Biota Environmental Sciences

Yandi Expansion Vegetation and Flora Survey

Hamersley Iron Pty Ltd

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1.0 Summary

Hamersley Iron Pty Ltd proposes to extend existing iron ore mining operations at Yandi, approximately 90 km northwest of Newman. To support an assessment of the biological impacts of the project, Biota Environmental Sciences was commissioned to assess the vegetation and flora and fauna of the Yandi Expansion area.

Vegetation
Twenty vegetation types were identified for the area:

1. Low Stony Hills

1a. *Hakea chordophylla* scattered low trees over *Grevillea wickhamii* scattered shrubs to open shrubland over *Acacia hilliana* and *Ptilotus rotundifolius* low open shrubland over *Triodia* aff. *basedowii* mid-dense hummock grassland; stony hillcrests.

1b. *Eucalyptus leucophloia* low open woodland over *Acacia hilliana* and *A. adoxa* var. *adoxa* low open shrubland over *Triodia* aff. *basedowii* mid-dense hummock grassland; skeletal hillslopes and low stony hills.

1c. *Eucalyptus leucophloia, Corymbia ferriticola* scattered low trees over *Eremophila latrobei* subsp. *filiformis* ms., *Senna* spp. scattered shrubs over *Cymbopogon ambiguus, Eriachne mucronata, Themeda* sp. Mt. Barricade and *T. triandra* open tussock grassland; exposed ridges and rocky gullies.

1d. *Eucalyptus gamophylla* low open woodland over *Acacia ancistrocarpa* open shrubland over *Triodia* aff. *basedowii* mid-dense hummock grassland; stony baseslopes.

1e. *Acacia inaequilatera, Grevillea wickhamii* scattered shrubs over *Triodia wiseana* mid-dense hummock grassland and *Paraneurachne muelleri* very open grassland; stony hillcrests.

1f. *Corymbia hamersleyana* scattered low trees over *Acacia inaequilatera, Grevillea wickhamii* scattered tall shrubs to tall open shrubland over *Acacia ancistrocarpa* open shrubland over *Acacia adoxa* var. *adoxa, Ptilotus calostachyus, Gompholobium polyzygum* low open shrubland over *Triodia* aff. *basedowii* mid-dense hummock grassland; low stony hills.

1g. *Acacia pruinocarpa, Acacia aneura* (flat curved; MET 15 548) scattered low trees over *Eremophila fraseri, Senna glutinosa* subsp. x *luerssenii* over *Triodia* aff. *basedowii* mid-dense hummock grassland; small low stony hills.

2. Valleys (mosaic communities)

2a. *Corymbia hamersleyana* open woodland over *Acacia inaequilatera, A. dictyophleba, A. tenuissima, A. ancistrocarpa, A. sclerosperma, A. pruinocarpa, Hakea chordophylla, Eremophila longiflora* tall open shrubland to open shrubland over *Triodia* spp. mid-dense hummock grassland; detrital stony lowlands adjacent to Yandicoogina Creek.

2b. Mosaic of Mulga *Acacia aneura* and other *Acacia* species on clay flats, including:

2b.1 *Eucalyptus xerothermica, Acacia aneura* low open woodland over *Acacia bivenosa* open shrubland over *Themeda triandra, Paraneurachne muelleri* open tussock grassland and *Triodia wiseana* and/or *Triodia pungens* open hummock grassland; shallow drainages and flats.

2b.2 *Acacia aneura* (flat curved; MET 15 548)*, Acacia ayersiana, A. pruinocarpa, Eucalyptus xerothermica* low woodland over *Eremophila forrestii, Senna artemisioides* subsp. *helmsii* shrubland over *Aristida contorta, A. inaequiglumis, Enneapogon polyphyllus* open annual grassland and mixed very open herbland; flats.

2c. *Acacia dictyophleba, A. pruinocarpa, Acacia pachyacra*, *A. inaequilatera, A. ancistrocarpa* tall open shrubland to shrubland over *Senna artemisioides* subsp. *oligophylla* low shrubland over *Triodia lanigera* mid-dense hummock grassland; semi-sandplain habitat in an alluvial fan.

3. Drainage lines

3a. *Eucalyptus leucophloia, Corymbia hamersleyana* low open woodland over *Acacia tumida* var. *pilbarensis, A. bivenosa, A. ancistrocarpa, Petalostylis labicheoides, Grevillea wickhamii* tall open shrubland over *Acacia adoxa* var. *adoxa, A. hilliana* low open shrubland over *Triodia* spp. mid-

dense hummock grassland with *Themeda triandra* and *Paraneurachne muelleri* very open tussock grassland; stony minor creeks.

3b. *Corymbia hamersleyana* open woodland over *Acacia tumida* var. *pilbarensis, A. dictyophleba, A. pyrifolia, Gossypium robinsonii, Petalostylis labicheoides, Grevillea wickhamii, Rulingia luteiflora, Eremophila longifolia* mixed shrubland to open shrubland over *Triodia pungens* open hummock grassland and *Themeda triandra* tussock grassland; secondary creeks.

3c. *Eucalyptus camaldulensis* open woodland over A*cacia citrinoviridis, A. coriacea* subsp. *pendens, A. pruinocarpa, Hakea lorea* subsp. *lorea, Atalaya hemiglauca* low open woodland over *Stylobasium spathulatum, Gossypium robinsonii* open shrubland over **Cenchrus ciliaris* closed tussock grassland; floodbank of Weeli Wolli Creek.

3d. *Eucalyptus camaldulensis* and *E. victrix* scattered trees over scattered mixed shrubs, sedges, tussock grasses and *Triodia pungens*; major creek channel.

3e. *Eucalyptus victrix* woodland over *Acacia coriacea* subsp. *pendens, Atalaya hemiglauca* and *Melaleuca glomerata* tall open shrubland over *Triodia pungens* open hummock grassland over *Cymbopogon dependens, Eulalia aurea* and *Themeda triandra* open tussock grassland; secondary braided channel of a major creek.

3f. *Acacia citrinoviridis, A. coriacea* subsp. *pendens* low open forest over *Acacia pyrifolia* scattered tall shrubs over *Corchorus crozophorifolius, Tephrosia rosea* var. *glabrior* scattered low shrubs to low open shrubland over *Triodia pungens* very open hummock grassland and *Themeda triandra, *Cenchrus ciliaris* open grassland; major creek flood-out.

3g. *Corymbia hamersleyana* scattered low trees over *Acacia citrinoviridis, A. pruinocarpa* low open woodland over *Triodia longiceps* mid-dense hummock grassland and **Cenchrus ciliaris* tussock grassland; Weeli Wolli Creek flood-out area.

3h. *Eucalyptus victrix* woodland to open woodland over *Acacia citrinoviridis* low open woodland over *Atalaya hemiglauca, Acacia tumida* var. *pilbarensis, A. bivenosa, Petalostylis labicheoides, Gossypium robinsonii* shrubland to tall shrubland over *Triodia pungens* hummock grassland and *Themeda triandra* open tussock grassland; Yandicoogina Creek flood-out area.

The vegetation was generally considered to be in very good to excellent condition, with the exception of areas along the Weeli Wolli Creek and parts of the Yandicoogina and Marillana Creek systems that were degraded through infestation with weeds, particularly Buffel Grass.

Flora

A total of 319 taxa of native vascular flora from 150 genera belonging to 53 families was recorded from the Yandi Expansion area. Thirteen introduced species were also recorded (Ruby Dock **Acetosa vesicaria,* Mexican Poppy **Argemone ochroleuca* subsp. *ochroleuca*, Beggars Ticks **Bidens bipinnata,* Buffel Grass **Cenchrus ciliaris*, Flaxleaf Fleabane **Conyza bonariensis,* Couch Grass **Cynodon dactylon,* Native Thornapple **Datura leichhardtii*, Spiked Malvastrum **Malvastrum americanum,* Jersey Cudweed **Pseudognaphalium luteoalbum*, Whorled Pigeon Grass **Setaria verticillata,* London Rocket **Sisymbrium irio,* Black Berry Nightshade **Solanum nigrum* and Common Sowthistle **Sonchus oleraceus*).

No Declared Rare Flora were recorded from the area, and none are expected to occur. Five Priority flora were recorded:

- *Olearia fluvialis* (Priority 2);
- *Sida* sp. Barlee Range (S van Leeuwen 1642) (Priority 2);
- *Abutilon trudgenii* ms. (Priority 3);
- *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) (Priority 3); and
- *Goodenia stellata* (Priority 4).

Features of Conservation Significance

No Threatened Ecological Communities or Declared Rare Flora are known from the Yandi Expansion area. None of the vegetation types appear to be restricted in the region based on their floristic composition, hence none are considered to be of regional conservation significance. The main feature of conservation significance in the study area is the major drainage system formed by the Weeli Wolli, Yandicoogina and Marillana Creeks.

The main features of conservation significance within the project area thus comprise:

- vegetation types 3c – 3h of major creeklines, particularly where these are in excellent to very good condition (ie. along Yandicoogina and Marillana Creeks); these comprise an ecosystem at risk (Kendrick 2003) and support suites of species restricted to major creekline habitats;
- vegetation type 1c of breakaways small areal extent and supports suites of species restricted to such rocky habitats; and
- the five Priority flora (*Olearia fluvialis, Sida* sp. Barlee Range (S van Leeuwen 1642), *Abutilon trudgenii* ms., *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) and *Goodenia stellata*).

Impacts of the Development

A total of 511 ha will be cleared for the proposed Yandi Expansion, which will include 4.2 ha of riverine vegetation along Yandicoogina and Marillana Creeks, and 0.16 ha of breakaway vegetation. Clearing of the latter small areas would not be expected to decrease the conservation value of these vegetation types of high conservation significance in the locality.

Four of the locations of *Abutilon trudgenii* identified within the project area will be cleared (two along the heavy haulage road and two within the pit area), and the location of *Goodenia stellata* will be cleared to construct the eastern cut-off drain. Both of these species have been recorded numerous times in the locality, and the loss of these stands of individuals would not be expected to impact on the conservation status of the species.

Both groundwater drawdown and disposal of excess dewatering water could impact riverine vegetation in the study area. Hydrological studies are currently under way to define the extent of these impacts, along with studies by the University of Western Australia to determine the likely effect on vegetation.

Other potential impacts of the project include introduction and/or spread of weed species within the study area, particularly into the section of Yandicoogina Creek west of the Marillana Creek junction, and an increase in fire frequency and dust levels.

Management Recommendations

- Prior to construction, undertake rare flora searches in the areas burnt prior to this survey to ensure that any such populations are fully documented.
- Maintain surface drainage features, and minimise disturbance to the Marillana, Yandicoogina and Weeli Wolli Creek systems, wherever possible. Both direct (eg. vegetation clearing, possible discharge of excess water from mine dewatering) and indirect (eg. groundwater drawdown, spread of weeds) mechanisms should be considered as part of the mine planning process. Impacts of such factors will need to be reviewed following completion of the hydrological and other studies.
- Avoid disturbance to the locations supporting Priority flora species wherever possible, particularly with respect to *Olearia fluvialis* and *Sida* sp. Barlee Range (S van Leeuwen 1642).
- Minimise disturbance to general vegetation and flora:
  - Clearing limits should be clearly defined in the field and strictly adhered to;
  - Existing tracks should be utilised wherever possible and off-road driving should be prohibited;
  - Appropriate weed hygiene measures should be carried out to minimise the risk of introduction/spread of weed propagules or infected soil (ie. standard washdown of earth-moving equipment should be done prior to any earthworks in the area of Yandicoogina Creek upstream of the Marillana Creek junction, and also prior to equipment leaving the Yandi Expansion area, to prevent spread of weeds into other areas).

2.0 Introduction

2.1 Scope of the Study

Hamersley Iron Pty Ltd proposes to expand existing iron ore mining operations at its Yandi minesite, approximately 90 km northwest of Newman, with a new open-cut pit, waste dump and physical plant in the Yandi Expansion area. The Western Australian Environmental Protection Authority will review the environmental acceptability of this expansion under an Environmental Protection Statement being prepared by Hamersley. To support an assessment of the biological impacts of the project, Biota Environmental Sciences was commissioned to assess the vegetation and flora and fauna of the Yandi Expansion area.

The scope of the study was to:

- define and map the vegetation types within the study area, and identify any vegetation types of conservation significance;
- identify the flora present within the study area, with particular emphasis on species of conservation significance; and
- prepare recommendations for management of any features of conservation significance within the study area.

2.2 Background to the Study Area

2.2.1 Pilbara IBRA Bioregion

The Interim Biogeographic Regionalisation for Australia (IBRA) recognises 85 bioregions (see Environment Australia 2000). The Pilbara Bioregion has four main components, based on the physiographic work of Beard (1975): the Hamersley Range, Fortescue Plains, Chichester Range and Roebourne Plains sub-regions. The Yandi Expansion area is located near the boundary of the Hamersley and Fortescue sub-regions, with the majority of the project area typical of the Hamersley Range and the major creek systems (Marillana, Yandicoogina and Weeli Wolli Creek) forming part of the Fortescue sub-region.

The Pilbara Bioregion is listed as a medium priority for funding for land purchase under the National Reserves System Co-operative Program due to the limited representation of the area in conservation reserves. The Hamersley Range sub-region is relatively well reserved, with 10-30% of the land area protected in reserves, while the Fortescue Plains sub-region is poorly reserved (2-3% only within reserves).

2.2.2 Land Systems

Land System (rangelands) mapping covering the project area has been prepared by the Department of Agriculture Western Australia (Department of Agriculture 2002). Six Land Systems occur within the Yandi Expansion area (Figure 2.1, Table 2.1), all of which are widely distributed through the Pilbara.

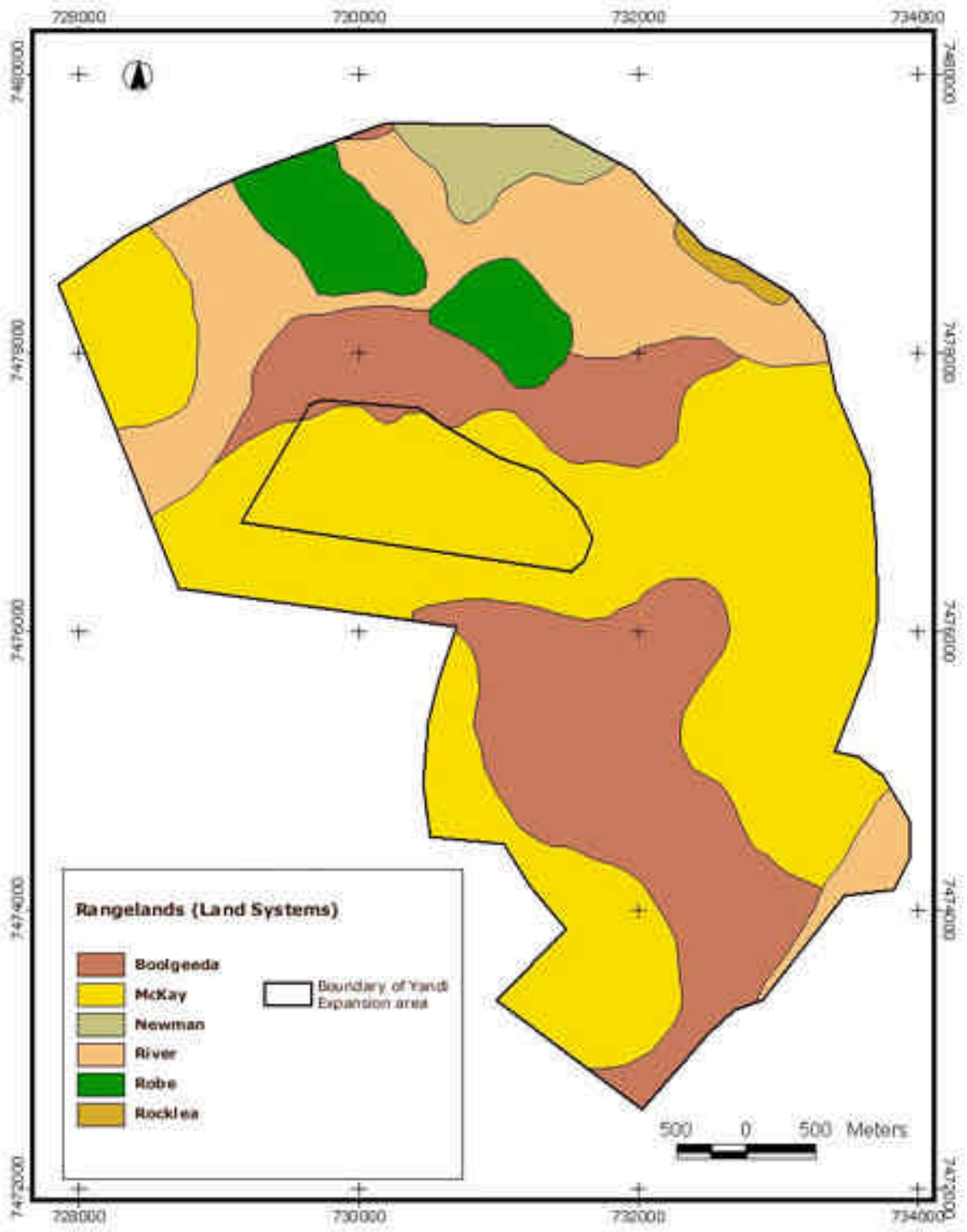


Figure 2.1: Land Systems within the Yandi Expansion area (data from Department of Agriculture 2002).

Table 2.1: Description and area of each Land System occurring within the Yandi Expansion area (data from Department of Agriculture 2002).

Land System	Description	Area within Yandi Expansion (ha)	% of area mapped in Pilbara
McKay	Hills, ridges, plateaux remnants and breakaways of metasedimentary and sedimentary rocks supporting hard spinifex grasslands; dominated the low hills of the study area	1151.93	0.27%
Boolgeeda	Stony lower slopes and plains found below hill systems supporting hard and soft spinifex grasslands and mulga shrublands; broadly distributed in the central and southern study area, on plains fringing river systems	640.70	0.08%
River	Active flood plains and major rivers supporting grassy eucalypt woodlands, tussock grasslands and soft spinifex grasslands; comprised the sections of Marillana, Yandicoogina and Weeli Wolli Creek within the study area	426.02	0.09%
Robe	Low limonite mesas and buttes supporting soft spinifex (and occasionally hard spinifex) grasslands; two small patches in the northern study area	143.14	0.17%
Newman	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands; a single patch along the northern boundary of the study area	59.62	<0.01%
Rocklea	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex (and occasionally soft spinifex) grasslands; a small strip along the north-eastern boundary of the study area	12.37	<0.01%

2.2.3 Beard's Vegetation Mapping

Beard (1975) mapped the vegetation of the Pilbara at a scale of 1:1,000,000. The study area lies within the Fortescue Botanical District of the Eremaean Botanical Province as defined by Beard. The vegetation of this province is typically open, and frequently dominated by spinifex, wattles and occasional eucalypts.

Beard mapped the area encompassing the Yandi Expansion area as the following vegetation units:

- Snappy Gum *Eucalyptus leucophloia* trees over *Triodia wiseana* hummock grassland; and
- Mulga trees in groves or patches.

However, due to the coarse scale at which Beard's mapping was done, these units are only broadly applicable to the actual vegetation occurring on site (see Section 4.1).

2.2.4 Previous Studies at Yandi

Numerous baseline biological studies have been done in the Yandi area as part of the environmental impact assessment process for both BHP Billiton Iron Ore and Hamersley Iron Pty Ltd.

Vegetation and flora surveys of particular relevance include the studies of the Yandicoogina Junction area (Mattiske and Associates 1995a) and the transport corridor extending south (Mattiske and Associates 1995b), which together encompass the current Yandi Expansion area. These reports were reviewed for context.

3.0 Methodology

3.1 Review of Existing Information

Searches of the Department of Conservation and Land Management (CALM) and Western Australian Herbarium rare flora databases were commissioned to identify rare and Priority flora species that have been previously recorded from the Yandi area.

Previous vegetation and flora studies of the area were also reviewed. These studies were used in conjunction with the results of the database searches to assist in identification of rare flora and vegetation types occurring within the Yandi Expansion area.

3.2 Field Survey

3.2.1 Survey Timing

Three botanists (Kelli McCreery and Raimond Orifici of Biota Environmental Sciences and Brian Morgan, Consultant Botanist) surveyed the Yandi Expansion area for vegetation and flora between 30th August and 5th of September 2004.

The site visit was done approximately 6 months after heavy rain in the area over the summer period (Figure 3.1). The vegetation was visibly drought-affected at the time of survey. Annual flora within the stony hills and plains habitats were typically dead, but still recognisable; specimens in good condition were uncommon and largely restricted to more mesic habitats such as creeklines.

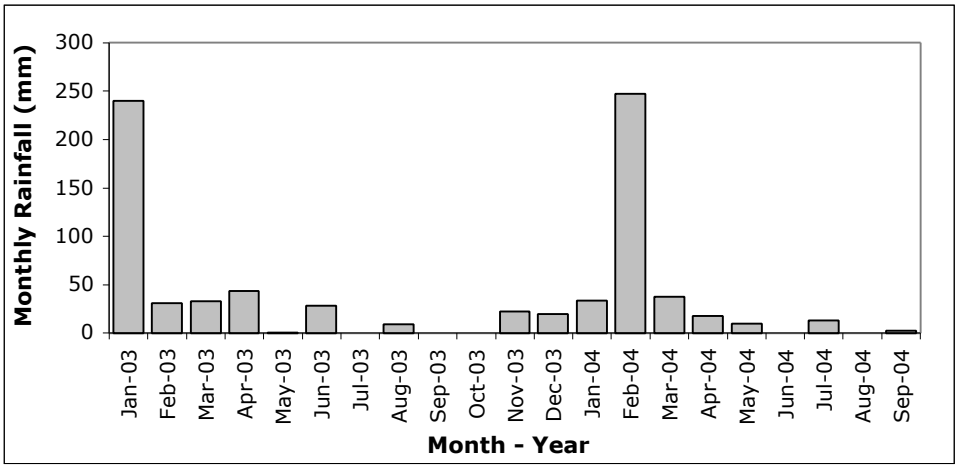


Figure 3.1: Monthly rainfall for the Newman weather station from January 2003 to September 2004 (data supplied by Bureau of Meteorology).

