Appendix 5B

Browns Oxide Project Flora Report – Metcalfe (2002)

FLORA ASSESSMENT STUDY

for

ENVIRONMENTAL IMPACT STATEMENT

BROWNS POLYMETALLIC PROJECT
BATCHELOR, NT

Prepared for

COMPASS RESOURCES NL

and

NSR Environmental Consultants PTY LTD

by

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Executive Summary – Flora

- The 37.5 km^2 survey area for the Compass Resources Browns Polymetallic Project is located approximately 2.5 km northwest of Batchelor. The existing vegetation comprises mainly *Eucalyptus*-dominated woodland and open woodland communities (59% of survey area). This vegetation formation, also known as savanna, is common, widespread and characteristic of the region generally.

- The central and eastern sections of the survey area, where the open cut and proposed mine footprint is currently located, is highly disturbed. This area includes the decommissioned open cut pits and overburden heaps of the Rum Jungle copper and uranium mine as well as extensive borrow pit and rehabilitation areas.

- The flora survey, undertaken during the late wet season and early dry (May to August 2002), recorded a total of 259 plant species from 81 families and 194 genera, including 31 introduced species.

- Field surveys and aerial photograph interpretation distinguished 10 main vegetation types within the project area, the most extensive vegetation type (1,915 ha) in upland or dryland habitats being *Eucalyptus miniata/E. tetrodonta* woodland (Darwin Woolybutt/Darwin Stringybark).

- Associated with low-lying, drainage areas were riparian habitats (124 ha), *Lophostemon* communities (228 ha) with (Ghost Gum) *Eucalyptus papuana* open woodlands (485 ha) and (Paperbark) *Melaleuca* spp. communities (66 ha) on surrounding floodplains.

- The channel of the Finniss River, a large perennial stream, with dense, well-developed riparian (or riverbank) vegetation roughly delineates the western boundary of the survey area. A narrow band of riparian vegetation fringes the degraded East Branch of the Finniss River, an intermittent water course which flows through the northern section of the project area. More luxuriant riparian vegetation fringes Rum Jungle Creek, a spring-fed stream in the southern section of the survey area.

- The level of disturbance to the existing vegetation ranges from moderate to significant, with impacts from previous landuse mainly arising from mining associated with the Rum Jungle project, access tracks, the old North Australia Railway easement, clearing for horticulture, pastoralism and frequent wildfires.

- A total of 31 introduced species were recorded during field surveys and weeds were found within each of the major habitats, with the highest density observed in disturbed sites. No Class A noxious weeds were recorded, but nine Class B declared noxious weeds including *Mimosa pigra, Senna obtusifolia* and *Hyptis suaveolens* occur within the site.

- Dense infestations of Gamba Grass (*Andropogon gayanus*) are characteristic of woodland and riparian habitats within the project area - as in the Batchelor region generally. Although not a declared species, Gamba Grass is recognised as a serious environmental weed and fire management hazard. Selective control of this species on site is recommended as part of future fire & weed management strategies.

- Approximately 324 ha (9%) of the survey area is disturbed from previous land use including mineral exploration and development, mining associated with Rum Jungle, borrow areas, pastoralism and horticulture. Weeds have proliferated in these areas.

- Several areas of evergreen monsoon vine-forest (rainforest) vegetation occur in association with perennial water from springs (32 ha). Smaller isolated pockets of dry monsoon vine-forest vegetation occur on dolomite outcrops within the project area but characteristically these areas were too small to map.

- Extensive *Acacia auriculiformis* (Darwin Black Wattle) woodlands occur within the survey area (248 ha) associated with areas of dolomite outcrop and deeper soils with higher soil moisture and may represent areas of degraded or regenerating monsoon vine-forests.

- No rare or endangered plant species of conservation significance were recorded within the project area although the site does include areas of suitable habitat for the rare plant *Indigofera schultzii.* A survey during the early to mid- wet season would be most appropriate to check for the presence of rare species including *Indigofera schultzii* and ephemeral ground orchids such as *Habenaria elongata.*

- Overall, the occurrence of plant species of special conservation significance is unlikely, especially given the level of previous disturbance. Indeed, none of the vegetation communities recorded have special conservation status at local, regional or national scales and are therefore unlikely to contain rare species.

- No extensive wetlands occur within the survey area. However, the survey area contains 2 small patches of evergreen vine-forest associated with perennial water from springs. Perennial water sources in a seasonally dry landscape represent sites of environmental sensitivity due to their flora and fauna-support functions. Consequently, although this community has no formal declared conservation significance, it has ecological importance at the local and regional scales.

- The vegetation of the project area suggests frequent, possibly annual burning. The presence and continued spread of introduced tall grasses including *Pennisetum polystachion* and *Andropogon gayanus* will perpetuate late season, high intensity fires. Implementation of a Fire Management Property Plan will be necessary to meet protection and control objectives within the lease and in relation to the local area.

- Ongoing management of the survey area will be required to meet legislative requirements relating to fire and weed control.

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for
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FLORA

1.0 INTRODUCTION

This report was requested by NSR Environmental Consultants Pty Ltd, on behalf of Compass Resources NL, in partial fulfilment of the requirements for an Environmental Impact Statement on the proposed Browns Polymetallic Project. Located 2.5 km northwest of Batchelor, the proposed Browns Project survey area incorporates the decomissioned Rum Jungle mine site, a former copper and uranium mine operating between 1954 and 1971, and will involve the open pit mining of a variety of metals including lead, cobalt, copper, nickel and silver. This report represents Stage 1 of a two stage process in which the terrestrial and aquatic flora occurring within the 37.5 km^2 survey area is examined. Stage 2 of the flora survey will involve the prediction of potential impacts on vegetation and corresponding recommendations for mitigation measures and safeguards.

The current report contains a comprehensive description of the flora and a stratification of the vegetation communities occurring within the survey area. This report provides information on the conservation significance of the plant species and vegetation communities that may be affected by the proposal. Associated vegetation management issues including fire and weeds are also addressed as part of this study. The flora survey aims to meet a number of principal objectives:

- To examine and describe the existing vegetation within the 37.5 km^2 Browns Project survey area with particular focus on those habitats likely to be most affected by the proposed development (eg. located close to the proposed mine footprint & downstream riparian sites)
- to determine the distribution and extent of the major vegetation communities present within the survey area (vegetation mapping and approximate area calculations)
- to undertake detailed (quantitative) examination of the flora at key locations (by line transects, quadrats, species inventories etc)
- to assess the site for the presence of flora of special conservation status including rare or endangered species and vegetation communities of restricted distribution
- to assess the botanical and ecological significance of existing vegetation in the local and regional contexts
- to make an initial weed assessment and discuss proliferation and control issues
- to discuss the existing fire regime and provide recommendations for future management of fire

This report is a compilation of the results of literature review, research and baseline field surveys, using the methodology outlined below, to facilitate the overall environmental assessment of the Browns Polymetallic Project.

2.0 METHODOLOGY

The flora assessment of the survey area was undertaken during 7 days in the field between May and August 2002. Prior to field reconnaissance, preliminary mapping of the area from aerial photographs distinguished 10 distinct vegetation communities within three broad habitat types: upland woodland (dryland communities), drainage areas and monsoon vine-forest. Previously mined, degraded or disturbed environments were also delineated during aerial photograph interpretation. Subsequent ground truthing and field verification of preliminary mapping provided the baseline for the vegetation map of the Browns Project survey area (Figure 1).

The percentage of the 37.5 km^2 project area occupied by each of the major vegetation types was also calculated using manual techniques. These area calculations, expressed in hectares, are approximate measures that may be refined at a later date using digital (GIS) techniques.

At the time of field survey, it was not possible to obtain a permit from the Northern Land Council in order to enter Aboriginal freehold land within the Browns Project survey area. Consequently access to several sections of the survey area, including the eastern and south-eastern portion of the site was restricted. At the time of writing this report, vegetation mapping, quantitative and qualitative assessment was incomplete for these areas. At other locations (vacant crown land and NT freehold land) access was negotiated with landowners where appropriate, prior to commencing fieldwork required for the vegetation survey.

To characterise terrestrial flora, the following information was recorded at selected sites within the major vegetation communities:

- vegetation structure (heights of upper, mid & ground stratum species)
- species composition and dominance
- % canopy cover (calculated from CSR, see McDonald *et al* 1990)
- presence and abundance of introduced species (weeds)
- disturbance (including fire, feral animals and anthropogenic impacts)
- environmental features including slope, landform, soils and drainage
- GPS location

Qualitative assessment of the flora included descriptions of vegetation structure and composition for each of the major communities. Plant species lists were compiled of the plant species recorded in the upper, mid and ground strata for the 10 main vegetation types (Appendix 1). However, species lists are intended as checklists rather than complete botanical inventories, which is beyond the scope of the current project. Flora surveys were commenced in May (late Wet season) in order to sample deciduous species, ferns and other ephemeral wet season species absent later during the Dry season. Project timing did not permit floristic survey any earlier during the wet season. The major vegetation communities were photographed during field surveys (Appendix 2)

Quantitative assessment of the existing vegetation was made at 12 selected locations within each of the major vegetation communities (Table1). Information from these sampling sites could serve as benchmark against which the impacts of the project may be assessed over time – as each site is relocatable and suitable as a long-term monitoring location (for measuring species richness, canopy cover etc). However, as part of Stage 2 (Impact Assessment) studies, additional control and impact sites, established in specific areas, would be required for an adequate long-term monitoring program. For example, the current sampling has 2 upstream (control) and 1 downstream (impact) riparian sites, but more replication would be required for a statistically rigorous sampling program that would enable the determination of potential impacts on flora arising from the project.

Where appropriate, site selection corresponded with the location of fauna sampling sites (see Fauna section of EIS). Quantitative sampling sites were unburnt with the exception of Communities 1 and 3 that had been partially burnt. The height and location of all plant species intercepted by a straight line (using a 50m surveyors tape and compass) was recorded and crown separation ratio (based on mean of 12 trees) calculated along each transect.

Data from vegetation transects was used for compilation of vegetation profile diagrams (Figures 2 to 13). The vegetation profiles present baseline information on species composition, community structure and species richness, while providing a rapid visual and botanical characterisation of the vegetation within each of the major vegetation types or communities. In addition to transect data, a 20 x 20m quadrat was established (adjacent to each transect) within which all plant species were listed (Appendix 1).

Unknown plant species were collected and pressed for botanical identification utilising reference books and field keys (Anon 1994; Booth *et.al* 2001*;* Cowie *et. al* 2000 and Dunlop *et. al 1995).* Plant species denoted by 'S' in Appendix 1 were sampled and forwarded to botanists Chris Mangion, Peter Horsfall, Jack Cusack and Nicole Conroy for identification with reference to voucher specimens from the Northern Territory Herbarium.

Overall, the study area was examined for the presence of rare plant species and ecological communities of conservation significance. In particular, the site was examined for rare plant species including *Indigofera schultzii*, known only to occur in the *Eucalyptus* savanna woodland of the Rum Jungle region. It is recognised that due to project timing, the majority of fieldwork was undertaken during the late wet season and the early dry, when some of the early to mid Wet season flora may have been absent (annual species) or unidentifiable (as a consequence of grazing, fire or dessication). However, all communities were surveyed prior to the commencement of control burning and ferns and other annual species were recorded in botanical inventories.

3.0 VEGETATION

3.1 Flora

Appendix 1 contains a plant species checklist compiled during seven field visits to the survey area. Species are listed according to the ten major plant communities found within the project area. A total of 259 plant species from 81 families and 194 genera were recorded. Plant families represented by the most species were: Poaceae (35 species); Myrtaceae (27 species); Fabaceae (16 species) and Rubiaceae (10 species) . Genera represented by the most species were *Acacia* (7); *Eucalyptus*(7), *Ficus*(5) and *Terminalia* (4). A total of 31 introduced species from 14 families were recorded which is an indication of relatively high levels of disturbance.

The flora of the project area was previously poorly known, with no recent vegetation assessments in the Batchelor region. A search of the Northern Territory Herbarium database (Low, 2001) for all records within a 17.5 km radius of the Browns Project site (ie centred on Rum Jungle) produced a listing of 430 plant species -126 species (29%) of which were recorded during the current vegetation survey (total 259 species). This species list however, includes plants from a broad range of habitats including mangroves, coastal areas and extensive jungles not found within the survey area. A more refined search – of the Browns Project survey area only – resulted in 89 species, 36% of which were recorded in the current survey (Appendix 3).

3.2 Vegetation Communities

Previous vegetation surveys

Mapping of the Bioregions of the Australian continent (Thackway and Cresswell 1995) places the Batchelor area within the Pine Creek-Arnhem Bioregion. Other previous large scale mapping of the study area at 1:1,000,000 scale and description of the vegetation at a gross level was undertaken by Wilson *et. al* (1990) as part of vegetation mapping of the Northern Territory. This stratification distinguished only one vegetation type within the proposed lease area – described as *Eucalyptus tetrodonta* (Stringybark), *E. miniata* (Woolly Butt), *Corymbia bleeseri* (Smooth-stemmed Bloodwood) woodland with trees ranging in cover from 10 to 29% over *Sorghum* grassland understorey ranging in cover from 30 to 69% (their Map Unit 9). Forming a broad swathe, this community extends south from Darwin almost to Adelaide River with large expanses also occurring further to the south and west.

The vegetation of the area has been mapped at a scale of 1:500,000 by Christian and Stewart (1953) as part of early Land Systems mapping for the Darwin-Katherine region. These maps classify the landscape in terms of recurring patterns of landform, soils and vegetation. However, no recent, more detailed mapping of the region including the survey area has been undertaken as part of Land Resource surveys. The Land Resource mapping for Litchfield Park (Lynch and Manning 1988) does not extend as far as the Batchelor region.

Previous mapping indicates that the *Eucalyptus*- dominated savanna formation is widespread and well represented in the region generally. However in this instance, the requirements of the Environmental Impact Statement required a more detailed stratification and description of the project area as follows:

Terrestrial Vegetation Communities

Overall, the vegetation in the lease area closely reflects the interplay of topography, soils and the influence of seasonal fluctuations in fresh water supply and drainage. Consequently the pattern of vegetation broadly corresponds with major topographic contours. Ten major plant communities were distinguished within the Browns Project survey area, as indicated in Figure 1. At a more detailed scale, the main factors determining the distribution of vegetation within the site are the drainage areas associated with Rum Jungle Creek, the Finniss River and the East Branch of the Finniss. These riparian corridors, and the surrounding seasonally flooded alluvial flats and minor tributary creeks, dominate the lowland section of the project area (Map units 5 to 8) occupying 903 ha or 24% of the Browns survey area.

Upland or dryland vegetation occurs on the surrounding gentle lower slopes and low hills (Map units 1 to 4). Broadly described as savanna, these *Eucalypt* dominated communities occupy 2,336 ha or 59% of the Browns survey area.

Dolomite outcrops are common in the Batchelor region and typically support a distinct vegetation community described as dry vine-forest. These communities have only a localised distribution and limited extent in the survey area – and typically have not been mapped. Larger expanses of this habitat occurs in the survey area (248 ha or 7 %) and are mapped as *Acacia auriculiformis* (Black Wattle) vine-forest communities. Vine-forest species also occur scattered through Ironwood (*Erythrophleum chlorostachys*) and *Eucalyptus*-dominated open forests in upland areas (Map unit 2). However, the majority of upland habitat in the survey area and surrounding region supports *Eucalyptus* open woodland and woodlands with *E.miniata* and *E. tetrodonta* as dominant species, either singly or as or co-dominants.

The current field assessment, involving aerial photograph interpretation, ground truthing and quantitative field survey distinguished 10 major vegetation types in terrestrial areas (Table 1). Preliminary mapping was verified and a draft vegetation map of the lease area was compiled. The final vegetation map of the project area was prepared at 1:20,000 scale, digitised and presented as Figure 1. Table 1 summarises the characteristics of the major vegetation communities.

Table 1: Summary Table of Major Vegetation Communities within the Browns Polymetallic Project survey area

MAP UNIT	PROFILE DIAGRAM (Figure #)	VEGETATION COMMUNITY AND DESCRIPTION (area)	SPECIES RICHNESS / % COVER (per 50m transect)	GPS LOCATION (TRANSECT# see Figure 1)
DRYLAND COMMUNITIES				
1	**Figure 2**	***Eucalyptus phoenicea/Corymbia bleeseri* Open Woodland** Eucalypt community in rocky outcrop areas, of restricted distribution in the survey area (23 ha)	17 (14 %)	O716877 E 8562078 N (Transect#11)
2	**Figure 3**	***Eucalyptus tetrodonta/ E. miniata/Erythrophleum chlorostachys* Tall Open Forest to Woodland** Dense, well-developed open forest and woodland with co-dominant to dominant Ironwood with *Eucalyptus* species, on deeper soils in upland areas (229 ha)	31 (32 %)	0715794 E 8562900N (Transect #1)
3	**Figure 4**	***Eucalyptus tetrodonta/ E. miniata* Open Woodland** Open woodland to open forest with grassy understoreys & sparse mid-stratum layer occurring on shallow, gravelly soils on gentle sideslopes & low hills. Very extensive in survey area (1,915 ha)	28 (21 %)	0715109 E 8562392 N (Transect # 6)
4	**Figure 5**	**Mixed Eucalypt Woodland** Variable dominant species forming woodland to low open woodland on gravelly upper slopes. Dense mid-stratum. Not extensive in survey area (69 ha)	24 (12 %)	0713358 E 8560524 N (Transect#12)
DRAINAGE AREAS				
5	**Figure 6**	**Riparian corridor** **Woodland to open woodland** Narrow linear band of riverbank species on small incised drainage lines. Typically fringed by alluvial flats with sparse trees amongst dense grassland. Larger drainage lines with dense tree layer & mid-stratum of riparian species, with terraced banks & sandy levees merging with Paparbark areas & extensive floodplain habitat (124 ha)	25 (18 %)	0715553 E 8564122 N (Transect # 5)
	Figure 7		24	0713414 E 8561280 N (Transect #8)
	Figure 8		20	0712670 E 8562478 N (Transect #9)
6	**Figure 9**	***Lophostemon* communities** **Open woodland to grassland** Highly variable formation structurally and floristically. Varies from dense monospecific stands of *Lophostemon lactifluus* fringing minor creeks to open woodlands with - *Lophostemon* dominant on broad drainage ways. Occurs in association with *Melaleuca* (Paperbark), riparian species and scattered *Eucalyptus*. (228 ha)	20 53 %	0714998E 8560415N (Transect #7)

MAP UNIT	PROFILE DIAGRAM (Figure #)	VEGETATION COMMUNITY AND DESCRIPTION (area)	SPECIES RICHNESS / % COVER (per 50m transect)	GPS LOCATION (TRANSECT# see Figure 1)
7	Figure 10	***Eucalyptus papuana/Corymbia foeslcheana/Melaleuca* spp. Open woodland to grassland** Open woodland community on drainage ways and floodplain areas including degraded areas from previous mining and rehabilitation. *Eucalyptus papuana* common throughout with variable co-dominant canopy species (485 ha)	17 13 %	0716247 E 8562474 N (Transect #2)
8	Figure 11	**Paperbark communities** **Woodland to open woodland** Paperbark communities dominated by *Melaleuca* spp. in seasonally wet areas (66 ha)	12 21 %	0719296 E 8563358 N (Transect #4)
MONSOON FOREST COMMUNITIES				
9	Figure 12	**Monsoon vine-forest** **Closed forest to open forest** Floristically distinct and diverse community in perennially moist areas & associated with rock outcrop. Comprising evergreen and semi-deciduous species with abundant vine species & often dense weeds on margins (32 ha)	20 83 %	0713142 E 3564482 N (Transect#10)
10	Figure 13	***Acacia auriculiformis* communities** **Woodland to open forest** Woodland areas with *Acacia auriculiformis* dominant, including degraded or recovering monsoon vine-forest (248 ha)	31 52 %	0724136 E 8556866 N (Transect #3)

Previous disturbance to the area has been significant in shaping the nature of the existing vegetation. Exploration for the first mining projects in the Rum Jungle area commenced late in the nineteenth century and the site currently contains very extensive waste rock dumps in the form of capped overburden heaps resulting from intensive copper and uranium mining during 1954 to 1971. It is anticipated that the proposed Browns Project open cut mine will overlap the Rum Jungle site. Consequent ecological issues and the potential impacts on terrestrial and aquatic vegetation will be addressed in Stage 2 of the Browns Project EIS document (Impact Assessment)

3.2.1 DRYLAND COMMUNITIES

The majority of the Brown's Polymetallic Project survey area (59%) comprises dryland vegetation on gentle lower slopes and foothills which support *Eucalyptus* dominated communities. These communities comprise various formations ranging from open woodland (with sparse trees with well-separated canopies – 0.3 to 20% canopy cover) to woodland (where upper stratum trees have clearly separated canopies – 21 to 52% canopy cover). A total of 115 species from 49 families were recorded from dryland communities during field surveys. Four main dryland communities were distinguished and are described as follows:

Eucalyptus phoenicea/Corymbia bleeseri open woodland (Map Unit 1)

This community has a very limited distribution in the survey area, occurring on the rocky crests of several low hills in the southern section of the survey area. (occupying 23 ha or 0.5% of the survey area.) The dominant species *Eucalyptus phoenicea* is typically a mid-height, multi-trunked Eucalypt characteristic of rocky habitats, ridges and hills. In the survey areas it forms an open woodland formation to 8m above and a sparse mid- and ground stratum layer (Figure 2). Common upper stratum species include *Corymbia bleeseri* and *Eucalyyptus miniata*. Ironwood (*Erythrophleum chlorostachys)* and Darwin Stringybark (*Eucalyptus tetrodonta)* also occur in this habitat.

Common mid-stratum species to 4m high include Xanthostemon paradoxus, Owenia vernicosa, Livistona humilus, Acacia spp. and Terminalia ferdinandiana. The ground stratum layer typically comprises dense annual grasses (Heteropogon contortus, Themeda triandra, Sorghum spp.), juvenile Eucalypts, herbs (Bonamia sp., Sauropus glaucus, Gomphrena spp., Cartonema spicatum, Pachynema spp) and a variety of sub-shrubs including Petalostigma quadriloculare and Grevillea dryandrii. No introduced species were recorded within this community. The vegetation sampling site (Transect 11) overlaps the location of Fauna Site 8

Eucalyptus tetrodonta/E. miniata/Erythrophleum chlorostachys tall open forest to woodland (Map Unit 2)

This community comprises well-developed, tall open forests on deeper soils of low plateau surfaces, upper hillslopes and rises. Open forests (mid-dense canopy cover) tend to occur where this community intergrades with dense, closed canopy monsoon forests, whereas more open woodland formations (sparse, well separated canopies) occur where Map Unit 2 merges with the *Eucalyptus*-dominated savanna woodland habitat (Map Unit 3).

