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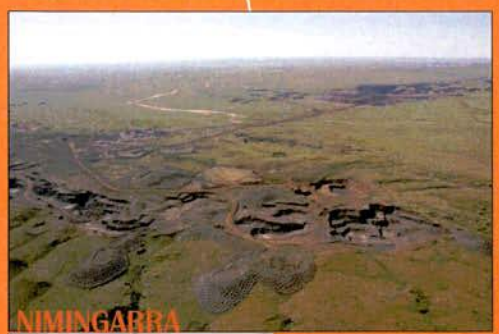
YARRIE

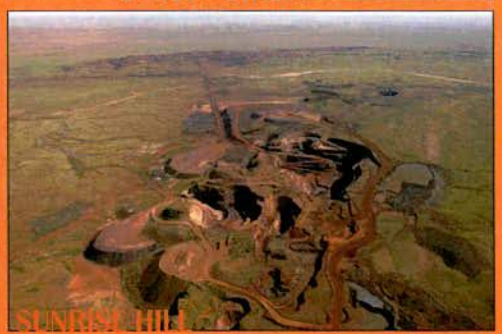
GOLDSWORTHY EXTENSION PROJECT

Environmental Protection Statement


CATTLE GORGE


NIMINGARRA


SHAY GAP


SUNRISE HILL

Volume Two
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BHP Billiton Iron Ore

Goldsworthy Extension Project

ENVIRONMENTAL PROTECTION STATEMENT

VOLUME 2

APPENDIX D

May 2005

ENVIRONMENTAL PROTECTION STATEMENT

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Biological Assessment

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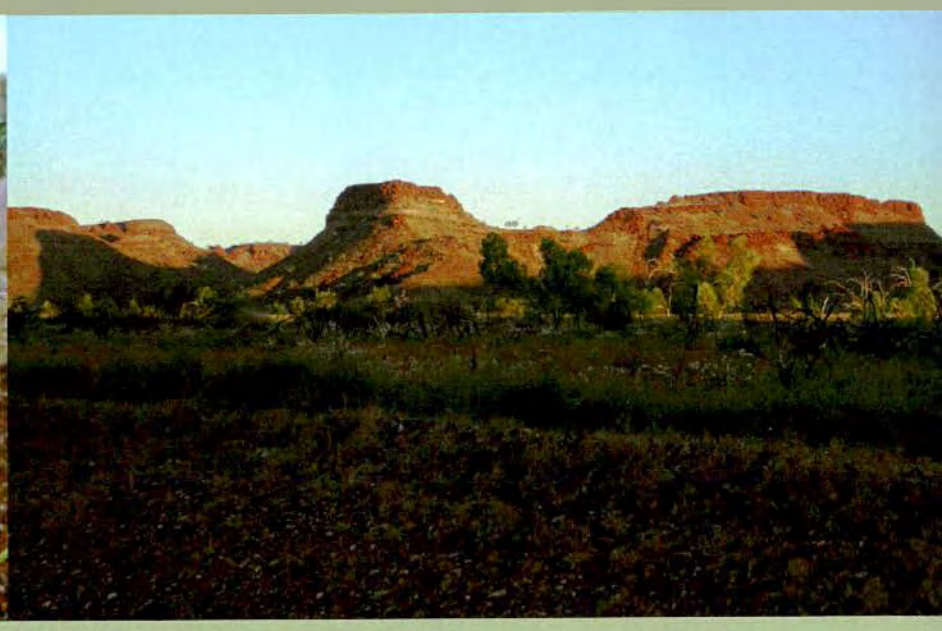

GOLDSWORTHY EXTENSION PROJECT

BIOLOGICAL ASSESSMENT SURVEY

May 2005

ecologia
ENVIRONMENT

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ecologia **Environment**
76 Thomas Street
WEST PERTH WA 6005
Phone (08) 9322 1944
Fax (08) 9322 1599
admin@ecologia.com.au

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EXECUTIVE SUMMARY

BHP Billiton (BHPBIO) is conducting a feasibility study and environmental impact assessment of the Goldsworthy Extension Project, detailing several ore bodies including Yarrie, Cattle Gorge, Nimingarra and Sunrise Hill. As clearing of native vegetation and modification of landforms will occur, a baseline flora, vegetation and survey was undertaken. This report details the outcomes and identifies potential environmental impacts associated with the Goldsworthy Extension Project.

Detailed floristic surveys were conducted for each of the five sites within the project area from 1998 to 2004. Yarrie was surveyed in 1998, and the remaining three project areas in 2004. A total of 140 flora survey sites were sampled, with innumerable opportunistic collections of flora also made.

Fauna survey work was also extensive with more than four thousand fauna trapping nights and 15850 minutes (264 hours) of opportunistic searching or recording of fauna in the project area.

For the four distinct study sites, Yarrie, Cattle Gorge, Nimingarra and Sunrise Hill, the flora surveys identified 209, 126, 183 and 201 distinct taxa respectively. Diverse flora compositions were noted as occurring across the four sites. In total 193 species of fauna were identified; a richness higher than other survey work in the Pilbara, but more likely due to the extent of the survey work.

This report includes descriptions and/or locations of all Declared Rare or Priority flora and fauna in Sections 4, 5 and 7. Management recommendations to mitigate impacts to these species are also included in Section 6.

1.0 INTRODUCTION

1.1 General Overview

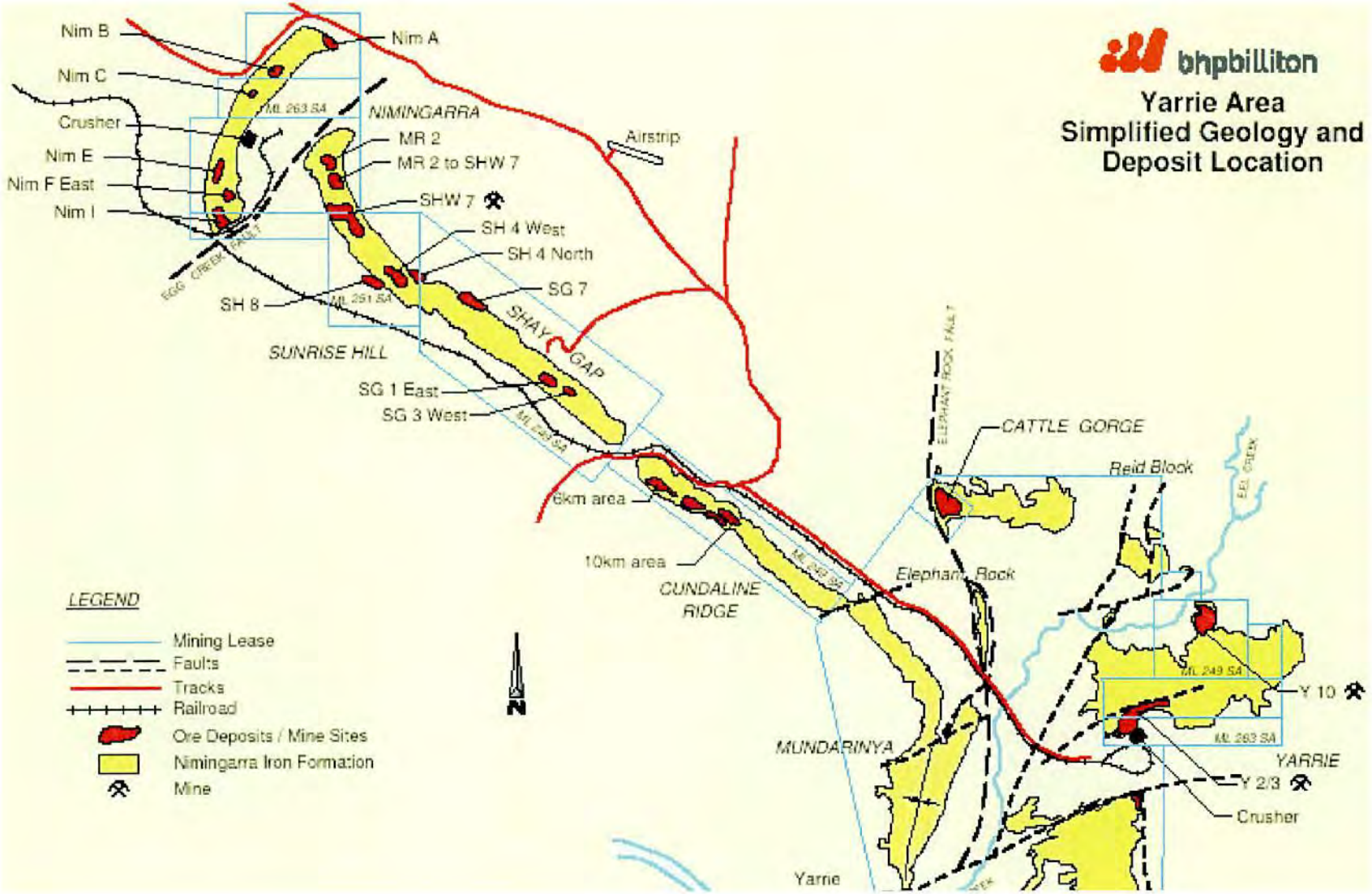
BHP Billiton (BHPBIO) is conducting a feasibility study and environmental impact assessment of the Goldsworthy Extension Project. Incorporated within this study is an assessment of the Goldsworthy Extension's impact on the region's flora and fauna.

The Goldsworthy Extension Project is examining the potential development of the Goldsworthy mine sites and associated infrastructure within the Pilbara, from Yarrie to Port Hedland (Figure 1.1). Specifically, the following BHPBIO sites are included within this report:

1. Yarrie
2. Cattle Gorge
3. Nimingarra
4. Sunrise Hill

A brief description of each site is included in Section 1.2.

As clearing of native vegetation and modification of landforms will be required for expansion, *ecologia* Environment (*ecologia*) has been commissioned by BHPBIO to undertake field-based flora, vegetation and fauna assessments of the sites within the project area. This report details the outcomes and identifies potential environmental impacts associated with the Goldsworthy Extension Project.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Yarrie Area
Simplified Geology and
Deposit Location
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Nim A
Nim C
Crusher
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Nim F East
Nim I
NIMINGARRA
Airstrip
MR 2
MR 2 to SHW 7
SHW 7
SH 4 West
SH 4 North
SG 7
SH 8
SUNRISE HILL
SHAY GAP
SG 1 East
SG 3 West
6km area
10km area
CUNDALINE RIDGE
CATTLE GORGE
Reid Block
Elephant Rock
MUNDARINYA
YARRIE
Y 10
Y 2/3
Crusher
Yarrie
LEGEND
Mining Lease
Faults
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Railroad
Ore Deposits / Mine Sites
Nimingarra Iron Formation
Mine

1.2 Background Information

1.2.1 Yarrie

The Yarrie mine is an open-cut operation located in the north-eastern Pilbara region of Western Australia, approximately 290 km by road east-southeast of Port Hedland and 35 km east of Shay Gap. It occupies the mining and special leases ML249SA Sections 4 and Section 6, ML263SA Sections 4-8, M45/594, M45/573, M45/558, L3116/5978, E45/1072, and E45/573. The Yarrie operations include mining of high-grade iron ore using conventional methods, primary crushing and the loading of ore into rail cars. Ore is transported from the mine *via* a thirty kilometre rail spur connected to the Port Hedland-Goldsworthy line.

1.2.2 Cattle Gorge

The Cattle Gorge represents a satellite deposit closely associated with the existing Yarrie Mine operation. Cattle Gorge has a nominal pit life of approximately three years and is expected to produce up to 11 Mt, which will be extracted at a rate of 6 Mtpa (mega tonnes per annum). The total area of disturbance associated with the pit and overburden storage area will be approximately 60 hectares. The ore will be processed at the existing Yarrie plant, which will be accessed by a new haul road aligned with Elephant Rock and the existing Yarrie access road.

1.2.3 Nimingarra

The Nimingarra site comprises six operational pits. The Nimingarra operation utilises an 'on site' crusher, with screening and blending all done in close association with the train load out, which is linked to the Port Hedland Goldsworthy rail line. The proposed new pit (Nimingarra I) is located at the southern end of the Nimingarra ridgeline. It will have a relatively short pit life of only 24 months and contains approximately 1 Mt of ore.

1.2.4 Sunrise Hill

Sunrise Hill is a large, and very linear, assemblage of existing pits. Approximately five pits are currently operational. However, the project area also contains historic pits from the Shay Gap operation that are now defunct. Ore is extracted from Sunrise Hill and hauled to the Nimingarra processing plant.

1.3 Previous Biological Surveys

The Pilbara is a region of considerable environmental significance, lying at the southern limits of the Northern Botanical Province in the Fortescue Botanical District (Beard, 1979). The region includes species from both the arid interior and the north-west, a region of high species endemism, as well as numerous species which are either endemic to the Pilbara or have restricted geographic distributions (Beard, 1975). Beard (1975) details early exploration in the Pilbara region. Broad scale vegetation mapping was first carried out by Burbidge (1945) and

later refined by Beard (1975, 1979). Early floristic surveys were carried out by Royce (1948) and Burbidge (1959). It was not until the increased development of mineral resources in the Pilbara that detailed flora and fauna surveys at specific sites were conducted (Muir, 1983). These include recent botanical studies such as Atkins (1986), BHP-Utah Minerals International (1987), *ecologia* (1992a, 1992b, 1993, 1995a, 1995b, 1995c, 1997a, 1997b, 1999), Mattiske & Associates (1986, 1989, 1991), Minesite Rehabilitation Services Pty Ltd (1992) and Halpern Glick Maunsell (1997a).

Work on the vertebrate fauna of the Pilbara region has been largely confined to site-specific surveys, including Millstream (Burbidge, 1971), Marandoo (Texasgulf Australia Ltd, 1979; Ninox Wildlife Consulting, 1992), Karijini National Park (Muir, 1983), Burrup Peninsula (Butler, 1983), Channar area (Ninox Wildlife Consulting, 1985, 1986), Pilbara wetlands (Masini & Walker, 1989), Yandicoogina (BHP-UTAH Minerals International, 1987; *ecologia* 1995c), Hope Downs (*ecologia*, 1997a), Area C (*ecologia*, 1997b), Mt Whaleback (*ecologia*, 1997c), West Angelas (*ecologia*, 1997d) and Orebody 23 (*ecologia*, 1997e). These surveys have resulted from proposed or current mining activities and transport corridors.

Within the vicinity of the Goldsworthy project area, vegetation and flora surveys include a botanical assessment of the Y10 Crustal Deposit (*ecologia*, 1994a) and a baseline biological and soil survey of the Yarrie Crustal Deposits (Halpern Glick Maunsell, 1998). Fauna monitoring has primarily concentrated on the Western Pebble-mound Mouse, *Pseudomys chapmani,* within the Yarrie mining area (Piggott, 1993, 1994a, 1994b, 1995; Halpern Glick Maunsell, 1997b, 1997c, 1997d, 1998) and some baseline biological survey work has been completed in the same area on the crustal deposit (Halpern Glick Maunsell, 1998), the general Yarrie mining area (Moloch Fauna Consultants, 1992), and the Goldsworthy Extension Project Area Phase II (Dames and Moore, 1992). During this survey, 34 bird, one frog, six reptile and five mammal species, including the Ghost Bat, *Macroderma gigas*, were recorded. A summary of fauna data from the project area by Halpern Glick Maunsell (1998) indicates that ten mammal, 25 bird and seven reptile species have been recorded prior to this survey.

CALM research projects and opportunistic collecting by amateur naturalists have further supplemented the available information. A small number of species-specific studies have examined aspects of the ecology of some endemic Pilbara fauna such as the Pilbara Ningaui, *Ningaui timealeyi,* (Dunlop & Sawle, 1982) and the Western Pebble-mound Mouse, *Pseudomys chapmani,* (Dunlop & Pound, 1981; Anstee, 1994). CALM, in association with the Western Australian Museum (WAM), is currently undertaking a five year regional biological survey of the Pilbara to provide comprehensive, long-term baseline data for future management.

1.4 Land use History

The mineral exploration history of the Pilbara began in 1888 when gold was found in the Pilbara Creek. Although this did not prove productive, more consistent deposits were subsequently discovered at Marble Bar. Tin was discovered in 1899, and manganese and asbestos have also since been mined in the Pilbara. Massive iron-ore deposits were discovered, with exploitation expanding immensely in the 1960s when the Commonwealth embargo on exporting iron-ore was relaxed (Beard, 1975). Subsequently, the construction of several mining towns, including Newman, was undertaken. Newman was developed in the early 1970s to provide accommodation for workers at the Mt Whaleback iron-ore mine. Ports such as Port Hedland and Dampier, and standard gauge railways from Mt Tom Price and Paraburdoo to Dampier,

Pannawonica to Cape Lambert and Mt Goldsworthy and Mt Newman to Port Hedland were also constructed. The development of the iron-ore industry has resulted in activity within the Pilbara, increasing from cattle and sheep stations and small coastal ports to a large mining economic base with a commensurate increase in population.

Yarrie Pastoral Station was established in the late 19th century. The station currently runs cattle throughout the area. Plans to mine at Yarrie were outlined in November 1985 as part of the "Goldsworthy Extension Project." An intensive drilling program took place in 1991/92 throughout the Nimingarra/Shay Gap area and at Yarrie. A Consultative Environmental Review (CER) (Dames & Moore, 1992) was submitted for the development of an open cut iron mine at Yarrie in October 1992 and mining commenced at the Yarrie Y2/3 deposits in 1993. Approval for surface mining at the Yarrie Y10 deposit was granted in May 1995.

2.0 EXISTING ENVIRONMENT

2.1 Physical Environment

2.1.1 Climate

The Goldsworthy project area is situated in the Pilbara region of Western Australia and experiences an arid-tropical climate with two distinct seasons; a hot summer from October to April and a mild winter from May to September (Gentilli, 1972). Annual evaporation exceeds rainfall by as much as 2,500 mm per year. Low seasonal, but unreliable rainfall, together with extreme temperatures and high diurnal temperature variations are also characteristic climatic features of the region. This region has records of years in which no rainfall was experienced in any month, which is typical of a desert climate (Beard, 1975). Summer temperatures may reach as high as 49 °C, with a mean annual maximum of 30 °C and mean winter maximum of 23 °C (ranging from 14 – 35 °C). Light frosts occasionally occur during July and August. The climate experienced throughout the year is usually very dry. Since the project area is located in the north-eastern Pilbara and relatively close to the coast, the humidity is generally higher than many other parts of the region.

Rainfall in the Pilbara is highly unpredictable and recordings are highest at stations around the Hamersley Ranges, which lie at altitudes of up to 900 m (Beard, 1975). The majority of the Pilbara has a 'bimodal' rainfall distribution, resulting in two rainfall maxima per year; between December and March, and between May and June. From January to March, rain results from moist tropical storms penetrating from the north, producing sporadic and drenching thunderstorms. Tropical cyclones moving south from northern Australian waters also bring sporadic heavy rains. From May to June, extensive cold fronts move easterly across the state and occasionally reach the Pilbara, although these are less frequent in the north than in areas to the south. These fronts produce only light winter rains that are ineffective for plant growth other than herbs and grasses. Larger perennial species require the intense and prolonged storms of summer. Surface water can be found in some pools and springs in the Pilbara all year round, although watercourses only flow briefly due to the short wet season.

Within the study region, meteorological data have been recorded at Marble Bar (21°11'S 119°45'E), providing an indication of climatic conditions experienced within the project area (Table 2.1). Compared to the more northern town of Port Hedland, Marble Bar experiences higher daily maximum temperatures in all months except June and July, and shows greater variation in temperature. The relative stability of temperatures at Port Hedland is indicative of its location near the coast. Mean annual maximum and minimum temperatures for Marble Bar are 35.3 °C and 19.9 °C, respectively. Mean monthly maxima range from 41.7 °C during December to 26.8 °C in July, while mean monthly minima range from 26.1 °C in January to 11.7 °C in July (Figure 2.1, Table 2.1).

The calculated average annual rainfall is 342 mm, occurring over 34.7 rain days (Table 2.1). It follows a fairly typical Pilbara bimodal distribution pattern with a peak between December and March and a smaller peak in May and June (Figure 2.1). Most of the rainfall occurs in the summer period, with over 70 % of total annual precipitation occurring between December and March. Yarrie Station receives an average 338 mm of rainfall annually, and follows a similar pattern to Marble Bar.

Table 2.1 Summary of climatic data for Marble Bar.

MARBLE BAR	Elevation: 189 m Location: 21°11'S 119°45'E											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
TEMPERATURE (°C)												
Daily max. (mean)	41.0	40.0	39.2	36.0	30.6	27.0	26.8	29.5	33.8	37.5	40.5	41.7
Daily min. (mean)	26.1	25.6	24.7	21.3	16.5	13.0	11.7	13.3	16.7	20.2	23.6	25.5
RAINFALL (mm)												
Mean	75	79	54	20	23	24	11	7	1	4	9	35
Mean # rain days	7.3	7.3	4.7	1.8	2.3	2.2	1.5	0.9	0.4	0.6	1.5	4.4

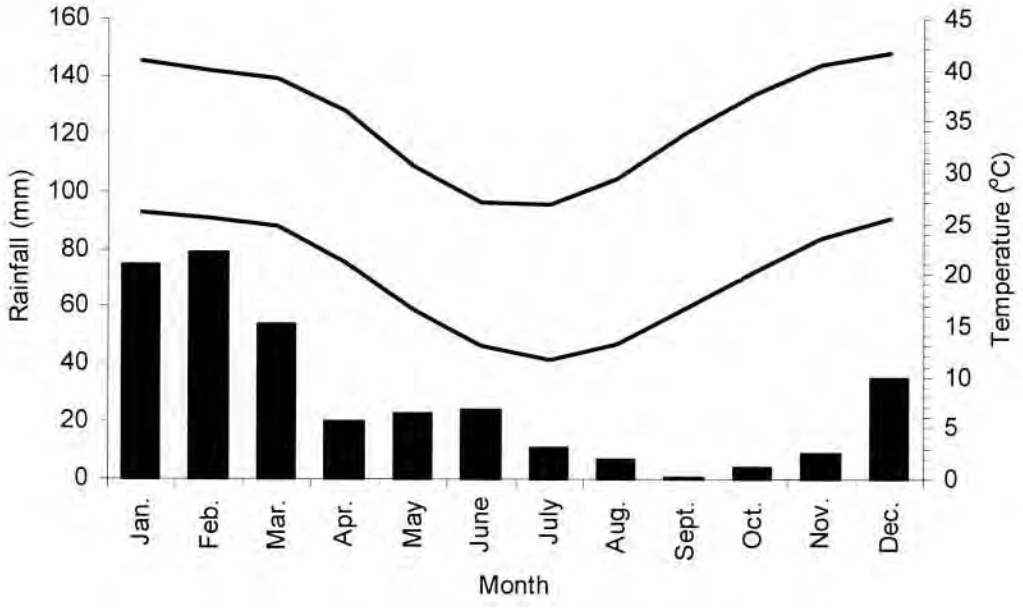


Figure 2.1 Summary of climatic data for Marble Bar.

2.1.2 Geology

The Pilbara region comprises a large part of the ancient continental shield of Western Australia, consisting of both Proterozoic and Archaean rocks. The latter constitutes a block known as the Pilbara Block, overlain by Proterozoic rock deposited in the Hamersley and Bangemall Basins. The Hamersley Basin occupies most of the southern part of the Pilbara Block and can be divided into three stratigraphic groups; the Fortescue, Hamersley and Turee Creek Groups (Beard, 1975; Jarvis, 1979). The Goldsworthy project area lies close to the sedimentary Canning Basin to the north-east.

The geology of the Goldsworthy region has been mapped at a broad scale by Wells (1959). A summary of the main geological elements, which are important to both the development of the landscape and the vegetation, is briefly outlined below.

The Archaean geology of the Shay gap area comprises the exposed northern portions of the Muccan and Warrawagine batholiths, flanked by the supracrustal rocks belonging to the Warrawoona and Gorge Creek Groups (BHP Iron Ore Pty Ltd, 1995). The sites within the project area are generally located in an area that consists of Archaean banded iron formations (BIF) belonging to the Gorge Creek Group, with shallow iron enrichment in the crustal deposits. The stratigraphy of the Yarrie plateau is dominated by an elevated block of the Cleaverville Formation (BIF) that has undergone several stages of deformation, overlying an intruded basement granitoid.

Horizontally bedded Cretaceous sandstone and siltstone of the Callawa formation and a thin cover of Tertiary to recent sediments occur sporadically throughout lowland areas. Dolerite dykes and sills are common but rarely have surface expression and are not extensive anywhere within the survey area.

2.1.3 Landforms

The Goldsworthy Extension project area is centred on the Yarrie Plateau, which runs south-west to north-east and consists of slightly undulating hills with minor drainage lines. The plateau terminates in an abrupt escarpment along its south-eastern edge, and is highly dissected with gorges and deep valleys in the northern and western parts. Surrounding the plateau are open plains, dissected in the west and the north of the project area by Eel Creek, a tributary of the De Grey River.

Based on a modification of the landform-vegetation classification system developed by Dawe and Dunlop (1983) for the biological survey of the Hamersley Range National Park (Karijini National Park), five main landform types can be recognised in the project area:

(1) Ridges and Hills: ridges and hills of the Yarrie plateau. The surface is largely covered with skeletal soils, with areas of exposed rock. There are associated minor drainage lines.

(2) Scree Slopes: gravelly loams with pockets of skeletal soil on slopes 12-15^{o} surrounding the plateau, elevation to 40 m; undulating.

(3) Gorges: major gorges occur in the western and northern parts of the plateau, they include steeply sloping walls of exposed rock with caves and pools in the base of the gorges.

(4) Major Drainage Lines: Eel Creek consists of a shallow eroded channel of sand and large pebbles with a sandy or gravelly washline and associated outwash areas.

(5) Outwash plains: loamy broad plains at the base of the plateau surround the project area.

2.1.4 Soils

The Goldsworthy project area lies within a region of soils that have been broadly mapped by Bettenay *et al.* (1967) as "gradational soils within a neutral reaction trend through the profile (Gn2.12)". At a higher resolution the area is mapped at unit My54: "broad, very undulating plains with scattered rock outcrops occurring as mesas; chief soils are neutral and acid red earths (Gn2.12, Gn 2.11) with some hard red soils (Dr2.32) along pediments of unit Oc61."

As a result of the sparse vegetation cover and the erosive force of the heavy summer rains, much of the soil on the hill slopes tends to be transported down to the valleys and plains. Thus, species and associations on the hills and slopes tend to be correlated with geology rather than soil type (Beard, 1975)

2.1.5 Pilbara Biogeographic Region

The project area lies in the Pilbara biogeographic region of the Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway & Cresswell, 1995), revised by Environment Australia in November, 2000 (Figure 2.2). IBRA is a system of some eighty-five biogeographic regions covering the whole of Australia, including Tasmania, and is the result of collaboration between all State conservation agencies, with co-ordination by the Australian Nature Conservation Agency (ANCA). Bioregions are defined on the basis of geology, landform, vegetation, fauna and climate.

The Pilbara biogeographic region is similar to that commonly recognised as the Pilbara region, and includes four major components; Hamersley, Fortescue Plains, Chichester and Roebourne. Roebourne, the component relevant to this biological assessment, is summarised by Thackway and Cresswell (1995) as follows:

> "Quaternary alluvial plains with a grass savannah of mixed bunch and hummock grasses, and dwarf shrub steppe of *Acacia translucens* over *Triodia pungens*. Arid tropical with summer rain."

This is perhaps more relevant to the lowland areas surrounding the plateau and ridgelines, whereas the upland areas more closely resemble the Hamersley component:

> "Mountainous areas of Proterozoic sedimentary ranges and plateaux with Snappy Gum over *Triodia* on skeletal sandy soils of the ranges."

The project area includes portions of the Abydos Plain and George Ranges 'natural regions' outlined by Beard (1975). These 'natural regions' are more localised regions defined by climate, landform, geology and soil on a finer scale, and described by Clarke (1926).

With an area of 179,287 km^2, the Pilbara bioregion is within the largest area class. Other regions vary from 2,372 to 423,751 km^2 (Thackway & Cresswell, 1995), most being between 14,000 and 200,000 km^2 in size. The size of the Pilbara bioregion is, however, fairly typical of bioregions situated in remote arid and semi-arid areas.

Dominant limiting factors and constraints for the Pilbara listed by Thackway and Cresswell (1995) include extinction of critical weight range mammals, wildfire, feral animals (in particular, the cat and fox), weeds, and grazing or pastoral activities. The reservation status of the bioregion is 1 - 5 %, which is relatively low (some bioregions have a greater than 10 % reservation status).

The project area lies close to the border of the Great Sandy Desert and Dampierland bioregions and there are some Torresian elements to the flora and fauna. The Great Sandy Desert bioregion is characterised by Quaternary red longitudinal sand dune fields overlying Jurassic and Cretaceous sandstones of the Canning Basin, with some areas of gently undulating lateritised uplands that support shrub steppe.

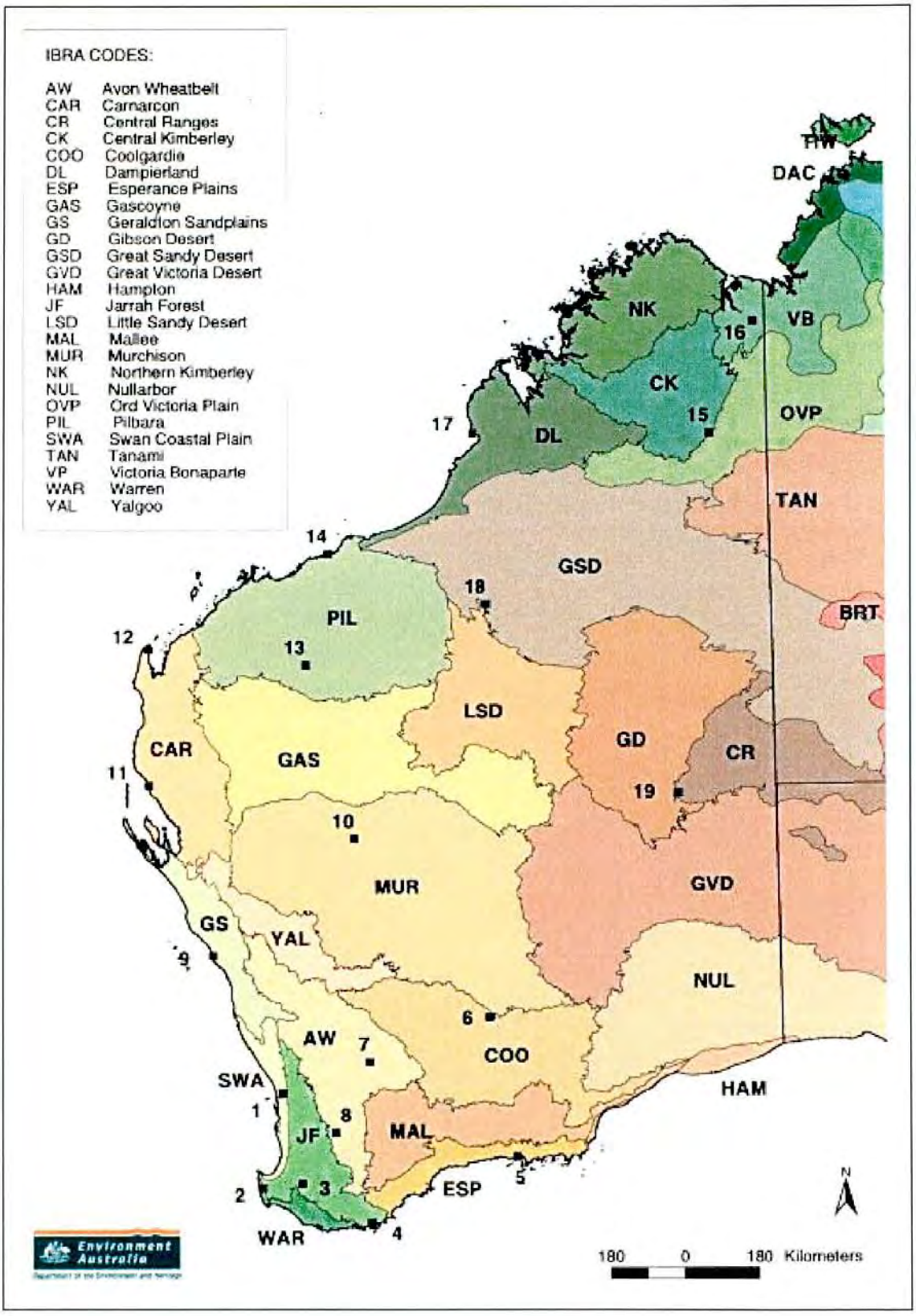


Figure 2.2 Map of Western Australia, showing the IBRA regions (source: www.deh.gov.au/parks/nrs/ibra/version5-1/wa.html).

3.0 METHODOLOGY

3.1 Vegetation and Flora

The project area is situated in the Fortescue Botanical District within the Eremaean Botanical Province, close to the border with the Canning Botanical District to the north. The Fortescue Botanical District is characterised by tree and shrub steppe with some short grass savannah on the coast, and is divided into eight subdistricts. The relevant subdistrict to the project area is Gorge Range. This subdistrict has been described as isolated sections of ranges of highly metamorphosed Archaean and lower Proterozoic rocks of sedimentary and volcanic origin, with tree steppe on rocky grounds of ranges, replaced by shrub steppe in the valleys and lower slopes (Beard, 1975).

3.1.1 Detailed Floristic Survey

Detailed floristic surveys were conducted for each of the five sites within the project area from 1998 to 2004. Yarrie was surveyed in 1998, and the remaining areas in 2004. The floristic field surveys involved both ground truthing and systematic flora sampling using quadrats. Quadrats were used to gain an objective assessment of the vegetation as a whole, while ground truthing was used to describe parts of the project area not assessed by quadrat sampling. Flora surveys were also conducted using opportunistic collections and specific Priority flora searches along transects. Quadrat survey techniques vary in some respects between the 1998 Yarrie survey, and the current work at the other three project areas.

Different numbers of systematic flora sampling quadrats were established at the different sites, and sites were chosen based on field observations and study of aerial photographs and topographical features. The number of sites chosen was calculated to adequately represent the size and heterogeneity of the study area. Vegetation type, life-form strata, percentage cover, surface soil type, litter cover and disturbance details were recorded from all quadrats.

Prior to the field survey, searches of the WA Herbarium and Department of Conservation and Land Management (CALM) Scheduled and Priority flora Databases were conducted to provide details of the exact locations of flora previously recorded in the vicinity of the proposed development. Given the sporadic nature of floristic collection within the region, the area selected was relatively large to capture all likely taxa. When rare flora were recorded during the field survey, an estimate of the number of individuals was made, significant material was collected to enable the submission of voucher specimens to the WA Herbarium, and the locations were recorded on a GPS.

3.1.2 Vegetation Mapping

Vegetation mapping is the delineation of plant communities into groups or associations. The distinctive characteristics that these groups or associations share include features such as species dominance, stratum structure and species composition. Ground truthing and cluster analysis (analysis of the species that comprise each vegetation type and their similarities to each other) were employed to map plant communities. Community types were plotted using aerial

photography to pinpoint the locations of community margins. Both Systat TM and Pattern were used for cluster analysis.

3.1.3 Site-Specific Methodology

Yarrie

The flora and vegetation of the Yarrie site was surveyed from the 3rd – 9th of June, 1998. Quadrats were 100 m x 100 m or an equivalent area of 10 000 m^2 in sites such as narrow creeklines and gullies. However, a small number of sites were less than the standard 10 000 m^2 because the entire area encompassed by the vegetation type was smaller. A total of 38 sites were sampled during the survey. Approximately 54 mm of rainfall had fallen in the 3 months prior to the survey being undertaken, with the greatest majority (46mm) falling in March.

Cattle Gorge

The floristic survey of the Cattle Gorge site was conducted between the 3rd – 7th of February, 2004 and the proposed Cattle Gorge Rail Corridor from the 11th – 14th of March, 2004. A total of 26 systematic flora quadrats were sampled and quadrats were 100 m x 100 m or an equivalent area of approximately 10 000 m^2 where normal quadrats could not be established (*e.g.* along narrow drainage lines). A further ten sites were established along the proposed haul road. Approximately 49 mm of rainfall had fallen in the 3 months prior to the survey being undertaken, with the greatest majority (25mm) falling in December.

Nimingarra

The floristic survey for the Nimingarra site was conducted from the 20th – 28th of October, 2004. A total of 29 flora quadrats were systematically sampled. Quadrats were 50 m x 50 m or an equivalent area of approximately 2500 m^2 where square quadrats could not be established. The vegetation survey and mapping for this area was conducted between the 12th – 14th of January, 2005. No rainfall had been recorded in the 3 months preceeding this survey.

Sunrise Hill

The floristic survey of the Sunrise Hill area was surveyed from the 29th of October – 8th of November, 2004. A total of 46 sites were systematically sampled for this area. Quadrats were 50 m x 50 m or an equivalent area of 2500 m^2 in sites where square quadrats could not be established. The vegetation survey and mapping for this area was conducted between the 15th – 18th of January, 2005. No rainfall had been recorded in the 3 months preceeding this survey.

3.2 Fauna

Following a preliminary reconnaissance, detailed survey sites were chosen as being:

(i) representative of vegetation associations;

(ii) areas of conservation value or ecological sensitivity; and

(iii) areas of environmental impact arising from the proposed development.

These site characteristics are the criteria for site selection and are detailed for each site in the ensuing text and tables.

The inventory of fauna was carried out using a variety of sampling techniques at the different sites, including systematic and opportunistic sampling. Systematic sampling refers to data methodically collected over a fixed time period in a discrete fauna habitat type, using an equal or standardised sampling effort. The resulting information can be analysed statistically, facilitating comparisons within and among sites and between seasons. Opportunistic sampling refers to data collected non-systematically within and outside fixed sampling sites, accompanied by little or no detailed habitat descriptions. Table 3.1 presents a summary of the total fauna survey effort for the project.

Table 3.1 Total fauna survey effort for the Goldsworthy Extension Biological Assessment Survey.

Site	Pit Trap	Elliott Trap	Funnel Trap	Cage Trap	Bird Census	Bat Record-ing	Night Work	Hand Search-ing
Yarrie	230	500			900	420	690	400
Cattle Gorge	280	700	264		3040	340	1070	930
Nimingarra	358	860	321	84	1800	247	1544	687
Sunrise Hill	249	620	249	60	1860	119	1598	210
Total	**1117**	**2680**	**834**	**144**	**7600**	**1126**	**4902**	**2227**

3.2.1 Sampling Methods

The methodology adopted for the current survey was formulated in context with the EPA's Guidance Statements for Terrestrial Fauna and Flora Surveys for Environmental Impact Assessment (Anon., 2004a, b). At Nimingarra, Sunrise Hill and Cattle Gorge, pits were positioned in a line running through a site, with a row of 20 Elliott traps placed adjacent to this line. Due to the conditions of the substrate, and the temperature during the time of the surveys, grids established consisted of eight pits. The layout of the grids and the number of pits facilitated rapid clearing to minimise fauna mortality.

A combination of trapping, opportunistic searching and bird census, as well as nocturnal work and bat recording, was conducted. The details of these activities are as follows:

Systematic Sampling

Mammals and Herpetofauna

(1) Pit-trap and drift fence: PVC pipe (16 cm diameter, minimum 35 cm deep) and 20 L plastic buckets (30 cm diameter, 40 cm deep) were set into the ground. Each pit was subtended by a five metre flywire drift fence (30 cm high).

(2) Elliott box traps: Within each site, a single line of 20 medium sized Elliott box traps (9 x 9 x 32 cm) were arranged, and baited with Universal Bait (a mixture of peanut butter, rolled oats and sardines).

(3) Cage Traps: Wire cage traps, both collapsible and rigid and of varying sizes, were placed at fauna sites near to the pits. Traps were baited with apples and calico bags containing Universal Bait.

(4) Funnel traps: Funnel traps (Ecosystematica Type III) were placed in association with pit traps in the later surveys (Nimingarra, Sunrise Hill, Cattle Gorge), as they were not available for the earlier surveys. Funnel traps were placed adjacent to pits in each site at the ends of the drift fences.

(5) Spotlighting: The sites were searched for nocturnal fauna using hand-held spotlights.

Birds

Systematic methods employed to census avifauna of the sites involved intensive timed bird transects within each survey site. Censuses involved recording the number of individuals of each species observed at a site. The surveys were designed to cover as much ground as possible within the site during a 20 minute period. Bird transect methodology is consistent with other Pilbara surveys carried out by *ecologia*.

Bats

Bat echolocation calls were detected using an Anabat system (Titley Electronics, Ballina, NSW). This consists of an Anabat detector that is able to transform ultrasonic bat echolocation calls for analysis with computer software (Analook and Anabat, URL: <http://users.lmi.net/corben/anabat.htm>). The transformed calls were stored on minidiscs (Sony Premium) using a Sony MZ-R900 Minidisc Recorder and played back through a ZCAIM (Zero-Crossings Analysis Interface Module) onto a PC. Anabat 6.3 g was used to download files and Analook 4.9 g used to analyse call characteristics.

Non-systematic Sampling

To supplement the systematic sampling, the presence of all vertebrate species was assessed via:

(1) Secondary evidence: Tracks, diggings, scats, burrows and nests were recorded where possible; and

(2) Opportunistic sightings: The presence of species was recorded while searching, travelling and during trap establishment within the project area during the day or night.

3.2.2 Site Specific Methodology

Yarrie

A seven day fauna survey was conducted within the Yarrie project area between the 3rd – 9th of June, 1998. Assessment of terrestrial fauna was carried out using both systematic and opportunistic sampling methods. Five systematic fauna survey sites were selected as being representative of the major habitat types within the area (Table 3.2). Sites 1-4 each had ten pits positioned in the standard CALM Pilbara Grid (Figure 3.1). Site 5 had only six pits due to the rocky substrate. Each of the five sites were trapped for five nights (*ecologia,* 1999).

Table 3.2 Yarrie fauna survey site locations (Datum: GDA 94).

Site	Site Description*	Location (UTM)	Criteria for Selection
1	Riverine	51K 220482 mE 7722133 mN	(i), (iii)
2	Gorge	51K 217714 mE 7719737 mN	(i), (iii)
3	Shrubland	51K 216123 mE 7717914 mN	(i), (iii)
4	Scree Slope	51K 221971 mE 7722278 mN	(i), (iii)
5	Plateau / Hilltop	51K 221297 mE 7718629 mN	(i), (iii)

* For site descriptions see Section 5.2.1

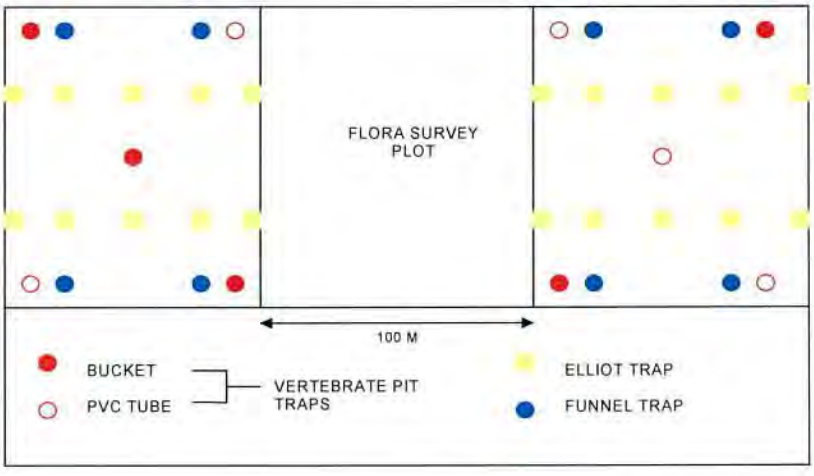


Figure 3.1 Pilbara trapping grid format based on CALM Pilbara biological survey work.

Table 3.3 Yarrie survey effort.

Site	Pit Trap	Elliott Trap	Bird Census	Mist Netting	Night Work	Microhabitat Searching
1	50	100	180	60	120	70
2	50	100	180	180	210	105
3	50	100	180	60	120	105
4	50	100	180	60	120	60
5	30	100	180	60	120	60
Total	**230**	**500**	**900**	**420**	**690**	**400**

*Trapping is measured in nights, whereas opportunistic searching, nocturnal work, bat recording and bird censuses are recorded in minutes.

Cattle Gorge

Opportunistic Survey

An assessment of the fauna and fauna habitats of the Cattle Gorge area was produced following a rigorous desktop review of biological surveys undertaken in similar areas, available literature, voucher fauna databases and remote sensing imagery. This assessment formed the foundation for an opportunistic field fauna survey from the 3rd – 7th of February, 2004, and ensured that fauna collection was executed in the most efficient manner. An *a priori* assessment of the fauna likely to occur in the study area also allowed a more effective targeting of Rare or Priority fauna.

Systematic Survey

Systematic Survey work was undertaken at Cattle Gorge between the 10th and 21st of December, 2004. A total of five systematic grids were established over the ore body and the associated haul road (Table 3.4). Each grid was surveyed for a minimum of seven nights (Table 3.5). Bird censusing was undertaken within each site, as well as opportunistically over the disturbance footprint.

Table 3.4 Cattle Gorge Fauna survey site locations (Datum: GDA 94).

Site	Site Description*	Location (UTM)	Criteria for Selection
1	Minor Drainage/Minor Gorge	51K 212302 mE 7725992 mN	(i), (iii)
2	Minor Drainage	51K 212689 mE 7725811 mN	(i), (iii)
3	Spinifex steppe	51K 212690 mE 7724702 mN	(i), (iii)
4	Major Drainage/Riverine	51K 213228 mE 7722803 mN	(i), (iii)
5	Alluvial Plain	51K 214861 mE 7719342 mN	(i), (iii)

* For site descriptions see Section 5.3.1

Table 3.5 Cattle Gorge survey effort.

Site	Pit Trap	Elliott Trap	Funnel Trap	Bird Census	Bat Recording	Night Work	Hand Searching
1	56	140	56	360	60	200	
2	56	140	56	360		90	
3	56	140	56	360		180	120
4	56	140	48	590	160	120	
5	56	140	48	650		120	90
Opp				720	120	360	720
Total	**280**	**700**	**264**	**3040**	**340**	**1070**	**930**

*Trapping is measured in nights, whereas opportunistic searching, nocturnal work, bat recording and bird censuses are recorded in minutes.

Nimingarra

A sixteen day fauna survey was conducted within the Nimingarra project area between the 2nd and 17th of November, 2004. Assessment of terrestrial fauna was carried out using both systematic and opportunistic sampling methods. Six systematic fauna survey sites were selected as being representative of the major habitat types within the area (Table 3.6). Site 1 had ten pits, while sites 2 – 6 had eight pits. Non-systematic fauna sites shown in Table 3.7 below were selected due to their being appropriate for survey of bats.

Table 3.6 Nimingarra Fauna survey site locations (Datum: GDA 94).

Site	Site Description*	Location (UTM)	Criteria for Selection
1	Major Drainage Line / Gully	51K 188859.3 mE 7741403.0 mN	(i), (iii)
2	Major Drainage Line / Gully	51K 188100.1 mE 7737358.1 mN	(i), (iii)
3	Rocky Scree Slope	51K 187322.8 mE 7739822.2 mN	(i), (iii)
4	Alluvial Plain	51K 187387.6 mE 7736519.9 mN	(i), (iii)
5	Alluvial Plain	51K 188488.8 mE 7740048.0 mN	(i), (iii)
6	Dry River Bed	51K 189025.2 mE 7737795.8 mN	(i), (iii)
ECD	Egg Creek Dam	51K 188821.9 mE 7738340.2 mN	Opportunistic
BC	Bat Cave	51K 188524.1 mE 7740758.4 mN	(i), (iii)

*For site descriptions see Section 5.4.1.

Table 3.7 Nimingarra survey effort.

Site	Pit Trap	Elliott Trap	Funnel Trap	Cage Trap	Bird Census	Bat Recording	Night Work	Hand Searching
1	70	140	49	-	340	60	240	-
2	48	120	40	18	280	-	-	20
3	64	160	56	-	260	-	140	49
4	56	140	56	21	320	70	360	288
5	56	140	56	21	320	-	-	245
6	64	160	64	24	280	10	-	85
ECD	N/A	N/A	N/A	-	N/A	50	100	-
BC	N/A	N/A	N/A	-	N/A	57	114	-
AOP	N/A	N/A	N/A	N/A	N/A	N/A	440	N/A
General	N/A	N/A	N/A	N/A	N/A	N/A	150	N/A
Total	**358**	**860**	**321**	**84**	**1800**	**247**	**1544**	**687**

*Trapping is measured in nights, whereas opportunistic searching, nocturnal work, bat recording and bird censuses are recorded in minutes. ECD = Egg Creek Dam, BC = Bat Cave, AOP = Alluvial Outwash Plain, General = General roads around Nimingarra.

Sunrise Hill

A fifteen day fauna survey was conducted within the Sunrise Hill project area between the 22nd of November and 6th of December, 2004. Assessment of terrestrial fauna was carried out using both systematic and opportunistic sampling methods. Five systematic fauna survey sites were selected as being representative of the major habitat types within the area (Table 3.8). Sites 1-4 had eight pits. Site 5 was a small, confined and flooded *Melaleuca* woodland that had four pits and ten Elliott traps (Table 3.9).

Table 3.8 Sunrise Hill Fauna survey site locations (Datum: GDA 94).

Site	Site Description*	Location (UTM)	Criteria for Selection
1	Gorge / Riverine	51K 201218.7 mE 7728719.5 mN	(i), (iii)
2	*Melaleuca* Woodland / Gorge	51K 195579.9 mE 7732647.0 mN	(i), (ii) (iii)
3	Slope / Spinifex Steppe	51K 192219.2 mE 7734589.4 mN	(i), (iii)
4	Major Drainage Line / Gully	51K 190517.9 mE 7738230.7 mN	(i), (iii)
5	*Melaleuca* Woodland	51K 196210.5 mE 7731961.0 mN	(i), (ii), (iii)

For site descriptions see Section 5.5.1.

Table 3.9 Sunrise Hill survey effort.

Site	Pit Trap	Elliott Trap	Funnel Trap	Cage Trap	Bird Census	Bat Recording	Night Work	Hand Searching
1	55	140	56	18	500	60	220	120
2	56	140	56	15	600	-	240	15
3	56	140	55	15	380	-	-	75
4	56	140	56	12	380	-	160	-
5	26	60	26	N/A	-	59	118	-
AOP	N/A	N/A	N/A	N/A	N/A	N/A	650	N/A
General	N/A	N/A	N/A	N/A	N/A	N/A	150	N/A
Termitaria	N/A	N/A	N/A	N/A	N/A	N/A	60	N/A
Total	**249**	**620**	**249**	**60**	**1860**	**119**	**1598**	**210**

*Trapping is measured in nights, whereas opportunistic searching, nocturnal work, bat recording and bird censuses are recorded in minutes. AOP = Alluvial Outwash Plain, General = Roads around Sunrise Hill, Termitaria = Roadside termite mounds.