3.2.2 Vegetation Sampling Method

Thirty-nine sites were assessed within the Yandi Expansion survey area (Figure 4.1; Appendix 2).

Quadrats were 50 m x 50 m in size. This is generally accepted as the standard plot size in the Pilbara, as it gives a good sample of flora presence while being small enough to accommodate within a single vegetation type. Quadrat shape and/or size was adjusted as

necessary to fit smaller or oddly shaped habitats (eg. flowlines), or small vegetation stands.

The quadrats were uniquely numbered (YEX01 to YEX39) and marked with pink flagging tape, but were not permanently marked.

The following parameters were recorded for each quadrat:

1. Location	AMG coordinates recorded in WGS84 (GDA94) datum using a hand-held Global Positioning System (GPS), to an accuracy within 5 m; readings taken at all four corners;
2. Vegetation Description	Broad description based on the height and estimated cover of dominant species after Aplin's (1979) modification of the vegetation classification system of Specht (1970);
3. Habitat	Description of landform and habitat;
4. Soil	Broad description of soil type and stony surface mantle;
5. Disturbance Details	Evidence of grazing, mining exploration activities, weed invasion, frequent fires etc. Note that fire effects are only considered as a negative impact if they appear to be caused by repeated burning (such as that done for pastoral purposes). Fire is a natural and frequent process in the Pilbara to which the vegetation has adapted, and to class areas as being in poor condition simply because they have been recently burnt is misleading; and
6. Percentage Foliar Cover	Estimated visually for each species. Estimates were made to the nearest percent where possible, or a range (eg. 5-10%) was used. '+' was used where only occasional individuals were present, with a cover of less than 1%.

Colour photographs of the vegetation at each site were taken using a digital camera.

Numerous exploration tracks allowed access to the majority of the survey area. Additional foot traverses were done to allow assessment of areas that were inaccessible by vehicle. Opportunistic flora collections were made on these traverses to supplement the list of species recorded from the flora survey sites.

Particular attention was paid to searching habitats and vegetation types likely to support flora species with sporadic distributions (eg. creeklines). Location coordinates were recorded for stands of rare or unusual flora using a hand-held GPS (WGS84 datum). Readings were typically accurate to within 5m.

3.2.3 Flora Identifications

Common species that were well known to the survey botanists were identified in the field. Voucher specimens of most flora were collected and assigned a unique number to facilitate tracking of data.

The vouchers were identified by keying out, reference to appropriate publications, use of reference collections and comparison to the collections held at the Western Australian Herbarium. Some specimens of difficult taxa were submitted to relevant specialists for identification (see Section 7.0). Specimens will be lodged with the Western Australian Herbarium and Karratha Regional Herbarium for all taxa for which suitable material is available.

Nomenclature was checked against the current listing of scientific names recognised by the Western Australian Herbarium <http://www.florabase.calm.wa.gov.au>, and updated as necessary.

3.2.4 PATN Floristic Analysis

A spreadsheet of species presence / absence at each site assessed during the Yandi Expansion was generated and used in a PATN floristic clustering analysis. Releves were also included in the dataset where the list of species recorded was believed to be a good sample of the available flora.

The analysis examined the variation in species composition in a combined dataset of some 2160 sites from 19 projects:

- 45 sites from the current survey of the Yandi Expansion area (designated project YANEXP in Table 4.2);
- 118 sites from the FMG Stage A rail corridor (Biota 2004a) (project FMGA);
- 219 sites from the survey of the FMG Stage B rail corridor and Mindy Mindy, Christmas Creek, Mt Lewin and Mt Nicholas mine areas (Biota 2004b) (project FMGB);
- 286 sites from the Hope Downs rail corridor between Port Hedland and Weeli Wolli (Biota and Trudgen 2002) (project HDRAIL);
- 56 sites from an extension to the Hope Downs rail corridor through the Hamersley Range (Biota 2004c) and an addition to the same rail corridor through the Chichester Range (Biota 2004d) (project HDRAIL A/D);
- 312 sites from the core area surveyed for Robe River Iron Associates' West Angelas mine (Trudgen and Casson 1998) (project WASA);
- 12 sites from the West Angelas mine access road (Trudgen and Casson 1998) (project WAACRD);
- 59 sites from the West Angelas Coondewanna West rail corridor (Trudgen and Casson 1998) (project WACOOWES);
- 84 sites from an alternative rail corridor to the Coondewanna West route, extending from the West Angelas mine north to near Mt Robinson, then west towards Juna Downs (Trudgen and Casson 1998) (project WAMTROB);
- 46 sites from a rail corridor in the Four Corners Bore area, on Hamersley Station (Trudgen and Casson 1998) (project WAFCBOR);
- 3 sites from near Eight Mile Well on Hamersley Station (Trudgen and Casson 1998) (project WAEIMIWE);
- 22 other sites from Hamersley Station (Trudgen and Casson 1998) (project WAHAMSTN);
- 26 sites from the Fortescue Slopes study area, along the lower slopes of the Chichester Range (Trudgen and Casson 1998) (project WAFORSLO);
- 104 sites from the West Angelas Millstream Rail Segment, extending from the Fortescue Slopes study area along the lower slopes of the Chichester Range parallel to the existing Hamersley Iron rail line, then to Barowanna Hill (project MILL);
- 296 sites from the West Angelas George River rail corridor, extending along the southern slopes of the Chichester Range to approximately the Table Hill area (Trudgen and Casson 1998) (project WAGEORIV);
- 97 sites from the West Angelas Hamersley Parallel rail corridor; parallel to the existing Hamersley Iron rail line, extending northwest through the Chichester Range from near Barowanna Hill (Trudgen and Casson 1998) (project WAHAMPAR);

- 144 sites from the West Angelas Mt Herbert rail corridor, extending from the central Chichester Range down the Chichester escarpment to join the George River rail corridor (Trudgen and Casson 1998) (project WAMTHER);
- 141 sites from the West Angelas Mt Leal study area, extending from the Fortescue Slopes study area west across the mid-slopes of the Chichester Range to near the Millstream Road intersection with the Wittenoom-Roebourne Road (Trudgen and Casson 1998) (project WAMTLEA); and
- 90 sites from the Panorama survey area, south-southeast of Port Hedland (Trudgen et al. 2002) (project PAN).

The analysis thus included sites from an area of approximately 300 km by 300 km, extending from Port Hedland west to the Mt Herbert area, south to West Angelas and east to Mt Nicholas, including survey areas in both the Hamersley Range and Chichester Range.

3.2.5 Map Preparation

Vegetation types were mapped onto a hardcopy of rectified colour aerial photography supplied by Hamersley Iron. The resulting map was scanned and registered, and the vegetation polygons were digitised in ArcView GIS 3.2. The polygons were then attributed according to their vegetation classification codes. Other point sources datasets, such as locations of quadrats, weeds and Priority flora, were generated into spatial data using ArcView and saved as separate shapefiles.

3.3 Limitations of the Assessment

There are two peak flowering periods in the Pilbara – after summer rain and after winter rain. The field work was done in spring, which means that some of the summer peak species (particularly grasses and some herbs) would have been dormant at the time of the survey.

Fungi and nonvascular flora (eg. algae, mosses and liverworts) were not specifically sampled.

Approximately a third of the study area had been burnt in August 2004, two weeks preceding the survey. These areas were mapped from aerial photography only, as ground truthing was generally not possible. These areas may not be mapped to the same accuracy as unburnt areas, however given the familiarity of the survey botanists with the site, the mapping should still give a reasonable representation of the vegetation.

As the study area was only visited once, and conditions were quite dry at the time, the flora recorded for the Yandi Expansion is unlikely to be a complete representation of the species in the area. The flora species list should therefore be taken as indicative rather than exhaustive.

The recently burnt sections of the study area could not be surveyed for rare flora. Given the level of survey work that has been completed in the Yandi locality, it is unlikely that any species additional to those known for the area would be recorded.

4.0 Vegetation

4.1 Vegetation Types

4.1.1 General Overview

The Yandi Expansion area falls within the area mapped by Mattiske Consulting (1995a, 1995b) as the Yandicoogina Junction area and the southern transport corridor. The vegetation types mapped by Mattiske generally correspond with those mapped for the current exercise, although they are at considerably broader level.

Twenty vegetation types were identified by Biota within the Yandi Expansion area (Figure 4.1). Broadly, the vegetation comprised spinifex hummock grasslands on low stony hills and ranges, with open Eucalypt woodlands and *Acacia* shrublands over spinifex on plains, and Eucalypt woodlands in major creeks.

Hills generally had a scattered overstorey of Snappy gum *Eucalyptus leucophloia*, Bloodwood *Corymbia hamersleyana*, Kanji *Acacia inaequilatera* and/or *Hakea chordophylla* over moderately dense spinifex, predominantly *Triodia* aff. *basedowii*, with some *Triodia wiseana* on slopes. Soils were generally skeletal sandy clay loams, with greater than 80% stony detrital material, over (frequently exposed) massive, banded iron formation. Rocky, sheltered ridges often had a suite of specialist plants or species more typical of lowlands.

Undulating, low stony plains in valleys had Bloodwood *Corymbia hamersleyana* over sparse mixed shrubs and various species of spinifex. Alluvial flats had Mulga *Acacia aneura* and other *Acacia* communities over moderately rich assemblages of shrubs, herbs and tussock grasses, as well as spinifex *Triodia wiseana* and *T. pungens* (although spinifex was much less conspicuous in this community than in those above). Soils varied from relatively deep, stony, red clay loams on low undulating plains to deep red clay loam soils with massive clay substrates on Mulga flats.

The drainage lines in the study area varied from small gullies in upper hills to some of the major creeklines in the Hamersley Ranges (Weeli Wolli, Yandicoogina and Marillana Creeks). Small, stony creeks in hills differed very little from the vegetation type surrounding them, and were usually species poor with occasional eucalypts over *Triodia* aff. *basedowii* and *T. wiseana*. Lower in the landscape, they become more densely vegetated and species rich, including Eucalypt and Bloodwood species, shrubs, annual and perennial tussock grasses and herbs. Major creeklines had woodlands and forests of River Red Gum *Eucalyptus camaldulensis*, Coolibah *E. victrix* and other tree species over mixed shrublands, grasslands and herbs. Spinifex (usually *Triodia pungens* or *T. longiceps*) was comparatively sparse in drainage lines. Typical shrubs in drainage lines included *Acacia coriacea* subsp. *pendens* (major creeks only), *A. ancistrocarpa* (mainly in minor creeks), *A. bivenosa, A. pyrifolia, A. tumida* var. *pilbarensis, Gossypium robinsonii* and *Petalostylis labicheoides*. Major creeks sometimes had areas of apparent permanent or persistent water, that supported specialised water plants.

4.1.2 Description of Individual Vegetation Types

Vegetation types recorded from the Yandi Expansion area are described in more detail below. Vegetation was considered to be in excellent condition, unless otherwise specified.

1. Low Stony Hills

1a. *Hakea chordophylla* scattered low trees over *Grevillea wickhamii* scattered shrubs to open shrubland over *Acacia hilliana* and *Ptilotus rotundifolius* low open shrubland over *Triodia* aff. *basedowii* mid-dense hummock grassland
This vegetation was recorded from skeletal stony hillcrests. Occasional low trees of *Eucalyptus leucophloia* were also noted, and there were often patches of *Triodia wiseana* on hillcrests. Other associated species: *Acacia aneura* (flat curved; MET 15548), *A. dictyophleba, Aristida contorta, A. holathera* var. *holathera, Dysphania rhadinostachya, Eucalyptus leucophloia, Senna glutinosa* subsp. x *luerssenii, Solanum lasiophyllum, Triodia pungens* and *T. wiseana.* Sites YEX35, YEX37.

1b. *Eucalyptus leucophloia* low open woodland over *Acacia hilliana* and *A. adoxa* var. *adoxa* low open shrubland over *Triodia* aff. *basedowii* mid-dense hummock grassland
This vegetation was recorded from skeletal hillslopes and low stony hills. Steeper slopes and slopes of creeks and gullies sometimes had patches of *Triodia wiseana* mid-dense hummock grassland. Other associated species: *Acacia aneura* (flat curved; MET 15548), *A. inaequilatera, Amphipogon caricinus, Bulbostylis barbata, Dampiera candicans, Grevillea wickhamii, Ptilotus calostachyus, Triodia pungens* and *T. wiseana.* Sites YEX01, YEX06, YEX13, YEX24, YEX30, YEX36.

1c. *Eucalyptus leucophloia, Corymbia ferriticola* scattered low trees over *Eremophila latrobei* subsp. *filiformis* ms., *Senna* spp. scattered shrubs over *Cymbopogon ambiguus, Eriachne mucronata, Themeda* sp. Mt. Barricade and *T. triandra* open tussock grassland
The vegetation of exposed ridges and rocky gullies was variable, and often included species otherwise typical of low-lying areas. Other associated species: *Acacia pruinocarpa, Enchylaena tomentosa, Eriachne pulchella* subsp. *dominii, Gomphrena cunninghamii, Polycarpaea* spp., *Rhagodia eremaea, Rhodanthe margarethae, Salsola tragus, Triodia pungens* and *T. wiseana*. Releves YEX-B, YEX-D, YEX-H (two latter releves not shown on map as locations not recorded).

1d. *Eucalyptus gamophylla* low open woodland over *Acacia ancistrocarpa* open shrubland over *Triodia* aff. *basedowii* mid-dense hummock grassland
This vegetation was recorded from detrital stony baseslopes. Other associated species: *Acacia tenuissima, Goodenia stobbsiana, Grevillea wickhamii, Sida arenicola* and *Triodia pungens.* Site YEX05.

1e. *Acacia inaequilatera, Grevillea wickhamii* scattered shrubs over *Triodia wiseana* mid-dense hummock grassland and *Paraneurachne muelleri* very open grassland
This vegetation was recorded from skeletal stony hillcrests. Other associated species: *Aristida holathera* var. *holathera, Corymbia hamersleyana, Cymbopogon ambiguus, Schizachyrium fragile* and *Solanum phlomoides.* Site YEX22.

1f. *Corymbia hamersleyana* scattered low trees over *Acacia inaequilatera, Grevillea wickhamii* scattered tall shrubs to tall open shrubland over *Acacia ancistrocarpa* open shrubland over *Acacia adoxa* var. *adoxa, Ptilotus calostachyus, Gompholobium polyzygum* low open shrubland over *Triodia* aff. *basedowii* mid-dense hummock grassland
This vegetation was recorded from low undulating stony hills (burnt 1-2 years ago). Occasional *Eucalyptus leucophloia* or *E. gamophylla* were sometimes noted. Other associated species: *Acacia pruinocarpa, Corchorus lasiocarpus* subsp. *parvus, Hakea chordophylla, Ptilotus exaltatus, Senna notabilis* and *Sida arenicola.* Site YEX18 and releve YEX-A.

1g. *Acacia pruinocarpa, Acacia aneura* (flat curved; MET 15 548) scattered low trees over *Eremophila fraseri, Senna glutinosa* subsp. x *luerssenii* over *Triodia* aff. *basedowii* mid-dense hummock grassland
This vegetation was recorded from small low stony hills. Other associated species: *Aristida contorta, Dysphania rhadinostachya, Maireana villosa, Paraneurachne muelleri, Solanum lasiophyllum* and *Triodia wiseana.* Site YEX12.

2. Valleys (Mosaic Communities)

2a. *Corymbia hamersleyana* open woodland over *Acacia inaequilatera, A. dictyophleba, A. tenuissima, A. ancistrocarpa, A. sclerosperma, A. pruinocarpa, Hakea chordophylla, Eremophila longiflora* tall open shrubland to open shrubland over *Triodia* spp. mid-dense hummock grassland

This vegetation was recorded from detrital stony lowlands adjacent to Yandicoogina Creek. The dominant spinifex species was variable depending on soil and local aspect, and this vegetation type is therefore a mosaic. The dominant species was typically *Triodia* aff. *basedowii* nearer to hills or on alluvial clay-loam drainage flats, *Triodia lanigera* on valley floors and plains, or *Triodia pungens* near creeks and on alluvial clay flat areas. *Aristida holathera* var. *holathera* was often present as a scattered tussock grass, becoming dense in areas burnt 1-2 years ago. Other associated species: *Acacia* aff. *aneura* (scythe-shaped; MET 15 743), *Corchorus* aff. *lasiocarpus* subsp. *lasiocarpus, Eragrostis eriopoda, Eucalyptus gamophylla, Eulalia aurea, Gossypium australe, Paraneurachne muelleri, Ptilotus astrolasius* var. *astrolasius, Senna notabilis, Sida* aff. *cardiophylla* (Site 1215) and *S. arenicola.* Sites YEX10, YEX14, YEX15, YEX27, YEX31.

2b. Mosaic of Mulga *Acacia aneura* and other *Acacia* species on clay flats, including:

2b.1 *Eucalyptus xerothermica, Acacia aneura* low open woodland over *Acacia bivenosa* open shrubland over *Themeda triandra, Paraneurachne muelleri* open tussock grassland and *Triodia wiseana* and/or *Triodia pungens* open hummock grassland.

This vegetation was recorded from shallow drainages and flats. *Aristida holathera* var. *holathera* was often prominent in recently burnt areas. Other associated species: *Acacia pruinocarpa, Aristida contorta, Corymbia hamersleyana, Eulalia aurea, Gossypium australe, Ptilotus astrolasius* var. *astrolasius, P. calostachyus, Senna artemisioides* subsp. *oligophylla* and *S. notabilis.* Sites YEX04, YEX19 (burn regrowth).

2b.2 *Acacia aneura* (flat curved; MET 15 548), *Acacia ayersiana, A. pruinocarpa, Eucalyptus xerothermica* low woodland over *Eremophila forrestii, Senna artemisioides* subsp. *helmsii* shrubland over *Aristida contorta, A. inaequiglumis, Enneapogon polyphyllus* open annual grassland and mixed very open herbland

This vegetation was recorded from flats. Other associated species: *Acacia tenuissima, Codonocarpus cotinifolius, Cymbopogon ambiguus, Eremophila longifolia, Pterocaulon sphaeranthoides* and *Triodia lanigera.* Site YEX09.

2b.3 *Acacia pruinocarpa, A. synchronicia, Acacia aneura* tall open shrubland over *Senna glutinosa* subsp. x *luerssenii* open shrubland over *Triodia wiseana (T. pungens)* hummock grassland

This vegetation was recorded from loamy flats adjacent to Weeli Wolli Creek. An open annual grassland dominated by *Aristida contorta* was also often recorded. Other associated species: *Acacia bivenosa, A. dictyophleba, Enneapogon lindleyanus, Ptilotus exaltatus, Senna artemisioides* subsp. *helmsii, S. artemisioides* subsp. *oligophylla* and *Solanum lasiophyllum.* Sites YEX03, YEX32 and releve YEX-N.

2c. *Acacia dictyophleba, A. pruinocarpa, Acacia pachyacra, A. inaequilatera, A. ancistrocarpa* tall open shrubland to shrubland over *Senna artemisioides* subsp. *oligophylla* low shrubland over *Triodia lanigera* mid-dense hummock grassland

This vegetation was recorded from semi-sandplain habitat in an alluvial fan. *Triodia pungens* was common in lower lying areas, and an open tussock grassland of *Eragrostis eriopoda* and *Paraneurachne muelleri* was also often recorded. Other associated species: *Aristida holathera* var. *holathera*, *Goodenia microptera, Hakea lorea* subsp. *lorea, Ptilotus astrolasius* var. *astrolasius, Senna notabilis, Scaevola parvifolia* subsp. *pilbarae* and *Senna notabilis.* Sites YEX23, YEX33.

3. Creeks

3a. *Eucalyptus leucophloia, Corymbia hamersleyana* low open woodland over *Acacia tumida* var. *pilbarensis, A. bivenosa, A. ancistrocarpa, Petalostylis labicheoides, Grevillea wickhamii* tall open shrubland over *Acacia adoxa* var. *adoxa, A. hilliana* low open shrubland over *Triodia* spp. mid-dense hummock grassland with *Themeda triandra* and *Paraneurachne muelleri* very open tussock grassland

This vegetation was recorded from stony minor creeks including rocky gullies, occurring on skeletal sandy clay loams. *Eucalyptus gamophylla* was also sometimes recorded. The hummock grassland was variably dominated by *Triodia pungens* (in creekbeds, low in the landscape) or *T.*

aff. *basedowii* and *T. wiseana* (on stony banks). Other associated species: *Acacia dictyophleba, A. tenuissima, Bonamia pannosa, Eragrostis cumingii, Eulalia aurea, Hakea chordophylla* and *Ptilotus obovatus* var. *obovatus.* Site YEX26 and releves YEX-G, YEX-J.

3b. *Corymbia hamersleyana* open woodland over *Acacia tumida* var. *pilbarensis, A. dictyophleba, A. pyrifolia, Gossypium robinsonii, Petalostylis labicheoides, Grevillea wickhamii, Rulingia luteiflora, Eremophila longifolia* mixed shrubland to open shrubland over *Triodia pungens* open hummock grassland and *Themeda triandra* tussock grassland

This vegetation was recorded from clay loam substrates in secondary creeks. *Paraneurachne muelleri* and *Eragrostis cumingii* were also typically recorded from the grass stratum. Condition of this vegetation was considered to be Very Good to Excellent (some areas were invaded by Buffel grass **Cenchrus ciliaris*). Other associated species: *Acacia bivenosa, A. citrinoviridis, A. sclerosperma, Centipeda minima, *Conyza bonariensis, Eragrostis tenellula, Eucalyptus victrix, E. xerothermica, Ptilotus obovatus* var. *obovatus, Senna artemisioides* subsp. *oligophylla* x *helmsii, Sida* aff. *fibulifera* and *Sida* sp. spiciform panicles. Sites YEX07, YEX08, YEX11, YEX20, YEX34.