The dominant upper stratum species - *Eucalyptus tetrodonta, E. miniata* and *Erythrophleum chlorostachys* - form a mid-dense to dense upper stratum to 15m high. Ironwood (*Erythrophleum chlorostachys)* is an outstanding and typically large, ubiquitous tree throughout this community. Other common canopy species include *Eucalyptus confertiflora, Syzygium suborbiculare (*Red Bush Apple) and *Alstonia actinophylla* (Milkwood) with occasional *Acacia auriculiformis (*Black Wattle).

The understorey layer is typically mid-dense with low trees to 6m, the most common species being *Buchanania obovata, Gardenia megasperma, Breynia cernua, Pandanus spiralis, Flueggia virosa, Persoonia falcata* and *Livistona humilus.* The middle stratum species in areas of seasonally elevated soil moisture (such as valley floor habitats) may include *Exocarpus latifolius, Canarium australianum, Opilia amentacea, Petalostigma pubescens, Acacia auriculiformis* and *Ficus opposita*.

The ground stratum is typically a mid-dense to sparse grassy layer including (*Sorghum* spp., *Themeda triandra, Chryspogon latifolius* and *Eriachne* spp.*)* with a variety of herbs and subshrubs (Figure 3) often occurring amongst woody regrowth from lignotubers. Few introduced species, occurring in low densities were recorded in Community 2.

Eucalyptus tetrodonta/ E. miniata open woodland (Map Unit 3)

The *Eucalyptus tetrodonta/ Eucalyptus miniata* open woodland community covers approximatey 1,915 ha (or 51%) of the survey area and largely comprises Eucalypt-dominated open woodlands with minor areas of more dense woodland habitat. The dominant species is characteristically *Eucalyptus miniata* (Darwin Woollybutt), with *E.*

*tetrodonta (*Darwin Stringybark) either singly or in co-dominant stands. *E. confertiflora* may be locally abundant and *Erythrophleum chlorostachys* (Ironwood), *E. tectifica* and *Corymbia foelscheana* may be common canopy forming tree species throughout the open woodland habitat. This formation typically occurs on the well-drained upland areas and low foothills of the survey area.

This community is characterised by a relatively sparse upper stratum of *Eucalyptus miniata* and *E. tetrodonta,* 12 to 20 m high, over a sparse to mid-dense understorey. The dominant species varies locally with changing topographic conditions and associated variations in drainage and soil type. *Eucalyptus miniata* (Darwin Woollybutt) is the most widespread dominant tree on the shallower, yellowish soils of the upper slopes. In these areas, thin *Eucalyptus tetrodonta* may also be present, with occasional *E. tectifica* especially in rockier areas and on low crests.

On the lower slopes, and particularly where this community intergrades with alluvial flats and low-lying areas, *E. confertiflora*, *Coymbia polycarpa* and *E. papuana* may become locally common. Other species including *Corymbia grandifolia* and *Erythrophleum chlorostachys* may become abundant towards drainage areas. Common secondary tree species from 6 to 8m high include *Planchonia careya, Terminalia ferdinandiana* and *Buchanania obovata.*

The mid-stratum layer typically comprises mixed species approximately 2 to 6 m high including many widespread and characteristic woodland shrubs and low trees. Common mid-stratum species include *Acacia* spp., *Cycas armstrongii*, *Brachychiton megaphyllus* and *Livistona humilis.* Abundant coppicing from lignotubers, especially by *Eucalyptus* spp. and *Erythrophleum,* is indicative of a high frequency of fire in this habitat. Turkey bush *(Calytrix exstipulata),* Quinine Bush (*Petalostigma pubescens)* and Native Gardenia (*Gardenia megasperma)* may be locally common in this vegetation community.

The relatively open tree canopy promotes a dense layer of seasonal and perennial grass species and subshrubs. Grasses include annual sorghum (*Sorghum* spp.), *Eriachne* spp., *Chrysopogon latifolius* and *Heteropogon contortus* (Black Speargrass) – these species are widespread and common throughout this vegetation community. The introduced tall grass *Andropogon gayanus* (Gamba Grass) is also abundant in Community 3, mainly in disturbed areas such as roadsides but more sparse infestations of Gamba Grass were also observed throughout woodland habitats.

Species composition in the ground layer might include *Flemingia lineata* and *Fleuggia virosa,* low herbs such as *Buchnera* sp., *Distichostemon hispidulus* and *Waltheria indica*, and vines including *Ampelocissus* spp. may be locally abundant. The introduced grasses *Pennisetum polystachion* and *P. pedicellatum* (Mission Grass) may be common along roadsides and disturbed areas. Aside from introduced grasses, weeds were relatively absent from this community. Figure 4 is a vegetation profile through this open woodland habitat and is characteristic of the vegetation structure within this vegetation type.

Mixed Eucalypt Woodland (Map Unit 4)

This community is of limited extent in the survey area (occupying 69 ha or 2%) and was recorded in two locations. The first is situated on the plateau-like surface of a low rise in the southern-western corner of the survey area surrounding the Area 55 deposit. The second area is situated on the sideslopes of a rocky hill on the western margin of the survey area (Figure 1). Mixed Eucalypt woodland may be more extensive in the south-east of the survey area – however, ground truthing was not possible in this area. This community is a variable vegetation formation comprising woodland and open woodland

on shallow, rocky soils and is characterised by variable dominance of upper stratum species.

Changes in dominance and species composition closely reflect local variations in topography, fire regime, soils and drainage. In the north-western community, fire has been excluded from a hillside (located on Bluey Kerle's property) for approximately 30 years. Fire exclusion has resulted in a shift in species composition and the Eucalypt woodland now supports a mix of vine-forest species and *Eucalyptus* and is mapped as mixed Eucalypt woodland in Figure 1.

This community typically occurs on hills and low rises in upland areas and has characteristically well drained, shallow soils with pockets of sandy substrate and occasional localised areas of perched water table. Pools of water were also observed in scrapes and borrow pits from mining activities in the vicinity of the Area 55 Deposit.

Upper stratum species commonly include a mixture of *Eucalyptus* species and other tree genera including *Eucalyptus tectifica*, *Eucalyptus clavigera, Alstonia actinophylla* and *Erythrophleum chlorostachys* occurring as sparse to very sparse canopy trees to 10 m high. Common secondary trees include *Syzygium bleeseri* ssp *bleeseri, Xanthostemon paradoxus, Melaleuca viridiflora* and *Corymbia bleeseri,* the latter being particularly associated with rocky, ridge-top areas. A total of 55 species were recorded from Community 4 (2% of survey area) indicating high species richness compared to 66 species recorded within the very extensive Community 3 (59% of survey area).

A varied, typically mid-dense to dense understorey layer of low trees and shrubs approximately 2 to 6 m high is characteristic of this community. Figure 5 shows a cross-section through this vegetation type, indicating typical structure and species composition of Community 4 in the southern section of the project area. Common mid-stratum species include *Petalostigma pubescens*, *Cycas armstrongii, Pandanus spiralis, Livistona humilus, Planchonia careya, Terminalia ferdinandiana, Cochlospermum fraserii* and *Grevillea decurrens.*

The ground stratum may include a variety of herbs and sub-shrubs such as *Hibbertia* spp., *Flemingia lineata, Grevillea dryandrii* and *Pachynema complanatum.* Dense grasses were recorded within the ground stratum, particularly in areas with sparse canopy cover, with *Eriachne* spp*., Sorghum* sp and *Chrysopogon latifolius* common species throughout Community 4.

A full listing of plant species recorded from the four major plant communities in dryland areas is contained in Appendix 1.

3.1.2 DRAINAGE AREAS

Drainage areas within the survey area include several distinct habitats associated with the Finniss River, Rum Jungle Creek and the Finniss River East Branch and the numerous minor tributary creeks and drainage ways that carry water during the wet season. Drainage areas occupy 904 ha or 24% of the 3,750 ha Browns survey area.. The linear swathe of riparian vegetation associated with these drainage channels has been mapped in Figure 1 as riparian corridor (Community 5) which occupies a total of 124 ha. Species composition varies in response to the nature of the drainage channel and may include vine-forest species, Paperbarks, aquatic plants and a wide range of species dependent on high soil moisture levels. A total of 142 species from 56 different families were recorded from

drainage areas during field surveys. Of this total, 19 species were aquatic plants or species restricted to wetland habitats.

The main channel of the Finniss River is a large, permanent watercourse flowing roughly from south to north along the western boundary of the survey area. It typically has steep banks 3 to 5 m high, may include several flood terraces, and is characterised by sandy, heavily vegetated levees. In contrast, Rum Jungle Creek is a small, permanent spring-fed stream that joins the main channel of the Finniss in the south-eastern corner of the survey area. Rum Jungle Creek within the survey area is characteristically an incised channel 0.5 to 1.5m deep flowing within a relatively narrow corridor of dense riparian vegetation. This linear band is situated within a broad drainage way comprising alluvial flats with heavy soils supporting *Lophostemon* open woodland (Community 6) and extensive areas of *Eucalyptus papuana/Corymbia foelscheana/Melaleuca* open woodland (Community 7).

Community 6 (228 ha) and Community 7 (485 ha) comprise alluvial flats surrounding drainage areas and represent wet season floodplain areas and transitional habitats between upland woodlands and the lowland drainage lines. They are characterised by seasonal inundation or waterlogging for up to several months of the year and include several swampy areas and/or areas of perched water table supporting distinctive Paperbark forests (Community 8). In general, site drainage is typically slow and substrates in drainage areas tend to have clay soils at depth. Four main vegetation communities outlined above have been distinguished and mapped within drainage areas in the project area (Figure 1) and are described in detail as follows:

Riparian Corridor (Map Unit 5)

Three main drainage lines supporting riparian vegetation dissect the survey area as follows:

Finniss (East Branch) River

The Finniss River (East Branch), where it flows through the project area, is a semi-permanent stream within a distinct channel that dries to a number of pools in the late dry season. The bed is typically broad with low, earthy banks 1 to 3 m high with abundant sandy to rocky mid-stream shoals. Downstream of the Rum Jungle Mine the river shows evidence of pollution from acid rock drainage and the riverbed contains abundant white residue (sulphate salt efflorescence) that has precipitated as the acidic creek water gradually evaporates and dries (Appendix 2 – Photographs). Downstream pollution from acid and Copper producing Rum Jungle waste rock dumps has had a severe impact on this river system (Jeffree, 2002) but since the 1982 remediation works, monitoring of the aquatic fauna and riparian vegetation indicates some recovery and regeneration respectively (ANSTO, 2002; Twining *et al* 2001)

Evidence of the detrimental impacts on riparian vegetation in the East Finniss has previously been detected by measurement of areas of bare soil (in comparison to previous canopy cover); the numbers of dead *Pandanus* stumps on river banks and the presence/absence of rooted or submerged plants. The deterioration of tree roots in the riverbanks also encourages gullying and the gently sloping banks and mid-channel sand deposits (Figure 6) which are characteristic of the East Finniss are actually an indication of the negative impacts of mine effluents on riparian vegetation (Jeffree 2002).

Although riparian vegetation on the East Finniss shows obvious signs of degradation it currently supports a reasonable density and diversity of riparian species at Site 5 (Figure 1). Abundant algae occurs in upstream sections of the river but no other submerged aquatic species were observed, despite apparently suitable habitat. No fish or other aquatic fauna was observed upstream of the former railway bridge. Semi-aquatic vegetation occurs as clumps on mid-channel sand shoals (*Phragmites vallatoria,*

Psedoraphis spinescens), with grasses on the upper banks and moss is common on the lower bank surface. An introduced fern species (*Pitrogramma colmelanos*) was particularly abundant on steeper sections of the riverbank where the trunks and roots of the trees often define the bank itself (eg *Acacia auriculiformis, Melaleuca cajuputi* and *Barringtonia acutangula).*

The East Branch riparian corridor typically merges rapidly with surrounding *Eucalyptus* woodland areas - having little or no surrounding floodplain areas. River fringing vegetation typically includes a narrow band of *Acacia auriculiformis* with *Melaleuca cajuputji, M. leucadendra, Terminalia carpentariae* and *Corymbia polycarpa. C*ommon mid-stratum species in the narrow fringing corridor include *Pandanus spiralis, Barringtonia acutangula* and occasional Weeping Tea Tree (*Leptospermum longifolium*) lining the creek bank (Appendix 2). The noxious weed, *Mimosa pigra* is also common in the creek bed downstream of Rum Jungle. Dense weeds, in particular Snake Weeds (*Stachytarpheta spp.),* Horehound *(Hyptis suaveolens)* and Gamba Grass (*Andropogon gayanus)* are characteristic of the disturbed ground stratum layer (see Figure 6).

Rum Jungle Creek

The southern branch of Rum Jungle Creek is a permanent narrow, incised channel 0.5 to 1.5m deep that flows through a broad drainage way in the southern section of the survey area. In heavily vegetated areas, root systems of the riverbank species and bare mud line the creek channel and the creek itself is typically clear, shallow and swift-flowing. *Pandanus spiralis, Nauclea orientalis* and *Lophostemon grandiflorus* are the tree species characteristic of this narrow riparian zone (Figure 7). Flora Site 8 overlaps Fauna Site 6.

In downstream areas, riparian vegetation may increase in width and diversify including species such as *Timonius timon*, *Diospyros calycantha, Ixora timorensis, Carallia brachiata* and *Ficus racemosa.* Near its confluence with the Finniss River, the vegetation includes vine-forest species such as large *Terminalia microcarpa*, *Sterculia holtzei* and *Syzygium nervosum,* the buttressed roots of these species growing within the narrow creek channel. The creek has two main branches - one that was dry at the time of survey, the other clear and flowing. This apparently perennial branch is fed from springs upstream and contained the most diverse aquatic flora observed within the survey area (described below).

Finniss River

The Finniss River is a much larger system than the two drainage lines described previously. It has a deeper channel with several terraces in the steep banks and a relatively extensive floodplain. The floodplain and watercourse contain a number of permanent billabongs (Appendix 2) and the main channel appears to maintain continuous flows throughout the dry season.

The banks of the Finniss River are heavily vegetated by large trees to 20 m with a typically mid-dense, varied understorey layer from 4 to 8m high (Figure 8). The river levees are prime habitat for Bamboo (*Bambusa arnhemica),* an endemic species which, as part of it's natural life cycle, dies after flowering. Consequently large areas of Bamboo have died since flowering took place several years ago and the Finniss riverbank is currently thickly strewn with the huge dead culms. Bamboo is now actively regenerating and young plants comprise a conspicuous element of the understorey.

Dominant riparian tree species include *Syzygium armstrongii, Ficus racemosa, Maranthes corymbosa* and *Buchanania arborescens*. Common mid-stratum species include *Diospyros calycantha, Canthium schultzii, Eleaocarpus arnhemicus, Barringtonia acutangula* and young *Bambusa arnhemica.* The riparian community was the most diverse vegetation type with a total of 99 species from 48 different families

recorded within the survey area. Weeds are common in the disturbed terrain surrounding the river banks and commonly include *Centrosema pubescens, Stachytarpheta* spp., *Senna obtusifolia, Andropogon gayanus* and *Hyptis suaveolens.*

Aquatic flora

The 3 major drainage lines provide a variety of habitats for aquatic flora, with the majority of the19 aquatic and wetland species recorded occurring within the permanent waters of Rum Jungle Creek. The typically narrow, steep-sided and shallow (1-1.5m deep) creek channel provides habitat for the submerged herb *Blyxa auberti* and the semi-emergent, *Hygrophila angustifolia.* These species occur both in the deeper pools and within fast-flowing sections of the creek. The upper creekbanks support the delicate herbs *Canscora diffusa, Nelsonia campestris* and *Ammania baccifera*. Scattered colonies of Taro (*Colocasia esculenta)* were observed in muddy sections of of the Rum Jungle Creek tributary. Grasses and sedges including *Echinochloa colona* and *Cyperus haspan* occur in shallow water and on muddy banks. Dense *Ischaemum australe* grassland with minor areas of Bladey Grass (*Imperata cylindrica)* is characteristic of river-fringing flats and floodplain areas in most riparian habitats.

Other semi-aquatic and emergent species recorded in Rum Jungle Creek and to a lesser extent in the Finniss (East Branch) River also include *Cyperus aquatilis, Staurogyne leptocaulis Hygrophila angustifolia, Persicaria attenuata* and *Echinochloa colona*. As the water levels gradually falls and the larger pools recede during the dry season, several species grow in the drying streambed including the tall reed *Phragmites vallatoria,* the sedge *Eleocharis geniculata* and the fine grass *Pseudoraphis spinescens*. The noxious weed *Mimosa pigra* (Giant Sensitive Plant) was common on the East Branch of the Finniss, where the introduced fern *Pitrogramma colomelanos* also formed dense cover on the steep riverbanks.

The main channel of the Finniss River is notably devoid of aquatic flora, possibly due to the typically steep banks combined with wet season scour and flooding, deep water and rocky substrates. However, the shallow banks of backwater billabongs and large, permanent waterholes along the Finniss River support abundant water lilies (*Nymphaea violacea* and *Nymphoides indica),* submerged species *(Blyxa aubertii)* and semi-aquatics including *Persicaria attenuata* and *P. barbata.*

***Lophostemon* communities (Map Unit 6)**

The numerous small drainage lines and tributary creeks that flow into the Finniss River system and drain the survey area typically support a narrow but dense woodland community in which *Lophostemon lactifluus* is dominant (Appendix 2 – Photographs). A second species, *Lophostemon grandiflorus* also forms monospecific stands in localised areas of the broad drainage way flanking Rum Jungle Creek and the Finniss River floodplain system. Together, *Lophostemon* communities occupy 228 ha or 6% of the Browns survey area.

Lophostemon lactifluus is a ubiquitous species, well adapted to seasonal inundation and waterlogged soils. It is most common in more upstream areas of the survey area on minor tributaries. In contrast, *Lophostemon grandiflorus* tends to occur along the larger drainage ways within the project area and characteristically forms monospecific stands in floodplain areas with prolonged seasonal inundation. *Lohphostemon grandiflorus* also occurs as a common riparian species lining the main creek channel.

Lophostemon grandiflorus may also grow in association with Paperbarks (*Melaleuca dealbata, M. cajuputi, M. nervosa, M leucadendra)* and *Pandanus spiralis. Eucalyptus* species (particularly *E.papuana* and *Corymbia polycarpa*) tend to occur in slightly higher sites with better drainage but may become common to co-dominant with *Lophostemon* in transitional areas. A total of 35 species from 19 families were recorded within this community and the flora sampling site (Transect 7) overlaps Fauna Site 4.

The mid-stratum in *Lophostemon* communities is sparse and characterised by *Pandanus spiralis, Melaleuca viridiflora* and *Planchonia careya.* Grasses are dense and diverse in this habitat, the most common species including *Eriachne burkittii, Paspalum scrobiculatum, Themeda triandra* and *Ischaemum* spp. Other species tolerant of seasonal waterlogging, including sedges (*Fuirena ciliaris, Fimbristylis pauciflora, Sporobolis pyramidalis)* and floodplain herbs (*Ludwigia octovalvis, Nelsonia campestris* and *Limnophila fragrans)* were also recorded in this community. Weeds were moderately abundant with highest densities on creek banks and levees Figure 9 indicates the structure and species composition of Community 6 in the vicinity of Rum Jungle Creek.

***Eucalyptus papuana/Corymbia foelscheana/Melaleuca* open woodland (Map Unit 7)**

This community is highly variable both floristically and structurally but occupies a predictable position in the landscape – the seasonally flooded flats surrounding the major drainage lines. Dominance varies with local variations in the soils and especially drainage across these floodplain areas with three dominant to co-dominant species found throughout this community within the survey area. Ghost gums (*Eucalyptus papuana)* are ubiquitous in lowland and floodplain areas and typically occur as scattered trees above dense grassland (open woodlands).

Toward upland areas, where site drainage is more positive, *Corymbia foelscheana* may become locally abundant to dominant. However, in more swampy areas of the floodplain *Melaleuca* spp. becomes locally prevalent. This community may include a range of other tree species and shrubs in response to localised variations in topography and drainage. It also occurs as degraded woodland in extensive lowland borrow areas near the Rum Jungle mine.

The riparian vegetation fringing the main drainage lines within the survey area may be only several trees in width, but is characteristically flanked by a distinctive corridor of grassland in which *Ischaemum ausrale* forms dense monospecific stands (Figures 9 & 10). *Ischaemum australe* is a common grass in floodplain areas and in habitats experiencing seasonal flooding, seepage or inundation. Scattered trees amongst this characteristic grassland commonly include *Eucalyptus papuana, Corymbia polycarpa, Lophostemon grandiflorus, Melaleuca dealbata* and *Acacia auriculiformis* (Darwin Black Wattle). These grassland and woodland areas occur on the seasonally flooded drainage ways and surrounding flats and overall comprise a floristically variable open woodland formation mapped as Community 7. This vegetation type covers 13% or 485 ha of the Browns survey area and 51 species from 21 families were recorded in this plant community (Appendix 1)

Ten weed species occur in this habitat and introduced grasses may form dense infestations on river levees particularly where the native vegetation has been disturbed by seasonal flooding and/or feral animals. Previous clearing and grazing has also encouraged the proliferation of weeds in this community especially *Andropogon gayanus* (Gamba Grass) which forms extremely dense stands to 3 to 4 m high in paddocks in lowland drainage areas

of the survey area. *Stachytarpheta spp., Hyptis suaveolens* and *Sida acuta* were also recorded in this habitat.

Paperbark *(Melaleuca)* Communities (Map Unit 8)

Woodland formations in which *Melaleuca* spp. is dominant occasionally occur along the main drainage ways within the survey area and as isolated pockets in lowland terrain, covering approximately 66 ha (less than 2 % of the project area). Paperbarks are characteristic of areas with high soil moisture conditions, waterlogging and/or seasonal inundation. These areas may support tall open forest (52 to 81% canopy cover) with *M. cajuputji* or *M. dealbata* on floodplains, to low woodland formations (3-6m high), characterised by almost monospecific stands of *Melaleuca viridiflora* (Broadleaf Paperbark). Community 8 is of relatively restricted distribution in the project area and typically intergrades with the riparian corridor (Community 5) and floodplain assemblages (Community 7).

This community is relatively simple floristically, with the upper stratum mainly comprising *Melaleuca* species, particularly *Melaleuca viridiflora, M. nervosa, M. dealbata* or *M. leucadendra (*mostly 2 to 8 m high*).* Occasional *Lophostemon grandiflorus, Pandanus spiralis* and *Acacia* spp. may occur in this habitat. A total of 50 species from 24 families were recorded within Paperbark communities within the project area.