3.2.3 Taxonomy and Nomenclature

Field identification of vertebrate species was based on the following field guides:

Mammals	Menkhorst & Knight (2001)
Skinks	Storr *et al.* (1999); Wilson & Swan (2003)
Bats	Churchill (1998); Menkhorst & Knight (2001)
Agamids	Cogger (2000); Wilson & Swan (2003)
Birds	Simpson & Day (2004)
Varanids	Cogger (2000); Wilson & Swan (2003)
Snakes	Storr *et al.* (2002); Wilson & Swan (2003)
Geckos	Storr *et al.* (1990); Cogger (2000); Wilson & Swan (2003)
Reptiles	Cogger (2000); Wilson & Swan (2003)
Pygopods	Storr *et al.* (1990); Cogger (2000); Wilson & Swan (2003)
Amphibians	Tyler *et al.* (2000); Cogger (2000)

In most cases, fauna species were identified in the field. Where the taxonomy of specimens was not clearly discernable, or when species were collected that are known to exhibit significant morphological variation or are not yet fully described, vouchers were lodged with WA Museum. In this report, nomenclature is based on the WA Museum FaunaBase (WAM, 2004).

3.3 Zoogeography and Biogeography

Several zoogeographic regions are recognised in continental Australia. In Western Australia regions can be most broadly defined as the mesic Bassian region of the south-west, the Torresian region of subtropical northern Western Australia, and the arid Eyrean region (Figure 3.2).

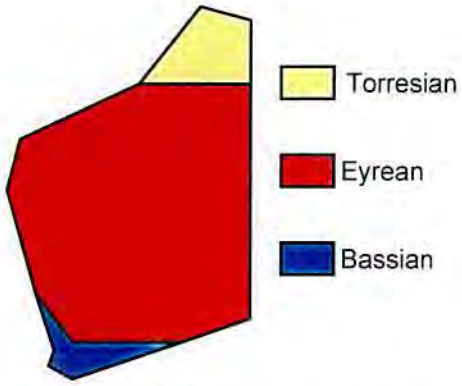


Figure 3.2 Western Australia's Zoogeographic boundaries.

When describing fauna and fauna conservation values, it is interesting to note whether species have a widespread distribution or only occupy the biogeographic regions from which they were collected. Species that are endemic to a particular bioregion may be considered of higher conservation value than cosmopolitan species. There are exceptions where cosmopolitan species, such as the Peregrine Falcon *Falco peregrinus* are in decline.

Where a biological inventory survey reveals a high level of endemism across a broad range of taxa, it is usually interpreted that the area may have high conservation value. In such instances, the physical characteristics of the region may be unique and impose strong influences or selective pressures on the resident fauna, such that the fauna occurring may be dependant on those characteristics that are not present in other areas. In this instance, loss of habitat can result in a significant loss of fauna diversity in a regional or state context.

The distribution ranges of the species captured during the survey were considered in context with the boundary of the Pilbara biogeographic region so an assessment could be made on the conservation value of the survey area.

3.4 Short Range Endemic Fauna

The EPA's Guidance Statement for Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (Anon., 2004a) requires that the EIA of proposals consider the potential impacts on the conservation of short-range endemic fauna. In particular, the principles and objectives for the protection of biodiversity as outlined in The National Strategy for the Conservation of Australia's Biological Diversity (Commonwealth of Australia, 1996).

To assess this, a desktop literature review, database searches, and consultation with key specialists at the Western Australian Museum (WA Museum) were undertaken in order to

evaluate the potential for short-range endemic fauna occurring in the Project area. Following the completion of the review, an environmental risk assessment was conducted to evaluate the potential risks associated with the proposal and, if necessary allow BHPBIO to formulate additional management actions to reduce the potential risks.

3.5 Survey Limitations and Constraints

3.5.1 Flora

According to the EPA Guidance Statement for Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (Anon., 2004b), flora and vegetation surveys may be limited by the following:

- Scope (*i.e.* the influence in terms of reference, such as what life forms *etc.* were sampled);
- Proportion of flora collected and identified (based on sampling, timing and intensity;
- Sources of information (*i.e.* pre-existing background versus new material);
- The proportion of the task achieved and further work which might be needed;
- Timing/weather/season/cycle;
- Disturbances (*e.g.* fire, flood, accidental human intervention, *etc.*);
- Intensity (*i.e.* in retrospect, was the intensity adequate?);
- Completeness (*e.g.* was the relevant area fully surveyed?);
- Resources (*e.g.* degree of expertise available in plant identification to taxon level);
- Access problems;
- Availability of contextual information; and
- Experience levels.

An assessment of these aspects is detailed in Table 3.10.

Table 3.10 Flora and vegetation survey constraints.

Aspect	Constraint (yes/no); Significant, moderate or negligible	Comment
Scope	No	The scope was diverse and detailed all aspects of flora and vegetation assessment, including searches for Priority and Declared Rare Flora.
Proportion of flora identified, recorded and/or collected	No	Very few specimens remained undetermined from this survey work.
Sources of information *e.g.* previously available information (whether historic or recent) *vs* new data	No	The botanical surveys of the Yarrie and Cattle Gorge areas were conducted by *ecologia* previous to the current Goldsworthy (Nimingarra/Sunrise Hill) surveys. The Yarrie and Cattle Gorge areas are within 50 kilometres of the Goldsworthy area and offered a useful source of comparative data. In addition to this, flora and vegetation data from a survey in the Panorama area were also used for regional comparative analysis.
The proportion of the task achieved and further work which might be needed	No	The objectives were met with 75 individual 50 metres x 50 metres or equivalent survey sites in the Nimingarra / Sunrise Hill areas. In addition to this there are 39 individual survey sites in the Yarrie area and 26 survey sites Cattle Gorge area, of 100 metres x 100 metres in both. This gives a total of 140 survey sites across these project areas.
Timing/weather/season/cycle	Yes - moderate	For Nimingarra and Sunrise Hill, the surveys were conducted during the end of the dry season. As a consequence the full compliment of annuals and semi-perennials that may occur in the area may not have been recorded in this survey. Rainfall for the three months preceeding each survey is detailed in Section 3.1.3
Disturbances which affected results of survey	No	Some of the areas at Nimingarra and Sunrise Hill were previously disturbed by earlier mining activities at Goldsworthy and includes open cut pits, waste rock dumps and ripped areas. Some of these features are currently affected by active mining or have undergone rehabilitation of varying success levels.
Intensity (in retrospect, was the intensity adequate?)	No	The intensity of these surveys is considered to be adequate.
Completeness	No	A complete survey of the Nimingarra / Sunrise Hill area was achieved in the current round of work, with the Yarrie and Cattle Gorge completed previously.
Resources	No	Resources were adequate for the botanical survey and vegetation mapping with investment in fieldwork including 23 person days for Nimingarra / Sunrise Hill, 14 person days for Cattle Gorge and 10 person days for the Yarrie area. Malcolm Trudgen, a Pilbara region botanist, was responsible for plant specimen determination/taxonomy ensuring the highest integrity with species identification.
Remoteness and/or access problems	No	Due to the previous mining and exploration work, tracks and roads were available, so accessibility was not a major restriction.
Availability of contextual (*e.g.* biogeographic) information on the region	No	The Pilbara region is subject to increasing levels of survey work, and is a commonly explored in parts botanically and a good amount of literature is available on the flora of the area.
Competency/experience of the consultant carrying out the survey	No	Conrad Slee is a qualified natural scientist with significant field experience. Malcolm Trudgen is renowned for his expertise in plant taxonomy within the Pilbara region.

3.5.2 Fauna

According to the EPA Guidance Statement for Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (2004a), fauna surveys may be limited by the following:

- Competency/experience of the consultant carrying out the survey;
- Scope (what fauna groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions, *e.g.* pitfall trapping in waterlogged soils?);
- Proportion of fauna identified, recorded and / or collected;
- Sources of information *e.g.* previously available information (whether historic or recent) *vs.* new data;
- The proportion of the task achieved and further work which might be needed;
- Timing/weather/season/cycle;
- Disturbances (*e.g.* fire, flood, accidental human intervention *etc.*), which affected results of survey;
- Intensity (in retrospect, was the intensity adequate?);
- Completeness (*e.g.* was the relevant area fully surveyed?);
- Resources (*e.g.* degree of expertise available in animal identification to taxon level);
- Remoteness and/or access problems; and
- Availability of contextual (*e.g.* biogeographic) information on the region.

An assessment of these aspects is detailed in Table 3.11.

Table 3.11 Fauna survey constraints.

Aspect	Constraint (yes/no); Significant, moderate or negligible	Comment
Competency/experience of the consultant carrying out the survey	No	All members of the survey team have had appropriate training, experience and mentoring in fauna identification and fauna assemblage surveys. Senior personnel have specific training and have undertaken no less than 15 similar surveys in the immediate area, and the principal zoologist has more than 10 years experience in terrestrial fauna surveys.
Scope	No	All terrestrial fauna groups were sampled for appropriately and adequately.
Proportion of fauna identified, recorded and/or collected	No	Across the vertebrate groups, approximately 20 – 75% of the expected fauna were recorded. The highest proportion was among the birds. The lowest proportion was the amphibians
Sources of information *e.g.* previously available information (whether historic or recent) *vs.* new data	No	Several other unpublished reports for BHPBIO produced by *ecologia* and others. Voucher records for most species are substantial for the area.
The proportion of the task achieved and further work which might be needed	No	The baseline biological survey is complete.
Timing/weather/season/cycle	Yes- moderate	Hot weather reduced the number of traps which could be set and cleared effectively. Due to the heat, animals were seeking shelter earlier in the day and activity had decreased noticeably.
Disturbances which affected results of survey	No	There were no disturbances which were of impact to the survey.
Intensity (in retrospect, was the intensity adequate?)	No	Due to the number of discrete survey areas (4), the overall survey intensity was more than adequate
Completeness	No	The survey was complete
Resources	No	Voucher specimens of amphibians, reptiles and mammals were identified by Brad Maryan of the Western Australian Museum.
Remoteness and/or access problems	No	All areas which needed to be sampled to adequately represent the fauna of the area were accessible by road.
Availability of contextual (*e.g.* biogeographic) information on the region	No	WA Museum fauna database, Department of Conservation and Land Management lists, Interim Biogeographic Regionalisation of Australia (IBRA) (Thackway & Cresswell, 1995), several unpublished reports undertaken by *ecologia*.

Significant = greater than 60 % of potential fauna not sampled
Moderate = 20-60 % of potential fauna not sampled
Negligible = less than 20 % of potential fauna not sampled

4.0 FLORA

Across all of the areas surveyed including Yarrie, Cattle Gorge, Nimingarra and Sunrise Hill, there are 444 distinct taxa that have been recognised.

There have been no other surveys of this scope undertaken in the immediate area for which data are available to compare flora diversity. Therefore, figures are presented below that consider flora richness as a measure of diversity for six (6) baseline flora and vegetation surveys undertaken by *ecologia* for BHPBIO in the Pilbara region of Western Australia. These surveys were located predominantly in the SE Pilbara near the town of Newman and include:

- East Opthalmia Biological and Soil Survey – 25 km E of Newman
- Packsaddle Range Biological Survey – 120 km WNW of Newman
- Satellite Ore Body 24 Biological Survey – 10km NW of Newman
- Jimblebar Wheelarra Hill Biological Survey – 35 km ESE of Newman
- Mining Area C Biological Survey – 120km WNW of Newman

It is important to note that larger surveys cover a greater variety of vegetation units, and so support greater species richness. Survey area is not the best measure of vegetation and floristic diversity when making broad comparisons of surveys. Prior to undertaking any biological survey, an assessment of habitat complexity is made to determine the survey effort required for any given area. Therefore, it is intuitive that more complex areas, that are likely to be more speciose, require more survey work. For the purpose of comparing flora diversity, the number of survey days (person days) is used as a measure of the size and flora/vegetation complexity of each of the project areas.

Figure 4.0a shows that, although the Goldsworthy Extension project area supports a high species richness (444 taxa), it is comparable to other surveys of a similar size (Area C – 422 taxa). The R^2 value also shows that there is a high degree of correlation between these two variables, even when considering smaller surveys such as Packsaddle Range (218 taxa).

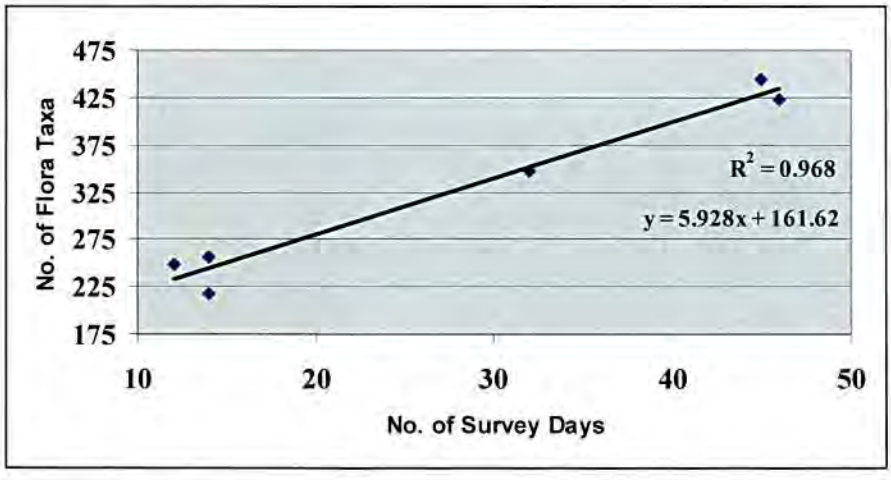


Figure 4.0a Graph to show the relationship between the survey intensity and the number of species recorded for six (6) baseline flora and vegetation surveys undertaken for BHPBIO in the Pilbara region of Western Australia.

If each of the four ore bodies described within this report are separated out and compared with surveys of a smaller (similar) size, the species richness of the Goldsworthy Extension area is again shown to be similar to other sites in the Pilbara (Figure 4.0b).

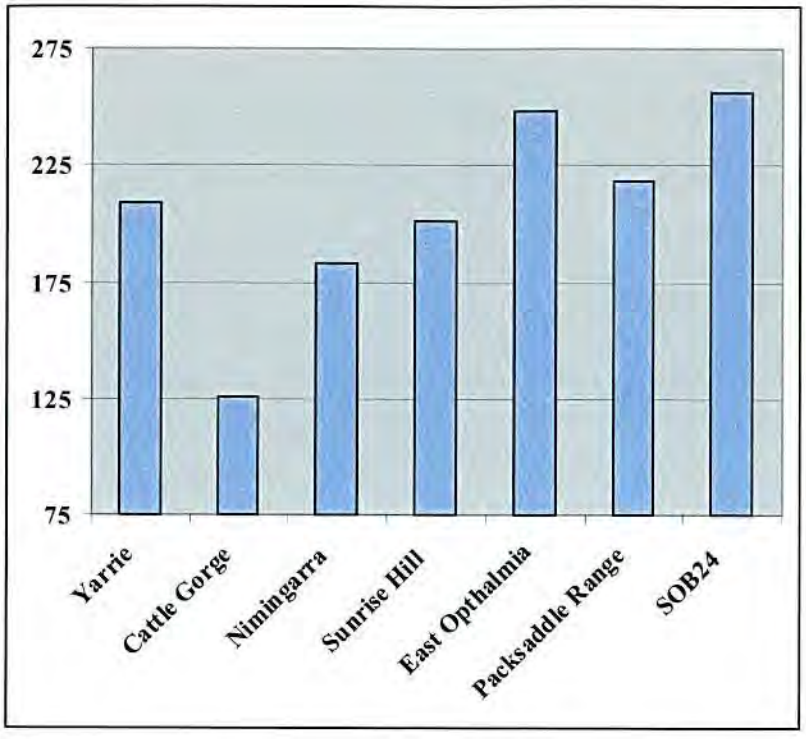


Figure 4.0b Graph to show that, when each ore body within the Goldsworthy Extension Project is considered as distinct, the species richness is very comparable with other surveys of a similar size.

4.1 Yarrie

4.1.1 Vegetation

The vegetation at Yarrie was classified into twelve vegetation associations based on ground truthing and statistical analyses (Figure 4.1a,b,c,d). The community types from this survey are as follows:

(1) Scattered *Corymbia hamersleyana* over sparse *Acacia inaequilatera / Grevillea pyramidalis* subsp. *pyramidalis* and sparse to moderately dense *Triodia wiseana* on calcrete baseplains;

(2) *Triodia wiseana* steppes;

(3) Sparse emergents over open *Triodia epactia/T. wiseana* on steep rocky slopes;

(4) *Triodia epactia* dominated steppes;

(5) Open density emergents over moderately dense *Triodia epactia*;

(6) *Triodia basedowii* steppes;

(7) Sparse mixed shrubs over sparse *Triodia epactia* on low rocky slopes;

(8) Sparse *Eucalyptus leucophloia* and other *Eucalyptus* spp. over *Acacia tumida* var. *pilbarensis*, mixed soft grasses and *Triodia epactia* on gullies;

(9) Open to dense *Acacia tumida* var. *pilbarensis* over *Triodia epactia* on major drainage lines;

(10) *Eucalyptus camaldulensis/E. victrix* over sparse to moderately dense tall shrubs and mixed soft grasses and spinifex;

(11) Dense *Sesbania formosa* over dense *Cyperus vaginatus* on minor spring;

(12) Sparse *Corymbia hamersleyana/Eucalyptus candida* ms over *Indigofera monophylla* and mixed shrubs and *Ipomoea muelleri* on sandplains.

4.1.2 Flora Biodiversity

A total of 209 taxa of vascular flora, from 47 families and 105 genera, were collected from the Yarrie study area, 67 of which were represented by a single taxon (Appendix A). The most frequently represented families were Poaceae (30 taxa), Papilionaceae (22 taxa), Mimosaceae (16 taxa), Malvaceae (12 taxa) and Myrtaceae (11 taxa). The genera represented by the greatest number of taxa were *Acacia* (16 taxa), *Eucalyptus, Ptilotus,* and *Eriachne* (all with six taxa) and *Triodia, Cyperus, Senna, Euphorbia, Solanum* and *Goodenia* (all with five taxa). The most widely distributed taxa within the sites were *Grevillea wickhamii* ssp. *aprica, Acacia ptychophylla, Acacia inaequilatera, Corymbia hamersleyana* and *Acacia tumida* var. *pilbarensis.*

4.1.3 Conservation Significance

No species of Threatened Flora as listed in the *Environment Protection and Biodiversity Act 1999* (EPBC Act) or Declared Rare Flora (DRF) as listed in the Department of Conservation and Land Management *Wildlife Conservation (Rare Flora) Schedule 2004* (See Appendix E) were collected during the flora and vegetation survey of the Yarrie area. Two Priority 2 species, *Euphorbia clementii* and *Euphorbia drummondii* subsp Pilbara (B.G.Thomson 3503) were collected (Table 4.1). *Euphorbia drummondii* is a small much branched prostrate herb with ovate to oblong leaves 3-10 x 1.5-5 mm placed opposite each other along the stems. The style is notched and the capsule is approximately 2 mm diameter and green. *Euphorbia clementii* is a small upright herb with the ovate leave 10-20 x 4-10 mm placed oppositely along the sometimes red-brown stems. The capsule is approximately 2 mm diameter and green.

A search of CALM databases indicates that two other Priority species, *Fimbristylis* sp. Shay Gap (K.R.Newbey 10293) (Priority 1) and *Ptilotus mollis*, (Priority 2) have been previously recorded from within a 50 km radius of the project site (Atkins, 2005). A further one Priority species, *Bulbostylis burbidgeae* (Priority 3) has been previously recorded from within a 100 km radius of the project site (Atkins, 2005).

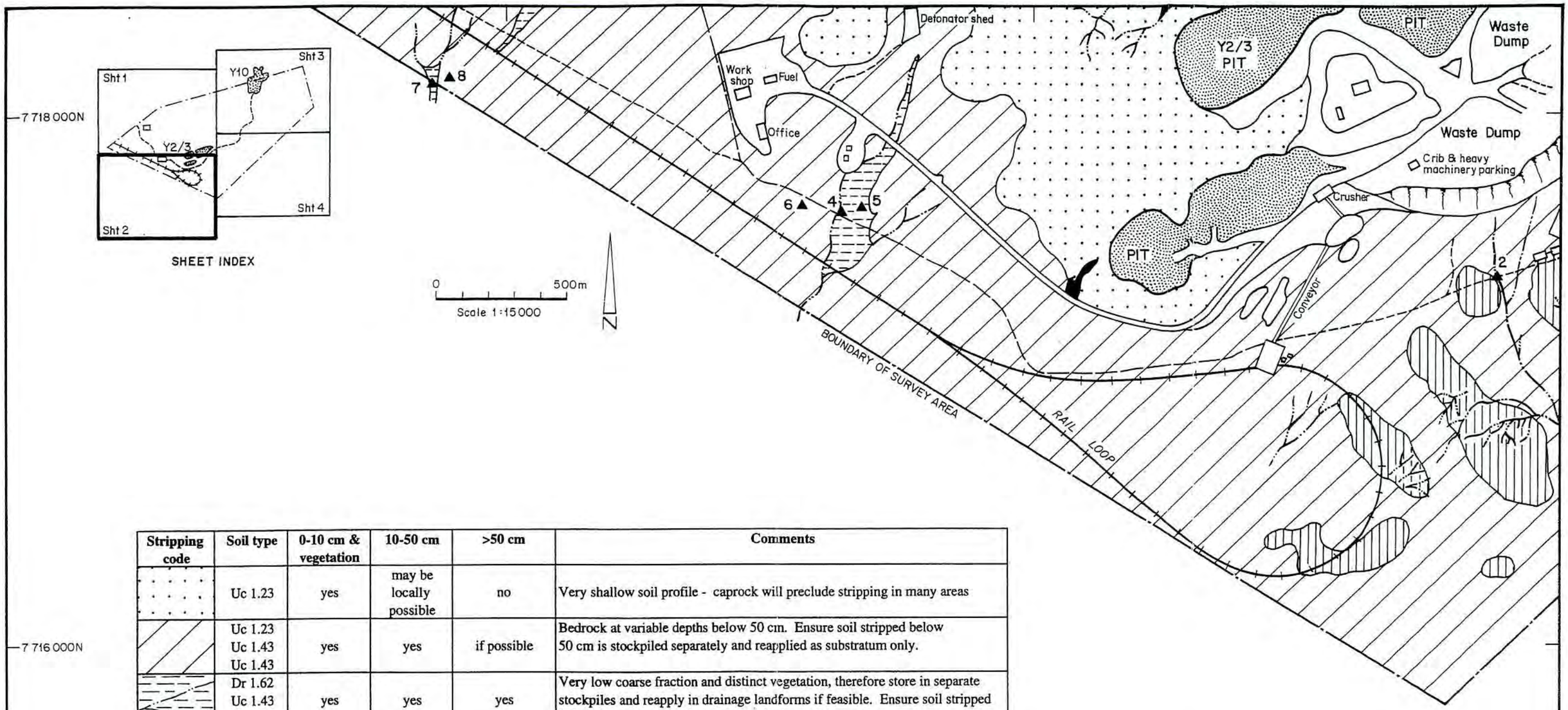
Table 4.1 Locations of the two Priority flora species recorded during the 1998 Yarrie survey.

Species	Site Number	Site Location (UTM) AGD84
Euphorbia clementii	9	51K 224158 mE 7720819 mN
Euphorbia clementii	17	51K 222051 mE 7721002 mN
Euphorbia drummondii	2	51K 217714 mE 7719737 mN
Euphorbia drummondii	5	51K 221297 mE 7718629 mN
Euphorbia drummondii	38	51K 217138 mE 7717656 mN

Four introduced species were recorded from within the Yarrie project area in 1998, of which **Cenchrus ciliaris*, was the most widely distributed along Eel Creek and Chinaman's Creek. **Aerva javanica* was recorded at low densities within *Triodia wiseana* dominated base plains and the weedy native **Acacia farnesiana* was also recorded at low densities within Eel Creek. The species **Chloris gayana* was recorded from a single location near the site office. None of these species are Gazetted Declared Weeds as listed by the Agriculture Protection Board.

4.1.4 Impact Assessment

The principal impacts from extension of the Yarrie mine will be the loss of vegetation through clearing activities due to extension of pit areas, waste dumps and haul road construction. Further clearing may result in the loss of some *E. clementii* and *E. drummondii* ssp. Pilbara (B.G.Thomson 3503) plants. Weed species present may be further dispersed due to disturbance and use of heavy machinery. Access roads within the project area are already established. Any further construction of roads should take into account Priority flora that may occur.



Stripping code	Soil type	0-10 cm & vegetation	10-50 cm	>50 cm	Comments
	Uc 1.23	yes	may be locally possible	no	Very shallow soil profile - caprock will preclude stripping in many areas
	Uc 1.23 Uc 1.43 Uc 1.43	yes	yes	if possible	Bedrock at variable depths below 50 cm. Ensure soil stripped below 50 cm is stockpiled separately and reapplied as substratum only.
	Dr 1.62 Uc 1.43 Uc 1.23	yes	yes	yes	Very low coarse fraction and distinct vegetation, therefore store in separate stockpiles and reapply in drainage landforms if feasible. Ensure soil stripped below 50 cm is stockpiled and reapplied as substratum
	Uf 1.33	yes	may be locally possible	no	Calcareous bedrock will limit stripping locally. Soils from these areas have a much higher salt content and must be kept separate from other stockpiles and only used within the same stripping area.
	Uc 1.43	no	no	no	Eel creek - bed. Soil too alkaline for rehabilitation usage.
	not determined	no	no	no	Rocky gullies and faces- skeletal soils only. Steep slopes and large boulders probably preclude stripping, particlularly given low yields.

▲ 8 Soil Profile site

Figure 4.1 Distribution of Soil Types in the Yarrie Project Area

Stripping code	Soil type	0-10 cm & vegetation	10-50 cm	>50 cm	Comments
	Uc 1.23	yes	may be locally possible	no	Very shallow soil profile - caprock will preclude stripping in many areas
	Uc 1.23 Uc 1.43 Uc 1.43	yes	yes	if possible	Bedrock at variable depths below 50 cm. Ensure soil stripped below 50 cm is stockpiled separately and reapplied as substratum only.
	Dr 1.62 Uc 1.43 Uc 1.23	yes	yes	yes	Very low coarse fraction and distinct vegetation, therefore store in separate stockpiles and reapply in drainage landforms if feasible. Ensure soil stripped below 50 cm is stockpiled and reapplied as substratum
	Uf 1.33	yes	may be locally possible	no	Calcareous bedrock will limit stripping locally. Soils from these areas have a much higher salt content and must be kept separate from other stockpiles and only used within the same stripping area.
	Uc 1.43	no	no	no	Eel creek - bed. Soil too alkaline for rehabilitation usage.
	not determined	no	no	no	Rocky gullies and faces- skeletal soils only. Steep slopes and large boulders probably preclude stripping, particlularly given low yields.

Figure 4.1 Distribution of Soil Types in the Yarrie Project Area

216 000E

218 000E

7 720 000N

▲ 11 Soil Profile site

Sht 1 Sht 3 Y10 Y2/3 Sht 4 Sht 2

SHEET INDEX

N

0 500m

Scale 1:15 000

Limit of Aerial Photography

BOUNDARY OF SURVEY AREA

Camp

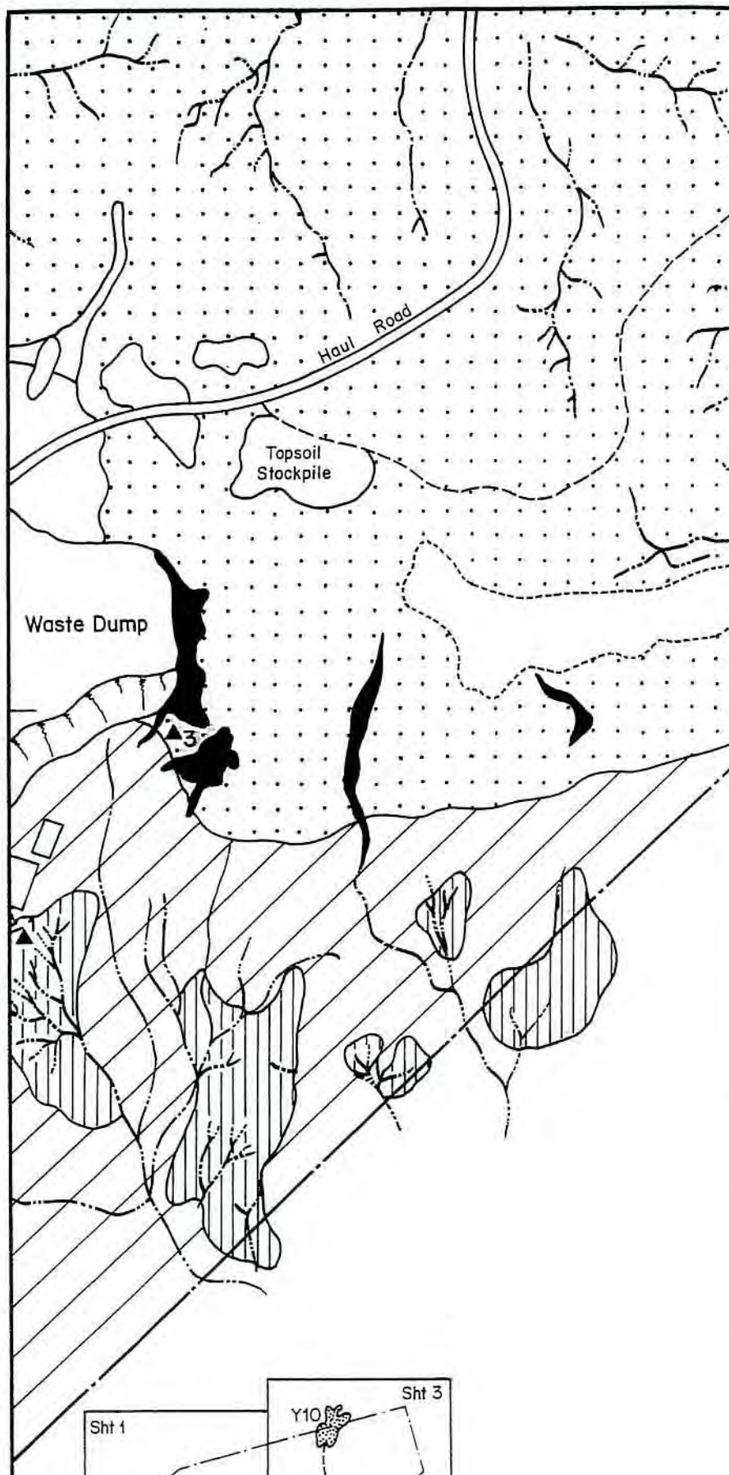
Eel Creek

9 ▲10

▲11

PIT

ecologia



Stripping code	Soil type	0-10 cm & vegetation	10-50 cm	>50 cm	Comments
	Uc 1.23	yes	may be locally possible	no	Very shallow soil profile - caprock will preclude stripping in many areas
	Uc 1.23 Uc 1.43 Uc 1.43	yes	yes	if possible	Bedrock at variable depths below 50 cm. Ensure soil stripped below 50 cm is stockpiled separately and reapplied as substratum only.
	Dr 1.62 Uc 1.43 Uc 1.23	yes	yes	yes	Very low coarse fraction and distinct vegetation, therefore store in separate stockpiles and reapply in drainage landforms if feasible. Ensure soil stripped below 50 cm is stockpiled and reapplied as substratum
	Uf 1.33	yes	may be locally possible	no	Calcareous bedrock will limit stripping locally. Soils from these areas have a much higher salt content and must be kept separate from other stockpiles and only used within the same stripping area.
	Uc 1.43	no	no	no	Eel creek - bed. Soil too alkaline for rehabilitation usage.
	not determined	no	no	no	Rocky gullies and faces- skeletal soils only. Steep slopes and large boulders probably preclude stripping, particlularly given low yields.

▲ 3 Soil profile site

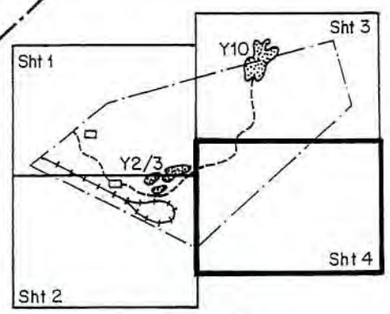
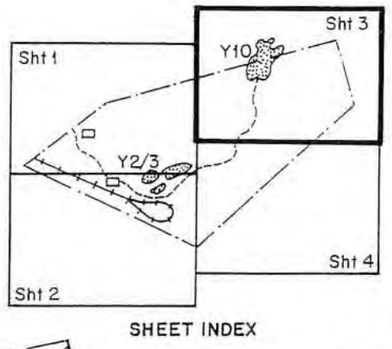
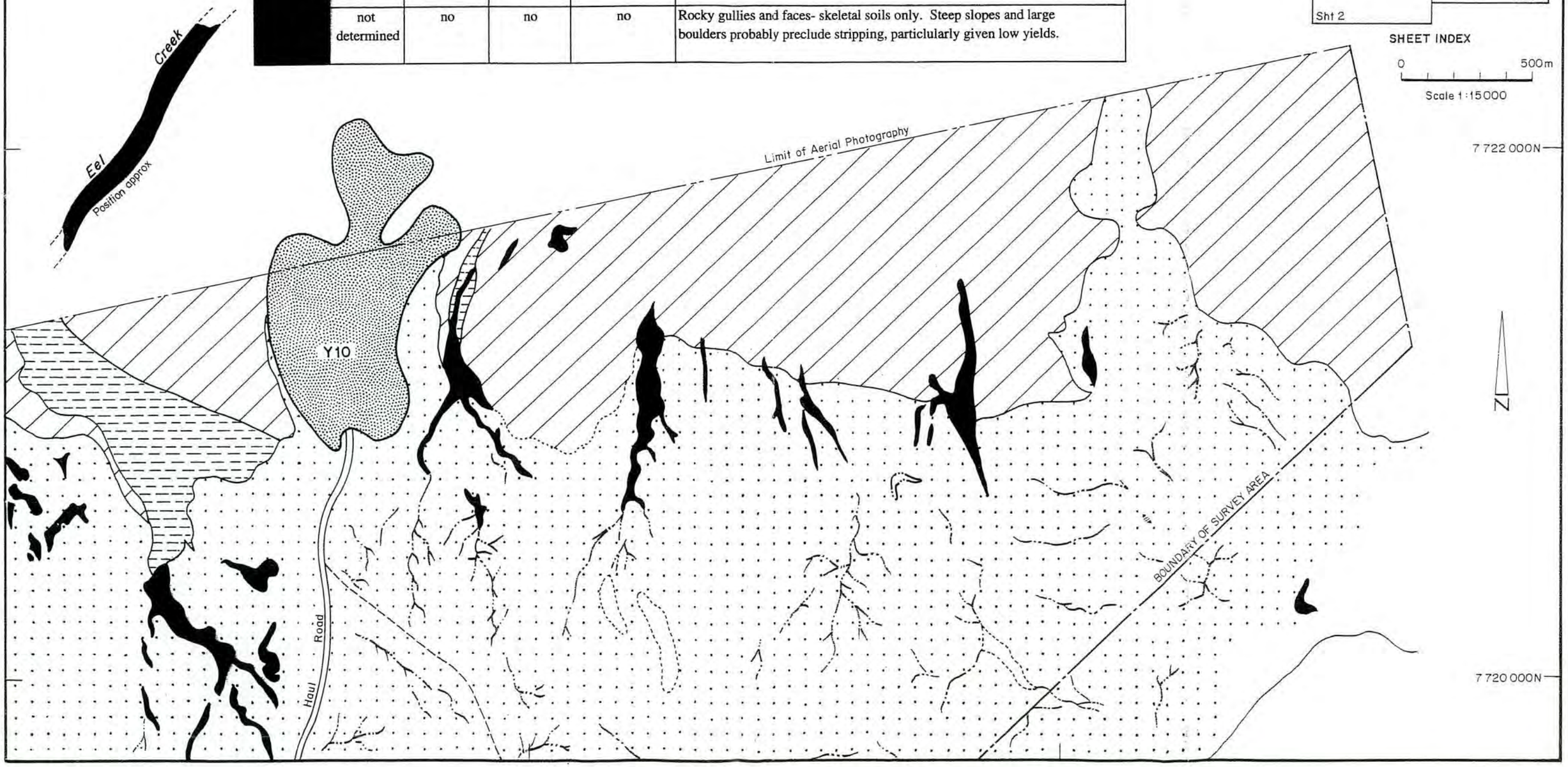


Figure 4.1 Distribution of Soil Types in the Yarrie Project Area

Stripping code	Soil type	0-10 cm & vegetation	10-50 cm	>50 cm	Comments
	Uc 1.23	yes	may be locally possible	no	Very shallow soil profile - caprock will preclude stripping in many areas
	Uc 1.23 Uc 1.43 Uc 1.43	yes	yes	if possible	Bedrock at variable depths below 50 cm. Ensure soil stripped below 50 cm is stockpiled separately and reapplied as substratum only.
	Dr 1.62 Uc 1.43 Uc 1.23	yes	yes	yes	Very low coarse fraction and distinct vegetation, therefore store in separate stockpiles and reapply in drainage landforms if feasible. Ensure soil stripped below 50 cm is stockpiled and reapplied as substratum
	Uf 1.33	yes	may be locally possible	no	Calcareous bedrock will limit stripping locally. Soils from these areas have a much higher salt content and must be kept separate from other stockpiles and only used within the same stripping area.
	Uc 1.43	no	no	no	Eel creek - bed. Soil too alkaline for rehabilitation usage.
	not determined	no	no	no	Rocky gullies and faces- skeletal soils only. Steep slopes and large boulders probably preclude stripping, particlularly given low yields.

Figure 4.1 Distribution of Soil Types in the Yarrie Project Area





4.2 Cattle Gorge

4.2.1 Cattle Gorge

4.2.1.1 Vegetation

The vegetation surveyed for the Cattle Gorge area was classified into seven community types based on aerial photographs and ground truthing (Figure 4.2). These community types were distinctive from those of other previous surveys due to the dominance and composition of particular plant species. The community types from this survey are as follows:

(1) Open to scattered *Grevillea wickhamii* tall shrubland, over *Acacia tumida* var. *pilbarensis/Tephrosia spechtii* medium shrubs, over moderately dense *Triodia epactia* hummock steppe on hill crests and gentle slopes;

(2) Moderately dense *Grevillea wickhamii* tall shrubland, over *Acacia tumida* var. *pilbarensis,* often with scattered *Corymbia hamersleyana* low trees, over moderately dense *Triodia epactia* hummock steppe along moderate to gentle gullies and hill slopes;

(3) Scattered *Grevillea pyramidalis* subsp. *pyramidalis / Acacia pyrifolia / Senna glutinosa* subsp. *glutinosa* tall to medium shrubs, over sparse medium to low shrubs, over *Acacia ptychophylla* dwarf shrubs, over open to moderately dense *Triodia wiseana* hummock steppe on steep scarp slopes;

(4) Moderately dense to dense *Acacia tumida* var. *pilbarensis* tall shrubland, over sparse to scattered medium / low shrubs, over soft grasses such as *Cymbopogon ambiguus,* over open to sparse *Triodia epactia* hummock grassland at rocky outcrops on steep upper scarp slopes;

(5) Scattered *Eucalyptus leucophloia* with scattered *Corymbia hamersleyana* or *Grevillea wickhamii* subsp. *aprica*, over *Acacia spondylophylla* with open to moderately dense *Triodia epactia / Triodia wiseana* on moderately steep hill slopes;

(6) Scattered *Acacia inaequilatera/Grevillea pyramidalis* low trees, sometimes with *Corymbia hamersleyana* low trees, over scattered *Grevillea wickhamii* ssp. *aprica / Acacia ptychophylla*, and other medium to low shrubs, over moderately dense *Triodia wiseana / Triodia wiseana* hummock steppe.

(7) Scattered *Acacia inaequilatera,* sometimes with *Corymbia hamersleyana* or *Corymbia flavescens* low trees, over scattered mixed *Acacia* species as medium to low shrubs, over moderately dense *Triodia wiseana* hummock steppe on gentle lower hill slopes;

4.2.1.2 Flora Biodiversity

A total of 29 plant families, including 56 genera, were recorded for the Cattle Gorge area. Of these genera, 34 were represented by a single taxon. The flora recorded included 126 distinct taxa, of which 23 families, 33 genera and 82 species were recorded for the Cattle Gorge area; and 24 families, 44 genera and 71 species were recorded for the proposed Rail Corridor (Appendix A). The most frequently represented families were Mimosaceae (17 taxa), Poaceae (15 taxa), Malvaceae (13 taxa), Tiliaceae (12 taxa) and Papilionaceae (11 taxa). The highest species richness was recorded for a site that was located on a gentle lower slope. The lowest species richness was recorded on a minor channel near a hill crest.

Floristic collections have been made for the proposed Cattle Gorge Haul Road that runs adjacent Elephant Rock to the Yarrie Access Road. Identification of taxa collected is, as yet, incomplete.

4.2.1.3 Conservation Significance

No species of Threatened Flora as listed in the EPBC Act or DRF as listed in the CALM Rare Flora List were collected during the flora and vegetation survey of the Cattle Gorge area. In addition, there were no Priority flora species found during the survey of the Cattle Gorge area.

A search of CALM databases indicates that two Priority species, *Fimbristylis* sp. Shay Gap (K.R.Newbey 10293) (Priority 1) and *Ptilotus mollis* (Priority 2) have been previously recorded from within a 50 km radius of the project site (Atkins, 2005). A further Priority species, *Bulbostylis burbidgeae* (Priority 3) has been previously recorded from within a 100 km radius of the project site (Atkins, 2005).

The flora survey of the Cattle Gorge for this report showed no record of any weed species present. However, along the area of the Cattle Gorge Rail Corridor flora survey, the weed species **Malvastrum americanum* was found. This weed species was relatively uncommon within the survey area.

4.2.1.4 Impact Assessment

The primary impact of extension at the Cattle Gorge will be the loss of vegetation through clearing and mining activities. The vegetation of the Cattle Gorge area contains a variety of community types. The community types containing *Triodia* steppe may support the Priority 2 species *Euphorbia clementii*. Further clearing may result in the loss of some *E. clementii* plants. However, clearing operations may also lead to an increase in plant numbers due to the preference of this species for recently disturbed soil. Weed species present may be further dispersed due to disturbance and use of heavy machinery. Access roads within the project area are already established. Any further construction of roads should take into account Priority flora that may occur.

7727000mN

212000mE

213000mE

Extent of Available
Aerial Photography

5
4
3
19
18
20
21
2
16
1
17
6
26
22
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25
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13
10
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12
15
9

7726000mN

7725000mN

N

SCALE 1 : 10 000

0 500

Metres

MAP GRID OF AUSTRALIA
Grid based on Transverse Mercator Projection

214000mE

Legend

☐ Site Locations

Site Vegetation Units

Open to scattered *Grevillea wickhamii* over *Acacia tumida/Tephrosia spechtii* with moderately dense *Triodia epactia* steppe on hill crests and gentle slopes.

Moderately dense *Grevillea wickhamii / Acacia tumida* often with scattered *Corymbia hamersleyana,* over moderately dense *Triodia epactia* steppe along moderate to gentle gullies and hill slopes.

Scattered *Grevillea pyramidalis / Acacia pyrifolia / Senna glutinosa* over sparse medium shrubs, over *Acacia ptychophylla* with open to moderately dense *Triodia wiseana* steppe on steep scarp slopes.

Moderately dense to dense *Acacia tumida* with sparse to scattered medium / low shrubs over soft grasses such as *Cymbopogon ambiguus* with open to sparse *Triodia epactia* at rocky outcrops on steep upper scarp slopes.

Scattered *Eucalyptus leucophloia* with scattered *Corymbia hamersleyana* or *Grevillea wickhamii,* over *Acacia spondylophylla* with open to moderately dense *Triodia epactia / Triodia wiseana* on moderaly steep hill slopes.

Scattered *Acacia inaequilatera / Grevillea pyramidalis* sometimes with *Corymbia hamersleyana,* over *Grevillea wickhamii / Acacia ptychophylla,* with moderately dense *Triodia epactia / Triodia wiseana* steppe.

Scattered *Acacia inaequilatera* sometimes with *Corymbia hamersleyana* or *Corymbia flavescens,* over scattered meduim to low *Acacia* species, with open to dense *Triodia wiseana* steppe on gentle lower slopes.

ecologia
ENVIRONMENTAL CONSULTANTS

Author: C.Slee | Drawn: S.Coleman

Client: **BHP BILLITON**

Project: **YARRIE February 2004**

VEGETATION MAP, SITE LOCATIONS AND PRIORITY FLORA LOCATIONS FOR THE CATTLE GORGE SURVEY AREA

A3

Date: 11 May 2004
Scale: 1:10 000
Figure No. **4.2**
Plan No. **CG-001**

4.3 Nimingarra and Sunrise Hill Ridge

4.3.1 Vegetation

The vegetation surveyed for the Nimingarra area (Figure 4.3) has been classified along with that of the Sunrise Hill ridge area (Figure 4.4). This is due to their close proximity to one another and the fact that this allows for a greater level of statistical power at the analysis stage due to a higher number of replicates. There are 26 vegetation communities that have been identified based on descriptions given in the field, aerial photographs, ground truthing and data analysis using the PATN® program. The PATN analysis (see Appendix F) has classified these vegetation types using grouping based on the species composition (specifically the taxa present at each site as presence/absence data). This analysis and grouping also incorporates data gained from the Cattle Gorge and Yarrie areas, with the addition of survey data from the Panorama area that are also within the region, but not particularly close to any of the four areas.

The vegetation types are categorised as: forest, woodland, scattered trees over shrubland, and various shrubland types over grasses and spinifex (*Triodia* spp.) based on the PATN analysis classification described above. These have been further categorised into a number of sub-communities as described below. These categories allow for fine scale identification and mapping of the vegetation types of the Nimingarra and Sunrise Hill areas. Vegetation complexes have been divided where possible to identify unique vegetation that may contain flora of potential regional and state conservation significance.

Many of these vegetation types have a ground stratum of *Triodia* spp. hummock grassland, which at higher density levels on mostly flat terrain is often described as hummock steppe.

A) Forest

The forest vegetation types included medium to tall forest, and medium forest, have a tree cover of greater than 70 % (dense), or 30 % to 70 % cover (moderately dense) and can be made up of trees of mixed heights such as low (<5 m), medium (5 – 15 m) and tall (>15 m).

The forest vegetation communities are:

A1. *Melaleuca argentea / Eucalyptus victrix* dense to moderately dense tall to medium forest, over *Atalaya hemiglauca / Ficus brachypoda / Ficus opposita* var. *indecora* low trees, over *Typha domingensis* rushes, over *Cyperus vaginatus* sedgeland on peaty sand in shaded / sheltered locations near cliffs / gorge bases. This vegetation type was recorded at sites 41, 47 and 65.

A2. *Corymbia hamersleyana* and / or *Corymbia flavescens* and / or *Eucalyptus victrix* moderately dense to scattered medium forest to woodland, sometimes with *Melaleuca argentea,* over *Acacia tumida* var. *pilbarensis / Acacia colei* var. *colei* tall to low shrubland, often over *Bonamia pannosa, Trachymene oleracea, Waltheria indica* herbs, sometimes with *Cyperus* spp. sedges, on sand to sandy clay creek beds and gully confluences that may be degraded or disturbed by cattle grazing or hydrology change from roads. This vegetation type was recorded at sites 29, 39, 51, 56 and 68.

A3. *Ficus virens* dense medium forest over *Ficus brachypoda* over *Atalaya hemiglauca / Corymbia flavescens* open low trees over *Ficus opposita* var. *indecora / Grevillea pyramidalis* subsp. *pyramidalis* over *Tinospora smilacina* lianas, at base of sheltered gorge/cliff, with *Stemodia* sp. Shay Gap and *Corymbia* sp. (apparently new taxa). This vegetation type was recorded at site 71.

B) Woodland

The woodland vegetation types included medium woodland, medium trees over shrubland and spinifex, low woodland, and low trees over shrubland and spinifex. The woodland types are defined by having trees at a density of less than 30 % cover that varies in height description in the same forms as described for the forest types. The woodland vegetation types, while being dominated by particular tree species, also have an important part of their description based on the presence and density of shrubs, grasses, herbs and spinifex.

The woodland and scattered trees over shrubland communities are:

B1. *Eucalyptus leucophloia* medium woodland over mixed shrubs such as *Senna glutinosa* subsp. *glutinosa / Acacia inaequilatera / Acacia adoxa* var. *adoxa / Indigofera monophylla* (small calyx form) over *Triodia epactia* hummock. This vegetation type was recorded at site 28.

B2. *Acacia ampliceps / Sesbania formosa / Corymbia hamersleyana* open medium trees over *Ficus opposita* var. *indecora* over *Typha domingensis* rushes over *Cyperus vaginatus sedges* in areas disturbed by cattle. This vegetation type was recorded at site 69.

B3. *Corymbia hamersleyana* scattered low woodland over *Grevillea wickhamii* subsp. *aprica* medium shrubs over *Corchorus* aff. *parviflorus* (2) sparse low shrubs over *Acacia hilliana* dwarf shrubs over *Triodia epactia* open hummock grassland on cream / brown / pale yellow sandy clay with gravel on undulating plains. This vegetation type was recorded at site 32.

B4. *Corymbia hamersleyana / Corymbia flavescens* low trees over mixed *Acacia* spp. and other shrubs over *Acacia adoxa* var. *adoxa / Indigofera monophylla* (small calyx form) / *Bonamia rosea / Tephrosia* sp. Bungaroo Creek(M.E.Trudgen 11601) / *Bonamia linearis / Isotropis atropurpurea* over *Triodia epactia* hummock grassland on sand to clayey sand plain. This vegetation type was recorded at sites 15, 20 and 23.

B5. *Corymbia hamersleyana* scattered low trees, often found with *Eucalyptus odontocarpa* mallee over *Acacia tumida* var. *pilbarensis* open tall shrubland, over *Templetonia hookeri* over *Pterocaulon sphaeranthoides, Acacia adoxa* var. *adoxa* over *Triodia epactia* hummock grass on broad gullies and minor channels. This vegetation type was recorded at sites 16, 57, 67 and 52.

B6. *Eucalyptus leucophloia / Grevillea pyramidalis* subsp. *pyramidalis* scattered low trees / medium shrubs over *Acacia colei* var. *colei* and *Solanum horridum* medium / low shrubs over *Triodia epactia* hummock grassland on hilltops that are sometimes dust and rock blast affected. This vegetation type was recorded at sites 42 and 43.

B7. *Acacia inaequilatera* scattered low trees with or without *Corymbia hamersleyana* over *Grevillea* subsp. *aprica,* over *Acacia hilliana / Acacia adoxa* var. *adoxa* dwarf shrubs over *Triodia epactia* open to moderately dense hummock grassland. This vegetation type was recorded at sites 2, 21, 22, 31, 53 and 62.

B8. *Acacia inaequilatera* low trees over *Grevillea wickhamii* subsp. *aprica* medium shrubs over *Acacia ptychophylla* over *Triodia epactia* hummock grassland on scarp plateaux. This vegetation type was recorded at sites 63 and 75.

B9. *Acacia inaequilatera* scattered low trees, over *Acacia* sp. Ruddall River (B.R.Maslin 2046A) scattered medium shrubland over *Triodia epactia* moderately dense hummock grassland steppe with *Acacia pyrifolia* and *Eucalyptus leucophloia* on gentle slopes to gravel plains. This vegetation type was recorded at site 6.

