens	5	
	Corymbia bella	5	
	Melaleuca dealbata	5	
	Livistona humilis	5	
	Flemingia sp.sericea	10	
	Corymbia polycarpa	1	
	Flemingia lineata	1	
	Grewia asiatica	1	
Other Species Mid: (outside quadrat)	Melaleuca cajuputi, Petalostigma pubescens, Planchonia careya, Pogonolobus reticulatus.		

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Main Species Lower:	Themeda triandra	20
	Andropogon gayanus	10
	Hyptis suaveolens	1
	Merremia quinata	1
	Passiflora foetida	1
	Goodenia armstrongiana	<1
	Indigofera trita	<1
	Indigofera linifolia	<1
	Rhynchosia minima	<1
	Sebastiania chamaelea	<1
	Stylosanthes guianensis	<1

Notes: Site patchily burnt in recent weeks. Grewia asiatica resprouting after burn

SITE **Easting** **Northing** **Veg. Unit**
B13 716564 8562322 7

Upper Stratum Cover %: 20 Average Height Upper: 20m
 Mid Stratum Cover %: 45 Average Height Mid: 1m
 Lower Stratum Cover %: 30 Average Height Lower: 0.7m

% cover

Main Species Upper:	Corymbia bella	20
	Melaleuca delbata	1
	Lophostemon lactiflorus	1
Main Species Mid:	Corymbia bella	20
	Flemingia lineata	15

Browns Oxide Project – Appendix 3 – Summary Quadrat Data

Lophostemon lactifluus			5	
Acacia pallidifolia			1	
Flueggea virosa			1	
Grewia retusifolia			1	
Livistona humilis			1	
Main Species Lower:				
Themeda triandra			20	
Imperata cylindrica			10	
Indigofera trita			1	
Andropogon gayanus			1	
Passiflora foetida			1	
SITE	Easting	Northing		Veg. Unit
B14	716948	8562856		12
Upper Stratum Cover %:	70	Average Height Upper:		20m
Mid Stratum Cover %	25	Average Height Mid:		3m
Lower Stratum Cover %	50	Average Height Lower:		0.5m
		% cover		
Main Species Upper:				
Acacia auriculiformis			30	
Lophostemon grandiflorus			17.5	
Melaleuca dealbata			17.5	
Timonius timon			5	
Other Species Upper: (outside quadrat)				
Corymbia bella, Syzygium nervosum, Syzygium suborbiculare.				

Browns Oxide Project – Appendix 3 – Summary Quadrat Data

Main Species Mid:	Lophostemon grandiflorus	15
	Acacia auriculiformis	5
	Jasminum aemulum	5
	Flueggea virosa	1
	Planchonia careya	1
Other Species Mid: (outside quadrat)	Capparis sepiaria, Flagellaria indica, Lophostemon lactiflorus, Pandanus spiralis, Strychnos lucida, Tylophora flexuosa.	
Main Species Lower:	Andropogon gayanus	20
	Calopogonium mucunoides	20
	Passiflora foetida	5
	Pennisetum polystachion	5
	Hyptis suaveolens	1
	Ipomoea triloba	1
	Sida acuta	1
	Scleria ligulata	<1
	Gymnanthera oblonga	<1
Other Species Lower: (outside quadrat)	Imperata cylindrica, Ischaemum australe, Ludwigia octovalvis, Pennisetum pedicellatum, Pseudoraphis spinescens, Stachytarpheta spp.	

Browns Oxide Project – Appendix 3 – Summary Quadrat Data

SITE	Easting	Northing	Veg. Unit
B15	717135	8562290	1
Upper Stratum Cover %:	25	Average Height Upper:	18m
Mid Stratum Cover %	30	Average Height Mid:	2.5m
Lower Stratum Cover %	nil - burnt	Average Height Lower:	NA
		% cover	
Main Species Upper:	Eucalyptus tetrodonta	20	
	Corymbia foelscheana	5	
	Terminalia ferdinandiana	1	
	Corymbia bleeseri	1	
Other Species Upper: (outside quadrat)	Brachychiton diversifolius, Erythrophleum chlorostachys, Eucalyptus phoenicea, Owenia vernicosa, Xanthostemon paradoxus.		
Main Species Mid:	Corymbia foelscheana	5	
	Livistona humilis	5	
	Persoonia falcata	5	
	Buchanania obovata	5	
	Eucalyptus tetrodonta	5	
	Acacia latescens	1	
	Grevillea dryandrii	1	
	Brachychiton megaphyllus	1	
	Cycas armstrongii	1	4 individuals
	Grevillea decurrens	1	

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Other Species Mid:
(outside quadrat)

Acacia gonocarpa, Gardenia megasperma, Hakea arborescens, Planchonia careya.

Lower Stratum:
species list only

Bonamia media, Distichostemon hispidulus, Eriachne sulcata, Evolvulus alsinoides, Flemingia sp.sericea, Goodenia armstrongiana, Gomphrena canescens, Polycarpaea corymbosa, Ptilotus distans, Sauropus glaucus, Sorghum intrans, Spermacoce sp., Stemodia lythrifolia, Trachymene didiscoides, Triodia bitextura.

Notes:

Site recently burnt - ground cover virtually absent; some resprouts. Many of the shrub species resprouts only

SITE	Easting	Northing	Veg. Unit
B16	716913	8562144	1

Site had been recently burnt and so fiercely that even the foliage on the taller trees had been burnt off. Any cover estimates would have been meaningless. Species list only compiled.