Dense grasses including *Themeda triandra, Ischaemum australe* and *Eriachne burkittii* typically comprise the ground layer. Dense infestations of the introduced vine Calopo (*Calopogonium mucunoides)* may smother the ground layer and extend into the mid stratum in some Paperbark areas (Figure 11 & Appendix 2 – Photographs). Sedges (*Fimbristylis littoralis*, *Cyperus haspan, Fuirena ciliata, Rhyncospora* sp.) and wetland herbs (*Limnophila fragrans, Drosera indica)* are common ground layer species.

3.2.3 RAINFOREST COMMUNITIES

Vine-forest or rainforest communities occur within the survey area in areas with seasonally high soil moisture or perennial water sources. These conditions support the development of dense woodland to closed canopy forest comprising a distinct and diverse flora. Of the 259 species recorded within the survey area, almost half (113 species or 44%) were recorded from vine-forest communities.

Evergreen Monsoon Vine-forest (Map Unit 9)

Evergreen monsoon vine-forest associated with the permanent water of springs occurs within the survey area. These habitats support a floristically distinctive community in which evergreen trees typically form a closed canopy forest up to 20m high. Tree species are characteristic of areas with perennially high soil moisture and include *Sterculia holtzei, Myristica insipida, Calophyllum sil, C. soulattri, Terminalia microcarpa, Syzygium minutuliflorum*, *S. nervosum,* the palm *Carpentaria acuminata* and the fern *Microsorum grossum.* Other canopy species include *Maranthes corymbosa, Ficus racemosa, Acacia auriculiformis* and *Gmelina schlechteri*

Due to reduced light levels beneath the typically dense canopy, the mid-stratum layer may be mid-dense to sparse and comprises mainly juvenile canopy trees and vines. Other low trees recorded in spring jungles include *Carallia brachiata, Pleomele angustifolia, Pongamia pinnata, Vavaea australiana, Ficus hispida* and *Exocarpos*

latifolius (Figure 12). Vines and scramblers are common in this habitat (*Flagellaria indica, Adenia heterophylla, Capparis sepiaria, Smilax australis, Opilia amentacea* for example) and clumps of *Pandanus aquaticus* typically occur along the stream channel.

Weeds species were uncommon beneath the canopy of evergreen vine-forest - being largely restricted to the fringes of this habitat. Weed species fringing vine-forests may proliferate in the locally high soil moisture levels and in these situations introduced grasses (especially *Andropogon gayanus, Pennisetum* spp,) may form dense, tall stands and exotic vines (*Calopogonium mucunoides, Centrosema pubescens)* may smother the fringing vegetation. Dense infestations of snakeweed (*Stachytarpheta* spp.) and Horehound (*Hyptis suaveolens)* are particularly common fringing vine forest areas.

Ground orchids are expected to occur in this habitat during the wet season as well as a number of deciduous and semi-deciduous vine species and annual plants that lose their leaves or above-ground foliage during the dry season. A survey during the early to mid-wet season would be necessary to detect the full range of plant species.

Acacia auriculiformis communities (Map Unit 10)

This vegetation type is broadly similar to evergreen monsoon vine forests - having a diverse flora and a large number of species in common. However, although these habitats are floristically rich (89 species from 46 families) and support a suite of species not associated with other more widespread Eucalypt woodland habitats, the *Acacia auriculiformis* (Black Wattle) communities typically represent degraded or regenerating vine-forest habitats. These forests typically occur in areas with slightly lower soil moisture than evergreen vine-forests and include parts of the survey area where jungles appear to be recovering from the impacts of disturbance (eg clearing, fire, mining etc). Many vine-forest species are frequently fire-sensitive and may become restricted to habitats associated with permanent water or to fire-protected rocky outcrops.

Vegetation structure reflects the lack of perennial water supply with open forest and woodland structural formations more common than closed canopy forests. Upper stratum species in this vegetation community include the rainforest coloniser species *Acacia auriculiformis,* tall *Erythrophleum chlorostachys* and *Terminalia microcarpa* (Figure 13). Large Banyan Figs *(Ficus virens)* and Milkwood trees (*Alstonia actinophylla)* may be key species in the re-establishment of vine-forest vegetation.

In areas where the canopy is closed, a mid-stratum layer may be relatively sparse and the ground layer characterised by vines and seedlings and saplings of upper stratum species. Common vines include *Tinospora smilacina, Parsonsia velutina, Smilax australis* and *Abrus precatorius*. Patches of *Hypoestes floribunda* and ferns including *Cheilanthes nitida* may occur in the ground stratum.

Dense weed infestations are characteristic of the fringes of these areas with class B noxious weeds *Hyptis suaveolens*, *Sida acuta*, *Senna obtusifolia* and *Pennisetum polystachion* recorded at Site 3. Other weed species recorded here included *Andrographis paniculata, Sida acuta* and *Tecoma stans.* Vines including *Cardiospermum halicacibum* and smothering Wild Passionfruit (*Passiflora foetida)* and Calopo (*Calopogonium mucunoides)* were also thick at this location. Figure 13 shows a cross-section through this community adjacent to the Intermediate Open Cut and indicates the typical structure and species composition of this community within the survey area.

4. 0 CONSERVATION SIGNIFICANCE - FLORA

Although the majority of habitats within the project area are in a fairly natural condition, the site has a relatively long history of disturbance mainly as a result of mining. Anthropogenic impacts also include clearing, grazing, horticulture, the introduction of exotic plant species and impacts from domestic and feral animals and have affected 324 ha (9%) of the Browns survey area. Nevertheless, the remnant native vegetation does not appear to be significantly degraded overall and certain areas have shown considerable natural revegetation (indicated by the expansion of Community 10 over several decades).

In particular, Rum Jungle Creek and the main branch of the Finniss River remain in a fairly natural condition with no aquatic weeds, low turbidity and high water quality which in turn supports healthy riparian ecosystems. Although polluted from acid mine drainage close to Rum Jungle, the East Branch of the Finniss River, indicates progressive improvement (ie return to normal condition) with increasing distance downstream (Pidsley, ed. 2002; Twining et.al. 2001). Water quality in the East Finniss is improved by flushing from springs entering the river near Mt Burton, on the northern boundary of the survey area, just upstream of the confluence with the Finniss River.

The conservation significance of vegetation in natural habitats can be considered on a number of different levels (ie at the level of the individual species, or the plant community) and at several different spatial scales (eg local, regional or national) as follows;

4.1 Plant species of conservation significance

In general, the plant species recorded within the Browns Project survey area are common and widespread in the region generally. These findings however, are based on the results of relatively limited field surveys commenced in the late wet season. A comprehensive botanical survey during the early to mid-wet season may reveal different results. Nevertheless, the current survey strongly indicates that it is unlikely that any plant species of botanical or conservation significance are present on the site. There are, however, a number of specific conservation issues regarding flora which are considered separately below:

Rare species

None of the 259 plant species recorded during this survey and listed in Appendix 1, nor any recorded on the NT Herbarium database (Appendix 3) are classified as rare, endangered or vulnerable. The species present were checked against local (Leach *et al.*1992), regional (Connors, Oliver and Woirnarski, 1996) and national (Briggs and Leigh 1988; Environment Australia Website, 2001) lists of plants of conservation significance. Indeed, rarity is unlikely, given the recent history of widespread, frequent fire and extensive disturbance from previous mining over much of the site. Most important, however, is the absence of plant communities of restricted distribution or vegetation types known to contain a high proportion of rare species – sandstone escarpment habitats, wetlands suitable for *Utricularia* spp. for example – as this significantly reduces the likelihood that rare and endangered flora would occur there.

However, the Northern Territory Herbarium data base does record 3 species of conservation significance (currently classified as vulnerable or rare) from the 20 minute grid square surrounding the Browns project survey area: *Indigofera schultziana, Habenaria elongata* and *Helicteres* D2164 Glenluckie Ck. The current and future conservation status of these species are considered individually as follows:

***Indigofera schultziana* F.Muell. (Fabaceae) –2R**

Despite extensive searching within the survey area, this perennial subshrub with ovate to orbicular leaves was not detected. *Indigofera schultziana* is a rare species, endemic to the Darwin region and is known only from Eucalypt savanna at Rum Jungle and in the Finniss River area. (Dunlop *et al.*1995*)*. Consequently the Browns survey area, which includes 2.33 km^2 of 'Eucalypt savanna' vegetation, may contain areas of suitable habitat for this species. This species is poorly known however, and botanists do not know whether the aerial parts of this small plant in the pea family, are annual or short-lived. Consequently, it is possible that *I. shultziana* may be present within the site but was not detected during surveys conducted during the late wet and early dry season, when aerial parts may well be absent.

Two collections have been made of this species but none from within the survey area. The NT Herbarium considers this species should be coded as vulnerable (I. Cowie, September 01) in future assessment of conservation status. Vulnerable species are not presently endangered but are at risk of disappearing from the wild over a longer period (20-50 years) through continued depletion. Vulnerable species may also occur on sites likely to experience changes in land use that would threaten the survival of the species in the wild (Leach *et al 1992).* The ranking of '2' denotes species with a very restricted distribution in Australia and with a maximum geographic range of less than 100km.

***Habenaria elongata* R.Br. (Orchidaceae) –3rC**

This species is a slender ground orchid with annual growth arising from a perennial tuber. It grows and flowers in the early to mid wet season and is cryptic or dies back to the perennial tuber during the dry season. It is known from 6 locations from Darwin to Milingimbi in Arnhem Land and is usually found in woodland on sandy soils in association with *Grevillea pteridifolia*. In the Batchelor region, however, it was recorded from a stony hillside habitat.

Current field surveys found no evidence of this species, nor were any substantial areas of it's preferred habitat (*Grevillea pteridifolia* woodland) observed within the survey area. The NT herbarium will rate this species in the poorly known or data deficient category in its review of rare species. The ranking of '3' denotes species with a range over 100 km in Australia but occurring only in small populations which are mainly restricted to highly specific and localised habitats.

***Helicteres* D2164 Glenluckie Ck. (Sterculiaceae) –2V**

This species is one of many, as yet undescribed *Helicteres* species from the Darwin region (Brock 1997). However, this perennial subshrub is known from only 3 locations in the vicinity of Darwin. The closest location to the survey area is a collection of approximately 100 plants beside the Stuart Highway near Batchelor, the remaining 2 locations occur on private land further north and a substantial population occurs at Mt Bundey, east of Darwin. The NT Herbarium will rate this species as endangered because 2 of the 3 populations are considered quite vulnerable.

Endemic species

A total of 14 species from 11 families recorded from the project area are endemic to the Northern Territory (ie naturally occur nowhere else). Endemic species recorded include *Carpentaria acuminata, Bambusa arnhemica, Sterculia holtzei, Flemingia trifoliastrum, Cochlospermum fraseri, Pachynema dilatatum, Flacourtia territorialis, Urena lobata, Grevillea decurrens, Livistona humilus, Briedelia tomentosa, Lophostemon lactifluus* and *Syzygium minutuliflorum.* Appendix 1 contains a complete listing of endemic species. However, endemism in the Northern Territory is quite common overall, with approximately 11% of the flora comprising endemic species. Consequently, although

endemic to the NT, the 14 species recorded have quite widespread distributions, are typically locally common (Liddle *et al* 1994) and none have special or declared conservation status (Leach *et al.*1992).

Protected species

A high proportion of Northern Territory plant species from the Orchidaceae and Cycadaceae families have rare status and these groups are generally conferred some intrinsic ecological value due to their relatively restricted distribution (Ian Cowie pers. comm). Thus the presence of cycads and orchids in the project area is of some botanical importance as follows:

Cycads

Within the survey area *Cycas armstrongii* is a common understorey species particularly within *Eucalyptus* dominated woodlands (Map Units 1 to 4). It is a common species, having a wide distribution within the region and elsewhere across the Top End. However, to ensure the conservation and sound environmental management (including harvesting) of this species, it is classified by Northern Territory Environmental Legislation as a protected species (Schedule 8, Regulation 15 of the Territory Parks and Wildlife Conservation Act 1994).

The implications of this legislation are that *Cycas armstrongii* may not be collected or removed from bushland unless it is part of the lawful use of the land. Thus although cycads are protected species, with some intrinsic ecological value, their presence does not preclude development in areas with appropriate zoning or development approval.

Orchids

The same legislation that classes all members of the Cycadaceae family as protected species states that all members of the Orchidaceae family have the same conservation status.
One orchid species, *Cymbidium canaliculatum* was recorded from within the project area during field surveys. This species occurs as epiphyte arising from the hollow branches and spouts of *Eucalyptus* trees, usually *Corymbia foescheana, Corybia bleeseri* and *Eucalyptus clavigera* (Brock 1997). *Cymbidium canaliculatum* was observed in the survey area within Mixed Eucalypt Woodland near the Area 55 Deposit. This species is relatively common and widespread in the NT, with a distribution extending to WA, QLD and NSW (Brock 1997)

Summary

No rare or endangered plant species, nor any plant species of special conservation status were observed during field surveys within the proposed project area. However, field survey during the early to mid-wet season may be required to further investigate whether Indigofera schultzii (2R) and Habenaria elongata (3r) occur within the survey area.

4.2 Plant communities of conservation significance

Approximately 59% of the project area comprises *Eucalyptus* and *Corymbia* dominated vegetation communities, either as woodland or open woodland formations. Overall, this vegetation type, where trees co-occur with a more or less continuous grass cover, is commonly known as savanna and occurs across vast areas of northern Australia. Savanna is characteristic of the monsoonal tropics where there is a distinct dry season and where fire is a major factor determining vegetation structure.

The survey area also contains minor areas of riparian, floodplain, *Lophostemon* and Paperbark communities associated with the three main drainage lines. These communities are also common and widespread in the region generally. The vine-forest areas (including both *Acacia auriculiformis* woodland and evergreen vine-forest vegetation) within the project area do not have special botanical significance or declared conservation status and their small extent leaves them prone to degradation, particularly from fire and weed invasion. However, these habitats have a relatively limited distribution at the landscape scale and support a distinctive flora of ecological importance as follows.

The Browns Project survey area contains two areas of closed canopy monsoon vine-forest (Community 9) associated with perennial water (Figure 1). Several, more extensive areas of *Acacia auriculiformis* vine-forests (Community 10) occur within the survey area. The two communities, here referred to as vine-forests have ecological significance largely due to the general scarcity of perennial water and the frequency and extent of annual burning. Vine forest communities are characteristically fire-sensitive and fire restricted and typically occur as small disjunct patches in a 'sea of savanna'.

Vine-forests contain a distinct and diverse flora. For example although vine-forest communities occupy only 8% of the Browns survey area, they contain over 40% of the plant species recorded. However, their scattered and relatively restricted pattern of distribution overall presents a challenge for their adequate conservation. It follows that environmental assessment projects need to consider the cumulative impacts of clearing numerous small areas of vine-forest habitat, particularly in relation to biodiversity conservation objectives.

Vine-forests are typically of local significance as a habitat to specialised fauna and these sites are important sources of water for surrounding fauna and flora. In addition, over 70% of vine-forest species produce small fleshy fruit or exposed seeds (Wightman and Andrews 1989) which represents an important but widely scattered resource for frugivorous species such as birds and bats. Indeed, these forests are habitat for a number of fauna species restricted to vine-forests (eg Rose Crowned Fruit Dove, Emerald Pigeon, host-specific butterflies etc.). Thus the conservation of individual vine-forest isolates becomes more critical when their disjunct distribution is taken into consideration and important ecological interrelationships are understood.

Although vine-forests (as well as the main riparian corridors), are important areas at the local scale for the reasons outlined above and in terms of maintaining healthy ecological function (eg maintenance of biodiversity, habitat heterogeneity and water quality), they do not have any declared conservation status. Consequently disturbance to these isolated vine-forest patches arising from mining activity should be avoided where possible.

In summary, no plant communities of special conservation status occur within the project area. However, future development in the vicinity of the two springs supporting evergreen vine-forest vegetation (Community 9) should be undertaken in the light of their local and regional ecological importance and with the conservation of these areas in mind.

4.3 Ecological and Conservation Values - Flora

Local Significance

Despite its proximity to Darwin and to Batchelor, the previous history of mining, other landuse and the current levels of weed infestation, the vegetation of the survey area comprises a range of habitats that remain in relatively intact natural condition. It follows

that the survey area contains a variety of ecosystems with habitats of importance to a variety of fauna (see Fauna Section of EIS).

The survey area contains several sites of significance to local Aboriginals who are the Traditional Owners of the land. These sites have been acknowledged, are declared Sites of Significance and access to these areas prohibited.

Healthy natural habitats have an intrinsic conservation significance that is difficult to quantify and not often recognised, but which contributes to important values such as clean air and water, biological diversity and environmental stability. Thus although the flora does not have local conservation significance, its value as a habitat confers some local significance in terms of its water and land resources, its many values as a resource for indigenous people and its intrinsic ecological value in maintaining numerous free services.

Regional Significance

The terrestrial vegetation communities within the area proposed for development are typical of *Eucalypt* forest and woodland of the Top End and comprise part of an extensive bioregion (the Pine Creek bioregion covering 30,404 km^2. Thus in the regional context, the conservation value of terrestrial flora found on the site is not significant. Further, 42.7% of the bioregion is currently reserved, predominantly for conservation purposes (Woinarski, Connors and Oliver 1996) so these woodland habitats are well represented in reserves elsewhere in the region.

Summary

The project area contains common and widespread vegetation types of no declared conservation status in the local and regional contexts.
However, the proposed survey area includes minor areas of monsoon vine-forest associated with perennial water and areas of quality riparian habitat having local and regional ecological importance. It follows that the proposed development should avoid vine-forest and riparian areas where possible in order to reduce negative environmental impacts on the ecological and natural resource values of vegetation in the region.

5.0 WEEDS

Weed species and infestations

A total of 31 weed species were recorded from the project area (Table 2), 9 of which are declared noxious weeds Class B (NT Weeds Management Act 2001). The relatively high number of naturalised and invasive species is thought to reflect the long history of terrain disturbance arising from mining and other landuse combined with the relatively large survey area (37.5 km^2) comprising a range of different habitats. In contrast, a total of 16 weed species were recorded during a flora survey the 160 ha Mt Grace Magnesite Project survey area during 2001.

Weed infestations were distributed patchily within all the major plant communities in the project area but typically were concentrated in disturbed areas, such as roadsides, along tracks, around mines and associated areas cleared of vegetation. Indeed, 324 ha (9%) of the survey area comprises disturbed habitat (see Map Unit 11, Figure 1). In addition, several introduced species known to pastoralists as improved pasture species have been planted within these areas to assist in the rehabilitation of the Rum Jungle mine site (Kraatz and Norrington 2002). In natural areas however, riparian habitats and the fringes

of monsoon vine-forest are the key habitats for weeds, characterised by a wide variety of weed species occurring in dense stands (Appendix 1).

Table 2 : Weed species recorded within the proposed Brown's Polymetallic Project Area (listed according to Smith, 2002)

Weed species	Common Name	Classification
Ageratum conyzoides		—
Andrographis paniculata		—
Andropogon gayanus	Gamba Grass	—
Bidens bipinnata	Cobbler's Peg	—
Calopogonium mucunoides	Calopo	—
Centrosema molle	Centro	—
Crotalaria goreensis	Gambia Pea	—
Cyanthillium cinereum		—
Echinochloa colona	Barnyard Grass	—
Eclipta D78475 Gove		—
Hibiscus subdariffa	Rosella	—
Hyptis suaveolens	Horehound	Noxious, Class B
Leucaena leucocephala	Coffee Bush	—
Mangifera indica	Mango	—
Melinis repens	Red Natal Grass	—
Mimosa pigra	Mimosa, Giant Sensitive Plant	Noxious, Class A/B Class A south of 14 °S Class B, north of 14 °S
Passiflora foetida	Wild Passionfruit	—
Pennisetum pedicellatum	Mission Grass	—
Pennisetum polystachion	Mission Grass	Noxious, Class B
Physalis minima	Wild Gooseberry	—
Pitrogramma colomelanos		—
Senna obtusiflolia	Sicklepod	Noxious, Class B
Sida acuta	Spinyhead Sida	Noxious, Class B
Sida cordifolia	Flannel Weed	Noxious, Class B
Stachytarpheta cayennensis	Snake Weed	Noxious, Class B
Stachytarpheta jamaicensis	Snake Weed	Noxious, Class B
Sylosanthes hamata	Verano	—
Stylosanthes guianensis	Stylo	—
Themeda quadrivalvis	Grader Grass	Noxious, Class B
Tecoma stans	Yellow Bells	—
Urochloa mutica	Para Grass	—

Riverine habitats are typically subject to intermittent natural disturbance from flooding and both riparian and vine-forest communities are prone to impacts from feral animals, particularly rooting by feral pigs and pugging by buffalo and cattle. Indeed, the highest weed numbers were recorded from riverine habitat (24 of the 31 species recorded) with similarly high diverstiy in vine-forest communities including *Acacia auriculiformis* woodland areas (17 species). Dryland habitats, in comparison had 9 introduced species.

Weeds of the Rum Jungle mine site have been investigated previously as part of monitoring (Kraatz 1998, Kraatz and Applegate, eds 1992) and site integrity assessments by Kraatz and Norrington (2002) who summarised the results of rehabilitation work including weed control, undertaken between 1993-98. The latter report notes that weeds at Rum Jungle represent a major management problem and that despite control efforts spanning 5 years, no weed species were eradicated, but limited success was achieved in the management of some species. Kraatz and Norrington (2002) report a total of 8 species from the Rum Jungle mine site, all of which were recorded during the current survey.

Of particular concern, is the distribution and density of the tall, introduced grasses *Pennisetum polystachion* (Mission Grass) and *Andropogon gayanus* (Gamba Grass). Although not a declared noxious weed, Gamba Grass has a similar growth pattern and habit as Mission Grass, a Class B weed. The prolific seasonal growth of both species produces dense, robust stands, 3 to 4m high that, in contrast to native species, remain green until late into the dry season. These species have the potential to have a widespread and major impact on the fire ecology of the Top End by changing vegetation structure and species composition (with associated reductions in savanna biodiversity.)

Mission Grass became established at Rum Jungle in the early 1990's and by 1998 had become uncontrollable. Gamba Grass is locally prevalent in the Batchelor region and has followed a similar pattern of rapid invasion and currently forms very dense stands in disturbed or grazed areas within the Browns survey area.

Of the 28 weed species observed (Table 2), several species were recorded in very low densities eg. *Ageratum conyzoides, Andrographis paniculata, Leucaena leucocephala, Mangifera indica, Leucaena leucocephala, Tecoma stans* and *Physalis minima.* Three introduced species associated with wetland habitats, including 2 grasses (*Echinochloa colona, Urochloa mutica)* and a daisy (*Eclipta* D78475 Gove), were observed within the survey area. However, the introduced status of the naturalised *Echinochloa colona* remains unclear (Cowie *et al* 2000). Para Grass (*Urochloa mutica)* occurs sporadically in areas receiving seasonal inundation. Also associated with wetland areas, *Mimosa pigra* (Class B noxious weed) occurs as isolated outbreaks near the Rum Jungle Tailings Dam, around Whites Open Cut and downstream along the East Branch of the Finniss River.