B10. *Acacia inaequilatera* scattered low trees, over *Grevillea wickhamii* var. *aprica / Acacia tumida* var. *pilbarensis / Grevillea pyramidalis* subsp. *pyramidalis / Dodonaea coriacea / Ptilotus calostachyus,* over *Acacia hilliana* sparse dwarf shrubland, over *Bonamia media* var. *villosa / Goodenia stobbsiana / Fimbristylis simulans* over *Triodia epactia* moderately dense hummock grassland on gentle hillcrest / scarp plateaux. This vegetation type was recorded at site 60.

B11. *Ficus brachypoda* or *Ficus virens* low trees over *Atalaya hemiglauca* over *Jasminum didymum* over *Triumfetta maconochieana* over *Nicotiana benthamiana, Pterocaulon sphaeranthoides* herbs in shallow gorges with *Stemodia* sp. Shay Gap (apparently new species). This vegetation type was recorded at sites 8, 14, 54, 55 and 66.

C) Shrublands

The shrubland vegetation types included tall shrubland, medium shrubland, low shrubland and dwarf shrubland. Some of the vegetation with scattered tree and shrub communities occurred over spinifex hummock steppe / grasslands. Tall shrubland is dominated by a tallest stratum of shrubs that are greater than two metres in height, usually with lower shrub strata below. Medium shrubland has a tallest stratum of shrub species that are between one and two metres in height. Low shrubland and dwarf shrublands are 0.5 – 1 m and less than 0.5 m in height, respectively.

The shrubland vegetation types are:

C1. *Acacia tumida* var. *pilbarensis* scattered to sparse tall to low shrubland with or without *Corymbia hamersleyana / Grevillea wickhamii* subsp. *aprica* over *Acacia hilliana / Acacia adoxa* dwarf shrubs over *Triodia epactia* open to moderately dense hummock grassland. This vegetation type was recorded at sites 58, 44, 35 and 61.

C2. *Acacia orthocarpa* sparse to scattered tall / medium shrubland with *Acacia inaequilatera* over sparse to scattered *Acacia adoxa* var. *adoxa / Acacia hilliana* dwarf shrubs over *Triodia epactia* open to moderately dense hummock grassland. This vegetation type was recorded at sites 7, 12, 18, 25, 38 and 45.

C3. *Acacia tumida* var. *pilbarensis / Acacia colei* var. *colei* tall to low shrubland, over *Acacia inaequilatera / Acacia pyrifolia* over *Ptilotus calostachyus* often over *Salsola tragus* over

Aristida contorta, Aristida holathera / Cymbopogon ambiguus grasses over *Ipomoea muelleri / Mukia maderaspatana* lianas over *Triodia epactia / Triodia lanigera / Triodia wiseana* hummock grass on rehabilitated soil or waste rock dumps. This vegetation type was recorded at sites 30, 36, 64 and 70.

C4. Mixed medium to tall shrubland including *Tephrosia spechtii* over *Acacia adoxa* var. *adoxa / Acacia hilliana* sparse to moderately dense dwarf shrubland over sparse to open *Triodia epactia* hummock grassland on hillcrests, slopes / breakaways and gullies. This vegetation type was recorded at sites 27, 33, 40, 46 and 50.

C5. Mixed medium shrubs over *Acacia inaequilatera* low shrubs or *Acacia adoxa* var *adoxa* dwarf shrubs over *Indigofera monophylla* (small calyx form) / *Corchorus* aff. *parviflorus / Bonamia media* var. *villosa* over *Triodia epactia* or *Triodia wiseana* hummock grassland on steep slopes and breakaways. This vegetation type was recorded at sites 3, 9, 11, 48 and 49.

C6. *Grevillea wickhamii* subsp. *aprica* open to scattered medium – low shrubland usually with *Corymbia hamersleyana* low trees over *Acacia adoxa* var. *adoxa* dwarf shrubland over *Triodia epactia* open hummock grassland along drainage lines. This vegetation type was recorded at sites 1, 5, 13 and 26.

C7. *Acacia inaequilatera* scattered medium shrubland over *Acacia stellaticeps / Acacia hilliana / Acacia adoxa* var. *adoxa*, *Acacia* sp. Ruddall River (B.R. Maslin) / *Acacia tumida* var. *pilbarensis / Ptilotus calostachyus* over *Triodia epactia* moderately dense hummock grassland on low undulating slopes to plains and spurs. This vegetation type was recorded at site 34.

C8. *Acacia ptychophylla, Acacia ancistrocarpa, Acacia pyrifolia, Grevillea wickhamii* subsp. *aprica* scattered low shrubland over *Dodonaea coriacea, Acacia colei* var. *colei* dwarf shrubs over *Triumfetta maconochieana* over *Triodia wiseana* moderately dense hummock grassland on steep south-facing scarp slopes. This vegetation type was recorded at site 72.

C9. *Melaleuca glomerata* sparse medium shrubland with *Ficus opposita* var. *indecora*, over *Typha domingensis* rushes over *Cyperus vaginatus* sedges over *Flaveria australasica* herbs on clay loam to peat soil in swampy channels. This vegetation type was recorded at site 74.

C10. Mixed shrubs including *Triumfetta* spp. over *Trachymene oleracea* over *Evolvulus alsinoides* var. *villosicalyx* over *Bulbostylis barbata* over *Triodia epactia / Triodia wiseana* hummock spinifex steppe on moderate slopes, minor channels and granite plains. This vegetation type was recorded at sites 10, 37, 59 and 73.

4.3.2 Flora Biodiversity

4.3.2.1 Nimingarra

A total of 183 distinct flora taxa, from 41 families and 149 genera were recorded during the Nimingarra survey (Appendix A). This included 180 species with 50 subspecies, varieties, forms and affinities recognised. Of these, 17 genera were represented by a single taxon. The plant families that recorded the highest number of species were: Poaceae (23 taxa), Mimosaceae (19 taxa), Papilionaceae (19 taxa), Malvaceae (13 taxa) and Amaranthaceae (11 taxa). The genera with the most species recorded were: *Acacia* (19 taxa), *Sida* and *Ptilotus* (eight taxa each), *Tephrosia* (eight taxa), and *Eriachne* and *Solanum* (five taxa each). The most commonly recorded taxa for the Nimingarra area were: *Triodia epactia, Grevillea wickhamii* var. *aprica, Ptilotus calostachyus* var. *calostachyus, Acacia adoxa* var. *adoxa, Acacia inaequilatera, Acacia tumida* var. *pilbarensis, Indigofera monophylla* (small calyx form), *Triumfetta maconochiena, Corymbia hamersleyana* and *Goodenia stobbsiana.*

4.3.2.2 Sunrise Hill Ridge

A total of 201 distinct flora taxa, from 45 families and 100 genera were recorded during the Sunrise Hill survey. This included 198 species with 63 subspecies, varieties, forms and affinities recognised (Appendix A). Of these, 19 genera were represented by a single taxon. The plant families that recorded the highest number of species were Poaceae (31 taxa), Mimosaceae (25 taxa), Papilionaceae, Amaranthaceae, Asteraceae (11 taxa each), Myrtaceae (nine taxa) and Tiliaceae (nine taxa). The genera with the most recorded species were: *Acacia* (24 taxa), *Ptilotus* and *Eriachne* (eight taxa each), *Triodia / Senna / Triumfetta* and *Sida* (five taxa each). The most commonly recorded taxa for the Sunrise Hill area were *Triodia epactia, Cymbopogon ambiguus, Triodia wiseana, Grevillea wickhamii* var. *aprica, Ptilotus calostachyus* var. *calostachyus, Acacia adoxa* var. *adoxa, Acacia colei* var. *colei, Acacia inaequilatera, Acacia tumida* var. *pilbarensis, Indigofera monophylla* (small calyx form), *Triumfetta maconochiena, Corymbia hamersleyana* and *Goodenia stobbsiana.*

4.3.3 Declared Rare Flora and Priority taxa

No species of Threatened Flora as listed in the EPBC Act or DRF as listed in the CALM Rare Flora List were collected during the flora and vegetation survey of the Nimingarra and Sunrise Hill area.

During a previous flora survey of the proposed NIM B waste dump extension (*ecologia*, 2004), the two Priority 2 taxa *Euphorbia clementii* and *Goodenia hartiana* ms were recorded from only a few individuals. Although the current survey was extensive, it failed to again locate these species. *Euphorbia clementii* was represented by two plants, one at 51K 188486 mE 7742104 mN and a second recorded at 51K 188105 mE 7741798 mN (WGS 84). *Goodenia hartiana* ms was recorded from only a single plant at 51K 188870 mE 7742890 mN (WGS 84). The failure to locate these species during the current survey is not likely due to survey timing or previous rainfall, as this species can be collected at any time of the year. In fact, previous collection (Yarrie and NIMB) were both made during relatively dry periods.

A search of CALM databases indicates that two other Priority species, *Fimbristylis* sp. Shay Gap (K.R.Newbey 10293) (Priority 1) and *Ptilotus mollis* (Priority 2) have been previously recorded from within a 50 km radius of the project site (Atkins, 2005). A further Priority species, *Bulbostylis burbidgeae* (Priority 3) has been previously recorded from within a 100 km radius of the project site (Atkins, 2005).

4.3.4 Weed Species

The flora survey of the Nimingarra area for this report showed no record of any weeds species of conservation significance. However, the species **Aerva javanica* was found from a number of locations in the Nimingarra area, mainly along disturbed road sides and old rehabilitation on rock waste dumps. This weed species can be invasive, but is important to the pastoral industry and is only worthy of concern when found in undisturbed native vegetation.

The flora survey of the Sunrise Hill ridge area near Nimingarra showed records of a number of weed species present. These weed species were associated with disturbance due to roads, waste rock dumps, rehabilitation areas, and cattle grazing on the lower slope areas. These weeds included **Aerva javanica*, **Cenchrus ciliaris* and **Nerium oleander*.

4.3.5 Other species of interest

The species *Erythrophleum chlorostachys* was recorded from the Nimingarra area and is considered to be of regional significance as it is a new record for the east Pilbara and Pilbara region in general. *E. chlorostachys* was recorded from the location (WGS84) UTM 51K 191354 mE 7742938 mN (+/- 4m). The habitat that this species was found in was flat red-orange soil sandplains within vegetation of *Acacia tumida / Acacia ancistrocarpa* open medium shrubland over *Bonamia rosea* sparse dwarf shrubs over *Triodia schinzii* open hummock grassland. The *E. chlorostachys* was recorded from from the north-eastern end of the Nimingarra Mining Lease area that is over two kilometres away from the nearest proposed disturbance areas (Nimingarra B Pit and its surrounds). This taxon may be more widespread on the sandplain areas outside of the mining activities but further flora searching effort would be required to establish whether or not this is the case.

In addition to this, there were a number of *Acacia* species collected during the survey of Nimingarra and Sunrise Hill Ridge that are of an unclear taxonomic status. These species have affinities with other *Acacia* species and may be hybrids, but for the purposes of this report will be described under the affinity name until further specimen material can be collected from the plants to confirm the identification. The *Acacia* species with affinities and hybridisation are two forms of *A.* aff. *ancistrocarpa*, *A.* aff. *Acacia tumida* subsp. *pilbarensis* x ?(hybrid), *A.* aff. *pyrifolia* and *A. hilliana* x *stellaticeps* (hybrid).

4.3.6 Conservation Significance

There are a few factors that need to be considered for conservation significance of the Nimingarra and Sunrise Hill Ridge areas. The vegetation of each of these areas contains a variety of community types; however, the communities of highest significance are those containing *Triodia* steppe as they may support the Priority 2 species *Euphorbia clementii,* which has been previously recorded in vegetation near the Nimingarra B Pit and Waste Rock Dump. Further clearing may result in the loss of *E. clementii* plants if present, however, clearing operations may also lead to an increase in plant numbers due to the preference of this species for recently disturbed soil. Targeted follow-up surveys have been conducted surrounding the Nimingarra B Pit and waste rock dumps, with no further individual plants of *E. clementii* recorded for the area. Since this taxon was extensively searched for during the course of the Nimingarra flora and vegetation surveys and not recorded for any other location, it is very unlikely that a natural population exists in the area that may be viable under current conditions.

At the Sunrise Hill Ridge area there are two species of conservation significance. These species have only been recorded during the survey work involved in this project, and are therefore apparently new taxa. These taxa are *Stemodia* sp. Shay Gap and *Corymbia* sp. (SRH 71.8). However, these species were not recorded within or in close proximity to areas of current or proposed disturbance. In addition to this, there will be further surveys to determine the extent and habitat requirements of these species. One of the flora survey sites (Site 71) at Sunrise Hill ridge included both of these new taxa; however, *Stemodia* sp. Shay Gap was also recorded from a number of locations along this ridge.

The *Corymbia* sp. (SRH 71.8) was recorded from a single plant growing as a small shrub in an overhanging ironstone cliff environment near *Ficus* forest. This plant was badly injured and possibly later killed by exposure to one of several lightning strike-initiated bushfires in the Sunrise Hill/Shay Gap area in mid-January 2005. As yet, further searching has not been successful in locating other individuals of this taxon nearby to the original collection. Post-fire conditions limited the value of follow-up searching for this taxon in January when the most recent survey effort was made.

Stemodia sp. Shay Gap was recorded from a number of populations at Sunrise Hill Ridge (see Figure 4.4). The species seems to have a very clear preference for cracks and crevices on steep near vertical to slightly overhanging cliffs at an aspect of south to west. It is a herb species of about 30 – 50 cm in height, with serrated lush to dark green leaves that are quite conspicuous in comparison to other plants growing in the same cliff environment. The flowers are slightly tubular in form, asymmetrical in shape and purple to dark lilac in colour.

There tends to be strong regionalisation between the project areas. However, the vegetation types at Nimingarra and Sunrise Hill share moderate similarities with each other, and also share some vegetation site types with Yarrie. There seems to be some local significance with vegetation types at Cattle Gorge. Several vegetation types support *Stemodia* sp. Shay Gap, which themselves are restricted in distribution and are therefore locally significant. These include cliff, gorge and associated swamp/pool areas with *Melaleuca argentea* and *Eucalyptus victrix* forest over rushes and sedges, or *Ficus brachypoda* and *Atalaya hemiglauca* forest to scattered trees over mixed shrubs in rocky cliff environments. This includes flora survey sites 41, 47, 55, 65, 65 and 71. These areas are recommended for special conservation consideration and are not to be subject to disturbance activities.

Along the south-western side and south-eastern end of the Sunrise Hill ridge, there are pockets of vegetation associated with accumulated water and shaded environments at the base of cliff/gorge systems. These areas support two main types of vegetation that are very restricted in local distribution that includes *Melaleuca argentea / Eucalyptus victrix* forest, and sparse *Ficus brachypoda* dense forest to sparse trees, both types with *Atalaya hemiglauca*, *Ficus opposita* var. *indecora* trees, and the first of these with *Typha domingensis* and/or *Cyperus vaginatus*. These vegetation types were recorded from flora Sites 41, 47, 65 and 71. In addition to this, in Nimingarra Flora Site 29 near the Egg Creek crossing of the Haul Road the vegetation appears to have once had the *M. argentea / E. victrix* forest vegetation type, but has changed due to water abstraction from bores to a degraded version of this. Given the limited number of representatives of these vegetation types and restricted range, it is recommended that no disturbance occurs in these areas.

4.3.7 Impact Assessment

The primary impact of extension of mining activities at Nimingarra and Sunrise Hill Ridge will be the loss of vegetation through clearing and mining activities. Major access roads within some parts of these project areas are already established. Any further construction of roads should take into account all flora of conservation significance that may occur in the area.

Weed species may be further dispersed into new areas of disturbance either by the use of heavy machinery, wind and animal vectors. Cleared and rehabilitated areas should be monitored and any new weed infestations should be eradicated by the spot spraying of emergents using herbicidal control.

The condition of the vegetation in areas adjacent to existing access roads, pits and waste rock dumps was moderate to poor due to factors such as associated soil disturbance, dust transferral from roads, and loose rock from dumping activities and blasting. However, in areas that were more than about 50 m from existing mining activities, the vegetation condition was in many cases between pristine and good.

Vegetation Legend

A) Forest

Melaleuca argentea / Eucalyptus victrix tall to medium forest, over *Atalaya hemiglauca* and *Ficus* spp. low trees and other shrubs, over *Typha domingensis* rushes, over *Cyperus vaginatus* sedgeland.

Corymbia hamersleyana / Corymbia flavescens / Eucalyptus victrix medium forest to woodland, sometimes with *Melaleuca argentea,* over *Acacia tumida* var. *pilbarensis / Acacia colei* var. *colei* tall to low shrubland, often with mixed herbs and *Cyperus* spp. sedges.

Ficus virens / Ficus brachypoda and other associated species mixed dense medium to low forest with *Tinospora smilacina* lianas and *Stemodia* sp. Shay Gap.

B) Woodland

Eucalyptus leucophloia medium woodland, over mixed shrubs such as *Senna glutinosa* subsp. *glutinosa / Acacia inaequilatera / Acacia adoxa* var. *adoxa / Indigofera monophylla* (small calyx form), over *Triodia epactia* hummock.

Acacia ampliceps / Sesbania formosa / Corymbia hamersleyana open medium trees, over *Ficus opposita* var. *indecora,* over *Typha domingensis* and *Cyperus vaginatus* rushes and sedges.

Corymbia hamersleyana low woodland, over *Grevillea wickhamii* subsp. *aprica / Corchorus* aff. *parviflorus* (2) and other medium to low shrubs, over *Acacia hilliana* dwarf shrubs, over *Triodia epactia* open hummock grassland.

Corymbia hamersleyana / Corymbia flavescens low trees over mixed *Acacia* spp. and other shrubs over *Acacia adoxa* var. *adoxa / Indigofera monophylla* (small calyx form) */ Bonamia* spp. */ Tephrosia* sp. Bungaroo Creek */ Isotropis atropurpurea,* over *Triodia epactia* hummock grassland.

Corymbia hamersleyana low trees, often found with *Eucalyptus odontocarpa* mallee, over *Acacia tumida* var. *pilbarensis* tall shrubland, over *Templetonia hookeri* and other shrubs and herbs including *Acacia adoxa* var. *adoxa*, over *Triodia epactia* hummock grass.

Corymbia zygophylla low trees, over *Acacia tumida* var. *pilbarensis / Acacia ancistrocarpa / Jacksonia aculeata / Jasminum didymum Bulbostylis barbata* medium to low shrubs, with sedges, over *Triodia epactia* or *T. wiseana* or *T. schinzii* hummock grassland.

Eucalyptus leucophloia / Grevillea pyramidalis subsp. *pyramidalis* scattered low trees, over *Acacia colei* var. *colei* and *Solanum horridum* medium / low shrubs over *Triodia epactia* hummock grassland.

Acacia inaequilatera low trees with or without *Corymbia hamersleyana,* over *Grevillea* subsp. *aprica,* over *Acacia hilliana / Acacia adoxa* var. *adoxa* dwarf shrubs, over *Triodia epactia* open to moderately dense hummock grassland.

Acacia inaequilatera low trees over *Grevillea wickhamii* subsp. *aprica* medium shrubs over *Acacia ptychophylla* over *Triodia epactia* hummock grassland.

Acacia inaequilatera scattered low trees with *Acacia pyrifolia* and *Eucalyptus leucophloia,* over *Acacia* sp. Ruddall River(B.R.Maslin 2046A) scattered medium shrubland, over *Triodia epactia* moderately dense hummock grassland steppe.

Acacia inaequilatera low trees, over *Grevillea wickhamii* var. *aprica / Acacia tumida* var. *pilbarensis* and other shrubs including *Acacia hilliana,* with *Fimbristylis simulans / Goodenia stobbsiana* over *Triodia epactia* moderately dense hummock grassland.

Ficus brachypoda or *Ficus virens* low trees, over *Atalaya hemiglauca* over *Jasminum didymum,* over *Triumfetta maconochieana* and other shrubs and herbs, with *Stemodia* sp. Shay Gap.

C) Shrublands

Acacia tumida var. *pilbarensis* tall to low shrubland with or without *Corymbia hamersleyana / Grevillea wickhamii* subsp. aprica, over *Acacia hilliana / Acacia adoxa* dwarf shrubs, over *Triodia epactia* hummock grassland.

Acacia orthocarpa tall/medium shrubland with *Acacia inaequilatera,* over *Acacia adoxa* var. *adoxa / Acacia hilliana* dwarf shrubs, over *Triodia epactia* open to moderately dense hummock grassland.

Acacia tumida var. *pilbarensis / Acacia colei* var. *colei* tall to low shrubland, over other *Acacia* spp. */ Ptilotus* spp. and other shrubs, incl. *Salsola tragus,* over *Aristida* spp. and *Cymbopogon ambiguus* grasses, with lianas over *Triodia epactia / Triodia lanigera / Triodia wiseana* hummock grass on rehab.

Mixed medium to tall shrubland including *Tephrosia spechtii,* over *Acacia adoxa* var. *adoxa / Acacia hilliana* sparse to moderately dense dwarf shrubland, over sparse to open *Triodia epactia* hummock grassland.

Mixed medium shrubs over *Acacia inaequilatera* low shrubs or *Acacia adoxa* var. *adoxa* dwarf shrubs, over *Indigofera monophylla* (small calyx form) aff. */ Corchorus parviflorus / Bonamia media* var. *villosa,* over *Triodia epactia* or *Triodia wiseana* hummock grassland.

Grevillea wickhamii subsp. *aprica* open to scattered medium - low shrubland usually with *Corymbia hamersleyana* low trees, over *Acacia adoxa* var. *adoxa* dwarf shrubland over *Triodia epactia* open hummock grassland.

Acacia inaequilatera scattered medium shrubland over *Acacia stellaticeps / Acacia hilliana / Acacia adoxa* var. *adoxa, Acacia* sp. Ruddall River(B.R. Maslin) */ Acacia tumida* var. *pilbarensis / Ptilotus calostachyus,* over *Triodia epactia* moderately dense hummock grassland.

Acacia ptychophylla, Acacia ancistrocarpa, Acacia pyrifolia, Grevillea wickhamii subsp. *aprica* scattered low shrubland over *Dodonaea coriacea, Acacia colei* var. *colei* dwarf shrubs over *Triumfetta maconochieana* over *Triodia wiseana* moderately dense hummock grassland.

Melaleuca glomerata sparse medium shrubland with *Ficus opposita* var. *indecora,* over *Typha domingensis* and *Cyperus vaginatus* rushes and sedges, over *Flaveria australasica* herbs.

Mixed shrubs including *Triumfetta* spp. over *Trachymene oleracea* over *Evolvulus alsinoides* var. *villosicalyx,* over *Bulbostylis barbata* sedges, over *Triodia epactia / Triodia wiseana* hummock steppe.

Areas of no vegetation - cleared (Open-cut mine pits, tracks, roads, active waste rock dumps etc.)

= 16 (small squares of cleared areas linked together into a roughly triangular shape)

ecologia ENVIRONMENTAL CONSULTANTS	**NIMINGARRA AND SUNRISE HILL VEGETATION LEGEND**	Date: 14 February 2005
		Scale: NTS
Client: **BHP BILLITON**		Author: C.S. / S.C.
Project: **GOLDSWORTHY EXTENSION BIOLOGICAL SURVEY**		Figure No.
	A4	Plan No. **GWY-004**

Legend
- Site Locations
- Priority Flora

N

SCALE 1 : 25 000

0 1

Kilometres

AUSTRALIAN MAP GRID

Grid based on Transverse Mercator Projection

To PORT HEDLAND

187500mE

190000mE

7742500mN

7740000mN

7737500mN

Goodenia hartiana (P2)

Euphorbia clementii (P2)

Euphorbia clementii (P2)

NIMINGARRA A

NIMINGARRA B

NIMINGARRA C

NIMINGARRA F EAST

NIMINGARRA I

CREEK

EGG

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29

ecologia ENVIRONMENTAL CONSULTANTS	Client: BHP BILLITON	NIMINGARRA VEGETATION MAP SITE AND PRIORITY FLORA LOCATIONS	Date: 23 March 2005
	Project: GOLDSWORTHY EXTENSION BIOLOGICAL SURVEY		Scale: 1:25 000
			Figure No. 4.3
Author: C.Slee	Drawn: S.Coleman	A3	Plan No. GWY-001

190000mE
192500mE
195000mE
197500mE
7737500mN
7735000mN
SUNRISE HILL WEST 7
SUNRISE HILL RIDGE
CREEK
EGG
33
34
32
40
31
43
35
46
50
42
39
44
48
45
38
36
37
30
54
52
49
51
N
SCALE 1 : 25 000
0
1
Kilometres
AUSTRALIAN MAP GRID
Grid based on Transverse Mercator Projection

Legend
Site Locations

ecologia
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Author: C.Slee
Drawn: S.Coleman

Client: BHP BILLITON
Project: GOLDSWORTHY EXTENSION BIOLOGICAL SURVEY

SUNRISE HILL VEGETATION MAP
SITE AND PRIORITY FLORA LOCATIONS

Date: 14 February 2005
Scale: 1:25 000
Figure No. 4.4a
A3
Plan No. GWY-002

192500mE
195000mE
197500mE
200000mE
7732500mN
7730000mN
SUNRISE HILL RIDGE
SHAY GAP RIDGE
36
37
30
51
70
56
55
41
58
47
57
71
Stemodia sp. Shay Gap
Corymbia sp.
60
53
72
61
64
73
74
75
62
63
66
67
65
68
59
69
130
140
150
120
110
220
210
240
230
N
SCALE 1 : 25 000
0
1
Kilometres
AUSTRALIAN MAP GRID
Grid based on Transverse Mercator Projection

Legend
- Site Location
- Priority Flora Site Location

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Author: C.Slee
Drawn: S.Coleman

Client: BHP BILLITON

Project: GOLDSWORTHY EXTENSION BIOLOGICAL SURVEY

SUNRISE HILL VEGETATION MAP
SITE AND PRIORITY FLORA LOCATIONS

A3

Date: 14 February 2005
Scale: 1:25 000
Figure No. 4.4b
Plan No. GWY-003

4.4 Regional Comparison

Specialist botanists Ted Griffen and Malcolm Trudgen were commissioned to analyse the flora data collected across each of the three ore bodies, and make a comparison of flora species richness and community structure within the Goldsworthy Extension project area, and beyond the project area by comparison with data from outlying sites.

The objective of this analysis was to provide a regional overview of the conservation value of the flora and vegetation within the project area. The numerical classification package PATN was tailored by Ted Griffen and Malcolm Trudgen for this purpose. The outcomes of this application are most instructive where data from numerous comparable survey sites, beyond the area of immediate interest, are available. On this occasion few data exist for comparison, due to the lack of local site specific flora assessment. Data collected by Malcolm Trudgen (Trudgen *et al.* 2001) from an area known as Panorama, 125km to the south of the project area, have been used as the foundation for regional comparison beyond the Goldsworthy area.

It should be noted that the total number of species used in the comparative analysis (Appendix F) is lower than the number of species reported in the main body of this document for each of the ore bodies. This is due to the fact that only flora species recorded within defined quadrats are used for analysis between the various ore bodies. Additional plant species opportunistically collected outside of quadrats are not used in the analysis as they are not collected by a standardised protocol. In most, if not all cases, these species are typically not dominant, and are uncommon or sparse in their distribution and density.

At a regional level, based on PATN floristic analysis (See Appendix F), it is clear that there are significant differences in the flora composition of the different areas. There is a very high proportion of species not shared between the project areas so strong regionalisation exists. Part of this may be related to different numbers of survey quadrats in each area, variation in range of landscape types for each project and temporal variation of sampling between areas.

The Nimingarra and Sunrise Hill areas share about half of their site groups and more than half their total species, and are more similar to each other than the other project areas included in the analysis. This is likely to primarily relate to the adjacent nature of the location of these areas.

The Sunrise Hill area shares four site vegetation groups with the Yarrie area and less than half the total species, and the Yarrie area has a higher level of similarity with the Sunrise Hill area than either Nimingarra or Cattle Gorge. Sunrise Hill is a linear ore body spanning some 20km that extends perpendicular to Nimingarra. Though it is disjunct from Yarrie, it lies between Yarrie and Nimingarra. However, Cattle Gorge is the closest ore body to Yarrie.

It is interesting to note that all of the Goldsworthy Extension ore bodies share many (more than half) common species with Panorama, but few common vegetation groups (i.e. two for Sunrise Hill and one for Nimingarra, Cattle Gorge and Yarrie).

Cattle Gorge was found to have the least in common with the other areas at Goldsworthy. However, the proportion of common species and vegetation units shared with Panorama was not markedly different to the other Goldsworthy sites. Cattle Gorge was not comparatively species rich, with only 75 species recorded *vs.* more than 150 at each of the other sites, and the vegetation was relatively uniform. Perhaps the most notable point is that the dominant vegetation type recorded at Cattle Gorge was not present in any of the other sites. The structure

of the unit is relatively homogenous and may be a degraded vegetation community that exists as a result of frequent fires or other disturbance. Whatever the case, despite the unique nature of the vegetation, the species from which it is comprised are common and well represented elsewhere. Further survey work soon to be undertaken on the adjacent Cunderline ridge may well reveal the presence of this same vegetation as the dominant ridgeline unit.

5.0 FAUNA

5.1 Biodiversity and Biogeographic Affinities of the Vertebrate Fauna of the Goldsworthy Extension Project Area

Mammals

A total of 41 species of native and introduced mammals were expected to occur in the project area. Thirty two species in total were recorded. One species, *Planigale* sp., remains unidentified as this species group is currently undergoing taxanomic revision.

The great majority of the native terrestrial mammals in the area have Eyrean biogeographic affinities, including many of the dasyurids and rodents. The Euro *Macropus robustus erubescens*, Echidna *Tachyglossus aculeatus* and the majority of the introduced species have widespread distributions and range over most of Australia. The Common Rock-rat *Zyzomys argurus*, Northern Quoll *Dasyurus hallucatus* and Delicate Mouse *Pseudomys delicatulus* have predominantly Torresian distributions. Two-thirds of the bat species have ranges extending into the other major biogeographic regions. Bat species with a predominantly Torresian distribution include the Little Red Flying-fox *Pteropus scapulatus*, Ghost Bat *Macroderma gigas* and Orange Leaf-nosed Bat *Rhinonicteris aurantius*.

Birds

A total of 103 species of birds may occur or utilise habitats within the project area. During the four discrete survey periods nearly all of these species (92) were observed. This is attributed to the broad variety of habitats represented within the Goldsworthy Extension area, including areas of long-term inundation.

The majority of avifauna species have broad distributions over much of Western Australia. Many species have Eyrean biogeographic affinities and approximately 15 % have Torresian affinities. Many species are at the northern limit of their range, including the Red-capped Robin *Petroica goodenovii* and Grey Butcherbird *Cracticus torquatus*. Some species, including the Spinifex Pigeon *Geophaps plumifera* and Little Corella *Cacatua sanguinea* are also at the edge of their range and do not occur in the sandy deserts to the north and east.

Herpetofauna

Of the 89 species of herpetofauna likely to occur based on literature searches and known habitat preferences, 62 species of reptile and 4 frogs were recorded. This is a high success rate for the capture of expected species (*i.e.* usually only 40-50 % of expected species are recorded), and this is attributable to the lengthy and intensive survey duration. Only one species could not accurately be described to species level. This species of *Eremiascincus*, and others in the genus, are currently undergoing taxanomic revision.

Most of the potential herpetofauna species have strong affinities with the Eyrean biogeographic region. Some species, such as *Carlia munda*, are at the southern limit of their range within the Pilbara. Several species, including *Varanus pilbarensis*, *Ctenotus rubicundus*, *Lerista zeitzi*, *Demansia rufescens* and *Liasis olivaceus barroni*, have relatively restricted distributions in the

northern / central Pilbara, encompassing the Goldsworthy project area. Species with Torresian affinities recorded include the skinks *Carlia munda* and *Morethia ruficauda*. Of the amphibian species recorded, *Cyclorana maini* and *Uperoleia glandulosa* have strictly Eyrean affinities, while *Litoria rubella* and *Limnodynastes spenceri* have both Eyrean and Torresian biogeographic affinities.

Fishes

Three fish species were recorded during the survey, all at Sunrise Hill. These are the Spangled Perch *Leiopotherapon unicolor*, the Rainbowfish *Melanotaenia* sp. and the Hytle's Tandin *Neosilurus hyrtili*. However, the Spangled Perch was also recorded at Cattle Gorge and Yarrie.

5.2 Yarrie

5.2.1 Biodiversity

Systematic sampling and opportunistic collecting during the field survey yielded a total of 88 vertebrate species, including 14 native and three introduced mammal species, 43 birds, 24 reptiles, three amphibians and one fish species (Appendix D).

Mammals

Seventeen mammal species were recorded during the survey, including four dasyurids, two macropods, one Microchiropteran bat species, five rodents, the Echidna *Tachyglossus aculeatus* and three introduced species.

Birds

Forty-three bird species were recorded in the project area, including 17 non-passerines and 26 passerines. Twenty-six families were represented in the avifauna, with the Columbidae (pigeons and doves) making the greatest contribution to species richness within the non-passerines, while the Meliphagidae (honeyeaters) and Artamidae (Woodswallows and Butcherbirds) dominated the passerines.

Herpetofauna

The survey yielded a total of 24 reptile species from seven families and three amphibian species from two families. The greatest number of species was recorded from the families Scincidae and Gekkonidae. Poorly represented were the Pygopodidae, Typhlopidae and Boidae. Based on known habitat preferences, species distributions and database searches, up to 86 reptile and three amphibian species may occur within the area.

The three amphibian species recorded were Main's Frog *Cyclorana maini*, Desert Tree Frog *Litoria rubella* and Spencer's Frog *Limnodynastes spenceri*.

Fish

The Spangled Perch *Leiopotherapon unicolor* was recorded from more permanent pools associated with the ore body.

Fauna Habitats

Fauna habitats are closely aligned with landform - vegetation associations. Five main habitats were identified by *ecologia* (1999) within the Yarrie area. These are as follows:

(1) Riverine – Eucalypt species on stony to sandy substrate in channel and *Acacia* thicket on sandy soils on banks;

(2) Gorge – steep-sided gorge with scattered *Eucalyptus leucophloia* over *Triodia* species. Skeletal, sandy or stony soils, pools in base;

(3) Shrubland – *Grevillea pyramidalis* shrubland over *Triodia*;

(4) Scree slope – Scattered mixed shrubs over *Triodia*. Substrate stony to rocky. Thick shrubs in minor drainage lines; and

(5) Plateau/hilltop – Scattered mixed shrubs over *Triodia* on skeletal soils.

Riverine habitat along Eel Creek consists of tall *Eucalyptus* species with dense thickets of *Acacia* species over sandy soils on the banks. Flowering eucalypts attract honeyeaters and the sandy soils of the banks support burrowing reptiles. The greatest number of vertebrate fauna species was recorded from this riverine habitat due to the high number of bird species. In addition, the diverse array of microhabitats present is expected to support numerous reptile species.

An intermediate number of species was recorded from Shrubland and Scree Slope habitat. These habitats were characterised by an intermediate number of bird species and relatively high numbers of herpetofauna species. Scree slopes consisted of gentle to medium sloping areas of rocky to gravely soils with a vegetation cover of shrubs, including *Grevillea wickhamii* and *Acacia inaequilatera*. These flowering shrubs attract several species of honeyeater.

Few species were recorded from the Gorge or Hilltop habitats. There was a low number of bird species recorded in the Gorge habitat and a low number of reptile and mammal species recorded from the Hilltop habitat.

5.2.2 Conservation Significance

Fauna species that have been formally recognised as rare, threatened with extinction, or as having high conservation value are protected by law under Commonwealth and State Legislation. At the National level, fauna are protected under the EPBC Act. Within Western Australia, rare fauna are listed under the Western Australian *Wildlife Conservation Act 1950*. International Agreements include the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA) that cover migratory bird species, particularly transequatorial waders. In addition, fauna are protected internationally under the IUCN Red List. See Appendix E for an explanation of conservation codes.

5.2.2.1 Species Protected by International Agreements

Two international agreements address components of the Australian fauna, with a focus on protecting migratory species. These two agreements are the JAMBA and the CAMBA.

No bird species listed under these agreements were observed during the survey.

5.2.2.2 Commonwealth EPBC Act

Schedule 1 of the EPBC Act 1999 contains a list of species that are considered Critically Endangered, Endangered, Vulnerable, Extinct, Extinct in the wild and Conservation Dependent (Appendix E). One species listed under the EPBC Act were observed during the survey

- **Northern Quoll *Dasyurus hallucatus***

The Northern Quoll previously occurred throughout the region, but is now believed to be restricted to the Hamersley Ranges (Strahan, 1995). It is most abundant in open eucalypt woodland within 150 km of the coast. This species was recorded from five captures at Site 5

5.2.2.3 WA *Wildlife Conservation Act 1950 (Specially Protected Fauna) Notice 2003*

Classification of rare and endangered fauna under the WA *Wildlife Conservation (Specially Protected Fauna) Notice 2003* recognises four distinct Schedules, as detailed in Appendix E

No scheduled species were observed during the survey.

5.2.2.4 CALM Priority Fauna

Species on the CALM Priority Fauna list include those removed from the Scheduled Fauna list and other species known from only a few populations or in need of monitoring. Four Priority codes are recognised, as detailed in Appendix E.

Two Priority 4 fauna species were recorded during the survey, the Western Pebble-mound Mouse, *Pseudomys chapmani*, and the Lakeland Downs Short-tailed Mouse, *Leggadina lakedownensis*.

- **Western Pebble-mound Mouse *Pseudomys chapmani* – Priority 4**

The Western Pebble-mound Mouse, *Pseudomys chapmani* is virtually identical to the Sandy Inland Mouse, *Pseudomys hermannsburgensis*, making it difficult to distinguish the two species in the field and consequently, it is often confused with this species. *P. chapmani* is usually identified by having a slightly shorter tail, ears and feet. The Western Pebble-mound Mouse inhabits hummock grassland areas of *Triodia*, *Senna*, *Acacia* and *Ptilotus* on skeletal soils containing an abundance of small (~5 g) pebbles (Strahan, 1995), which it uses to construct its mound.

When first described, it was thought that the range of the Western Pebble-mound Mouse had decreased substantially due to the occurrence of unused mounds in the Murchison and Gascoyne. This was subsequently attributed to the effects of feral species such as foxes **Vulpes vulpes*, cats **Felis catus* and cattle **Bos taurus*. Consequently, it was classified as a Scheduled species. Since then, it has been found on many sites associated with development projects, particularly iron ore mining in the Pilbara, and is possibly one of the most abundant small mammals in the region. Its status has thus been shifted from Schedule 1 to Priority 4.

This species was recorded from ten captures at Site 2 (see Plate 5.1), as well as observed mounds.

- **Lakeland Downs Short-tailed Mouse *Leggadina lakedownensis* – Priority 4**

The Lakeland Downs Short-tailed Mouse, *Leggadina lakedownensis* inhabits arid and semi-arid Australia (Moro & Morris, 2000b). This species is omnivorous, feeding on both plant matter and invertebrates (Moro & Bradshaw, 2002). *Leggadina lakedownensis* is a solitary species, which shelters in burrows during the heat of the day (Moro & Morris, 2000a). The taxonomy of the Pilbara form of this species is currently unresolved, though it is considered that there is enough genetic difference to allocate full subspecific status (Morris, 2000).

This species was recorded from two captures at Site 3 (see Plate 5.3).

5.2.2.5 IUCN Listed Species

The following species listed by IUCN were recorded during the survey.

Lower Risk/Near Threatened

These are taxa that have been evaluated, but do not qualify for Conservation Dependent, but are close to qualifying for Vulnerable status.

- **Lakeland Downs Short-tailed Mouse *Leggadina lakedownensis***

See Section 5.2.2.4.

- **Delicate Mouse *Pseudomys delicatulus***

The Delicate Mouse *Pseudomys delicatulus* is a tropical species, distributed across much of northern Australia (Strahan, 1995; Cole & Woinarski, 2000). This species is primarily granivorous, feeding mainly on the seeds of native grasses. As a result of this, populations can undergo dramatic fluctuations in response to climatic conditions (Strahan, 1995).

This species was recorded from one individual captured at Site 1 (see Plate 5.1).

- **Desert Mouse *Pseudomys desertor***

Prolonged drought conditions during the 1950s and 1960s explain why this rodent was once considered to be rare. Today it is known that its populations fluctuate significantly in response to rain (Strahan, 1995) and, despite its name, the Desert Mouse may primarily be an inhabitant of wetter micro-habitats. Populations are often associated with water sources such as bores, where permanently moist soils support sedge and grass habitats (Strahan, 1995).

This species was recorded from 19 captures at Site 3 and three captures at Site 5 (Plate 5. 3 and 5.5).

- **Northern Quoll *Dasyurus hallucatus*** (see Section 4.2.2.2)

5.2.3 Impact Assessment

CALM Priority fauna species such as the Western Pebble-mound Mouse *Pseudomys chapmani* and the Lakeland Downs Short-tailed Mouse *Leggadina lakedownensis* are at risk of disturbance through clearing of habitat and displacement through invasion of introduced species such as the House Mouse **Mus musculus*.

5.3 Cattle Gorge

5.3.1 Biodiversity

The combination of a systematic and an opportunistic survey yielded approximately 15 mammal species, 77 species of bird, three species of amphibian, one species of fish and 28 species of reptile including the Olive Python *Liasis olivaceous barroni*.

Mammals

Fourteen native species of mammal were recorded during the Cattle Gorge survey. This comprised two Dasyurids, two macropods, seven bats and three native rodents. One introduced species was also recorded.

Birds

A total of 77 species of bird were recorded in the Cattle Gorge area. All of the species recorded during the February survey, were again recorded in December. The species total for Cattle Gorge exceeds that of the other three survey areas (Yarrie, Sunrise Hill and Nimingarra) by approximately 40%. This is primarily attributable to the persistence of water bodies along the proposed haul road, and aligned with Eel Creek and Cattle Gorge Creek, where a total of 22 species of water bird were identified utilising these fresh water habitats. The families Accipitridae, Scolopacidae and Columbidae make the greatest contribution to species richness within the non-passerines and Meliphagidae (honeyeaters) and Estrildidae (Grass Finches) dominating the passerines.

Herpetofauna

Twenty-eight species of reptile from seven families and three amphibian species were recorded within the project area. The greatest number of species recorded was from the families Scincidae (skinks) and Gekkonidae (geckoes), which is typical as these two groups are diverse, and individuals are both conspicuous and common. Poorly represented families were Typhlopidae (blind snakes) and Boidae (pythons).

Fish

The Spangled Perch *Leiopotherapon unicolor* was recorded from permanent pools in Cattle Gorge creek. At the time, this species was abundant, with more than 20 individuals within one of the pools. The Spangled Perch is widespread throughout northern Australia, and is one of the most common fish in the Pilbara (Allen, 1989).

Fauna Habitats

Four main fauna habitats were recognised within the Cattle Gorge: Gorge, Shrubland, Scree Slope and Hilltop habitat, with the haul road aligned predominantly with alluvial plain. Fauna habitats are closely aligned with landform / vegetation associations and these habitats are typical of an upland area, and surrounding lowland landform types. The Cattle Gorge Plateau and its associated Scree Slopes and Gorges occupy the major part of the study area.

Gorge habitat includes steeply sloping rocky areas vegetated with eucalypts and spinifex, with a base of rock pools. The Common Rock Rat, *Zyzomys argurus,* is confined to this habitat and uses the crevices and rocks for shelter. Other vertebrates that utilise the rock crevices include *Gehyra punctata*, while the Fire-tail Skink, *Morethia ruficauda exquisitia,* is almost always recorded from exfoliating rock in gully or gorge habitats. The Pilbara Olive Python, *Liasis olivaceus barroni,* is known to prefer gullies that support intermittent fresh water pools and one individual was recorded during the survey. Few birds were recorded in these areas, although many bat species would utilise the caves for potential roosting sites.

Shrubland habitat consists primarily of *Grevillea pyramidalis* with occasional *Acacia inaequilatera* over *Triodia pungens*. The shrubland habitat is not well represented within the Cattle Gorge area and is different to habitats usually encountered in the Pilbara, but is quite common in surrounding areas. The Lakeland Downs Mouse, *Leggadina lakedownensis,* was recorded exclusively from this habitat in a previous survey (*ecologia,* 1999).

The Scree Slopes were characterised by intermediate numbers of birds and relatively high numbers of reptiles. In a previous survey, Richard's Pipit, *Anthus novaeseelandiae,* was recorded exclusively from this habitat and other common birds included the Spinifexbird, *Eremiornis carteri*, Spinifex Pigeon, *Geophaps plumifera,* and Striated Grasswren, *Amytornis striatus* (*ecologia,* 1999). The skink, *Egernia depressa,* was recorded only from this habitat, found in the crevices in the rocky part of the site. Mammal species such as the Little Red Kaluta, *Dasykaluta rosamondae,* also favour these *Triodia* dominated grasslands on skeletal soils.

Hilltop habitat has a similar vegetation cover to the scree slopes and hence will support similar fauna assemblages. However, the presence of stunted eucalypts, such as the Snappy Gum, *Eucalyptus leucophloia,* create litter beds at the base of trees that attract species such as the Pilbara Death-adder, *Acanthophis wellsi*, and small fossorial skinks such as *Carlia triacantha.*

Site Descriptions

Five fauna habitat types were recognised and surveyed using transects for bird censuses, while trapping grids, opportunistic collections and nocturnal searching was utilised for other classes of vertebrates. Each unit represents a fauna habitat that was characteristic of the overall habitats in the project area. The sites are described as follows;

Site 1. Gentle to Moderately Steep Gully: The vegetation is moderately dense *Grevillea wickhamii* subsp. *aprica / Acacia tumida* var. *pilbarensis* medium shrubland with scattered *Corymbia hamersleyana* tree over other mixed shrubs over open *Triodia epactia* hummock grassland

Site 2. Major Gully: The vegetation at this site is transitionary from: Scattered *Corymbia hamersleyana / Eucalyptus leucophloia* trees over *Acacia tumida* var. *pilbarensis / Grevillea wickhamii* ssp. *aprica* medium to low shrubs with *Acacia hilliana* dwarf shrubs, over open *Triodia epactia* hummock grassland to a scattered form of this vegetation without *C. hamersleyana* and with the presence of *Cymbopogon ambiguus, Eriachne* spp. and other grasses as well as *Triumfetta* spp. low shrubs.

Site 3. Undulating Low Slope: The vegetation at this site is scattered *Corymbia hamersleyana* low trees over *Grevillea wickhamii* ssp. *aprica / Acacia tumida* var. *pilbarensis* scattered medium shrubs over sparse *Acacia hilliana* low shrubs over open *Triodia epactia* hummock grassland.

Site 4. Sandplain near Creekline: The vegetation at this site is open *Acacia ?stellaticeps / Acacia colei* var. *colei* open to sparse tall / medium shrubs over mixed grazed low shrubs and post-fire regrowth over *Triodia ?epactia* sparse hummock grassland.

Site 5. Undulating Gravelly to Rocky Plains: The vegetation at this site is sparse to scattered *Corymbia hamersleyana* low woodland over *Acacia inaequilatera* and other species with patches of *Acacia colei* var. *colei* medium to low shrubs over *Triodia epactia* with patches of *T. wiseana* hummock grassland.

Plate 5.1 Site 1 looking south.

Plate 5. 2 Site 2 showing variation in site from rocky scree slopes to outcropping.

Plate 5.3 Site 3 looking south.

Plate 5.4 Site 4 looking south.

Plate 5.5 Site 5 looking south.

5.3.2 Conservation Significance

5.3.2.1 Species Protected by International Agreements

Two international agreements address components of the Australian fauna, with a focus on protecting migratory species. These two agreements are JAMBA and CAMBA.

The following bird species listed under these agreements were recorded within the area.

- **Wood Sandpiper *Tringa glareola***

This species is represented by 26 specimen records in museum collections. It breeds in northern Europe and northern Asia and spends northern winter on freshwater swamps in Africa and from southern and eastern Asia to Australia (Western Australian Museum, 2004).

This species was recorded at Cattle Gorge during both the February and December surveys.

- **Fork-tailed Swift *Apus pacificus***

This species is a relatively common trans-equatorial migrant throughout mainland Australia in October to April (Slater *et al.*, 2003).

This species was recorded at Cattle Gorge during the February survey.

- **Great Egret *Ardea alba***

This is a common species occurring throughout the world and most of Australia (Simpson & Day, 2004). It is the only egret commonly observed in inland waters in Western Australia (Slater *et al.*, 2003). It is considered scarce in the nearby Karijini National Park (Johnstone, 1983), with single birds being recorded at several sites.

This species was recorded at Cattle Gorge during the December survey.

- **Common Sandpiper *Actitis hypoleucos***
- **Marsh Sandpiper *Tringa stagnatilis***
- **Greenshank *Tringa nebularia***
- **Snipe *Gallinago* sp.**

5.3.2.2 Commonwealth EPBC Act

Schedule 1 of the EPBC Act contains a list of species that are considered Critically Endangered, Endangered, Vulnerable, Extinct, Extinct in the wild and Conservation Dependent (Appendix E). Four species protected under this Act were found in the Cattle Gorge and associated haul road survey area.

- **Pilbara Olive Python *Liasis olivaceus barroni***

The populations of this subspecies are restricted to the Pilbara region where they are most often encountered along major drainage systems, especially those associated with rock outcrops (Wilson & Knowles, 1988). Moloch Fauna Consultants (1992) reported a Pilbara Olive Python from a "rock pool at the head of a gully on the Callawa mesa".

The opportunistic survey revealed one large (< 1.5 m) individual in a rock pool at Site 1. The individual was captured during the February survey (Figure 5.1).

- **Orange or Pilbara Leaf-nosed-bat *Rhinonicteris aurantius***

See Section 5.4.3.2.

- **Mulgara *Dasycercus cristicauda* – Vulnerable**

This species prefers sandy substrates vegetated with *Triodia* spp. Populations are thought to contract to core habitat areas during harsh years and have been documented as undergoing expansion in response to good conditions (Woolley, 1995).

Habitat located within the project area is suitable for this species. One individual was observed on the Alluvial Outwash Plain whilst spotlighting.

- **Northern Quoll *Dasyurus hallucatus*** (see Section 4.2.2.2)

5.3.2.3 WA *Wildlife Conservation Act 1950 (Specially Protected Fauna) Notice 2003*

Classification of rare and endangered fauna under the WA *Wildlife Conservation (Specially Protected Fauna) Notice 2003* recognises four distinct Schedules, as detailed in Appendix E.

Three Schedule 1 species were recorded within the project area:

- **Pilbara Olive Python *Liasis olivaceus barroni* – Schedule 1**

See Section 5.3.2.2.

- **Orange or Pilbara Leaf-nosed-bat *Rhinonicteris aurantius* – Schedule 1**

See Section 5.4.3.2.

- **Mulgara *Dasycercus cristicauda* – Schedule 1.**

See Section 5.3.2.2.

5.3.2.3 CALM Priority Fauna

Species on the CALM Priority Fauna list include those removed from the Scheduled Fauna list and other species known from only a few populations or in need of monitoring. Four Priority codes are recognised, as detailed in Appendix E.

- **Star Finch *Neochmia ruficauda subclarescens* – Priority 4**

The Western race of the Star Finch *Neochmia ruficauda subclarescens* was recorded from the Cattle Gorge area during the December survey. This species is generally found in and around grassland near water (Slater *et al.*, 2003; Simpson and Day, 2004).