3c. *Eucalyptus camaldulensis* open woodland over A*cacia citrinoviridis, A. coriacea* subsp. *pendens, A. pruinocarpa, Hakea lorea* subsp. *lorea, Atalaya hemiglauca* low open woodland over *Stylobasium spathulatum, Gossypium robinsonii* open shrubland over **Cenchrus ciliaris* closed tussock grassland

This vegetation was recorded from clay substrates on a major creek floodbank (Weeli Wolli Creek). It was in very poor condition, due to invasion by Buffel grass **Cenchrus ciliaris*. Other associated species: *Cyperus vaginatus, Eucalyptus victrix, *Malvastrum americanum, Ptilotus obovatus* var. *obovatus, Rulingia luteiflora* and *Themeda triandra.* Site YEX02.

3d. *Eucalyptus camaldulensis* and *E. victrix* scattered trees over scattered mixed shrubs, sedges, tussock grasses and *Triodia pungens*

This vegetation type was recorded from a major creek channel, from areas of scoured coarse river sand. Occasional Silver Cadjeput *Melaleuca argentea* trees were recorded. Permanent water areas sometimes had the aquatic or semi-aquatic species Bulrush *Typha domingensis, Potamogeton tricarinatus* and *Schoenoplectus subulatus* and fringing plants such as *Cyperus vaginatus, Lobelia quadrangularis* and *Ammannia* spp. Condition was considered to be Very Good, with scattered weeds including Buffel grass **Cenchrus ciliaris,* Mexican poppy **Argemone ochroleuca* and Ruby dock **Acetosa vesicaria.* Other associated species: *Acacia coriacea* subsp. *pendens, A. tumida* var. *pilbarensis, Atalaya hemiglauca, Cleome viscosa, Corchorus crozophorifolius, Eragrostis tenellula, Eulalia aurea, Melaleuca glomerata, Pluchea rubelliflora, Rostellularia adscendens, Stemodia grossa, Themeda triandra* and *Wahlenbergia tumidifructa.* Sites YEX16, YEX28 and releves YEX-E, YEX-K, YEX-L.

3e. *Eucalyptus victrix* woodland over *Acacia coriacea* subsp. *pendens, Atalaya hemiglauca* and *Melaleuca glomerata* tall open shrubland over *Triodia pungens* open hummock grassland over *Cymbopogon dependens, Eulalia aurea* and *Themeda triandra* open tussock grassland

This vegetation type was recorded from coarse river sand in a secondary braided channel of a major creek. Scattered Silver Cadjeput *Melaleuca argentea* trees occurred in some areas. Condition was considered to be Very Good, with occasional weeds including Buffel grass **Cenchrus ciliaris* and Mexican poppy **Argemone ochroleuca*. Other associated species: *Acacia citrinoviridis, A. pyrifolia, Cleome viscosa, Corchorus crozophorifolius, Cyperus vaginatus, Cymbopogon obtectus, Enneapogon clelandii, Eriachne helmsii, Eucalyptus camaldulensis, *Malvastrum americanum, Pluchea dentex, Stemodia grossa* and *Tephrosia rosea* var. *glabrior.* Sites YEX21, YEX25, YEX39.

3f. *Acacia citrinoviridis, A. coriacea* subsp. *pendens* low open forest over *Acacia pyrifolia* scattered tall shrubs over *Corchorus crozophorifolius, Tephrosia rosea* var. *glabrior* scattered low shrubs to low open shrubland over *Triodia pungens* very open hummock grassland and *Themeda triandra, *Cenchrus ciliaris* open grassland

This vegetation type was recorded from clay loam in a major creek flood-out. Occasional Coolibah *Eucalyptus victrix* trees were also noted. Condition was considered to be Very Good, due to some patches of Buffel grass **Cenchrus ciliaris* in Yandicoogina Creek. Other associated species: *Atalaya hemiglauca, Cleome viscosa, Corymbia ferriticola, Eragrostis cumingii, Eriachne tenuiculmis, Polycarpaea longiflora* and *Triodia pungens.* Site YEX17 and releves YEX-M.

3g. *Corymbia hamersleyana* scattered low trees over *Acacia citrinoviridis, A. pruinocarpa* low open woodland over *Triodia longiceps* mid-dense hummock grassland and **Cenchrus ciliaris* tussock grassland
This vegetation type was recorded from clay loam substrate in a major creek (Weeli Wolli Creek) flood-out area. Condition was considered to be poor to very poor due to invasion by Buffel grass **Cenchrus ciliaris*. Other associated species: *Acacia bivenosa, Aristida inaequiglumis, Atalaya hemiglauca, Enneapogon polyphyllus, Eragrostis eriopoda, Paraneurachne muelleri, Ptilotus obovatus* var. *obovatus* and *Themeda triandra.* Site YEX38.

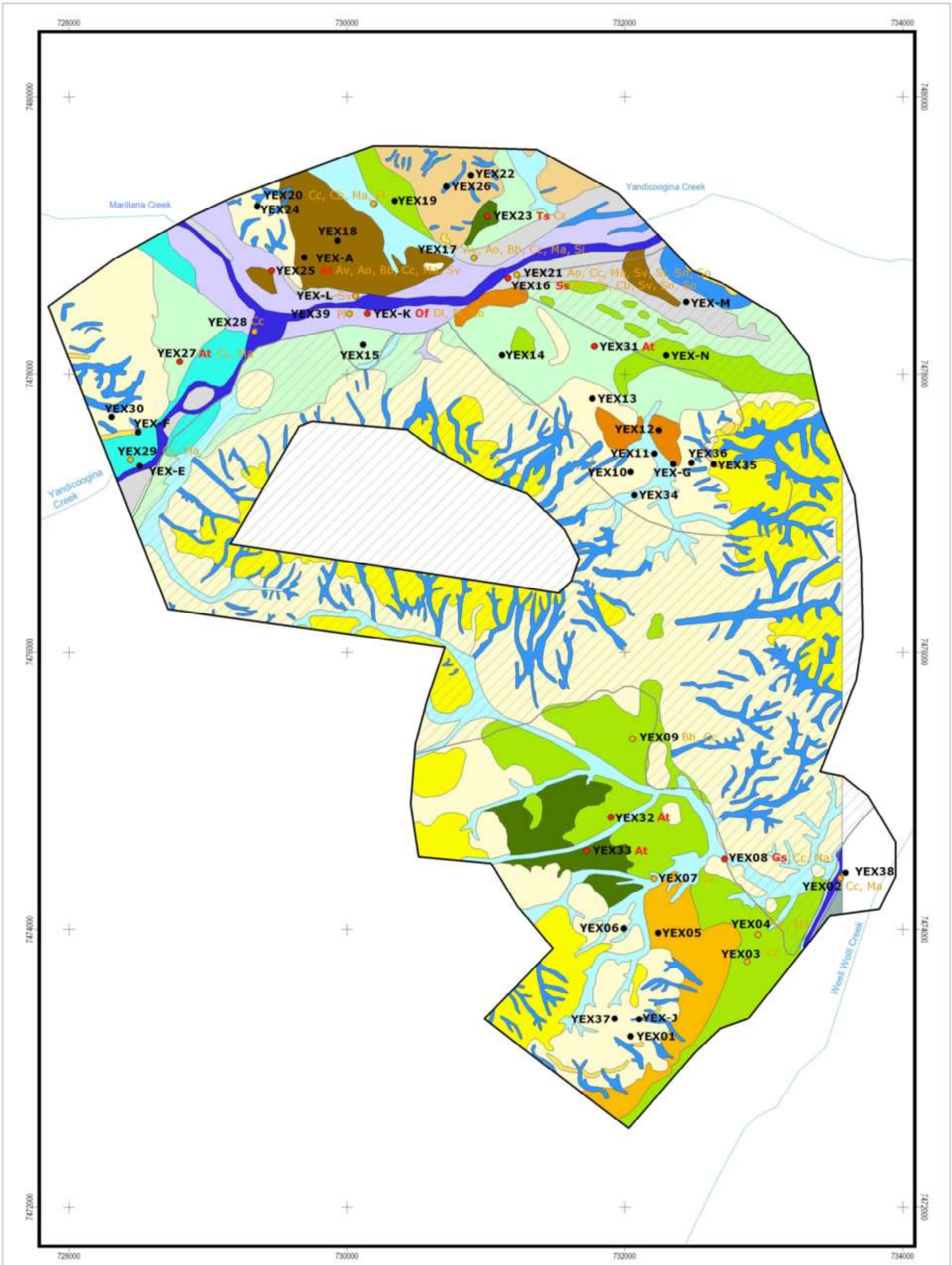
3h. *Eucalyptus victrix* woodland to open woodland over *Acacia citrinoviridis* low open woodland over *Atalaya hemiglauca, Acacia tumida* var. *pilbarensis, A. bivenosa, Petalostylis labicheoides, Gossypium robinsonii* shrubland to tall shrubland over *Triodia pungens* hummock grassland and *Themeda triandra* open tussock grassland
This vegetation type was recorded from stony clay loam in a major creek flood-out (Yandicoogina Creek). Other associated species: *Acacia pyrifolia, Aristida inaequiglumis, *Cenchrus ciliaris, Digitaria brownii, Enneapogon lindleyanus, Eriachne mucronata, Eulalia aurea, Hakea lorea* subsp. *lorea, Hybanthus aurantiacus, Pluchea dentex, Porana commixta* and *Stemodia grossa.* Site YEX29 and Releve YEX-F.

4.1.3 Area of Individual Vegetation Types

The area of each vegetation type within the Yandi Expansion area is shown in Table 4.1. (The unmapped section is the area that was lacking aerial photography.) The vegetation types with the smallest areal extent in the study area were units 3c and 3g (both associated with major creeklines) and unit 1c (occurring on breakaways).

Table 4.1: Area of each vegetation type within the Yandi Expansion area.

Vegetation Type	Total area mapped within the Yandi Expansion area (ha)
Low Stony Hills	
1a	221.41
1b	743.10
1c	5.49
1d	49.80
1e	44.28
1f	63.51
1g	17.42
Valley Floors	
2a	217.38
2b	199.49
2c	43.88
Creeks	
3a	207.68
3b	157.09
3c	1.12
3d	36.91
3e	84.34
3f	66.44
3g	1.79
3h	36.08
Total	**2197.22**



Vegetation in the Yandi Project Area

500 0 500 1000 m

Scale: 1: 25,000

See Legend for more Information

Legend

Burnt August 2004

Biota Vegetation Sites

Priority Flora

Of *Olearia fluvialis*
Ss *Sida* sp. Barlee Range (S van Leeuwen 1642)
At *Abutilon trudgenii* ms.
Ts *Themeda* sp. Hamersley Station (M.E. Trudgen 11431)
Gs *Goodenia stellata*

Weeds

Ao *Argemone ochroleuca* subsp. *ochroleuca*
Av *Acetosa vesicaria*
Bb *Bidens bipinnata*
Cb *Conyza bonariensis*
Cc *Cenchrus ciliaris*
Dl *Datura leichhardtii*
Ma *Malvastrum americanum*
Pl *Pseudognaphalium luteoalbum*
Si *Sisymbrium irio*
Sn *Solanum nigrum*
So *Sonchus oleraceus*
Sv *Setaria verticillata*

1. Hills

1a *Hakea chordophylla* scattered low trees over *Grevillea wickhamii* scattered shrubs to open shrubland over *Acacia hilliana* and *Ptilotus rotundifolius* low open shrubland over *Triodia* aff. *basedowii* mid-dense hummock grassland

1b *Eucalyptus leucophloia* low open woodland over *Acacia hilliana* and *A. adoxa* var. *adoxa* low open shrubland over *Triodia* aff. *basedowii* mid-dense hummock grassland

1c *Eucalyptus leucophloia, Corymbia ferriticola* scattered low trees over *Eremophila latrobei* subsp. *filiformis* ms., *Senna* spp. scattered shrubs over *Cymbopogon ambiguus, Eriachne mucronata, Themeda* sp. Mt Barricade and *T. triandra* open tussock grassland

1d *Eucalyptus gamophylla* low open woodland over *Acacia ancistrocarpa* open shrubland over *Triodia* aff. *basedowii* mid-dense hummock grassland

1e *Acacia inaequilatera, Grevillea wickhamii* scattered shrubs over *Triodia wiseana* mid-dense hummock grassland and *Paraneurachne muelleri* very open grassland

1f *Corymbia hamersleyana* scattered low trees over *Acacia inaequilatera, Grevillea wickhamii* scattered tall shrubs to tall open shrubland over *Acacia ancistrocarpa* open shrubland over *Acacia adoxa* var. *adoxa, Ptilotus calostachyus, Gompholobium polyzygum* low open shrubland over *Triodia* aff. *basedowii* mid-dense hummock grassland

1g *Acacia pruinocarpa, Acacia aneura* (flat curved; MET 15548) scattered low trees over *Eremophila fraseri, Senna glutinosa* subsp. x *luerssenii* over *Triodia* aff. *basedowii* mid-dense hummock grassland

2. Valleys (Mosaic Communities)

2a *Corymbia hamersleyana* open woodland over *Acacia inaequilatera, A. dictyophleba, A. tenuissima, A. ancistrocarpa, A. sclerosperma, A. pruinocarpa, Hakea chordophylla, Eremophila longifolia* tall open shrubland to open shrubland over *Triodia* aff. *basedowii* mid-dense hummock grassland

2b Mosaic of Mulga *Acacia aneura* and other *Acacia* species on clay flats, including:

2b1 *Eucalyptus xerothermica, Acacia aneura* low open woodland over *Acacia bivenosa* open shrubland over *Themeda triandra, Paraneurachne mueller*i open tussock grassland and *Triodia wiseana* and/or *Triodia pungens* open hummock grassland

2b2 *Acacia aneura* (flat curved; MET 15548), *Acacia ayersiana, A. pruinocarpa, Eucalyptus xerothermica* low woodland over *Eremophila forrestii, Senna artemisioides* subsp. *helmsii* shrubland over *Aristida contorta, A. inaequiglumis, Enneapogon polyphyllus* open annual grassland and mixed very open herbland

2b3 *Acacia pruinocarpa, A. synchronicia, A. aneura* tall open shrubland over *Senna glutinosa* subsp. *luerssenii* open shrubland over *Triodia wiseana* (*T. pungens*) hummock grassland

2c *Acacia dictyophleba, A. pruinocarpa, A. pachyacra, A. inaequilatera, A. ancistrocarpa* tall open shrubland to shrubland over *Senna artemisioides* subsp. *oligophylla* low shrubland over *Triodia lanigera* mid-dense hummock grassland

3. Creeks

3a	*Eucalyptus leucophloia, Corymbia hamersleyana* low open woodland over *Acacia tumida* var. *pilbarensis, A. bivenosa, A. ancistrocarpa, Petalostylis labicheoides, Grevillea wickhamii* tall open shrubland over *A. adoxa* var. *adoxa, A. hilliana* low open shrubland over *Triodia* spp. mid-dense hummock grassland with *Themeda triandra* and *Paraneurachne muelleri* very open tussock grassland
3b	*Corymbia hamersleyana* open woodland over *Acacia tumida* var. *pilbarensis, A. dictyophleba, A. pyrifolia, Gossypium robinsonii, Petalostylis labicheoides, Grevillea wickhamii, Rulingia luteiflora, Eremophila longifolia* mixed shrubland to open shrubland over *Triodia pungens* open hummock grassland and *Themeda triandra* tussock grassland
3c	*Eucalyptus camaldulensis* open woodland over *Acacia citrinoviridis, A. coriacea* subsp. *pendens, A. pruinocarpa, Hakea lorea* subsp. *lorea, Atalaya hemiglauca* low open woodland over *Stylobasium spathulatum, Gossypium robinsonii* open shrubland over **Cenchrus ciliaris* closed tussock grassland
3d	*Eucalyptus camaldulensis* and *E. victrix* scattered trees over scattered mixed shrubs, sedges, tussock grasses and *Triodia pungens*
3e	*Eucalyptus victrix* woodland over *Acacia coriacea* subsp. *pendens, Atalaya hemiglauca* and *Melaleuca glomerata* tall open shrubland over *Triodia pungens* open hummock grassland over *Cymbopogon dependens, Eulalia aurea* and *Themeda triandra* open tussock grassland
3f	*Acacia citrinoviridis, A. coriacea* subsp. *pendens* low open forest over *Acacia pyrifolia* scattered tall shrubs over *Corchorus crozophorifolius, Tephrosia rosea* var. *glabrior* scattered low shrubs to low open shrubland over *Triodia pungens* very open hummock grassland and *Themeda triandra, *Cenchrus ciliaris* open grassland
3g	*Corymbia hamersleyana* scattered low trees over *Acacia citrinoviridis, A. pruinocarpa* low open woodland over *Triodia longiceps* mid-dense hummock grassland and **Cenchrus ciliaris* tussock grassland
3h	*Eucalyptus victrix* wooodland to open woodland over *Acacia citrinoviridis* low open woodland over *Atalaya hemiglauca, Acacia tumida* var. *pilbarensis, A. bivenosa, Petalostylis labicheoides, Gossypium robinsonii* shrubland to tall shrubland over *Triodia pungens* hummock grassland and *Themeda triandra* open tussock grassland
	No Aerial Coverage

4.2 Vegetation Condition

The study area had been partially burnt two weeks prior to the survey; approximately a third of the study area was affected (Figure 4.1). Fire is a part of the landscape, however it is usually through lightning strikes in summer, or sometimes through methodological mosaic burns. The current burn was for pastoral purposes and was neither controlled like a mosaic burn nor during the summer months as would be expected of a lightning fire. Nonetheless, this area is expected to regenerate fully and the fire is therefore not considered to have decreased vegetation condition.

The main signs of disturbance resulting from human activities were land clearing and dust associated with mining activities, and the presence of weeds. Clearing was limited to the network of vehicle tracks and drill pads associated with exploration and development. Dust was evident on vegetation along main access tracks however this did not appear to be having an obvious effect on vegetation condition. Signs of cattle grazing were noted in creeklines in the northern portion of the study area and also in Weeli Wolli Creek at the southern end.

Thirteen weed species were recorded from the Yandi Expansion area, mostly from drainage areas (see Section 5.3). Buffel Grass **Cenchrus ciliaris* was widespread and abundant as a result of pastoral activities. The remaining species generally occurred as scattered individuals or in isolated patches.

The vegetation of the section of Weeli Wolli Creek within the study area was seriously degraded, with almost total cover of Buffel Grass in the understorey. The length of Weeli Wolli downstream from this point is also very degraded from pastoral activities (K. McCreery, pers. obs.). Upstream is the Weeli Wolli Springs, which is in excellent condition and an area of high conservation significance.

Yandicoogina Creek is a tributary of Weeli Wolli Creek. The vegetation of Yandicoogina Creek within the study area was in excellent condition west of the junction with Marillana Creek, and in moderately good condition for the remainder, with several weed species present (including Buffel Grass) but at very low density. It would therefore be quite vulnerable to future degradation if physical disturbance was to result in the proliferation of one or more weed species.

Marillana Creek is a tributary of Yandicoogina Creek. The short section of Marillana Creek within the study area was in moderately good condition, with several weed species recorded from the area but at relatively low densities.

With the exception of the floodbanks of Weeli Wolli Creek and tracks associated with mine activities, the vegetation was thus in Very Good to Excellent condition.

4.3 Vegetation Conservation Significance

4.3.1 Results of the PATN Analysis

As described in Section 3.2.4, the data from the Yandi Expansion study was included in a PATN analysis of 2160 sites from 19 survey areas in the Pilbara. A summary of the results of this analysis is shown in Table 4.2.

With the exception of a single releve (YEX-J), all of the sites from the Yandi Expansion area occurred in floristic community types that have also been recorded from other areas in the Pilbara (see Table 4.2). Releve YEX-J has been separated in a unique floristic group (group 42) at the 100-group level of classification, however this is a spurious result, as the releve was actually incomplete (containing only five species) and should not have been included in the analysis.

It therefore appears that the vegetation types of the Yandi Expansion area are not restricted in the Pilbara in terms of their floristic composition. This is as expected, given that most of the landforms and flora species recorded are widespread in the Hamersley Range sub-region, and the Land Systems occurring in the study area are also widespread and relatively abundant. The vegetation types occurring on the low stony hills and plains dominating the project area comprise suites of common species for the area, and are likely to have a widespread distribution in this section of the Pilbara.

Vegetation types 1a, 1b, 1e and 1f (the *Triodia* aff. *basedowii* and *T. wiseana* hummock grasslands dominating the low stony hills of the study area) occurred entirely within group 54 at the 100-group level of the analysis. This floristic group was relatively common in the locality, including sites from low hills in the Hamersley Ranges only.

Vegetation type 1d (*Triodia* aff. *basedowii* hummock grasslands with an overstorey of *Eucalyptus gamophylla* and *Acacia ancistrocarpa*, indicative of deep loamy soils on stony detrital base-slopes) occurred in group 57 at the 100-group level of the analysis. Vegetation types 2a, 2b.1 and 2c of detrital lowlands and valley floors, and 3b of creeklines, also occurred mainly within group 57. This floristic group appears to include sites from more mesic areas such as low base-slopes, valley floors and shallow drainages. This group was relatively common in the locality, and again included only sites from the Hamersley Ranges.

Vegetation type 1g (*Triodia* aff. *basedowii* hummock grasslands with scattered Mulga and *Acacia pruinocarpa* on low stony hills in the central section of the study area) occurred in group 88 at the 100-group level of the analysis, along with vegetation types 2b.2 and 2b.3 of the valley floors, and vegetation type 3g in a flood-out area of Weeli Wolli Creek. All of these sites contained Mulga as a dominant or conspicuous species. Floristic group 88 was relatively widely distributed across the Hamersley Ranges, including sites from various different project areas (Table 4.2).