Overall, however, the wetland habitats within the survey area were in relatively intact condition supporting native aquatic species. With the exception of the East Branch of the Finniss River, which has been subject to acid mine drainage and heavy metal pollution, elsewhere a range of aquatic species typical of healthy drainage areas were observed. Invasive aquatic species *Salvinia molesta* and *Eichhornia crassipes* (Water Hyacinth) were not recorded from within the survey area.

In dryland areas, several Class B species were well established at the time of this survey (*Hyptis suaveolens, Stachytarpheta* spp.and *Sida* spp.). However, no Class A weed species (to be eradicated) were present and the declared Class B noxious weeds Lantana (*Lantana camara),* Bellyache Bush *(Jatropha gossypifolia)* and Candlebush (*Senna alata)* were not observed within the project area. Infestations of these species are common in the Darwin region. No Aleman Grass (*Echinochloa polystachya)* nor Olive Hymenachne (*Hymenachne amplexicaulis)* was observed during field surveys. Introduction of these and other recognised environmental weeds could lead to environmental decline and loss of biodiversity through the exclusion of native plant species and may create management problems within the mining lease.

Proposed widespread clearing of native vegetation and the large scale terrain disturbance involved in the development of the mine may create conditions highly favourable for the proliferation of weed species, particularly in locations where adjacent areas already

support populations of exotic species. However, future management of the site will anticipate and address these issues, to be discussed in more detail in Stage 2 of this project.

Northern Territory Weeds Legislation

Within Australia, each state and territory has legislation governing weed issues. Primarily weeds legislation compels landholders to eradicate, control or stop the spread of serious weeds where appropriate. In the Northern Territory, the Department of Business, Industry and Resource Development administers *the Weeds Management Act 2001* which replaced the *Noxious Weeds Act 1962* in July 2001. Under NT legislation, there are 3 main categories: Class A – to be eradicated; Class B - growth and spread to be controlled; and Class C – not to be introduced to the Territory (Smith 2002).

No Class A noxious weed species were recorded, however nine Class B weeds occur within the Browns survey area. The distribution of many Class B species is extremely widespread and so attempted eradication is impractical, but the prevention of their further spread is possible and a requirement of Northern Territory legislation. Indeed, under the Weeds Management Act, the landholder must take all reasonable measures to prevent the land being infested with declared weeds and is responsible for preventing their spread to other land.

Consequently all landholders are encouraged to develop and comply with a Weed Management Plan for their property. The 9 noxious weeds concerned whose control would be addressed within a WMP are *Pennisetum polystachion (*Mission Grass)*, Hyptis suaveolens* (Horehound), *Sida cordifolia (*Flannel Weed) and *S. acuta (*Spinyhead Sida), *Mimosa pigra (*Mimosa), *Senna obtusifolia* (Sicklepod), *Stachytarpheta cayennensis* and *S. jamaicensis* (Snakeweeds), and *Themeda quadrivalvis* (Grader Grass).

The delineation and classification of other exotic species such as Gamba Grass (*Andropogon gayanus)* is quite problematical. Although this species is recognised by the Department of Primary Industries and Fisheries as a serious environmental weed that invades native habitat, displaces native species and dramatically increases fuel loads (threatening not only native vegetation but infrastructure), this species is still actively utilised by pastoralists (L Hills, DPIF, pers. comm.). Consequently, although Gamba Grass poses a serious environmental threat to the region and is considered a major environmental weed elsewhere in the world, it is currently not a declared species under existing legislation (Smith 1995). Within the survey area the most extensive and well-developed stands of Gamba Grass were observed in previously grazed floodplain (Community7) and dryland habitats (Community 3) north of Rum Jungle Creek (see Appendix 2 - Photographs)

Weed management

Given the current high, but localised levels of weed infestation, the priority for weed management in the project area is to assist in the control of existing weeds and to prevent introductions of class B weeds into natural and disturbed habitats. The development of a Weed Management Plan would detail appropriate control measures that might include slashing, select chemical control and washdown facilities. The management plan may include long-term (potentially collaborative) rehabilitation goals for previously mined sites within the survey area.

New weed species may spread into the project area by human activity, windborne seed or by machinery that has previously been operating in weed infested areas. It follows that mine machinery and vehicles that have worked on the Browns Project site may continue to

spread Class B weeds once they leave the site. Consequently, the installation of washdown facilities for mine equipment may be necessary to satisfy weed control and management regulations.

The riverine and monsoon vine-forest habitats were found to have the highest numbers and densities of exotic species. High seasonal soil moisture levels within the drainage way and disturbance by flood events, dirt tracks and feral animals encourages the growth of weed species particularly *Hyptis suavelolens, Stachytarpheta* spp. and the smothering vines *Calopogonium mucunoides* and *Passiflora foetida.* Consequently, periodic natural disturbance and dense infestations will make weed management in these areas difficult.

The declared noxious weed Mission Grass, (*Pennisetum polystachion)* was common but not particularly abundant within the project area and where present, was largely restricted to roadsides and disturbed areas. Unlike Gamba Grass, this species does not readily invade Eucalypt dominated savanna, but sparse infestations may occurs sporadically throughout all habitats. During the construction and operational phases of the Browns mine, the further proliferation of Gamba Grass (*Andropogon gayanus*) is likely to result from clearing and associated disturbance, and this may lead to degradation of monsoon vine-forest habitat due to it fostering more frequent, high-intensity fires.

The presence and further spread of Gamba Grass and Mission Grass is considered the most serious weed management issue for the proposed mine site and potentially represents a major environmental and fire hazard for surrounding land (B Williams, NT Bushfires Council). The Department of Primary Industries strongly recommends that a Weed Management Plan be implemented to prevent this, to ensure that Class B weeds are dealt with and that weeds do not become a major financial or management problem.

Listed in decreasing order of importance, the following weed species were considered by officers of the Department of Primary Industry and Fisheries as 'priority' weeds in the Batchelor area: *Hyptis suaveolens, Mimosa pigra, Sida acuta, Senna obtusifolia, Senna occidentalis, Senna alata, Stachytarpheta spp., Salvinia molesta* and *Jatropha gossypifolia.* Six of these species already occur within the project area (Table 2). During and after mine construction, regular monitoring for introductions of those species not already present on site (eg. *Salvinia molesta, Jatropha gossypifolia*) should be undertaken. New outbreaks and spread of those species already present should also be a priority for control.

A second priority for weed control is to minimise environmental changes that will encourage the spread and proliferation of weeds. Terrain disturbance and enrichment of normally nutrient poor substrates facilitates the proliferation of exotic or native increaser species. Such situations are to be avoided because complete dominance of certain invasive weed species has a serious effect on biodiversty and destabilises previously diverse ecosystems.

The project area is surrounded to the north, east and west by extensive and intact Eucalypt woodland or savanna. The Mt Burton Wildlife Sanctuary is also located to the north west of the survey area. The vegetation in these areas is currently in a healthy condition and is relatively free of exotic species. The protection of these surrounding habitats will be acknowledged in the Weed Management Plan that will also incorporate appropriate strategies to achieve this aim.

Summary

The vegetation of the proposed project area is overall in reasonable natural condition especially given the previous landuse history including intense mining. However, of a

total of 31 weed species recorded from the survey area, 9 species are declared Class B weeds. Consequently weed management of the site will, by law, focus on control of these species and the prevention of their spread - particularly into areas disturbed by construction and operational activities.

It will also be necessary to prevent the escape of declared weeds or invasive species into surrounding natural habitats and important to prevent the introduction of new declared weeds to the mine from other areas. The development of a Weed Management Plan and the installation of washdown facilities for mine equipment is recommended to satisfy weed control and management regulations.

6.0 FIRE

Similar to tropical savannas throughout the world, fire is an annual event in the landscape of Northern Australia, with up to 50% or more of the region burnt each year (Williams 1995). Consistent with this trend, field surveys indicate a pattern of frequent, extensive burning in the surrounding landscape combined with controlled burning within selected areas of the proposed survey area. Species composition, coppicing from lignotubers, the sparse mid-stratum layer and the prevalence of grasses all suggest frequent, probably annual burning within much of the wider survey area.

Future fire management of the site will have a number of key objectives including reduction of the flammable fuel loads around the area for fire protection and to prevent extensive, destructive wildfires. Landholders are legally responsible for containing fire on their property and may be held liable if fire escapes and damages the property of others (the adjoining market gardens, pastoral properties and the Mt Burton Wildlife Sanctuary for example). Consequently, clearing of vegetation along fire breaks and trails are basic requirements for fire prevention and control. It is a legal requirement that a 4 m fire break be maintained around the entire boundary.

The NT Bushfires Council recommends that contact with the Batchelor Regional Fire Control Officer is established and coordination sought in the preparation of a fire management property plan for the project area. The plan may involve strategic fuel reduction, controlled burns, clearance around assets, provision of appropriate fire control equipment and the clearing and maintenance of fire breaks. Given the serious fire hazard posed by Gamba Grass (*Andropogon gayanus)* on the site, fire management should include its control or removal from certain areas due to its high fuel loading. The grading of any new fire breaks and trails will create extensive, linear corridors that will encourage the spread of weeds into areas where they were previously absent. Consequently fire and weed management will need to be closely coordinated within the project area in order to meet legislative requirements for weed and fire management.

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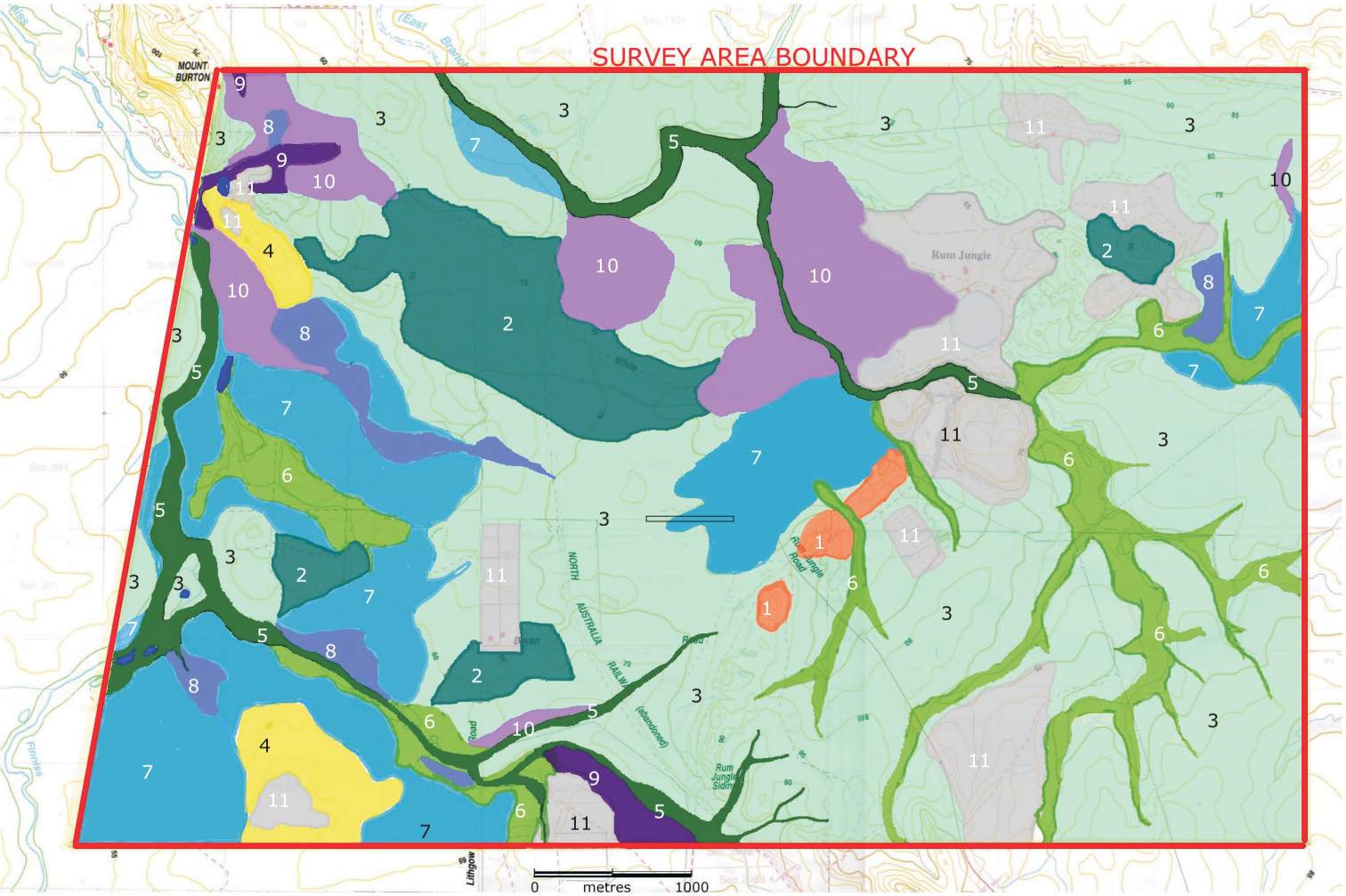
FIGURES



KEY - VEGETATION MAP

BROWNS POLYMETALLIC PROJECT

MAP UNIT	VEGETATION COMMUNITY
	UPLAND EUCALYPT COMMUNITIES
1	*Eucalyptus phoenicea/E. bleeseri* open woodland
2	*Eucalyptus tetrodonta/ E. miniata/ Eythrophleum chlorostachys* woodland
3	*Eucalyptus tetrodonta/ E. miniata* open woodland to woodland
4	Mixed Eucalypt woodland
	DRAINAGE AREAS
5	Riparian corridor
6	*Lophostemon* open woodland communities
7	*Eucalyptus papuana /E. foelscheana/ Melaleuca* spp. open woodland
8	Paperbark woodland to open woodland communities
	MONSOON FOREST COMMUNITIES
9	Monsoon vine-forest
10	*Acacia auriculiformis* woodland communities
	OTHER
11	Previous mining areas, disturbed sites & rehabilitation areas

Community 1 - *Eucalyptus phoenicea /Corymbia bleeseri* Open Woodland

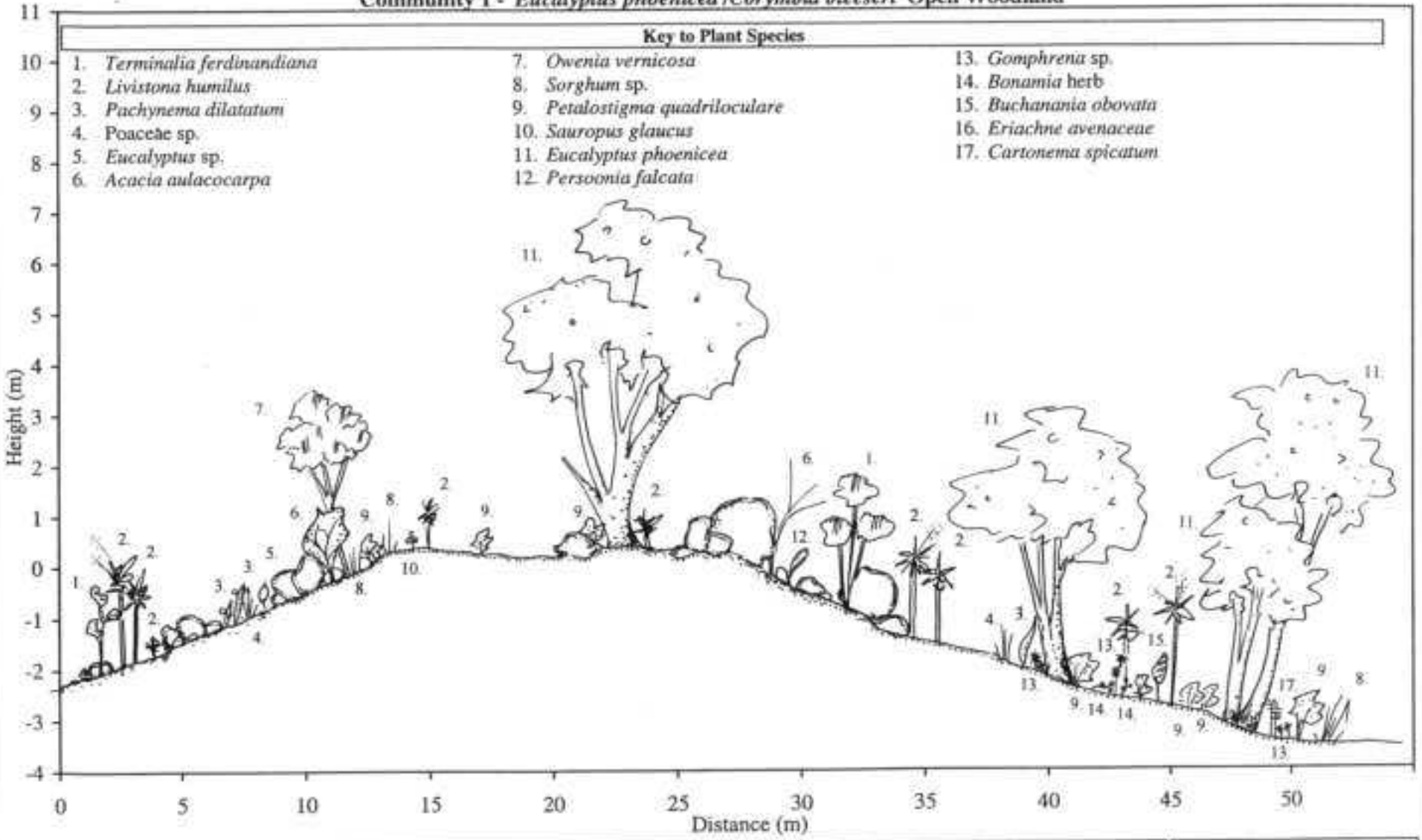


Figure 2 : Profile diagram of vegetation transect (Site 11) through *Eucalyptus phoenicea /Corymbia bleeseri* open woodland on low, rocky hills in the southern section of the survey area

BROWNS POLYMETALLIC PROJECT

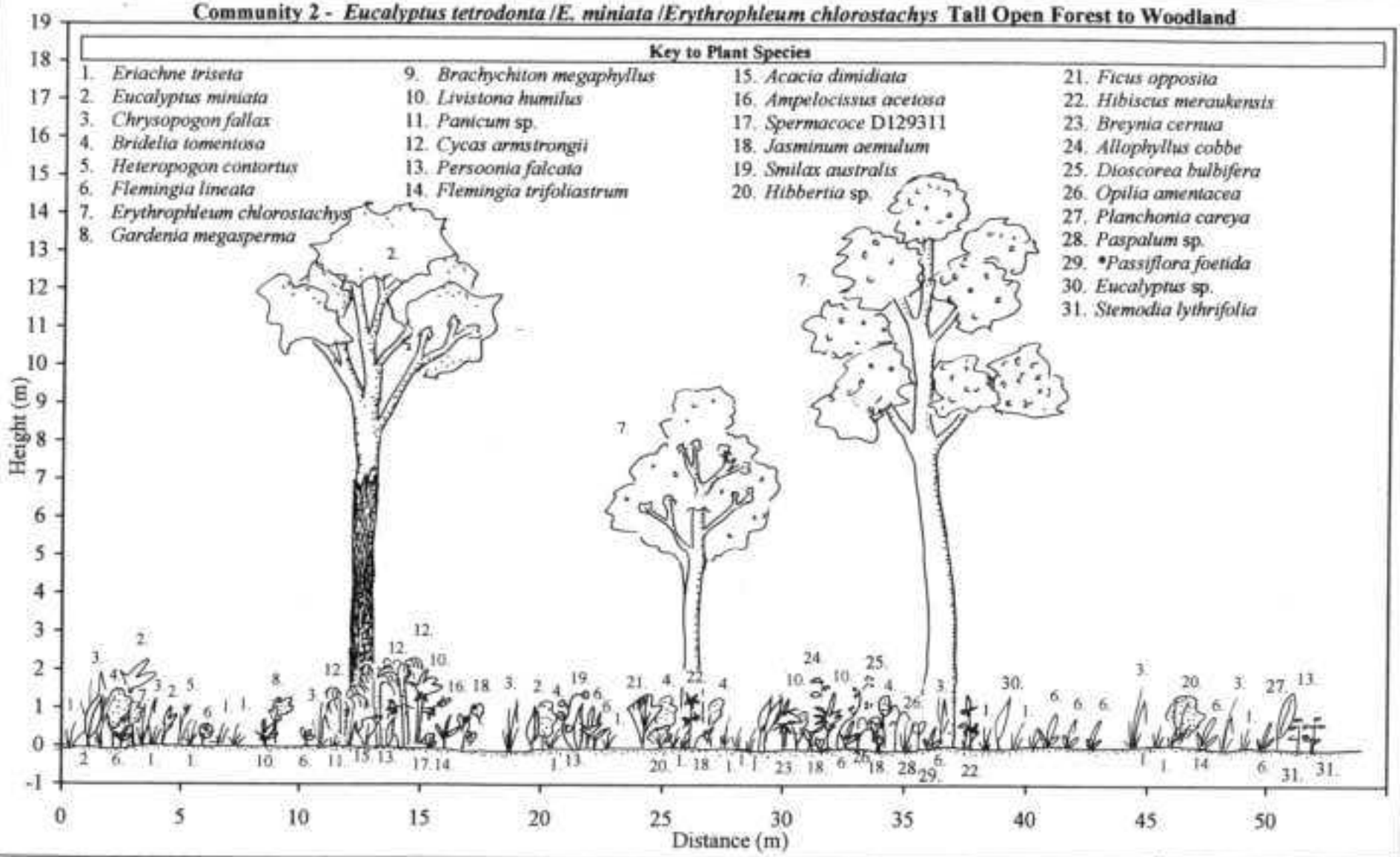


Figure 3: Profile diagram of vegetation transect (Site 1) in *Eucalyptus tetrodonta /E. miniata* and Ironwood woodland near proposed open cut mine