- **Pictorella Mannikin *Heteromunia pectoralis* – Priority 4**

This species was recorded during the December survey. Up to 154 of these birds were recorded on two occasions at Cattle Gorge Creek and Eel Creek. This record signifies one of only very few for the Pilbara region.

- **Australian Bustard *Ardeotis australis* – Priority 4**

This large, primarily terrestrial bird is fairly widespread throughout Australia and generally inhabits grassy plains, although also often seen in areas of low shrub adjacent to grassland. This species is nomadic, varying in abundance and group size from one solitary bird to family groups (Johnstone and Storr, 1998).

5.3.2.4 IUCN Listed Species

Lower Risk/Near Threatened

- **Star Finch *Neochmia ruficauda subclarescens***

See section 5.3.2.3.

- **Pictorella Mannikin *Heteromunia pectoralis***

See Section 5.3.2.3.

- **Mulgara *Dasycercus cristicauda***

See Section 5.3.2.2.

- **Pilbara Olive Python *Liasis olivaceus barroni***

See Section 5.3.2.2.

- **Orange or Pilbara Leaf-nosed-bat *Rhinonicteris aurantius***

See Section 5.4.3.2

- **Northern Quoll *Dasyurus hallucatus***

See Section 4.2.2.2)

5.3.3 Impact Assessment

An Orange Leaf-nosed Bat, *Rhinonicteris aurantius,* was observed foraging one night across the haul road adjacent to the Cattle Gorge area. This is a significant record as there are no previously recorded roost sites for this species in this region of the Pilbara. However, it is not known wether this species may be roosting in the immediate project area, so it is recommended that further work be done to establish if and where this species may be roosting, as the species is

known to forage near to its selected roosts (Strahan, 1995). Impacts to this species will come mainly from disturbance to roost caves, as this species is extremely selective on roost microhabitat and requires caves with high humidity (Strahan, 1995).

Impacts to the Pilbara Olive Python, *Liasis olivaceous barroni*, which was recorded during the opportunistic fauna survey, come in the form of loss of habitat, mainly gorges and major gullies/drainage lines, and from increased traffic in the area. A management plan may be required to determine the potential impacts of mining on this species, and to propose simple strategies to reduce those impacts and conserve this species.

A single Mulgara, *Dasycercus cristicauda,* was observed moving across a road adjacent the Cattle Gorge impact area. This species prefers sandy substrates vegetated with *Triodia* spp. Populations are thought to contract to core habitat areas during harsh years and have been documented as undergoing expansion in response to good conditions (Woolley, 1995). Sandy substrates vegetated with *Triodia* spp. are common on the floodplain surrounding Cattle Gorge. The loss of habitat associated with the construction of the haul road would not be considered a significant impact to the Mulgara. However, there is potential for secondary impact to with fauna deaths from road or haul traffic. Restrictions on vehicle speed, and a heightened awareness of the presence of Mulgara can reduce impact to this species.

There are large reed beds at nearby Eel Creek, which provide habitat for a number of species of waterbirds and shorebirds. It is paramount that these beds are conserved to maintain the presence of these species in the area. Even relatively sedentary passerines such as the Star Finch, *Neochmia ruficauda* depend on Eucalypts and reed beds along these creek lines. The record of the Pictorella Mannikin *Heteromunia pectoralis* in the project area is significant, as the species was recorded in high numbers, indicating an established population. This species is very rarely recorded in the Pilbara.

7727000mN

212000mE

213000mE

Extent of Available
Aerial Photography

1

2

3

Liasis olivaceous barroni

7726000mN

7725000mN

N

SCALE 1 : 10 000

0 500

Metres

MAP GRID OF AUSTRALIA
Grid based on Transverse Mercator Projection

214000mE

Legend

- Fauna Site
- Priority Fauna Site

Site Vegetation Units

- Open to scattered *Grevillea wickhamii* over *Acacia tumida/Tephrosia spechtii* with moderately dense *Triodia epactia* steppe on hill crests and gentle slopes.
- Moderately dense *Grevillea wickhamii / Acacia tumida* often with scattered *Corymbia hamersleyana,* over moderately dense *Triodia epactia* steppe along moderate to gentle gullies and hill slopes.
- Scattered *Grevillea pyramidalis / Acacia pyrifolia / Senna glutinosa* over sparse medium shrubs, over *Acacia ptychophylla* with open to moderately dense *Triodia wiseana* steppe on steep scarp slopes.
- Moderately dense to dense *Acacia tumida* with sparse to scattered medium / low shrubs over soft grasses such as *Cymbopogon ambiguus* with open to sparse *Triodia epactia* at rocky outcrops on steep upper scarp slopes.
- Scattered *Eucalyptus leucophloia* with scattered *Corymbia hamersleyana* or *Grevillea wickhamii,* over *Acacia spondylophylla* with open to moderately dense *Triodia epactia / Triodia wiseana* on moderaly steep hill slopes.
- Scattered *Acacia inaequilatera / Grevillea pyramidalis* sometimes with *Corymbia hamersleyana,* over *Grevillea wickhamii / Acacia ptychophylla,* with moderately dense *Triodia epactia / Triodia wiseana* steppe.
- Scattered *Acacia inaequilatera* sometimes with *Corymbia hamersleyana* or *Corymbia flavescens,* over scattered meduim to low *Acacia* species, with open to dense *Triodia wiseana* steppe on gentle lower slopes.

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ENVIRONMENTAL CONSULTANTS

Author: C.Slee | Drawn: S.Coleman

Client: **BHP BILLITON**

Project: **YARRIE February 2004**

LOCATION MAP OF THE CATTLE GORGE FAUNA SURVEY SITES

A3

Date: 14 February 2005
Scale: 1:10 000
Figure No. **5.1**
Plan No. **CG-002**

5.4 Nimingarra

5.4.1 Biodiversity

During the Nimingarra fauna survey, a approximately 103 vertebrate fauna species were recorded, comprising three introduced and 14 native mammal species, 52 bird species, 34 reptile species and one amphibian species. Numbers used for mammals, reptiles and amphibians in this section are based on field identifications, and may change with confirmation from the Western Australian Museum

Mammals

The systematic survey at Nimingarra recorded a total of 17 mammal species. Of these species, three were introduced and 14 were native (Appendix D). The native mammals were represented by seven species of bat, four species of dasyurid, five species of murid, two species of macropod and one species of canid. The two introduced species recorded during the survey were the House Mouse **Mus musculus* and Cattle **Bos taurus*. Rock Wallabies *Petrogale rothschildi* were sighted at Site 1.

The most significant mammal record is that of the Orange Leaf-nosed Bat *Rhinonicteris aurantius* (Section 5.4.3.2).

Birds

A total of 52 species of birds were recorded during the Nimingarra systematic survey, including 24 passerines and 28 non-passerines. Thirty-two families were represented in the avifauna. The most commonly represented families were the Meliphagidae (Honeyeaters) with six species, Columbidae (Pigeons and Doves) with five species, Accipitridae (Eagles, Goshawks and Harriers) with four species, Ardeidae (Egrets and Herons) with three species and Halcyonidae (Kookaburras and Forest Kingfishers) with three species. Fifteen families of avifauna were represented by a single species (Appendix D). A number of species were observed to breeding within the Nimingarra area, these were: Common Bronzewing, Rainbow Bee-eater and Fairy Martin.

Herpetofauna

The systematic survey at Nimingarra recorded 34 species of reptile, and one species of amphibian. The reptiles were represented by two species of agamid, one species of python, ten species of skink, two species of pygopod, nine species of gecko, six species of elapid, one species of tortoise, one species of blind snake and six species of varanid. The only species of amphibian recorded was the Desert Tree-frog *Litoria rubella* (Appendix D). Nimingarra was the only location for which tortoises (*Chelodina steindachneri)* were recorded, and this species was observed occupying an artificial dam.

Fauna Habitats

Four distinct fauna habitat types were recognised and surveyed using transects for bird census, while trapping grids, opportunistic collections and nocturnal searching was utilised for other

classes of vertebrates. Each unit represents a fauna habitat that was characteristic of the overall habitats in the project area. The sites are described as follows;

(1) Sandplain/Alluvial Outwash Plain: This habitat type is represented through much of the region; there is consistency in this habitat across both Nimingarra and Sunrise Hill. The vegetation is typically patchy stands of *Acacia tumida* var. *pilbarensis / A. colei* var. *colei* tall / medium shrubs over dense to moderately dense *Triodia epactia* hummock grassland.

(2) Gullies/Major Drainage Lines: There are a number of drainage lines dissecting the slopes of Nimingarra, ranging from minor drainage lines to minor gorge formations. These are typically vegetated with *Corymbia hamersleyana* trees over mixed mid level shrubs, mainly *Acacia tumida* var. *pilbarensis, A. colei* var. *colei, Grevillea wickhamii* subsp. *aprica* and *Petalostylis labicheoides*. The slopes of these drainage lines are dominated by *Triodia epactia*. A number of these drainage lines also have large stands of *Ficus* spp. which provide an additional specific sheltered microhabitat.

(3) Slopes/*Triodia* Steppe: Common throughout the project area, these slopes are typically with rocky substrate, mainly vegetated with *Triodia epactia* hummock grass.

(4) Riverine: The substrate ranges from sand through to loose stones and rocks. The site is vegetated by very sparse *Corymbia hamersleyana* trees, with open *Melaleuca argentea* woodland, that is quite dense in places, with disjunct beds of *Typha domingensis* rushes.

Site Descriptions

Six fauna sites were selected based on the three habitat types identified. These sites were selected to give the best possible representation of the fauna inhabiting the area. Location of fauna sites is shown on Figure 5.2. Sites 2 and 4 are severely degraded by cattle.

Site 1: Site 1 is a major drainage line, opening into a gorge at the south-eastern end of the site. The vegetation consists mainly of sparse *Corymbia hamersleyana* woodland over moderately dense *Acacia tumida* var. *pilbarensis*, *Petalostylis labicheoides* and *Grevillea wickhamii* subsp. *aprica* shrubland. The rocky scree slopes adjacent to the drainage line were vegetated with moderately dense *Triodia epactia*. There are numerous rocky outcrops throughout the site, some that have localised stands of *Ficus* sp. trees (see Plate 5.6).

Plate 5.6 Site 1 looking northwest.

Site 2: Site 2 is an open plain vegetated with mixed low shrubland and Triodia epactia, which develops into a major drainage line, with minor gorge formation and open sandplain at the base. The vegetation upstream consists mainly of very sparse Corymbia hamersleyana over low Acacia tumida var. pilbarensis shrubs, over Acacia adoxa var. adoxa / A. hilliana dwarf shrubs with T. epactia hummock grass. The main vegetation change is on the sandplain outwash, where the vegetation changes into open Eucalyptus spp. woodland over Acacia tumida var. pilbarensis, Grevillea wickhamii subsp. aprica and Indigofera monophylla (small calyx form) shrubs. There is a large amount of rocky outcropping, with dry rock pools. The site has been exposed to recent fire. The sand plain at the base is degraded through heavy grazing by cattle.

Site 3: Site 3 is a northwest facing rocky scree slope with some low rocky outcropping. The slope is vegetated with very sparse *Corymbia hamersleyana* trees, over *Grevillea wickhamii* subsp. *aprica / Acacia inaequilatera* shrubs over moderately dense *Triodia epactia* hummock grassland (see Plate 5.7).

Plate 5.7 Site 3 looking northeast along the slope.

Site 4: Site 4 is a sandplain, vegetated with open *Corymbia zygophylla* over open mixed low shrubs and sparse *Triodia epactia*. The site has been recently burnt and shows evidence of grazing by cattle. The site is overlooked from the north-west and the south by rocky slopes. The site has large patches of leaf litter, bark and fallen logs (see Plate 5.8).

Plate 5.8 Site 4 looking east towards the rail line.

Site 5: Site 5 is a sandplain, vegetated with *Corymbia zygophylla* and *Corymbia hamersleyana* over open *Grevillea wickhamii* subsp. *aprica, Acacia tumida* var. *pilbarensis* and *A. inaequilatera* over moderately dense open *Triodia epactia / T. wiseana* hummock grassland. The scattered dense stands of *A. tumida* var. *pilbarensis* have a dense

accumulation of leaf litter beneath them, which provides good habitat for numerous species including small skinks and *Delma* species (see Plate 5.9).

Plate 5.9 Site 5 looking southwest.

Site 6: Site 6 is a dry riverbed which is part of Egg Creek. The site is vegetated by very sparse *Corymbia hamersleyana* trees, with open *Melaleuca argentea* woodland that is quite dense in places, with disjunct beds of *Typha domingensis* (see Plate 5.10).

Plate 5.10 Site 6 looking south.

Other Selected Fauna Sites

Two sites were specifically selected as opportunistic sampling sites for bats.

Bat Cave: This cave is situated near Site 5 at 51K 188524.1, UTM 7740758 (GDA 94) (Plate 5.11). This site was situated on a ridge below the Nimingarra site office. The site was selected as it is one of the largest caves observed in the area, and thus it was decided that it would be highly likely it would support a variety of bat species.

Plate 5.11 Cave near Site 5 surveyed for bats.

Egg Creek Dam: This site was selected for bat recording as it is a major open body of water in the area, which makes it ideal for bats to come to drink. The dam is located at 51K 188821.9, UTM 7738340 (GDA 94).

5.4.2 Conservation Significance

5.4.2.1 Species Protected by International Agreements

Two international agreements address components of the Australian fauna, with a focus on protecting migratory species. These two agreements are the JAMBA and the CAMBA.

No bird species protected under international agreements were recorded within the Nimingarra project area.

5.4.2.2 Commonwealth EPBC Act

Schedule 1 of the EPBC Act contains a list of species that are considered Critically Endangered, Endangered, Vulnerable, Extinct, Extinct in the wild and Conservation Dependent (Appendix E). Two species listed under this act were recorded.

- **Orange or Pilbara Leaf-nosed-bat *Rhinonicteris aurantius* – Vulnerable**

This bat species has a largely Torresian distribution but isolated populations occur in the Pilbara. It is known to prefer deep, humid caves for roosting (Churchill, 1998), although foraging occurs over a wider range of habitats. There are relatively few records of this species in the Pilbara.

This species was reported from a single call recorded at the Bat Cave. This is not unusual, as the species is uncommon, and tends to be present in very low numbers (See Section 5.4.3.2).

- **Northern Quoll *Dasyurus hallucatus*** (see Section 4.2.2.2)

5.4.2.3 WA *Wildlife Conservation Act 1950 (Specially Protected Fauna) Notice 2003*

Classification of rare and endangered fauna under the WA *Wildlife Conservation (Specially Protected Fauna) Notice 2003* recognises four distinct Schedules, as detailed in Appendix E.

- **Orange or Pilbara Leaf-nosed-bat *Rhinonicteris aurantius* – Schedule 1**

See Section 5.4.2.2.

5.4.2.4 CALM Priority Fauna

Species on the CALM Priority Fauna list include those removed from the Scheduled Fauna list and other species known from only a few populations or in need of monitoring. Four Priority codes are recognised, as detailed in Appendix E.

No CALM Priority species were recorded at Nimingarra.

5.4.2.5 IUCN Listed Species

The following species listed by IUCN were recorded during the survey. See Appendix E for definitions of categories.

Vulnerable

- **Orange or Pilbara Leaf-nosed-bat *Rhinonicteris aurantius* – VU A1c**

See Section 5.4.2.2.

Lower Risk/Near Threatened

These are taxa that have been evaluated, but do not qualify for Conservation Dependent, but are close to qualifying for Vulnerable status.

- **Northern Quoll *Dasyurus hallucatus***

See Section 5.2.1.5.

This species was recorded from secondary evidence, namely scats observed at Site 4, as well as an individual roadkill male from near the Nimingarra Crusher.

- **Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris***

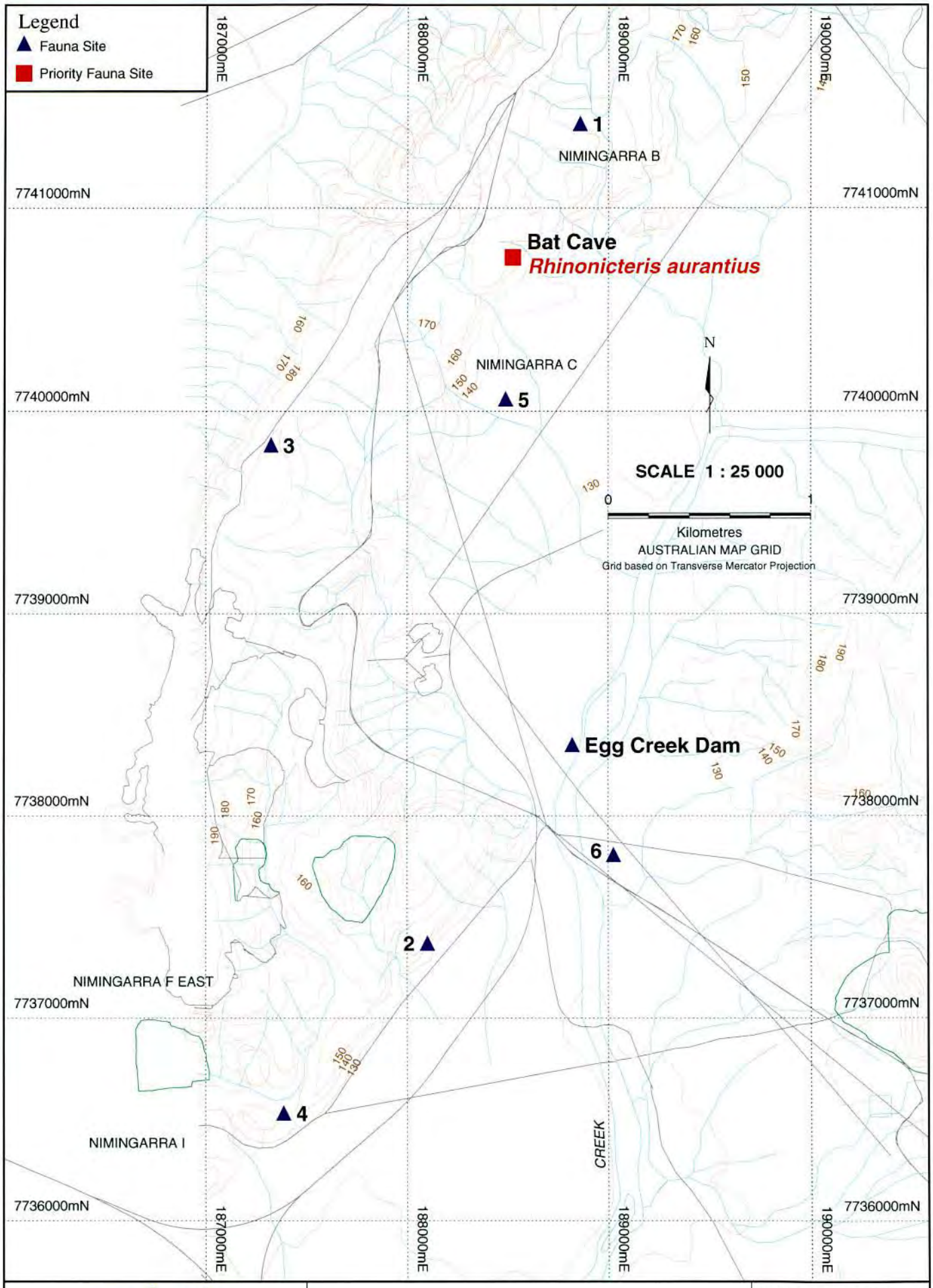
This species is widespread across much of northern Australia and down the East coast. Feeding above the canopy, this species is rarely encountered unless roosting, for which it favours tree-hollows, abandoned nests of other mammals and overhangs (Strahan, 1995).

This species was recorded on one occasion at the Egg Creek Dam.

5.4.3 Impact Assessment

The record of an Orange Leaf-nosed Bat, *Rhinonicteris aurantius,* at Nimingarra is extremely significant, as there are no known roosts of this species previously reported in the area. Due to the Conservation status of this species, and the paucity of records of roost caves, it is critical that a targeted survey is conducted to establish the extent of this species' presence in the area, and identify all caves that are being utilised.

Impacts to this species would mainly be destruction of suitable roosting caves through either mining or covering with overburden dumps and clearing of foraging habitat.



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Project: GOLDSWORTHY EXTENSION BIOLOGICAL SURVEY

LOCATION MAP OF THE NIMINGARRA FAUNA SURVEY SITES

A4

Date: 14 February 2005

Scale: 1:25 000

Author: C.S. / S.C.

Figure No. 5.2

Plan No. GWY-005

5.5 Sunrise Hill

5.5.1 Biodiversity

The Sunrise Hill fauna survey yielded approximately of 92 vertebrate fauna species, comprising two introduced and 10 native mammal species, 45 bird species, 30 reptile species, two species of amphibian and three species of fish.

Mammals

The systematic survey at Sunrise Hill recorded a total of 12 mammal species, of which only two were introduced (Appendix D). The native mammals are represented by five species of bat, two species of dasyurid, one species of murid and two species of macropod. The five bat species are represented by two families, Vespertilionidae with four species and Emballonuridae with a single species. Rock Wallabies *Petrogale rothschildi* were sighted at Site 2. Two introduced species were recorded at Sunrise Hill, these were: the Feral Cat **Felis catus* and Cattle **Bos taurus*.

Birds

A total of 52 species of birds were recorded during the Sunrise Hill systematic survey including 25 passerines and 27 non-passerines. Thirty-five families were represented in the avifauna. The most diverse families were the Meliphagidae (Honeyeaters) with six species, Accipitridae (Eagles, Goshawks and Harriers) with six species, Columbidae (Pigeons and Doves) with five species, Artamidae (Woodswallows and Butcherbirds) with three species, Halcyonidae (Kookaburras and Forest Kingfishers) with three species and Falconidae (Falcons) with three species. Nineteen bird families are represented by a single species (Appendix D).

Herpetofauna

The systematic survey at Sunrise Hill recorded a total of 30 species of reptile, and two species of amphibian. The reptiles are represented by three species of agamid, seven species of skink, ten species of gecko, four species of varanid, two species of pygopod, two species of python and three species of elapid. The two species of amphibian recorded were the Desert Tree-frog *Litoria rubella* and the Glandular Toadlet *Uperoleia glandulosa* (Appendix D).

Fish

Three fish species were recorded during the Sunrise Hill fauna survey. These are the Spangled Perch *Leiopotherapon unicolor*, the Rainbowfish *Melanotaenia* sp. and the Hyrtl's Tandin *Neosilurus hyrtili* Fish were recorded from a number of rock pools along Sunrise Hill, especially those at Sites 1, 2 and 5.

Fauna Habitats

Due to the close proximity of all the survey areas in the Goldsworthy region, there is considerable similarity and overlap of habitat types. This is particularly apparent between Nimingarra and Sunrise Hill, although there are distinct differences.

Six fauna habitat types were recognised and surveyed using transects for bird census, while trapping grids, opportunistic collections and nocturnal searching was utilised for other classes of vertebrates. Each unit represents a fauna habitat that was characteristic of the overall habitats in the project area. The sites are described as follows;

(1) Sandplain/Alluvial Outwash Plain: This habitat type is represented through much of the region; there is consistency in this habitat across both Nimingarra and Sunrise Hill. The vegetation is typically patchy stands of *Acacia tumida / A. colei* over dense to moderately dense *Triodia epactia* hummock grassland.

(2) Gullies/Major Drainage Lines: There are a number of drainage lines dissecting the slopes of Nimingarra, ranging from minor drainage lines to minor gorge formations. These are typically vegetated with *Corymbia hamersleyana* over mixed mid level shrubs, mainly *Acacia tumida, A. colei, Grevillea wickhamii* and *Petalostylis labicheoides*. The slopes of these drainage lines are dominated by *Triodia epactia*. A number of these drainage lines also have large stands of *Ficus* spp. which provide an additional specific sheltered microhabitat.

(3) Slopes/*Triodia* Steppe: Common throughout the project area these slopes are typically with rocky substrate, mainly vegetated with *Triodia epactia*.

(4) Riverine: The substrate ranges from sand through to loose stones and rocks. The site is vegetated by very sparse *Corymbia hamersleyana*, with open *Melaleuca* sp., which in places becomes quite dense, with disjunct beds of *Typha domingensis*.

(5) Gorges: Often vegetated similarly to the riverine habitat, the gorge systems in the project area were defined by being much deeper, with high rock walls, and often containing pools of water.

(6) *Melaleuca* Woodland: this habitat was present in only a few small pockets along Sunrise Hill. Situated at the base of Gorges, this habitat was often inundated by water at ground level, either through runoff, or from permanent seeps out of the rocks. This habitat type was targeted quite intensively due to the distinct micro-climate within.

Site descriptions

Five fauna sites were selected based on the habitat types identified. These sites were selected to give the best possible representation of the fauna inhabiting the area. Location of fauna sites is shown on Figure 5.3.

Site 1: Site 1 is a dry riverbed, with open Eucalypt woodland over hummock grasses with a sandy / rocky substrate. The banks of the riverbed are vegetated with *Triodia* spp. The north-west end of the site is the base of a gorge, with a large permanent rock pool, with some *Melaleuca* sp. The south-east, downstream end of the site is densely vegetated with *Melaleuca* sp woodland, with an understorey consisting of *Typha domingensis* beds and other rushes. The site has a large amount of wood, bark and leaf litter scattered throughout (see Plate 5.12).

Site 2: Site 2 is a *Melaleuca* sp. woodland with a creek inundating the bases of the trees. Upstream, the site becomes a gorge, with stands of *Ficus* and numerous rock pools.

There are a large number of caves dotting the walls of the gorge. At the very top of the gorge it opens out into a plain atop Sunrise Hill which has been recently burnt and is in the early stages of regeneration, with numerous small shrubs and grasses. The *Melaleuca* woodland at the base of the gorge is severely degraded by cattle (Plate 5.13), with numerous animals using the area as shelter and a place to water during the day, (see Plate 5.14).

Plate 5.12 **Site 1 photos taken from centre of site looking south-east and north west, respectively.**

Plate 5.13 **Site 2 photos showing severe degradation of understorey by presence of cattle *Bos taurus*.**

Plate 5.14 **Site 2 photos looking first at the gorge upstream and downstream and at the *Melaleuca* woodland at the base.**

Site 3: Site 3 is a rocky scree slope vegetated with dense *Triodia epactia / T. wiseana*. The top of the site is a rocky cliff face, with small amounts of alluvium deposited at the base. The vegetation under the rock face consists of stands of *Ficus*, with scattered *Atalaya* sp., *Grevillea pyramidalis* and *G. wickhamii* (see Plate 5.15).

Plate 5.15 **Site 3 looking from bottom of site up towards ridge and north-west along slope.**

Site 4: Site 4 is a major drainage line, vegetated with *Acacia tumida / Grevillea wickhamii* stands, with the slopes vegetated with *Triodia epactia* hummocks, scattered *G. wickhamii*, *A. adoxa* and *A. hilliana* (see Plate 5.16).

Plate 5.16 **Site 4 looking onto site from hilltop and looking north.**

Site 5: Site 5 is a small stand of *Melaleuca* sp. with bases inundated by water pools. The top of the site is the base of a gorge with a small, deep permanent pool, and large vertical rocky faces. Surrounding the site are slopes and spinifex steppe with large, dense hummocks (see Plate 5.17).

Plate 5.17 **Site 5 showing *Melaleuca* woodland with permanent water, as well as dense layer of leaf litter, and finally *Triodia* sp. hummocks at the edge of the site.**

5.5.2 Conservation Significance

5.5.2.1 Species Protected by International Agreements

Two international agreements address components of the Australian fauna, with a focus on protecting migratory species. These two agreements are the JAMBA and the CAMBA.

No bird species listed under these agreements were observed during the survey.

5.5.2.2 Commonwealth EPBC Act

Schedule 1 of the EPBC Act contains a list of species that are considered Critically Endangered, Endangered, Vulnerable, Extinct, Extinct in the wild and Conservation Dependent (Appendix E). Only one species listed under this act was recorded.

- **Northern Quoll *Dasyurus hallucatus***

See Section 5.2.1.5.

5.5.2.3 WA *Wildlife Conservation Act 1950 (Specially Protected Fauna) Notice 2003*

Classification of rare and endangered fauna under the WA *Wildlife Conservation (Specially Protected Fauna) Notice 2003* recognises four distinct Schedules, as detailed in Appendix E.

No Schedule fauna were recorded during the survey at Sunrise Hill.

5.5.2.4 CALM Priority Fauna

Species on the CALM Priority Fauna list include those removed from the Scheduled Fauna list and other species known from only a few populations or in need of monitoring. Four Priority codes are recognised, as detailed in Appendix E.

One Priority species was recorded at Sunrise Hill.

- **Bush Stone-curlew *Burhinus grallarius* – Priority 4**

This species was formerly found in most grassy woodlands in Australia and Tasmania; but is now generally scarce except in the north (WAM, 2004).

5.5.2.5 IUCN Listed Species

The following species listed by International Union for Conservation of Nature and Natural Resources (IUCN) were recorded during the survey.

Lower Risk/Near Threatened

These are taxa that have been evaluated, but do not qualify for Conservation Dependent, but are close to qualifying for Vulnerable status.

- **Northern Quoll *Dasyurus hallucatus***

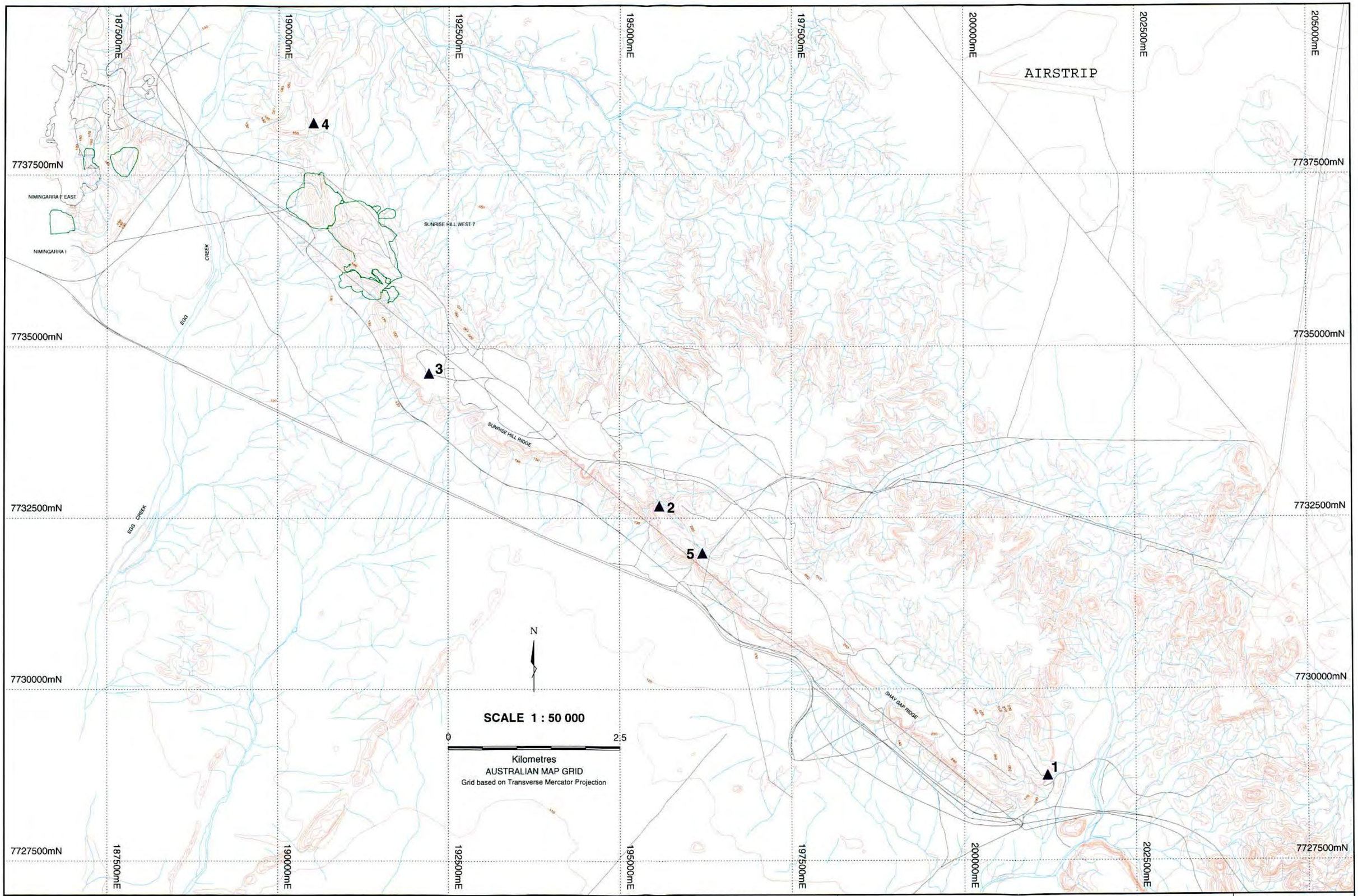
See Section 5.2.1.5.

This species was recorded from three sites at Sunrise Hill during the survey.

5.5.3 Impact Assessment

Impacts to the Bush Stone-curlew, *Burhinus grallarius,* include mainly loss and clearing of suitable woodland habitat, as well as through predation by introduces species such as Feral Cats **Felis catus* and Foxes **Vulpes vulpes.*

The record of the bat species *Vespadelus baverstocki* at Site 2 denotes a significant range extension for the species north of its previously known distribution. Impacts to this species would come from loss of roost caves and foraging areas.



Legend

▲ Fauna Site

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Author: C.Slee | Drawn: S.Coleman

Client: BHP BILLITON

Project: GOLDSWORTHY EXTENSION BIOLOGICAL SURVEY

LOCATION MAP OF THE SUNRISE HILL FAUNA SURVEY SITES

A3

Date: 14 February 2005
Scale: 1:50 000
Figure No. 5.3
Plan No. GWY-006

5.6 Short Range Endemic Fauna

Literature Review

Endemism refers to the restriction of fauna species to a particular area, whether it is at the continental, national or even local level (Allen *et al.*, 2002). Species that exhibit tight local range restrictions are known as short-range endemics. Short-range endemic fauna is dominated by invertebrate species, a group which is poorly studied and contains a number of undescribed species. It is only relatively recently that extensive, reliable taxonomic evaluation of these species has begun and thus, the availability of literature relevant to short-range endemic fauna is scarce. Short-range endemics occur in most of the 26 biogeographic regions of Western Australia, including the Pilbara region in which the Goldsworthy Extension Project is located.

Recent taxonomic and survey work has revealed that short-range endemics are more common in Australia than was originally thought, and that some taxonomic groups are made up entirely of these types of species, although this is rare (Harvey, 2002). It has also been demonstrated that many taxa that appear to be rare are often just poorly documented and may be more widespread than originally thought.

A number of factors, including the ability and opportunity to disperse, life history, physiology, habitat requirements, habitat availability, biotic and abiotic interactions and historical conditions, will influence not only the distribution of a taxon, but also the tendency for differentiation and speciation (Ponder and Colgan, 2002), and all of these factors influence whether or not a species is endemic. However, physical barriers that prevent migration between adjacent populations of the same species are perhaps the strongest determinant for endemism. Islands, mountains, aquifers, lakes and caves are examples of the types of landscapes that promote endemism. Thus, those taxa that exhibit short-range endemism are generally characterised by poor dispersal, reliance on habitat types that are discontinuous, low growth rates and low fecundity (Harvey, 2002).

The desktop literature review of published articles, database analysis, and personal communications with key specialists from the WA Museum revealed that there is only one specific study of a potential short range endemic that may occur around the project area. Johnson *et al.* (2004) describes the genetic and morphological characteristics of several populations of the pulmonate gastropod species assemblage of *Rhagada* that occur in the NW Pilbara, and on the Dampier Archipelago. The study has shown that although mainland populations were allopatric in their distribution, there was insignificant genetic or morphological variation within species and between populations on the mainland.

Despite the lack of other published records or other survey results, it is not possible to definitively say that short-range endemic species do not exist in the Project area, or will not be detrimentally affected by the proposed mining activities. Consequently, an initial assessment of the physical characteristics of the project area, and consideration of landscape attributes that promote short-range endemism was conducted in order to evaluate the potential risk of mining to the maintenance of biodiversity of local fauna species. The assessment focused on the main fauna groups of vertebrates, freshwater fish and invertebrates.

Consideration of Faunal Groups

Vertebrates

The vertebrate fauna of Australia is generally too mobile to allow the maintenance of genetic variation between population fragments. Thus, among mammals, birds, reptiles and amphibians, short-range endemism is rare, and no short-range endemic vertebrates are expected to occur in the Goldsworthy Extension Project area.

Freshwater Fish

Short-range endemism is common among freshwater fishes, as they are limited in their dispersal by terrestrial surroundings and radiations of congeneric species have resulted from geographic barriers and geographic isolation within and between drainage systems (Allen *et al.*, 2002), particularly in northern regions where inland water bodies arise seasonally and only persist for short periods. Speciation among the freshwater fishes of Australia can occur on finer scales in response to new geological barriers or drying of water bodies isolating local populations (Phillips, 2004).

It is not likely that any short-range endemic fish species that are currently protected species are considered likely to occur within the Goldsworthy Extension Project area. Both *Milyeringa veritas* and *Ophisternon candidum* occur in the Pilbara, however, both are restricted to wells, sinkholes, caves and bores. These habitat types are not known to occur within the proposed disturbance footprint for the Project.

However, several isolated and disjunct pools/creeks occur in the study area, and these may support species that are divergent either genetically or morphologically. The extent of this divergence is very much dependent on the connectivity of the water ways in the area. Most of the larger creeks would flow prolifically after heaving rain, allowing the capacity for dispersal of offspring and a general mixing of the gene pool. Providing the proposed activity does not significantly disturb the natural flow regimes, then populations of freshwater fish should not be significantly influenced.

Invertebrates

Short-range endemics are more common among the invertebrates than the vertebrates. Widespread and uniform short-range endemism is found in both freshwater and terrestrial molluscs, onychophorans, millipedes, some arachnids and some crustaceans. Short-range endemism also occurs in other groups but is not uniform throughout (Harvey, 2002). Due to the lack of knowledge of the extent of endemism among this group there is a perceived risk of influencing local populations of specific taxa. However, this risk is slight due to the fact the physical characteristics of the Goldsworthy Extension Project area do not specifically promote endemism. For instance, there are no known physical barriers to dispersal. The typical mesa physiography of the deposit is contiguous with rugged terrain on most sides, and the alluvial outwash plains are further represented immediately adjacent proposed impact area. Therefore, any species that occupy either of these main landform types are not limited in their distribution beyond the disturbance footprint.

Conclusion

There is little risk that the proposed mining and development activities associated with the Goldsworthy Extension Project may have an influence on local populations of short-range endemic fauna species, with any possible influence on locally endemic species resulting in the consequential loss of biodiversity. Nevertheless, the characteristics of the project area, the nature and scale of impact, and the faunal assemblages of the area should be formerly considered via a Risk Assessment process to more accurately determine what risk, if any, the proposed work constitutes for short range endemic fauna.

5.7 Priority Fauna Potentially Occurring

This section outlines the listed fauna species of conservation significance which may be present within the general project area, but were not specifically located during the survey. The survey intensity and variety of techniques utilised were suitable for detecting all of the species described below. However, most of these species are so uncommon that they are infrequently found during any baseline biological survey. For instance, a total of 12 baseline surveys have been undertaken by *ecologia* to reveal only one individual of the species *Ramphotyphlops ganei* (P1).

5.7.1 Commonwealth EPBC Act

Schedule 1 of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* contains a list of species that are considered Critically Endangered, Endangered, Vulnerable, Extinct, Extinct in the wild and Conservation Dependent (Appendix E).

There are no species listed under this Act that were not recorded during the survey and that are expected to occur exclusively in the impact areas identified within the Goldsworthy Extension project area

5.7.2 WA *Wildlife Conservation Act 1950 (Specially Protected Fauna) Notice 2003*

Classification of rare and endangered fauna under the WA *Wildlife Conservation (Specially Protected Fauna) Notice 2003* recognises four distinct Schedules, as detailed in Appendix E.

There are no species listed under this Act that were not recorded during the survey and that are expected to occur exclusively in the impact areas identified within the Goldsworthy Extension project area

5.7.3 CALM Priority Fauna

Species on the CALM Priority Fauna list include those removed from the Scheduled Fauna list and other species known from only a few populations or in need of monitoring. Four Priority codes are recognised, as detailed in Appendix E.

- ***Ramphotyphlops ganei* – Priority 1**

Little is known about this species of Blind Snake, which is endemic to the Pilbara. It is thought to be associated with moist gorges and gullies (Wilson and Swan, 2003). One individual was recently collected north east of Roy Hill Station, approximately half way between Newman and Port Hedland (M. Ladyman *pers obs.*).

- **Unpatterned Robust Lerista *Lerista macropisthopus remota* – Priority 2**

Lerista macropisthopus remota is the arid-central interior subspecies of the Unpatterned Robust Lerista *Lerista macropisthopus*. It is primarily found in the Robertson Range and Mundiwindi areas east of Newman. It is classified as Priority 2 by CALM (taxa with few, poorly known populations on conservation lands) and needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

- **Spectacled Hare-wallaby** *Lagorchestes conspicillatus leichhardti* – **Priority 3**

This is a stock, thickset wallaby with shaggy, grey-brown fur presenting a grizzled appearance. It has a distinctive orange eye patch (the "spectacles" that give the species its common name) extending back to below the ear (Menkhorst and Knight, 2004).

Spectacled Hare Wallabies are solitary, nocturnal wallabies, spending the day in refuges in dense vegetation, usually hummock grass (Menkhorst and Knight, 2004). They move at a slow walk for preference, although they can move at speed when pursued. They feed on green shoots of grasses, herbs and shrubs. Although there is no defined breeding season, births peak bi-annually in March and September (Menkhorst and Knight, 2004).

It is known to inhabit tropical tussock and hummock grasslands with mid-dense or sparse tree and shrub cover (Menkhorst and Knight, 2004). The species is abundant on Barrow Island, however the mainland population has declined drastically in the western parts of its distribution since European settlement (Burbidge and Johnson, 1983; Menkhorst and Knight, 2004). It has been suggested that this decline may be in part due to frequent burning of the Spinifex grasslands, preventing the development of hummocks large enough to provide the wallabys with shelter (Burbidge and Johnson, 1983).

Many anecdotal records exist for this species around the Shay Gap / Goldsworthy area, particularly for the period between 1985 and 1995. However, a search of the records of the W.A. Museum reveals that only one confirmed record exists. This record is of a skeleton found near Shay Gap, and the date of lodgement is 1990.

- **Ghost Bat *Macroderma gigas* – Priority 4**

The Ghost Bat *Macroderma gigas* is the largest Microchiropteran bat in Australia. Ghost Bats occur in a variety of habitats, from arid spinifex hillsides, to open tall forest and tropical rainforest (Churchill, 1998). Their distribution is determined by the availability of suitable roosting sites. The preferred roosting habitats of Ghost Bats in the Pilbara are caves beneath bluffs of low rounded hills composed of Marramamba geology and granite rock piles. They have also been known to roost in large colonies in sandstone caves, under boulder piles and in abandoned mines (Churchill, 1998). In addition to being classified as Priority Four by CALM (in need of monitoring), the Ghost Bat is classed as VU A2c by the IUCN.

- **Long-tailed Dunnart *Sminthopsis longicaudata* – Priority 4**

This species occupies rocky hills and mesas. Little is known of the biology of this species and more intensive survey work would be required to determine the existence of populations at Yarrie. A total of four specimens from the Pilbara region, all from areas to the south have been lodged with the WA Museum. Two of these specimens have been caught in the last 10 years (*ecologia*, 1999).

5.7.4 IUCN Listed Species

The following species listed by International Union for Conservation of Nature and Natural Resources (IUCN) may occur within the project area but were not recorded during the survey. See Appendix E for definitions of conservation codes.

Lower Risk/Near Threatened

These are taxa that have been evaluated, but do not qualify for Conservation Dependent, but are close to qualifying for Vulnerable status.

- **White-striped Freetail-bat *Tadarida australis***

Widely distributed across southern Australia, the calls of this species are audible to humans. *Tadarida australis* is a fast flying bat which hunts above the canopy. This species roosts communally, commonly in small groups, but also in groups that may be up to several hundred individuals. It usually roosts under loose tree bark, in dead trees and in buildings (Strahan, 1995).

6.0 GENERAL RECOMMENDATIONS

The following monitoring and management recommendations are applicable to the Goldsworthy Extension Project to reduce the impacts it may have on the flora, fauna and surrounding ecosystems:

6.1 Priority Species and Further Surveys

(1) Due to the lack of rainfall preceding all the flora surveys on each of the ore bodies it is recommended that follow-up surveys be undertaken during a more opportune time of the year, following significant rain. These targeted surveys should assess the proposed disturbance footprints and should determine:

a. The presence of DRF and Priority Flora across the project area that may not have been present due to their life history;

b. The presence of herbs and other annuals that may not have been present during the previous surveys

(2) Due to the paucity of records and the conservation status of the Orange or Pilbara Leaf-nosed-bat, *Rhinonicteris aurantius*, a targeted survey to investigate the presence and potentially quantify the level of activity of this species in the project area needs to be undertaken. This can be achieved as a three stage process:

a. Undertake a broad survey for suitable roost caves across all potential disturbance areas up to 10 km from where individuals of this species were observed. Cave habitat requirements are very specific for this species, so it is relatively easy to identify potential roost caves.

b. If suitable caves are located, a monitoring survey must be undertaken. This should involve acoustic recording at each suitable cave for a period of no less than two hours per night, immediately after twilight. Each cave should be surveyed for four (4) nights, and the survey should be undertaken during a period of high local humidity (February-April). Recordings should be analysed by an expert with the requisite skills to recognise the unique calls of *R. aurantius*.

c. If roost caves are located and shown to support individuals, then ongoing monitoring and management strategies for this species will need to be formulated.

(3) Due to the current conservation status of the Pilbara Olive Python, *Liasis olivaceus barroni*, and the relatively high number of records of this species over the project area, it is recommended that management be specifically tailored for this species. As the species is relatively cryptic, it is not recommended that further survey work be undertaken to attempt to quantify the population of this species in the impact area.

(4) The observation of the Mulgara, *Dasycercus cristicauda,* is one of only few records for this area based on database searches and personal communication. It is difficult to know exactly how common this species is, as most collections are unpublished. Less than five records were made during collections from the Telfar Gas Pipeline trench, that traversed

an area adjacent to Goldsworthy, and Biota recorded one specimen during a survey for BHPBIO (pers. Comm.). As this species exhibits a boom and bust population cycle, it is recommended that disturbance to *Triodia* grasslands over loamy soils be minimised and vehicle speed on the proposed Cattle Gorge haul road be kept below 50 km/hr.

(5) Nineteen species of water bird were observed utilising water bodies along Eel and Cattle Gorge Creek. Though few of these are listed species, these data indicate that permanent or semi-permanent water is a limited resource in the Goldsworthy Extension area. As most of the water bodies are aligned with the Yarrie access road and rail line, it is apparent that human disturbance is not a detrimental influence to the utility of this resource. Therefore, it is recommended that with construction of the Haul Road the flow regime of these creeks should not be altered.

(6) An environmental risk assessment should be conducted to evaluate the potential risks of disturbance to Short Range Endemic Fauna associated with the Project. This will allow, if necessary, BHPBIO to formulate additional management actions to reduce the potential risks.

(7) The two plant taxa that are apparently new and therefore of conservation significance are *Stemodia* sp. Shay Gap and *Corymbia* sp. (SRH 71.8). Further targeted flora searches within the proposed disturbance areas at Sunrise Hill and Nimingarra are required to establish a complete awareness of the distribution of these taxa. These searches will allow for a higher level of certainty as to whether or not these taxa may exist near any proposed areas of disturbance. Searches should also consider other regionally significant species, including *Erythrophleum chlorostachys*.

(8) Populations of species of significance within the project area should be clearly flagged and avoided by works and personnel. Significant populations should be monitored throughout the life of the project. If the monitoring program suggests that dust or other secondary mining effects are impacting the populations, appropriate management policies to directly address the problems should be implemented.

(9) Along the south-western side and south-eastern end of the Sunrise Hill ridge, there are a number of pockets of vegetation associated with accumulated water and shaded environments at the base of clif /gorge systems. These areas support two main types of vegetation that are very restricted in local distribution that include: *Melaleuca argentea/Eucalyptus victrix* forest, and; sparse *Ficus brachypoda* dense forest to sparse trees, both types with *Atalaya hemiglauca, Ficus opposita* var. *indecora* trees, and the first of these with *Typha domingensis* and/or *Cyperus vaginatus*. These vegetation types were recorded from Flora Sites 41, 47, 65 and 71. In addition to this, there is Nimingarra Flora Site 29 near the Egg Creek crossing with the Haul Road where the vegetation appears to have once had the *M. argentea/E. victrix* forest vegetation type, but has changed due to water abstraction from bores to a degraded version of this. Given the limited number of representatives of these vegetation types and restricted range, it is recommended that no disturbance occurs in these areas.

6.2 Clearing and Rehabilitation

(10) The most significant impact of the Goldsworthy Extension Project will be the loss of natural vegetation through clearing. In the design phase of the project, designated areas of native vegetation to be cleared should be minimised to reduce impacts on surrounding ecosystems. Physical disturbance by construction or personnel activities to sites identified as having local ecological significance should be minimised. This will reduce impact to many fauna species including the Priority 4 Pebble-mound Mouse, *Pseudomys chapmanii* and Lakeland Downs Short-tailed Mouse, *Leggadina lakedownensis*

(11) Ultimate clearing boundaries should be well defined in the field (staked and flagged) and staff should be educated as to the importance of adhering to these limits.

(12) Dust suppression techniques, including imposing speed limits and soil binding in high traffic areas, should be applied during works to reduce impact to adjacent vegetation.

(13) Off-road driving should be limited to that which is unavoidable during the course of normal safe operations.

(14) During clearing and mining operations, topsoil should be stripped, hauled and respread. Stockpiled topsoil should be utilised in rehabilitation works soon after removal to maintain viable seed stores.

(15) Monitoring of topsoil stockpiles and subsequent areas of rehabilitation should pay particular attention to the presence of weed species to ensure that these species are not increasing subsequent to disturbance. Should the population density or distribution be increasing, species-specific application of herbicides may be required.

(16) Wherever possible, large trees should be bypassed rather than removed. Where removal is unavoidable, trees should be stockpiled but not burnt as they provide fauna habitat in rehabilitation areas.

(17) Vegetation debris, logs, topsoil and rocks should be returned to areas that have been disturbed and in need of rehabilitation. These materials assist with rehabilitation by providing seed stores, moisture traps and fauna microhabitats.

(18) Rehabilitation of overburden storage areas, disused tracks, borrow pits and other work areas should be initiated. This should be carried out progressively.

6.3 Weed Management

(19) Weed Risk areas should be sign-posted and all personnel made aware of their presence.

(20) Education of construction personnel with respect to the appearance of weed species should be carried out in order to prevent inadvertent dispersal by clothing or machinery. This could include providing information handouts or booklets describing the problem of weed species and how best to control them.

(21) Clearing and vehicular traffic within weed-infested areas should be minimised.

(22) All earth moving and mobile construction equipment used in weed-infested areas should be cleaned prior to movement to non-infested areas. Similarly, any equipment or vehicle considered to have been working in a Weed Risk area should be cleaned down before being remobilised to other areas of the project. This will help to prevent the spread of weeds or the regeneration of certain weed species from plant fragments.