Vegetation type 3a of creeklines was split between groups 54 and 57, highlighting variability in floristic composition, even within structurally similar vegetation with common dominant species. As discussed previously, both of these floristic groups are widespread in the Hamersley Ranges.

Vegetation types 3c, 3d, 3e, 3f and 3h of creeklines were mainly in group 49 at the 100-group level, with occasional sites in group 40 (releve YEX-K) and group 48 (releve YEX-M). These floristic groups all comprised sites in creekline vegetation in the region, and all three groups were widespread in the Hamersley Ranges (Table 4.2).

4.3.2 Summary of Vegetation Types of Conservation Significance

Given that none of the vegetation types appear to be restricted in the region based on their floristic composition, none are considered to be of regional conservation significance. However, the vegetation types occurring in the major creeks in the study area (particularly in the section of Yandicoogina Creek west of the Marillana Creek junction) are of conservation value at the scale of the Hamersley Ranges.

Large creek systems that have persistent or available water do not occur extensively within the Hamersley Range. These typically have a high relative species richness; creek banks in particular may have over 100 species per standard 50 m by 50 m survey quadrat (a figure typically only rivalled by Mulga vegetation). The flora (and fauna) assemblage of these areas also includes numerous species that are restricted to and reliant on such habitat.

In addition, all ephemeral watercourses of the Hamersley sub-region are considered to be at risk, as they are frequently subject to threatening processes, particularly heavy grazing pressure and weed infestation (Kendrick 2003). Many creeklines in the Hamersley Range are seriously degraded by Buffel Grass **Cenchrus ciliaris* and other **Cenchrus* species, the introduction and spread of which are a result of pastoral activities. They are often also

under serious threat from grazing and trampling by cattle and other introduced herbivores, as stock tend to gravitate towards them for foraging and shelter. Any major creeklines within the Hamersley Range supporting relatively intact vegetation are therefore of conservation significance.

While the section of Weeli Wolli Creek within the Yandi Expansion area is infested with Buffel Grass, the sections of Yandicoogina and Marillana Creeks currently have only minor levels of weeds. The vegetation types 3c, 3d, 3e, 3f and 3h, particularly within the latter two creeks, are therefore of high conservation value at the level of the Hamersley Ranges.

The other vegetation type of high conservation value at this scale is unit 1c (vegetation of breakaways). Although breakaways are widespread through the Hamersley Ranges, they comprise only a small proportion of the area, and typically support restricted flora species (sometimes including Priority taxa).

Table 4.2: Summary of number of sites from each project area in the 14-groups and 100-groups of the PATN analysis.
Numbers in brackets indicate the number of these sites with >5% cover of taxa with affinities to Mulga (ie. *Acacia aneura, A. ayersiana, A. catenulata* and/or *A. minyura*).

Group 14	Group 100	WAMTLEA	WAMTHER	WAHAMPAR	WAGEORIV	MILL	WAFORSLO	WAHAMSTN	WAEIMIWE	WAFCBOR	WAMTROB	WACOOWES	WAACRD	WASA	YANEXP	HDRAIL A/D	HDRAIL	FMGA	FMGB	PAN	Biota Vegetation Mapping Types (and Associated Sites / Releves) from the Yandi Expansion Study (see Section 4.0 for explanation of vegetation codes)
1	1		7	4	26																
	2		7	1	17																
	3	7	5	2	9																
	4				5					2											
	5	7	4	1	4		1														
	6	5	7	5	18					1									1		
	7	3	5	17	29																
	8	5	11	5	7																
	9	1		11	4																
	10		9	6	21																
	11		1	2	9															2	
	12	2	3	6	4																
	13			3	2																
	14		7	11	4												1				
	15				1									1		3	3	5			
	16					1										3					
	17	1			2																
	18		25	2						7											
2	19	4	3	2	3	1	1				1										
3	20	1		4	1	1										3	8				
	21													1			4				
	22																1			26	
	23																			12	
	24				1												1		2	12	
4	25	3			4		2										1				
	26					5											1	6	5		
	27																1	4	1(1)		
	28			1										3		3	8				
	29	1															1			7	
	30					10												1			
	31																8	5			
	32																4			2	
	33																2	2			
	34	3			10		5														
	35	8			1	9				2							3	1	4		
5	36	1						9(5)	3	5(2)											
	37							8													
	38							1		1							1		3		
	39										4(1)						2				
	40	1		1											1						**3d** (YEX-K)
	41										1										
	42														1						**3a** (YEX-J)
	43																	2			
	44																2				
6	45	1	7	7	16											4	3		1	6	
	46		3		1												4				
	47																14	8			
	48				1	1				1					1	1					**3f** (YEX-M)
	49							1(1)							9	4	2	1	2		**3c** (YEX02); **3d** (YEX16, 28); **3e** (21, 25, 39); **3f** (YEX17); **3h** (YEX29, YEX-F)
	50																5	5			
	51															1		3			
	52																		1		
	53															11	17			2	
7	54									2					12	4	3	1	11		**1a** (YEX35, 37); **1b** (YEX01, 06, 13, 24, 30, 36); **1e** (YEX22); **1f** (YEX18); **2a** (YEX10); **3a** (YEX-G)
	55																	1	28(2)		
	56																		30		
8	57														14	1		1	8		**1d** (YEX05); **2a** (YEX14, 15, 27, 31); **2b.1** (YEX04, 19); **2c** (YEX23); **3a** (YEX26); **3b** (YEX07, 08, 11, 20, 34)
	58														1		35	11	2		**2c** (YEX33)
9	59															6	12	13		3	
	60																26	3		12	
	61															1	29	9			
	62																47	5		6	
10	63	19	7	2	5	1	2			1				1							
	64		2		1		3			2											
	65	5			12	3	1							1							
	66	12			9	14	2				2	1									
	67	15			13	3	2														
	68	2			7	25															
	69	6			12	8															
	70	4	1		18	9															
11	71	1					1			1	3(1)	2(1)		25(9)							
	72										3	1		1							
	73				1					1	6	1		31(3)							
	74										4	7(1)		16(10)		1(1)					
	75													6(1)							
	76		1		1		1				1(1)	1		3(1)							
	77			1							4	7	5	64(1)							
12	78	4	3		3	1	2			1											
	79	3	9	1	8																
	80		1		2		2														
	81	4			4	3	1							1				2			
	82	1	5																		
	83							1			1			10(2)							
	84																2	1			
	85															3	9	6			
	86	11	11	2																	
	87					9															
13	88							1		15(6)	4(1)			11	6(1)	2					**1g** (YEX12); **2b.2** (YEX09); **2b.3** (YEX03, 32, YEX-N); **3g** (YEX38)
	89										3			18							
	90							1(1)		4(3)	10(9)	3(1)	1(1)	16(11)							
	91										4			9(3)							
	92										15(11)	20(12)	2(1)	16(12)							
	93										7(5)	1		1(1)							
	94										5(5)	12(9)	4(4)	69(51)							
	95										1	3		8(6)				1(1)			
	96										5(4)							3(1)	5(3)		
14	97																13(7)	3(1)	39(13)		
	98																		34(24)		
	99																		19(12)		
	100															5(2)	13(3)	15(7)	24(4)		
																					low stony hills; valley floors; creeklines

EXPLANATION OF PROJECT CODES

FMGA	FMG Stage A rail corridor between Port Hedland and Mindy Mindy (Biota 2004c)
FMGB	FMG Stage B rail corridor (this study)
HDRAIL	Hope Downs rail corridor between Port Hedland and Weeli Wolli (Biota and Trudgen 2002)
HDRAIL A/D	Hope Downs rail corridor - Chichester Range Addition (Biota 2004a) and Hamersley Range Extension (Biota 2004b)
MILL	West Angelas Millstream Rail Segment
PAN	Panorama study area (Trudgen et al. 2002)
WAACRD	West Angelas mine access road (Trudgen and Casson 1998)
WACOOWES	West Angelas Coondewanna West rail corridor (Trudgen and Casson 1998)
WAEIMIWE	West Angelas Eight Mile Well survey (Trudgen and Casson 1998)
WAFCBOR	West Angelas Four Corners Bore rail corridor (Trudgen and Casson 1998)
WAFORSLO	West Angelas Fortescue Slopes rail corridor (Trudgen and Casson 1998)
WAGEORIV	West Angelas George River rail corridor (Trudgen and Casson 1998)
WAHAMPAR	West Angelas Hamersley Parallel rail corridor (Trudgen and Casson 1998)
WAHAMSTN	West Angelas Hamersley Station survey (Trudgen and Casson 1998)
WAMTHER	West Angelas Mt Herbert rail corridor (Trudgen and Casson 1998)
WAMTLEA	West Angelas Mt Leal rail corridor (Trudgen and Casson 1998)
WAMTROB	West Angelas Mt Robinson rail corridor (Trudgen and Casson 1998)
WASA	West Angelas mine area (Trudgen and Casson 1998)
YANEXP	Hamersley Iron Yandi Expansion area (Biota in prep.)

5.0 Flora

5.1 General

A total of 319 taxa of native vascular flora from 150 genera belonging to 53 families was recorded from the Yandi Expansion area (see Appendix 1). Thirteen introduced species were also recorded (see Section 5.3).

The number of vascular flora recorded from the Yandi expansion area is comparable to the number of species recorded for surveys undertaken in similar areas of a similar size. The previous surveys of the Yandicoogina Junction area and southern transport corridor recorded 336 species from 57 families and 392 species from 60 families respectively (Mattiske and Associates 1995a, 1995b), however both areas were considerably larger than the current study area.

The families and genera with the greatest number of taxa are shown in Table 5.1. These families and genera are typically predominant in the vegetation of the central Pilbara, and usually have most representatives on flora lists from this region, due to their prominence in the Eremaean flora. Some of the families (eg. the Amaranthaceae, Malvaceae and Poaceae) are more species rich in the Northern flora and poorer in the Southern flora, while others (such as the Mimosaceae) are abundant in all three.

Table 5.1: Most species rich families and genera within the Yandi Expansion Area.

Family	**No. of Native Taxa**
Poaceae (grass family)	52
Malvaceae (hibiscus family)	31
Mimosaceae (wattle family)	29
Papilionaceae (pea family)	23
Asteraceae (daisy family)	18
Amaranthaceae (mulla-mulla family)	18
Chenopodiaceae (goosefoot family)	11
Convolvulaceae (morning glory family)	10
Myrtaceae (eucalypt/myrtle family)	10
Euphorbiaceae (spurge family)	9
Caesalpiniaceae (cassia family)	9
Goodeniaceae (leschenaultia family)	9
Genus	**No. of Native Taxa**
Acacia (wattle family)	28
Ptilotus (mulla mulla family)	13
Sida (hibiscus family)	10
Abutilon (hibiscus family)	8
Hibiscus (hibiscus family)	8
Senna (cassia family)	8
Eriachne (grass family)	7
Tephrosia (pea family)	7
Goodenia (leschenaultia family)	7
Solanum (potato family)	7
Euphorbia (spurge family)	6
Triodia (grass family)	5

The most frequently encountered species through the area included: *Acacia bivenosa, A. dictyophleba, A. pruinocarpa, Aristida holathera* var. *holathera, Bulbostylis barbata, Corymbia hamersleyana, Dysphania rhadinostachya, Eriachne pulchella* subsp. *dominii,*

Goodenia microptera, G. stobbsiana, Gossypium australe (Burrup Peninsula form), *Grevillea wickhamii, Paraneurachne muelleri, Polycarpaea holtzei, Porana commixta, Pterocaulon sphaeranthoides, Ptilotus astrolasius* var. *astrolasius, P. exaltatus, Senna glutinosa* subsp. x *luerssenii, Themeda triandra, Trichodesma zeylanicum* var. *zeylanicum, Triodia pungens, T.* aff. *basedowii* and *T. wiseana.* Some of these species were common dominant species in the area (eg. the spinifex *Triodia* spp.) or frequently contributed to vegetation structure (eg. the wattles *Acacia bivenosa* and *A. dictyophleba* and the eucalypt *Corymbia hamersleyana*). Others were species with wide environmental tolerance, but usually with low abundance (eg. *Eriachne pulchella* subsp. *dominii* and *Porana commixta*).

5.2 Flora of Conservation Significance

5.2.1 Levels of Conservation Significance

While all native flora are protected under the *Wildlife Conservation Act 1950-1979*, a number of plant species are assigned an additional level of conservation significance based on the limited number of known populations and the perceived threats to these populations (Table 5.2). Species of the highest conservation significance are designated Declared Rare Flora (DRF), either extant or presumed extinct. Species that appear to be rare or threatened, but for which there is either insufficient information to properly evaluate their conservation significance or they are variously threatened to a lesser degree than DRF, are assigned to one of four Priority flora categories.

In addition, the presence of some flora species means that it may be necessary to refer proposals to the Federal Minister for the Environment under the *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*). In the Pilbara, only the two DRF species *Lepidium catapycnon* and *Thryptomene wittweri* are currently listed under the *EPBC Act*.

Table 5.2: Categories of conservation significance for flora species (Atkins 2004).

Declared Rare Flora - Extant Taxa. Taxa that have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction or otherwise in need of special protection.
Declared Rare Flora - Presumed Extinct. Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently.
Priority 1 - Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations which are under threat.
Priority 2 - Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under threat.
Priority 3 - Poorly Known Taxa. Taxa which are known from several populations, at least some of which are not believed to be under threat.
Priority 4 - Rare Taxa. Taxa which are considered to have been adequately surveyed and which whilst being rare, are not currently threatened by any identifiable factors.

5.2.2 DRF and Priority flora previously recorded from the vicinity of the project area

One Declared Rare Flora and four Priority flora have been recorded previously in the vicinity of Yandi:

- *Lepidium catapycnon* (Declared Rare Flora);
- *Goodenia omearana* (Priority 1);
- *Olearia fluvialis* (Priority 2);

- *Abutilon trudgenii* (Priority 3);
- *Goodenia stellata* (Priority 4).

5.2.3 DRF and Priority flora recorded from the Yandi Expansion Area

The two DRF species known to occur in the Pilbara, *Lepidium catapycnon* and *Thryptomene wittweri*, were not recorded from the Yandi Expansion area. There are therefore no flora of significance under the *EPBC Act* in the survey area.

The survey recorded five Priority species (Table 5.3), each of which is discussed below. Locations of these species are shown on Figure 4.1.

Table 5.3: Summary of Priority flora locations within the Yandi Expansion area.

Species	Priority	Records
Olearia fluvialis	P2	1 (YEX-K)
Sida sp. Barlee Range (S van Leeuwen 1642)	P2	1 (YEX16)
Abutilon trudgenii ms.	P3	5 (YEX25, 27, 31, 32, 33)
Themeda sp. Hamersley Station (M.E. Trudgen 11431)	P3	1 (YEX23)
Goodenia stellata	P4	1 (YEX08)

- ***Olearia fluvialis*** **Priority 2**

This perennial, low-shrub form daisy was recorded as scattered individuals from releve YEX-K in Yandicoogina Creek (Figure 4.1).

O. fluvialis was recorded from three sites during the West Angelas surveys (Trudgen and Casson 1998), and is also known from the Hamersley Range and Karijini National Park (Atkins 2004), and from Marillana Creek (Weston and Trudgen 1995; K. McCreery and M. Maier, pers. obs.). A collection of *O. fluvialis* was also made from the Shaw River, during another survey south-south-east of Port Hedland (Trudgen et al. 2002), and has been recorded from the Turner River and Chinnamon Creek (Biota and Trudgen 2002). This species appears to be quite uncommon, rather than rare, and is certainly restricted to sporadic populations in riverine habitats.

- ***Sida*** **sp. Barlee Range (S van Leeuwen 1642)** **Priority 2**

This low shrub was recorded as scattered individuals from a single site (YEX16) on the bank of Yandicoogina Creek (Figure 4.1). Five specimens of this species are currently lodged at the Western Australian Herbarium from four separate locations; Kookhabinna Gorge in the Barlee Range Nature Reserve, southwest of Turee Creek Homestead, west of Hamersley Homestead and near Tom Price.

- ***Abutilon trudgenii*** **ms.** **Priority 3**

This short-lived (1-2 years) low shrub is stimulated by fire and is consequently typically recorded from recently burnt areas. *A. trudgenii* is poorly collected, rather than rare, because of its straggly, open appearance and inconspicuous flowers.

Specimens of *A. trudgenii* are lodged at the WA Herbarium from Cane River, Hillside Station, Goldsworthy and Tom Price. However, according to the Priority Species List this species is known from other locations including Warralong, Woodstock, Point Sampson, Karratha and Pannawonica (Atkins 2004). It has also been recorded from Yanrey Station on the eastern side of the Exmouth Gulf (M. Maier, pers. obs.), west of Dampier (Halpern Glick Maunsell 2000), south-south-east of Port Hedland (Trudgen et al. 2002), from the Hope Downs rail corridor (Biota and Trudgen 2002), the Fortescue Metals Group rail corridors (Biota 2004a, 2004b), and 23 times by Trudgen and Casson (1998) during the West Angelas surveys. This species is poorly collected rather than rare and should be removed from the Priority flora list.

During the current survey this species was recorded from five sites, mostly on alluvial clay flats (Figure 4.1, Table 5.3). It is probable that it will also be recorded from the recently burnt sections of the Yandi Expansion area when these are surveyed in 2005.

***Abutilon trudgenii* ms.: growth form, leaf, and fruit (note reflexed pedicels).**

- ***Themeda* sp. Hamersley Station (ME Trudgen 11,431)** **Priority 3**

This perennial tussock grass is from 1.3 to 1.8 m tall, and typically grows in red cracking clay in tussock grasslands or in clayey creeks. It often occurs as an occasional specimen but may form dense grasslands over large areas of cracking clay plains. It differs from the more common and widespread *Themeda triandra* by its larger size and sturdier culms and its pale bluish colouring (*T. triandra* has yellowish colouring).

Atkins (2004) lists *Themeda* sp. Hamersley Station as occurring at Karratha, Millstream, Hamersley Station, West Angelas and Coondewanna Flats. According to Florabase, there appear to be eight records of this species. It has also recently been observed at West Angelas and Wannamunna Flats (50km south-east of West Angelas) (Kelli McCreery, pers. obs.), and has been recorded from the Hope Downs rail corridor (Biota and Trudgen 2002) and Fortescue Metals Group rail corridors (Biota 2004a, 2004b).

During the current survey, *Themeda* sp. Hamersley Station was recorded from a single site (YEX23) on a floodplain north of Yandicoogina Creek (Figure 4.1).

- ***Goodenia stellata*** **Priority 4**

This small rhizomatous perennial herb has been recorded from several localities in the West Angelas area (Trudgen and Casson 1998), and is known from numerous populations in the vicinity of Yandi (Weston and Trudgen 1995; Halpern Glick Maunsell 1997). It is also known from a number of additional Pilbara locations including Yampire Gorge, Sandstone and Erlistoun Station (Atkins 2004), and extends to the South Carnarvon Range in the Little Sandy Desert. Of concern with respect to this species is that what appear to be populations of numerous individuals (rosettes) may in fact be clones of one or a few individuals.

During the current survey, this species was recorded once from YEX08, in a tributary of Weeli Wolli Creek (Figure 4.1).

5.2.4 Other Flora of Conservation Interest

Several families and genera show a particularly high degree of speciation in the Pilbara (eg. the Malvaceae and Tiliaceae families, and the genera *Euphorbia, Indigofera* and *Tephrosia*). As a consequence of the sporadic nature of botanical collections from the Pilbara and the lack of resources for taxonomic research, there are numerous undescribed taxa, most of which are poorly collected.

The following undescribed flora are not listed as DRF or Priority species by CALM, but may still be of some conservation interest:

- ***Euphorbia*** The spurge genus *Euphorbia* in the Pilbara contains many more taxa than are currently recognised. The undescribed taxa recorded from the Yandi Expansion area have been recorded previously during surveys in the region and are not restricted to the project area.
- ***Indigofera monophylla*** *Indigofera 'monophylla'* in the Pilbara contains a number of distinct entities. The forms present in the Yandi Expansion area are frequently recorded during surveys in the region.
- ***Polymeria* aff. *ambigua*** The two forms of *Polymeria* with apparent affinities to *P. ambigua* collected from the Yandi Expansion area have been recorded during previous surveys in the region and are not restricted.
- ***Tephrosia*** The pea genus *Tephrosia* contains many more taxa than are currently recognised for the Pilbara. The undescribed taxa recorded from the Yandi Expansion area have been recorded previously during surveys in the region.
- **Malvaceae** The Malvaceae family is in urgent need of a taxonomic revision, and most Pilbara surveys record undescribed taxa from this group. A number of the *Abutilon, Hibiscus* and *Sida* taxa collected from the Yandi Expansion area appear to represent undescribed taxa. While the status of these taxa is not known, all have been recorded during previous surveys in the region and are thus not restricted to the project area.

5.3 Introduced Flora

Thirteen species of introduced flora were recorded from the project area (Table 5.4). With the exception of **Sisymbrium irio*, which appears to be a new record for the Pilbara, all of the species are common weeds in the region. Drainage features are particularly susceptible to weeds, and most of the Yandi Expansion sites with substantial weed infestations were located in such habitats.

Table 5.4: Introduced flora recorded from the Yandi Expansion area.

Species	Number of Records
**Acetosa vesicaria* (Ruby Dock)	2 (YEX17, 25)
**Argemone ochroleuca* subsp. *ochroleuca* (Mexican Poppy)	4 (YEX16, 17, 21, 25)
**Bidens bipinnata* (Beggars Ticks)	3 (YEX09, 17, 25)
**Cenchrus ciliaris* (Buffel Grass)	14 (YEX02, 03, 04, 08, 09, 16, 17, 20, 21, 23, 25, 27, 28, 29)
**Conyza bonariensis* (Flaxleaf Fleabane)	2 (YEX16, 20)
**Cynodon dactylon* (Couch)	1 (YEX-K)
**Datura leichhardtii* (Native Thornapple)	1 (YEX-K)
**Malvastrum americanum* (Spiked Malvastrum)	9 (YEX02, 04, 08, 17, 20, 21, 25, 27, 29)
**Pseudognaphalium luteoalbum* (Jersey Cudweed)	3 (YEX20, 39, YEX-K)
**Setaria verticillata* (Whorled Pigeon Grass)	5 (YEX07, 16, 21, 25, YEX-L)
**Sisymbrium irio* (London Rocket)	2 (YEX17, 21)
**Solanum nigrum* (Black Berry Nightshade)	2 (YEX16, 21)
**Sonchus oleraceus* (Common Sowthistle)	3 (YEX16, 21, YEX-K)

Distribution of the weed species was as follows (see also Figure 5.1):

- Ruby Dock **Acetosa vesicaria* occurred as scattered individuals at two sites, one in Marillana Creek and one in Yandicoogina Creek.