BROWNS POLYMETALLIC PROJECT

Community 3 - *Eucalyptus tetrodonta /E. miniata* Open Woodland

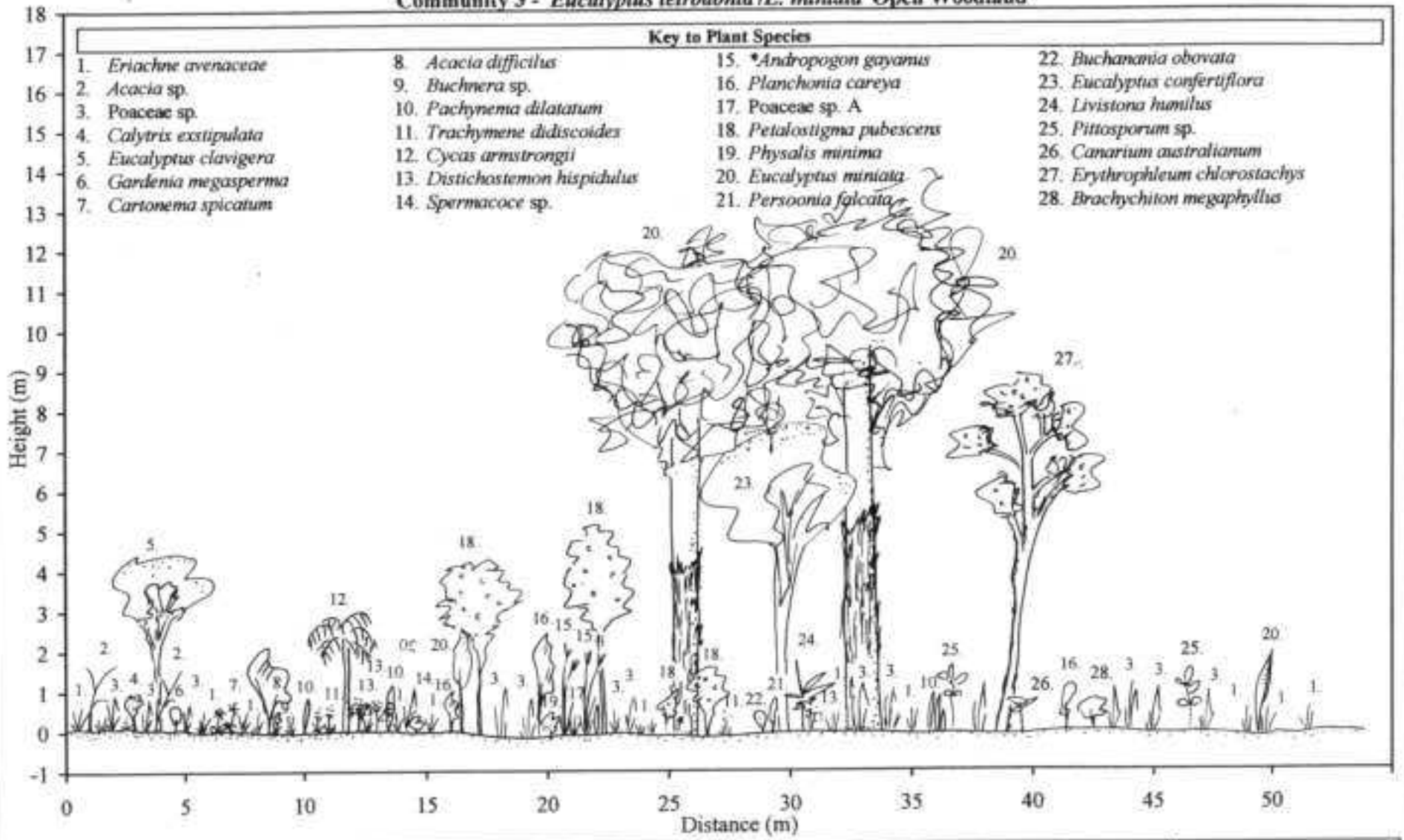


Figure 4: Profile diagram of vegetation transect (Site 6) through *Eucalyptus tetrodonta /E. miniata* open woodland

BROWNS POLYMETALLIC PROJECT

Community 4 - Mixed Eucalypt Woodland

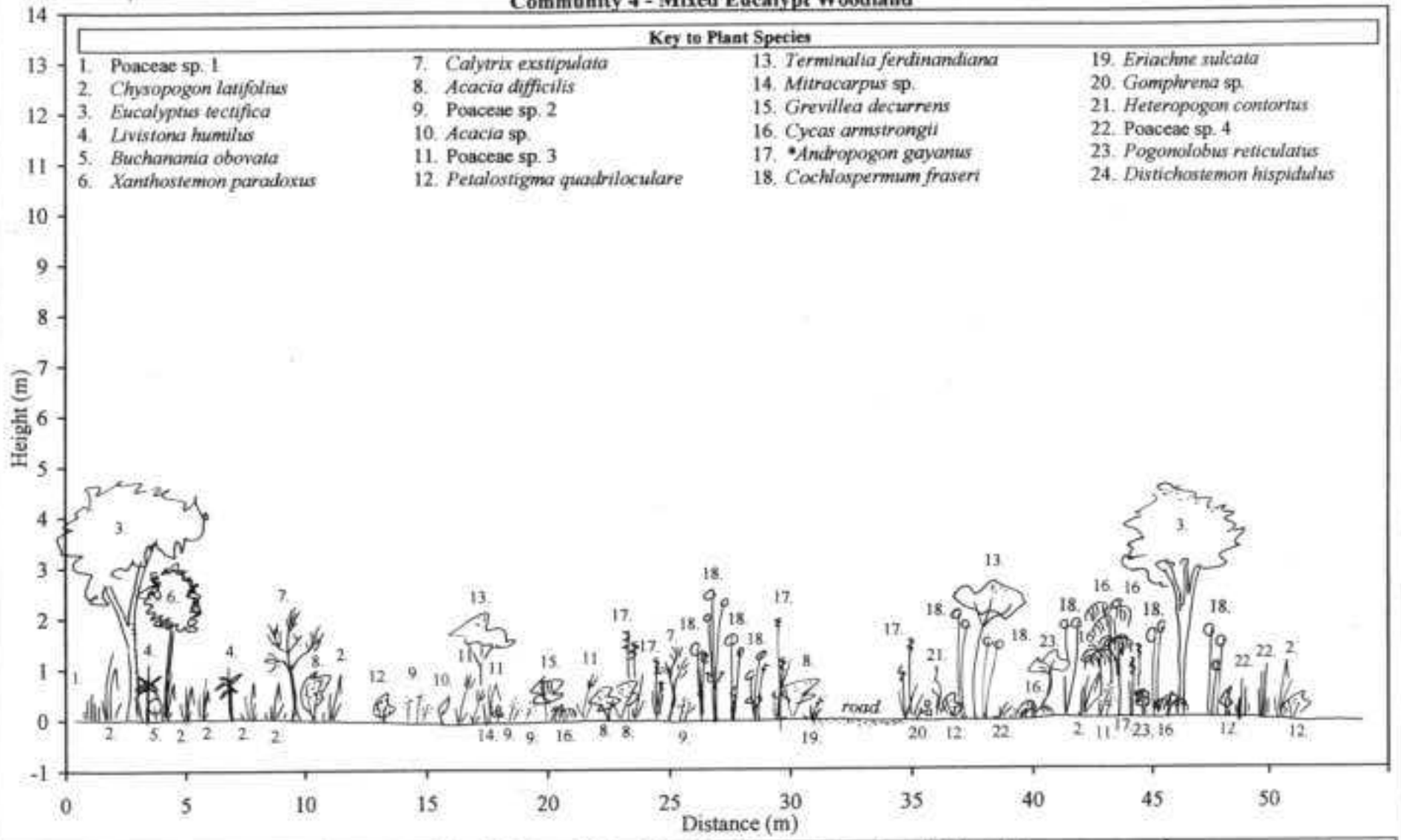


Figure 5 : Profile diagram of vegetation transect (Site 12) through Mixed Eucalypt Woodland near Area 55 Deposit

BROWNS POLYMETALLIC PROJECT

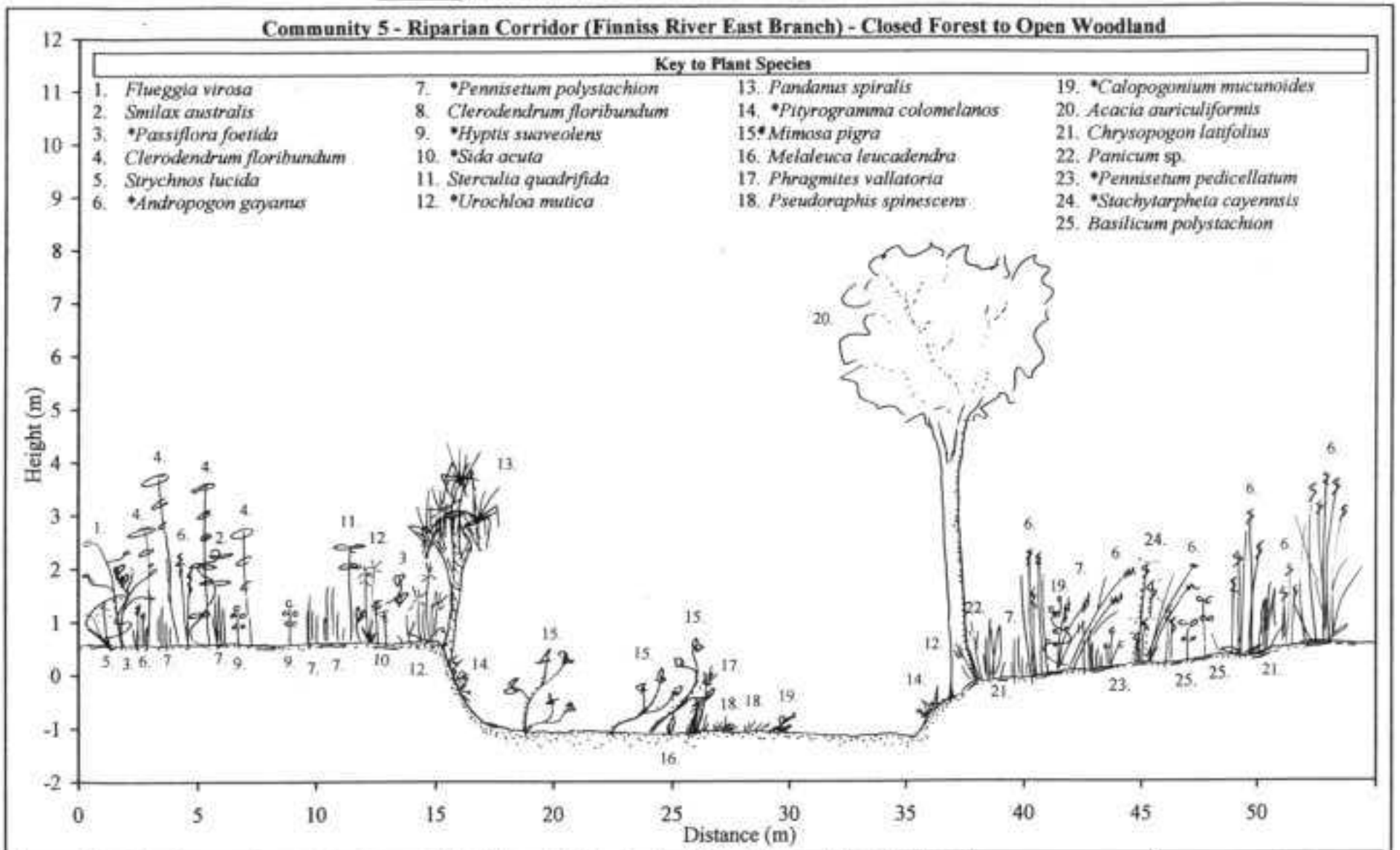


Figure 6: Profile diagram of vegetation transect (Site 5) through Riparian Corridor on Finniss River East Branch, downstream of Rum Jungle

BROWNS POLYMETALLIC PROJECT

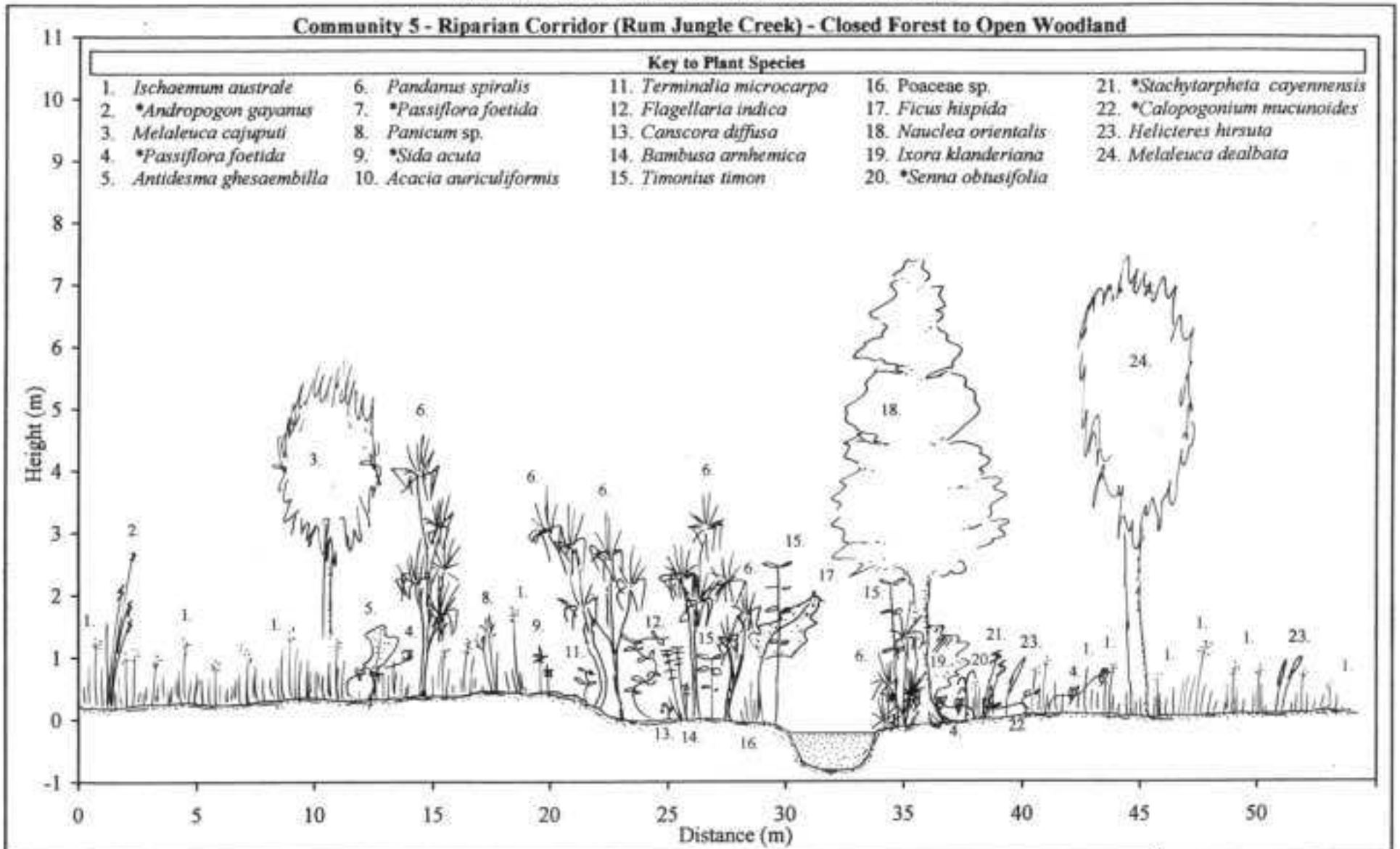


Figure 7: Profile diagram of vegetation transect (Site 8) through Riparian Corridor at Rum Jungle Creek (upstream of proposed Browns Project)

BROWNS POLYMETALLIC PROJECT

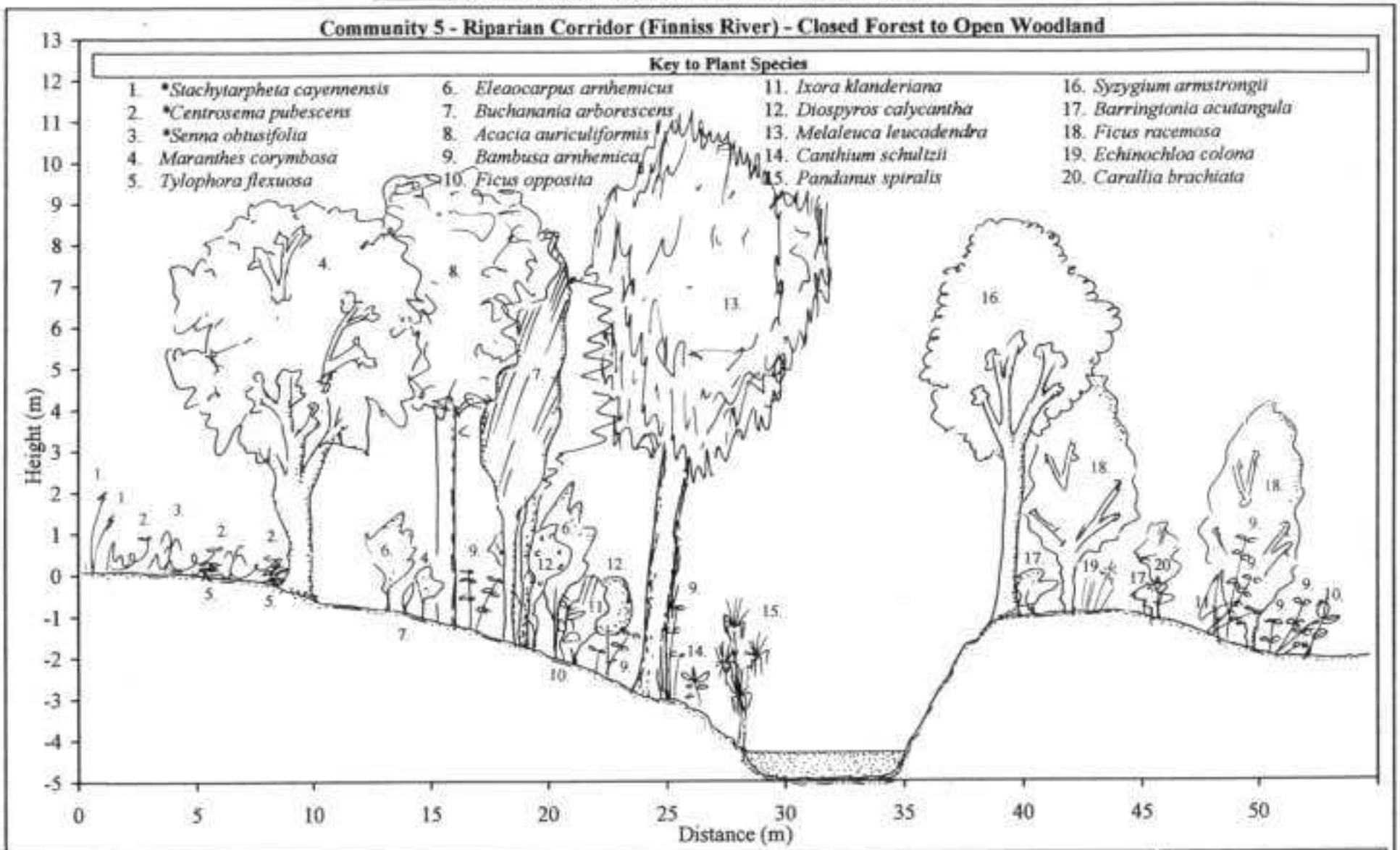


Figure 8 : Profile diagram of vegetation transect (Site 9) through Riparian Corridor habitat on Finniss River (upstream of proposed Browns Project)

BROWNS POLYMETALLIC PROJECT

Community 6 - *Lophostemon* Open Woodland to Grassland

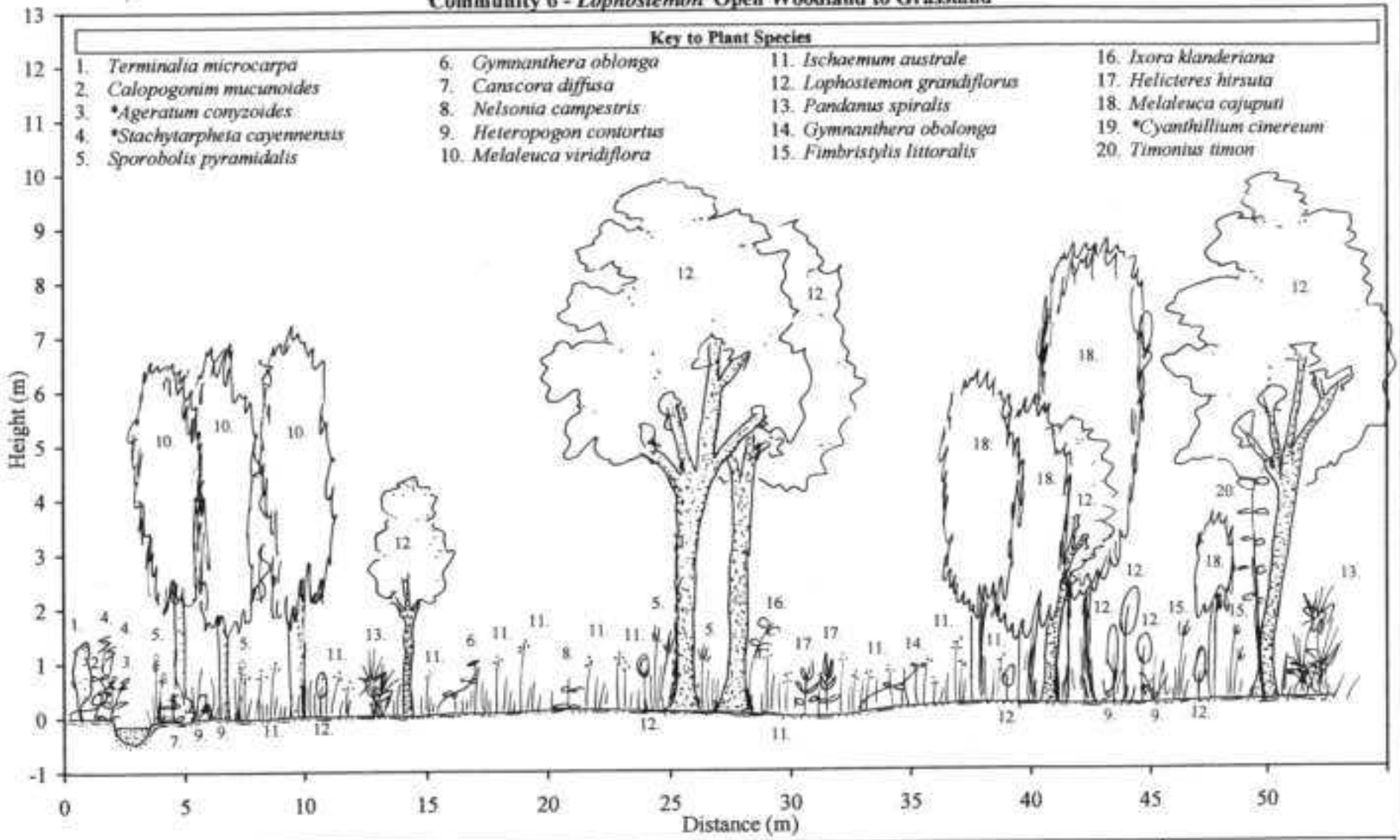


Figure 9 : Profile diagram of vegetation transect (Site 7) within *Lophostemon* open woodland to grassland community, on Rum Jungle Creek floodplain