(23) Periodic monitoring and spot spraying of emergent weed plants with herbicide may be required to control weed populations during the life of the project.

(24) BHPBIO should keep abreast of developments in rehabilitation strategies, weed hygiene and control techniques in the Pilbara through regular liaison with the Agriculture Protection Board and CALM.

6.4 Bush Fires

(25) The increased risk of bush fires in the project area should be addressed by the ongoing implementation of a Bushfire contingency plan.

(26) Other steps to minimise fires include ensuring all machinery is well lubricated to reduce sparks, controlling the establishment of weeds in the area and ensuring proper disposal of rubbish, particularly glass.

6.5 Feral Animal Control

(27) There is little that can be done to completely eradicate populations of feral animals. However, proper hygienic practices with foodstuffs, including the use of suitable containers and regular cleaning, and appropriate disposal of wastes help to maintain populations of these species at a minimum.

(28) To lessen the risk of death to native species and reduce road-kill which can provide a food source for feral animals, vehicle movements along established tracks should be minimised and when necessary, should be within speed limits.

(29) Feral Cat populations should be controlled within the project area by trapping near frequented areas such as tips and camps.

(30) If ongoing monitoring demonstrates that populations of feral fauna such as foxes, goats or rabbits have increased dramatically, then control measures should be implemented. This may include baiting or direct culling as required.

(31) No project staff should be permitted to bring pets into the project area.

7.0 DISCUSSION

7.1 Regional Comparison

Australia has an international obligation to maintain biodiversity. The Commonwealth government has initiated the National Strategy for the Conservation of Biological Diversity, which incorporates elements of the National Strategy for Ecologically Sustainable Development (NSESD). Biological diversity (biodiversity) relates to the richness of the biota at a local, regional, state, national or even global level, and includes all components of the living environment, from bacteria to insects, plants, and vertebrate fauna. Biodiversity can be thought of as existing at several levels, including genetic, population and species (or taxon) diversity. This study examines biodiversity at the species and population level, and places it within a local, regional and national context.

At a sub-regional level, based on PATN floristic analysis (see Appendix F), it is clear that there are significant differences in the flora composition of the different areas, and hence the vegetation on a local scale is relatively diverse. Part of the reason for this may be related to different numbers of survey quadrats in each area, variation in range of landscape types for each project and temporal variation of sampling between areas. However, there is commonality in the portion of species and vegetation units that each of the Goldsworthy ore bodies share the outlier area (Panorama) used for comparison in this data analysis. There are also a significant portion of species found at only one location with the project area. These points highlight the diversity across the breadth of the project area. Though there is insufficient comparable data beyond, but in the immediate vicinity of Goldsworthy, to determine whether this level of species richness is unique. Analysis of flora data from multiple surveys undertaken by ecologia in close proximity to each other tends to indicate that more sampling across more vegetation units will consistently reveal more species, irrespective of where the survey is undertaken.

The total number of vertebrate fauna species recorded for the five sites; Yarrie, Cattle Gorge, Nimingarra and Sunrise Hill is 193. These data are presented on a site by site basis in Figure 7.1. The Yarrie survey recorded a total of 88 species, comprising 17 mammals, 43 birds, 24 reptiles, three amphibians and one fish species. Nimingarra had a total of 103 vertebrate species, including 17 mammals, 52 birds, 34 reptiles, and one amphibian. Sunrise Hill also had a high number of 92 recorded species, including 12 mammals, 45 birds, 30 reptiles, two amphibians and three species of fish. Combining the opportunistic and systematic surveys of Cattle Gorge a total of 124 species were recorded, comprising 15 mammal species, 77 bird species, 28 reptile species, three amphibian species and one species of fish. Fauna sampling is limited by environmental factors, and these lists are only representative of the fauna species that were present at the time. However, the five different sites were surveyed at different times of the year, and therefore combining the sites would provide a reliable indication of the species present within the Goldsworthy area.

The current surveys recorded higher numbers of species compared with previous surveys conducted within the Goldsworthy region. A survey by Halpern Glick Maunsell (1998) recorded a total of only 42 species, including ten mammal species, 25 bird species and seven reptile species. Similarly, a fauna survey for the Goldsworthy Phase 2 Development Programme yielded 46 vertebrate species, comprising five mammals, 34 birds, six reptiles and one amphibian. Though the Goldsworthy Extension Biological Survey describes a relatively rich

fauna inventory, this is a consequence of the high intensity of survey work. There are few other occasions where such intensive biological survey work is undertaken in a localised area. In total, the survey effort comprised over 4750 trap nights, 7600 minutes (126 hours) of bird census work, 7200 minutes of hand searching and 1100 minutes of acoustic recording for bat species. It is likely that if the same amount of survey work was undertaken in a similar area on a similar scale, a similar suite of fauna would be recorded.

It is worthwhile considering the described richness of other survey sites of the eastern Pilbara region including Orebody 18 (*ecologia*, 1995*a*), 23 (*ecologia*, 1997e), 24 (*ecologia*, 2004), 25 (*ecologia*, 1995a) and Mining Area C (*ecologia*, 1997b). These surveys yielded total numbers of species ranging from 59 (Orebody 23) to 143 (Area C). The Mining Area C biological survey involved a similar survey effort and intensity to the Goldsworthy Extension Project. However, the survey period did not extend over the same duration as Goldsworthy Extension, with all of the survey work undertaken in one month. The number of species recorded for these surveys are more comparable to the current surveys, although the actual composition of species would be different between the two areas.

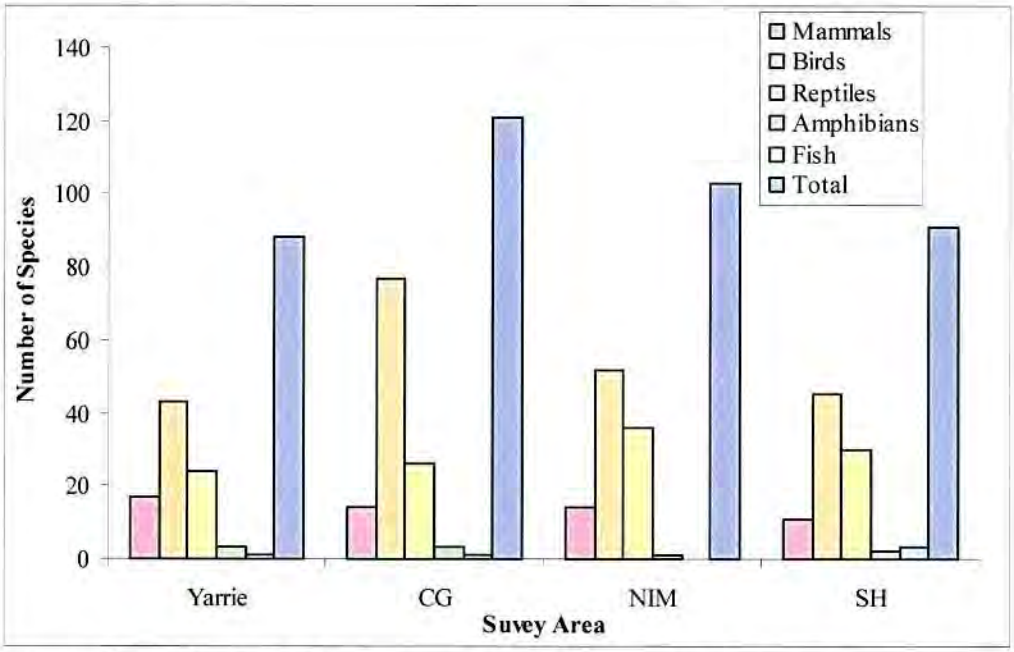

Figure 7.1 Number of fauna species in each group for the four survey sites. CG = Cattle Gorge, NIM = Nimingarra, SH = Sunrise Hill.

The significance of the biota of the project area has been assessed at four spatial scales; international/national, state, regional and local.

7.2 International / National Significance

Fauna species whose conservation is dependent, because of their migration patterns, on the action of other nations as well as Australia's, are of international significance. Such considerations are recognised by State legislation, Federal legislation and also International treaties. In addition, endangered animals are listed and their conservation status reviewed by the International Union for the Conservation of Nature (IUCN), a United Nations agency.

Seven species listed under JAMBA/CAMBA were recorded in during the surveys and are discussed in Section 5:

- Wood Sandpiper *Tringa glareola*
- Common Sandpiper *Actitis hypoleucos*
- Fork-tailed Swift *Apus pacificus*
- Great Egret *Ardea alba*
- Marsh Sandpiper *Tringa stagnatilis*
- Greenshank *Tringa nebularia*
- Snipe *Gallinago* sp.

The following species listed on the IUCN Red List were recorded within the project area and have been described in Section 5:

- Orange Leaf-nosed Bat *Rhinonicteris aurantius*
- Lakeland Downs Mouse *Leggadina lakedownensis*
- Delicate Mouse *Pseudomys delicatulus*
- Desert Mouse *Pseudomys desertor*
- Northern Quoll *Dasyurus hallucatus*
- Yellow-bellied Sheathtail Bat *Saccolaimus flaviventris*
- Star Finch *Neochmia ruficauda subclarescens*
- Pictorella Mannikin *Heteromunia pectoralis*
- Mulgara *Dasycercus cristicauda*

National significance refers to those features of the environment which are recognised under legislation as being of importance to the Australian community. Species scheduled under the Commonwealth EPBC Act are regarded as nationally significant, and 4 species that are scheduled under the EPBC Act were recorded during the survey and are detailed in Section 5:

- Northern Quoll *Dasyurus hallucatus*

- Pilbara Olive Python *Liasis olivaceus barroni*
- Orange or Pilbara Leaf-nosed Bat *Rhinonicteris aurantius*
- Mulgara *Dasycercus cristicauda*

7.3 State Significance

State significance refers to those features of the environment that are recognised under State legislation as of importance to the Western Australian community. Fauna that are regarded as "rare and/or endangered" under the WA Wildlife Conservation Act, or habitats that are site or type specific and possess high ecological value are of state significance. Similarly, flora protected under state legislation, or new species of flora, are significant at this level.

Habitats that exhibit such a level of significance will contain specific, habitat dependent fauna or high biodiversity and are poorly represented elsewhere. Conservation significance is greater if a species or habitat is poorly represented in conservation reserves.

The following species Scheduled under the WA Wildlife Conservation Act were recorded during the survey and are detailed in Section 5:

- Pilbara Olive Python *Liasis olivaceus barroni*
- Orange or Pilbara Leaf-nosed Bat *Rhinonicteris aurantius*
- Mulgara *Dasycercus cristicauda*

The two plant taxa that are apparently new and therefore of conservation significance are *Stemodia* sp. Shay Gap and *Corymbia* sp. (SRH 71.8). Further targeted flora searches within the proposed disturbance areas at Sunrise Hill and Nimingarra are required to establish a complete awareness of the distribution of these taxa. These searches will allow for a higher level of certainty as to whether or not these taxa may exist near any proposed areas of disturbance.

The records of *E. clementii* and *E. drummondii* ssp. Pilbara (B.G.Thomson 3503) are also significant at the state level. Clearing associated with the project may result in the loss of individuals of this species. However, it is also know that these species re establish well in disturbed areas.

7.4 Regional Significance

Regional significance addresses the representation of species and habitats at a biogeographic regional level.

The collection of *Erythrophleum chlorostachys* is considered to be of regional significance. Hence, further targeted flora searches within the proposed disturbance areas at Sunrise Hill and Nimingarra are required to establish a complete awareness of the distribution of this taxon.

Fauna species of regional significance (CALM Priority Species) which occurred within the Goldsworthy project area are listed below (details of these species are outlined in Section 5:

- Western Pebble-mound Mouse *Pseudomys chapmani*
- Lakeland Downs Short-tailed Mouse *Leggadina lakedownensis*
- Bush Stone-curlew *Burhinus grallarius*
- Star Finch *Neochmia ruficauda subclarescens*
- Pictorella Mannikin *Heteromunia pectoralis*
- Australian Bustard *Ardeotis australis*

Species that may potentially occur within the area and are considered regionally significant include:

- *Ramphotyphlops ganei*
- Unpatterned Robust Lerista *Lerista macropisthopus remota*
- Ghost Bat *Macroderma gigas*
- Long-tailed Dunnart *Sminthopsis longicaudata*
- Spectacled Hare-wallaby *Lagorchestes conspicillatus leichhardti*

In regional terms, the project area encompasses landforms and vegetation associations that are widespread throughout the north-east Pilbara including Hilltop habitat, Riverine areas, Gorge and Scree Slopes. These landforms and associations, characteristic of the north-east Pilbara, are represented within conservation areas in the Pilbara, such as Millstream – Chichester National Park. Moreover, there are significant areas of similar habitat in the surrounding country which are generally poorly developed and hence have not been greatly disturbed (*ecologia*, 1999).

Given the limited habitat diversity and the widespread occurrence of all landform units/vegetation associations, and the degraded appearance of portions of the project area, none of the features present are considered to be of regional significance. In addition, this area is not a target for broad expansion of mining from the resource industry, as compared with other areas of the Pilbara.

7.5 Local Significance

One of the major issues from a biodiversity perspective is whether individual species would be restricted to particular habitats of the project area. Species are of local significance when their presence is confined to a specialised habitat type that is not common within the local area, and whose disturbance or removal may lead to local extinction.

Areas of local ecological significance are defined as habitats, landforms, vegetation associations or locations which support or have the capacity to support species of local conservation significance, or which are in better condition than other locations. Based on these criteria there are few of these areas within the project area. Most of the habitat of the project area is well represented in the region.

However, along the south-western side and south-eastern end of the Sunrise Hill ridge, there are pockets of vegetation associated with accumulated water and shaded environments at the base of cliff/gorge systems. These areas support two main types of vegetation that are very restricted in local distribution that include *Melaleuca argentea/Eucalyptus victrix* forest, and sparse *Ficus brachypoda* dense forest to sparse trees, both types with *Atalaya hemiglauca*, *Ficus opposita* var. *indecora* trees, and the first of these with *Typha domingensis* rushes and/or *Cyperus vaginatus* sedges. These vegetation types were recorded from Flora Sites 41, 47, 65 and 71, and all fall outside the areas of proposed disturbance.

In addition to these sites, Nimingarra flora site 29 near the Egg Creek crossing with the haul road appears to have once had the *M. argentea /E. victrix* forest vegetation type, but has changed due to water abstraction from bores to a degraded version. Given the limited number of representatives of these vegetation types and restricted range, it is recommended that no disturbance occurs in these areas as they could be considered locally significant.

Riverine habitat and permanent water are areas of high ecological value, considering areas that contain permanent water are scarce. Riverine habitat supports a high avifaunal diversity including waterbirds and migratory species. These ecosystems are of considerable environmental significance and need to be carefully managed.

8.0 STUDY TEAM

The BHPBIO Goldsworthy Extension Assessment of Flora and Fauna described in this document was planned, coordinated and executed by:

ecologia Environment
76 Thomas Street
WEST PERTH
WA 6005

Project Staff

Dr. M. Ladyman	BSc. (Zool/Geog) PhD (Zool)	Project Manager
K. Rodda	BSc. (Hons) Zool/Bot	Senior Zoologist
M. Menz	BSc. (Zool/Mar. Sci.)	Zoologist / Ornithologist
C. Slee	BSc. (Hons.) Env. Mgmt.	Botanist
M. O'Connell	BSc. (Mar. Sci.)	Zoologist
G. Swann		Ornithologist
B. Morgan	BSc. (Bot)	Botanist
S. Ford	BSc. (Zool) Hons	Zoologist
A. Larcombe	BSc. (Env) (Hons) Zool.	Environmental Scientist
P. Cullen		Research Assistant
L. Dalgliesh	BSc. (Hons.) Zool.	Research Assistant
J. Oates	BSc (Zool/Bot) Hons (Zool)	Research Assistant
R. Schmidiger		Research Assistant
S. Perks		Research Assistant

Permits

Flora Surveys:

C. Slee, *ecologia* Environment Consultants.
"Licence for Scientific or Other Prescribed Purposes.", Licence N°. SL 006736
Valid from 28 January 2004 to 28 January 2005

B. Morgan, *ecologia* Environmental Consultants
"Licence for Scientific of Other Prescribed Purposes", Licence No. SL 006737
Valid from 1 February 2004 to 1 February 2005

Fauna Surveys:

M. H. M. Menz, *ecologia* Environment.
"Licence to take fauna for scientific purposes.", Licence N°. SF004719
Valid from 1st October 2004 to 31st March 2005.

M. Ladyman, *ecologia* Environment Consultants
"Licence to Take Fauna for Scientific Purposes" Licence No. SF 004431
Valid until the 31st March, 2004

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APPENDICES

Appendix A:

Combined Flora Species List Table for Nimingarra, Sunrise Hill, Yarrie, Cattle Gorge, Cattle Gorge Corridor and Cattle Gorge Haul Road

APPENDIX A: Combined Flora Species by Site Matrix for Nimingarra (Nim) , Sunrise Hill (S Hill), Yarrie, Cattle Gorge (CG), Cattle Gorge Corridor (CGC) and Cattle Gorge Haul Road (CGHR). Classification and nomenclature according to the Western Australian Herbarium and R.J. Hnatiuk (1990), Census of Australian Vascular Plants. Australian Government Publishing Service.
Key: * = introduced species, § = taxa that could not be fully identified due to a lack of material, ⚑ = Priority taxa.

Family	Species	Location					
		Nim.	S. Hill	Yarrie	CGC	CGC	CGHR
ADIANTACEAE							
	Cheilanthes brownii		X				
MARSILEACEAE							
	Marsilea hirsuta		X				
TYPHACEAE							
	Typha domingensis	X	X				
POTAMOGETONACEAE							
	Potamogeton sp.			X			
POACEAE							
	Amphipogon strictus		X				
	Aristida contorta	X	X				
	Aristida holathera			X			
	Aristida holathera var. *holathera*	X	X				
	Aristida inaequiglumis			X			
	Aristida latifolia		X				
	Brachyachne convergens					X	
	**Cenchrus ciliaris*		X	X			
	**Chloris gayana*			X			
	Chloris virgata		X				
	Chrysopogon fallax	X	X	X			
	Cymbopogon ambiguus	X	X	X	X		
	Cymbopogon ?ambiguus				X		
	Cymbopogon obtectus	X					
	**Cynodon dactylon*		X				
	Dactyloctenium radulans					X	
POACEAE (cont.)	*Dicanthium fecundum*			X			
	Digitaria brownii	X					

Family	Species	Location					
		Nim.	S. Hill	Yarrie	CGC	CGC	CGHR
	Enneapogon oblongus	X	X				
	Enneapogon polyphyllus			X			
	Eragrostis basedowii			X			
	Eragrostis cumingii		X				
	Eragrostis elongata		X				
	Eragrostis eriopoda			X			
	Eragrostis aff. *eriopoda*	X			X		
	Eragrostis elongata	X	X				
	Eragrostis lanipes			X			
	Eragrostis tenellula		X				
	Eriachne aristidea	X	X	X			
	Eriachne ciliata	X	X		X		
	Eriachne helmsii			X			
	Eriachne lanata	X	X		X		
	Eriachne meliacea			X			
	Eriachne mucronata			X			
	Eriachne mucronata (typical form)	X	X		X		
	Eriachne ?obtusa				X		
	Eriachne obtusa	X	X				
	Eriachne ovata			X			
	Eriachne pulchella		X				
	Eriachne pulchella subsp. *dominii*		X				
	Eriachne pulchella var. *pulchella*			X			
	Eriachne tenuiculmis		X				
	Eulalia aurea			X			
	Heteropogon contortus	X					
	**Lolium* sp.			X			
	Panicum laevinode					X	
	Paraneurachne muelleri			X			
	Paspalidium rarum		X	X			
	Paspalidium tabulatum (Whim Creek form)	X					
	Pennisetum basedowii			X			
POACEAE (cont.)	*Setaria surgens*	X					
	?Sporobolus australasicus					X	

Family	Species	Location					
		Nim.	S. Hill	Yarrie	CGC	CGC	CGHR
	Sporobolus australasicus	X	X	X			
	Themeda australis			X			
	Themeda triandra		X				
	Triodia basedowii			X			
	Triodia biflora	X	X				
	Triodia brizoides			X			
	Triodia epactia	X	X		X	X	
	Triodia lanigera		X				
	Triodia longiceps		X	X		X	
	Triodia pungens			X			
	Triodia schinzii	X					
	Triodia wiseana	X	X	X	X	X	
	Urochloa gilesii			X			
	Yakirra australiensis	X	X				
CYPERACEAE							
	Bulbostylis barbata	X	X			X	
	Cyperus aff. *cunninghamii*			X			
	Cyperus bifax			X			
	Cyperus blakeanus	X					
	Cyperus conicus	X					
	Cyperus cunninghamii subsp. *cunninghamii*		X		X		
	Cyperus dactylotes			X			
	Cyperus hesperius				X		
	Cyperus difformis? (det. Uncertain)		X				
	Cyperus squarrosa			X			
	Cyperus vaginatus	X	X	X		X	
	Eleocharis geniculata		X				
	Fimbristylis depauperata		X	X			
	Fimbristylis rara			X			
	Fimbristylis simulans	X	X		X	X	
	Fuirena ciliaris			X			
MORACEAE							
	Ficus brachypoda		X				
	Ficus opposita var. *indecora*		X	X			
	Ficus platypoda			X			

Family	Species	Location					
		Nim.	S. Hill	Yarrie	CGC	CGC	CGHR
	Ficus virens var. *sublanceolata*		X				
PROTEACEAE							
	Grevillea pyramidalis			X		X	
	Grevillea pyramidalis subsp. *leucadendron*	X					
	Grevillea pyramidalis subsp. *pyramidalis*	X	X		X		
	Grevillea sp.			X			
	Grevillea refracta subsp. *refracta*		X				
	Grevillea wickhamii	X	X	X		X	
	Grevillea wickhamii subsp. *aprica*	X	X		X		
	Hakea chordophylla	X	X	X	X		
	Hakea coriacea	X					
	Hakea lorea subsp. *lorea*		X		X		
	Hakea macrocarpa	X					
	Hakea suburea					X	
SANTALACEAE							
	Santalum lanceolatum	X					
LORANTHACEAE							
	Amyema ?bifurcata			X			
	Amyema benthamii			X			
	Amyema linophyllum subsp. *linophyllum*			X			
	Amyema miraculosum			X			
CHENOPODIACEAE							
	Dysphania plantaginella		X				
	Dysphania rhadinostachya subsp. *rhadinostachya*	X	X				
	Salsola tragus	X	X	X			
AMARANTHACEAE							
	**Aerva javanica*	X	X	X			
	Alternanthera nodiflora			X			
	Amaranthus pallidiflorus	X	X	X			

Family	Species	Location					
		Nim.	S. Hill	Yarrie	CGC	CGC	CGHR
	Gomphrena canescens					X	
	Gomphrena cunninghamii	X	X	X			
	Ptilotus arthrolasius	X					
	Ptilotus astrolasius			X			
	Ptilotus astrolasius var. *astrolasius*	X	X				
	Ptilotus auriculifolius			X			
	Ptilotus axillaris	X	X	X			
	Ptilotus calostachyus			X		X	
	Ptilotus calostachyus var. *calostachyus*	X	X				
	Ptilotus clementii		X				
	Ptilotus exaltatus	X					
	Ptilotus exaltatus var. *exaltatus*	X	X				
	Ptilotus fusiformis		X				
	Ptilotus fusiformis var. *fusiformis*	X					
	Ptilotus incanus var. *elongatus*	X	X				
	Ptilotus murrayi var. *murrayi*					X	
	Ptilotus obovatus			X			
	Ptilotus obovatus var. *obovatus*		X				
	Ptilotus polystachyus			X			
NYCTAGINACEAE							
	Boerhavia ?dominii			X			
	Boerhavia ?coccinea				X		
	Boerhavia coccinea			X			
	Boerhavia gardneri		X		X		
	Boerhavia schomburgkiana			X			
GYROSTEMONACEAE							
	Codonocarpus cotinifolius		X		X		
AIZOACEAE							
	Trianthema pilosa	X					
	Trianthema triquetra			X		X	
MOLLUGINACEAE							
	Mollugo molluginis	X	X	X	X	X	

Family	Species	Location					
		Nim.	S. Hill	Yarrie	CGC	CGC	CGHR
PORTULACACEAE							
	Calandrinia eremaea			X			
	Portulaca oleracea			X		X	
CARYOPHYLLACEAE							
	Polycarpaea holtzei	X	X				
	Spergularia sp.			X			
RANUNCULACEAE							
	Clematis ?sp.					X	
MENISPERMACEAE							
	Tinospora smilacina	X	X	X			
LAURACEAE							
	Cassytha aurea			X			
	Cassytha capillaris	X	X		X		
	Cassytha filiformis	X	X				
CAPPARACEAE							
	Capparis spinosa			X			
	Cleome tetrandra var. *tetrandra*			X			
	Cleome uncifera subsp. *uncifera*		X		X		
	Cleome viscosa	X	X	X	X	X	
SURIANACEAE							
	Stylobasium spathulatum			X			
BYBLIDACEAE							
	Byblis filifolia						
MIMOSACEAE							
	Acacia ?hilliana x *stellaticeps*(GLD(NIM)23.28)	X	X				

Family	Species	Location					
		Nim.	S. Hill	Yarrie	CGC	CGC	CGHR
	Acacia adoxa var. *adoxa*	X	X		X		
	Acacia aff. *ancistrocarpa*(GLD(NIM)17.2)	X	X				
	Acacia aff. *ancistrocarpa*(GLD(NIM)18.11)	X	X				
	Acacia aff. *pyrifolia*	X					
	Acacia ampliceps		X	X		X	
	Acacia ancistrocarpa	X	X	X	X		
	Acacia atkinsiana		X				
	Acacia ayersiana			X			
	Acacia bivenosa	X	X			X	
	Acacia citrinoviridis			X			
	Acacia colei var. *?colei*				X		
	Acacia colei var. *colei*	X	X			X	
	Acacia coriacea subsp. *sericophylla*	X	X				
	Acacia drepanocarpa subsp. ?Pilbara form	X	X				
	Acacia elachantha	X					
	Acacia eriopoda		X				
	**Acacia farnesiana*			X		X	
	Acacia ?hamersleyensis			X			
	Acacia hilliana	X	X				
	Acacia holosericea			X			
	Acacia inaequilatera	X	X	X	X	X	
	Acacia maitlandii		X				
	Acacia monticola			X			
	Acacia orthocarpa	X	X			X	
	Acacia ptychophylla		X	X	X	X	
	Acacia pyrifolia	X	X	X	X	X	
	Acacia rhodophloia			X			
	Acacia sp.Rudall River(B.R.Maslin 2046A)	X	X				
MIMOSACEAE (cont.)	*Acacia spondylophylla*		X		X		
	Acacia stellaticeps	X	X			X	
	Acacia trachycarpa	X	X	X		X	
	Acacia translucens			X			
	Acacia tumida subsp. *?pilbarensis*	X	X	X	X	X	
	Acacia tumida var. *pilbarensis*	X	X				
	Acacia victoriae			X		X	

Family	Species	Location					
		Nim.	S. Hill	Yarrie	CGC	CGC	CGHR
CAESALPINIACEAE							
	Dichrostachys spicata		X				
	Senna curvistyla	X	X				
	Erythrophleum chlorostachys	X					
	Petalostylis cassioides	X					
	Petalostylis labicheoides	X	X	X			
	Senna artemisioides subsp. *oligophylla*			X		X	
	Senna artemisioides subsp. aff. *oligophylla* (thinly sericeous)		X				
	Senna glutinosa subsp. *glutinosa*	X	X	X	X		
	Senna glutinosa subsp. *pruinosa*	X	X	X	X		
	Senna glutinosa subsp. *leurssenii*			X			
	Senna notabilis	X	X	X	X	X	
	Senna symonii					X	
	Senna venusta	X	X		X		
PAPILIONACEAE							
	Cajanus cinereus	X	X	X			
	Cajanus marmoratus	X					
	Cajanus sp.1			X			
	Cajanus sp. 2			X			
	Crotalaria cunninghamii			X			
	Crotalaria ramosissima	X					
	Crotalaria sp.			X			
	Cullen badocana			X			
	Cullen ?martinii			X			
PAPILIONACEAE (cont.)	*Cullen lachnostachys*			X			
	Cullen pustulata			X			
	Cullen stipulaceum	X	X		X	X	
	Genista canariensis	X					
	Glycine canescens			X			
	Indigastrum parviflorum					X	
	Indigofera ?georgei			X			
	Indigofera monophylla	X	X	X	X	X	

Family	Species	Location					
		Nim.	S. Hill	Yarrie	CGC	CGC	CGHR
	Indigofera monophylla (forma)		X		X		
	Indigofera monophylla (small calyx form)	X	X				
	Indigofera rugosa				X		
	Indigofera trita	X					
	Isotropis atropurpurea	X		X			
	Jacksonia aculeata	X					
	Leptosema anomalum	X					
	Lotus australis			X			
	Paratephrosia sp.			X			
	Rhynchosia minima		X	X			
	Rhynchosia minima var. *australe*					X	
	Sesbania cannabina		X	X			
	Sesbania formosa		X	X			
	Swainsona formosa	X					
	Swainsona sp. 1			X			
	Swainsona sp. 2			X			
	Templetonia hookeri	X	X	X		X	
	Tephrosia aff. *supina*		X			X	
	Tephrosia aff. *supina* (HD133-20)	X					
	Tephrosia aff. *uniovulata* (HD76)	X					
	Tephrosia rosea			X			
	Tephrosia rosea var. *clementii*	X	X		X		
	Tephrosia rosea var. *glabrior*	X					
	Tephrosia sp.Bungaroo Creek(M.E.Trudgen 11601)	X			X		
	Tephrosia spechtii	X	X		X		
PAPILIONACEAE (cont.)	*Tephrosia* sp.	X					
ZYGOPHYLLACEAE							
	Tribulus cistoides			X			
	Tribulus macrocarpus			X			
	Tribulus platypterus	X		X			
	Tribulus suberosus	X	X		X		
POLYGALACEAE							
	Polygala aff. *isingii*	X	X				

Family	Species	Location					
		Nim.	S. Hill	Yarrie	CGC	CGC	CGHR
	Polygala isingii		X				
EUPHORBIACEAE							
	Euphorbia aff. *wheeleri*(GLD(SRH)WP076)		X				
	Bridelia tomentosa			X			
	Euphorbia australis	X	X				
	Euphorbia australis subsp. *vaccaria*			X			
	Euphorbia biconvexa			X			
	Euphorbia clementii			X			
	Euphorbia coghlanii	X	X			X	
	Euphorbia drummondii			X			
	Euphorbia cf. *boophthona*				X		
	Euphorbia maconochieana			X			
	Euphorbia ?wheeleri				X		
	Euphorbia sp.	X					
	Euphorbia sp. (PAN5-15)	X					
	Euphorbia sp. (site 1089)		X				
	Flueggea virosa subsp. *melanthesoides*	X	X				
	Phyllanthus exilis		X				
	Phyllanthus maderaspatensis	X					
	Phyllanthus trachygyne			X			
	Securinega melanthesoides			X			
SAPINDACEAE							
	Atalaya hemiglauca	X	X	X	X	X	
	Dodonaea coriacea	X	X		X		
	Dodonaea pachyneura			X			
TILIACEAE							
	Corchorus sp.A Kimberley Flora(K.F.Kenneally & B.P.M.Hyland 10421)	X					
	Corchorus aff. *obtectus* ms				X		

Family	Species	Location					
		Nim.	S. Hill	Yarrie	CGC	CGC	CGHR
	Corchorus aff. *parviflorus* (1)		X				
	Corchorus aff. *parviflorus* (2)	X	X				
	Corchorus aff. *parviflorus*	X	X		X	X	
	Corchorus aff. *sidoides*				X		
	Corchorus aff. *tectus* ms				X		
	Corchorus laniflora			X			
	Corchorus cf. *tectus*					X	
	Corchorus sidoides aff. subsp. *vermicularis*		X			X	
	Corchorus sidoides aff. subsp. *vermicularis* (GLD(NIM)17.16)	X					
	Corchorus sidoides subsp. ?*sidoides*				X		
	§*Corchorus* sp.		X			X	
	Corchorus walcottii			X			
	Triumfetta chaetocarpa		X		X		
	Triumfetta clementii	X	X		X		
	Triumfetta johnstonii	X	X	X	X		
	Triumfetta maconochieana	X	X	X	X		
	Triumfetta plumigera	X	X		X		
	Triumfetta propinqua			X			
	Triumfetta ramosa			X			
MALVACEAE							
	Abutilon cunninghamii			X			
	Abutilon lepidum			X			
MALVACEAE (cont.)	*Abutilon malvifolium*					X	
	Abutilon otocarpum			X			
	Abutilon oxycarpum			X			
	Gossypium australe			X			
	Gossypium australe (Whim Creek form)	X	X				
	Hibiscus aff. *coatesii*				X		
	Hibiscus sp. aff. *leptocladus*				X		
	Hibiscus sp. aff. *leptocladus*(GLD(NIM)20.8)						
	Hibiscus burtonii				X		
	Hibiscus coatesii	X					
	Hibiscus goldsworthii			X			

Family	Species	Location					
		Nim.	S. Hill	Yarrie	CGC	CGC	CGHR
	Hibiscus leptocladus	X		X			
	Hibiscus panduriformis			X			
	Hibiscus sturtii aff. var. campylo*chlamys*		X				
	Hibiscus sturtii aff. var. campylo*chlamys*(MET15,957)	X					
	Hibiscus sturtii aff. var. *platychlamys*		X		X		
	**Malvastrum americanum*					X	
	Sida ?cardiophylla (juvenile)	X	X				
	Sida aff. *cardiophylla*					X	
	Sida aff. *cardiophylla* (site 1086)	X	X				
	Sida aff. *fibulifera*					X	
	Sida aff. *fibulifera(B181-5B)*						
	Sida arenicola	X	X		X		
	Sida cardiophylla	X			X	X	
	Sida aff. *cardiophylla*				X		
	Sida clementii					X	
	Sida corrugata			X			
	Sida rohlenae			X			
	Sida rohlenae subsp. *rohlenae*	X	X				
	Sida sp.			X	X		
	Sida sp.A Kimberley Flora(P.A.Fryxell & L.A.Craven 3900)	X	X		X		
MALVACEAE (cont.)	*Sida virgata*			X			
STERCULIACEAE							
	Melhania oblongifolia			X			
	Waltheria indica	X	X				
ELATINACEAE							
	Bergia ammannioides			X			
	Bergia pedicellaris		X				
VIOLACEAE							
	Hybanthus aurantiacus	X	X	X		X	

Family	Species	Location					
		Nim.	S. Hill	Yarrie	CGC	CGC	CGHR
LYTHRACEAE							
	Ammannia baccifera		X				
	Ammannia multiflora		X	X			
COMBRETACEAE							
	Terminalia canescens	X		X			
MYRTACEAE							
	Calytrix carinata	X					
	Corymbia deserticola	X					
	Corymbia flavescens	X	X		X	X	
	Corymbia ?hamersleyana				X		
	Corymbia hamersleyana	X	X	X			
	Corymbia lenziana			X			
	Cormybia sp.(SRH 71.8)		X				
	Corymbia zygophylla	X					
	Eucalyptus camaldulensis var. *obtusa*			X			
	Eucalyptus candida ms			X			
	Eucalyptus leucophloia	X	X	X			
	Eucalyptus leucophloia subsp. *leucophloia*	X	X		X		
	Eucalyptus odontocarpa		X	X			
	Eucalyptus sp.			X			
MYRTACEAE (Cont.)	*Eucalyptus victrix*	X	X	X	X		
	Melaleuca argentea	X	X				
	Melaleuca glomerata	X	X	X			
	Melaleuca lasiandra			X			
	Melaleuca leucadendra			X			
APIACEAE							
	Trachymene oleracea	X	X	X			
OLEACEAE							
	Jasminum didymum			X			
	Jasminum didymum subsp. *lineare*	X	X				
GENTIANACEAE							

Family	Species	Location					
		Nim.	S. Hill	Yarrie	CGC	CGC	CGHR
	Centaurium minus		X				
APOCYNACEAE							
	Carissa lanceolata	X	X	X			
	Nerium oleander		X				
ASCLEPIADACEAE							
	Cynanchum floribundum		X				
CONVOLVULACEAE							
	Bonamia linearis	X			X	X	
	Bonamia aff. *media*				X	X	
	Bonamia media var. *villosa*	X	X		X	X	
	Bonamia pannosa	X	X	X		X	
	Bonamia rosea	X		X			
	Bonamia sp.			X			
	Bonamia sp. (HD94-6)		X				
	Evolvulus alsinoides			X			
	Evolvulus alsinoides var. *decumbens*	X					
	Evolvulus alsinoides var. *villosicalyx*	X	X				
	Ipomoea muelleri	X	X	X			
	Ipomoea polymorpha					X	
	Merremia dissecta		X				
	Operculina aequisepala					X	
	Polymeria sp. (Site 1365)		X				
	Polymeria aff. *ambigua*					X	
	Polymeria ambigua			X			
	Polymeria calycina					X	
BORAGINACEAE							
	Heliotropium chrysocarpum	X					
	Heliotropium cunninghamii	X		X			
	Heliotropium tenuifolium	X					
	Heliotropium vestitum	X					

Family	Species	Location					
		Nim.	S. Hill	Yarrie	CGC	CGC	CGHR
	Trichodesma zeylanicum			X			
	Trichodesma zeylanicum var. *zeylanicum*	X	X				
VERBENACEAE							
	Clerodendrum floribundum			X			
	Clerodendrum floribundum var. *angustifolium*		X				
	Clerodendrum tomentosum var. *lanceolatum*	X	X				
SOLANACEAE							
	Nicotiana benthamiana	X	X				
	Solanum beaugleholei				X		
	Solanum cleistogamum	X	X				
	Solanum cunninghamii	X					
	Solanum dioicum	X	X		X		
	Solanum diversiflorum	X		X	X	X	
	Solanum horridum	X	X				
	Solanum horridum/ferocissimum			X			
	Solanum lasiophyllum		X	X		X	
	Solanum phlomoides			X	X		
SOLANACEAE (Cont.)	§*Solanum* sp.				X		
	Solanum terraneum			X			
SCROPHULARIACEAE							
	Stemodia grossa	X	X	X		X	
	Stemodia sp.			X			
	Stemodia sp. Shay Gap(GLD(SRH)55.19)						
	Stemodia viscosa			X			
	Striga curviflora			X			
BIGNONIACEAE							
	Dolichandrone heterophylla			X			
ACANTHACEAE							
	Rostellularia adscendens			X			

Family	Species	Location					
		Nim.	S. Hill	Yarrie	CGC	CGC	CGHR
RUBIACEAE							
	Oldenlandia ?crouchiana					X	
	Oldenlandia crouchiana	X	X	X			
	Oldenlandia galioides	X	X				
CUCURBITACEAE							
	Mukia maderaspatana	X	X	X			
	Trichosanthes cucumerina var. *cucumerina*		X				
CAMPANULACEAE							
	Wahlenbergia tumidifructa		X	X			
LOBELIACEAE							
	Lobelia quadrangularis			X			
GOODENIACEAE							
	Dampiera candicans	X	X	X	X	X	
	Dampiera canescens			X			
	Dampiera cinerea			X			
	Goodenia grandiflora			X			
	Goodenia lamprosperma		X	X			
	Goodenia microptera	X	X				
	Goodenia sp.			X			
	Goodenia stobbsiana	X	X	X	X	X	
	Goodenia vilmoriniae			X			
	Scaevola ?cunninghamii			X			
	Scaevola amblyanthera var. *centralis*		X				
ASTERACEAE							
	Blumea tenella		X				
	Centipeda cunninghamii			X			
	Centipeda minima subsp. macrocephala		X				
	Flaveria australasica		X	X			
	Olearia stuartii		X				

Family	Species	Location					
		Nim.	S. Hill	Yarrie	CGC	CGC	CGHR
	Pluchea dentex			X			
	Pluchea rubelliflora		X	X			
	Pluchea sp.			X			
	Pluchea tetranthera	X	X	X	X	X	
	Pterocaulon serrulatum	X	X				
	Pterocaulon sp.			X			
	Pterocaulon sphaeranthoides	X	X	X			
	Rhodanthe margarethae		X				
	**Sonchus oleraceus*		X				
	Streptoglossa decurrens	X	X				

Appendix B:

Flora and Vegetation Site Descriptions

Appendix B1:
Flora and Vegetation Site Descriptions
For Cattle Gorge

Explanation of codes:
* = Introduced species
† = Priority species
subsp. = sub species
var. = variety

VEGETATION CONDITION

Pristine	Vegetation pristine; no disturbance evident at all.
Excellent	Strata essentially intact: some signs of human non native disturbance; e.g. feral scats, litter, minor tracks.
Good	One or more strata significantly impacted; e.g. grazing, some weeds, some vegetation removal.
Poor	One or more strata severely impacted; e.g. dense weed invasion, substantial clearing or tracks.
Degraded	native vegetation largely or totally removed.

DENSITY (Vegetation, leaf litter, woodlitter)

Scattered	0-2% total cover
Sparse	2-10%
Open	10-30%
Moderately dense	30-70%
Dense	70-100%

FIRE HISTORY

Recent	0-2 years (completely devoid of vegetation or vegetation re-seeding/re-shooting. Eucalypts and shrubs may have juvenile foliage from rootstock and/or branches. Shrubs, spinifex, herbs and grasses may evident as seedlings)
Moderate	2-5 years (burn scars on shrubs and trees still obvious, shrubs and spinifex may not be fully mature but species composition resembles original vegetation)
Old	5 years + (Vegetation mature but burn scars evident on trees, no evidence of fire damage on shrubs, grasses, herbs and spinifex)
None evident	No burn scars evident. Vegetation mature.

Site 1: **Sparse *Grevillea wickhamii* / *Acacia tumida* / *Grevillea pyramidalis* tall to medium shrubland over *Tephrosia spechtii* and other shrubs over moderately dense *Triodia epactia* hummock grassland.**

Date:	04/02/2004
Location:	UTM 51K 0212766 mE, 7726051 mN (+/- 4m)
Topography:	hill crest
Slope:	negligible
Soil texture:	clay loam
Soil colour:	red-orange
Surface layer:	stones/boulders
Rock type:	ferrous
Leaf litter:	negligible
Distribution:	widespread
Wood litter:	negligible
Vegetation condition:	good
Disturbance details:	some tracks
Fire History	moderate

Vegetation Cover

Shrubs >2m	2-10%	*Grevillea wickhamii, Grevillea pyramidalis*
Shrubs 1-2m	2-10%	*Tephrosia spechtii, Acacia tumida, Acacia pyrifolia, Triumfetta* aff. *chaetocarpa*
Shrubs 0.5-1m	<2%	*Ptilotus calostachyus, Triumfetta johnsonii*
Shrubs 0-0.5m	<2%	*Senna notabilis, Dampiera candicans, Acacia ptychophylla, Acacia spondylophylla, Tephrosia* sp. Bungaroo Creek, *Solanum dioicum, Bonamia media* var. *villosa, Corchorus* aff. *tectus* ms, *Corchorus* aff. *parviflorus*
Herbs	<2%	*Goodenia stobbsiana*
Soft Grasses	<2%	*Eriachne lanata*
Hummock (Spinifex)	30-70%	*Triodia epactia*

Site 2: **Scattered *Corymbia hamersleyana* and *Eucalyptus leucophloia* medium to low trees, over moderately dense *Acacia tumida / Grevillea wickhamii* medium shrubland, over moderately dense *Triodia epactia* hummock grassland.**

Date:	04/02/2004
Location:	UTM 51K 0212711 mE, 772609 mN (+/- 5m)
Topography:	gully sides/base
Slope:	moderate
Soil texture:	clay loam
Soil colour:	brown
Surface layer:	stones/boulders
Rock type:	laterite
Leaf litter:	sparse
Distribution:	mainly under shrubs
Wood litter:	sparse
Vegetation condition:	pristine
Fire History	moderate

Vegetation Cover

Trees 5-15m	<2%	*Eucalyptus leucophloia, Corymbia hamersleyana*
Trees <5 m	<2%	*Corymbia ?hamersleyana, Eucalyptus leucophloia* subsp. *leucophloia*
Shrubs 1-2 m	30-70%	*Acacia tumida, Tephrosia spechtii, Sida* sp. A (Kimberley Flora), *Sida arenicola, Hibiscus sturtii* aff. var. *platychlamys, Grevillea wickhamii* subsp. *aprica, Corchorus* aff. *tectus* ms
Shrubs 0-0.5 m	<2%	*Indigofera monophylla, Acacia ptychophylla, Triumfetta maconochieana, Triumfetta johnsonii, Solanum dioicum*
Sedges	<2%	*Cyperus cunninghamii* subsp. *cunninghamii*
Soft Grasses	<2%	*Eriachne mucronata, Cymbopogon ambiguus*
Hummock (spinifex)	30-70%	*Triodia epactia, Triodia wiseana*

Site 3: **Sparse *Grevillea wickhamii* tall shrubs, over moderately dense *Acacia ptychophylla* medium shrubland and sparse herbs, over moderately dense *Triodia epactia* hummock grassland.**

Date:	04/02/2004
Location:	UTM 51K 0212915 mE , 7726610 mN (+/- 4m)
Topography:	hill crest
Slope:	gentle
Soil texture:	loam
Soil colour:	red-orange
Surface layer:	surface crust, stones/boulders
Rock type:	ferrous
Leaf litter:	negligible
Distribution:	widespread
Wood litter:	negligible
Vegetation condition:	pristine
Fire History	moderate

Vegetation Cover

Trees <5 m	<2%	*Codonocarpus cotinifolius*
Shrubs >2m	2-10%	*Grevillea wickhamii*
Shrubs 1-2 m	30-70%	*Acacia ptychophylla, Grevillea pyramidalis, Acacia tumida*
Shrubs 0.5-1 m	30-70%	*Triodia epactia, Ptilotus calostachyus, Solanum dioicum, Triumfetta* aff. *chaetocarpa, Solanum phlomoides*
Shrubs 0-0.5m	30-70%	*Acacia ptychophylla, Acacia spondylophylla, Dampiera candicans, Solanum dioicum, Senna notabilis, Tephrosia* sp. Bungaroo Creek, *Sida* aff. *cardiophylla, Corchorus* aff. *tectus* ms
Hummock (spinifex)	30-70%	*Triodia epactia, Triodia wiseana*

Site 4: **Scattered *Senna glutinosa* subsp. *glutinosa* low shrubs, over scattered *Acacia ptychophylla* and other dwarf shrubs, over moderately dense *Triodia wiseana* hummock grassland.**

Date:	04/02/2004
Location:	UTM 51K 0212497 mE, 7726625 mN (+/- 5)
Topography:	scarp
Slope:	steep
Soil texture:	clay loam
Soil colour:	brown
Surface layer:	stones/boulders
Rock type:	laterite
Leaf litter:	negligible
Distribution:	mainly under shrubs
Wood litter:	negligible
Vegetation condition:	pristine
Fire History	moderate

Vegetation Cover

Shrubs 0.5-1 m	<2%	*Senna glutinosa* subsp. *glutinosa, Grevillea wickhamii* subsp. *wickhamii*
Shrubs 0-0.5 m	<2%	*Acacia ptychophylla, Indigofera monophylla, Triumfetta johnsonii, Senna notabilis, Solanum phlomoides, Solanum dioicum, Bonamia media* var. *villosa*
Herbs	<2%	*Dampiera candicans*
Hummock (spinifex)	30-70%	*Triodia wiseana*

Site 5: **Scattered *Corymbia hamersleyana* low trees, over scattered *Grevillea pyramidalis* and *Acacia inaequilatera* medium shrubs, over open to moderately dense *Triodia wiseana* hummock grassland.**

Date:	04/02/2004
Location:	UTM 51K 0212693 mE, 7726864 mN (+/- 5m)
Topography:	Colluvial spur separated by minor gullies
Slope:	gentle
Soil texture:	clay loam
Soil colour:	red-orange
Surface layer:	coarse gravel/pebbles, stones/boulders
Rock type:	ferrous
Leaf litter:	negligible
Distribution:	widespread
Wood litter:	negligible
Vegetation condition:	pristine
Fire History	moderate

Vegetation Cover

Trees <5 m	<2%	*Corymbia hamersleyana*
Shrubs >2 m	<2%	*Acacia inaequilatera, Grevillea pyramidalis* subsp. *pyramidalis*
Shrubs 1-2 m	<2%	*Tephrosia spechtii, Senna glutinosa*
Shrubs 0.5-1 m	<2%	*Corchorus* aff. *tectus* ms
Shrubs 0-0.5 m	<2%	*Ptilotus calostachyus, senna notabilis, Acacia ptychophylla, Indigofera rugosa, Tephrosia* sp. Bungaroo Creek
Hummock (spinifex)	30-70%	*Triodia wiseana*

Site 6: **Open *Grevillea wickhamii/Acacia tumida* medium shrubland, over *Acacia ptychophylla* and *Corchorus* aff. *obtectus* ms low to dwarf shrubs, over *Triodia epactia* hummock grassland and *Eriachne pulchella* soft tussock grasses..**

Date:	04/02/2004
Location:	UTM 51K 0213517 mE, 7725911 mN (+/- 4m)
Topography:	hill crest
Slope:	gentle
Soil texture:	clay
Soil colour:	red-orange
Surface layer:	stones/boulders
Rock type:	ironstone/shale
Leaf litter:	sparse
Distribution:	mainly under shrubs
Wood litter:	sparse
Vegetation condition:	pristine
Fire History	moderate

Vegetation Cover

Shrubs >2m	<2%	*Grevillea wickhamii*
Shrubs 1-2 m	2-10%	*Grevillea wickhamii, Acacia tumida, Sida* sp. A (Kimberley Flora), *Tephrosia spechtii, Triumfetta* aff. *chaetocarpa, Senna glutinosa* subsp. *glutinosa*
Shrubs 0.5-1 m	<2%	*Acacia ptychophylla*
Shrubs 0-0.5 m	<2%	*Corchorus* aff. *obtectus* ms, *Acacia spondylophylla, Triumfetta plumigera, Solanum dioicum*
Herbs	<2%	*Dampiera candicans*
Soft grasses	T <10%	*Eriachne pulchella, Eriachne mucronata*
Hummock (spinifex)	10-30%	*Triodia epactia*

Site 7: **Scattered *Corymbia hamersleyana* low trees, over open *Grevillea wickhamii / Acacia tumida* var. *pilbarensis* tall shrubland, over open *Acacia ptychophylla / Acacia spondylophylla* dwarf shrubs, over moderately dense *Triodia epactia* hummock grassland.**

Date:	04/02/2004
Location:	UTM 51K 0213393 mE, 7725681 mN (+/- 4m)
Topography:	hill slope
Slope:	moderate
Soil texture:	clay loam
Soil colour:	red-orange
Surface layer:	Stones/boulders
Rock type:	ferrous
Leaf litter:	negligible
Distribution:	widespread
Wood litter:	sparse
Vegetation condition:	pristine
Fire History	moderate

Vegetation Cover

Trees <5 m	<2%	*Corymbia hamersleyana*
Shrubs >2 m	10-30%	*Grevillea wickhamii, Acacia tumida* var. *pilbarensis*
Shrubs 1-2 m	<2%	*Senna glutinosa* subsp. *glutinosa, Sida* sp. A (Kimberley Flora)
Shrubs 0.5-1 m	<2%	*Tephrosia spechtii*
Shrubs 0-0.5 m	10-30%	*Acacia ptychophylla, Acacia spondylophylla, Solanum dioicum, Grevillea pyramidalis, Triumfetta johnsonii, Triumfetta* aff. *chaetocarpa, Bonamia media* var. *villosa*
Herbs	<2%	*Euphorbia ?wheeleri, Goodenia stobbsiana*
Soft Grasses	<2%	*Eriachne ciliata, Cymbopogon ambiguus*
Hummock (spinifex)	30-70%	*Triodia epactia*

Site 8: **Scattered *Grevillea pyramidalis* / *Acacia pyrifolia* tall shrubs, over sparse *Grevillea wickhamii* / *Acacia tumida* var. *pilbarensis* medium to low shrubland, over other scattered mixed shrubs, over open to dense *Triodia wiseana* hummock grassland.**

Date:	05/02/2004
Location:	UTM 51K 0212377 mE, 7725019 mN (+/- 4m)
Topography:	scarp
Slope:	steep
Soil texture:	clay loam
Soil colour:	red-orange
Surface layer:	stones/boulders
Rock type:	ironstone
Leaf litter:	negligible
Distribution:	mainly under shrubs
Wood litter:	negligible
Vegetation condition:	pristine
Fire History	moderate

Vegetation Cover

Shrubs >2 m	<2%	*Grevillea pyramidalis, Acacia pyrifolia*
Shrubs 1-2 m	2-10%	*Tephrosia spechtii, Grevillea wickhamii, Acacia pyrifolia, Sida* sp. A (Kimberley Flora),
Shrubs 0.5-1 m	<2%	*Corchorus* aff. *obtectus* ms, *Acacia tumida, Senna glutinosa* subsp. *glutinosa, Triumfetta maconochieana, Ptilotus calostachyus, Hibiscus* aff. *coatesii*
Shrubs 0-0.5 m	<2%	*Solanum dioicum, Triumfetta maconochieana, Dampiera candicans, Senna notabilis, Sida* aff. *cardiophylla, Cullen stipulaceum, Solanum diversiflorum*
Herbs	<2%	*Bonamia media* var. *villosa*
Hummock (spinifex)	10-30%	*Triodia wiseana*

Site 9: **Scattered *Corymbia hamersleyana* low trees, over sparse *Grevillea wickhamii / Grevillea pyramidalis* tall shrubs, over sparse *Acacia ptychophylla* and other *Acacia* spp. medium to dwarf shrubs, over moderately dense *Triodia wiseana* hummock grassland.**

Date:	05/02/2004
Location:	UTM 51K 0212483 mE, 7724655 mN (+/- 4m)
Topography:	hill slope
Slope:	gentle
Soil texture:	loam
Soil colour:	red-orange
Surface layer:	stones/boulders
Rock type:	ferrous
Leaf litter:	negligible
Distribution:	mainly under shrubs
Wood litter:	negligible
Vegetation condition:	excellent
Disturbance Details:	some earthwork adjacent to road
Fire History	moderate

Vegetation Cover

Trees 5-15 m	<2%	*Corymbia hamersleyana*
Shrubs >2 m	2-10%	*Grevillea wickhamii, Grevillea pyramidalis*
Shrubs 1-2 m	<2%	*Acacia ?colei, Acacia adoxa* var. *adoxa*
Shrubs 0.5-1 m	<2%	*Tephrosia spechtii, Solanum phlomoides, Euphorbia* cf. *boophthona*
Shrubs 0-0.5 m	2-10%	*Acacia ptychophylla, Senna notabilis, Solanum dioicum, Corchorus* aff. *tectus* ms
Herbs	N	*Mollugo molluginis, Goodenia stobbsiana, Cleome uncifera* subsp. *uncifera, Boerhavia gardneri, Bonamia* aff. *media, Bonamia media* var. *villosa*
Sedges	N	*Fimbristylis simulans*
Soft Grasses	<2%	*Eriachne obtusa*
Hummock (spinifex)	30-70%	*Triodia wiseana*

Site 10: **Moderately dense *Acacia tumida* var. *pilbarensis* tall shrubland, over sparse *Grevillea pyramidalis* and *Tephrosia spechtii* medium shrubs, over open *Triumfetta maconochieana* and other dwarf shrubs, over open *Triodia wiseana / T. epactia* hummock grassland.**

Date:	05/02/2004
Location:	UTM 51K 0212403 mE, 7725043 mN (+/- 4m)
Topography:	rocky outcrop
Slope:	steep
Soil texture:	clay loam
Soil colour:	brown
Surface layer:	stones/boulders
Rock type:	ironstone
Leaf litter:	moderate
Distribution:	widespread
Wood litter:	moderate
Vegetation condition:	pristine
Fire History:	moderate

Vegetation Cover

Shrubs >2 m	30-70%	*Acacia tumida*
Shrubs 1-2 m	2-10%	*Tephrosia spechtii, Senna glutinosa* subsp. *glutinosa, Grevillea pyramidalis, Tribulus suberosus, Sida* sp. A (Kimberley Flora), *Atalaya hemiglauca*
Shrubs 0.5-1 m	<2%	*Indigofera monophylla, Solanum beaugleholei, Triumfetta johnsonii, Tribulus suberosus, Boerhavia ?coccinea*
Shrubs 0-0.5 m	10-30%	*Triumfetta maconochieana, Corchorus* aff. *obtectus* ms, *Corchorus* aff. *parviflorus, Cleome viscosa*
Sedges	<2%	*Cyperus cunninghamii* subsp. *cunninghamii*
Soft Grasses	<2%	*Eriachne mucronata, Cymbopogon ambiguus*
Hummock (spinifex)	10-30%	*Triodia epactia, Triodia wiseana*

Site 11: **Open to sparse *Grevillea wickhamii / Acacia tumida* var. *pilbarensis* tall shrubland, over sparse *Tephrosia spechtii* and other medium to low shrubs, over moderately dense *Triodia epactia* hummock grassland.**

Date:	05/02/2004
Location:	UTM 51K 0212734 mE, 7724919 mN (+/- 4m)
Topography:	hill slope
Slope:	moderate
Soil texture:	loam
Soil colour:	red-orange
Surface layer:	surface crust, stones/boulders
Rock type:	ferrous
Leaf litter:	negligible
Distribution:	mainly under shrubs
Wood litter:	negligible
Vegetation condition:	excellent
Disturbance Details:	some earthworks adjacent to track, track goes through plot
Fire History:	very recent – moderate. Part of plot burnt.