- Mexican Poppy **Argemone ochroleuca* occurred as scattered individuals at one site in Marillana Creek and three sites in Yandicoogina Creek. Although this species is listed as a Declared Plant under the *Agriculture and Related Resources Protection Act 1976,* there are no specific requirements for its control in the Pilbara region; it is listed as P1 (movement of plants or their seeds is prohibited) for the whole of the State, *except* the municipal districts of Ashburton, East Pilbara, Port Hedland and Roebourne.
- Beggars Ticks **Bidens bipinnata* is an annual daisy that is a common weed of creekline and Mulga habitats. It was recorded once from Marillana Creek, once from Yandicoogina Creek and once from a floodplain associated with a tributary of Weeli Wolli Creek.
- Buffel Grass **Cenchrus ciliaris* was introduced as a fodder species by pastoralists. While this highly invasive species has demonstrated allelopathic capacities (whereby it releases chemicals that inhibit growth of other species), it is not listed as a Declared Weed due to its importance to the pastoral industry. In spite of this, **Cenchrus ciliaris* is acknowledged by the Department of Agriculture Weed Science Group as a serious environmental problem and its spread is to be actively avoided (Rod Randall, pers. comm.).

  Dense grasslands of **Cenchrus* are common along creeklines and on loamy plains in the Pilbara, particularly those that have been subject to disturbance. Within the Yandi Expansion area, **C. ciliaris* was recorded from 14 sites, largely associated with the Yandicoogina, Marillana and Weeli Wolli Creek systems.
- Flaxleaf Fleabane **Conyza bonariensis* is an occasional weed of drainage areas in the Pilbara and was recorded from two sites associated with the Yandicoogina Creek system.
- Couch **Cynodon dactylon* was recorded from a single location in Yandicoogina Creek. It is a very occasional weed of inland drainage areas in the Pilbara.
- Native Thornapple **Datura leichhardtii* was recorded from a single location in Yandicoogina Creek. As indicated by the common name, this species was originally thought to be native, however it is actually a native of Mexico (Hussey et al. 1997). While it remains a Declared Plant in other regions of Western Australia, **D. leichhardtii* was removed from the Department of Agriculture's Declared Plants list for the Eastern Pilbara in 2004 (Department of Agriculture 2004).
- Spiked Malvastrum **Malvastrum americanum* was recorded as scattered individuals from nine sites, all located within the Yandicoogina, Marillana or Weeli Wolli Creek systems. This species can be abundant in creekline and Mulga habitats, particularly in good seasons.
- Jersey Cudweed **Pseudognaphalium luteoalbum* was recorded from three sites associated with the Yandicoogina Creek system. This species is an occasional weed of drainage areas in the Pilbara.
- Whorled Pigeon Grass **Setaria verticillata* was recorded as scattered individuals at three sites in Yandicoogina Creek, one site in Marillana Creek and one site in a tributary of Weeli Wolli Creek. In good seasons, this species can be abundant in some habitats.
- London Rocket **Sisymbrium irio* was recorded as scattered individuals at two sites in Yandicoogina Creek.
- Black berry nightshade **Solanum nigrum* was recorded as scattered individuals at two sites in Yandicoogina Creek.
- Common Sowthistle **Sonchus oleraceus* was recorded as scattered individuals at three locations in Yandicoogina Creek. This species is a common weed of creek habitat in the Pilbara, but is rarely abundant.

6.0 Discussion

6.1 Summary of Features of Conservation Significance within the Yandi Expansion Area

Features of conservation significance have been assessed at the following levels:

1. National level – features at this level would essentially comprise nationally listed flora species (essentially Declared Rare Flora) or nationally listed Threatened Ecological Communities (including only some of the TECs listed at the State level) protected under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*;
2. State level – features at this level would essentially comprise species on the Declared Rare and Priority flora listing maintained by CALM or Threatened Ecological Communities listed by CALM;
3. Pilbara bioregion level – features at this level would include regionally restricted flora species and vegetation communities; and
4. Hamersley Ranges sub-region level – features at this level would include flora taxa of restricted distribution within the sub-region and ephemeral watercourses and other ecosystems as risk (see Kendrick 2003).

6.1.1 National Level

No flora species or Threatened Ecological Communities listed under the *EPBC Act 1999* are known from the Yandi Expansion area. There are thus no features of national conservation significance within the project area.

6.1.2 State Level

At the State level, there are no Declared Rare Flora known from the Yandi Expansion area, however five Priority flora have been recorded. No Threatened Ecological Communities listed by CALM occur in the area.

6.1.3 Pilbara Bioregion Level

The vegetation types recorded from the study area do not appear to be restricted within the region in terms of their floristic composition. With the exception of the Priority flora (mainly *Olearia fluvialis* and *Sida* sp. Barlee Range (S van Leeuwen 1642)), the flora species recorded are relatively common and widespread in the region.

6.1.4 Hamersley Ranges Sub-region Level

The suite of flora species recorded from the Yandi Expansion area is largely typical of that expected for this part of the Hamersley Ranges. With the exception of *Sida* sp. Barlee Range (S van Leeuwen 1642), all of the Priority flora species have been recorded during other surveys in the locality. The study area thus has moderate conservation value for both general flora and significant flora species.

The following vegetation types are of conservation significance at the level of the Hamersley Ranges sub-region:

- 3c, 3d, 3e, 3f and 3h, associated with the Yandicoogina, Marillana and Weeli Wolli Creek systems; comprise an ecosystem at risk (Kendrick 2003) and support suites of species restricted to major creekline habitats; and

· 1c of breakaways; small areal extent and supports suites of species restricted to such rocky habitats.

6.2 Impacts of the Proposed Development

The proposed development is relatively small in scale, but is situated adjacent to existing mining operations along Marillana Creek. The initial impact of the development would comprise direct clearing of vegetation to establish the mine pit and infrastructure, with subsequent possible impacts including changes to surface and below ground hydrology. An increase in the level of weeds and fires within the area is also possible. While the impacts of the Yandi Expansion alone are unlikely to be significant, the proposed project is located along a creek system already subject to several other mining developments, and cumulative impacts therefore need to be considered.

6.2.1 Vegetation Clearing

Clearing of vegetation will be required for the mine pit area, a waste dump, and for establishment of infrastructure such as physical plant, a conveyor, an access track and haul road.

The area of each vegetation type required to be cleared for the proposed project (on the basis of the currently proposed mine plan) is shown in Table 6.1. A total of 511 ha will be cleared for the development.

Table 6.1: Area of each vegetation type to be cleared for the Yandi Expansion.

Vegetation Type	Area to be cleared (ha)	Proportion of total area mapped within the Yandi Expansion area (%)
Low Stony Hills		
1a	11.50	5.2
1b	213.97	28.8
1c	0.16	3.0
1d	27.13	54.5
1e	-	-
1f	1.31	2.1
1g	12.29	70.6
Valley Floors		
2a	27.06	12.4
2b	98.40	49.3
2c	34.99	79.7
Creeklines		
Minor Creeks		
3a	22.80	11.0
3b	52.58	33.5
Major Creeks		
3c	-	-
3d	0.34	0.9
3e	1.75	2.1
3f	1.11	1.7
3g	-	-
3h	0.97	2.7
Unmapped*	4.60	8.7
Total	**510.96**	**22.7**

* would comprise vegetation types 1a, 1b and 3a.

Clearing in the vicinity of the significant vegetation types should be avoided where possible, and otherwise minimised. This essentially comprises riverine vegetation of Weeli Wolli, Yandicoogina and Marillana Creeks (vegetation types 3c-3h) and vegetation of breakaways (vegetation type 1c). Based on the current mine plan, a total of 4.2 ha of riverine vegetation will be required to be cleared, together with 0.16 ha of breakaway habitat. Clearing of these small areas would not be expected to decrease the conservation value of these habitats in the locality.

Similarly, clearing of the locations supporting the five Priority flora species should be avoided wherever possible, particularly with respect to the less widespread *Olearia fluvialis* and *Sida* sp. Barlee Range (S van Leeuwen 1642). The current mine plan indicates that four of the locations of *Abutilon trudgenii* identified within the project area will be cleared (two along the heavy haulage road and two within the pit area) and the location of *Goodenia stellata* will be cleared to construct the eastern cut-off drain. Both of these species have been recorded numerous times in the locality, and the loss of these stands of individuals would not be expected to impact on the conservation status of the species.

6.2.2 Groundwater Drawdown

Drawdown of groundwater levels in underground aquifers as a result of mining below the watertable and/or water abstraction from borefields can impact phreatophytic vegetation dependent on such water sources (eg. Cadjeputs *Melaleuca argentea,* River Red Gums *Eucalyptus camaldulensis* and Coolibahs *E. victrix*). The nature of such impacts depends on the location, depth and extent of any drawdown cone, together with the speed of drawdown and timeframe of the impact.

Within the Yandi Expansion area, phreatophytic vegetation is restricted to the major creek systems of Yandicoogina, Marillana and Weeli Wolli Creek. The sections of these creeks within the study area support various combinations of Cadjeput *Melaleuca argentea,* River Red Gum *Eucalyptus camaldulensis*, Coolibah *E. victrix* and an assemblage of aquatic plants, all of which are reliant on either surface water or ground water.

The degree of likely drawdown arising from the development, and therefore the distance along the creek alluvium that may be affected, are uncertain at present. Similarly the cumulative impacts of mine dewatering from the various operations along Marillana Creek are at present unknown. Hydrological studies for the Yandi Expansion area are under way and will be completed in 2005, and a study by the University of Western Australia is also being undertaken to investigate the probable impacts of groundwater drawdown on phreatophytic vegetation in the Yandi Expansion area.

6.2.3 Disposal of Excess Water

Water arising from dewatering of mine pits is typically utilised in mine operations wherever possible (eg. for dust suppression, cooling systems etc), with the aim of having nil discharge requirements. Where dewatering generates water quantities in excess of those that can be used on site, the excess is typically discharged into existing creek systems, provided that the water quality is appropriate. This can lead to the establishment of artificially high densities of riverine vegetation, which cannot be maintained post-closure.

Hydrological studies are currently under way to determine whether the proposed Yandi Expansion project will generate excess water from mine pit dewatering.

6.2.4 Disruption to Surface Hydrology

Given the presence of three major creek systems in the project area, care will need to be taken to minimise disruption to existing surface water flows.

Two crossings of Yandicoogina Creek will need to be constructed for a heavy haulage road and light vehicle access road; the former will be a causeway style crossing, while the latter will be bridged. Neither crossing would be expected to impede surface water flow through this creek system.

The mine pit and waste dump are located over the tributary system from the Weeli Wolli Creek in the southern section of the study area. The section of the tributary within the mine put and waste dump areas will obviously be lost, while the remaining sections will need to be diverted around the mine pit via cut-off drains. This would result in a reduction in water input to the section of the creek tributary system downstream of the pit, which may effectively mean that a greater area will be lost than that immediately impacted by the mine pit and waste dump.

6.2.5 Introduction and/or Spread of Weed Species

Thirteen introduced flora species were recorded from the Yandi Expansion area, at least one of which is a serious environmental weed (Buffel grass **Cenchrus ciliaris*; Section 5.3). Earthworks, disturbance to vegetation, vehicle movement and other factors have the potential to introduce additional weeds to the area and to spread existing populations of introduced flora within the development areas. The presence of cattle may add to the disturbance, through trampling and also selective grazing, as they tend to prefer native grasses to Buffel Grass.

Mesic habitats such as creeklines and floodplains are particularly susceptible to weed invasion. Within the Yandi Expansion area, the main areas supporting significant weed infestations were within Weeli Wolli Creek, and to a lesser extent areas of Marillana Creek and the section of Yandicoogina Creek downstream of the junction with Marillana Creek. Care will need to be taken to avoid spread of weeds into the section of Yandicoogina Creek upstream of the junction with Marillana Creek, particularly during construction of the light vehicle access road.

6.2.6 Increase in Fire Frequency / Intensity

The long-term effect of changed fire regimes on vegetation condition is unknown, however repeated burns can favour the spread of weeds such as Buffel Grass as these tend to recover before native grasses and herbs. In addition, frequent fires can prevent the regeneration of some vegetation communities (eg. Mulga) by continually removing stands of perennial species before they can reach reproductive maturity and replenish the soil seed bank.

6.2.7 Dust

Dust generated during the construction, operation and maintenance of the proposed mine has the potential to negatively affect surrounding vegetation, but this is considered to be a minor impact provided standard dust suppression measures are implemented.

6.3 Recommendations for Management

The following management strategies are aimed at minimising disturbance to the vegetation and flora of the Yandi Expansion area:

- Prior to construction, undertake rare flora searches in the areas burnt prior to this survey to ensure that any such populations are fully documented.

- Maintain surface drainage features, and minimise disturbance to the Marillana, Yandicoogina and Weeli Wolli Creek systems, wherever possible. Both direct (eg. vegetation clearing, possible discharge of excess water from mine dewatering) and

indirect (eg. groundwater drawdown, spread of weeds) mechanisms should be considered as part of the mine planning process. Impacts of such factors will need to be reviewed following completion of the hydrological and other studies.

- Avoid disturbance to the locations supporting Priority flora species wherever possible, particularly with respect to *Olearia fluvialis* and *Sida* sp. Barlee Range (S van Leeuwen 1642).

- Minimise disturbance to general vegetation and flora:
  - Clearing limits should be clearly defined in the field and strictly adhered to;
  - Existing tracks should be utilised wherever possible and off-road driving should be prohibited;
  - Appropriate weed hygiene measures should be carried out to minimise the risk of introduction/spread of weed propagules or infected soil (ie. standard washdown of earth-moving equipment should be done prior to any earthworks in the area of Yandicoogina Creek upstream of the Marillana Creek junction, and also prior to equipment leaving the Yandi Expansion area, to prevent spread of weeds into other areas).

7.0 Acknowledgements

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List of Vascular Flora Recorded from the Yandi Expansion Area

Appendix 1

BIOta

NB. - Use of an asterisk (*) prior to a species name indicates an introduced (weed) species.

Acanthaceae
Dicladanthera forrestii
Rostellularia adscendens subsp. *clementii*
Adiantaceae
Cheilanthes sieberi subsp. *sieberi*
Aizoaceae
Trianthema glossostigma
Trianthema pilosa
Amaranthaceae
Achyranthes aspera
Alternanthera nana
Alternanthera nodiflora
Amaranthus pallidiflorus
Gomphrena cunninghamii
Ptilotus aervoides
Ptilotus astrolasius var. *astrolasius*
Ptilotus auriculifolius
Ptilotus calostachyus var. *calostachyus*
Ptilotus clementii
Ptilotus exaltatus var. *exaltatus*
Ptilotus fusiformis var. *fusiformis*
Ptilotus gaudichaudii var. *gaudichaudii*
Ptilotus helipteroides var. *helipteroides*
Ptilotus obovatus var. *obovatus*
Ptilotus polystachyus var. *polystachyus*
Ptilotus roei
Ptilotus rotundifolius
Apiaceae
Trachymene oleracea subsp. *oleracea*
Asclepiadaceae
Sarcostemma viminale subsp. *australe*
Asteraceae
**Bidens bipinnata*
Calotis plumulifera
Centipeda minima
Chrysocephalum apiculatum
**Conyza bonariensis*
Flaveria australasica
Helichrysum gilesii
Ixiochlamys cuneifolia
Olearia fluvialis
Pluchea dentex
Pluchea dunlopii
Pluchea ferdinandi-muelleri
Pluchea rubelliflora
**Pseudognaphalium luteoalbum*
Pterocaulon sphaeranthoides
Rhodanthe floribunda
Rhodanthe margarethae
**Sonchus oleraceus*
Streptoglossa bubakii
Streptoglossa decurrens
Vittadinia arida
Vittadinia obovata
Boraginaceae
Heliotropium cunninghamii
Heliotropium inexplicitum
Heliotropium pachyphyllum
Heliotropium tenuifolium
Trichodesma zeylanicum var. *zeylanicum*
Brassicaceae
Lepidium muelleri-ferdinandii
Lepidium oxytrichum
Lepidium phlebopetalum
**Sisymbrium irio*
Caesalpiniaceae
Petalostylis labicheoides
Senna artemisioides subsp. x *artemisioides*
Senna artemisioides subsp. *helmsii*
Senna artemisioides subsp. *oligophylla*
Senna artemisioides subsp. *oligophylla* x *helmsii*
Senna glutinosa subsp. *glutinosa*
Senna glutinosa subsp. x *luerssenii*
Senna glutinosa subsp. *pruinosa*
Senna notabilis
Campanulaceae
Wahlenbergia tumidifructa
Capparaceae
Capparis spinosa var. *nummularia*
Cleome viscosa
Caryophyllaceae
Polycarpaea corymbosa var. *corymbosa*
Polycarpaea holtzei
Polycarpaea longiflora
Chenopodiaceae
Chenopodium melanocarpum
Dysphania kalpari
Dysphania rhadinostachya
Enchylaena tomentosa
Maireana planifolia
Maireana planifolia x *villosa*
Maireana villosa
Rhagodia eremaea
Salsola tragus
Sclerolaena cornishiana
Sclerolaena eriacantha
Convolvulaceae
Bonamia media var. *villosa*
Bonamia pannosa
Bonamia rosea
Convolvulus angustissimus subsp. *angustissimus*
Evolvulus alsinoides var. *decumbens*
Evolvulus alsinoides var. *villosicalyx*
Ipomoea muelleri
Polymeria aff. *ambigua* (CGC-25)
Polymeria aff. *ambigua* (PAN 26B-20)
Porana commixta
Cucurbitaceae
Mukia maderaspatana
Cyperaceae
Bulbostylis barbata
Cyperus difformis

Cyperus iria
Cyperus vaginatus
Eleocharis geniculata
Fimbristylis dichotoma
Fimbristylis simulans
Schoenoplectus subulatus
Elatinaceae
Bergia trimera
Euphorbiaceae
Euphorbia australis (mid-green form)
Euphorbia aff. *australis* (B191)
Euphorbia boophthona
Euphorbia coghlanii
Euphorbia sp. (site 1089)
Euphorbia tannensis subsp. *eremophila* (Hamersley form)
Leptopus decaisnei var. *decaisnei*
Phyllanthus erwinii
Phyllanthus maderaspatensis
Goodeniaceae
Dampiera candicans
Goodenia lamprosperma
Goodenia microptera
Goodenia muelleriana
Goodenia stellata
Goodenia stobbsiana
Goodenia triodiophila
Goodenia vilmoriniae
Scaevola parvifolia subsp. *pilbarae*
Gyrostemonaceae
Codonocarpus cotinifolius
Haloragaceae
Haloragis gossei
Lamiaceae
Clerodendrum tomentosum
Dicrastylis cordifolia
Dicrastylis georgei
Lobeliaceae
Lobelia quadrangularis
Loranthaceae
Amyema hilliana
Amyema miquelii
Lythraceae
Ammannia auriculata
Ammannia baccifera
Ammannia multiflora
Malvaceae
Abutilon dioicum
Abutilon fraseri
Abutilon lepidum
Abutilon aff. *lepidum* (1) (MET 15 352)
Abutilon aff. *lepidum* (4)
Abutilon macrum
Abutilon otocarpum
Abutilon trudgenii
Gossypium australe (Burrup Peninsula form)
Gossypium australe (Whim Creek form)
Gossypium robinsonii
Gossypium sturtianum
Hibiscus brachychlaenus
Hibiscus burtonii
Hibiscus aff. *coatesii* (MET 16,542)
Hibiscus aff. *coatesii* (site 664)
Hibiscus goldsworthii
Hibiscus leptocladus
Hibiscus sturtii var. aff. *campylochlamys* (MET 15,957)
Hibiscus sturtii var. *platychlamys*
**Malvastrum americanum*
Sida aff. *cardiophylla* (site 1215)
Sida aff. *fibulifera* (Site 1394)
Sida arenicola
Sida cardiophylla
Sida echinocarpa
Sida sp. A Kimberley Flora (P.A.Fryxell & L.A.Craven 3900)
Sida sp. Barlee Range (S.van Leeuwen 1642)
Sida sp. spiciform panicles (E. Leyland sn 14/8/90)
Sida sp. Wittenoom (W.R. Barker 1,962)
Sida sp. 'rugose'
Mimosaceae
Acacia adoxa var. *adoxa*
Acacia adsurgens
Acacia ancistrocarpa
Acacia aneura var. *aneura*
Acacia aneura var. *longicarpa*
Acacia aneura var. aff. *longicarpa* (MET 16,050)
Acacia aneura (flat curved; MET 15 548)
Acacia aneura (grey bushy form; MET 15 732)
Acacia aff. *aneura* (scythe-shaped; MET 15,743)
Acacia ayersiana
Acacia bivenosa
Acacia citrinoviridis
Acacia colei var. *colei*
Acacia coriacea subsp. *pendens*
Acacia coriacea subsp. *sericophylla*
Acacia dictyophleba
Acacia elachantha
Acacia farnesiana
Acacia hilliana
Acacia inaequilatera
Acacia maitlandii
Acacia pachyacra
Acacia pruinocarpa
Acacia pyrifolia
Acacia sclerosperma
Acacia synchronicia
Acacia tenuissima
Acacia tumida var. *pilbarensis*
Dichrostachys spicata
Molluginaceae
Mollugo molluginis
Moraceae
Ficus brachypoda