BROWNS POLYMETALLIC PROJECT

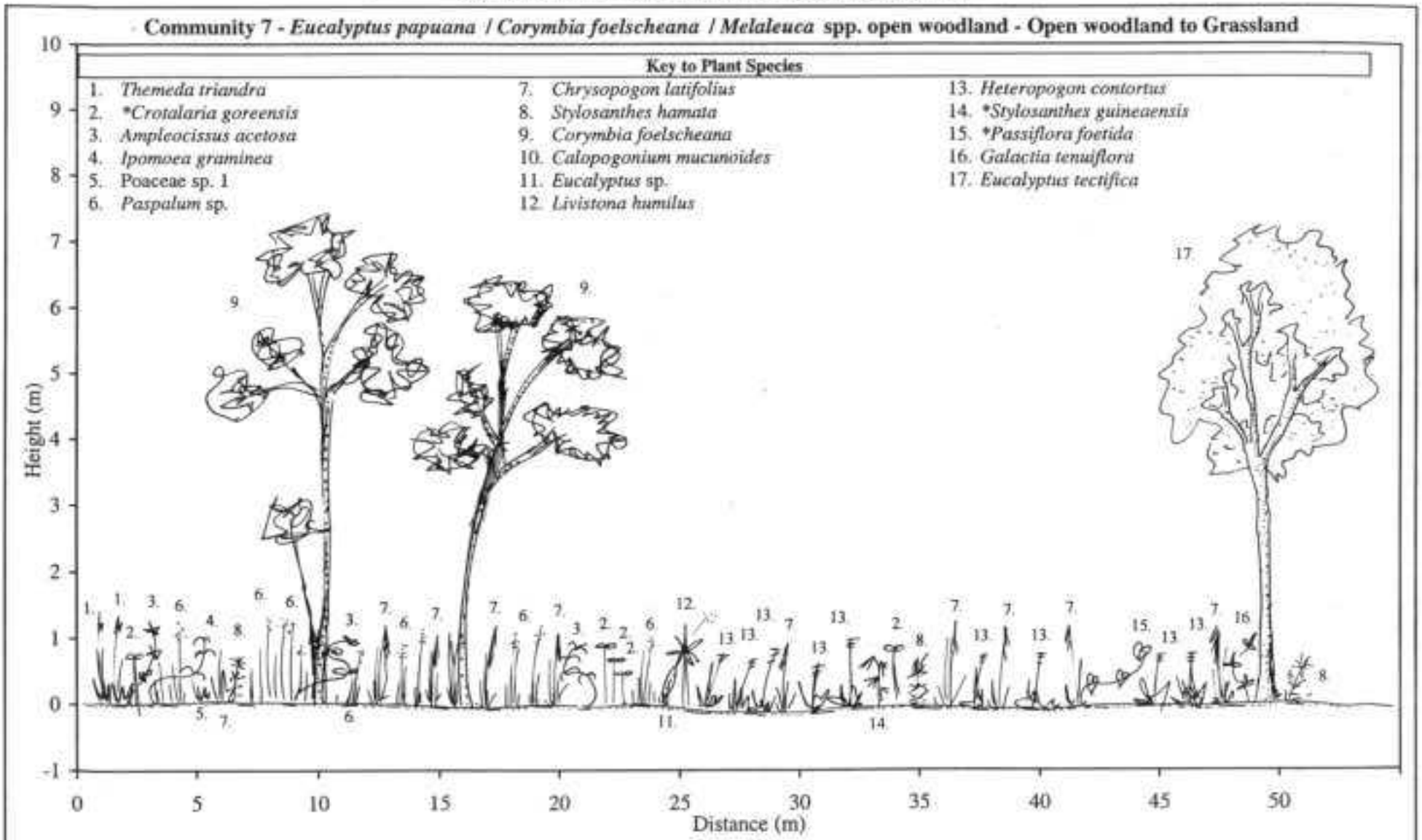


Figure 10: Profile diagram of vegetation transect (Site 2) through *Eucalyptus papuana /Corymbia foelscheana /Melaleuca* spp. open woodland community, near proposed Browns Project open cut mine

BROWNS POLYMETALLIC PROJECT

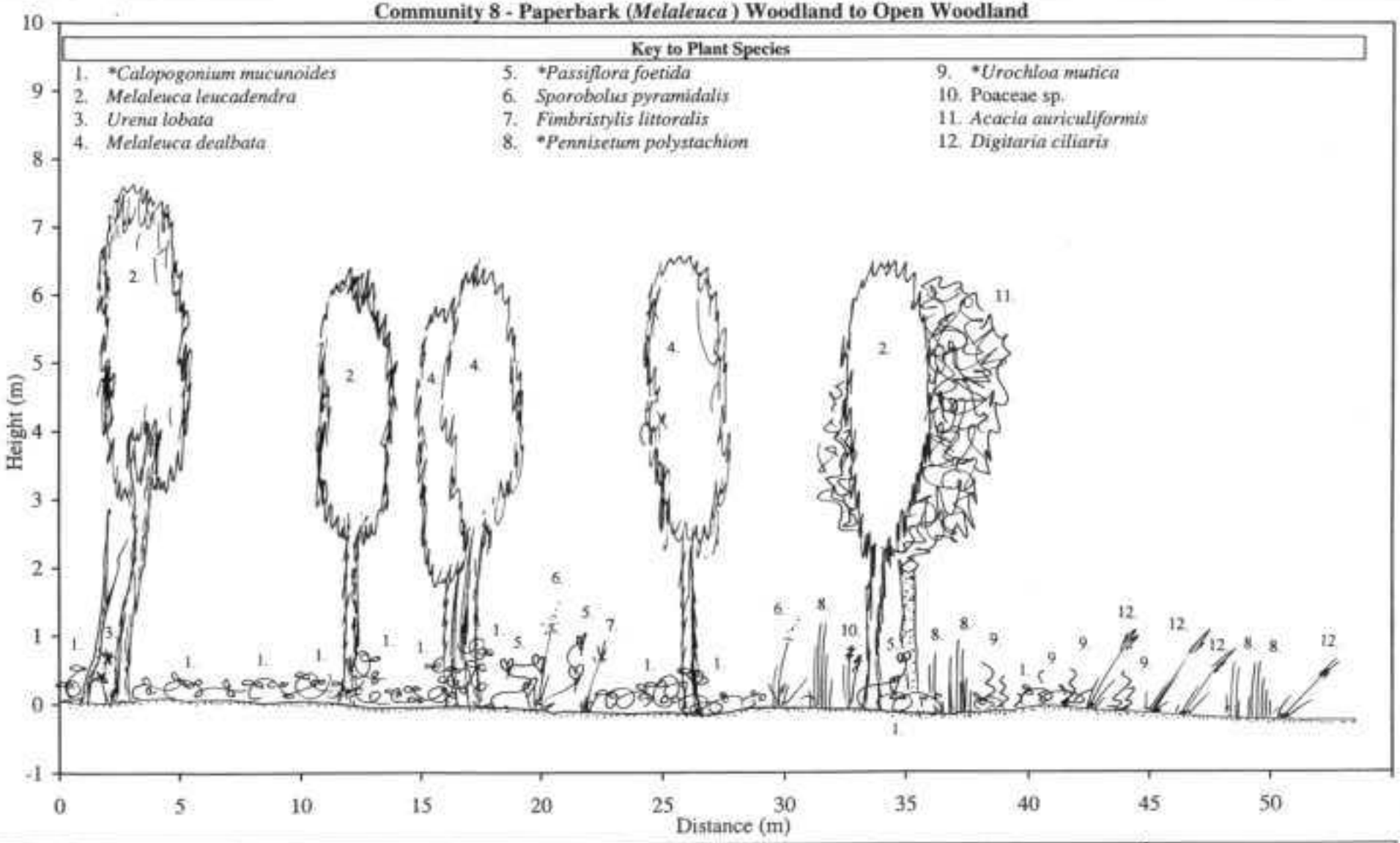


Figure 11: Profile diagram of vegetation transect (Site 4) in Paperbark (*Melaleuca*) woodland to open woodland community

BROWNS POLYMETALLIC PROJECT

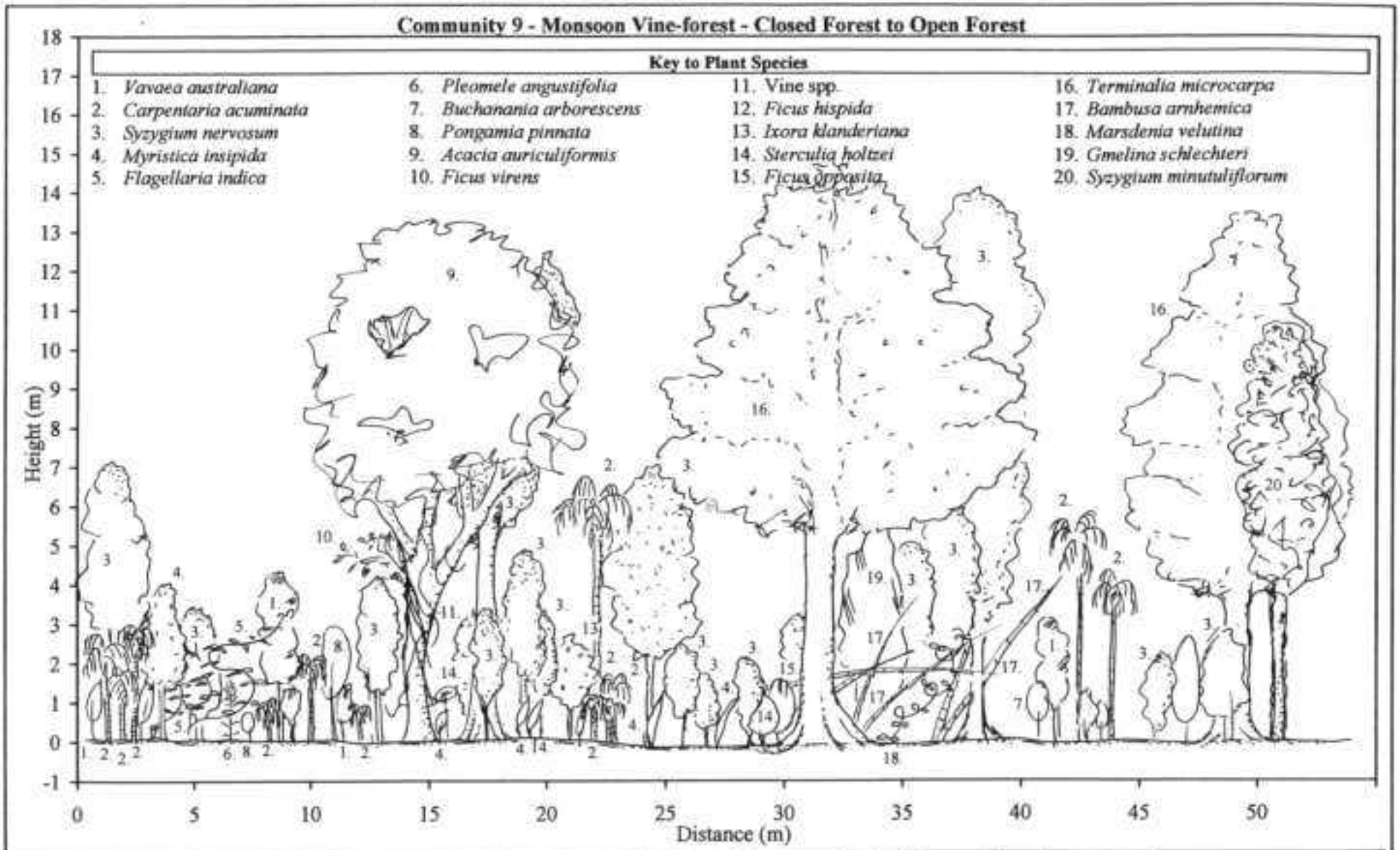


Figure 12: Profile diagram of vegetation transect (Site 10) in Monsoon vine-forest habitat associated with perennial spring near Mount Burton

BROWNS POLYMETALLIC PROJECT

Community 10 - *Acacia auriculiformis* (Darwin Black Wattle) - Woodland to Open Forest

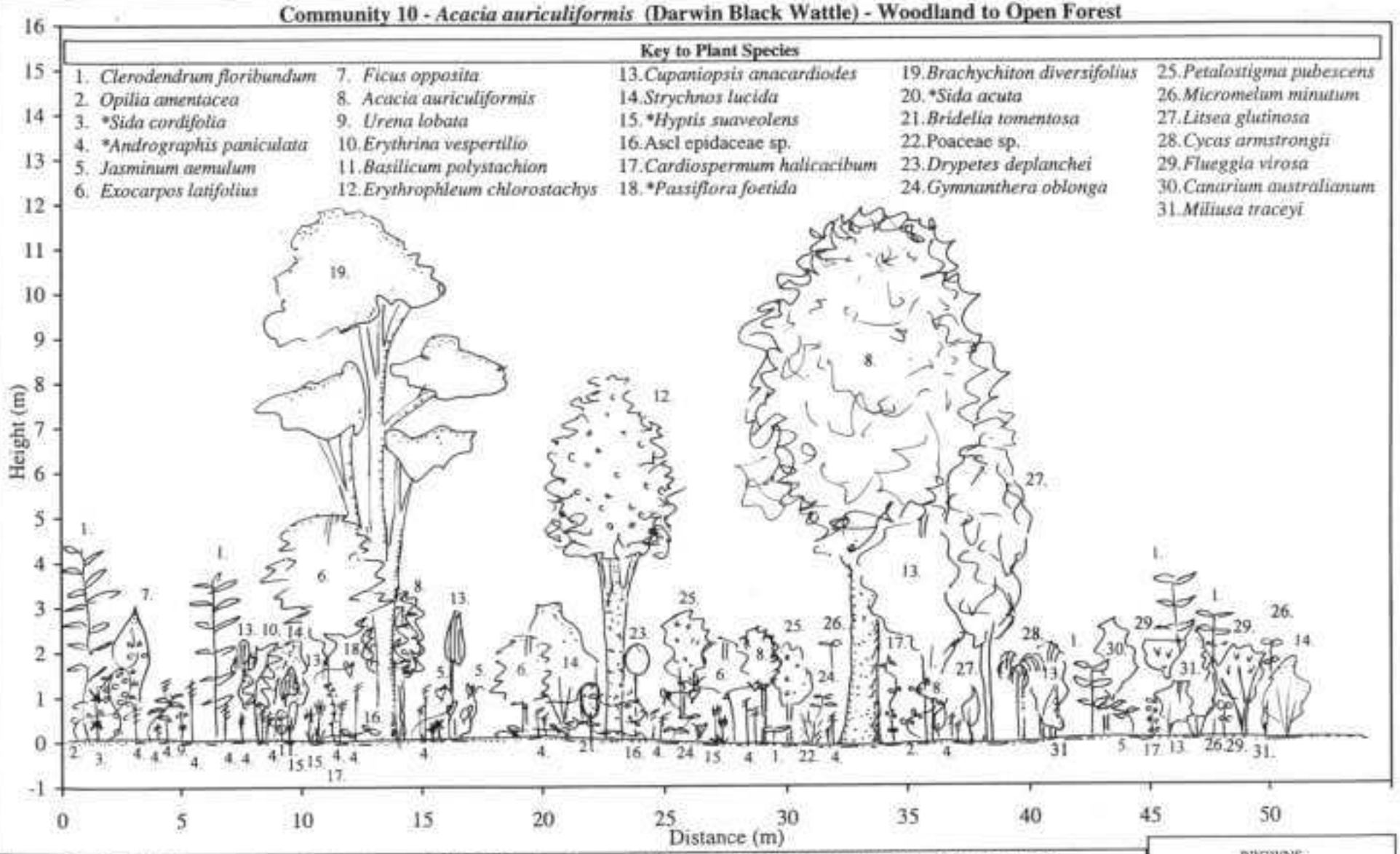


Figure 13 : Profile diagram of vegetation transect (Site 3) in *Acacia auriculiformis* woodland community, at Rum Jungle

APPENDICES

APPENDIX 1

PLANT SPECIES LIST

APPENDIX 1

PLANT SPECIES LIST

Plant species recorded during field surveys of the 37.5 km^2 Browns Project survey area , recorded during 7 site visits between May and August 2002, listed according to Dunlop *et al.* (1995).

*	denotes an introduced species
S	indicates plant species collected for botanical identification by the NT Herbarium
endemic	denotes a species endemic to the Northern Territory (Leach *et.al.*, 1992)
B	denotes a Noxious Weed Class B (Smith 1995)
WONS	Weed of National Significance

DRYLAND AREAS
(115 species)

Map Unit	Species	Family	Conservation status
1	***Eucalyptus phoenicea/Corymbia.bleeseri* Open Woodland (31 species)**		
	Upper stratum		
	Corymbia bleeseri	Myrtaceae	
	Eucalyptus phoenicea	Myrtaceae	
	Erythrophleum chlorostachys	Caesalpiniaceae	
	Eucalyptus miniata	Myrtaceae	
	Eucalyptus sp.	Myrtaceae	
	Eucalyptus tetrodonta	Myrtaceae	
	Owenia vernicosa	Meliaceae	
	Terminalia ferdinandiana	Combretaceae	
	Mid and lower strata		
	Acacia aulacocarpa	Mimosaceae	
	Acacia difficils	Mimoscaeae	
	Acacia oncinocarpa	Mimosaceae	
	Bonamia sp.	Convolvulaceae	
	Borreria sp.	Rubiaceae	
	Buchanania obovata	Anacardiaceae	
	Calytrix extstipulata	Myrtaceae	
	Cartonema spicatum	Commelinaceae	
	Cycas armstrongii	Cycadaceae	
	Eriachne avenaceae	Poaceae	
	Eucalyptus phoenicea	Myrtaceae	
	Eucalyptus sp.	Myrtaceae	
	Exocarpos latifolius	Santalaceae	
	Gomphrena sp.	Amaranthaceae	
	Grevillea decurrens	Proteaceae	endemic
	Grevillea dryandrii	Proteaceae	
	Heteropogon contortus	Poaceae	
	Livistona humilus	Arecaceae	
	Pachynema dilatatum	Dilleniaceae	

Persoonia falcata	Proteaceae
Petalostigma quadriloculare	Euphorbiaceae
Pogonolobus reticulatus	Rubiaceae
Owenia vernicosa	Meliaceae
Poaceae sp.	Poaceae
Stenocarpus cunninghamii	Proteaceae
Sauropus glaucus	Euphorbiaceae
Sorghum sp.	Poaceae
Terminalia ferdinandiana	Combretaceae
Xanthostemon paradoxus	Myrtaceae

Map Unit	Species	Family	Conservation status
2	***Eucalyptus tetrodonata/E.miniata/ Erythrophleum chlorostachys* - Tall open forest to Woodland (63 species)**		
	Upper stratum		
	Alstonia actinophylla	Apocynaceae	
	Brachychiton diversifolius	Sterculiaceae	
	Canarium australianum	Burseraceae	
	Corymbia foelscheana	Myrtaceae	
	Corymbia bleeseri	Myrtaceae	
	Erythrophleum chlorostachys	Caesalpiniaceae	
	Eucalyptus confertiflora	Myrtaceae	
	Eucalyptus miniata	Myrtaceae	
	Eucalyptus tetrodonta	Myrtaceae	
	Mid stratum		
	Acacia auriculiformis	Mimosaceae	
	Acacia difficilis.	Mimosaceae	
	Acacia dimidiata	Mimosaceae	
	Acacia sp.	Mimosaceae	
	Allophylus cobbe	Sapindaceae	
	Alphitonia excelsa	Rhamnaceae	
	Brachychiton megaphyllus	Sterculiaceae	
	Breynia cernua	Euphorbiaceae	endemic
	Bridelia tomentosa	Euphorbiaceae	endemic
	Buchanania obovata	Anacardiaceae	
	Canarium australianum	Burseraceae	
	Cycas armstrongii	Cycadaceae	
	Denhamia obscura	Celastraceae	
	Erythrophleum chlorostachys	Caesalpiniaceae	
	Eucalyptus miniata	Myrtaceae	
	Exocarpos latifolius	Santalaceae	
	Ficus opposita	Moraceae	
	Flueggia virosa	Euphorbiaceae	
	Gardenia megasperma	Rubiaceae	
	Livistona humilis	Arecaceae	endemic
	Pandanus spiralis	Pandanaceae	
	Persoonia falcata	Proteaceae	

Petalostigma pubescens	Euphorbiaceae	
Planchonia careya	Lecythidaceae	
Strychnos lucida	Loganiaceae	
Syzygium suborbicularis	Myrtaceae	
Terminalia ferdinandiana	Combretaceae	
Timonius timon	Rubiaceae	
Trema tomentosa	Ulmaceae	

Lower stratum

* *Andropogon gayanus*	Poaceae	
Ampelocissus acetosa	Vitaceae	
Buchnera ramesissima	Scrophulariaceae	S
Chrysopogon latifolius	Poaceae	
Crotalaria medicaginea	Fabaceae	
Cycas armstrongii	Cycadaceae	
Dioscorea bulbifera	Dioscoreaceae	
Distichostemon hispidulus	Sapindaceae	
Elephantopus scaber	Asteraceae	S
Eriachne sp.	Poaceae	
Eriachne triseta	Poaceae	
Eucalyptus sp.	Myrtaceae	
Flemingia lineata	Fabaceae	S
Flemingia trifoliastrum	Euphorbiaceaee	S
Flueggia virosa	Euphorbiaceae	
Grewia retusifolia	Tiliaceae	
Heteropogon contortus	Poaceae	
Hibbertia sp.	Dilleniaceae	
Hibiscus meraukensis	Malvaceae	S
* *Hyptis suaveolens*	Lamiaceae	B
Jasminum aemulum	Oleaceae	
Opilia amentacea	Opiliaceae	
Pachynema sp.	Dilleniaceae	
Panicum sp.	Poaceae	
Paspalum sp.	Poaceae	
**Passiflora foetida*	Passifloraceae	
**Pennisetum polystachion*	Poaceae	B
Pyncnspora lutescens	Fabaceae	
Smilax australis	Smilacaceae	
Sorghum sp.	Poaceae	
Sorghum stipodeum	Poaceae	
Spermacoce D129311	Rubiaceae	S
Stemodia lythrifolia	Scrophulariaceae	S
Waltheria indica	Sterculiaceae	S