Vegetation Cover

Shrubs >2 m	10-30%	*Grevillea wickhamii, Acacia tumida*
Shrubs 1-2 m	2-10%	*Tephrosia spechtii*
Shrubs 0.5-1 m	<2%	*Tephrosia spechtii*
Shrubs 0-0.5 m	<2%	*Triumfetta johnsonii, Solanum dioicum, Solanum diversifolium*
Herbs	<2%	*Goodenia stobbsiana, Bonamia media* var. *villosa*
Hummock (spinifex)	30-70%	*Triodia epactia*

Site 12: **Scattered *Corymbia hamersleyana* low trees, over scattered *Hakea lorea* subsp. *lorea* / *Acacia inaequilatera* tall shrubs, over sparse *Acacia ptychophylla* and other medium to low shrubs, over moderately dense *Triodia wiseana* / *Triodia epactia* hummock grassland.**

Date:	05/02/2004
Location:	UTM 51K 0212747 mE, 7724736 mN (+/- 3m)
Topography:	undulating plain
Slope:	gentle
Soil texture:	sandy clay, clay loam
Soil colour:	brown
Surface layer:	stones/boulders
Rock type:	ironstone
Leaf litter:	negligible
Distribution:	mainly under shrubs
Wood litter:	negligible
Vegetation condition:	excellent
Disturbance Details:	
Fire History:	moderate

Vegetation Cover

Trees < 5 m	<2%	*Corymbia hamersleyana*
Shrubs >2 m	<2%	*Hakea lorea* subsp. *lorea, Acacia inaequilatera*
Shrubs 1-2 m	<2%	*Grevillea wickhamii, Grevillea pyramidalis* subsp. *pyramidalis, Acacia tumida, Corchorus* aff. *tectus* ms, *Tephrosia spechtii, Hakea lorea* subsp. *lorea*
Shrubs 0.5-1 m	2-10%	*Acacia ptychophylla, Corchorus* aff. *tectus* ms, *Ptilotus calostachyus, Senna notabilis*
Shrubs 0-0.5 m	<2%	*Corchorus* aff. *parviflorus, Triumfetta johnsonii, Solanum dioicum*
Climbers	<2%	*Cassytha capillaris*
Herbs	<2%	*Mollugo molluginis, Dampiera candicans, Goodenia stobbsiana*
Hummock (spinifex)	30-70%	*Triodia wiseana, Triodia epactia*

Site 13: **Open *Grevillea wickhamii / Acacia tumida* var. *pilbarensis* tall shrubland, over sparse *Tephrosia spechtii* and other shrubs, over *Goodenia stobbsiana* herbs, over moderately dense *Triodia epactia* hummock grassland.**

Date:	05/02/2004
Location:	UTM 51K 0212831 mE, 7724922 mN (+/- 4m)
Topography:	hill slope (mid to lower slope)
Slope:	gentle
Soil texture:	sandy loam
Soil colour:	red-orange
Surface layer:	surface crust, coarse gravel/pebbles, stones/boulders
Rock type:	ferrous
Leaf litter:	sparse
Distribution:	mainly under shrubs
Wood litter:	sparse
Vegetation condition:	pristine
Fire History:	moderate

Vegetation Cover

Shrubs >2 m	10-30%	*Grevillea wickhamii, Acacia tumida*
Shrubs 1-2 m	2-10%	*Tephrosia spechtii*
Shrubs 0.5-1 m	<2%	*Triumfetta johnsonii, Solanum dioicum*
Shrubs 0-0.5 m	<2%	*Corchorus* aff. *tectus* ms, *Solanum dioicum*
Herbs	<2%	*Goodenia stobbsiana, Dampiera candicans, Ptilotus calostachyus*
Soft Grasses	<2%	*Eriachne mucronata, Eriachne lanata*
Hummock (spinifex)	30-70%	*Triodia epactia*

Site 14: **Scattered *Grevillea wickhamii* / *Acacia pyrifolia* tall shrubland, over scattered *Tephrosia spechtii* / *Acacia tumida* var. *pilbarensis* medium shrubs, over moderately dense *Triodia epactia* hummock grassland.**

Date: 05/02/2004
Location: UTM 51K 0212480 mE, 7725029 mN (+/- 4m)
Topography: hill crest
Slope: gentle
Soil texture: clay loam
Soil colour: brown
Surface layer: stones/boulders
Rock type: ironstone
Leaf litter: negligible
Distribution: mainly under shrubs
Wood litter: sparse
Vegetation condition: pristine
Fire History: moderate

Vegetation Cover

Shrubs >2 m	2-10%	*Grevillea wickhamii, Acacia pyrifolia*
Shrubs 1-2 m	<2%	*Tephrosia spechtii, Acacia tumida*
Shrubs 0-0.5 m	<2%	*Goodenia stobbsiana., Solanum dioicum, Triumfetta johnsonii,Senna notabilis, Acacia ptychophylla*
Herbs	<2%	*Dampiera candicans, Bonamia media* var.*villosa*
Soft Grasses	T	*Eriachne lanata*
Hummock (spinifex)	30-70%	*Triodia epactia*

Site 15: **Scattered *Corymbia hamersleyana* low trees, over scattered *Acacia inaequilatera/ Acacia tumida / Grevillea wickhamii* tall shrubland, over sparse *Acacia ptychophylla* dwarf shrubs, over moderately dense *Triodia epactia* hummock grassland.**

Date:	05/02/2004
Location:	UTM 51K 0212869 mE, 7724748 mN (+/- 4m)
Topography:	undulating plain, hill slope (lower slopes on edge of plain)
Slope:	gentle
Soil texture:	loam
Soil colour:	red-orange
Surface layer:	coarse gravel/pebbles, stones/boulders
Rock type:	ferrous
Leaf litter:	negligible
Distribution:	mainly under shrubs
Wood litter:	negligible
Vegetation condition:	pristine
Fire History:	moderate

Vegetation Cover

Trees < 5 m	<2%	*Corymbia hamersleyana*
Shrubs >2 m	<2%	*Acacia inaequilatera, Acacia tumida, Grevillea wickhamii*
Shrubs 1-2 m	<2%	*Acacia ?colei, Senna glutinosa* subsp. *glutinosa*
Shrubs 0.5-1 m	<2%	*Solanum dioicum, Hibiscus* aff. *coatesii, Sida arenicola, Hibiscus* sp. aff. *leptocladus*
Shrubs 0-0.5 m	2-10%	*Acacia ptychophylla, Senna notabilis, Tephrosia spechtii, Acacia pyrifolia, Solanum diversiflorum, Triumfetta johnsonii, Sida cardiophylla, Bonamia linearis, Pluchea tetranthera, Corchorus* aff. *sidoides*
Soft Grasses		*Eragrostis* aff. *eriopoda*
Herbs	<2%	*Ptilotus calostachyus, Mollugo molluginis, Dampiera candicans*
Hummock (spinifex)	30-70%	*Triodia epactia, Triodia wiseana*

Site 16: **Scattered *Corymbia hamersleyana* medium to low trees, over sprase *Grevillea wickhamii* and *Acacia tumida* medium to low shrubland, over sparse *Ptilotus calostachyus* and *Acacia ptychophylla* low to dwarf shrubs, over moderately dense *Triodia epactia / Triodia wiseana* hummock grassland..**

Date:	06/02/2004
Location:	UTM 51K 0212361 mE, 7725896 mN (+/- 4m)
Topography:	gully sides
Slope:	moderate
Soil texture:	loam
Soil colour:	red-orange
Surface layer:	stones/boulders
Rock type:	laterite/ironstone
Leaf litter:	plentiful
Distribution:	mainly under shrubs
Wood litter:	plentiful
Vegetation condition:	pristine
Fire History:	moderate

Vegetation Cover

Trees 5-15 m	<2%	*Corymbia hamersleyana*
Trees <5 m	<2%	*Corymbia hamersleyana*
Shrubs >2 m	2-10%	*Grevillea wickhamii*
Shrubs 1-2 m	<2%	*Acacia tumida, Sida* sp. A (Kimberley Flora), *Acacia pyrifolia*
Shrubs 0.5-1 m	<2%	*Ptilotus calostachyus, Solanum beaugleholei, Solanum dioicum, Sida cardiophylla, Dampiera candicans, Tephrosia spechtii, Triumfetta johnsonii, Corchorus* aff. *tectus* ms
Shrubs 0-0.5 m	2-10%	*Acacia ptychophylla*
Herbs	<2%	*Goodenia stobbsiana, Dampiera candicans*
Hummock (spinifex)	30-70%	*Triodia epactia., Triodia wiseana*

Site 17: **Scattered *Corymbia hamersleyana* low trees, over *Acacia tumida* var. *pilbarensis / Grevillea wickhamii* tall shrubland, over *Tephrosia spechtii* medium shrubs, over moderately dense *Triodia epactia* hummock grassland.**

Date:	06/02/2004
Location:	UTM 51K 0212398 mE, 7725901 mN (+/- 4m)
Topography:	creek bed
Slope:	gentle
Soil texture:	loam
Soil colour:	red-orange
Surface layer:	fine gravel, coarse gravel/pebbles, stones/boulders
Rock type:	ferrous
Leaf litter:	moderate
Distribution:	widespread
Wood litter:	moderate
Vegetation condition:	good
Disturbance Details:	considerable earthworks from drilling
Fire History:	moderate

Vegetation Cover

Trees < 5 m	<2%	*Corymbia hamersleyana*
Shrubs >2 m	>70%	*Acacia tumida* var. *pilbarensis, Grevillea wickhamii, Sida* aff. *cardiophylla*
Shrubs 1-2 m	2-10%	*Tephrosia spechtii*
Shrubs 0.5-1 m	<2%	*Ptilotus calostachyus, Indigofera monophylla, Hibiscus* aff. *coatesii, Hibiscus burtonii*
Shrubs 0-0.5 m	<2%	*Solanum phlomoides, Solanum dioicum*
Soft Grasses	N	*Eriachne mucronata*
Herbs	<2%	*Goodenia stobbsiana, Dampiera candicans*
Hummock (spinifex)	10-30%	*Triodia epactia*

Site 18: **Moderately dense *Acacia tumida* medium trees to tall shrubland, over sparse *Tephrosia spechtii* medium shrubs, with *Cymbopogon ambiguus* tussock grass, over sparse *Triodia epactia* hummock grassland..**

Date:	06/02/2004
Location:	UTM 51K 0212104 mE, 7726504 mN (+/- 6m)
Topography:	rocky outcrop
Slope:	steep
Soil texture:	loam
Soil colour:	brown
Surface layer:	stones/boulders
Rock type:	ironstone/laterite
Leaf litter:	moderate
Distribution:	widespread
Wood litter:	moderate
Vegetation condition:	pristine
Fire History:	moderate

Vegetation Cover

Trees 5-15 m	<2%	*Acacia tumida*
Trees < 5 m	<2%	*Acacia tumida*
Shrubs >2 m	30-70%	*Acacia tumida, Sida* sp. A (Kimberley Flora), *Cullen stipulaceum*
Shrubs 1-2 m	2-10%	*Tephrosia spechtii, Ficus platypoda, Senna venusta*
Shrubs 0.5-1 m	<2%	*Senna notabilis, Triumfetta maconochieana, Sida arenicola, Triumfetta* aff. *chaetocarpa, Cleome viscosa, Sida* sp.
Shrubs 0-0.5 m	<2%	*Triumfetta maconochieana, Sida arenicola, Tribulus suberosus, Solanum dioicum*
Herbs	<2%	*Euphorbia ?wheeleri, Mollugo mollugensis*
Sedges	<2%	*Cyperus cunninghamii* subsp. *cunninghamii*
Soft Grasses	2-10%	*Cymbopogon ambiguus, Eriachne ciliata, Eriachne mucronata*
Hummock (spinifex)	2-10%	*Triodia epactia, Triodia wiseana*

Site 19: **Scattered *Acacia inaequilatera / Grevillea pyramidalis* tall shrubland, over scattered mixed emergent shrubs, over moderately dense *Triodia wiseana / Triodia epactia* hummock grassland. .**

Date:	06/02/2004
Location:	UTM 51K 0211935 mE, 7726498 mN (+/- 4m)
Topography:	hill slope
Slope:	gentle
Soil texture:	loam
Soil colour:	red-orange
Surface layer:	coarse gravel/pebbles, stones/boulders
Rock type:	ferrous
Leaf litter:	negligible
Distribution:	mainly under shrubs
Wood litter:	negligible
Vegetation condition:	pristine
Fire History:	moderate

Vegetation Cover

Shrubs >2 m	<2%	*Acacia inaequilatera, Grevillea pyramidalis, Cullen stipulaceum*
Shrubs 1-2 m	<2%	*Tephrosia spechtii, Grevillea wickhamii, Acacia ancistrocarpa, Tephrosia rosea* var. *clementii*
Shrubs 0.5-1 m	<2%	*Corchorus* aff. *tectus* ms, *Acacia ptychophylla*
Shrubs 0-0.5 m	<2%	*Senna notabilis, Solanum diversiflorum, Sida* aff. *cardiophylla, Triumfetta clementii, Solanum beaugleholei, Solanum dioicum, Bonamia* aff. *media, Bonamia media* var. *villosa, Corchorus sidoides* subsp. *?sidoides*
Herbs	<2%	*Dampiera candicans, Mollugo molluginis*
Hummock (spinifex)	30-70%	*Triodia wiseana, Triodia epactia*

Site 20: **Sparse *Acacia pyrifolia / Acacia tumida* tall to medium shrubland, over, sparse *Acacia ptychophylla* dwarf shrubs, over open *Triodia wiseana / Triodia epactia* hummock grassland.**

Date:	06/02/2004
Location:	UTM 51K 0212063 mE, 7726507 mN (+/- 4m)
Topography:	scarp
Slope:	steep
Soil texture:	loam
Soil colour:	red-orange
Surface layer:	stones/boulders
Rock type:	laterite/ironstone
Leaf litter:	negligible
Distribution:	mainly under shrubs
Wood litter:	negligible
Vegetation condition:	pristine
Fire History:	moderate

Vegetation Cover

Shrubs >2 m	2-10%	*Acacia pyrifolia, Cullen stipulaceum, Acacia inaequilatera*
Shrubs 1-2 m	2-10%	*Acacia tumida, Acacia pyrifolia, Grevillea pyramidalis* subsp. *pyramidalis, Acacia colei* var. *?colei*
Shrubs 0.5-1 m	<2%	*Senna notabilis, Sida cardiophylla, Tribulus suberosus, Solanum beaugleholei, Corchorus sidoides* subsp. *?sidoides, Triumfetta* aff. *chaetocarpa*
Shrubs 0-0.5 m	2-10%	*Acacia ptychophylla, Solanum dioicum, Triumfetta johnsonii, Triumfetta maconochieana, Corchorus* aff. *tectus* ms
Herbs	<2%	*Bonamia media* var. *villosa*
Hummock (spinifex)	10-30%	*Triodia wiseana, Triodia epactia*

Site 21: **Sparse *Grevillea wickhamii* tall shrubland, over scattered medium shrubs, over sparse *Senna notabilis/Ptilotus calostachyus* low shrubs, over moderately dense *Triodia epactia / Triodia wiseana* hummock grassland. .**

Date:	06/02/2004
Location:	UTM 51K 0212225 mE, 7726429 mN (+/- 4m)
Topography:	hill slope
Slope:	moderate
Soil texture:	loam
Soil colour:	red-orange
Surface layer:	coarse gravel/pebbles, stones/boulders
Rock type:	ferrous
Leaf litter:	negligible
Distribution:	widespread
Wood litter:	negligible
Fire History:	moderate

Vegetation Cover

Shrubs >2 m	2-10%	*Grevillea wickhamii*
Shrubs 1-2 m	<2%	*Tephrosia spechtii*
Shrubs 0.5-1 m	<2%	*Dampiera candicans, Solanum* sp., *Ptilotus calostachyus, Triumfetta* aff. *chaetocarpa*
Shrubs 0-0.5 m	2-10%	*Senna notabilis, Ptilotus calostachyus, Acacia tumida, Tephrosia* sp. Bungaroo Creek, *Triumfetta johnsonii, Corchorus* aff. *obtectus* ms
Herbs	<2%	*Bonamia* aff. *media*
Hummock (spinifex)	30-70%	*Triodia epactia, Triodia wiseana*

Site 22: **Scattered *Corymbia hamersleyana* low trees, over *Grevillea wickhamii / Acacia tumida* tall to medium shrubland, over scattered to open *Tephrosia spechtii / Acacia spondylophylla* low to dwarf shrubs, over moderately dense *Triodia epactia* hummock grassland..**

Date:	06/02/2004
Location:	UTM 51K 0212588 mE, 7725703 mN (+/- 5m)
Topography:	gully sides
Slope:	moderate
Soil texture:	loam
Soil colour:	brown
Surface layer:	stones/boulders
Rock type:	ironstone/laterite
Leaf litter:	moderate
Distribution:	mainly under shrubs
Wood litter:	sparse
Vegetation condition:	pristine
Fire History:	moderate

Vegetation Cover

Trees < 5 m	<2%	*Corymbia hamersleyana*
Shrubs >2 m	2-10%	*Grevillea wickhamii*
Shrubs 1-2 m	<2%	*Acacia tumida, Sida* sp. A (Kimberley Flora),
Shrubs 0.5-1 m	<2%	*Tephrosia spechtii, Acacia ancistrocarpa*
Shrubs 0-0.5 m	10-30%	*Acacia spondylophylla, Acacia ptychophylla, Triumfetta johnsonii, Solanum dioicum, Corchorus* aff. *parviflorus*
Herbs	<2%	*Goodenia stobbsiana*
Hummock (spinifex)	30-70%	*Triodia epactia, Triodia wiseana*

Site 23: **Scattered *Eucalyptus leucophloia* low trees, over sparse *Grevillea wickhamii* tall shrubland, over mixed medium and low shrubs, over open *Acacia spondylophylla / Acacia ptychophylla* dwarf shrubs, over moderately dense *Triodia epactia / T. wiseana* hummock grassland..**

Date:	06/02/2004
Location:	UTM 51K 0212618 mE, 7725718 mN (+/- 4m)
Topography:	hill slope
Slope:	moderate
Soil texture:	loam
Soil colour:	red-orange
Surface layer:	surface crust, stones/boulders
Rock type:	ferrous
Leaf litter:	negligible
Distribution:	
Wood litter:	negligible
Vegetation condition:	excellent
Disturbance Details:	some drilling tracks
Fire History:	moderate

Vegetation Cover

Trees < 5 m	<2%	*Eucalyptus leucophloia*
Shrubs >2 m	2-10%	*Grevillea wickhamii, Hakea lorea* subsp. *lorea*
Shrubs 1-2 m	<2%	*Grevillea pyramidalis, Corymbia hamersleyana, Acacia tumida, Sida* sp. A (Kimberley Flora)
Shrubs 0.5-1 m	<2%	*Ptilotus calostachyus, Senna glutinosa* subsp. *pruinosa*
Shrubs 0-0.5 m	10-30%	*Acacia ptychophylla, Acacia spondylophylla, Indigofera monophylla, Senna glutinosa* subsp. *glutinosa*
Herbs	<2%	*Goodenia stobbsiana, Mollugo mollugensis*
Soft Grasses	<2%	*Eriachne pulchella*
Hummock (spinifex)	30-70%	*Triodia epactia, Triodia wiseana*

Site 24: **Scattered *Eucalyptus leucophloia / Corymbia hamersleyana* low trees, over sparse *Grevillea wickhamii* tall shrubland , over open *Acacia spondylophylla* dwarf shrubs, over moderately dense *Triodia epactia* hummock grassland.**

Date:	06/02/2004
Location:	UTM 51K 0212688 mE, 7725715 mN (+/- 5m)
Topography:	gully sides
Slope:	moderate
Soil texture:	clay loam
Soil colour:	brown
Surface layer:	stones/boulders
Rock type:	ironstone
Leaf litter:	moderate
Distribution:	mainly under shrubs
Wood litter:	moderate
Vegetation condition:	pristine
Fire History:	moderate

Vegetation Cover

Trees 5-15 m	<2%	*Eucalyptus leucophloia, Corymbia hamersleyana*
Shrubs >2 m	2-10%	*Grevillea wickhamii* subsp. *aprica*
Shrubs 1-2 m	2-10%	*Sida* sp. A (Kimberley Flora)
Shrubs 0.5-1 m	2-10%	*Corchorus* aff. *tectus* ms, *Senna venusta, Indigofera monophylla*
Shrubs 0-0.5 m	10-30%	*Acacia spondylophylla, Triumfetta johnsonii, Indigofera monophylla, Solanum dioicum*
Herbs	<2%	*Goodenia stobbsiana*
Soft Grasses	<2%	*Eriachne mucronata*
Hummock (spinifex)	30-70%	*Triodia epactia*

Site 25: **Scattered *Eucalyptus leucophloia* / *Corymbia hamersleyana* medium to low trees, over mixed emergent shrub, over moderately dense *Triodia wiseana* hummock grassland.**

Date:	06/02/2004
Location:	UTM 51K 0212943 mE, 7725346 mN (+/- 4m)
Topography:	hill slope
Slope:	moderate
Soil texture:	loam
Soil colour:	red-orange
Surface layer:	surface crust, stones/boulders
Rock type:	ferrous
Leaf litter:	negligible
Distribution:	
Wood litter:	negligible
Vegetation condition:	pristine
Fire History:	old

Vegetation Cover

Trees 5-15 m	<2%	*Eucalyptus leucophloia*
Trees < 5 m	<2%	*Corymbia hamersleyana*
Shrubs >2 m	<2%	*Grevillea wickhamii*
Shrubs 0-0.5 m	<2%	*Senna glutinosa* subsp. *glutinosa, Acacia ptychophylla, Acacia tumida, Pluchea tetranthera*
Sedges	<2%	*Cyperus hesperius*
Soft Grasses	<2%	*Cymbopogon ambiguus*
Hummock (spinifex)	30-70%	*Triodia wiseana*

Site 26: **Open *Grevillea wickhamii* tall shrubland, over open *Tephrosia spechtii / Acacia tumida* medium shrubs, over sparse *Acacia ptychophylla / Acacia spondylophylla* low shrubs, over sparse *Triodia epactia* hummock grassland..**

Date:	06/02/2004
Location:	UTM 51K 0213182 mE, 7725668 mN (+/- 5m)
Topography:	minor channel
Slope:	gentle
Soil texture:	clay loam
Soil colour:	brown
Surface layer:	stones/boulders
Rock type:	ferrous, laterite/ironstone
Leaf litter:	moderate
Distribution:	mainly under shrubs
Wood litter:	moderate
Vegetation condition:	pristine
Fire History:	moderate

Vegetation Cover

Shrubs >2 m	10-30%	*Grevillea wickhamii* subsp. *aprica*
Shrubs 1-2 m	10-30%	*Tephrosia spechtii, Acacia tumida* subsp. *pilbarensis*
Shrubs 0.5-1 m	2-10%	*Acacia ptychophylla, Acacia spondylophylla*
Shrubs 0-0.5 m	<2%	*Corchorus* aff. *tectus* ms
Herbs	<2%	*Goodenia stobbsiana*
Hummock (spinifex)	2-10%	*Triodia epactia*

Appendix B2:
Flora and Vegetation Site Descriptions for the Goldsworthy (Nimingarra / Sunrise Hill) area

Goldsworthy **Site** 01

Described C. SLEE **Date** 20/10/200 50 by 50

Location Nimingarra Mining Lease, west of track to pit Nim F.

Air Photo Aerial **Photo** 1 & 2 **on** 1 **Video** N **E Photo** 1

WGS84 50 812951 mE, 7737560 mN

Habitat In the base of a gently sloping shallow gully in upper slope between hillcrests. In an upper branch of a gully.

Soil Red-orange to brown fine gravelly loam to clay loam, with a loose coarse gravelly surface. Significant leaf litter, some woody litter.

Rock Type Ferrous.

Vegetation *Corymbia hamersleyana* scattered low trees over *Acacia tumida* var. *pilbarensis*, *Grevillea wickhamii* subsp. *aprica* open scrub over *Tephrosia spechtii* low open shrubland over *Acacia adoxa* var. *adoxa*, *Indigofera monophylla* (small calyx form) sparse dwarf shrubland over *Triodia epactia* sparse hummock grassland

Veg Condition Pristine, no disturbance, no weeds observed.

Fire 1-5 years

Notes Sites not pegged. GPS at centre. WGS 84. height of *Acacia tumida* layer prefire from old stems. Status: Dry, many annuals probably not available. Search intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	2%	< 0.5 m	1.5	
Acacia hilliana	0.5%	< 0.5 m	1.16	
Acacia pyrifolia	0.5 %	1- 2 m	1.22	
Acacia tumida var. *pilbarensis*	60%	0.5-1 m	1.2	
Cajanus cinereus	0.5%	0.5- 1 m	1.19	
Chrysopogon fallax	+		1.21	
Corchorus aff. *parviflorus* (1)	0.5%	< 0.5 m	1.20	
Corymbia hamersleyana	0.5%	< 5 M	1.1	
Goodenia stobbsiana	+		1.14	
Grevillea wickhamii subsp. *aprica*	5%	< 0.5 m	1.4	
Indigofera monophylla (small calyx form)	1%	< 0.5 m	1.6	
Petalostylis cassioides	0.5%	< 0.5 m	1.17	
Petalostylis labicheoides	2%	1-2 m	1.12	
Ptilotus calostachyus var. *calostachyus*	0.5%	0.5-1 m	1.15	
Senna venusta	0.5%	< 0.5 m	1.10	
Sida ?cardiophylla (juvenile)	0.5%	0.5-1 m	1.8	
Sida sp.A Kimberley Flora(P.A.Fryxell & L.A.Craven 3900)	0.5%	1-2 m	1.13	
Solanum dioicum	0.5%	< 0.5 m	1.11	
Tephrosia aff. *uniovulata* (HD76)	0.5%	< 0.5 m	1.18	
Tephrosia spechtii	5%	0.5-1 m	1.3	
Triodia epactia	5%		1.7	
Triumfetta maconochieana	0.5%	< 0.5 m	1.9	

Goldsworthy **Site** 02

Described C. SLEE **Date** 20/10/200 50 by 50

Location Nimingarra Mining Lease, west of moonscaping waste dump between gullies to the north and south.

Air Photo **Photo** 3 & 4 **on** 1 **Video** N **E Photo**

WGS84 50 812829 mE, 7737626 mN

Habitat Gentle upper slopes near hillcrest

Soil Fine gravelly sandy loam with small outcrops and coarse gravel to pebbles on the surface

Rock Type Ferrous

Vegetation *Acacia inaequilatera* scattered low trees over *Ptilotus calostachyus* sparse low shrubs over *Acacia hilliana* sparse dwarf shrubs over *Goodenia stobbsiana* scattered herbs over Triodia *epactia* moderately dense hummock steppe.

Veg Condition Pristine, no disturbance.

Fire 1-5 years

Notes Negligible leaf litter and wood litter. GPS +/- 4 m error. Photos looking south. Post-fire regrowth dominated by *Triodia*. Status: Dry, many annuals probably not available. Search intensity: Very thorough.

.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	1%	< 0.5 m	2.10	
Acacia ancistrocarpa	0.5%	1- 2 m	2.7	
Acacia hilliana	3%	< 0.5 m	2.2	
Acacia inaequilatera	0.5%	< 5 m	2.1	
Bonamia media var. *villosa*	+		2.13	
Corchorus aff. *parviflorus* (2)	0.5%	< 0.5 m	2.11	
Goodenia stobbsiana	2%		2.3	
Grevillea wickhamii subsp. *aprica*	0.5%	0.5 – 1 m	2.5	
Indigofera monophylla (small calyx form)	0.5%	< 0.5 m	2.6	
Ptilotus calostachyus var. *calostachyus*	5%	0.5- 1 m	1.15	
Solanum diversiflorum	0.5%	< 0.5 m	2.12	
Tephrosia sp.Bungaroo Creek(M.E.Trudgen 11601)	0.5%	< 0.5 m	2.9	
Tephrosia spechtii	1%	0.5 – 1 m	2.14	
Triodia epactia	40%		2.4	
Triumfetta johnstonii	0.5%	0.5 – 1 m	2.8	

Goldsworthy **Site** 03

Described C. SLEE **Date** 20/10/200 50 by 50

Location Nimingarra Mining Lease, east of moonscaping rock dump.

Air Photo 5 & 6 **on** 1 **Video** N **E Photo**

WGS84 50 187004 mE, 7739368 mN

Habitat Moderately steep west-north-west facing mid to upper slope

Soil Brown to red sandy loam with coarse gravel and pebbles on surface

Rock Type Ferrous

Vegetation *Acacia adoxa* var. *adoxa* and *Acacia hilliana* sparse dwarf shrubland over *Indigofera monophylla* (small calyx form) dwarf shrubland over *Triodia epactia* hummock steppe.

Veg Condition Pristine, no disturbance.

Fire 1 – 5 years

Notes Negligible leaf litter and wood litter. GPS +/- 4 m error. Status: Dry, many annuals probably not available. Search intensity: Thorough. Regeneration post-fire 3-4 years. Photo 5 looking NNE, photo 6 looking SSW across moonscape.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	5 %	< 0.5 m	1.5	
Acacia hilliana	2 %	< 0.5 m	3.4	
Bonamia media var. *villosa*	+		3.7	
Corchorus aff. *parviflorus* (2)	0.5 %	0.5 – 1 m	3.2	Determination uncertain
Corymbia flavescens	0.5 %	1- 2 m	3.1	
Heliotropium tenuifolium	0.5 %	< 0.5 m	3.6	
Indigofera monophylla (small calyx form)	0.5 %	< 0.5 m	3.5	
Ptilotus calostachyus var. *calostachyus*	0.5 %	0.5 – 1 m	3.3	
Sida ?cardiophylla (juvenile)	0.5 %	< 0.5 m	3.8	
Triodia epactia	65 %		3.9	
Triumfetta maconochieana	0.5 %	< 0.5 m	3.10	

Goldsworthy **Site** 04

Described C. SLEE **Date** 21/10/200 50 by 50`

Location Nimingarra Mining Lease, west of track

Air Photo 26 **on** 1 **Video** N **E Photo**

WGS84 50 812759mE, 7737525mN

Habitat Low outcrop/breakaway on mid to upper west slope

Soil Brown sandy clay to loam with surface level plates and slab outcrop, stones and boulders and coarse gravel and pebbles

Rock Type Ferrous

Vegetation *Grevillea wickhamii* subsp. *aprica*, *Petalostylis labicheoides* and *Acacia tumida* var. *pilbarensis* open medium shrubland over *Acacia adoxa* var. *adoxa* sparse dwarf shrubland over *Triodia epactia* hummock grassland.

Veg Condition Pristine, no disturbance.

Fire 1 – 5 years

Notes Negligible leaf litter and wood litter. GPS +/- 4 m error. Status: Dry, many annuals probably not available. Search intensity: Thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	5 %	< 0.5 m	1.5	
Acacia hilliana	0.5 %	< 0.5 m	1.16	
Acacia inaequilatera	0.5 %	0.5 – 1 m	2.1	
Acacia tumida var. *pilbarensis*	5 %	1 – 2 m	4.2	
Bonamia media var. *villosa*	+		4.4	
Corchorus aff. *parviflorus* (1)	1 %	< 0.5 m	4.3	
Grevillea wickhamii subsp. *aprica*	10 %	1 – 2 m	4.1	
Petalostylis labicheoides	10 %	1 – 2 m	1.12	
Ptilotus calostachyus var. *calostachyus*	0.5 %	0.5 – 1 m	1.15	
Tephrosia spechtii	0.5 %	< 0.5 m	1.3	
Triodia epactia	5 %		1.7	

Goldsworthy **Site** 05

Described C. SLEE **Date** 21/10/200 50 by 50

Location Nimingarra Mining Lease

Air Photo 33 **on** 1 **Video** N **E Photo**

WGS84 50 812372 mE, 7737584 mN

Habitat Minor gully base and drainage line facing west on flat plains

Soil Red to brown sand to sandy clay with loose soil and coarse gravel to pebbles on the surface

Rock Type Ferrous

Vegetation *Corymbia hamersleyana* scattered low trees over *Acacia tumida* var. *pilbarensis*, *Petalostylis labicheoides* open tall shrubland over *Grevillea wickhamii* subsp. *aprica* sparse medium shrubland over *Acacia adoxa* var. *adoxa* sparse dwarf shrubland over *Triodia epactia* open hummock grassland.

Veg Condition Pristine, no disturbance.

Fire > 5 years

Notes Sparse leaf litter under shrubs and moderate wood litter. GPS +/- 4 m error. Status: Dry, many annuals probably not available. Search intensity: Thorough.

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Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	5 %	< 0.5 m	1.5	
Acacia pyrifolia	1 %	0.5 – 1 m	1.22	
Acacia tumida var. *pilbarensis*	15 %	> 2 m	1.2	
Cleome viscosa	+		5.3	
Corymbia hamersleyana	1 %	< 5 m	5.1	
Eriachne mucronata (typical form)	+			
Goodenia stobbsiana	+		1.14	
Grevillea wickhamii subsp. *aprica*	5 %	1 – 2 m	1.4	
Indigofera monophylla (small calyx form)	2 %	< 0.5 m	1.6	
Petalostylis labicheoides	5 %	> 2 m	1.12	
Tephrosia rosea var. *clementii*	0.5 %	< 0.5 m	5.4	
Trachymene oleracea	+		5.2	
Triodia epactia	15 %		1.7	
Triumfetta johnstonii	1 %	< 0.5 m	5.5	
Triumfetta maconochieana	0.5 %	< 0.5 m	1.9	

Goldsworthy **Site** 06

Described C. SLEE **Date** 21/10/200 50 by 50

Location Nimingarra Mining Lease

Air Photo 35 **on** 1 **Video** N **E Photo**

WGS84 50 812334 mE, 7737950 mN

Habitat Very gently sloping gravel plains

Soil Brown to red-orange sandy clay with coarse gravel and pebbles

Rock Type Ferrous

Vegetation *Acacia inaequilatera* scattered low trees over *Acacia* sp.Rudall River(B.R.Maslin 2046A) scattered medium shrubland over *Triodia epactia* moderately dense hummock steppe.

Veg Condition Pristine, no disturbance.

Fire > 5 years

Notes Sparse leaf litter under shrubs and negligible wood litter. GPS +/- 4 m error. Status: Dry, many annuals probably not available, finished flowering. Search intensity: Very thorough. Regeneration: old hummocks.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia aff. *pyrifolia* (GLD(NIM)6.4)	0.5 %	1 – 2 m	6.4	
Acacia inaequilatera	0.5 %	< 5 m	2.1	
Acacia sp.Rudall River(B.R.Maslin 2046A)	0.5 %	1 – 2 m	6.3	
Eucalyptus leucophloia				
Solanum dioicum	0.5 %	< 0.5 m	6.2	
Triodia epactia	50 %		6.1	

Goldsworthy **Site** 07

Described C. SLEE **Date** 22/10/200 50 by 50

Location Nimingarra Mining Lease west of old haul road and north of NIMF.

Air Photo 40 **on** I **Video** N **E Photo**

WGS84 50 187204 mE, 7738620 mN

Habitat Gentle slope facing east-south-east on hill crest

Soil Brown to red-orange clay loam with coarse gravel and pebbles and stones and boulders

Rock Type Ferrous

Vegetation *Acacia orthocarpa* scattered tall shrubland over *Ptilotus calostachyus* scattered low shrubland over *Triodia epactia* moderately dense hummock grassland.

Veg Condition Excellent, minimal disturbance, road edge and cleared areas nearby

Fire > 5 years

Notes Sparse leaf litter under shrubs andsparse wood litter. GPS +/- 4 m error. Status: Dry, many annuals probably not available. Search intensity: Very thorough.

.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	0.5 %	0.5 – 1 m	7.8	
Acacia inaequilatera	0.5 %	0.5 -1 m	2.1	
Acacia orthocarpa	1 %	> 2 m	7.1	
Eriachne ciliata	+		7.10	
Goodenia stobbsiana	+		1.14	
Grevillea wickhamii subsp. *aprica*	0.5 %	1 – 2 m	1.4	
Mukia maderaspatana	+		7.7	
Oldenlandia crouchiana	+		7.9	
Petalostylis labicheoides	0.5 %	0.5 – 1 m	1.12	
Pterocaulon sphaeranthoides	+		7.13	
Ptilotus calostachyus var. *calostachyus*	0.5 %	0.5 -1 m	1.15	
Senna glutinosa subsp. *glutinosa*	0.5 %	0.5 – 1 m	7.6	
Sida ?cardiophylla (juvenile)	0.5 %	0.5 -1 m	7.11	
Solanum dioicum	0.5 %	< 0.5 m	7.3	
Solanum diversiflorum	0.5 %	< 0.5 m	7.5	
Trichodesma zeylanicum var. *zeylanicum*	0.5 %	0.5 – 1 m	7.2	
Triodia epactia	35 %		7.4	
Triumfetta maconochieana	0.5 %	< 0.5 m	7.12	

Goldsworthy **Site** 08

Described C. SLEE **Date** 22/10/200 50 by 50

Location Nimingarra Mining Lease north of moonscaping waste dump

Air Photo 42 **on** 1 **Video** N **E Photo**

WGS84 50 186997 mE, 7739465 mN

Habitat Steep west facing rocky outcrop/cliffs

Soil Dark brown loam to clay loam with loose soil and stones and boulders

Rock Type Ferrous

Vegetation *Acacia tumida* var. *pilbarensis* sparse tall shrubland over *Sida* sp.A Kimberley Flora(P.A.Fryxell & L.A.Craven 3900) sparse medium to low shrubland over *Cymbopogon ambiguus*, *Eriachne mucronata* (typical form) open tussock grassland over *Cyperus cunninghamii* subsp. *cunninghamii* sedges.

Veg Condition Pristine, no disturbance.

Fire > 5 years

Notes Moderate leaf litter. GPS +/- 7 m error. Status: Dry, many annuals probably not available. Search intensity: Thorough, safety limitations.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia tumida var. *pilbarensis*	5 %	> 2 m	1.2	
Amaranthus pallidiflorus	+		8.25	
Atalaya hemiglauca	0.5 %	0.5 – 1m	8.7	
Cajanus cinereus	0.5 %	0.5 – 1 m	8.3	
Corymbia flavescens	0.5 %	< 5 m	8.10	
Cymbopogon ambiguus	10 %		8.13	
Cyperus cunninghamii subsp. *cunninghamii*	0.5 %		8.17	
Enneapogon oblongus	+		8.24	
Eriachne ciliata	+		8.15	
Eriachne mucronata (typical form)	5 %		8.14	
Evolvulus alsinoides var. *villosicalyx*	+		8.18	
Ficus brachypoda	0.5 %	1 – 2 m	8.9	
Gomphrena cunninghamii	+		8.21	
Hibiscus leptocladus	0.5 %	< 0.5 m	8.20	
Mukia maderaspatana	+		7.7	
Nicotiana benthamiana	+		8.8	
Paspalidium tabulatum (Whim Creek form)	+		8.22	
Ptilotus incanus var. *elongatus*	1 %	0.5 – 1 m	8.4	
Santalum lanceolatum	0.5 %	0.5 – 1 m	8.2	
Senna venusta	0.5 %	< 0.5 m	8.6	
Sida aff. *cardiophylla* (site 1086)	0.5 %	0.5 – 1 m	8.5	
Sida aff. *fibulifera* (B181-5B)	0.5 %	< 0.5 m	8.27	
Sida rohlenae subsp. *Rohlenae*	0.5 %	< 0.5 m	8.23	
Sida sp.A Kimberley Flora(P.A.Fryxell & L.A.Craven 3900)	5 %	1 -2 m	8.1	
Solanum cleistogamum	0.5 %	< 0.5 m	8.12	
Solanum horridum	0.5 %	< 0.5 m	8.11	
Tephrosia sp.	+		8.26	
Tribulus suberosus	0.5 %	< 0.5 m	8.19	
Triumfetta clementii	1 %	< 0.5 m	8.16	
Triumfetta johnstonii	0.5 %	< 0.5 m	2.8	
Triumfetta maconochieana	0.5 %	< 0.5 m	1.9	

Goldsworthy **Site** 09

Described C. SLEE **Date** 22/10/200 50 by 50

Location Nimingarra Mining Lease

Air Photo **Photo on** 1 **Video** N **E Photo**

WGS84 50 812965 mE, 7738718 mN

Habitat Steep north-west to west facing hill slope

Soil Brown to red-orange loam with stones and boulders and surface level plates

Rock Type Ferrous

Vegetation Acacia inaequilatera scattered low trees over *Senna glutinosa* subsp *glutinosa* and other species scattered medium shrubland over *Triodia epactia* moderately dense hummock grassland.

Veg Condition Pristine, no disturbance.

Fire > 5 years

Notes Sparse leaf litter mainly under shrubs and sparse wood litter. GPS +/- 4 m error. Status: Dry, many annuals probably not available. Search intensity: Good, safety limitations.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia inaequilatera	1 %	< 5 m	2.1	
Bonamia media var. *villosa*	0.5 %	< 0.5 m	9.2	
Corchorus aff. *parviflorus* (1)	0.5 %	< 0.5 m	4.3	
Cymbopogon ambiguus	+		8.13	
Euphorbia sp.	+		9.1	
Goodenia stobbsiana	+		1.14	
Indigofera monophylla (small calyx form)	0.5 %	< 0.5 m	1.6	
Senna glutinosa subsp. *glutinosa*	2 %	1 -2 m	7.6	
Trachymene oleracea	+		5.2	
Tribulus suberosus	0.5 %	0.5 – 1 m	8.19	
Triodia epactia	40 %		1.7	

Goldsworthy **Site** 10

Described C. SLEE **Date** 22/10/200 50 by 50

Location Nimingarra Mining Lease west of pit

Air Photo 45 **on** 1 **Video** N **E Photo**

WGS84 50 812778 mE, 7738792 mN

Habitat Minor channel on low north-west to west slope to plain

Soil Brown to red-orange sand to sandy clay with fine gravel, loose soil and coarse gravel and pebbles

Rock Type Ferrous and granite outcroppings

Vegetation *Acacia tumida* var. *pilbarensis* tall shrubland over *Petalostylis labicheiodes* sparse medium shrubland over *Eriachne mucronata* (typical form) sparse tussock grassland over *Triodia epactia* moderately dense hummock grassland over *Bulbostylis barbata* on sand.

Veg Condition Pristine, no disturbance.

Fire > 5 years

Notes Sparse leaf litter mainly under shrubs and moderate wood litter. GPS +/- 4 m error. Status: Dry, many annuals probably not available. Search intensity: Thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	0.5 %	< 0.5 m	10.8	
Acacia hilliana	0.5 %	< 0.5 m	10.7	
Acacia pyrifolia	1 %	1 – 2 m	10.23	
Acacia tumida var. *pilbarensis*	15 %	> 2 m	10.1	
Atalaya hemiglauca	0.5 %	1 – 2 m	10.3	
Bonamia media var. *villosa*	+		10.25	
Bulbostylis barbata	+		10.21	
Carissa lanceolata	0.5 %	1 – 2 m	10.10	
Corchorus aff. *parviflorus* (2)	0.5 %	< 0.5 m	10.12	
Cymbopogon ambiguus	1 %		10.19	
Dampiera candicans	0.5 %	0.5 – 1 m	10.13	
Eriachne ciliata	+		10.20	
Eriachne mucronata (typical form)	2 %		10.18	
Euphorbia sp.	+		10.16	
Evolvulus alsinoides var. *villosicalyx*	+		10.26	
Goodenia stobbsiana	+		10.14	
Hibiscus sturtii var. aff. *campylochlamys* (MET 15,957)	0.5 %	< 0.5 m	10.17	
Hybanthus aurantiacus	0.5 %	< 0.5 m	10.24	
Indigofera monophylla (small calyx form)	0.5 %	< 0.5 m	10.6	
Petalostylis labicheoides	5 %	1 – 2 m	10.2	
Sida aff. *cardiophylla* (site 1086)	0.5 %	0.5 – 1 m	10.5	
Solanum diversiflorum	0.5 %	< 0.5 m	10.27	
Solanum horridum	0.5 %	< 0.5 m	10.15	
Tephrosia rosea var. *glabrior*	1 %	0.5 – 1 m	10.4	
Trachymene oleracea	+		*10.9*	
Triodia epactia	40 %		10.22	
Triumfetta johnstonii	0.5 %	< 0.5 m	10.11	
Triumfetta maconochieana	0.5 %	< 0.5 m	10.28	

Goldsworthy **Site** 11

Described C. SLEE **Date** 23/10/200 50 by 50

Location Nimingarra Mining Lease

Air Photo 49 **on** 1 **Video** N **E Photo**

WGS84 50 812695 mE, 7737955 mN

Habitat Steep north-north-west hill slope below breakaway

Soil Brown to red-orange sandy clay to loam with coarse gravel, pebbles, stones and boulders

Rock Type Ferrous

Vegetation *Acacia inaequilatera* sparse low trees over mixed emergents scattered low shrubland over *Triodia wiseana*, *Triodia epactia* moderately dense hummock grassland.