Main Species Upper:

Eucalyptus phoenicea
Xanthostemon paradoxus
Eucalyptus miniata
Corymbia bleeseri

Browns Oxide Project – Appendix 3 – Summary Quadrat Data

Other Species Upper:	Cochlospermum fraseri, Corymbia foelscheana, Erythrophloeum chlorostachys, Owenia vernicosa,
Main Species Mid:	Terminalia carpentariae Livistona humilis Brachychiton megaphyllus Cycas armstrongii Persoonia falcata 3 individuals
Other Species Mid:	Acacia gonocarpa, Breynia cernua, Buchananiania obovata, Capparis umbonata, Erythrophloeum chlorostachys, Grevillea decurrens, Grevillea dryandrii, Petalostigma quadriloculare.
Lower Stratum Species:	Andropogon gavanus (several clumps), Cymbopogon bombycinus, Eriachne obtusa, Goodenia armstrongiana, Pachynema dilatatum, Polycarpaea longiflora, Sauropus glaucus, Spermacoe sp.
SITE	Easting Northing Veg. Unit
B17	717134 8561994 6
Upper Stratum Cover %:	Average Height Upper: 16m
Mid Stratum Cover %	Average Height Mid: 3m
Lower Stratum Cover %	Average Height Lower: 0.2m
	% cover
Main Species Upper:	Melaleuca viridiflora 25
	Lophostemon lactiflorus 10

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	Pandanus spiralis	5			
	Terminalia microcarpa	1			
Main Species Mid:	Melaleuca viridiflora	50			
	Pandanus spiralis	1			
Main Species Lower:	Pseudoraphis spinescens	15			
	Glinus oppositifolius	15			
	Ammania baccifera	1			
	Bacopa floribunda	1			
	Cyperus difformis	1			
	Cyperus haspan	1			
	Eragrostis fallax	1			
	Eragrostis leporina	1			
	Eriocaulon sp.	1			
	Ludwigia adscendens	1			
	Paspalum scrobiculatum	1			
Other Species Lower: (outside quadrat)	Elytrophorus spicatus, Ischaemum australe				
SITE	Easting	Northing	Veg. Unit		
B18	716580	8563176	10		
Upper Stratum Cover %:	70	Average Height Upper:	24m		
Mid Stratum Cover %	45	Average Height Mid:	3m		
Lower Stratum Cover %	5	Average Height Lower:	0.2m		

Browns Oxide Project – Appendix 3 – Summary Quadrat Data

	% cover
Main Species Upper:	
Ganophyllum falcatum	20
Polyalthia australis	20
Syzygium nervosum	10
Artocarpus glaucus	10
Glochidion sumatranum	5
Carallia brachiata	1
Myristica insipida	1
Syzygium minutiflorum	1
Other Species Upper: (outside quadrat)	
Acacia auriculiformis, Antiaris toxicaria, Canarium australianum, Cupaniopsis anacardioides, Ficus virens.	
Main Species Mid:	
Polyalthia australis	20
Artocarpus glaucus	5
Glochidion sumatranum	5
Mallotus philippensis	5
Solanum seaforthianum	5
Aida racemosa	1
Cupaniopsis anacardioides	1
Denhamia obscura	1
Micromelum minutum	1
Syzygium nervosum	1
Other Species Mid: (outside quadrat)	
Capparis separia, Exocarpos latifolius, Ficus scobina, Helicteres isora, Litsea glutinosa, Strychnos lucida, Wrightia pubescens	
Main Species Lower:	
Passiflora foetida	5
Hyptis suaveolens	1

Browns Oxide Project – Appendix 3 – Summary Quadrat Data

SITE	Easting	Northing	Veg. Unit
B19	716675	8562275	13
Upper Stratum Cover %:	35	Average Height Upper:	6m
Mid Stratum Cover %	5	Average Height Mid:	2m
Lower Stratum Cover %	80	Average Height Lower:	0.7m
		% cover	
Main Species Upper:		35	
	Pandanus spiralis	1	
	Melaleuca dealbata	1	
	Melaleuca viridiflora		
Main Species Mid:		5	
	Pandanus spiralis	1	
	Flemingia lineata	1	
	Grewia asiatica	1	
Main Species Lower:		60	
	Imperata cylindrica	10	
	Themeda triandra	10	
	Ischaemum australe	1	
	Cyperus haspan	1	
	Fimbristylis dichotoma	1	
	Panicum sp.	1	
	Rhynchospora sp.	1	

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SITE	Easting	Northing	Veg. Unit
B20	716800	8563242	14

Site burnt c.4 weeks prior - all ground cover and shrubs burnt and most trees defoliated to c.10m. Resprouting individuals present. Species list only

Main Species Upper:
 Erythrophleum chlorostachys
 Acacia auriculiformis
 mostly dead/dying

Main Species Mid:
 present as low resprouts only

Acacia difficilis, Alphitonia excelsa, Brachychiton diversifolius, Breynia cernua, Buchanania obovata, Clerodendrum floribundum, Cycas armstrongii, Denhamia obscura, Flemingia sp.sericea, Flueggea virosa, Jasminum molle, Livistona humilis, Persea falcata, Petalostigma quadriloculare, Planchonia careya, Syzygium suborbiculare.

Main Species Lower:
 Andropogon gayanus, Hyptis suaveolens, Pennisetum polystachion.