Map Unit	Species	Family	Conservation status
3	***Eucalyptus tetrodonata/E.miniata* Open Woodland (66 species)**		
	Upper stratum		
	Corymbia bleeseri	Myrtaceae	
	Corymbia foelscheana	Myrtaceae	
	Erythrophleum chlorostachys	Caesalpiniaceae	
	Eucalyptus clavigera	Myrtaceae	
	Eucalyptus confertiflora	Myrtaceae	
	Eucalyptus miniata	Myrtaceae	
	Eucalyptus tectifica	Myrtaceae	
	Eucalyptus tetrodonta	Myrtaceae	
	Mid stratum		
	Acacia aulacocarpa	Mimosaceae	
	Acacia difficilis	Mimosaceae	
	Acacia holosericea	Mimosaceae	
	Acacia sp.	Mimosaceae	S
	Alphitonia excelsa	Rhamnaceae	
	Brachychiton megaphyllus	Sterculiaceae	
	Bridelia tomentosa	Euphorbiaceae	
	Buchanania obovata	Anacardiaceae	
	Calytrix exstipulata	Myrtaceae	
	Canarium australianum	Burseraceae	
	Clerodendrum floribundum	Verbenaceae	
	Cochlospermum fraseri	Bixaceae	endemic
	Cycas armstrongii	Cycadaceae	
	Dilichondrone filiformis	Bignoniaceae	
	Erythrophleum chlorostachys	Caesalpiniaceae	
	Eucalyptus miniata	Myrtaceae	
	Eucalyptus sp.	Myrtaceae	
	Exocarpos latifolius	Santalaceae	
	Ficus opposita	Moraceae	
	Ficus platypoda	Moraceae	
	Flueggia virosa	Euphorbiaceae	
	Gardenia megasperma	Rubiaceae	
	Goodenia armstrongiana	Goodeniaceae	S
	Grevillea decurrens	Proteaceae	endemic
	Grevillea pteridifolia	Proteaceae	
	Hakea arborescens	Proteaceae	
	Livistona humilis	Arecaceae	endemic
	**Melinis repens*	Poaceae	
	Owenia vernicosa	Meliaceae	
	Pandanus spiralis	Pandanaceae	
	**Passiflora foetida*	Passifloraceae	
	Persoonia falcata	Proteaceae	
	Petalostigma pubescens	Euphorbiaceae	
	Pittosporum sp.	Pittosporaceae	
	Pouteria sericea	Sapotaceae	

Planchonia careya	Lecythidaceae	
Strychnos lucida	Loganiaceae	
Syzygium suborbicularis	Myrtaceae	
Terminalia ferdinandiana	Combretaceae	
Terminalia grandiflora	Combretaceae	
Trema tomentosa	Ulmaceae	
Xanthostemon paradoxus	Myrtaceae	
Lower stratum		
Acacia sp.	Mimosaceae	
* *Andropogon gayanus*	Poaceae	
Ampelocissus acetosa	Vitaceae	
Borreria sp	Rubiaceae	
Buchnera sp.	Scrophulariaceae	
Cartonema spicatum	Commelinaceae	
Cycas armstrongii	Cycadaceae	
Distichostemon hispidulus	Sapindaceae	
Eriachne avenaceae	Poaceae	S
Eriachne sulcata	Poaceae	S
Flemingia trifoliastrum	Euphorbiaceae	endemic
Heteropogon contortus	Poaceae	
Jasminum aemulum	Oleaceae	
Pachynema dilatatum	Dilleniaceae	
**Pennisetum polystachion*	Poaceae	B
Physalis minima	Solancaeae	
Poaceae sp.	Poaceae	
Pseudopogonantherum sp.	Poaceae	
Sorghum sp.	Poaceae	
Sorghum stipodeum	Poaceae	
Spermacoce sp.	Rubiaceae	
**Stylosanthes hamata*	Fabaceae	
Themeda triandra	Poaceae	
Trachymene didiscoides	Apiaceae	S

Map Unit	Species	Family	Conservation status
4	**Mixed Eucalypt Woodland (55 species)**		
	Upper stratum		
	Alstonia actinophylla	Apocynaceae	
	Bryachychiton diversifolius	Sterculiaceae	
	Corymbia bleeseri	Myrtaceae	
	Cymbidium canaliculatum	Orchidaceae	
	Erythrophleum chlorostachys	Caesalpiniaceae	
	Eucalyptus clavigera	Myrtaceae	
	Eucalyptus miniata	Myrtaceae	
	Eucalyptus tectifica	Myrtaceae	
	Eucalyptus tetrodonta	Myrtaceae	
	Syzygium eucalyptoides ssp. *blesseri*	Myrtaceae	
	Terminalia grandiflora	Combretaceae	
	Xanthostemon paradoxus	Myrtaceae	

Mid stratum		
Acacia difficilis	Mimosaceae	
Erythrophleum chlorostachys	Caesalpiniaceae	
Brachychiton megaphyllus	Sterculiaceae	
Buchanania obovata	Myrtaceae	
Calytrix exstipulata	Myrtaceae	
Cochlospermum fraseri	Bixaceae	endemic
Cycas armstrongii	Cycadaceae	
Erythrophleum chlorostachys	Caesalpiniaceae	
Eucalyptus tectifica	Myrtaceae	
Ficus opposita	Moraceae	
Fleuggia virosa	Euphorbiaceae	
Gardenia megasperma	Rubiaceae	
Grevillea decurrens	Proteaceae	
Livistona humilis	Arecaceae	endemic
Melaleuca viridiflora	Myrtaceae	
Pandanus spiralis	Pandanaceae	
Persoonia falcata	Proteaceae	
**Pennisetum polystachion*	Poaceae	B
Petalostigma pubescens	Euphorbiaceae	
Planchonia careya	Lecythidaceae	
Pogonolobus reticulatus	Rubiaceae	
Terminalia ferdinandiana	Combretaceae	
Terminalia grandiflora	Combretaceae	
Xanthostemon paradoxus	Myrtaceae	
Lower stratum		
Ampelocissus acetosa	Vitaceae	
* *Andropogon gayanus*	Poaceae	
Borreria sp.	Rubiaceae	
Chysopogon latifolius	Poaceae	
Crotalaria medicaginea	Fabaceae	
Cycas armstrongii	Cycadaceae	
Distichostemon hispidulus	Sapindaceae	
Eriachne stipacea	Poaceae	S
Eriachne sulcata	Poaceae	
Eriachne triseta	Poaceae	S
Flemingia trifoliastrum	Fabaceae	endemic
Gomphrena sp.	Amaranthaceae	
Heteropogon contortus	Poaceae	S
* *Hyptis suaveolens*	Lamiaceae	B
Pachynema complanatum	Dilleniaceae	endemic
**Passiflora foetida*	Passifloraceae	
**Pennisetum pedicellatum*	Poaceae	
**Pennisetum poystachion*	Poaceae	B
Petalostigma quadriloculare	Euphorbiaceae	
Poaceae sp. 1	Poaceae	
Poaceae sp. 2	Poaceae	
Poaceae sp. 3	Poaceae	
Poaceae sp. 4	Poaceae	

Pycnospora lutescens	Fabaceae	S
**Sida acuta*	Malvaceae	B
**Sida cordifolia*	Malvaceae	B
Smilax australis	Smilacaceae	
Sorghum sp.	Poaceae	
Sorghum stipodeum	Poaceae	
Themeda triandra	Poaceae	

DRAINAGE AREAS
(142 species)

Map Unit	Species	Family	Conservation status
5	**Riparian corridor (99 species)**	**Closed forest to open woodland**	
	Upper and mid strata		
	Acacia auriculiformis	Mimosaceae	
	Acacia holosericea	Mimosaceae	
	Acacia sp.	Mimosaceae	
	Alphitonia excelsa	Rhamnaceae	
	Alstonia actinophylla	Apocynaceae	
	Antidesma ghesaembilla	Euphorbiaceae	
	Bambusa arnhemica	Poaceae	endemic
	Barringtonia acutangula	Lecythidaceae	
	Brachychiton diversifolius	Sterculiaceae	
	Breynia cernua	Euphorbiaceae	endemic
	Buchanania arborescens	Anacardiaceae	
	Canarium australianum	Burseraceae	
	Canthium schultzii	Rubiaceae	endemic
	Carallia brachiata	Rhizophoraceae	
	Clerodendrum foribundum	Verbenaceae	
	Corymbia polycarpa	Myrtaceae	
	Cupaniopsis anacardiodes	Sapindaceae	
	Diospyros calycantha	Ebenaceae	
	Drypetes deplancei	Euphorbiaceae	
	Eleaocarpus arnhemicus	Elaeocarpaceae	
	Erythrina vespertilio	Fabaceae	
	Erythrophleum chlorostachys	Caesalpiniaceae	
	Eucalyptus papuana	Myrtaceae	
	Ficus hispida	Moraceae	
	Ficus opposita	Moraceae	
	Ficus racemosa	Moraceae	
	Flueggia virosa	Euphorbiaceae	
	Ixora klanderiana	Rubiaceae	
	Leptospermum longifolium	Myrtaceae	
	**Leucaena leucocephala*	Mimosaceae	
	Litsea glutinosa	Lauraceae	
	Lophostemon grandiflorus	Myrtaceae	
	Lophostemon lactifluus	Myrtaceae	
	**Mangifera indica*	Anacardiaceae	

Maranthes corymbosa	Chrysobalanaceae	
Melaleuca cajuputji	Myrtaceae	
Melaleuca leucadendra	Myrtaceae	
**Mimosa pigra*	Mimosaceae	A/B, WONS
Nauclea orientalis	Rubiaceae	
Pandanus aquaticus	Pandanaceae	
Pandanus spiralis	Pandanaceae	
Petalostigma pubescens	Euphorbiaceae	
Sterculia quadrifida	Sterculiaceae	
Strychnos lucida	Loganiaceae	
Syzygium armstrongii	Myrtaceae	
Syzygium nervosum	Myrtaceae	
Terminalia carpentariae	Combretaceae	
Terminalia microcarpa	Combretaceae	
Timonius timon	Rubiaceae	
Vavaea australiana	Meliaceae	

Lower Stratum

**Ageratum conyzoides*	Asteraceae	S
**Androphogon gayanus*	Poaceae	
Asclepidaceae sp.	Asclepidaceae	
Basilicum polystachion	Lamiaceae	
Bridelia tomentosa	Euphorbiaceae	endemic
**Calopogonium mucunoides*	Fabaceae	
Canscora diffusa	Gentianaceae	S
Cayratia trifoliata	Vitaceae	
**Centrosema molle*	Fabaceae	
Chrysopogon latifolius	Poaceae	
Cleome viscosa	Capparaceae	
**Echinochloa colona*	Poaceae	S
Eleocharis geniculata	Cyperaceae	S
Ficus racemosa	Moraceae	
Flagellaria indica	Flagellariaceae	
Grewia retusifolia	Tiliaceae	
Helicteres hirsuta	Sterculiaceae	
Heteropogon contortus	Poaceae	S
**Hyptis suaveolens*	Lamiaceae	B
Ischaemum australe	Poaceae	
Ixora timorensis	Rubiaceae	
Ludwigia octovalvis	Onagraceae	S
Merremia hederacea	Convolvulaceae	
Nelsonia campestris	Acanthaceae	S
Opilia amentaceae	Opiliaceae	
Pandanus spiralis	Pandanaceae	
Panicum sp.	Poaceae	
**Passiflora foetida*	Passifloraceae	
**Pennisetum pedicellatum*	Poaceae	
**Pennisetum polystachion*	Poaceae	B
Phragmites vallatoria	Poaceae	S
**Pityrogramma colomelanos*	Hemionitidaceae	
Poaceae sp.	Poaceae	

Protoasparagus racemosus	Liliaceae	
Pseudoraphis spinescens	Poaceae	
**Senna obtusifolia*	Caesalpineaceae	B
**Sida acuta*	Malvaceae	B
**Stachytarpheta cayennensis*	Verbenaceae	B
**Stachytarpheta jamaicensis*	Verbenaceae	B
Urena lobata	Malvaceae	
**Urochloa mutica*	Poaceae	S

AQUATIC & WETLAND SPECIES
(19 species)

Ammania baccifera	Lythraceae	S
Blyxa aubertii	Hydrocharitaceae	S
Cyperus aquatilis	Cyperaceae	
Cyperus haspan	Cyperaceae	S
Colocasia esculenta	Araceae	S
* *Eclipta* D78475 GOVE	Asteraceae	S
**Echinochloa colona*	Poaceae	
Eleocharis geniculata	Cyperaceae	S
Fiurena ciliaris	Cyperaceae	
Hygrophila angustifolia	Acanthaceae	S
Ludwigia octovalvis	Onagraceae	S
Lymnophila fragrans	Scrophulariaceae	
Nelsonia campestris	Acanthaceae	S
Nymphaea violaceae	Nymphaeaceae	S
Nymphoides indica	Menyanthaceae	
Persicaria attenuata	Polygonaceae	S
Persicaria barbata	Polygonaceae	S
Phragmites vallatoria	Poaceae	S
Staurogyne leptocaulis	Acanthaceae	S

Map Unit	Species	Family	Conservation status
6	***Lophostemon* communities (35 species) Open woodland to grassland**		
	Upper stratum		
	Buchanania obovata	Anacardiaceae	
	Eucalyptus papuana	Myrtaceae	
	Lophostemon grandiflorus	Myrtaceae	
	Lophostemon lactifluus	Myrtaceae	
	Melaleuca dealbata	Myrtaceae	
	Melaleuca nervosa	Myrtaceae	
	Melaleuca cajuputi	Myrtaceae	
	Melaleuca leucadendra	Myrtaceae	
	Melaleuca viridiflora	Myrtaceae	
	Pandanus spiralis	Pandanaceae	
	Terminalia microcarpa	Combretaceae	
	Timonius timon	Rubiaceae	

Mid stratum		
Acacia auriculiformis	Mimosaceae	
Ixora klanderiana	Rubiaceae	
Livistona humilis	Arecaceae	endemic
Lophostemon grandiflorus	Myrtaceae	
Melaleuca viridiflora	Myrtaceae	
Pandanus spiralis	Pandanaceae	
Planchonia careya	Lecythidaceae	
Timonius timon	Rubiaceae	
Lower stratum		
*Ageratum conyzoides	Asteraceae	
**Andropogon gayanus*	Poaceae	
**Calopogonium mucunoides*	Fabaceae	
Canscora diffusa	Gentianaceae	
**Cyanthillium cinereum*	Asteraceae	
Eriachne burkittii	Poaceae	
Fimbristylis littoralis	Cyperaceae	S
Flemingia lineata	Fabaceae	
Fuirena ciliaris	Cyperaceae	
Gymnanthera oblonga	Asclepidaceae	
Helicteres hirsuta	Sterculiaceae	
Heteropogon contortus	Poaceae	S
**Hyptis suaveolens*	Lamiaceae	B
Ipomoea sp.	Convolulaceae	
Ischaemum australe	Poaceae	
Nelsonia campestris	Acanthaceae	
**Pennisetum polystachion*	Poaceae	B
Sporobolis pyramidalis	Poaceae	
**Stachytarpheta cayennensis*	Verbenaceae	

Map Unit	Species	Family	Conservation status
7	***Eucalyptus papuana /Corymbia foelscheana/ Melaleuca* spp. Open Woodland (51 species)**		
	Upper stratum		
	Acacia aruiculiformis	Mimosaceae	
	Brachychiton diversifolius	Sterculiaceae	
	Canarium australianum	Burseraceae	
	Corymbia foelscheana	Myrtaceae	
	Corymbia polycarpa	Myrtaceae	
	Corymbia grandifolius	Myrtaceae	
	Eucalyptus clavigera	Myrtacea	
	Eucalyptus tectifica	Myrtacea	
	Eucalyptus papuana	Myrtacea	
	Lophostemon grandiflorus	Myrtaceae	
	Lophostemon lactifluus	Myrtaceae	
	Melaleuca dealbata	Myrtaceae	

Melaleuca nervosa	Myrtaceae	
Melaleuca cajuputi	Myrtaceae	
Melaleuca viridiflora	Myrtaceae	
Pandanus spiralis	Pandanaceae	
Terminalia microcarpa	Combretaceae	
Terminalia grandiflora	Combretaceae	

Mid stratum

Barringtonia acutangula	Lecythidaceae	
Breynia cernua	Euphorbiaceae	endemic
Fleuggia virosa	Euphorbiaceae	
Grewia retusifolia	Tiliaceae	
Livistona humilus	Arecaceae	endemic
Pandanus spiralis	Pandanaceae	
Petalostigma pubescens	Euphorbiaceae	
Syzygium eucalyptoides ssp. *bleeseri*	Myrtaceae	
Timonius timon	Rubiaceae	

Lower stratum

Ampleocissus acetosa		
**Andropogon gayanus.*	Poaceae	
Bothriochloa bladhii ssp. bladhii	Poaceae	
**Calopogonium mucunoides*	Fabaceae	
Cartonema spicatum	Commelinaceae	
Chrysopogon latifolius	Poaceae	
**Crotalaria goreensis*	Fabaceae	
Eucalyptus sp.	Myrtaceae	
Galactia tenuiflora	Fabaceae	
Grewia retusifolia	Tiliaceae	
Heteropogon contortus	Poaceae	
Helicteres hirsuta	Sterculiaceae	
**Hyptis suaveolens*	Lamiaceae	B
Ipomoea graminea	Convolvolaceae	
Ischaemum australe	Poaceae	
Pachynema dilatatum	Dilleniaceae	endemic
Panicum maximum var. *coloratum*	Poaceae	
**Passiflora foetida*	Passifloraceae	
**Pennisetum polystachion*	Poaceae	B
Protoasparagus racemosa	Liliaceae	
Pseudoraphis spinescens	Poaceae	
Smilax australis	Smilacaceae	
**Stylosanthes guineaensis*	Fabaceae	
**Stylosanthes hamata*	Fabaceae	
Themeda triandra	Poaceae	
**Urochloa mutica*	Poaceae	
**Urochloa subquadripara*	Poaceae	

Map Unit	Species	Family	Conservation status
8	**Paperbark (*Melaleuca*) Woodland Open Woodland (50 species)**		
	Upper stratum		
	Acacia auriculiformis	Mimosaceae	
	Corymbia grandifolia	Myrtaceae	
	Eucalyptus papuana	Myrtaceae	
	Erythrophleum chlorostachys	Caesalpiniaceae	
	Lophostemon grandiflorus	Myrtaceae	
	Lophostemon lactifluus	Myrtaceae	endemic
	Melaleuca cajuputji	Myrtaceae	
	Melaleuca dealbata	Myrtaceae	
	Melaleuca leucadendra	Myrtaceae	
	Melaleuca viridiflora	Myrtaceae	
	Planchonia careya	Lecythidaceae	
	Pandanus spiralis	Pandanaceae	
	Terminalia grandiflora	Combretaceae	
	Terminalia microcarpa	Combretaceae	
	Mid stratum		
	Acacia auriculiformis		
	Antidesma ghaesembila	Euphorbiaceae	
	Breynia cernua	Euphorbiaceae	
	Buchania obovata	Anacardiaceae	
	Ficus opposita	Moraceae	
	Lophostemon grandiflorus	Myrtaceae	
	Melaleuca cajuputji	Myrtaceae	
	Melaleuca dealbata	Myrtaceae	
	Melaleuca leucadendra	Myrtaceae	
	Pandanus spiralis	Pandanaceae	
	Planchonia careya	Lecythidaceae	
	Timonius timon	Rubiaceae	
	Lower stratum		
	**Ageratum conyzoides*	Asteraceae	S
	*Andropogon gayanus	Poaceae	
	**Calopogonium mucunoides*	Fabaceae	
	**Centrosema molle*	Fabaceae	
	Digitaria ciliaris	Poaceae	S
	Drosera indica	Droseraceae	
	**Echinochloa colona*	Poaceae	S
	Ectrosia leporina	Poaceae	
	Eriachne burkittii	Poaceae	S
	Eriachne sp.	Poaceae	S
	Fimbristylis dichotoma	Cyperaceae	S
	Fimbristylis littoralis	Cyperaceae	S
	Fimbristylis pauciflora	Cyperaceae	S
	Fimbristylis sp.	Cyperaceae	
	Gymnanthera oblonga	Asclepidaceae	

Heteropogon contortus	Poaceae	
**Hyptis suaveolens*	Lamiaceae	B
Ischaemum australe	Poaceae	
Limnophila fragrans	Scrophulariaceae	
Ludwigia hyssopifolia	Onagraceae	
Pandanus spiralis	Pandanaceae	
Paspalum scrobiculatum	Poaceae	S
**Passiflora foetida*	Passiforaceae	
**Pennisetum pedicellatum*	Poaceae	
Poaceae sp.	Poaceae	
Rhyncospora sp.	Cyperaceae	
Sorghum sp.	Poaceae	
Smilax australis	Smilacaceae	
Sporobolus pyramidalis	Poaceae	
**Stachytarpheta* sp.	Verbenaceae	B
Stephania japonica	Menispermaceae	
Themeda triandra	Poaceae	
Urena lobata	Malvaceae	
**Pennisetum polystachion*	Poaceae	B
**Urochloa mutica*	Poaceae	

MONSOON VINE-FORESTS
(113 species)

Map Unit	Species	Family	Conservation status
9	**Monsoon Vine-forest - Closed forest to open forest (56 species)**		
	Upper stratum		
	Acacia auriculiformis	Mimosaceae	
	Buchanania arborescens	Anacardiaceae	
	Canarium australianum	Burseraceae	
	Carpentaria acuminata	Arecaceae	endemic
	Erythrophleum chlorostachys	Caesalpiniaceae	
	Ficus racemosa	Moraceae	
	Ficus virens	Moraceae	
	Gmelina schlechteri	Verbenaceae	
	Lophostemon grandiflorus	Myrtaceae	
	Maranthes corymbosa	Chrysobalanaceae	
	Melaleuca cajuputji	Myrtaceae	
	Mellicope elleryana	Rutaceae	
	Nauclea orientalis	Rubiaceae	
	Pongamia pinnata	Fabaceae	
	Sterculia holtzei	Sterculiaceae	endemic
	Syzygium minutuliflorum	Myrtaceae	endemic
	Syzygium nervosum	Myrtaceae	
	Terminalia microcarpa	Combretaceae	

Mid stratum

Acacia auriculiformis	Mimosaceae	
Bambusa arnhemica	Poaceae	endemic
Buchanania arborescens	Anacardiaceae	
Breynia cernua	Euphorbiaceae	endemic
Callophyllum sil	Clusiaceae	
Callophyllum soulattri	Clusiaceae	
Canarium australianum	Burseraceae	
Carpentaria acuminata	Arecaceae	endemic
Embelia curvinervia	Myrsinaceae	S
Exocarpos latifolius	Santalaceae	
Ficus hispida	Moraceae	
Ficus opposita	Moraceae	
Flagellaria indica	Flagellariaceae	
Gmelina schlechteri	Verbenaceae	
Ixora klanderiana	Rubiaceae	
Ixora timorensis	Rubiaceae	
Litsea glutinosa	Lauraceae	
Livistona humilus	Arecaceae	endemic
Micromelum minutum	Rutaceae	
Myristica insipida	Myristicaceae	
Pandanus aquaticus	Pandanaceae	
Pandanus spiralis	Pandanaceae	
Pleomele angustifolia	Agavaceae	
Sterculia quadrifida	Sterculiaceae	
Syzygium nervosum	Myrtaceae	
Terminalia microcarpa	Combretaceae	
Terminalia sp.	Combretaceae	
Timonius timon	Rubiaceae	
Vavaea australiana	Meliaceae	