Veg Condition Pristine, no disturbance.

Fire > 5 years

Notes Sparse leaf litter mainly under spinifex and negligible wood litter. GPS +/- 5 m error. Status: Dry, many annuals probably not available. Search intensity: Very thorough.

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Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia inaequilatera	2 %	< 5 m	2.1	
Atalaya hemiglauca	0.5 %	0.5 – 1 m	11.2	
Bonamia media var. *villosa*	+		11.3	
Indigofera monophylla (small calyx form)	0.5 %	< 0.5 m	1.6	
Tribulus suberosus	0.5 %	0.5 – 1 m	11.1	
Triodia epactia	5 %		11.5	
Triodia wiseana	40 %		11.4	

Goldsworthy **Site** 12

Described C. SLEE **Date** 23/10/200 50 by 50

Location Nimingarra Mining Lease north-west of site office and west of NIM workshop

Air Photo 51 **on** 1 **Video** N **E Photo**

WGS84 50 187382 mE, 7739687 mN

Habitat Hill crest with banded ironstone formation outcrops

Soil Brown to orange loam and clay loam with coarse gravel and pebbles and rock outcrops

Rock Type Ferrous

Vegetation *Acacia orthocarpa* sparse tall shrubland over *Acacia inaequilatera*, *Grevillea wickhamii* subsp. aprica scattered medium shrubland over *Acacia hilliana* sparse dwarf shrubland over *Triodia epactia* open hummock grassland.

Veg Condition Excellent, minimal disturbance, tracks near water tank

Fire > 5 years

Notes Sparse leaf litter mainly under shrubs and spinifex and sparse wood litter. GPS +/- 4 m error. Status: Dry, many annuals probably not available. Search intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia aff. *ancistrocarpa* (GLD(NIM)18.11)	0.5 %	0.5 – 1 m	12.2	
Acacia hilliana	5 %	< 0.5 m	1.16	
Acacia inaequilatera	0.5 %	1 – 2 m	2.1	
Acacia orthocarpa	*3 %*	*> 2 m*	*12.1*	
Bonamia media var. *villosa*	+		12.5	
Gomphrena cunninghamii	+		12.4	
Grevillea wickhamii subsp. *aprica*	0.5 %	1 – 2 m	1.4	
Mukia maderaspatana	+		7.7	
Petalostylis labicheoides	0.5 %	1 – 2 m	1.12	
Polygala aff. *isingii*	+		12.6	
Ptilotus calostachyus var. *calostachyus*	0.5 %	0.5 – 1 m	1.15	
Senna venusta	0.5 %	< 0.5 m	1.10	
Solanum dioicum	0.5 %	< 0.5 m	12.3	
Tephrosia spechtii	0.5 %	< 0.5 m	12.7	

Goldsworthy **Site** 13

Described C. SLEE **Date** 23/10/200 50 by 50

Location Nimingarra Mining Lease

Air Photo 52 **on** 1 **Video** N **E Photo**

WGS84 50 187371 mE, 7740162 mN

Habitat Rocky outcrop on upper slope, with minor channels

Soil Brown to orange ???? With coarse gravel, pebbles, stones and boulders and rocky outcrops

Rock Type Ferrous

Vegetation *Grevillea wickhamii* subsp. aprica sparse medium shrubland over *Acacia adoxa* var. *adoxa* sparse dwarf shrubland over *Triodia epactia* open hummock grassland

Veg Condition Pristine, no disturbance.

Fire >5 years

Notes Negligible leaf litter mainly under shrubs and sparse wood litter. GPS +/- 5 m error. Status: Dry, many annuals probably not available. Search intensity: Thorough.

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Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	8 %	< 0.5 m	1.5	
Acacia hilliana	0.5 %	< 0.5 m	1.16	
Acacia pyrifolia	0.5 %	0.5 – 1 m	1.22	
Bonamia media var. *Villosa*	+		13.14,15	
Eriachne ciliata	1 %		13.13	
Eriachne lanata	+		13.12	
Undetermined	0.5 %	0.5 – 1 m	13.6	
Goodenia stobbsiana	+		1.14	
Grevillea pyramidalis subsp. *pyramidalis*	0.5 %	1 – 2 m	13.3	
Grevillea wickhamii subsp. *aprica*	5 %	1 – 2 m	13.1	
Indigofera monophylla (small calyx form)	0.5 %	< 0.5 m	1.6	
Sida cardiophylla	0.5 %	0.5 – 1 m	13.7	
Sida sp.A Kimberley Flora(P.A.Fryxell & L.A.Craven 3900)	0.5 %	< 0.5 m	13.5	
Templetonia hookeri	0.5 %	1 – 2 m	13.8	
Tephrosia sp.Bungaroo Creek(M.E.Trudgen 11601)	0.5 %	< 0.5 m	13.4	
Tephrosia spechtii	1 %	0.5 – 1 m	13.2	
Triodia epactia	15 %		1.7	
Triumfetta johnstonii	0.5 %	< 0.5 m	13.10	
Triumfetta maconochieana	0.5 %	< 0.5 m	13.9	
Triumfetta plumigera	0.5 %	0.5 – 1 m	13.11	

Goldsworthy **Site** 14

Described C. SLEE **Date** 23/10/200 50 by 50

Location Nimingarra Mining Lease west of workshop

Air Photo 53 **on** 1 **Video** N **E Photo**

WGS84 50 187901 mE, 7739371 mN

Habitat Moderate to steep south facing cliff faces

Soil Brown to red sandy clay to loam with loose soil, coarse gravel, pebbles, stones and boulders

Rock Type Ferrous

Vegetation *Ficus brachypoda*, *Atalaya hemiglauca* sparse low trees over mixed shrubland over *Trachymene oleracea*, cliff herb (14.4) open herbs over sedges and hummock grassland

Veg Condition Excellent, minimal disturbance, affected by dust from nearby roads

Fire > 5 years

Notes Moderate leaf litter mainly under shrubs and plentiful wood litter. GPS +/- 7 m error. Status: Dry, many annuals probably not available. Search intensity: Thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Atalaya hemiglauca	5 %	< 5 m	14.2	
Cyperus cunninghamii subsp. *cunninghamii*	5 %		14.5	
Evolvulus alsinoides var. *villosicalyx*	0.5 %	< 0.5 m	14.14	
Ficus brachypoda	5 %	< 5 m	14.1	
Flueggea virosa subsp. *melanthesoides*	2 %	< 5 m	14.7	
Undetermined	10 %		14.4	
Gomphrena cunninghamii	+		14.8	
Indigofera trita	0.5 %	< 0.5 m	14.15	
Mukia maderaspatana	+		14.17	
Nicotiana benthamiana	10 %		14.3	
Paspalidium tabulatum (Whim Creek form)	5 %		14.6	
Senna glutinosa subsp. *glutinosa*	0.5 %	< 0.5 m	14.9	
Sida aff. *fibulifera* (B181-5B)	0.5 %	< 0.5 m	14.11	
Sida rohlenae subsp. *Rohlenae*	1 %	< 0.5 m	14.12	
Triodia biflora	2 %		14.16	
Triumfetta clementii	0.5 %	< 0.5 m	14.13	
Triumfetta maconochieana	0.5 %	< 0.5 m	14.10	

Goldsworthy Site 15

Described C. SLEE **Date** 24/10/200 50 by 50
Location Nimingarra Mining Lease
Air Photo **Photo** 54 **on** 1 **Video** N **E Photo**
WGS84 50 186898 mE, 7740518 mN
Habitat Very gentle to negligible slope on gravelly to sandy clay plaina
Soil Brown to orange sandy clay o clay loam with loose soil and coarse gravel and pebbles
Rock Type Ferrous
Vegetation *Corymbia hamersleyana* scattered low woodland over *Acacia tumida* var. *pilbarensis* sparse tall shrubland over *Acacia* aff. *ancistrocarpa*(GLD(NIM)17.2) sparse medium shrubland over mixed open dwarf shrubland over *Triodia epactia* moderately dense hummock grassland.
Veg Condition Excellent, minimal disturbance, light cattle grazing
Fire 1 – 5 years
Notes Moderate leaf litter mainly under shrubs and moderate wood litter. GPS +/- 4 m error. Status: Dry, many annuals probably not available. Search intensity: Very thorough.

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Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	5 %	< 0.5 m	1.5	
Acacia aff. *ancistrocarpa* (GLD(NIM)17.2)	8 – 10 %	1 – 2 m	15.3	
Acacia elachantha	1 %	> 2 m	15.5	
Acacia hilliana	5 %	< 0.5 m	1.16	
Acacia inaequilatera	0.5 %	1- 2 m	2.1	
Acacia tumida var. *pilbarensis*	5 %	> 2 m	15.2	
Atalaya hemiglauca	0.5 %	0.5 – 1 m	8.7	
Bonamia linearis	+		15.12	
Bonamia rosea	2 %	< 0.5 m	15.9	
Corchorus parviflorus	2 %	< 0.5 m	15.4	
Corymbia hamersleyana	1 %	< 5 m	15.1	
Eriachne obtusa	+		15.7	
Goodenia stobbsiana	+		1.14	
Grevillea wickhamii subsp. *aprica*	0.5 %	1- 2 m	1.4	
Indigofera monophylla (small calyx form)	0.5 %	< 0.5 m	1.6	
Ptilotus astrolasius var. astrolasius	0.5 %	< 0.5 m	15.11	
Ptilotus calostachyus var. *calostachyus*	0.5 %	0.5 – 1 m	1.15	
Sida cardiophylla	0.5 %	< 0.5 m	15.10	
Tephrosia sp.Bungaroo Creek(M.E.Trudgen 11601)	0.5 %	< 0.5 m	15.6	
Tephrosia spechtii	0.5 %	0.5 – 1 m	15.8	

Goldsworthy **Site** 16

Described C. SLEE **Date** 24/10/200 50 by 50

Location Nimingarra Mining Lease

Air Photo **Photo** 60 **on** 1 **Video** N **E Photo**

WGS84 50 188168 mE, 7740513 mN

Habitat Gentle north-east to east slope of small gully base and minor channels

Soil Brown to red-prange sandy clay with fine gravel and stones and boulders

Rock Type Ferrous

Vegetation *Acacia tumida* var. *pilbarensis* open tall shrubland over *Petalostylis labicheoides* moderately dense medium shrubland over mixed low to dwarf shrubland over *Cymbopogon ambiguus* sparse soft grasses.

Veg Condition Pristine, no disturbance

Fire 1 – 5 years

Notes Plentiful leaf litter widespread and plentiful wood litter. GPS +/- 5 m error. Status: Dry, many annuals probably not available. Search intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	0.5 %	< 0.5 m	1.5	
Acacia tumida var. *pilbarensis*	20 %	> 2 m	1.2	
Atalaya hemiglauca	0.5 %	1 – 2 m	8.7	
Cajanus cinereus	2 %	0.5 – 1 m	16.2	
Cassytha capillaris	+		16.9	
Corymbia hamersleyana	0.5 %	< 5 m	16.7	
Cymbopogon ambiguus	8 – 10 %		16.1	
Grevillea wickhamii subsp. *aprica*	0.5 %	1 – 2 m	16.6	
Hibiscus sturtii var. aff. *campylochlamys* (MET 15,957)	0.5 %	0.5 – 1 m	16.14	
Indigofera monophylla (small calyx form)	0.5 %	< 0.5 m	1.6	
Mukia maderaspatana	+		7.7	
Petalostylis labicheoides	65 %	1 – 2 m	1.12	
Pterocaulon serrulatum	+		16.4	
Santalum lanceolatum	0.5 %	1 – 2 m	16.5	
Sida sp.A Kimberley Flora(P.A.Fryxell & L.A.Craven 3900)	1 %	0.5 – 1 m	16.3	
Solanum cunninghamii	0.5 %	0.5 – 1 m	16.8	
Templetonia hookeri	0.5 %	1 – 2 m	16.11	
Trachymene oleracea	2 %		16.12	
Tribulus platypterus	0.5 %	< 0.5 m	16.10	
Triodia epactia	1 %		1.7	
Triumfetta johnstonii	0.5 %	0.5 – 1 m	16.15	
Triumfetta maconochieana	0.5 %	< 0.5 m	16.13	

Goldsworthy **Site** 17

Described C. SLEE **Date** 24/11/200 50 by 50

Location Nimingarra Mining Lease

Air Photo **Photo** 61 **on** I **Video** N **E Photo**

WGS84 50 188972 mE, 7740504 mN

Habitat Very gently south-east to east sloping undulating sandplains

Soil Red-orange sand with loose soil

Rock Type Nil

Vegetation *Corymbia zygophylla* scattered low woodlands over *Acacia* aff. *ancistrocarpa*(GLD(NIM)17.2) moderately dense tall shrubland over *Acacia coriacea* subsp. *sericophylla*, *Hakea macrocarpa* sparse tall shrubland over *Triodia epactia*, *Triodia wiseana* sparse hummock grassland over *Jacksonia aculeata*, *Heliotropium vestitum* and soft grasses.

Veg Condition Excellent, minimal disturbance, light cattle grazing

Fire 1 – 5 years

Notes Moderate leaf litter mainly under shrubs. GPS +/- 4 m error. Status: Dry, many annuals probably not available. Search intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia aff. *ancistrocarpa* (GLD(NIM)17.2)	45 %	> 2 m	17.2	
Acacia coriacea subsp. *sericophylla*	0.5 %	1 – 2 m	17.3	
Bonamia pannosa	0.5 %	< 0.5 m	17.22	
Bulbostylis barbata	+		17.11	
Calytrix carinata	0.5 %	0.5 – 1 m	17.20	
Corchorus sidoides aff. subsp. *vermicularis* (GLD(NIM)17.16)	0.5 %	< 0.5 m	17.16	
Corymbia zygophylla	1 %	< 5 m	17.1	
Crotalaria ramosissima	+		17.21	
Dampiera candicans	0.5 %	< 0.5 m	17.18	
Eragrostis aff. *Eriopoda*	0.5 %		17.19	
Eriachne obtusa	2 %		17.14	
Hakea macrocarpa	2 %	1 – 2 m	17.4	
Heliotropium vestitum	0.5 %	< 0.5 m	17.6	
Hibiscus aff. *Leptocladus* (GLD(NIM)20.8)	0.5 %	< 0.5 m	17.10	
Hibiscus leptocladus	0.5 %	< 0.5 m	17.9	
Jacksonia aculeata	5 %	0.5 – 1 m	17.5	
Jasminum didymum subsp. *lineare*	0.5 %	0.5 – 1 m	17.8	
Phyllanthus maderaspatensis var. *angustifolius*	0.5 %	< 0.5 m	17.23	
Ptilotus arthrolasius	1 %	< 0.5 m	17.13	
Ptilotus astrolasius var. *astrolasius*	0.5 %	< 0.5 m	17.17	
Ptilotus axillaris	1 %		17.12	
Setaria surgens	+		17.7	
Trianthema pilosa	1 %		17.15	
Triodia epactia	8-10%		1.7	
Triodia wiseana	2%		19.12	

Goldsworthy **Site** 18

Described C. SLEE **Date** 24/10/200 50 by 50

Location Nimingarra Mining Lease

Air Photo 62 **on** 1 **Video** N **E Photo**

WGS84 50 190508 mE, 7742431 mN

Habitat Hill crest

Soil Brown to orange sandy clay to loam with coarse gravel, pebbles, stones and boulders

Rock Type Ferrous

Vegetation *Acacia inaequilatera*, *Acacia orthocarpa* scattered medium shrubland over *Ptilotus calostachyus* sparse low shrubland over *Triodia epactia* moderately dense hummock grassland.

Veg Condition Excellent, minimal disturbance, old tracks and survey posts

Fire 1 – 5 years

Notes Negligible leaf litter and woody litter. GPS +/- 4 m error. Status: Dry, many annuals probably not available. Search intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	5 %	< 0.5 m	1.5	
Acacia aff. *ancistrocarpa* (GLD(NIM)18.11)	0.5 %	1 – 2 m	18.11	
Acacia colei var. *colei*	0.5 %	1 – 2 m	18.2	
Acacia hilliana	5 %	< 0.5 m	1.16	
Acacia inaequilatera	1 %	1 – 2 m	2.1	
Acacia orthocarpa	0.5 %	1 – 2 m	18.1	
Bonamia media var. *villosa*	+		18.5	
Cassytha capillaris	0.5 %		18.8	
Eriachne ciliata	2 %		18.7	
Fimbristylis simulans	+		18.6	
Gomphrena cunninghamii	+		18.9	
Goodenia stobbsiana	+		1.14	
Grevillea wickhamii subsp. *aprica*	0.5 %	0.5 – 1 m	1.4	
Indigofera monophylla (small calyx form)	0.5 %	< 0.5 m	1.6	
Petalostylis labicheoides	0.5 %	1 – 2 m	1.12	
Ptilotus exaltatus	+			
Salsola tragus	+		18.10	
Senna venusta	0.5 %	< 0.5 m	1.10	
Sida ?cardiophylla (juvenile)	0.5 %	< 0.5 m	18.4	
Solanum diversiflorum	0.5 %	< 0.5 m	2.12	
Trachymene oleracea	+		5.2	
Tribulus suberosus	0.5 %	0.5 – 1 m	18.3	
Triumfetta maconochieana	0.5 %	< 0.5 m	1.9	

Goldsworthy **Site** 19

Described C. SLEE **Date** 24/10/200 50 by 50

Location Nimingarra Mining Lease

Air Photo 63 **on** 1 **Video** N **E Photo**

WGS84 50 191354 mE, 7742938 mN

Habitat Sandplain flat

Soil Red-orange sand with loose soil

Rock Type Nil

Vegetation *Acacia tumida* var. *pilbarensis*, *Acacia ancistrocarpa* open medium shrubland over *Bonamia rosea* sparse dwarf shrubland over *Triodia wiseana* open hummock grassland.

Veg Condition Excellent, minimal disturbance, light cattle grazing

Fire 1 – 5 years

Notes Moderate leaf litter mainly under shrubs and moderate woody litter. GPS +/- 4 m error. Status: Dry, many annuals probably not available. Search intensity: Very thorough.

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Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia ancistrocarpa	5 %	1 – 2 m	19.1	
Acacia tumida var. *pilbarensis*	25 %	1 – 2 m	1.2	
Bonamia rosea	3 %	< 0.5 m	19.6	
Corchorus sidoides aff. subsp. *vermicularis* (GLD(NIM)17.16)	0.5 %	< 0.5 m	19.10	
Eriachne aristidea	+		19.7	
Erythrophleum chlorostachys	0.5 %	0.5 – 1 m	19.4	
Evolvulus alsinoides var. *decumbens*	0.5 %	< 0.5 m	19.9	
Hakea coriacea subsp. sericophylla	0.5 %	1 – 2 m	19.2	
Hakea macrocarpa	0.5 %	1 – 2 m	19.3	
Hybanthus aurantiacus	0.5 %	< 0.5 m	19.13	
Jacksonia aculeata	2 %	0.5 – 1 m	19.5	
Mukia maderaspatana	+		19.11	
Ptilotus astrolasius var. *astrolasius*	0.5 %	< 0.5 m	19.8	
Triodia schinzii	20 %		19.12	

Goldsworthy **Site** 20

Described C. SLEE **Date** 25/10/200 50 by 50

Location Nimingarra Mining Lease

Air Photo 67 **on** 1 **Video** N **E Photo**

WGS84 50 188024 mE, 7742165 mN

Habitat Flat sandplains

Soil Red sand with fine gravel and loose soil

Rock Type Ferrous gravel

Vegetation *Acacia drepanocarpa* subsp. *?pilbara* form sparse medium shrubland over *Acacia adoxa* var. *adoxa* and other species in scattered dwarf shrubland over *Triodia epactia* open hummock grassland.

Veg Condition Excellent, minimal disturbance, light cattle grazing

Fire 1 – 5 years

Notes Sparse leaf litter mainly under shrubs and negligible woody litter. GPS +/- 4 m error. Status: Dry, many annuals probably not available. Search intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	1 %	< 0.5 m	1.5	
Acacia ancistrocarpa	0.5 %	1 – 2 m	20.3	
Acacia colei var. *colei*	0.5 %	1 – 2 m	20.2	
Acacia drepanocarpa subsp. *?pilbara* form	5 %	1 – 2 m	20.1	
Acacia inaequilatera	0.5 %	1 – 2 m	2.1	
Acacia tumida var. *pilbarensis*	0.5 %	1 – 2 m	1.2	
Aristida holathera var. *holathera*	+		20.13	
Bonamia rosea	0.5 %	< 0.5 m	20.19	
Cajanus marmoratus	0.5 %	< 0.5 m	20.9	
Corchorus sidoides aff. subsp. *vermicularis* (GLD(NIM)17.16)	0.5 %	< 0.5 m	20.18	
Corymbia flavescens	0.5 %	< 0.5 m	20.10	
Crotalaria ramosissima	0.5 %	< 0.5 m	20.21	
Cullen stipulaceum	0.5 %	1 – 2 m	20.11	
Cymbopogon obtectus	+		20.20	
Digitaria brownii	+		20.15	
Eragrostis aff. *eriopoda*	+		20.14	
Gossypium australe (Whim Creek form)	0.5 %	0.5 – 1 m	20.23	
Heliotropium vestitum	0.5 %	< 0.5 m	20.17	
Hibiscus aff. *leptocladus* (GLD(NIM)20.8)	0.5 %	0.5 – 1 m	20.8	
Hibiscus aff. *leptocladus* (GLD(NIM)20.8)	0.5 %	< 0.5 m	20.12	
Indigofera monophylla (small calyx form)	0.5 %	< 0.5 m	1.6	
Isotropis atropurpurea	0.5 %	0.5 – 1 m	20.25	
Ptilotus astrolasius var. *astrolasius*	0.5 %	< 0.5 m	20.5	
Ptilotus fusiformis var. *fusiformis*	+		20.6	
Sida ?cardiophylla (juvenile)	0.5 %	< 0.5 m	20.7	
Sida arenicola	0.5 %	< 0.5 m	20.24	
Tephrosia sp.Bungaroo Creek(M.E.Trudgen 11601)	0.5 %	< 0.5 m	20.16	
Trianthema pilosa	+		20.22	
Triodia epactia	25 %		20.4	

Goldsworthy Site 21

Described C. SLEE **Date** 25/10/200 50 by 50
Location Nimingarra Mining Lease
Air Photo 68 **on** 1 **Video** N **E Photo**
WGS84 50 189717mE, 7743404mN
Habitat Gently undulating hills and slopes
Soil Brown to red-orange sandy clay
Rock Type Ferrous
Vegetation *Acacia inaequilatera* scattered medium shrubland over *Acacia hilliana* open dwarf shrubland over *Triodia epactia* moderately dense hummock steppe.
Veg Condition Pristine, no disturbance
Fire 1 – 5 years
Notes Negligible leaf litter mainly under shrubs and negligible woody litter. GPS +/- 3 m error. Status: Dry, many annuals probably not available. Some damage from cyclone. Search intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	1 %	< 0.5 m	1.5	
Acacia hilliana	15 %	< 0.5 m	1.16	
Acacia inaequilatera	1 %	1 – 2 m	2.1	
Acacia tumida var. *pilbarensis*	0.5 %	1 – 2 m	1.2	
Bonamia media var. *villosa*	+		12.5	
Genista canariensis	+			
Goodenia stobbsiana	+		1.14	
Grevillea wickhamii subsp. *aprica*	0.5 %	< 0.5 m	1.4	
Ptilotus calostachyus var. *calostachyus*	0.5%	0.5 – 1 m	1.15	
Tephrosia rosea var. *clementii*	0.5 %	0.5 – 1 m	5.4	
Triodia epactia	30 %		1.7	
Triumfetta johnstonii	0.5 %	0.5 – 1 m	2.8	

Goldsworthy **Site** 22

Described C. SLEE **Date** 26/10/200 50 by 50

Location Nimingarra Mining Lease

Air Photo 71 **on** 1 **Video** N **E Photo**

WGS84 50 188973 mE, 7742092 mN

Habitat Plateau on broad hill crest

Soil Brown to red-orange sandy clay to loam with coarse gravel and pebbles

Rock Type Ferrous

Vegetation *Corymbia hamersleyana* scattered low woodland over *Acacia inaequilatera* scattered low trees over *Grevillea wickhamii* subsp. *aprica* scattered medium shrubland over *Acacia hilliana* sparse dwarf shrubland over *Triodia epactia* open hummock grassland.

Veg Condition Excellent, minimal disturbance, long drainage culvert from nearby road present

Fire 1 – 5 years

Notes Negligible leaf litter mainly under shrubs and negligible woody litter. GPS +/- 4 m error. Status: Dry, many annuals probably not available. Search intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia hilliana	8 – 10 %	< 0.5 m	1.16	
Acacia inaequilatera	1 %	< 5 m	2.1	
Bonamia media var. *villosa*	+		22.2	
Corymbia hamersleyana	1 %	< 5 m	22.1	
Eriachne lanata	+		22.3	
Goodenia stobbsiana	+		1.14	
Grevillea wickhamii subsp. *aprica*	1 %	1 – 2 m	1.4	
Ptilotus calostachyus var. *calostachyus*	0.5 %	0.5 – 1 m	1.15	
Sida ?cardiophylla (juvenile)	0.5 %	< 0.5 m	22.4	
Triodia epactia	20 %		1.7	
Triumfetta johnstonii	0.5 %	< 0.5 m	2.8	

Goldsworthy **Site** 23

Described C. SLEE **Date** 26/10/200 50 by 50

Location Nimingarra Mining Lease

Air Photo **Photo** 74 **on** 1 **Video** N **E Photo**

WGS84 50 812282 mE, 7736580 mN

Habitat Low very gently undulating sandplains

Soil Brown to red-orange sand with loose soil

Rock Type Nil

Vegetation *Corymbia hamersleyana*, *Corymbia flavescens* scattered low woodland over mixed sparse medium to low shrubland over *Acacia stellaticeps*, *Acacia adoxa* var. *adoxa*, *Tephrosia* sp.Bungaroo Creek(M.E.Trudgen 11601) and *Isotropis atropurpurea* open dwarf shrubland over *Eragrostis* aff. *eriopoda* and other species open grassland over *Triodia schinzii* open hummock grassland.

Veg Condition Excellent, minimal disturbance, light cattle grazing

Fire 1 – 5 years

Notes Moderate leaf litter mainly under shrubs and moderate woody litter. GPS +/- 4 m error. Status: Dry, many annuals probably not available. Search intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia ?hilliana x stellaticeps (GLD(NIM)23.28)	0.5 %	0.5 – 1 m	23.28	
Acacia adoxa var. *adoxa*	5 – 7 %	< 0.5 m	1.5	
Acacia ancistrocarpa	1 %	0.5 – 1 m	19.1	
Acacia colei var. *colei*	0.5 %	1 – 2 m	20.2	
Acacia hilliana	0.5 %	< 0.5 m	1.16	
Acacia stellaticeps	5 – 10 %	< 0.5 m	23.24	
Acacia tumida var. *pilbarensis*	0.5 %	0.5 – 1 m	1.2	
Bonamia linearis	0.5 %		23.21	
Bonamia rosea	0.5 %	< 0.5 m	23.30	
Bulbostylis barbata	+		23.13	
Byblis filifolia	+		23.15	
Cajanus cinereus	0.5 %	1 – 2 m	23.27	
Carissa lanceolata	0.5 %	1 – 2 m	23.3	
Chrysopogon fallax	0.5 %		23.11	
Cleome viscosa	+		23.19	
Corchorus sidoides aff. subsp. *vermicularis* (GLD(NIM)17.16)	0.5 %	< 0.5 m	23.29	
Corymbia flavescens	0.5 %	< 5 m	23.2	
Corymbia hamersleyana	1 %	< 5 m	23.1	
Crotalaria ramosissima	0.5 %	< 0.5 m	23.22	
Cyperus blakeanus	1 %		23.34	
Dampiera candicans	0.5 %	< 0.5 m	10.13	
Eragrostis aff. *eriopoda*	5 – 8 %		23.9	
Eragrostis elongata	1 %		23.16	
Eriachne obtusa	2 %		23.10	
Goodenia microptera	+		23.18	
Grevillea wickhamii subsp. *aprica*	0.5 %	< 0.5 m	1.4	
Hakea chordophylla	0.5 %	1 – 2 m	23.25	
Heliotropium chrysocarpum	0.5 %	< 0.5 m	23.31	
Heliotropium cunninghamii	0.5 %	< 0.5 m	23.32	
Hibiscus leptocladus	0.5 %	< 0.5 m	23.14	
Hybanthus aurantiacus	+		23.26	
Indigofera monophylla (small calyx form)	2 %	< 0.5 m	1.6	
Isotropis atropurpurea	2 %	< 0.5 m	23.20	
Isotropis atropurpurea	5 %	< 0.5 m	20.25	

Leptosema anomalum	0.5 %	< 0.5 m	23.6
Mollugo molluginis	+		23.7
Phyllanthus maderaspatensis var. *angustifolius*	0.5 %	< 0.5 m	23.17
Pluchea tetranthera	1 %	< 0.5 m	23.4
Ptilotus calostachyus var. *calostachyus*	0.5 %	0.5 – 1 m	1.15
Ptilotus fusiformis var. *fusiformis*	+		20.6
Sida ?cardiophylla (juvenile)	0.5 %	0.5 – 1 m	23.33
Solanum diversiflorum	0.5 %	< 0.5 m	2.12
Sporobolus australasicus	+		23.12
Tephrosia sp.Bungaroo Creek(M.E.Trudgen 11601)	5 – 10 %	< 0.5 m	20.16
Triodia schinzii	15 %		23.5
Yakirra australiensis	0.5 %		23.8

Goldsworthy Site 24

Described C. SLEE **Date** 26/10/200 50 by 50
Location Nimingarra Mining Lease
Air Photo 75 **on** 1 **Video** N **E Photo**
WGS84 50 812858 mE, 7736253 mN
Habitat Flat sandplain
Soil Red-orange to red-brown sand with loose soil
Rock Type Nil
Vegetation *Corymbia zygophylla*, *Corymbia hamersleyana* and *Corymbia flavescens* sparse low woodland over *Acacia tumida* var. *pilbarensis* open medium shrubland over *Dodonea coriacea* sparse low shrubland over *Corchorus sidoides* aff. subsp. *vermicularis*(GLD(NIM)17.16) sparse dwarf shrubland over *Triodia wiseana* sparse hummock grassland.
Veg Condition Poor, moderate to heavy cattle grazing and trampling, dead acacias post-fire
Fire 1 – 5 years
Notes Moderate leaf litter mainly under shrubs and moderate woody litter. GPS +/- 4 m error. Status: Dry, many annuals probably not available. Search intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia ancistrocarpa	0.5 %	1 – 2 m	19.1	
Acacia tumida var. *pilbarensis*	15 %	1 – 2 m	1.2	
Aristida holathera var. *holathera*	0.5 %		24.18	
Bonamia linearis	+		24.10	
Bulbostylis barbata	+		24.15	
Cassia curvistyla	0.5 %	< 0.5 m	24.11	
Corchorus sidoides aff. subsp. *vermicularis* (GLD(NIM)17.16)	5 %	< 0.5 m	24.3	
Corymbia flavescens	0.5%	<5m	23.2	
Corymbia hamersleyana	0.5%	<5m	23.1	
Corymbia zygophylla	2 %	< 5 m	24.1	
Crotalaria ramosissima	1 %	< 0.5 m	24.6	
Dampiera candicans	0.5 %	0.5 – 1 m	10.13	
Dodonaea coriacea	5 %	0.5 – 1 m	24.2	
Eragrostis aff. *eriopoda*	1 %		24.19	
Euphorbia australis	+		24.16	
Goodenia microptera	+		24.14	
Jacksonia aculeata	1 %	0.5 – 1 m	24.5	
Jasminum didymum subsp. *lineare*	0.5 %	0.5 – 1 m	17.8	
Mollugo molluginis	+		24.20	
Phyllanthus maderaspatensis var. *angustifolius*	0.5 %	< 0.5 m	24.7	
Ptilotus calostachyus var. *calostachyus*	0.5 %	0.5 – 1 m	1.15	
Sida aff. *echinocarpa* (MET 15,350)	0.5 %	< 0.5 m	24.12	material inadequate
Sida aff. *echinocarpa* (MET 15,350)	0.5 %	0.5 – 1 m	24.9	material inadequate
Sida arenicola	0.5 %	0.5 – 1 m	24.13	
Solanum dioicum	0.5 %	< 0.5 m	24.8	
Trianthema pilosa	+		24.17	
Triodia wiseana	5 %		11.4	
Yakirra australiensis	+		24.21	

Goldsworthy **Site** 25

Described BRM **Date** 28/10/200 50 by 50

Location Nimingarra Mining Lease south of track to NIM crusher

Air Photo 82 **on** 1 **Video** N **E Photo**

WGS84 50 187347 mE, 7736577 mN

Habitat Midslope and rocky scree of hill

Soil Brown to red-orange sandy clay with loose soil, coarse gravel, pebbles, stones and boulders

Rock Type Ferrous

Vegetation *Corymbia hamersleyana* scattered low woodland over *Petalostylis labicheoides* sparse medium shrubland over *Grevillea wickhamii* subsp. *aprica* open low shrubland over *Acacia adoxa* var. *adoxa* scattered low shrubland over *Triodia epactia* moderately dense hummock grassland.

Veg Condition Poor, old drillpads, capped holes, loose boulders, earth piles, drums, old hoses, o-rings and stakes

Fire 1 – 5 years

Notes Sparse leaf litter mainly under shrubs and negligible woody litter. GPS +/- 4 m error. Status: Dry, many annuals probably not available. Search intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	1 %	< 0.5 m	1.5	
Acacia hilliana	0.5 %	< 0.5 m	1.16	
Acacia inaequilatera	0.5 %	0.5 – 1 m	2.1	
Acacia pyrifolia	0.5 %	0.5 – 1 m	1.22	
Acacia tumida var. *pilbarensis*	0.5 %	1 – 2 m	1.2	
Cajanus cinereus	0.5 %	0.5 – 1 m	25.2	
Corymbia hamersleyana	0.5 %	< 5 m	1.1	
Gomphrena cunninghamii	+		8.21	
Goodenia stobbsiana	+		1.14	
Goodenia stobbsiana	+		1.14	
Grevillea wickhamii subsp. *aprica*	15 %	0.5 – 1 m	1.4	
Oldenlandia crouchiana	+		25.3	
Petalostylis labicheoides	5 %	1 – 2 m	1.12	
Ptilotus calostachyus var. *calostachyus*	0.5 %	0.5 – 1 m	1.15	
Senna glutinosa subsp. *glutinosa*	0.5 %	< 0.5 m	14.9	
Solanum diversiflorum	0.5 %	< 0.5 m	2.12	
Solanum horridum	0.5 %	< 0.5 m	10.15	
Tephrosia aff. *supina* (HD133-20)	+		25.1	
Tribulus suberosus	0.5 %	0.5 – 1 m	18.3	
Triodia epactia	30 %		1.7	

Goldsworthy Site 26

Described C. SLEE **Date** 28/10/200 50 by 50

Location Nimingarra Mining Lease on track to NIM crusher

Air Photo 83 **on** 1 **Video** N **E Photo**

WGS84 50 187724 mE, 7736745 mN

Habitat Steep east-south-east facing rocky slope

Soil Brown to red-orange sandy clay with stones, boulders and surface level plates

Rock Type Ferrous and Banded Iron Formation

Vegetation *Corymbia hamersleyana*, *Hakea chordophylla* scattered low woodland over *Grevillea wickhamii* subsp. *aprica* scattered low shrubland over *Acacia adoxa* var. *adoxa*, *Acacia hilliana* moderately dense dwarf shrubland over *Triodia epactia* open hummock grassland over *Goodenia stobbsiana* sparse herbs.

Veg Condition Pristine, no disturbance

Fire 1 – 5 years

Notes Moderate leaf litter mainly under shrubs and sparse woody litter. GPS +/- 4 m error. Status: Dry, many annuals probably not available. Search intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	35 %	< 0.5 m	1.5	
Acacia ancistrocarpa	0.5 %	0.5 – 1 m	19.1	
Acacia hilliana	15 %	< 0.5 m	1.16	
Acacia pyrifolia	0.5 %	< 0.5 m	1.22	
Acacia tumida var. *pilbarensis*	0.5 %	< 0.5 m	1.2	
Bonamia rosea	+		20.19	
Corymbia hamersleyana	0.5 %	< 5 m	1.1	
Dampiera candicans	0.5 %	< 0.5 m	10.13	
Goodenia stobbsiana	5 %		1.14	
Grevillea pyramidalis subsp. *leucadendron*	0.5 %	< 0.5 m	26.3	
Grevillea wickhamii subsp. *aprica*	1 %	0.5 – 1 m	1.4	
Hakea chordophylla	0.5 %	< 5 m	26.1	
Indigofera monophylla (small calyx form)	0.5 %	< 0.5 m	1.6	
Ptilotus calostachyus var. *calostachyus*	0.5 %	0.5 – 1 m	1.15	
Sida sp.A Kimberley Flora(P.A.Fryxell & L.A.Craven 3900)	0.5 %	1 – 2 m	26.2	
Triodia epactia	25 %		1.7	
Triumfetta maconochieana	0.5 %	< 0.5 m	1.9	

Goldsworthy **Site** 27

Described C. SLEE **Date** 28/10/200 50 by 50

Location Nimingarra Mining Lease south-west of moonscaping waste dump

Air Photo 84 **on** 1 **Video** N **E Photo**

WGS84 50 187610 mE, 7739020 mN

Habitat Undulating hill slope and hill crest

Soil Red-orange fine sand to sandy clay with fine and coarse gravel, pebbles and rock outcrops

Rock Type Ferrous

Vegetation *Grevillea wickhamii* subsp. *aprica* scattered low shrubland over *Acacia adoxa* var. aprica sparse dwarf shrubland over *Goodenia stobbsiana* sparse herbs over *Triodia epactia* open hummock grassland.

Veg Condition Excellent, minimal disturbance, 2 drill holes, possibly affected by dust from waste dump

Fire 1 – 5 years

Notes Negligible leaf litter mainly under spinifex and negligible woody litter. GPS +/- 4 m error. Status: Dry, many annuals probably not available. Search intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	5 – 8 %	< 0.5 m	1.5	
Acacia hilliana	2 %	< 0.5 m	1.16	
Eriachne lanata	+		27.1	
Goodenia stobbsiana	5 %		1.14	
Grevillea wickhamii subsp. *aprica*	1 %	0.5 – 1 m	1.4	
Indigofera monophylla (small calyx form)	0.5 %	< 0.5 m	1.6	
Oldenlandia crouchiana	+		27.2	
Petalostylis cassioides	0.5 %	< 0.5 m	1.17	
Ptilotus calostachyus var. *calostachyus*	0.5 %	0.5 – 1 m	1.15	
Senna venusta	0.5%	<0.5m	1.10	
Tephrosia spechtii	0.5 %	0.5 – 1 m	2.14	
Triodia epactia	15 %		1.7	

Goldsworthy **Site** 28

Described C. SLEE **Date** 28/10/200 50 by 50

Location Nimingarra Mining Lease south east of rock dump

Air Photo 85 **on** 1 **Video** N **E Photo**

WGS84 50 187055 mE, 7736924 mN

Habitat Steep to moderate rocky hill slope

Soil Brown to red-orange sandy clay with coarse gravel, pebbles, stones and boulders

Rock Type Ferrous

Vegetation Eucalyptus leucophloia subsp. *leucophloia* sparse medium woodland over *Senna glutinosa* subsp. *glutinosa* sparse medium shrubland over *Acacia inaequilatera* scattered low shrubland over *Acacia adoxa* var. *adoxa*, *Indigofera monophylla* (small calyx form) moderately dense dwarf shrubland over *Triodia epactia* open hummock grassland.

Veg Condition Excellent, minimal disturbance, rock disturbance from nearbby rock dump

Fire 1 – 5 years

Notes Moderate leaf litter mainly under shrubs and moderate woody litter. GPS +/- 4 m error. Status: Dry, many annuals probably not available. Search intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	25 %	< 0.5 m	1.5	
Acacia inaequilatera	1 %	0.5 – 1 m	2.1	
Acacia pyrifolia	0.5 %	< 0.5 m	1.22	
Acacia tumida var. *pilbarensis*	0.5 %	< 0.5 m	1.2	
Corchorus aff. *parviflorus* (2)	0.5 %	< 0.5 m	28.3	Determination uncertain
Eriachne lanata	+		27.1	
Eucalyptus leucophloia subsp. *leucophloia*	2 – 4 %	5 – 15 m	28.1	
Gomphrena cunninghamii	+		8.21	
Hibiscus coatesii	0.5 %	0.5 – 1 m	28.4	
Indigofera monophylla (small calyx form)	10 %	< 0.5 m	1.6	
Ptilotus calostachyus var. *calostachyus*	1 %	0.5 – 1 m	1.15	
Senna glutinosa subsp. *glutinosa*	2 %	1 – 2 m	28.2	
Sida sp.A Kimberley Flora(P.A.Fryxell & L.A.Craven 3900)	0.5 %	1 – 2 m	28.5	
Tephrosia spechtii	0.5 %	0.5 – 1 m	2.14	
Tribulus suberosus	0.5 %	0.5 – 1 m	18.3	

Goldsworthy **Site** 29

Described C. SLEE **Date** 28/10/200 50 by 50

Location Nimingarra Mining Lease north of water pump and east of railway line

Air Photo 86 **on** 1 **Video** N **E Photo**

WGS84 50 188812 mE, 7737993 mN

Habitat Broad sandy creek bed

Soil Pale orange sand woth loose soil

Rock Type Nil

Vegetation *Corymbia flavescens* sparse medium trees over *Melaleuca argentea* moderately dense medium woodland over *Acacia colei* var. *colei* sparse tall shrubland over scattered grasses over *Cyperus vaginatus*, *Cyperus conicus* scattered sedges.

Veg Condition Poor, heavy cattle grazing and trampling and death of some species due to groundwater pumping nearby

Fire > 5 years

Notes Moderate leaf litter mainly under shrubs and moderate woody litter. GPS +/- 5 m error. Status: Dry, many annuals probably not available. Search intensity: Thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia colei var. *colei*	5 %	> 2 m	20.2	
Acacia trachycarpa	1 %	> 2 m	29.3	
Bonamia pannosa	+		29.12	
Cajanus cinereus	0.5 %	0.5 – 1 m	29.4	
Cassytha filiformis	+		29.13	
Corymbia flavescens	5 %	5 – 15 m	29.1	
Cyperus conicus	1 %		29.6	
Cyperus vaginatus	1 %		29.5	
Euphorbia coghlanii	+		29.11	
Heteropogon contortus	2 %		29.14	
Melaleuca argentea	35 %	5 – 15 m	29.2	
Oldenlandia galioides	+		29.10	
Sida rohlenae subsp. *Rohlenae*	0.5 %	< 0.5 m	29.8	
Trachymene oleracea	+		29.9	
Triumfetta johnstonii	0.5 %	0.5 – 1 m	2.8	
Typha domingensis	3 %		29.7	

Goldsworthy **Site** 30

Described C. SLEE **Date** 29/10/200 50 by 50

Location Sunrise Hill mining lease north of main track

Air Photo 96 **on** 1 **Video** N **E Photo**

WGS84 50 195078 mE, 7733537 mN

Habitat Rehabilitation crest, ripped and moonscaped

Soil Sandy clay with loose soil, fine and coarse gravel, pebbles, stones and boulders

Rock Type Ferrous

Vegetation *Acacia colei* var. *colei*, *Acacia trachycarpa* sparse tall shrubland over *Acacia inaequilatera*, *Acacia pyrifolia*, *Acacia stellaticeps*, *Acacia* aff. *ancistrocarpa*(GLD(NIM)17.2) open medium shrubland over *Ptilotus exaltatus* var. *exaltatus*, *Ptilotus calostachyus* var. *calostachyus*, *Ptilotus axillaris* sparse low shrubland over *Cymbopogon ambiguus* grasses over *Triodia epactia* open hummock grassland.

Veg Condition Degraded, completely altered and partially rehabilitated landscape

Fire > 5 years

Notes Moderate leaf litter mainly under shrubs and in scoop area and plentiful woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia aff. *ancistrocarpa* (GLD(NIM)17.2)	1 %	1 – 2 m	17.2	
Acacia colei var. *colei*	5 – 8 %	> 2 m	20.2	
Acacia inaequilatera	2 %	1 – 2 m	2.1	
Acacia pyrifolia	2 %	1 – 2 m	1.22	
Acacia stellaticeps	2 %	0.5 – 1 m	30.15	
Acacia trachycarpa	5 %	> 2 m	30.1	
Acacia tumida var. *pilbarensis*	0.5 %	1 – 2 m	1.2	
**Aerva javanica*	0.5 %	0.5 – 1 m		
Aristida contorta	+		30.9	
Aristida holathera var. *holathera*	2 %		30.7	
Cymbopogon ambiguus	10 %		30.6	
Eriachne obtusa	+		30.11	
Eucalyptus leucophloia subsp. *leucophloia*	0.5 %	1 – 2 m	30.12	
Gomphrena cunninghamii	0.5 %		8.21	
Ipomoea muelleri	0.5 %		30.5	
Mukia maderaspatana	1 %		7.7	
Ptilotus axillaris	0.5 %	< 0.5 m	30.3	
Ptilotus calostachyus var. *calostachyus*	5 %	0.5 – 1 m	1.15	
Ptilotus exaltatus var. *exaltatus*	2 %			
Ptilotus incanus var. *elongatus*			30.16	
Solanum lasiophyllum	0.5 %	< 0.5 m	30.14	
Streptoglossa decurrens	2 %	< 0.5 m	30.4	
Tephrosia aff. *supina* (HD205-10)	0.5 %	< 0.5 m	30.13	
Trichodesma zeylanicum var. *zeylanicum*	+		30.8	
Triodia epactia	0.5 %		1.7	
Triodia lanigera	0.5 %		30.10	

Goldsworthy **Site** 31

Described C. SLEE **Date** 29/10/200 50 by 50

Location Sunrise Hill mining lease west of moonscaping waste dump

Air Photo 97 **on** 1 **Video** N **E Photo**

WGS84 50 191482 mE, 7737337 mN

Habitat Gently slope of rocky to gravelly hill crest

Soil Brown to red-orange sandy clay with coarse gravel, pebbles and rocky outcroppings

Rock Type Ferrous

Vegetation Acacia orthocarpa sparse medium shrubland over *Grevillea wickhamii* subsp. *aprica*, *Acacia inaequilatera* sparse low shrubland over *Acacia adoxa* var. *adoxa*, *Acacia hilliana* sparse dwarf shrubland over *Triodia epactia* open hummock grassland.

Veg Condition Excellent, minimal disturbance, old access track

Fire 1 – 5 years

Notes Negligible leaf litter mainly under shrubs and negligible woody litter. GPS +/- 3 m. Status: Dry, many annuals not available. Intensity: Very thorough.

.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	2 %	< 0.5 m	1.5	
Acacia aff. *ancistrocarpa* (GLD(NIM)18.11)		0.5 – 1 m	31.1	
Acacia hilliana	1 %	< 0.5 m	1.16	
Acacia inaequilatera	1 %	0.5 – 1 m	2.1	
Acacia orthocarpa	5 – 8 %	1 – 2 m	7.1	
Bonamia media var. *villosa*	+		31.3	
Eriachne lanata	1 %		27.1	
Fimbristylis simulans	+		31.2	
Grevillea wickhamii subsp. *aprica*	2 %	0.5 – 1 m	1.4	
Ptilotus calostachyus var. *calostachyus*	0.5 %	0.5 – 1 m	1.15	
Triodia epactia	25 %		1.7	

Goldsworthy **Site** 32

Described C. SLEE **Date** 29/10/200 50 by 50

Location Sunrise Hill mining lease west of W4 pit and south of S3, S4W and S6 pits

Air Photo 98 **on** 1 **Video** N **E Photo**

WGS84 50 189798 mE, 7737746 mN

Habitat very gently undulating gravel to sandplains

Soil Cream to pale yellow-brown sandy clay loam with surface crust and coarse gravel and pebbles

Rock Type Ferrous and granite. Gravel types: decayed feldspar dominated by granite.

Vegetation *Corymbia hamersleyana* scattered low woodland over *Grevillea wickhamii* subsp. *aprica* sparse medium shrubland over *Corchorus* aff. *parviflorus* (2) sparse low shrubland over *Acacia hilliana* scattered dwarf shrubland over *Triodia epactia* open hummock grassland.

Veg Condition Excellent, minimal disturbance, affected by dust from surrounding roads

Fire 1 – 5 years

Notes Sparse leaf litter mainly under shrubs and sparse woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia bivenosa	0.5 %	0.5 – 1 m	32.9	
Acacia colei var. *colei*	0.5 %	1 – 2 m	20.2	
Acacia hilliana	0.5 %	< 0.5 m	1.16	
Acacia inaequilatera	0.5 %	1 – 2 m	2.1	
Acacia trachycarpa	0.5 %	1 – 2 m	32.5	
Bonamia sp. (HD94-6)	0.5 %	< 0.5 m	32.11	
Cassytha capillaris	+		32.12	
Cleome uncifera subsp. *uncifera*	+		32.13	
Codonocarpus cotinifolius	0.5 %	< 0.5 m	32.10	
Corchorus aff. *parviflorus* (2)	5 %	0.5 – 1 m	32.1	
Corymbia hamersleyana	0.5 %	< 5 m	1.1	
Grevillea pyramidalis subsp. *pyramidalis*	0.5 %	1 – 2 m	32.8	
Grevillea wickhamii subsp. *aprica*	5 %	1 – 2 m	1.4	
Indigofera monophylla	0.5 %	0.5 – 1 m	1.6	
Polygala aff. *isingii*	+		32.6	
Ptilotus astrolasius var. *astrolasius*	0.5 %	< 0.5 m	32.2	
Ptilotus axillaris	0.5 %	< 0.5 m	32.14	
Ptilotus calostachyus var. *calostachyus*	0.5 %	0.5 – 1 m	1.15	
Scaevola amblyanthera var. *centralis*	+		32.4	
Senna glutinosa subsp. *pruinosa*	0.5 %	1 – 2 m	32.7	
Stemodia grossa	+		32.3	
Triodia epactia	25 %		1.7	

Goldsworthy **Site** 33

Described C. SLEE **Date** 30/10/200 50 by 50

Location Sunrise Hill mining lease

Air Photo **Photo** 99 **on** 1 **Video** N **E Photo**

WGS84 50 190651 mE, 7738856 mN

Habitat Minor channel and small gully off hill crests

Soil Brown to red-orange sandy clay to loam with fine and coarse gravel and pebbles

Rock Type Ferrous

Vegetation *Grevillea wickhamii* subsp. *aprica* sparse tall shrubland over *Dampiera candicans* open low shrubland over *Acacia hilliana*, *Acacia adoxa* var. *adoxa* moderately dense dwarf shrubland over *Triodia epactia* open hummock grassland over *Goodenia stobbsiana* herbs.