Myoporaceae
Eremophila forrestii
Eremophila fraseri
Eremophila latrobei subsp. *filiformis*
Eremophila longifolia
Myrtaceae
Calytrix carinata
Corymbia candida subsp. *candida*
Corymbia hamersleyana
Eucalyptus camaldulensis
Eucalyptus gamophylla
Eucalyptus leucophloia
Eucalyptus victrix
Eucalyptus xerothermica
Melaleuca argentea
Melaleuca glomerata
Nyctaginaceae
Boerhavia coccinea
Boerhavia gardneri
Oleaceae
Jasminum didymum subsp. *lineare*
Papaveraceae
**Argemone ochroleuca* subsp. *ochroleuca*
Papilionaceae
Crotalaria medicaginea
Crotalaria novae-hollandiae subsp. *novae-hollandiae*
Cullen leucanthum
Cullen leucochaites
Glycine canescens
Gompholobium polyzygum
Indigofera georgei
Indigofera monophylla
Indigofera monophylla (brown calyx form)
Indigofera monophylla (small calyx form)
Indigofera rugosa
Isotropis atropurpurea
Rhynchosia minima var. *australis*
Swainsona decurrens
Swainsona kingii
Tephrosia arenicola
Tephrosia aff. *clementii* (2)
Tephrosia densa
Tephrosia rosea var. *glabrior*
Tephrosia aff. *supina* (HD133-20)
Tephrosia sp. Bungaroo Creek (M.E.Trudgen 11601)
Tephrosia sp. Pilbara Ranges (S.van Leeuwen 4246)
Vigna lanceolata
Poaceae
Amphipogon caricinus
Amphipogon sericeus
Aristida contorta
Aristida holathera var. *holathera*
Aristida inaequiglumis
Aristida latifolia
**Cenchrus ciliaris*
Chrysopogon fallax
Cymbopogon ambiguus
Cymbopogon dependens
Cymbopogon obtectus
**Cynodon dactylon*
Dichanthium sericeum subsp. *humilius*
Digitaria brownii
Digitaria ctenantha
Elytrophorus spicatus
Enneapogon caerulescens
Enneapogon clelandii
Enneapogon lindleyanus
Enneapogon polyphyllus
Enteropogon acicularis
Eragrostis cumingii
Eragrostis dielsii
Eragrostis eriopoda
Eragrostis leptocarpa
Eragrostis pergracilis
Eragrostis tenellula
Eriachne aristidea
Eriachne helmsii
Eriachne lanata
Eriachne mucronata
Eriachne pulchella subsp. *dominii*
Eriachne pulchella subsp. *pulchella*
Eriachne tenuiculmis
Eulalia aurea
Heteropogon contortus
Iseilema vaginiflorum
Paraneurachne muelleri
Paspalidium basicladum
Paspalidium jubiflorum
Perotis rara
Schizachyrium fragile
Setaria dielsii
Setaria surgens
**Setaria verticillata*
Sporobolus actinocladus
Sporobolus australasicus
Themeda sp. Hamersley Station (M.E.Trudgen 11431)
Themeda triandra
Triodia aff. *basedowii*
Triodia lanigera
Triodia longiceps
Triodia pungens
Triodia wiseana
Triraphis mollis
Polygalaceae
Polygala aff. *isingii*
Polygonaceae
**Acetosa vesicaria*
Portulacaceae
Calandrinia ptychosperma
Portulaca oleracea
Portulaca pilosa
Potamogetonaceae

Potamogeton tricarinatus
Proteaceae
Grevillea wickhamii
Grevillea wickhamii subsp. *aprica*
Grevillea wickhamii subsp. *hispidula*
Hakea chordophylla
Hakea lorea subsp. *lorea*
Rubiaceae
Oldenlandia crouchiana
Psydrax latifolia
Santalaceae
Anthobolus leptomerioides
Santalum lanceolatum
Sapindaceae
Atalaya hemiglauca
Dodonaea coriacea
Dodonaea petiolaris
Scrophulariaceae
Peplidium sp. E (Flora of Australia)
Stemodia grossa
Solanaceae
**Datura leichhardtii*
Nicotiana occidentalis subsp. *obliqua*
Solanum centrale
Solanum cleistogamum
Solanum gabrielae
Solanum horridum
Solanum lasiophyllum
**Solanum nigrum*
Solanum phlomoides
Sterculiaceae
Keraudrenia velutina subsp. *elliptica* ms.
Melhania oblongifolia
Rulingia luteiflora
Waltheria indica
Surianaceae
Stylobasium spathulatum
Tiliaceae
Corchorus crozophorifolius
Corchorus aff. *lasiocarpus* subsp. *lasiocarpus*
Corchorus lasiocarpus subsp. *parvus*
Corchorus tectus
Triumfetta maconochieana
Typhaceae
Typha domingensis
Violaceae
Hybanthus aurantiacus
Zygophyllaceae
Tribulus macrocarpus
Tribulus suberosus

Raw Data from Floristic Survey Sites and Representative Photographs

Appendix 2

BIOta

Yandi Expansion Site YEX01
Described by Brian Morgan **Date** 31/08/2004 50 x 50m
AMG Zone 50732041mE, 7473229mN 732061mE, 7473274mN 732017mE, 7473295mN 731995mE, 7473249mN
Habitat Gently sloping, East - facing upper slope of hill.
Soil Red brown pebbly, cobbly, loamy sand.
Rock Type Ironstone?
Vegetation Eucalyptus leucophloia scattered low trees over Hakea chordophylla scattered tall shrubs over Triodia aff. basedowii mid-dense hummock grassland
Veg Condition Excellent
Fire Age Burnt ? 5 years ago

Yandi Expansion Site YEX02
Described by Raimond **Date** 31/08/2004 10 x 250 m
AMG Zone 50733554mE, 7474371mN 733562mE, 7474368mN 733454mE, 7474136mN 733444mE, 7474142mN
Habitat Riparian zone (E. bank) of Weeli Wolli Creek.
Soil Red clay with small amount of loam present.
Rock Type Ironstone
Vegetation Eucalyptus victrix open woodland over Acacia coriacea subsp. pendens, A. citrinoviridis low open woodland over *Cenchrus ciliaris closed tussock grassland
Veg Condition Very poor; total domination of understorey by Buffel grass. Cattle also graze the vegetation.
Fire Age This side of creek not recently burnt

Yandi Expansion Site YEX03
Described by Brian Morgan **Date** 31/08/2004 50 x 50m
AMG Zone 50732881mE, 7473769mN 732920mE, 7473800mN 732953mE, 7473762mN 732913mE, 7473731mN
Habitat Flat plain
Soil Red-brown pebbly loam to clay loam
Rock Type Ironstone
Vegetation Acacia aneura var. aff. longicarpa (MET 16,050), A. synchronicia, A. pruinocarpa low open woodland over Senna glutinosa subsp. x luerssenii open shrubland over Senna artemisioides subsp. oligophylla x helmsii, Solanum lasiophyllum low open shrubland over Triodia wiseana open hummock grassland
Veg Condition Excellent
Fire Age Burnt >7-10 years ago.
Notes Vegetation very variable with mixing of Mulga and areas of Acacia synchronicia, A. pruinocarpa / Triodia wiseana.

Yandi Expansion Site YEX04
Described by Kelli **Date** 31/08/2004 50 x 50 m
AMG Zone 50732961mE, 7473965mN 732983mE, 7473946mN 732926mE, 7473884mN 732900mE, 7473898mN
Habitat Creek
Soil Red clay
Rock Type Ironstone
Vegetation Corymbia hamersleyana, Eucalyptus xerothermica, Acacia aneura (flat curved; MET 15 548) low open woodland over Acacia bivenosa open shrubland over Themeda triandra, Paraneurachne muelleri open tussock grassland and Triodia wiseana (T. pungens) open hummock grassland
Veg Condition Excellent
Fire Age Recent, extremely patchy - occasional trees burnt.

Yandi Expansion Site YEX05
Described by Raimond **Date** 31/08/2004 50 x 50 m
AMG Zone 50732240mE, 7473976mN 732276mE, 7474022mN 732311mE, 7473977mN 732283mE, 7473936mN
Habitat Rocky, alluvial clay mild slope at base of low hills.
Soil Red colluvial / alluvial clay with lots of ironstone pebbles on soil surface.
Rock Type Ironstone
Vegetation Eucalyptus gamophylla low open woodland over Acacia ancistrocarpa open shrubland over Triodia aff. basedowii mid-dense hummock grassland
Veg Condition Excellent
Fire Age No sign of fire in the last 3-4 years

Yandi Expansion Site YEX06
Described by Brian Morgan **Date** 31/08/2004 50 x 50 m
AMG Zone 50731993mE, 7474007mN 731957mE, 7474041mN 731921mE, 7474009mN 731957mE, 7473971mN
Habitat Moderate, NE facing hill slope.
Soil Red-brown pebbly, cobbly loamy sand
Rock Type Ironstone
Vegetation Eucalyptus leucophloia scattered low trees over Grevillea wickhamii, Hakea chordophylla scattered tall shrubs over Acacia hilliana, A. adoxa var. adoxa low open heath over Triodia aff. basedowii hummock grassland

Veg Condition Excellent
Fire Age Burnt >5-7 years ago

Yandi Expansion Site YEX07
Described by Raimond **Date** 31/08/2004 10 x 250 m
AMG Zone 50732213mE, 7474367mN 732414mE, 7474514mN 732420mE, 7474506mN 732213mE, 7474356mN
Habitat Seasonally flowing, small drainage line approximately 5-10 m width.
Soil Red alluvial clay loam
Rock Type Ironstone
Vegetation Corymbia hamersleyana open woodland over Eremophila longifolia, Acacia tumida var. pilbarensis tall open shrubland over Themeda triandra tussock grassland
Veg Condition Excellent
Fire Age No evidence of fire scars on mature trees

Yandi Expansion Site YEX08
Described by Brian Morgan **Date** 1/09/2004 105 x 25 m
AMG Zone 50732719mE, 7474510mN 732653mE, 7474596mN
Habitat Banks of narrow creek.
Soil Red-brown sand
Rock Type ?
Vegetation Eucalyptus victrix scattered trees over Corymbia hamersleyana, Eucalyptus xerothermica scattered low trees to low open woodland over Acacia dictyophleba, A. pyrifolia, Eremophila longifolia, Gossypium robinsonii tall open scrub over Senna artemisioides subsp. oligophylla x helmsii, Tephrosia rosea var. glabrior low open shrubland over *Cenchrus ciliaris, Themeda triandra open to closed tussock grassland and Triodia pungens very open hummock grassland
Veg Condition Good - Very Good; a lot of Cenchrus.
Fire Age Burnt >7-10 years ago.

Yandi Expansion Site YEX09
Described by Raimond **Date** 1/09/2004 50 x 50m
AMG Zone 50732057mE, 7475377mN 732109mE, 7475376mN 732110mE, 7475327mN 732058mE, 7475328mN
Habitat Alluvial clay flat with small ironstone pebbles on soil surface. Overstorey vegetation dominated by Mulga.
Soil Red alluvial clay loam.
Rock Type Ironstone.
Vegetation Acacia aneura (flat curved; MET 15 548), A. ayersiana low woodland over Eremophila forrestii shrubland over mixed tussock grassland
Veg Condition Excellent; due to absence of weeds and no evidence of grazing.
Fire Age No evidence of fire scars on main trunks of trees.
Notes Elevation 518 m

Yandi Expansion Releve YEX10
Described by Raimond **Date** 1/09/2004 50 x 50 m
AMG Zone 50732042mE, 7477297mN 732090mE, 7477320mN 732111mE, 7477276mN 732066mE, 7477252mN
Habitat Mildly sloping hill - foothill / lower base area
Soil Red clay-loam - alluvial / colluvial deposition. Lots of ironstone pebbles present on the soil surface
Rock Type Ironstone
Vegetation Corymbia hamersleyana low open woodland over Hakea chordophylla, Grevillea wickhamii subsp. hispidula tall open shrubland over Corchorus lasiocarpus subsp. aff. lasiocarpus (YEX24-11) low open shrubland over Triodia aff. basedowii mid-dense hummock grassland
Veg Condition Excellent; no signs of grazing livestock present and no weeds.
Fire Age Surrounding areas close by are burnt in the last 2

Yandi Expansion Site YEX11
Described by Kelli **Date** 1/09/2004 50 x 50m
AMG Zone 50732213mE, 7477428mN 732236mE, 7477445mN 732286mE, 7477381mN 732264mE, 7477360mN
Habitat Creek
Soil Red sandy clay
Rock Type Ironstone
Vegetation Corymbia hamersleyana low open woodland over Petalostylis labicheoides open shrubland over Themeda triandra tussock grassland and Triodia pungens open hummock grassland
Veg Condition Excellent
Fire Age None evident

Yandi Expansion Site YEX12
Described by Brian Morgan **Date** 1/09/2004 50 x 50 m
AMG Zone 50732244mE, 7477598mN 732292mE, 7477615mN 732309mE, 7477568mN 732262mE, 7477550mN
Habitat Very gently sloping to flat valley floor - west-facing
Soil Red-brown gravelly, pebbly, cobbly loamy-sand

Rock Type Ironstone
Vegetation Acacia aneura (grey bushy form; MET 15 732), A. aneura (flat curved; MET 15 548), A. pruinocarpa scattered low trees over Senna glutinosa subsp. x luerssenii, Eremophila fraseri subsp. fraseri open shrubland over Triodia aff. basedowii hummock grassland
Veg Condition Excellent
Fire Age Burnt >5-7 years ago

Yandi Expansion Site YEX13
Described by Brian Morgan **Date** 1/09/2004 95 x 30 m
AMG Zone 50731766mE, 7477827mN 731790mE, 7477846mN 731708mE, 7477895mN 731691mE, 7477871mN
Habitat Edge, breakaway and upper slope of flat ridge
Soil Red-brown gravelly, pebbly sand
Rock Type Ironstone
Vegetation Eucalyptus leucophloia low open woodland over Grevillea wickhamii subsp. hispidula scattered tall shrubs to tall open shrubland over Triodia aff. basedowii mid-dense hummock grassland
Veg Condition Excellent
Fire Age Burnt >5-7 years ago
Notes Irregular shaped flat - follows edge of ridge (breakaway) as it curves - snappy gum habitat

Yandi Expansion Site YEX14
Described by Raimond **Date** 1/09/2004 50 x 50 m
AMG Zone 50731116mE, 7478140mN 731161mE, 7478166mN 731187mE, 7478122mN 731146mE, 7478095mN
Habitat Alluvial, red clay-loam drainage flat
Soil Red alluvial clay-loam with ironstone pebbles on soils surface
Rock Type Ironstone
Vegetation Acacia aff. aneura (scythe-shaped; MET 15,743) low open woodland over Acacia ancistrocarpa open shrubland over Triodia aff. basedowii (T. pungens) mid-dense hummock grassland
Veg Condition Excellent; no weed species present and no evidence of livestock grazing.
Fire Age No evidence of fire scars or recent burn on veg.

Yandi Expansion Site YEX15
Described by Kelli **Date** 1/09/2004 50 x 50 m
AMG Zone 50730116mE, 7478214mN 730164mE, 7478228mN 730179mE, 7478181mN 730132mE, 7478166mN
Habitat Plain
Soil Red sandy clay loam
Rock Type Ironstone
Vegetation Corymbia hamersleyana scattered low trees over Eucalyptus gamophylla scattered low mallees over Acacia inaequilatera, Hakea chordophylla tall open shrubland over Triodia lanigera mid-dense hummock grassland
Veg Condition Excellent
Fire Age Old - none evident

Yandi Expansion Site YEX16
Described by Raimond **Date** 2/09/2004 300 x 8-10 m`
AMG Zone 50731161mE, 7478695mN 731155mE, 7478718mN 730914mE, 7478528mN 730918mE, 7478522mN
Habitat Riparian zone (permanently and seasonally wet) beside Yandicoogina Creek
Soil Red alluvial deposited sand and loam amongst a high level of ironstone pebble cover
Rock Type Ironstone
Vegetation Eucalyptus camaldulensis open woodland to woodland over Acacia coriacea subsp. pendens, Melaleuca glomerata tall open shrubland over Cyperus vaginatus open sedgeland and Themeda triandra very open tussock grassland
Veg Condition Very Good; Mexican poppy present - 2 young plants. Buffel grass also present on creek edge.
Fire Age No evidence of burn scars on the mature Eucalypts
Notes Quadrat is a long unbounded area to incorporate only the wet riparian zone beside the creek.

Yandi Expansion Site YEX17
Described by Raimond **Date** 2/09/2004 75 x 35 m
AMG Zone 50730916mE, 7478840mN 730989mE, 7478854mN 731012mE, 7478826mN 730939mE, 7478812mN
Habitat River flood banks
Soil Red-brown gravelly, pebbly, cobbly matrix with some coarse sand
Rock Type ?
Vegetation Acacia citrinoviridis, A. coriacea subsp. pendens low open forest over Acacia pyrifolia, Gossypium robinsonii scattered tall shrubs over Triodia pungens very open hummock grassland and *Cenchrus ciliaris, Themeda triandra open tussock grassland
Veg Condition Good to Very Good
Fire Age >7-10 years ago
Notes Site YEX16 was done in riparian vegetation adjacent to permanent pool in main river flow line

Yandi Expansion Site YEX18
Described by Brian Morgan **Date** 2/09/2004 45 x 55 m
AMG Zone 50729933mE, 7478963mN 729976mE, 7478944mN 729948mE, 7478897mN 728907mE, 7478915mN
Habitat Very gently sloping, north-facing slopes of low rises in Marillana Creek valley
Soil Red-brown gravelly, pebbly sand
Rock Type Ironstone
Vegetation Corymbia hamersleyana scattered low trees over Acacia inaequilatera, Grevillea wickhamii subsp. hispidula scattered tall shrubs to tall open shrubland over Acacia ancistrocarpa open shrubland over Acacia adoxa var. adoxa, Gompholobium polyzygum, Corchorus lasiocarpus subsp. parvus low open shrubland over Triodia aff. basedowii hummock grassland
Veg Condition Excellent
Fire Age Burnt about 2 years ago.
Notes Also scattered Eucalyptus leucophloia in this unit.

Yandi Expansion Site YEX19
Described by Raimond **Date** 2/09/2004 50 x 50 m
AMG Zone 50730343mE, 7497249mN 730381mE, 7479285mN 730418mE, 7479250mN 730385mE, 7479211mN
Habitat Alluvial clay floodplain / flat area
Soil Red clay-loam (mostly clay) with a very small amount of ironstone pebbles on the soil surface
Rock Type Ironstone
Vegetation Eucalyptus xerothermica low open woodland over Acacia bivenosa open shrubland over Triodia pungens open hummock grassland and Aristida holathera var. holathera grassland
Veg Condition Excellent; no weed species present, some evidence of cattle grazing in the area.
Fire Age Burnt in the last year

Yandi Expansion Site YEX20
Described by Kelli **Date** 2/09/2004 50 x 50 m
AMG Zone 50730194mE, 7479231mN 730222mE, 7479189mN 730180mE, 7479166mN 730155mE, 7479210mN
Habitat Creek
Soil Red sandy clay
Rock Type Ironstone
Vegetation Eucalyptus xerothermica, Corymbia hamersleyana low open woodland over Petalostylis labicheoides, Acacia sclerosperma subsp. sclerosperma, A. dictyophleba, Gossypium robinsonii shrubland to tall shrubland over Triodia pungens open hummock grassland and mixed open tussock grassland
Veg Condition Very Good; seedlings of Conyza bonariensis 5% cover, cattle dung and trampling - probably grazed as well.
Fire Age No evidence
Notes Would expect to see Goodenia stellata, but none seen

Yandi Expansion Site YEX21
Described by Brian Morgan **Date** 2/09/2004 200 x 10 m
AMG Zone 50731224mE, 7478720mN 731415mE, 7478787mN
Habitat Sandy, gravelly, cobbly low rises in river bed.
Soil Red-brown gravelly, pebbly, cobbly matrix with coarse sand
Rock Type ?
Vegetation Eucalyptus camaldulensis (E. victrix) open forest over Acacia coriacea subsp. pendens, A. citrinoviridis low open forest over Corchorus crozophorifolius low open shrubland over Themeda triandra, Eriachne helmsii, Cymbopogon obtectus, *Cenchrus ciliaris and Triodia pungens very open hummock grassland
Veg Condition Very Good
Fire Age >5-7 years since fire
Notes Only elevated area within this site (not adjacent wash line)

Yandi Expansion Site YEX22
Described by Raimond **Date** 2/09/2004 50 x 50 m
AMG Zone 50730891mE, 7479434mN 730935mE, 7479462mN 730963mE, 7479417mN 730917mE, 7479393mN
Habitat Rocky hill slope and upper slopes
Soil Red skeletal clay over plate ironstone
Rock Type Plate ironstone (?shale)
Vegetation Grevillea wickhamii, Acacia inaequilatera scattered shrubs over Triodia wiseana mid-dense hummock grassland and Paraneurachne muelleri very open tussock grassland
Veg Condition Excellent; no weed species present
Fire Age No evidence of recent fire
Notes Elevation at NW point 521 m

Yandi Expansion Site YEX23
Described by Kelli **Date** 2/09/2004 50 x 50 m
AMG Zone 50731013mE, 7479142mN 731062mE, 7479134mN 731056mE, 7479084mN 731005mE, 7479093mN
Habitat Floodplain

Soil	Red sandy plain
Rock Type	Ironstone
Vegetation	Acacia dictyophleba, A. inaequilatera, A. pachyacra tall shrubland to shrubland over Triodia pungens mid-dense hummock grassland
Veg Condition	Excellent
Fire Age	Partially burnt +/-2 years ago

Yandi Expansion Site YEX24

Described by	Brian Morgan	**Date**	3/09/2004	50 x 50 m
AMG Zone	50729355mE, 7497211mN	729248mE, 7479224mN	729280mE, 7479261mN	729318mE, 7479229mN

Habitat	Crest and moderately sloping west facing upper slope of low ridge
Soil	Red-brown gravelly, pebbly, cobbly sand
Rock Type	Ironstone
Vegetation	Eucalyptus leucophloia scattered low trees over Triodia aff. basedowii mid-dense hummock grassland
Veg Condition	Excellent
Fire Age	Last fire 2-3 years ago
Notes	This area of low ridge slopes has areas of Triodia aff. basedowii dominant and other areas where Triodia wiseana is dominant

Yandi Expansion Site YEX25

Described by	Raimond	**Date**	3/09/2004	40 x 65 m
AMG Zone	50729459mE, 7478747mN	729493mE, 7478767mN	729535mE, 7478710mN	729489mE, 7478692mN

Habitat	Minor drainage line approximately 25 m wide, and associated riparian zone on both banks lining channel.
Soil	Red skeletal clay (very small amount deposited through alluvial action) over outcropping ironstone. Soil in riparian zone is alluvial clay-loam
Rock Type	Outcropping ironstone
Vegetation	Eucalyptus victrix open woodland over Acacia coriacea subsp. pendens low open woodland over Themeda triandra, *Cenchrus ciliaris tussock grassland and Triodia pungens open hummock grassland
Veg Condition	Good to Very Good; several weed species but at generally low densities
Fire Age	No evidence of burn or fire scars

Yandi Expansion Site YEX26

Described by	Kelli	**Date**	3/09/2004	60 x 25 m
AMG Zone	50730716mE, 7479353mN	730734mE, 7479336mN	730690mE, 7479297mN	730668mE, 7479317mN

Habitat	Creek in hills
Soil	Red sandy clay loam
Rock Type	Ironstone
Vegetation	Eucalyptus gamophylla scattered low mallees over Acacia dictyophleba, A. bivenosa, A. ancistrocarpa shrubland over Acacia adoxa var. adoxa low open shrubland over Triodia pungens (T. wiseana) mid-dense hummock grassland
Veg Condition	Excellent
Fire Age	None evident
Notes	Site is 25 x 60 m to accommodate all veg.