Lower stratum

Adenia heterophylla	Passifloraceae	
**Calopogonium mucunoides*	Fabaceae	
Capparis sepiaria	Capparaceae	
**Centrosema molle*	Fabaceae	
Flemingia lineata	Fabaceae	
**Hyptis suaveolens*	Lamiaceae	B
Leea indica	Leeaceae	
Marsdenia velutina	Asclepidaceae	
Microsorum grossum	Polypodiaceae	
Opilia amentaceae	Opiliaceae	
Parsonsia velutina	Apocynaceae	S
**Passiflora foetida*	Passiforaceae	
**Pennisetum polystachion*	Poaceae	B
**Sida acuta*	Malvaceae	B
Smilax australis	Smilacaceae	
**Stachytarpheta* sp.	Verbenaceae	B
Urena lobata	Malvaceae	

Map Unit	Species	Family	Conservation status
10	***Acacia auriculiformis* communities – Woodland to open forest (89 species)**		
	Upper stratum		
	Acacia auriculiformis	Mimosaceae	
	Alstonia actinophylla	Apocynaceae	
	Amorphophallus galbra	*Araceae*	
	Brachychiton diversifolius	Sterculiaceae	
	Canarium australianum	Burseraceae	
	Cupaniopsis anacardiodes	Sapindaceae	
	Erythrophleum chlorostachys	Caesalpiniaceae	
	Eucalyptus papuana	Myrtaceae	
	Eucalyptus tetrodonta	Myrtaceae	
	Ficus platypoda	Moraceae	
	Ficus racemosa	Moraceae	
	Ficus virens	Moraceae	
	Ganophyllum falcatum	Sapindaceae	
	* *Mangifera indica*	Anacardiaceae	
	Nauclea orientalis	Rubiaceae	
	Pouteria sericea	Sapotaceae	
	Syzygium suborbicularis	Myrtaceae	
	Terminalia microcarpa	Combretaceae	
	Timonius timon	Rubiaceae	
	Mid stratum		
	Acacia auriculiformis	Mimosaceae	
	Alphitonia excelsa	Rhamnaceae	
	Antidesma ghaesembilla	Euphorbiaceae	
	Bambusa arnhemica	Poaceae	endemic
	Brachychiton diversifolius	Sterculiaceae	
	Breynia cernua	Euphorbiaceae	endemic
	Bridelia tomentosa	Euphorbiaceae	endemic
	Calytrix exstipulata	Myrtaceae	
	Canarium australianum	Burseraceae	
	Celtis philippensis	Ulmaceae	
	Clerodendrum floribundum	Verbenaceae	
	Croton argyratus	Euphorbiaceae	
	Cycas armstrongii	Cycadaceae	
	Cupaniopsis anacardiodes	Sapindaceae	
	Denhamia obscura	Celastraceae	
	Drypetes deplanchei	Euphorbiaceae	
	Embelia curvinervia	Myrsinaceae	
	Erythrina vespertilio	Fabaceae	
	Erythrophleum chlorostachys	Caesalpiniaceae	
	Exocarpos latifolius	Santalaceae	
	Ficus opposita	Moraceae	
	Ficus platypoda	Moraceae	
	Ficus virens	Moraceae	
	Flacourtia territorialis	Flacourtiaceae	endemic

Flueggia virosa	Euphorbiaceae	
Glycosmis trifoliata	Rutaceae	
Grevilllea pteridifolia	Proteaceae	
Helicteres isora	Sterculiaceae	S
Ixora klanderiana	Rubiaceae	
Litsea glutinosa	Lauraceae	
Livistona humilis	Arecaceae	endemic
Micromelum minutum	Rutaceae	
Miliusa traceyi	Annonaceae	
Mallotus philippensis	Euphorbiaceae	S
Pandanus spiralis	Pandanaceae	
Petalostigma pubescens	Euphorbiaceae	
Pleomele angustifolia	Agavaceae	
Polyalthia australis	Annonaceae	
Sterculia quadrifida	Sterculiaceae	
Strychnos lucida	Loganiaceae	
**Tecoma stans*	Bignoniaceae	S
Trema tomentosa	Ulmaceae	
Terminalia microcarpa	Combretaceae	
Wrightia pubescens	Apocynaceae	

Lower stratum

Abrus precatorius	Fabaceae	
Ampelocissus acetosa	Vitaceae	
**Andrographis paniculata*	Acanthaceae	S
* *Andropogon gayanus*	Poaceae	
Asclepidaceae *sp.*	Asclepidaceae	
Basilicum polystachion	Lamiaceae	S
**Calopogonium mucunoides*	Fabaceae	
Capparis sepiaria	Capparaceae	
Cardiospermum halicacibum	Sapindaceae	
**Cassia obtusifolia*	Caesalpiniaceae	
Flemingia lineata	Fabaceae	S
Flemingia sp.	Fabaceae	S
Flueggia virosa	Euphorbiaceae	
Gymnanthera oblonga	Asclepidaceae	
Hypoestes floribunda	Acanthaceae	
**Hyptis suaveloens*	Lamiaceae	B
Jasminum aemulum	Oleaceae	
Livistona humilis	Arecaceae	endemic
Opilia amentacea	Opliaceae	
Parsonsia velutina	Apocynaceae	S
* *Passiflora foetida*	Passiforaceae	
**Pennisetum pedicellatum*	Poaceae	
**Pennisetum polystachion*	Poaceae	B
**Physalis minima*	Solancaeae	S
Poaceae sp A	Poaceae	
Protoasparagus racemosa	Liliaceae	
**Senna obtusifolia*	Caesalpiniaceae	
**Sida acuta*	Malvaceae	
**Sida cordifolia*	Malvaceae	S

Smilax australis	Smilacaceae	
Sorghum sp.	Poaceae	
**Stachytarpheta* sp.	Verbenaceae	B
Stephania japonica	Menispermaceae	
Sterculia quadrifida	Sterculiaceae	
**Stylosanthes guineaensis*	Fabaceae	S
Tinospora smilacina	Menispermaceae	S
Urena lobata	Malvaceae	
Vigna lanceolata	Fabaceae	S

DISTURBED HABITATS

Map Unit	Species	Family	
11	**Previous mining areas, disturbed sites & rehabilitation areas (25 species)**		
	Acacia auriculiformis	Mimosaceae	
	Acacia difficilus	Mimosaceae	
	Acacia holosericea	Mimosaceae	
	Acacia mountfordiae	Mimosaceae	
	**Bidens bipinnata*	Asteraceae	
	Calytrix acheata	Myrtaceae	
	Chrysopogon latifolius	Poaceae	
	**Crotalaria goreensis*	Fabaceae	
	**Echinochloa colona*	Poaceae	
	Heteropogon contortus	Poaceae	
	**Hibiscus subdariffa*	Malvaceae	
	**Hyptis suaveloens*	Lamiaceae	B
	**Melinus repens*	Poaceae	
	* *Passiflora foetida*	Passiforaceae	
	**Pennisetum polystachion*	Poaceae	B
	**Pennisetum pedicellatum*	Poaceae	
	Petalostigma quadriloculare	Euphorbiaceae	
	**Sida acuta*	Malvaceae	
	Sorghum intrans	Poaceae	
	Sorghum stipodeum	Poaceae	
	**Stylosanthes guineaensis*	Fabaceae	
	**Stylosanthes hamata*	Fabaceae	
	Themeda quadrivalvis	Poaceae	B
	Themeda triandra	Poaceae	
	Urochloa subquadripara	Poaceae	

APPENDIX 2

PHOTOGRAPHS

DRYLAND COMMUNITIES

Community 1 - *Eucalyptus phoenicea/Corymbia bleeseri* open woodland occupies 23ha (0.5%) of the Browns Project survey area, occurring on rocky crests of low hills

Community 2- *Eucalyptus tetrodonta/E. miniata/*Ironwood open forest occurs on deeper soils of low plateau surfaces and occupies 229 ha (6%) of the Browns Project survey

DRYLAND COMMUNITIES cont.

Community 3 : *Eucalyptus tetrodonta/E. miniata* open woodland is the most extensive plant community within the survey area occupying 1,915 ha (59%) of the site. Also known as savanna, this community is common and widespread in the region generally.

Community 4 : Mixed Eucalypt woodland occurs on shallow, rocky soils and is characterised by variable dominance of upper stratum species. This community is of limited extent in the survey area, occupying less than 2% (69 ha).

DRAINAGE AREAS

Community 5 : Riparian corridor on the degraded East Finniss River downstream of the Rum Jungle mine. The broad, rocky to sandy channel is fringed by a narrow band of riverine species including *Pandanus spiralis, Nauclea orientalis* and *Acacia auriculiformis.* Algae visible in the foreground is the only aquatic species present.

Community 5 : Riparian corridor surrounding Rum Jungle Creek comprising linear swathe of riverine species. Community 5 occupies 124 ha (3%) of the survey area.

DRAINAGE AREAS cont.

Community 5: Riparian corridor, Finniss River. River banks are heavily vegetated with trees to 20m including *Ficus* and *Syzygium* spp. and Bamboo common in the mid stratum.

Community 5: Riparian corridor, Finniss River. The Finniss is a larger drainage system than Rum Jungle Ck and the East Branch, having extensive floodplains and several permanent billabongs (above). Riparian communities were the most diverse habitats, with a total of 99 species from 48 families recorded from within the survey area.

DRAINAGE AREAS cont.

Community 6: In seasonally inundated floodplain habitats *Lophostemon grandiflorus* communities occur with dense *Ischaemum* grassland. In upstream areas *Lophostemon lactifluus* woodlands surround minor drainage lines and both total an area of 228ha (6%)

.

Community 7: *Eucalyptus papuana/Corymbia foelschena/Melaleuca* open woodlands occur on broad, poorly drained flats surrounding drainage lines. Characterised by highly variable species composition this community occupies 485 ha (13%) of the survey area.

DRAINAGE AREAS cont.

Community 8: Paperbark (*Melaleuca* spp.) woodlands at Fauna Site 7 occur as isolated pockets in seasonally wet lowland terrain. Paperbark forests vary in extent, dominance (*Melaleuca dealbata* above)and structure in response to variations in soils and drainage.

Community 8: Paperbark communities cover less than 2% of the project area (66 ha) . *Melaleuca leucadendra* and *M. viridiflora* woodland near Dyson's overburden heap (Site 4) contains the smothering introduced vine species *Calopogonium mucunoides.*

MONSOON FOREST COMMUNITIES

Community 9: Evergreen monsoon vine-forest occurring on springs near Mt Burton with diverse, closed canopy forests to 20m **.** Overall vine- forests occupy 32 ha (1%) of the survey area and represent areas of environmental sensitivity and ecological value.

Community 10: *Acacia auriculiformis* (Black Wattle) communities are floristically rich vine-forest assemblages in drier habitats and cover 248 ha (7%) of the survey area.

DISTURBED AREAS

Map Unit 11: Extensive areas of disturbed vegetation occupy 324 ha (9%)the survey area

Mission Grass (*Pennisetum polystachion)* a Class B noxious weed common in disturbed sites within the survey area, particularly along roadsides and fringing vine- forest habitats. Future weed management will include measures to avoid the proliferation and to control the introduction and spread of Class B weeds.

Dense infestation of Gamba grass (*Andropogon gayanus)* in riparian habitat near Rum Jungle Creek. Although not a declared species, Gamba Grass is recognised as a serious environmental weed and fire management hazard.

DISTURBED AREAS cont.

Gamba Grass (*Andropogon gayanus*) is widespread in the Batchelor region and forms dense monospecific stands 3-4 m tall in disturbed habitats within the survey area. Selective control of this species within the Browns survey area is recommended as part of future fire and weed management strategies**.**

The **East Branch of the Finniss River** receives acid mine drainage from the Rum Jungle mine and during the last decade has been the focus of intensive research on the mining impacts and rehabilitation. Channel morphology and riparian vegetation indicate habitat degradation and the river bed contains abundant white residue (sulphate salt efflorescence) observed several kilometres downstream of the mine.

APPENDIX 3

PLANT SPECIES LIST for BROWNS PROJECT SURVEY AREA

NORTHERN TERRITORY HERBARIM DATABASE

APPENDIX 3

PLANT SPECIES LIST

Plant species recorded in the Northern Territory Herbarium database that occur within the Browns Polymetallic Project survey area. The following list of 89 species was extracted from the NT Herbarium database in August 2002 .

TAXON_NAME	COLLECTOR	VOUCHER_NO	COLLN_DATE
ACANTHACEAE Hypoestes floribunda R.Br.	Maconochie, J.R.	335	5/06/1967
AIZOACEAE Trianthema rhynchocalyptra F.Muell.	Byrnes, N.B.	46	10/01/1967
AIZOACEAE Trianthema rhynchocalyptra F.Muell.	Jensen	18648	31/03/1989
AIZOACEAE Trianthema rhynchocalyptra F.Muell.	Byrnes, N.B.	46	10/01/1967
AMARANTHACEAE Gomphrena atrorubra J.Palmer	Jackson, E.N.	853	13/05/1967
AMARANTHACEAE Ptilotus corymbosus R.Br.	Cole, M.	507	- -
ANACARDIACEAE Blepharocarya depauperata Specht	Hearne, D.A.	1491	10/08/1977
ANACARDIACEAE Buchanania arborescens (Blume) Blume	Tindale, M.D.	10178	9/08/1989
ANNONACEAE Miliusa brahei (F.Muell.) Jessup	Forster, B.A.		1/11/1973
APOCYNACEAE Wrightia pubescens R.Br.	Maconochie, J.R.	337	5/06/1967
ARACEAE Amorphophallus galbra F.M.Bailey	Byrnes, N.B.		21/11/1967
ARACEAE Amorphophallus galbra F.M.Bailey	Byrnes, N.B.	546	21/11/1967
ARACEAE Amorphophallus paeoniifolius (Dennst.) Nicolson	Byrnes, N.B.	NB1661	14/05/1969
ARACEAE Amorphophallus paeoniifolius (Dennst.) Nicolson	Anonymous		1/10/1967
ARECACEAE Livistona humilis R.Br.	Maconochie, J.R.	339	5/06/1967
ASCLEPIADACEAE Marsdenia velutina R.Br.	Byrnes, N.B.	54	10/01/1967
ASCLEPIADACEAE Tylophora erecta F.Muell. ex Benth.	Blake, S.T.	16731	8/08/1946
ASTERACEAE Ageratum conyzoides L.	Chippendale, G.M.	4372	23/05/1958
ASTERACEAE Eleutheranthera ruderalis (Sw.) Sch.Bip.	Russell-Smith, J.	8071	7/06/1989
CARYOPHYLLACEAE Polycarpaea longiflora F.Muell.	Ridley, W.F.	10	13/04/1967
CARYOPHYLLACEAE Polycarpaea violacea (Mart.) Benth.	Cole, M.	508	- -

CONVOLVULACEAE Ipomoea polymorpha Roem. & Schult.	Byrnes, N.B.	1288	19/01/1969
CYPERACEAE Fimbristylis acicularis R.Br.	Nelson, D.J.	1142	12/06/1964
DILLENIACEAE Hibbertia lepidota R.Br. ex DC.	McKean, J.L.		4/04/1973
DILLENIACEAE Pachynema sphenandrum F.Muell. & Tate	Cowie, I.D.	5252	3/03/1995
EUPHORBIACEAE Antidesma	Blake, S.T.	16157	26/06/1946
EUPHORBIACEAE Antidesma ghesaembilla Gaertn.	Blake, S.T.	16517	26/06/1946
EUPHORBIACEAE Breynia cernua (Poir.) Mull.Arg.	Byrnes, N.B.	45	10/01/1967
EUPHORBIACEAE Euphorbia schizolepis F.Muell. ex Boiss.	Byrnes, N.B.	50	10/01/1967
FABACEAE Canavalia papuana Merr. & L.M.Perry	Russell-Smith, J.	8070	7/06/1989
FABACEAE Crotalaria brevis Domin	Byrnes, N.B.	48	10/01/1967
FABACEAE Crotalaria brevis Domin	Byrnes, N.B.	48	10/01/1967
FABACEAE Cullen badocanum (Blanco) J.W.Grimes	Cole, M.	105	- -
FABACEAE Desmodium brownii Schindl.	Cowie, I.D.	1587	15/03/1991
FABACEAE Flemingia D39269 sericea	Blake, S.T.	16726	8/07/1946
FABACEAE Flemingia trifoliastrum Domin	Ridley, W.F.	8	13/04/1967
FABACEAE Pycnospora lutescens (Poir.) Schindl.	Muspratt, J.S.	138	8/03/1963
FABACEAE Tephrosia lamproloboides F.Muell.	Blake, S.T.	16734	8/08/1946
FABACEAE Tephrosia lamproloboides F.Muell.	Blake, S.T.	16734	8/08/1946
FABACEAE Tephrosia nematophylla F.Muell.	Chippendale, G.M.	7750	18/03/1961
FABACEAE Tephrosia porrecta R.Br. ex Benth.	Cowie, I.D.	1421	23/11/1990
FABACEAE Uraria lagopodioides (L.) Desv. ex DC.	Muspratt, J.S.	111	8/03/1963
GOODENIACEAE Goodenia holtzeana (Specht) Carolin	Chippendale, G.M.	4360	22/05/1958
GOODENIACEAE Goodenia holtzeana (Specht) Carolin	Cowie, I.D.	1582	15/03/1991
MELASTOMATACEAE Osbeckia australiana Naudin	Bateman, W.		9/09/1950
MELASTOMATACEAE Osbeckia australiana Naudin	Bateman, W.		1/06/1950
MENISPERMACEAE	Russell-Smith, J.		1/01/1990
MIMOSACEAE Acacia gonocarpa F.Muell.	Byrnes, N.B.	47	10/01/1967
MIMOSACEAE Acacia multisiliqua (Benth.) Maconochie	Cowie, I.D.	5253	3/03/1995
MIMOSACEAE Acacia torulosa Benth. ex F.Muell.	Tindale, M.D.	10177	9/08/1989
MORACEAE Ficus brachypoda (Miq.) Miq.	Gibbons, A.K.	28	14/03/2002
MYRSINACEAE Rapanea pedicellata B.Jackes	Byrnes, N.B.	2096	23/09/1971
MYRTACEAE Corymbia polysciada (F.Muell.) K.D.Hill & L.A.S.Johnson	Bowman, D.M.J.S.	65	25/11/1984
MYRTACEAE Eucalyptus miniata A.Cunn. ex Schauer	Bateman, W.	11385	1/05/1965

MYRTACEAE Eucalyptus phoenicea F.Muell.	Hearne, D.A.	68	10/05/1972
MYRTACEAE Eucalyptus phoenicea F.Muell.	Bowman, D.M.J.S.	67	25/11/1984
MYRTACEAE Melaleuca viridiflora Sol. ex Gaertn.	Eddy, N.G.		1/03/1956
ORCHIDACEAE Habenaria hymenophylla Schltr.	Byrnes, N.B.	55	1/10/1967
POACEAE Aristida holathera Domin var. holathera	Chippendale, G.M.	4359	22/05/1958
POACEAE Aristida holathera Domin var. holathera	Muspratt, J.S.	18	1/11/1961
POACEAE Aristida pruinosa Domin	Cowie, I.D.	279	5/06/1985
POACEAE Chrysopogon latifolius S.T.Blake	Chippendale, G.M.	7757	18/03/1961
POACEAE Eragrostis schultzii Benth.	Cowie, I.D.	1588	15/03/1991
POACEAE Sorghum interjectum Lazarides	Cowie, I.D.	1586	15/03/1991
POACEAE Sorghum intrans F.Muell. ex Benth.	Miles, J.F.	55	1/03/1947
POACEAE Sorghum intrans F.Muell. ex Benth.	Cowie, I.D.	1585	15/03/1991
POACEAE Triodia bitextura Lazarides	Byrnes, N.B.	52	10/01/1967
POACEAE Triodia bitextura Lazarides	Byrnes, N.B.	52	10/01/1967
POACEAE Urochloa pubigera (Roem. & Schult.) R.D.Webster	Muspratt, J.S.	330	19/12/1962
POACEAE Urochloa pubigera (Roem. & Schult.) R.D.Webster	Miles, J.F.	46	28/02/1947
PROTEACEAE Grevillea dryandri R.Br. subsp. dryandri	Blake, S.T.	16735	8/08/1946
PROTEACEAE Persoonia falcata R.Br.	Cowie, I.D.	1422	23/11/1990
RUBIACEAE Knoxia stricta Gaertn.	Byrnes, N.B.	59	10/01/1967
RUBIACEAE Spermacoce D137913 scabrisina	Harwood, R.K.	552	20/02/1999
RUBIACEAE Spermacoce D137913 scabrisina	Cowie, I.D.	1583	15/03/1991
RUBIACEAE Spermacoce leptoloba Benth.	Cowie, I.D.	1584	15/03/1991
SANTALACEAE Exocarpos latifolius R.Br.	Maconochie, J.R.	336	5/06/1967
SANTALACEAE Exocarpos latifolius R.Br.	Byrnes, N.B.	56	10/01/1967
SAPINDACEAE Allophylus cobbe (L.) Raeusch.	Byrnes, N.B.	58	10/01/1967
SAPINDACEAE Allophylus cobbe (L.) Raeusch.	Byrnes, N.B.	1289	19/01/1969
SAPINDACEAE Allophylus cobbe (L.) Raeusch.	Byrnes, N.B.	58	10/01/1967
SAPINDACEAE Allophylus cobbe (L.) Raeusch.	Byrnes, N.B.	1289	19/01/1969
SCROPHULARIACEAE Buchnera	Blake, S.T.	16153	26/06/1946
STERCULIACEAE Helicteres	Shaw, E.A.	866	4/06/1967
STERCULIACEAE Helicteres isora L.	Byrnes, N.B.	53	10/01/1967
STERCULIACEAE Helicteres isora L.	Byrnes, N.B.	53	10/01/1965
VERBENACEAE Stachytarpheta cayennensis (A.Rich.) Vahl	Rankin, M.O.	2686	7/04/1983
VITACEAE Ampelocissus frutescens Jackes	Bowman, D.M.J.S.	66	25/11/1984
ZYGOPHYLLACEAE Tribulopis pentandra R.Br.	Rankin, M.O.	2685	7/04/1983