Yandi Expansion Site YEX27

Described by	Raimond	**Date**	3/09/2004	50 x 50 m
AMG Zone	50728798mE, 7478092mN	728833mE, 7478132mN	728871mE, 7478099mN	728839mE, 7478059mN

Habitat	Alluvial clay flat area
Soil	Red alluvial clay-loam; small amount of pebbles present on soil surface
Rock Type	Ironstone
Vegetation	Corymbia hamersleyana low open woodland over Acacia dictyophleba, A. tenuissima open shrubland over Senna notabilis low open shrubland over Triodia pungens open hummock grassland
Veg Condition	Very Good; Malvastrum americanum present in localised patches
Fire Age	Burnt in the last 1-2 years (or less)
Notes	Elevation at NW point = 512 m

Yandi Expansion Site YEX28

Described by	Brian Morgan	**Date**	3/09/2004	35 x 85 m
AMG Zone	50729336mE, 7478309mN	729301mE, 7478312mN	729297mE, 7478227mN	729328mE, 7478224mN

Habitat	Scoured stony river bed / flood bank
Soil	Pebble - cobble matrix
Rock Type	?
Vegetation	Eucalyptus camaldulensis, E. victrix scattered trees over Tephrosia rosea var. glabrior, Corchorus lasiocarpus subsp. parvus scattered low shrubs over Triodia pungens, T. wiseana
Veg Condition	Very Good to Excellent
Fire Age	<3-4 years ago
Notes	Any flood banks in survey area were not included in search (small area)

Yandi Expansion Site YEX29
Described by Kelli **Date** 3/09/2004 50 x 50 m
AMG Zone 50728444mE, 7477386mN 728477mE, 7477350mN 728441mE, 7477317mN 728407mE, 7477352mN
Habitat Creek floodout
Soil Red stony (>80%) sand and clay
Rock Type Ironstone
Vegetation Eucalyptus victrix woodland to open woodland over Acacia citrinoviridis low open woodland over Atalaya hemiglauca, Acacia tumida var. pilbarensis, A. bivenosa, Gossypium robinsonii, Petalostylis labicheoides shrubland to tall shrubland over Themeda triandra open tussock grassland and Triodia pungens hummock grassland
Veg Condition Excellent
Fire Age None evident

Yandi Expansion Site YEX30
Described by Brian Morgan **Date** 3/09/2004 80 x 30 m
AMG Zone 50728305mE, 7477694mN 728320mE, 7477667mN 728391mE, 7477692mN 728382mE, 7477719mN
Habitat Moderately sloping, mid to upper slope of ridge spur
Soil Red-brown pebbly, cobbly sand with rocky outcrop
Rock Type Ironstone
Vegetation Grevillea wickhamii subsp. hispidula scattered shrubs over Dampiera candicans, Ptilotus calostachyus low shrubland over Triodia aff. basedowii mid-dense hummock grassland
Veg Condition Excellent
Fire Age About 2-3 years since fire

Yandi Expansion Site YEX31
Described by Brian Morgan **Date** 4/09/2004 50 x 50 m
AMG Zone 50731782mE, 7478203mN 731795mE, 7478154mN 731844mE, 7478167mN 731832mE, 7478216mN
Habitat Flat plain (valley floor)
Soil Red-brown loamy sand
Rock Type n/a
Vegetation Corymbia hamersleyana scattered low trees over Acacia dictyophleba, A. ancistrocarpa tall open shrubland over Triodia lanigera mid-dense hummock grassland
Veg Condition Excellent
Fire Age > 7 years since fire

Yandi Expansion Site YEX32
Described by Raimond **Date** 4/09/2004 50 x 50 m
AMG Zone 50731902mE, 7474809mN 731939mE, 7474843mN 731973mE, 7474806mN 731936mE, 7474772mN
Habitat Alluvial, stony clay drainage flat
Soil Red alluvial clay over ironstone with lots of ironstone pebbles on soil surface.
Rock Type Ironstone
Vegetation Acacia aneura var. aff. longicarpa (MET 16,050), A. aff. aneura (scythe-shaped; MET 15,743), A. pruinocarpa low open woodland over Triodia pungens, T. wiseana hummock grassland
Veg Condition Excellent; weed species present
Fire Age Possibly burnt in the last 3-4 years.
Notes Kangaroos graze vegetation in this area. Elevation at NE point is 509 m

Yandi Expansion Site YEX33
Described by Kelli **Date** 4/09/2004 50 x 50 m
AMG Zone 50731725mE, 7474569mN 731756mE, 7474606mN 731795mE, 7474574mN 731764mE, 7474536mN
Habitat Floodout alluvial plain
Soil Red sandy clay. Patches of sand overlay
Rock Type Ironstone
Vegetation Acacia dictyophleba, A. ancistrocarpa, A. pruinocarpa, A. inaequilatera tall open shrubland to open shrubland over Senna artemisioides subsp. oligophylla low shrubland over Triodia lanigera closed hummock grassland
Veg Condition Excellent
Fire Age No evidence of recent fire

Yandi Expansion Site YEX34
Described by Brian Morgan **Date** 4/09/2004 200 x 10-15 m
AMG Zone 50732068mE, 7477130mN 732226mE, 7477252mN
Habitat Banks of cobbly, stony creek
Soil Red-brown gravelly, pebbly and cobbly sand
Rock Type ?
Vegetation Corymbia hamersleyana scattered low trees over Acacia tumida var. pilbarensis, Grevillea wickhamii subsp. hispidula, Petalostylis labicheoides open scrub over Triodia pungens hummock grassland and Themeda triandra open tussock grassland
Veg Condition Excellent

Fire Age >5-7 years since fire
Notes The creek bank habitat is narrow (often 5 m); where drainage spreads, banks are up to 10-15 m wide. Survey did not include creek bed.

Yandi Expansion Site YEX35
Described by Raimond **Date** 4/09/2004 50 x 50 m
AMG Zone 50732640mE, 7477352mN 732672mE, 7477393mN 732713mE, 7477360mN 732680mE, 7477321mN
Habitat Ironstone hilltop
Soil Red skeletal clay over ironstone hill, with lots of ironstone pieces on the soil surface.
Rock Type Ironstone
Vegetation Grevillea wickhamii tall open shrubland over Ptilotus rotundifolius open shrubland over Acacia hilliana low shrubland over Triodia aff. basedowii mid-dense hummock grassland
Veg Condition Excellent; no weed species or other signs of disturbance present
Fire Age Patchily burnt in the last year
Notes Elevation at NW point 532 m. Some portions of the quadrat (¬ up to 40%) are in the areas which have been recently burnt; remainder unburnt for at least 3 years

Yandi Expansion Site YEX36
Described by Kelli **Date** 4/09/2004 50 x 50 m
AMG Zone 50732480mE, 7477363mN 732519mE, 7477331mN 732486mE, 7477293mN 732449mE, 7477323mN
Habitat Lower hill slopes, intersected by numerous small drainages
Soil Red skeletal detrital sandy clay loam (coarse fraction >80%)
Rock Type Ironstone
Vegetation Eucalyptus leucophloia scattered low trees over Acacia inaequilatera, Hakea chordophylla tall open shrubland over Acacia bivenosa, Grevillea wickhamii shrubland over Acacia hilliana, A. adoxa var. adoxa low shrubland over Triodia aff. basedowii closed hummock grassland
Veg Condition Excellent
Fire Age Burnt >5 years ago

Yandi Expansion Site YEX37
Described by Brian Morgan **Date** 4/09/2004 60 x 40 m
AMG Zone 50731927mE, 7473357mN 731882mE, 7473317mN 731913mE, 7473291mN 731957mE, 7473331mN
Habitat Crest of hill range
Soil Red-brown pebbly, cobbly sand
Rock Type Ironstone
Vegetation Hakea chordophylla, Grevillea wickhamii subsp. hispidula scattered tall shrubs over Triodia aff. basedowii mid-dense hummock grassland
Veg Condition Excellent
Fire Age >7 years since fire

Yandi Expansion Site YEX38
Described by Raimond **Date** 4/09/2004 50 x 50 m
AMG Zone 50733590mE, 7474408mN 733635mE, 7474435mN 733661mE, 7474392mN 733618mE, 7474361mN
Habitat Weeli Wolli Creek floodplain
Soil Red alluvial clay deposited during flooding of Weeli Wolli creek.
Rock Type Ironstone
Vegetation Corymbia hamersleyana scattered low trees over Acacia pruinocarpa, A. citrinoviridis low open woodland over Triodia longiceps mid-dense hummock grassland and *Cenchrus ciliaris tussock grassland
Veg Condition Very poor; due to domination of understorey stratum by Buffel grass in large areas of the quadrat
Fire Age Unburnt for more than 4-5 years
Notes Elevation at NW point is 513 m

Yandi Expansion Site YEX39
Described by Raimond **Date** 5/09/2004 50 x 50 m
AMG Zone 50730020mE, 7478436mN 730069mE, 7478436mN 730068mE, 7478385mN 730019mE, 7478386mN
Habitat Braided channel of Yandicoogina Creek, including the vegetated islands within the channel.
Soil Red ironstone pebbles deposited through alluvial action over sandy loam, with a small amount of clay
Rock Type Ironstone
Vegetation Eucalyptus camaldulensis woodland over Acacia coriacea subsp. pendens low open woodland over mixed open tussock grassland
Veg Condition Very good; only a few weed species present; Sisymbium sp. and Argemone ochroleuca.
Fire Age No evidence of burn / fire scars on mature trees

Yandi Expansion Releve YEX-F
Described by Raimond **Date** 3/09/2004 releve
AMG Zone 50728497mE, 7477583mN 728373mE, 7477590mN
Habitat Base of ridgeline / cliff / breakaway with drainage line and associated floodplain area at base of cliff.
Soil Red sandy clay-loam, alluvial deposition

Rock Type	Ironstone
Vegetation	Eucalyptus victrix open woodland over Stemodia grossa, Pluchea dentex low open shrubland over Themeda triandra very open tussock grassland
Veg Condition	Very Good; few weeds present, mostly in drainage line rather than on rocky ridge base.
Fire Age	Not burnt for quite a while. No fire scars.
Notes	Vegetation at base of cliff is low open shrubland of Abutilon lepidum and Sida sp.spiciform panicles(E.Leyland s.n.14/8/1990 over very open tussock grassland of Themeda triandra and Eulalia aurea

Yandi Expansion Releve YEX-G

Described by	Kelli	**Date**	4/09/2004	releve
AMG Zone	50732348mE, 7477355mN		732547mE, 7477389mN	
Habitat	Very minor drainage off a hillslope			
Soil	Red skeletal detrital sandy clay-loam with >80% coarse fraction			
Rock Type	Ironstone			
Vegetation	Grevillea wickhamii shrubland over Acacia hilliana, A. adoxa var. adoxa low shrubland over Triodia aff. basedowii, T. pungens hummock grassland			
Veg Condition	Excellent			
Notes	Corymbia hamersleyana lower down slope and Acacia hilliana in adjacent creeks (5-10 % cover)			

Yandi Expansion Releve YEX-J

Described by	Brian Morgan	**Date**	4/09/2004	releve
AMG Zone	50732102mE, 7473352mN			
Habitat	Rocky gully on side of ridge			
Vegetation	Eucalyptus leucophloia low open woodland over Senna glutinosa subsp. glutinosa open shrubland over Triodia pungens open hummock grassland and Eriachne mucronata, Cymbopogon ambiguus, Themeda triandra open grassland			

Yandi Expansion Releve YEX-K

Described by	Brian Morgan	**Date**	5/09/2004	releve
AMG Zone	50730149mE, 7478437mN			
Habitat	Scoured stony river bed			
Vegetation	Opportunistic collections along a riverine transect			
Notes	Releve along Marillana Creek from site YEX39, heading west along the creek for about 1.5 km and return to YEX39.			

Yandi Expansion Releve YEX-M

Described by	Brian Morgan	**Date**	5/09/2004	releve
AMG Zone	50732442mE, 7478522mN			
Habitat	Small flowline at base of steep ridge slope			
Soil	Red-brown sandy loam			
Vegetation	Acacia citrinoviridis (A. coriacea subsp. pendens) low woodland to low open forest over Triodia pungens very open hummock grassland and mixed grassland			
Veg Condition	Excellent (in small patches where not burnt)			
Fire Age	Burnt <6 months ago			
Notes	Eucalyptus victrix in flow line 100m to northwest			

Yandi Expansion Releve YEX-N

Described by	Raimond	**Date**	5/09/2004	releve
AMG Zone	50732297mE, 7478137mN		732276mE, 7478284mN	
Habitat	Rocky, alluvial, very mildly sloping plain			
Soil	Red alluvial clay with ironstone pebbles on soil surface			
Rock Type	Ironstone			
Vegetation	Acacia aneura var. aneura, A. ayersiana, Corymbia hamersleyana scattered low trees over Triodia lanigera mid-dense hummock grassland			
Veg Condition	Excellent; no weed species present			
Fire Age	Adjacent area around hill burnt in last year			

Name	YEX 01	YEX 02	YEX 03	YEX 04	YEX 05	YEX 06	YEX 07	YEX 08	YEX 09	YEX 10	YEX 11	YEX 12	YEX 13	YEX 14	YEX 15	YEX 16	YEX 17	YEX 18	YEX 19	YEX 20	YEX 21	YEX 22	YEX 23	YEX 24	YEX 25	YEX 26	YEX 27	YEX 28	YEX 29	YEX 30	YEX 31	YEX 32	YEX 33	YEX 34	YEX 35	YEX 36	YEX 37	YEX 38	YEX 39	YEX-F	YEX-G	YEX-J	YEX-K	YEX-M	YEX-N
Abutilon dioicum																					1							1											1					
Abutilon fraseri																											1																	
Abutilon lepidum																	1											1										1		1					
Abutilon aff. lepidum (1) (MET 15 352)									1																												1							
Abutilon aff. lepidum (4)			1																																									1
Abutilon macrum				1												1	1																												
Abutilon otocarpum		1		1			1	1	1		1								1	1						1					1														1
Abutilon trudgenii																									1		1				1	1	1											
Acacia adoxa var. adoxa					1	1												1				1		1		1				1				1	1					1	1			
Acacia adsurgens											1															1																		
Acacia ancistrocarpa				1	1		1	1		1				1				1	1				1	1		1	1				1	1	1							1				
Acacia aneura var. aneura																																												1
Acacia aneura var. longicarpa								1																														1						
Acacia aneura (flat curved; MET 15 548)	1			1					1			1							1					1						1						1							
Acacia aneura (grey bushy form; MET 15 732)				1								1																															
Acacia aneura var. aff. longicarpa (MET 16,050)			1																												1											
Acacia aff. aneura (scythe-shaped; MET 15,743)				1										1																	1											
Acacia ayersiana									1																																		1
Acacia bivenosa			1	1	1		1				1				1				1	1				1		1	1		1			1		1	1		1		1	1				
Acacia citrinoviridis		1					1	1								1	1		1		1							1									1	1					1	
Acacia colei var. colei																									1																			
Acacia coriacea subsp. pendens		1		1				1	1						1	1	1			1	1				1			1	1										1	1			1	
Acacia coriacea subsp. sericophylla																										1																	
Acacia dictyophleba					1		1	1		1	1			1	1			1	1	1		1	1	1		1	1				1	1	1		1				1					1
Acacia elachantha								1															1								1												
Acacia farnesiana																											1														1			
Acacia hilliana						1																													1	1					1			
Acacia inaequilatera					1		1			1			1		1			1	1			1	1	1		1				1			1	1		1	1				1			1
Acacia maitlandii																								1																			
Acacia pachyacra					1										1				1	1			1						1		1	1	1										1
Acacia pruinocarpa		1	1	1	1		1	1	1	1	1	1	1	1		1		1	1			1	1	1	1	1					1	1	1					1		1				
Acacia pyrifolia		1					1	1								1	1			1	1				1				1									1	1					1
Acacia sclerosperma subsp. sclerosperma																				1			1		1		1																	1
Acacia synchronicia			1	1																												1						1						
Acacia tenuissima					1		1		1		1		1	1												1	1				1					1					1				
Acacia tumida var. pilbarensis					1		1	1			1					1	1			1	1		1			1		1	1	1				1				1		1				1
Acetosa vesicaria																	1								1																			
Achyranthes aspera																1											1													1				
Alternanthera nana								1	1								1			1						1																		
Alternanthera nodiflora																									1																			
Amaranthus pallidiflorus																1	1				1				1			1										1	1					
Ammannia baccifera																																									1			
Ammannia multiflora																				1																								
Amphipogon caricinus																		1						1						1							1						
Amphipogon sericeus										1																																	
Amyema hilliana																	1				1										1												
Amyema miquelii																																						1					
Anthobolus leptomerioides									1			1																															
Argemone ochroleuca subsp. ochroleuca																1	1				1				1													1					
Aristida contorta			1	1			1	1	1			1		1			1		1		1			1				1		1		1		1			1						1
Aristida holathera var. holathera			1	1	1		1	1		1	1	1	1	1	1			1	1	1		1	1	1		1	1			1	1	1	1	1		1				1				1
Aristida inaequiglumis									1								1												1									1						
Aristida latifolia																							1																				
Atalaya hemiglauca		1						1								1	1		1		1			1		1	1	1			1						1	1	1				1	
Bergia trimera																				1					1																		
Bidens bipinnata									1								1								1														1					
Boerhavia coccinea				1					1								1											1	1			1											
Boerhavia gardneri																						1																					
Bonamia media var. villosa	1																	1				1		1						1							1						
Bonamia pannosa											1												1										1								1			
Bonamia rosea				1	1		1	1		1				1				1												1			1									
Bulbostylis barbata				1			1	1			1	1	1				1	1		1		1	1		1	1			1		1	1		1	1	1	1		1				
Calandrinia ptychosperma				1				1												1																							
Calotis plumulifera								1																																			
Calytrix carinata										1					1																					1							
Capparis spinosa var. nummularia																					1						1																
Cenchrus ciliaris		1	1	1				1	1							1	1			1	1		1		1		1	1	1								1	1	1					1
Centipeda minima																1				1					1													1						
Cheilanthes sieberi subsp. sieberi																																									1			
Chenopodium melanocarpum								1																																			
Chrysocephalum apiculatum				1											1								1				1				1	1											
Chrysopogon fallax				1			1	1			1								1		1				1		1																
Cleome viscosa			1	1			1				1					1	1			1	1				1			1	1		1	1	1	1			1					1
Clerodendrum tomentosum																1																											
Codonocarpus cotinifolius					1				1	1					1														1														
Convolvulus angustissimus subsp. angustissimus								1																																			
Conyza bonariensis																1				1																								
Corchorus crozophorifolius		1														1	1				1				1			1	1				1					1	1				1	
Corchorus laniflorus																1																											

Name	YEX 01	YEX 02	YEX 03	YEX 04	YEX 05	YEX 06	YEX 07	YEX 08	YEX 09	YEX 10	YEX 11	YEX 12	YEX 13	YEX 14	YEX 15	YEX 16	YEX 17	YEX 18	YEX 19	YEX 20	YEX 21	YEX 22	YEX 23	YEX 24	YEX 25	YEX 26	YEX 27	YEX 28	YEX 29	YEX 30	YEX 31	YEX 32	YEX 33	YEX 34	YEX 35	YEX 36	YEX 37	YEX 38	YEX 39	YEX-F	YEX-G	YEX-J	YEX-K	YEX-M	YEX-N
Corchorus lasiocarpus subsp. lasiocarpus																			1																									
Corchorus lasiocarpus subsp. aff. lasiocarpus (YEX24-11)										1			1											1													1							
Corchorus lasiocarpus subsp. parvus			1		1		1	1						1	1			1				1	1				1		1		1		1		1			1	1				
Corchorus tectus																			1					1																			
Corymbia candida subsp. candida								1																1			1																
Corymbia hamersleyana				1			1	1	1	1	1			1	1			1	1	1		1		1		1	1				1			1				1		1				1
Crotalaria medicaginea							1										1								1			1										1					
Crotalaria novae-hollandiae subsp. novae-hollandiae																						1																					
Cullen leucanthum																	1								1			1													1			
Cullen leucochaites					1																		1																				
Cymbopogon ambiguus			1						1			1		1		1	1		1			1		1				1	1		1	1		1								1
Cymbopogon dependens																																						1	1					
Cymbopogon obtectus				1							1										1				1	1	1					1					1				1			
Cynodon dactylon																																										1			
Cyperus difformis																				1																								
Cyperus iria																									1																			
Cyperus vaginatus		1														1				1	1				1			1										1	1				
Dampiera candicans																		1				1								1							1							
Datura leichhardtii		1																																							1			
Dichanthium sericeum subsp. humilius				1																																							
Dichrostachys spicata																																							1					
Dicladanthera forrestii		1																			1																1						
Dicrastylis cordifolia															1								1																				
Dicrastylis georgei										1	1																			1			1										1
Digitaria brownii							1									1	1			1	1				1			1	1									1					1
Digitaria ctenantha				1			1																						1									1				1		
Dodonaea coriacea										1			1	1				1	1			1		1						1	1					1							
Dodonaea petiolaris		1							1																																			
Dysphania kalpari									1									1																										
Dysphania rhadinostachya subsp. rhadinostachya	1			1		1	1	1			1	1	1	1			1			1	1	1	1	1	1	1			1	1	1	1	1	1	1			1					1
Eleocharis geniculata																																									1			
Elytrophorus spicatus																									1																		
Enchylaena tomentosa var. tomentosa				1																																1						
Enneapogon caerulescens				1																								1				1								1			
Enneapogon clelandii												1					1				1																	1	1				1	1
Enneapogon lindleyanus			1				1	1	1															1					1														
Enneapogon polyphyllus				1			1	1	1			1							1										1		1	1					1						1
Enteropogon acicularis		1														1	1							1		1			1									1					
Eragrostis cumingii				1			1	1	1		1	1				1	1			1			1		1	1			1				1					1				1	1
Eragrostis dielsii																																1											
Eragrostis eriopoda			1				1	1			1			1	1			1					1			1				1	1	1					1						1
Eragrostis leptocarpa																				1					1																		
Eragrostis pergracilis									1			1																																
Eragrostis tenellula		1						1								1	1			1					1				1										1				
Eremophila forrestii			1	1					1																							1											
Eremophila fraseri subsp. fraseri												1																																
Eremophila latrobei subsp. filiformis												1	1	1																			1										1
Eremophila longifolia				1			1	1	1		1									1						1	1				1	1	1									
Eriachne aristidea						1	1		1		1	1		1				1	1			1				1	1			1	1		1		1				1				1
Eriachne helmsii																					1																						
Eriachne lanata													1																															
Eriachne mucronata	1			1		1	1	1	1			1	1			1						1						1	1			1							1	1				
Eriachne pulchella subsp. dominii	1		1	1		1	1	1	1	1		1	1	1			1	1				1		1	1			1	1			1		1	1		1		1				1
Eriachne pulchella subsp. pulchella																							1										1			1							
Eriachne tenuiculmis							1	1									1			1					1			1	1					1				1	1			1	1	
Eucalyptus camaldulensis																1					1							1										1					
Eucalyptus gamophylla					1										1											1																	
Eucalyptus leucophloia subsp. leucophloia	1					1							1										1							1			1	1	1				1	1			
Eucalyptus victrix		1						1													1				1			1	1										1				
Eucalyptus xerothermica				1			1	1											1	1																							
Eulalia aurea		1					1				1					1			1							1	1		1									1	1				
Euphorbia aff. australis (B191)																											1				1												
Euphorbia australis (mid-green form)			1		1				1																				1														
Euphorbia boophthona						1																								1				1									
Euphorbia coghlanii		1					1									1	1				1		1		1		1	1										1					
Euphorbia tannensis subsp. eremophila (Hamersley form)							1	1							1					1	1		1			1						1						1					
Euphorbia sp. (site 1089)							1	1	1		1					1	1		1	1	1		1		1			1		1									1					
Evolvulus alsinoides var. decumbens								1																	1		1																
Evolvulus alsinoides var. villosicalyx				1			1	1	1		1	1					1		1						1		1		1			1							1				
Ficus brachypoda																1																											
Fimbristylis dichotoma																																				1							
Fimbristylis simulans	1					1						1						1					1							1						1	1						
Flaveria australasica																				1	1			1	1				1								1		1				
Glycine canescens							1	1												1																								
Gompholobium polyzygum																		1																									
Gomphrena cunninghamii	1					1				1	1	1					1				1			1	1			1	1	1				1				1					
Goodenia lamprosperma																				1	1				1																		
Goodenia microptera	1		1	1	1	1	1	1	1	1	1	1		1	1	1	1		1	1	1		1			1	1	1		1	1	1	1	1						1			
Goodenia muelleriana							1												1					1						1													

Name	YEX 01	YEX 02	YEX 03	YEX 04	YEX 05	YEX 06	YEX 07	YEX 08	YEX 09	YEX 10	YEX 11	YEX 12	YEX 13	YEX 14	YEX 15	YEX 16	YEX 17	YEX 18	YEX 19	YEX 20	YEX 21	YEX 22	YEX 23	YEX 24	YEX 25	YEX 26	YEX 27	YEX 28	YEX 29	YEX 30	YEX 31	YEX 32	YEX 33	YEX 34	YEX 35	YEX 36	YEX 37	YEX 38	YEX 39	YEX-F	YEX-G	YEX-J	YEX-K	YEX-M	YEX-N
Goodenia stellata								1																																					
Goodenia stobbsiana	1				1	1				1			1	1	1			1			1	1		1		1				1				1	1	1	1			1	1				
Goodenia triodiophila						1		1												1																									
Goodenia vilmoriniae																							1																						
Gossypium australe (Burrup Peninsula form)		1					1	1	1				1				1		1	1	1	1			1		1		1	1		1	1				1	1	1						1
Gossypium australe (Whim Creek form)																							1																						
Gossypium robinsonii		1					1	1								1	1			1	1				1			1	1									1	1						
Gossypium sturtianum		1						1																																					
Grevillea wickhamii (sterile)						1					1				1							1		1	1									1	1			1		1					
Grevillea wickhamii subsp. aprica																					1																								
Grevillea wickhamii subsp. hispidula				1	1		1			1		1	1	1				1	1	1			1			1				1	1			1			1							
Hakea chordophylla	1				1	1				1					1			1						1						1	1				1	1			1						
Hakea lorea subsp. lorea		1	1			1		1			1								1			1	1			1		1				1												1
Haloragis gossei			1							1																						1	1											
Helichrysum gilesii			1	1					1																																			
Heliotropium cunninghamii							1	1									1		1		1				1		1	1	1									1			1			
Heliotropium inexplicitum				1																																								
Heliotropium pachyphyllum											1							1			1		1	1			1			1								1			1			
Heliotropium tenuifolium																																1											
Heteropogon contortus																																						1			1			
Hibiscus brachychlaenus														1																														
Hibiscus burtonii				1					1			1																			1													
Hibiscus aff. coatesii (MET 16,542)										1									1			1	1	1																				
Hibiscus aff. coatesii (site 664)				1																												1											
Hibiscus goldsworthii																																						1		1			
Hibiscus leptocladus																							1		1								1										
Hibiscus sturtii var. aff. campylochlamys (MET 15,957)																								1																			
Hibiscus sturtii var. platychlamys			1	1			1	1			1	1							1				1				1				1	1	1										1
Hybanthus aurantiacus				1			1	1			1					1					1				1			1	1				1					1	1	1				
Indigofera georgei																				1																								
Indigofera monophylla (form not recorded)																							1			1																	1	
Indigofera monophylla (brown calyx form)							1										1				1				1			1					1					1						
Indigofera monophylla (small calyx form)								1		1												1																							
Indigofera rugosa																			1			1																							
Ipomoea muelleri																	1								1													1						
Iseilema vaginiflorum			1				1																																					
Isotropis atropurpurea							1															1			1								1						1					
Ixiochlamys cuneifolia																	1								1													1						
Jasminum didymum subsp. lineare							1	1			1					1										1	1												1					
Keraudrenia velutina subsp. elliptica				1																																							
Lepidium muelleri-ferdinandii																	1				1																	1			1			
Lepidium oxytrichum																																							1					
Lepidium phlebopetalum							1																								1												
Leptopus decaisnei var. decaisnei																					1						1																
Lobelia quadrangularis																				1																			1				
Maireana planifolia			1	1			1	1								1															1	1										
Maireana planifolia x villosa									1																																			
Maireana villosa			1									1																																
Malvastrum americanum		1		1				1									1			1	1				1		1		1								1	1	1				1	
Melaleuca argentea		1														1																						1				1			
Melaleuca glomerata																1	1				1				1			1										1				1			
Melhania oblongifolia								1																																				
Mollugo molluginis								1																									1		1		1							
Mukia maderaspatana				1			1		1								1			1	1									1													1
Nicotiana occidentalis subsp. obliqua							1		1								1				1																	1			1			
Oldenlandia crouchiana																											1		1														
Olearia fluvialis																																								1			
Paraneurachne muelleri			1	1	1	1	1	1			1	1		1	1			1	1		1	1		1		1	1		1	1	1	1	1	1				1			1			
Paspalidium basicladum				1								1				1	1				1									1									1		1			
Paspalidium jubiflorum																																							1					
Peplidium sp. E (Flora of Australia)																				1																								
Perotis rara				1			1																					1															
Petalostylis labicheoides								1			1								1	1													1										
Phyllanthus erwinii							1				1						1			1	1												1	1				1					
Phyllanthus maderaspatensis																1	1				1				1			1	1									1					
Pluchea dentex																1	1								1			1										1	1					
Pluchea dunlopii																				1																								
Pluchea ferdinandi-muelleri																																						1					
Pluchea rubelliflora		1														1				1					1																			
Polycarpaea corymbosa var. corymbosa				1			1	1			1	1						1	1			1	1		1	1	1		1					1	1								
Polycarpaea holtzei	1				1	1	1			1	1	1	1	1				1				1		1		1	1			1	1		1	1	1	1	1						
Polycarpaea longiflora						1	1			1	1					1	1				1		1		1	1			1	1	1		1					1				1		
Polygala aff. isingii	1																													1													
Polymeria aff. ambigua (CGC-25)								1																																				
Polymeria aff. ambigua (PAN 26B-20)							1	1			1									1			1																				
Porana commixta		1		1			1	1	1		1	1		1		1	1		1	1	1		1		1	1	1		1			1						1		1				1
Portulaca oleracea				1				1									1																										
Portulaca pilosa																			1																								
Pseudognaphalium luteoalbum																				1																			1				

Name	YEX 01	YEX 02	YEX 03	YEX 04	YEX 05	YEX 06	YEX 07	YEX 08	YEX 09	YEX 10	YEX 11	YEX 12	YEX 13	YEX 14	YEX 15	YEX 16	YEX 17	YEX 18	YEX 19	YEX 20	YEX 21	YEX 22	YEX 23	YEX 24	YEX 25	YEX 26	YEX 27	YEX 28	YEX 29	YEX 30	YEX 31	YEX 32	YEX 33	YEX 34	YEX 35	YEX 36	YEX 37	YEX 38	YEX 39	YEX-F	YEX-G	YEX-J	YEX-K	YEX-M	YEX-N
Psydrax latifolia				1					1																																			1
Pterocaulon sphaeranthoides	1		1	1	1		1	1	1	1	1						1		1	1	1				1	1			1		1	1	1	1			1	1	1	1					1
Ptilotus aervoides																																													1
Ptilotus astrolasius var. astrolasius				1	1				1	1	1	1						1	1	1	1		1	1			1			1	1		1	1		1		1						1
Ptilotus auriculifolius																	1				1										1							1							
Ptilotus calostachyus var. calostachyus	1								1	1			1	1				1	1					1					1				1	1		1				1				
Ptilotus clementii																													1	1	1														
Ptilotus exaltatus var. exaltatus			1	1			1	1	1			1		1		1		1	1					1	1		1	1		1		1	1	1										1
Ptilotus fusiformis var. fusiformis																									1																				
Ptilotus gaudichaudii var. gaudichaudii				1					1				1	1																1														
Ptilotus helipteroides var. helipteroides			1	1					1			1	1	1																		1												1
Ptilotus obovatus var. obovatus		1		1			1	1			1																		1		1	1	1				1		1		1			1
Ptilotus polystachyus var. polystachyus				1			1	1				1						1													1													1
Ptilotus roei			1																												1													
Ptilotus rotundifolius	1					1																		1					1					1		1								
Rhagodia eremaea		1																																			1		1					1
Rhodanthe floribunda			1																																									
Rhodanthe margarethae																	1																						1					
Rhynchosia minima var. australis							1	1								1	1		1	1	1				1		1		1				1					1	1					
Rostellularia adscendens var. clementii																																										1		
Rulingia luteiflora		1		1			1	1			1									1			1						1				1						1					
Salsola tragus			1				1																		1				1			1											
Santalum lanceolatum							1	1								1													1				1				1		1					
Sarcostemma viminale subsp. australe										1																																		
Scaevola parvifolia subsp. pilbarae					1			1			1				1								1																				
Schizachyrium fragile	1						1				1	1		1								1				1			1	1			1			1							
Schoenoplectus subulatus																																									1		
Sclerolaena cornishiana			1	1																											1											1
Sclerolaena eriacantha									1																																		
Senna artemisioides subsp. artemisioides																										1																	
Senna artemisioides subsp. helmsii			1	1			1	1	1	1		1																	1				1										1
Senna artemisioides subsp. oligophylla							1												1			1			1	1			1	1		1	1					1					1
Senna artemisioides subsp. oligophylla x helmsii		1	1	1	1		1	1						1									1							1	1											
Senna glutinosa subsp. glutinosa	1			1	1									1								1		1	1			1	1					1				1					
Senna glutinosa subsp. x luerssenii	1		1		1	1	1		1			1	1	1					1			1		1		1			1	1	1			1	1								1
Senna glutinosa subsp. pruinosa	1			1	1	1									1									1					1						1	1		1						
Senna notabilis				1			1				1							1	1				1	1	1		1			1				1					1					1
Setaria dielsii																	1																					1						
Setaria surgens											1																																	
Setaria verticillata							1									1					1				1																			
Sida arenicola					1					1				1				1					1	1										1										
Sida cardiophylla	1										1													1							1				1									
Sida aff. cardiophylla (site 1215)							1				1			1						1				1			1			1		1			1								1
Sida echinocarpa			1																1				1				1		1		1											1
Sida aff. fibulifera (site 1394)			1	1			1	1			1								1	1			1				1				1	1					1	1				
Sida sp.A Kimberley Flora(P.A.Fryxell & L.A.Craven 3900)																						1																					
Sida sp.Barlee Range(S.van Leeuwen 1642)																1																											
Sida sp.spiciform panicles(E.Leyland s.n.14/8/1990				1			1					1		1			1		1	1	1		1		1		1		1										1					
Sida sp.Wittenoom(W.R.Barker 1962)				1															1								1				1											
Sida sp. 'rugose'														1											1																			
Sisymbrium irio																	1				1																							
Solanum centrale																															1													
Solanum cleistogamum																																					1							1
Solanum gabrielae																																												1
Solanum horridum	1		1	1					1	1							1										1					1											
Solanum lasiophyllum			1	1	1			1	1	1	1	1		1		1															1	1	1	1	1			1					1
Solanum nigrum																1					1																	1						
Solanum phlomoides																	1	1	1		1	1	1	1	1			1		1								1						
Sonchus oleraceus																1					1																					1			
Sporobolus actinocladus																				1																								
Sporobolus australasicus			1	1				1	1			1		1				1	1							1						1		1				1					1
Stemodia grossa		1	1				1			1							1	1		1				1	1			1				1	1				1	1	1				1
Streptoglossa bubakii																			1								1																
Streptoglossa decurrens		1	1				1										1						1				1		1		1	1					1					1	1
Stylobasium spathulatum		1																				1																					
Swainsona decurrens																																												
Swainsona kingii																																					1							
Tephrosia arenicola																			1																								
Tephrosia aff. clementii (2)																			1																								
Tephrosia densa																																												
Tephrosia rosea var. glabrior							1	1								1	1			1	1		1		1			1	1									1						
Tephrosia aff. supina (HD133-20)																														1														
Tephrosia sp.Bungaroo Creek(M.E.Trudgen 11601)															1								1								1												
Tephrosia sp.Pilbara Ranges(S.van Leeuwen 4246)																								1																			
Themeda triandra		1		1			1	1			1					1	1			1	1		1		1	1	1	1	1		1		1				1	1	1					
Themeda sp.Hamersley Station(M.E.Trudgen 11431)																							1																				
Trachymene oleracea subsp. oleracea					1		1	1			1					1					1				1			1					1	1		1		1			1			
Trianthema glossostigma										1																																		
Trianthema pilosa																															1													

Name	YEX 01	YEX 02	YEX 03	YEX 04	YEX 05	YEX 06	YEX 07	YEX 08	YEX 09	YEX 10	YEX 11	YEX 12	YEX 13	YEX 14	YEX 15	YEX 16	YEX 17	YEX 18	YEX 19	YEX 20	YEX 21	YEX 22	YEX 23	YEX 24	YEX 25	YEX 26	YEX 27	YEX 28	YEX 29	YEX 30	YEX 31	YEX 32	YEX 33	YEX 34	YEX 35	YEX 36	YEX 37	YEX 38	YEX 39	YEX-F	YEX-G	YEX-J	YEX-K	YEX-M	YEX-N
Tribulus macrocarpus																															1													
Tribulus suberosus				1																									1															
Trichodesma zeylanicum var. zeylanicum		1	1	1			1	1			1						1		1		1	1	1	1	1		1		1	1		1	1	1					1						
Triodia aff. basedowii	1				1	1				1		1	1	1				1						1			1			1					1	1	1				1				
Triodia lanigera									1			1			1																1		1	1											1
Triodia longiceps		1															1																				1								
Triodia pungens				1	1	1	1	1	1	1	1		1	1			1	1	1	1	1		1		1	1	1	1	1			1		1	1		1	1	1		1			1	1
Triodia wiseana	1		1	1								1	1				1					1		1		1		1			1			1	1	1	1			1				
Triraphis mollis			1														1												1															
Triumfetta maconochieana																																							1					
Typha domingensis																1				1																								
Vigna lanceolata var. lanceolata																																									1		
Vittadinia arida							1														1											1											
Vittadinia obovata														1																													
Wahlenbergia tumidifructa							1													1					1				1									1				1		
Waltheria indica																	1			1	1			1	1		1	1	1									1						
"1" indicates species presence																																												

Plate 4.1: Type 1a: *Hakea chordophylla* scattered low trees over *Triodia* aff*. basedowii*. Site YEX35.

Plate 4.2: Type 1b: *Eucalyptus leucophloia* low open woodland over *Acacia hilliana, A. adoxa* low open shrubland over *Triodia* aff*. basedowii*. Site YEX13.

Plate 4.3: Type 1c: Exposed ridgeline, vegetation variable; *Themeda* sp. Mt. Barricade dominant here, with herb *Rhodanthe margarethae.*

Plate 4.4: Type 1d: *Eucalyptus gamophylla* low open woodland over *Triodia* aff. *basedowii*. Site YEX05.

Plate 4.5: Type 1e: Scattered *Acacia inaequilatera* over *Triodia wiseana.* Site YEX22.

Plate 4.6: Type 1f: Scattered *Corymbia hamersleyana* over *Triodia* aff*. basedowii;* burnt 1-2 years ago. Site YEX18.

Plate 4.7: **Type 1g: *Acacia pruinocarpa* and *aneura* (flat curved; MET 15 548) over *Eremophila fraseri* over *Triodia* aff. *basedowii*. Site YEX12.**

Plate 4.8: **Type 2a: Scattered *Corymbia hamersleyana* over *Triodia lanigera* or *T.* aff. *basedowii* on low stony plains. Site YEX31.**

Plate 4.9: **Type 2b.1: Eucalyptus *xerothermica* and *Acacia aneura* woodland over *Themeda triandra* and *Paraneurachne muelleri*. Site YEX04.**

Plate 4.10: **Type 2b.2: Low woodland of *Acacia* species over *Aristida contorta, A. holathera, Enneapogon polyphyllus* tussock grassland. Site YEX09.**

Plate 4.11: **Type 2b.3: *Acacia aneura, A. pruinocarpa* and *A. synchronicia* over *Triodia wiseana* and patches of *Aristida contorta*. Site YEX03.**

Plate 4.12: **Type 2c: Tall open shrubland of *Acacia* species over *Triodia lanigera* and mixed tussock grasses. Site YEX33.**

Plate 4.13: Type 3a: Shrubland in stony creeks over *Triodia* aff*. basedowii* with some *T. wiseana* and *T. pungens*. Site YEX26.

Plate 4.14: Type 3b: Secondary creeks with *Corymbia hamersleyana* over shrubland over *Triodia pungens* and tussock grasses. Site YEX11.

Plate 4.15: Type 3c: Major creek bank - *Eucalyptus camaldulensis* over **Cenchrus ciliaris* at Weeli Wolli Creek. Site YEX02.

Plate 4.16: Type 3d: Major creek - *Eucalyptus camaldulensis* over scoured river bed in Yandicoogina Creek. Site YEX28.

Plate 4.17: Type 3e: Major creek – *Eucalyptus victrix* over *Acacia coriacea, Atalaya hemiglauca* tall open shrubland at Yandicoogina Creek. YEX21.

Plate 4.18: Type 3f: Major creek bank – *Acacia citrinoviridis* and *A. coriacea* subsp. *pendens* at Yandicoogina Creek. Site YEX17.

Plate 4.19: Type 3g: *Corymbia hamersleyana, Acacia citrinoviridis* over **Cenchrus ciliaris* on floodplain of Weeli Wolli Creek. Site YEX38.

Plate 4.20: Area burnt in August 2004; central expansion area, looking west along conveyor corridor.