Veg Condition Pristine, no disturbance

Fire 1 – 5 years

Notes Moderate leaf litter mainly under shrubs and moderate woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	10 %	< 0.5 m	1.5	
Acacia hilliana	35 %	< 0.5 m	1.16	
Acacia pyrifolia	0.5 %	1 – 2 m	1.22	
Corchorus aff. *parviflorus* (1)	0.5 %	< 0.5 m	33.1	
Dampiera candicans	15 %	0.5 – 1 m	10.13	
Goodenia stobbsiana	1 %		1.14	
Grevillea wickhamii subsp. *aprica*	5 %	> 2 m	1.4	
Indigofera monophylla	0.5 %	0.5 – 1 m	1.6	
Petalostylis labicheoides	0.5 %	1 – 2 m	1.12	
Ptilotus calostachyus var. *calostachyus*	1 %	0.5 – 1 m	1.15	
Tephrosia spechtii	0.5 %	0.5 – 1 m		
Trachymene oleracea	+		5.2	
Triodia epactia	15 %		1.7	

Goldsworthy **Site** 34

Described C. SLEE **Date** 30/10/200 50 by 50

Location Sunrise Hill mining lease west of explosives magazine

Air Photo 100 **on** 1 **Video** N **E Photo**

WGS84 50 189918 mE, 7738313 mN

Habitat Undulating lower slopes to plains and low spurs with depressions in between

Soil Brown to red-orange sandy clay to loam with surface crust, fine and coarse gravel and pebbles

Rock Type Ferrous

Vegetation *Acacia inaequilatera*, *Acacia tumida* var. *pilbarensis* scattered medium shrubland over *Acacia stellaticeps*, *Acacia hilliana*, *Acacia adoxa* var. *adoxa*, Acacia sp.Rudall River(B.R.Maslin 2046A) moderately dense dwarf shrubland over *Triodia epactia* moderately dense hummock grassland.

Veg Condition Pristine, no disturbance

Fire 1 – 5 years

Notes Sparse leaf litter mainly under shrubs and sparse woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough. Adult Acacia spp dead from fire, shrubs to 1 – 1.5 m pre-fire.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	5 %	< 0.5 m	1.5	
Acacia hilliana	10 %	< 0.5 m	1.16	
Acacia inaequilatera	0.5 %	1 – 2 m	2.1	
Acacia sp.Rudall River(B.R.Maslin 2046A)	0.5 %	< 0.5 m	34.2	
Acacia stellaticeps	20 %	< 0.5 m	34.1	
Acacia tumida subsp. ?*pilbarensis* x ?	0.5 %	< 0.5 m	34.3	
Acacia tumida var. *pilbarensis*	0.5 %	1 – 2 m	1.2	
Bonamia media var. *villosa*	+		34.4	
Goodenia stobbsiana	+		1.14	
Ptilotus astrolasius var. *astrolasius*	0.5 %	< 0.5 m	32.2	
Ptilotus calostachyus var. *calostachyus*	0.5 %	0.5 – 1 m	1.15	

Goldsworthy **Site** 35

Described C. SLEE **Date** 30/10/200 50 by 50

Location Sunrise Hill mining lease west of Leighton's crib hut, *Typha* bed and light vehicle park

Air Photo 103 **on** 1 **Video** N **E Photo**

WGS84 50 190250 mE, 7736758 mN

Habitat Minor channel on gravel plains

Soil Mid to pale brown clay loam with surface crust, coarse gravel and pebble

Rock Type Ferrous

Vegetation *Acacia tumida* var. *pilbarensis* moderately dense tall shrubland over *Acacia hilliana* sparse dwarf shrubland over *Triodia epactia* sparse hummock grassland.

Veg Condition Excellent, minimal disturbance, probably affected by additional surface water flow from haul road, stockpile and Go-line areas

Fire > 5 years

Notes Plentiful leaf litter mainly widespread and plentiful woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia hilliana	5 %	< 0.5 m	1.16	
Acacia inaequilatera	0.5 %	1 – 2 m	2.1	
Acacia tumida var. *pilbarensis*	80 %	> 2 m	1.2	
Goodenia stobbsiana	+		1.14	
Grevillea wickhamii subsp. *aprica*	0.5 %	1 – 2 m	1.4	
Indigofera monophylla	0.5 %	< 0.5 m	1.6	
Triodia epactia	5 – 10 %		1.7	

Goldsworthy Site 36

Described C. SLEE **Date** 30/10/200 50 by 50

Location Sunrise Hill mining lease north-west of NIM Access Road from Yarrie

Air Photo 104 **on** 1 **Video** N **E Photo**

WGS84 50 193182 mE, 7733586 mN

Habitat Low gravelly rehabilitated slopes and undulating spurs

Soil Red-orange fine gravelly sandy clay

Rock Type Ferrous

Vegetation *Acacia colei* var. *colei*, *Acacia eriopoda* sparse tall shrubland over mixed medium to dwarf shrubland over *Ptilotus exaltatus* var. *exaltatus* sparse herbs over *Aristida holathera* var. *holathera* and *Cymbopogon ambiguus* open soft grasses over *Triodia lanigera*, *Triodia epactia* sparse hummock grassland.

Veg Condition Degraded, scraped slopes of gravel, ripped and rehabilitated and minor gully erosion

Fire > 5 years

Notes Moderate leaf litter mainly under shrubs and moderate woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough. Old rehabilitation

.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia colei var. *colei*	2 %	> 2 m	20.2	
Acacia eriopoda	1 %	> 2 m	36.1	
Acacia hilliana	0.5 %	< 0.5 m	1.16	
Acacia inaequilatera	1 %	1 – 2 m	2.1	
Acacia pyrifolia	0.5 %	1 – 2 m	1.22	
Acacia tumida var. *pilbarensis*	0.5 %	1 – 2 m	1.2	
Aristida contorta	0.5 %		36.4	
Aristida holathera var. *holathera*	10 %		36.3	
Corchorus sidoides aff. subsp. *vermicularis* (GLD(NIM)17.16)	0.5 %	< 0.5 m	20.18	
Cymbopogon ambiguus			36.20	
Enneapogon caerulescens var. *caerulescens*	+		36.19	
Eriachne aristidea	+		36.18	
Eriachne ciliata	2 %		36.17	
Euphorbia australis	1 %		36.12	
Ipomoea muelleri	0.5 %		36.13	
Mukia maderaspatana	0.5 %		7.7	
Ptilotus calostachyus var. *calostachyus*	0.5 %	0.5 – 1 m	1.15	
Ptilotus exaltatus var. *exaltatus*	5 %			
Ptilotus incanus var. *elongatus*	0.5 %	< 0.5 m	36.16	
Salsola tragus	0.5 %	< 0.5 m	36.10	
Senna artemisioides subsp. aff. *oligophylla* (thinly sericeous)	0.5 %	< 0.5 m	36.7	
	0.5 %	< 0.5 m	36.9	
Senna glutinosa subsp. *glutinosa*	0.5 %	< 0.5 m	36.8	
Senna venusta	0.5 %	< 0.5 m	8.6	
Solanum lasiophyllum	0.5 %	< 0.5 m	30.14	
Sporobolus australasicus	+		36.5	
Trichodesma zeylanicum var. *zeylanicum*	+		36.15	
Triodia epactia	2 %		1.7	
Triodia lanigera	5 %		36.6	
Triumfetta chaetocarpa	0.5 %	0.5 – 1 m	36.14	

Goldsworthy **Site** 37

Described C. SLEE **Date** 31/10/200 50 by 50

Location Sunrise Hill mining lease north of NIM Access road

Air Photo 105 **on** 1 **Video** N **E Photo**

WGS84 50 193695 mE, 7733606 mN

Habitat Steep rocky hill slope and mid scarp

Soil Brown to red-orange sandy clay to loam with coarse gravel, pebbles, stones and boulders

Rock Type Ferrous

Vegetation *Grevillea pyramidalis* subsp. *pyramidalis* scattered low trees over *Cajanus cinereus* scattered medium shrubland over mixed scattered shrubland over *Triodia wiseana, Triodia epactia* moderately dense hummock grassland.

Veg Condition Pristine, no disturbance

Fire > 5 years

Notes Moderate leaf litter mainly under spinifex and negligible woody litter. GPS +/- 7 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia ancistrocarpa	0.5 %	0.5 – 1 m	37.1	
Bonamia media var. *villosa*	+		37.3	
Bulbostylis barbata	+		17.11	
Cajanus cinereus	0.5 %	1 – 2 m	16.2	
Cymbopogon ambiguus	+		8.13	
Dampiera candicans	0.5 %	< 0.5 m	10.13	
Grevillea pyramidalis subsp. *pyramidalis*	1 %	< 5 m	32.8	
Indigofera monophylla	0.5 %	< 0.5 m	1.6	
Ptilotus calostachyus var. *calostachyus*	0.5 %	< 0.5 m	1.15	
Sida aff. *cardiophylla* (site 1086)	0.5 %	< 0.5 m	37.2	
Solanum horridum	0.5 %	< 0.5 m	10.15	
Trachymene oleracea	+		5.2	
Triodia epactia	10%		1.7	
Triodia wiseana	30%		11.4	
Triumfetta johnstonii	0.5 %	0.5 – 1 m	2.8	

Goldsworthy Site 38

Described C. SLEE **Date** 31/10/200 50 by 50

Location Sunrise Hill mining lease between moonscaping waste dump and rock dump

Air Photo 107 **on** 1 **Video** N **E Photo**

WGS84 50 192257 mE, 7734573 mN

Habitat Scarp plateau

Soil Brown to red sandy clay with fine and coarse gravel, pebbles, stones, boulders and slab outcrops

Rock Type Ferrous

Vegetation *Acacia inaequilatera* scattered low trees over *Corchorus* aff. *cardiophylla* (site 1086), *Acacia hilliana* scattered dwarf shrubland over *Triodia epactia* open hummock grassland

Veg Condition Excellent, minimal disturbance, one overgrown track and old drill holes

Fire > 5 years

Notes Sparse leaf litter mainly under shrubs and sparse woody litter. GPS +/- 3 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	0.5 %	< 0.5 m	1.5	
Acacia hilliana	2 %	< 0.5 m	1.16	
Acacia inaequilatera	0.5 %	< 5 m	2.1	
Cymbopogon ambiguus	1 %		8.13	
Eriachne lanata	+		38.3	
Goodenia stobbsiana	0.5 %		1.14	
Grevillea wickhamii subsp. *aprica*	0.5 %	1 – 2 m	1.4	
Hakea chordophylla	0.5 %	1 – 2 m	38.5	
Indigofera monophylla	0.5 %	< 0.5 m	1.6	
Mukia maderaspatana	+		7.7	
Ptilotus calostachyus var. *calostachyus*	0.5 %	0.5 – 1 m	1.15	
Ptilotus incanus var. *elongatus*	0.5 %	< 0.5 m	38.4	
Senna glutinosa subsp. *glutinosa*	0.5 %	< 0.5 m	14.9	
Sida aff. *cardiophylla* (site 1086)	0.5 %	< 0.5 m	37.2	
Sida aff. *cardiophylla* (site 1086)	0.5 %	< 0.5 m	38.1	
Solanum cleistogamum	0.5 %	< 0.5 m	38.2	
Solanum horridum	0.5 %	< 0.5 m	10.15	
Triodia epactia	20 %		1.7	
Triumfetta johnstonii	0.5 %	< 0.5 m	2.8	
Triumfetta maconochieana	0.5 %	< 0.5 m	1.9	

Goldsworthy **Site** 39

Described C. SLEE **Date** 31/10/200 50 by 50

Location Sunrise Hill mining lease north of access track

Air Photo 108 **on** 1 **Video** N **E Photo**

WGS84 50 191254 mE, 7735442 mN

Habitat Minor creekline at base of scarp slopes and edge of undulating plains

Soil Sand to sandy clay to clay with cracked clay, surface crust, fine gravel and loose soil

Rock Type Ferrous and granite

Vegetation *Corymbia hamersleyana, Corymbia flavescens* sparse medium woodland over *Acacia tumida* var. *pilbarensis, Cajanus cinereus* moderately dense medium shrubland over *Tephrosia rosea* var. *clementii* sparse low shrubland over **Cenchrus ciliaris, Themeda triandra* grassland over *Triodia epactia* scattered hummock grassland.

Veg Condition Poor, significant disturbance, heavy cattle grazing, trampling, **Cenchrus* weed present

Fire > 5 years

Notes Plentiful leaf litter mainly under shrubs and plentiful woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia aff. *ancistrocarpa* (GLD(NIM)17.2)	0.5 %	1 – 2 m	17.2	
Acacia colei var. *colei*	5 %	> 2 m	20.2	
Acacia pyrifolia	0.5 %	1 – 2 m	1.22	
Acacia tumida var. *pilbarensis*	15 %	> 2 m	1.2	
Cajanus cinereus	15 %	> 2 m		
Carissa lanceolata	5 %	> 2 m	39.2	
Cassytha filiformis	+		39.10	
**Cenchrus ciliaris*	0.5 %		39.5	
Corymbia flavescens	0.5 %	5 – 15 m	39.1	
Corymbia hamersleyana	5 %	5 – 15 m	1.1	
Dichrostachys spicata	0.5 %	1 – 2 m	39.4	
Euphorbia coghlanii	+		39.7	
Hybanthus aurantiacus	0.5 %	< 0.5 m	39.8	
Jasminum didymum subsp. *lineare*	1 %	0.5 – 1 m	17.8	
Pterocaulon sphaeranthoides	+		39.3	
Streptoglossa decurrens	0.5 %	< 0.5 m	30.4	
Tephrosia rosea var. *clementii*	5 %	0.5 – 1 m	5.4	
Themeda triandra	0.5 %	< 0.5 m	39.6	
Trachymene oleracea	+		5.2	
Triodia epactia	1 %		1.7	
Waltheria indica	0.5 %	< 0.5 m	39.9	

Goldsworthy **Site** 40

Described C. SLEE **Date** 31/10/200 50 by 50

Location Sunrise Hill mining lease north-west of SH access road

Air Photo 109 **on** 1 **Video** N **E Photo**

WGS84 50 191650 mE, 7737748 mN

Habitat Low ferritic sandstone ridge crest

Soil sandy loam with coarse gravel, pebbles, stones and boulders

Rock Type Silicious ironstone and ferritic sandstone

Vegetation *Tephrosia spechtii* sparse medium shrubland over *Acacia adoxa* var. *adoxa* sparse dwarf shrubland over *Triodia epactia* moderately dense hummock steppe.

Veg Condition Pristine, no disturbance

Fire 1 – 5 years

Notes Sparse leaf litter mainly under shrubs and sparse woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	5 %	< 0.5 m	1.5	
Acacia hilliana	0.5 %	< 0.5 m	1.16	
Acacia tumida var. *pilbarensis*	0.5 %	0.5 – 1 m	1.2	
Eriachne ciliata	+		40.2	
Evolvulus alsinoides var. *villosicalyx*	+		14.14	
Goodenia stobbsiana	+		1.14	
Grevillea wickhamii subsp. *aprica*	0.5 %	0.5 – 1 m	1.4	
Ptilotus calostachyus var. *calostachyus*	0.5 %	0.5 – 1 m	1.15	
Senna glutinosa subsp. *glutinosa*	0.5 %	0.5 – 1 m	14.9	
Solanum cleistogamum	0.5 %	< 0.5 m	38.2	
Tephrosia spechtii	2 %	1 – 2 m	40.1	
Triodia epactia	40 %		1.7	

Goldsworthy **Site** 41

Described C. SLEE **Date** 31/10/200 50 by 50

Location Sunrise Hill mining lease between two scarps

Air Photo 110 **on** 1 **Video** N **E Photo**

WGS84 50 195556 mE, 7732589 mN

Habitat Swamp depression

Soil Dark brown peaty clay with humus and loose soil

Rock Type Some Banded Iron Formations and quartz dominated granite

Vegetation *Melaleuca argentea* dense medium to tall forest over *Eucalyptus victrix* sparse medium trees over *Sesbania formosa* sparse medium trees over *Typha domingensis* sparse rushes over *Cyperus vaginatus* open sedges.

Veg Condition Poor, significant disturbance, heavy cattle grazing, trampling, water disturbance and eutrophication

Fire > 5 years

Notes Plentiful leaf litter mainly under shrubs and plentiful woody litter. GPS +/- 6 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia colei var. *colei*	0.5 %	> 2 m	20.2	
Atalaya hemiglauca	2 %	> 2 m	14.2	
Cyperus vaginatus	20 %		41.4	
Eucalyptus victrix	2 %	5 – 15 m	41.2	
Ficus opposita var. *indecora*	0.5 %	> 2 m	41.6	
Flueggea virosa subsp. *melanthesoides*	0.5 %	> 2 m	41.7	
Jasminum didymum subsp. *lineare*	0.5 %	1 – 2 m	41.5	
Melaleuca argentea	75 %	5 – 15 m	41.1	
Sesbania formosa	5 %	5 – 15 m	41.3	
Typha domingensis	2 %			WP70

Goldsworthy Site 42

Described C. SLEE **Date** 1/11/2004 50 by 50

Location Sunrise Hill mining lease north of SW7 pit and west of SW4 pit

Air Photo 111 **on** 1 **Video** N **E Photo**

WGS84 50 191283 mE, 7736196 mN

Habitat Small hill crest with steep sides and rocky edges

Soil Brown to red-orange sandy clay to loam with coarse gravel, pebbles, stones, boulders and rock slabs

Rock Type Ferrous

Vegetation *Grevillea pyramidalis* subsp. *pyramidalis* scattered medium shrubland over *Grevillea wickhamii* subsp. *aprica*
scattered low shrubland over *Triodia epactia*, *Triodia wiseana* and *Triodia biflora* open hummock grassland.

Veg Condition Poor, significant disturbance, affected by rock and dust from blasting

Fire > 5 years

Notes Sparse leaf litter mainly under spinifex and negligible woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia colei var. *colei*	0.5 %	0.5 – 1 m	20.2	
Acacia inaequilatera	0.5 %	1 – 2 m	2.1	
Cymbopogon ambiguus	+		8.13	
Eriachne lanata	+			
Eucalyptus leucophloia	0.5 %	< 5 m	3.1	
Euphorbia aff. wheeleri (GLD(SRH)WP076)	+		42.2	
Grevillea pyramidalis subsp. *pyramidalis*	0.5 %	1 – 2 m	42.1	
Grevillea wickhamii subsp. *aprica*	0.5 %	0.5 – 1 m	1.4	
Indigofera monophylla (small calyx form)	0.5 %	< 0.5 m	1.6	
Ptilotus calostachyus var. *calostachyus*	0.5 %	0.5 – 1 m	1.15	
Solanum horridum	0.5 %	< 0.5 m	10.15	
Triodia biflora	0.5 %		43.1	
Triodia epactia	25 %		1.7	
Triodia wiseana	1 – 2 %		42.3	

Goldsworthy **Site** 43

Described C. SLEE **Date** 1/11/2004 50 by 50

Location Sunrise Hill mining lease west of SW7 pit

Air Photo 112 **on** 1 **Video** N **E Photo**

WGS84 50 190702 mE, 7737095 mN

Habitat Hill crest and rocky edges

Soil Brown to red-orange sandy clay to loam with coarse gravel, pebbles, stones and boulders

Rock Type Ferrous

Vegetation *Eucalyptus leucophloia* subsp. *leucophloia*, *Acacia inaequilatera*, Grevillea pyramidalis subsp. pyramidalis scattered low trees and tall to medium shrubland over *Corchorus* aff. *parviflorus* (1), *Triumfetta maconochieana*, *Indigofera monophylla* (small calyx form) scattered dwarf shrubland over grasses over *Triodia epactia* open hummock grassland.

Veg Condition Poor, significant disturbance, affected by blast rocks and road dust

Fire > 5 years

Notes Sparse leaf litter mainly under shrubs and negligible woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia colei var. *colei*	0.5 %	1 – 2 m	20.2	
Acacia inaequilatera	0.5 %	1 – 2 m	2.1	
Corchorus aff. *parviflorus* (1)	0.5 %	< 0.5 m	4.3	
Cymbopogon ambiguus	0.5 %		8.13	
Eriachne lanata	+		43.4	
Eriachne mucronata (typical form)	+		43.2	
Eucalyptus leucophloia subsp. *leucophloia*	0.5 %	< 5 m	3.1	
Euphorbia aff. wheeleri (GLD(SRH)WP076)	+		42.2	
Goodenia microptera	+		43.5	
Grevillea pyramidalis subsp. *pyramidalis*	0.5 %	1 – 2 m	32.8	
Indigofera monophylla (small calyx form)	0.5 %	< 0.5 m	1.6	
Ptilotus incanus var. *elongatus*	0.5 %	< 0.5 m	43.3	
Sida ?*cardiophylla* (juvenile)	0.5 %	< 0.5 m	43.6	
Solanum horridum	0.5 %	< 0.5 m	10.15	
Triodia biflora	0.5 %		43.1	
Triodia epactia	30 %		1.7	
Triumfetta maconochieana	0.5 %	< 0.5 m	1.9	

Goldsworthy Site 44

Described C. SLEE **Date** 1/11/2004 50 by 50

Location Sunrise Hill mining lease south of Sunrise Ridge Haul road and east of S4 pit

Air Photo 113 **on** 1 **Video** N **E Photo**

WGS84 50 192122 mE, 7735497 mN

Habitat Minor gully base

Soil Brown to red-orange sandy clay to loam with loose soil, coarse gravel, pebbles, stones and boulders

Rock Type Ferrous

Vegetation *Corymbia hamersleyana* scattered low trees over *Acacia tumida* var. *pilbarensis* moderately dense medium shrubs over *Acacia adoxa* var. *adoxa*, *Indigofera monophylla* (small calyx form) sparse dwarf shrubland over *Triodia epactia* sparse hummock grassland.

Veg Condition Excellent, minimal disturbance, some large mature *Acacia tumida* var. *pilbarensis* had fallen due to cyclonic winds in February 2004

Fire 1 – 5 years

Notes Plentiful leaf litter mainly under shrubs and obstructions and plentiful woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	5 %	< 0.5 m	1.5	
Acacia inaequilatera	0.5 %	0.5 – 1 m	2.1	
Acacia tumida var. *pilbarensis*	55 %	1 – 2 m	1.2	
Corchorus aff. *parviflorus* (1)	0.5 %	0.5 – 1 m	4.3	
Corymbia hamersleyana	1 %	< 1 m	1.1	
Goodenia stobbsiana	+		1.14	
Grevillea wickhamii subsp. *aprica*	2 %	1 – 2 m	1.4	
Indigofera monophylla	2 %	< 0.5 m	1.6	
Petalostylis labicheoides	5 %	1 – 2 m	1.12	
Sida sp.A Kimberley Flora(P.A.Fryxell & L.A.Craven 3900)	0.5 %	0.5 – 1 m	44.1	
Triodia epactia	5 %		1.7	

Goldsworthy **Site** 45

Described C. SLEE **Date** 1/11/2004 50 by 50

Location Sunrise Hill mining lease south west of SH6 pit

Air Photo **Photo** 114 **on** 1 **Video** N **E Photo**

WGS84 50 192665 mE, 7734894 mN

Habitat Moderate west-facing slope of upper rocky and gravelly hill slope

Soil Brown to red-orange sandy clay to loam with coarse gravel, pebbles, stones and boulders

Rock Type Ferrous

Vegetation *Acacia inaequilatera* sparse low trees to medium shrubland over *Acacia adoxa* var. *adoxa*, *Acacia hilliana* sparse dwarf shrubland over *Cymbopogon ambiguus* sparse grassland over *Triodia epactia* open hummock grassland.

Veg Condition Excellent, minimal disturbance, some old track windrows and rock piles

Fire > 5 years

Notes Moderate leaf litter mainly under shrubs and moderate woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	2 %	< 0.5 m	1.5	
Acacia colei var. *colei*	0.5 %	1 – 2 m	20.2	
Acacia hilliana	1 %	< 0.5 m	1.16	
Acacia inaequilatera	1 %	1 – 2 m	2.1	
Cymbopogon ambiguus	5 %		8.13	
Dodonaea coriacea	0.5 %	< 0.5 m	45.2	
Grevillea wickhamii subsp. *aprica*	0.5 %	1 – 2 m	1.4	
Indigofera monophylla (small calyx form)	1 %	< 0.5 m	1.6	
Mukia maderaspatana	+		7.7	
Petalostylis labicheoides	0.5 %	0.5 – 1 m	1.12	
Pterocaulon sphaeranthoides	+		7.13	
Ptilotus calostachyus var. *calostachyus*	1 %	0.5 – 1 m	1.15	
Solanum horridum	0.5 %	< 0.5 m	10.15	
Stemodia grossa	0.5 %		45.1	
Streptoglossa decurrens	0.5 %	< 0.5 m	30.4	
Triodia epactia	25 %		1.7	

Goldsworthy Site 46

Described C. SLEE **Date** 1/11/2004 50 by 50

Location Sunrise Hill mining lease north of SH access road

Air Photo 115 **on** 1 **Video** N **E Photo**

WGS84 50 191968 mE, 7736764 mN

Habitat Rocky, stony moderately steep upper hill slopes and breakaway

Soil Brown to red-orange sandy clay to loam with coarse gravel, pebbles, stones, boulders and rock slabs

Rock Type Ferrous

Vegetation *Acacia orthocarpa, Templetonia hookeri* sparse medium shrubland over *Tephrosia spechtii* scattered low shrubland over *Acacia adoxa* var. *adoxa* sparse dwarf shrubland over *Triodia epactia* sparse hummock grassland.

Veg Condition Pristine, no disturbance, but waste dumps either side and old haul road adjacent uphill

Fire 1- 5 years

Notes Sparse leaf litter mainly under shrubs and sparse woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	5 %	< 0.5 m	1.5	
Acacia orthocarpa	2 %	1 – 2 m	7.1	
Acacia pyrifolia	0.5 %	< 0.5 m	1.22	
Acacia tumida var. *pilbarensis*	0.5 %	0.5 – 1 m	1.2	
Grevillea wickhamii subsp. *aprica*	0.5 %	< 0.5 m	1.4	
Indigofera monophylla	0.5 %	< 0.5 m	1.6	
Petalostylis labicheoides	0.5 %	0.5 – 1 m	1.12	
Ptilotus calostachyus var. *calostachyus*	0.5 %	< 0.5 m	1.15	
Sporobolus australasicus	+		36.5	
Templetonia hookeri	2 %	1 – 2 m	13.8	
Tephrosia spechtii	1 %	0.5 – 1 m	46.1	
Triodia epactia	5 – 10 %		1.7	

Goldsworthy **Site** 47

Described C. SLEE **Date** 1/11/2004 50 by 50

Location Sunrise Hill mining lease south east of site 41 and east of access road

Air Photo 116 **on** 1 **Video** N **E Photo**

WGS84 50 196183 mE, 7731926 mN

Habitat Swamp shielded by a south-west facing cliff and gorge system

Soil Dark brown peaty to clay with humus, loose soil, coarse gravel and pebbles

Rock Type Banded Ironstone Formation to sandstone or siliceous ironstone

Vegetation *Melaleuca argentea, Eucalyptus victrix* moderately dense medium forest over *Acacia colei* var. *colei* sparse tall shrubland over *Typha domingensis* sparse rushes over *Cyperus vaginatus* open sedges.

Veg Condition Poor, significant disturbance, cattle trampling and grazing, limited water disturbance

Fire > 5 years

Notes Plentiful leaf litter mainly under shrubs and plentiful woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia colei var. *colei*	5 %	> 2 m	20.2	
Ammannia baccifera	+		47.7	
Atalaya hemiglauca	1 %	> 2 m	47.2	
Cajanus cinereus	0.5 %	1 – 2 m	47.8	
Cyperus vaginatus	15 %		47.5	
Eucalyptus victrix	5 %	5 – 15 m	41.2	
Ficus opposita var. *indecora*	2 %	> 2 m	47.4	
Ficus virens var. *sublanceolata*	0.5 %	> 2 m	47.3	
Melaleuca argentea	70 %	5 – 15 m	47.1	
Rhynchosia minima	+		47.6	
Typha domingensis	5 %			

Goldsworthy Site 48

Described C. SLEE **Date** 2/11/2004 50 by 50

Location Sunrise Hill mining lease north-west of S6 pit

Air Photo 117 **on** 1 **Video** N **E Photo**

WGS84 50 193027 mE, 7735531 mN

Habitat Rocky breakaways and steep slopes of lateritic mesa

Soil Mid-brown sand to sandy clay with fine gravel, stones and boulders

Rock Type Laterite

Vegetation *Tephrosia rosea* var. *clementii, Ptilotus* calostachyus var. calostachyus sparse low shrubland over *Indigofera monophylla* (small calyx form), *Acacia hilliana* sparse dwarf shrubland over *Eriachne lanata* sparse tussock grassland over *Triodia epactia* open hummock grassland.

Veg Condition Excellent, minimal disturbance, slightly affected from gravel pushover from quarry on top of mesa

Fire 1 – 5 years

Notes Sparse leaf litter mainly under shrubs and sparse woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia ?hilliana x *stellaticeps* (GLD(NIM)23.28)	0.5 %	< 0.5 m	48.4	
Acacia adoxa var. *adoxa*	1 %	< 0.5 m	1.5	
Acacia hilliana	2 %	< 0.5 m	1.16	
Bonamia media var. *villosa*	+		48.3	
Corchorus aff. *parviflorus* (1)	0.5 %	< 0.5 m	48.5	
Cymbopogon ambiguus	+		8.13	
Dampiera candicans	0.5 %	< 0.5 m	10.13	
Eriachne lanata	5 %		48.2	
Goodenia stobbsiana	+			
Hakea chordophylla	0.5 %	1 – 2 m		
Indigofera monophylla	8 %	< 0.5 m	1.6	
Ptilotus calostachyus var. *calostachyus*	2 %	0.5 – 1 m	1.15	
Senna glutinosa subsp. *pruinosa*	0.5 %	< 0.5 m	48.6	
Tephrosia rosea var. *clementii*	5 %	0.5 – 1 m	48.1	
Tribulus suberosus	0.5 %	< 0.5 m	18.3	
Triodia wiseana	0.5 %		11.4	

Goldsworthy **Site** 49

Described C. SLEE **Date** 2/11/2004 50 by 50

Location Sunrise Hill mining lease

Air Photo 118 **on** 1 **Video** N **E Photo**

WGS84 50 194407 mE, 7734168 mN

Habitat Steep west-facing slope of rocky breakaway and lateritic mesa

Soil Mid-brown sand to sandy-clay with fine and coarse gravel, pebbles, stones and boulders

Rock Type Laterite

Vegetation *Corymbia hamersleyana* scattered low trees over *Acacia colei* var. *colei*, *Acacia tumida* var. *pilbarensis*, *Senna glutinosa* subsp. *glutinosa* medium shrubland over *Ptilotus calostachyus* var. *calostachyus* low shrubs over *Dampiera candicans*, *Indigofera monophylla*, *Acacia hilliana* sparse dwarf shrubland over *Triodia epactia* moderately dense hummock grassland.

Veg Condition Pristine, no disturbance, although gravel extraction has occurred on mesa top

Fire 1 – 5 years

Notes Sparse leaf litter mainly under shrubs and sparse woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	0.5 %	< 0.5 m	1.5	
Acacia colei var. *colei*	0.5 %	1 – 2 m	20.2	
Acacia coriacea subsp. *sericophylla*	1 %	1 – 2 m	49.4	
Acacia hilliana	1 %	< 0.5 m	1.16	
Acacia tumida var. *pilbarensis*	0.5 %	1 – 2 m	1.14	
Bonamia media var. *villosa*	+		49.1	
Corchorus aff. *parviflorus* (1)	1 %	< 0.5 m	48.5	
Corymbia hamersleyana	0.5 %	< 5 m	1.1	
Dampiera candicans	5 %	< 0.5 m	10.13	
Dodonaea coriacea	0.5 %	< 0.5 m	49.2	
Eriachne obtusa	+		49.6	
Goodenia stobbsiana	+		1.14	
Grevillea refracta subsp. *refracta*	0.5 %	< 0.5 m	49.5	
Hakea chordophylla	0.5 %	> 2 m	49.3	
Indigofera monophylla	2 %	< 0.5 m	1.6	
Ptilotus calostachyus var. *calostachyus*	0.5 %	0.5 – 1 m	1.15	
Senna glutinosa subsp. *glutinosa*	0.5 %	1 – 2 m	14.9	
Tribulus suberosus	0.5 %	0.5 – 1 m	18.3	
Triodia epactia	55 %		1.7	

Goldsworthy Site 50

Described C. SLEE **Date** 3/11/2004 50 by 50

Location Sunrise Hill mining lease east of SH haul road

Air Photo 119 **on** 1 **Video** N **E Photo**

WGS84 50 192528 mE, 7736452 mN

Habitat Colluvial spur and low undulating hill slopes facing north-north-east

Soil Brown to red-orange sandy clay to loam with fine and coarse gravel, pebbles, stones and boulders

Rock Type Sandstone and silicious ironstone

Vegetation *Ptilotus calostachyus* var. *calostachyus, Sida arenicola* scattered medium shrubland over *Acacia hilliana* open dwarf shrubland with *Acacia adoxa* var. *adoxa* and *Indigofera monophylla* (small calyx form) over *Goodenia stobbsiana* scattered herbs over *Triodia epactia* open hummock grassland.

Veg Condition Pristine, no disturbance

Fire 1 – 5 years

Notes Sparse leaf litter mainly under shrubs and moderate woody litter. GPS +/- 3 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	1 %	< 0.5 m	1.5	
Acacia hilliana	25 %	< 0.5 m	1.16	
Amphipogon strictus	+		50.3	
Dampiera candicans	0.5 %	< 0.5 m	10.13	
Eriachne lanata	+		50.2	
Goodenia stobbsiana	1 %		1.14	
Indigofera monophylla (small calyx form)	0.5 %	< 0.5 m	1.6	
Ptilotus calostachyus var. calostachyus	2 %	0.5 – 1 m	1.15	
Sida arenicola	0.5 %	0.5 – 1 m	50.1	
Triodia epactia	20 %		1.7	

Goldsworthy **Site** 51

Described C. SLEE **Date** 3/11/2004 50 by 50

Location Sunrise Hill mining lease north of access track on ridge

Air Photo **Photo** 120 **on** 1 **Video** N **E Photo**

WGS84 50 195505 mE, 7733771 mN

Habitat Sandy plain with sections of sandstone pavement at confluence of gullies

Soil Brown to red-orange sand to sandy clay with loose soil, coarse gravel and pebbles

Rock Type Pavement sandstone and silicious ironstone

Vegetation *Corymbia hamersleyana* scattered low woodland over *Acacia tumida* var. *pilbarensis* open tall shrubland with *Grevillea wickhamii* subsp. *aprica* over *Indigofera monophylla* (small calyx form) scattered dwarf shrubs over *Triodia epactia* open hummock grassland.

Veg Condition Pristine, no disturbance

Fire > 5 years

Notes Moderate leaf litter mainly under shrubs and moderate woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia colei var. *colei*	1 %	1 – 2 m	20.2	
Acacia tumida var. *pilbarensis*	15 %	> 2 m	1.2	
Bonamia pannosa	+		51.4	
Corymbia flavescens	0.5 %	< 5 m	51.2	
Corymbia hamersleyana	2 %	< 5 m	51.1	
Eriachne obtusa	+		51.5	
Goodenia stobbsiana	+		1.14	
Grevillea refracta subsp. *refracta*	0.5 %	> 2 m	51.3	
Grevillea wickhamii subsp. *aprica*	0.5 %	> 2 m	1.4	
Indigofera monophylla (small calyx form)	0.5 %	< 0.5 m	1.6	
Polymeria sp. (Site 1365)	+		51.7	
Trachymene oleracea	+		5.2	
Triodia epactia	25 %		1.7	
Waltheria indica	0.5 %	< 0.5 m	51.6	

Goldsworthy Site 52

Described C. SLEE **Date** 3/11/2004 50 by 50

Location Sunrise Hill mining lease

Air Photo 121 **on** 1 **Video** N **E Photo**

WGS84 50 195366 mE, 7734129 mN

Habitat Minor channel with gentle east-south-east facing slope between gravelly sandstone rises

Soil Brown to red-orange sand to sandy clay to clayey sand with humus, loose soil, coarse gravel and pebbles

Rock Type Ferrous

Vegetation *Acacia tumida* var. *pilbarensis* open tall shrubland over *Eucalyptus odontocarpa* open mallee (2.5 m) over *Sida arenicola* scattered medium shrubland over *Ptilotus calostachyus* var. *calostachyus, Tephrosia spechtii*, *Dampiera candicans* sparse low shrubland over *Acacia adoxa* var. *adoxa* sparse dwarf shrubland with *Scaevola amblyanthera* var. *centralis* over *Triodia epactia* moderately dense hummock grassland.

Veg Condition Pristine, no disturbance

Fire > 5 years

Notes Plentiful leaf litter mainly under shrubs and plentiful woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

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Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	8 %	< 0.5 m	1.5	
Acacia tumida var. *pilbarensis*	25 %	> 2 m	1.2	
Aristida holathera var. *holathera*	+		52.6	
Clerodendrum tomentosum var. *lanceolatum*	0.5 %	0.5 – 1 m	52.7	
Dampiera candicans	2 %	0.5 – 1 m	10.13	
Eucalyptus odontocarpa	30 %	> 2 m	52.1	
Hibiscus leptocladus	0.5 %	< 0.5 m	52.3	
Hibiscus sturtii var. aff. *campylochlamys* (MET 15,957)	0.5 %	< 0.5 m	52.4	
Hybanthus aurantiacus	0.5 %	< 0.5 m	19.13	
Indigofera monophylla (small calyx form)	0.5 %	< 0.5 m		
Ptilotus calostachyus var. *calostachyus*	1 %	0.5 – 1 m	1.15	
Scaevola amblyanthera var. *centralis*	0.5 %	< 0.5 m	52.2	
Sida arenicola	0.5 %	1 – 2 m	52.5	
Solanum horridum	0.5 %	0.5 – 1 m		
Tephrosia spechtii	2 %	0.5 – 1 m	1.3	
Waltheria indica	0.5 %	< 0.5 m	51.6	

Goldsworthy **Site** 53

Described C. SLEE **Date** 3/11/2004 50 by 50

Location Sunrise Hill mining lease north of Sunrise Hill access track

Air Photo 122 **on** 1 **Video** N **E Photo**

WGS84 50 198256 mE, 7731250 mN

Habitat Very broad hill crest and plateau

Soil Red-orange loam to clay-loam with fine and coarse gravel, pebbles, stones and boulders

Rock Type Ferrous and Banded Ironstone Formation

Vegetation *Acacia inaequliatera* sparse low trees over *Grevillea wickhamii* subsp. *aprica* scattered tall shrubland over *Acacia hilliana* sparse dwarf shrubland over *Triodia epactia* moderately dense hummock grassland.

Veg Condition Excellent, minimal disturbance, evidence of very old track windrows

Fire > 5 years

Notes Moderate leaf litter mainly under shrubs and spinifex and sparse woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	0.5 %	< 0.5 m	1.5	
Acacia hilliana	5 %	< 0.5 m	1.16	
Acacia inaequilatera	2 %	< 5 m	2.1	
Goodenia stobbsiana	+		1.14	
Grevillea wickhamii subsp. *aprica*	1 %	> 2 m	1.4	
Ptilotus calostachyus var. *calostachyus*	1 %	0.5 – 1 m	1.15	
Trachymene oleracea	+		5.2	
Triodia epactia	35 %		1.7	

Goldsworthy **Site** 54

Described C. SLEE **Date** 3/11/2004 50 by 50

Location Sunrise Hill mining lease west of powerline

Air Photo 123 **on** I **Video** N **E Photo**

WGS84 50 195605 mE, 7734416 mN

Habitat Steep rocky gorge sides and base

Soil Brown to pale orange sand to sandy clay with coarse gravel, pebbles, stones, boulders, slabs and cliff faces

Rock Type Sandstone

Vegetation *Ficus brachypoda*, Atalaya hemiglauca scattered low trees over *Acacia tumida* var. *pilbarensis*, *Acacia colei* var. *colei*, *Acacia ptychophylla* sparse tall shrubland over *Gossypium australe* (Whim Creek form) sparse medium shrubland over *Acacia adoxa* var. *adoxa*, *Triumfetta maconochieana* sparse dwarf shrubland over *Triodia wiseana* moderately dense hummock grassland.

Veg Condition Pristine, no disturbance

Fire > 5 years

Notes Moderate leaf litter mainly under shrubs and moderate woody litter. GPS +/- 8 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	5 %	< 0.5 m	1.5	
Acacia colei var. *colei*	0.5 %	> 2 m	20.2	
Acacia ptychophylla	1 %	> 2 m		
Acacia tumida var. *pilbarensis*	2 %	> 2 m	1.2	
Atalaya hemiglauca	5 %	< 5 m	54.11	
Cajanus cinereus	1 %	1 – 2 m	54.1	
Corchorus aff. *parviflorus* (1)	0.5 %	< 0.5 m	54.9	
Cymbopogon ambiguus	5 %		8.13	
Cyperus cunninghamii subsp. *cunninghamii*	+		54.8	
Enneapogon oblongus	+		54.14	
Eriachne mucronata (typical form)	5 %		54.3	
Euphorbia aff. *wheeleri* (GLD(SRH)WP076)	1 %		54.5	
Ficus brachypoda	1 %	< 5 m	54.13	
Gossypium australe (Whim Creek form)	5 %	1 – 2 m	54.2	
Indigofera monophylla	1 %	< 0.5 m	1.6	
Jasminum didymum subsp. *lineare*	0.5 %		54.12	
Mukia maderaspatana	+		7.7	
Nicotiana benthamiana	+		54.7	
Pterocaulon sphaeranthoides	+		7.13	
Ptilotus fusiformis	0.5 %	< 0.5 m	54.10	
Senna glutinosa subsp. *glutinosa*	0.5 %	< 0.5 m	54.4	
Solanum cleistogamum	0.5 %	< 0.5 m	38.2	
Streptoglossa decurrens	0.5 %	< 0.5 m	30.4	
Trachymene oleracea	+		5.2	
Tribulus suberosus	0.5 %	< 0.5 m	18.3	
Triodia wiseana	55 %		11.4	
Triumfetta maconochieana	2 %	< 0.5 m	54.15	
Waltheria indica	0.5 %	< 0.5 m	54.6	

Goldsworthy **Site** 55

Described C. SLEE **Date** 4/11/2004 50 byb 50

Location Sunrise Hill mining lease

Air Photo 295 **on** 2 **Video** N **E Photo**

WGS84 50 195674 mE, 7732876 mN

Habitat Steep to gentle south-west facing slope of gorge

Soil Dark brown to orange sandy to sandy clay to clay loam to peaty with loose soil, coarse gravel, pebbles, stones, boulders and rock outcroppings and cliff faces

Rock Type Ferrous and Banded Ironstone Formation

Vegetation *Ficus virens* var. *sublanceolata, Atalaya hemiglauca* sparse low trees over *Ptilotus incanus* var. *elongatus*, *Triumfetta maconochieana*, *Cajanus cinereus* sparse dwarf shrubland over *Cymbopogon ambiguus* grassland over *Cyperus cunninghamii* subsp. *cunninghamii* sparse sedges over *Triodia epactia* sparse hummock grassland.

Veg Condition Pristine, no disturbance

Fire < 1 year on slopes and > 5 years on gorge base

Notes Moderate leaf litter mainly under shrubs and moderate woody litter. GPS +/- 5 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	0.5 %	< 0.5 m	1.5	
Acacia colei var. *colei*	0.5 %	1 – 2 m	20.2	
Acacia inaequilatera	0.5 %	0.5 – 1 m	2.1	
Acacia tumida var. *pilbarensis*	0.5 %	1 – 2 m	1.2	
Amaranthus pallidiflorus	+		55.25	
Atalaya hemiglauca	2 %	< 5 m	8.7	
Bergia pedicellaris	+		55.14	
Blumea tenella	+		55.11	
Boerhavia gardneri	0.5 %	< 0.5 m	55.15	
Cajanus cinereus	1 %	< 0.5 m	55.18	
Centipeda minima subsp. *macrocephala*	+		55.23	
Clerodendrum floribundum var. *angustifolium*	0.5 %	1 – 2 m	55.10	
Corymbia flavescens	0.5 %	< 5 m	55.2	
Cymbopogon ambiguus	2 %		55.7.	
Cyperus cunninghamii subsp. *cunninghamii*	2 %		55.3	
Eragrostis elongata	+		55.9	
Eragrostis tenellula	2 %		55.8	
Eriachne ciliata	0.5 %		55.16	
Eriachne mucronata (typical form)	1 %		55.5	
Eriachne tenuiculmis	+		55.6	
Ficus opposita var. *indecora*	0.5 %	1 – 2 m	55.20	
Ficus virens var. *sublanceolata*	5 %	< 5 m	55.1	
Grevillea pyramidalis subsp. *pyramidalis*	0.5 %	1 – 2 m	55.4	
Indigofera monophylla	0.5 %	< 0.5 m	1.6	
Mukia maderaspatana	+		7.7	
Oldenlandia crouchiana	+		55.26	
Olearia stuartii	0.5 %	< 0.5 m	55.24	
Phyllanthus exilis	0.5 %	< 0.5 m	55.13	
Pterocaulon sphaeranthoides	+		7.13	
Ptilotus incanus var. *elongatus*	2 %	< 0.5 m	55.17	
Rhodanthe margarethae	+		55.12	
Sida sp.A Kimberley Flora(P.A.Fryxell & L.A.Craven 3900)	0.5 %	0.5 – 1 m	55.21	
Solanum horridum	0.5 %	< 0.5 m	10.15	
Stemodia grossa	+		55.22	
Stemodia sp. Shay Gap(GLD(SRH)55.19)	+		55.19	New Species

Triodia epactia	5 %		1.7
Triumfetta maconochieana	5 %	< 0.5 m	1.9

Goldsworthy **Site** 56

Described C. SLEE **Date** 4/11/2004 50 by 50

Location Sunrise Hill mining lease north east of bund and road

Air Photo 297 **on** 2 **Video** N **E Photo**

WGS84 50 196641 mE, 7733114 mN

Habitat Depression and gully confluence

Soil Orange-brown clay loam to sand with surface crust and loos soil

Rock Type Nil

Vegetation *Corymbia hamersleyana* scattered low trees over *Acacia colei* var. *colei* scattered tall shrubland over *Goodenia lamprosperma* open herbland.

Veg Condition Poor, significant disturbance, affected by seasonal inundation due to road bund on down-slope side resulting in tree deaths

Fire > 5 years

Notes Sparse leaf litter mainly under shrubs and sparse woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia colei var. *colei*	2 %	> 2 m	20.2	
Acacia tumida var. *pilbarensis*	0.5 %	< 0.5 m	1.2	
Aristida holathera var. *holathera*	+		56.2	
Centipeda minima subsp. *macrocephala*	+		56.9	
Corymbia hamersleyana	0.5 %	5 – 15 m	1.1	
Dysphania rhadinostachya subsp. *rhadinostachya*	+		56.8	
Euphorbia coghlanii	0.5 %	< 0.5 m	56.6	
Euphorbia sp. (site 1089)	+		56.5	
Goodenia lamprosperma	15 %		56.1	
Mollugo molluginis	+		56.3	
Mukia maderaspatana	+		7.7	
Pluchea tetranthera	+		56.7	
Pterocaulon sphaeranthoides	0.5 %		7.13	
Senna venusta	0.5 %	< 0.5 m	8.6	
Solanum horridum	0.5 %	< 0.5 m	10.15	
Sporobolus australasicus	+		36.5	
Streptoglossa decurrens	0.5 %	< 0.5 m	30.4	
Trachymene oleracea	0.5 %		5.2	
Trichodesma zeylanicum var. *zeylanicum*	+		56.4	

Goldsworthy **Site** 57

Described C. SLEE **Date** 4/11/2004 50 by 50

Location Sunrise Hill mining lease

Air Photo 298 **on** 2 **Video** N **E Photo**

WGS84 50 197683 mE, 7731913 mN

Habitat Minor channel and gully

Soil Brown to red-orange sandy clay to loam with humus and loose soil

Rock Type Nil

Vegetation *Corymbia hamersleyana* sparse medium trees over *Acacia tumida* var. *pilbarensis* open tall shrubland over *Templetonia hookeri* scattered medium shrubland over *Triodia epactia* open hummock grassland.

Veg Condition Excellent, minimal disturbance

Fire > 5 years

Notes Plentiful leaf litter mainly widespread and plentiful woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia tumida var. *pilbarensis*	25 %	> 2 m	1.2	
Corymbia hamersleyana	5 %	5 – 15 m	1.1	
Dampiera candicans	0.5 %	< 0.5 m	10.13	
Goodenia stobbsiana	0.5 %		1.14	
Grevillea wickhamii subsp. *aprica*	0.5 %	1 – 2 m	1.4	
Hibiscus sturtii var. aff. campylochlamys (MET 15,957)	0.5 %	< 0.5 m	52.4	
Indigofera monophylla	0.5 %	< 0.5 m	1.6	
Mukia maderaspatana	+		7.7	
Pterocaulon sphaeranthoides	+		7.13	
Solanum cleistogamum	0.5 %	< 0.5 m	38.2	
Templetonia hookeri	1 %	1 – 2 m	13.8	
Tephrosia spechtii	0.5 %	0.5 – 1 m	1.3	
Triodia epactia	20 %		1.7	

Goldsworthy **Site** 58

Described C. SLEE **Date** 4/11/2004 50 by 50

Location Sunrise Hill mining lease

Air Photo 299 **on** 2 **Video** N **E Photo**

WGS84 50 196883 mE, 7732318 mN

Habitat Gentle south-south-west facing slope on hill crests between gullies

Soil Brown to red-orange sandy clay to loam with fine gravel, stones and boulders

Rock Type Silicious Ironstone

Vegetation *Corymbia hamersleyana, Acacia inaequilatera* scattered low woodland over *Grevillea wickhamii* subsp. *aprica* sparse medium shrubland over *Tephrosia spechtii* sparse low shrubland over *Acacia hilliana* open dwarf shrubland over *Triodia epactia* open hummock grassland.

Veg Condition Pristine, no disturbance

Fire 1 – 5 years

Notes Sparse leaf litter mainly under shrubs and sparse woody litter. GPS +/- 3 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	0.5 %	< 0.5 m	1.5	
Acacia hilliana	15 %	< 0.5 m	1.16	
Acacia inaequilatera	1 %	< 5 m	2.1	
Acacia tumida var. *pilbarensis*	0.5 %	1 – 2 m	1.2	
Corchorus aff. *parviflorus* (1)	0.5 %	< 0.5 m	4.3	
Corymbia hamersleyana	1 %	< 5 m	1.1	
Goodenia stobbsiana	0.5 %		1.14	
Grevillea wickhamii subsp. *aprica*	2 %	1 – 2 m	1.4	
Indigofera monophylla	0.5 %	< 0.5 m	1.6	
Ptilotus calostachyus var. *calostachyus*	0.5 %	0.5 – 1 m	1.15	
Tephrosia spechtii	2 %	0.5 – 1 m	1.3	
Triodia epactia	25 %		1.7	

Goldsworthy Site 59

Described C. SLEE **Date** 4/11/2004 50 by 50

Location Sunrise Hill mining lease north of railway line and NIM Access road

Air Photo 300 **on** 2 **Video** N **E Photo**

WGS84 50 200605 mE, 7728454 mN

Habitat Moderate to steep south-west facing scarp slopes

Soil Brown to red-orange sandy clay to loam with coarse gravel, pebbles, surface level plates, boulders and rock outcroppings

Rock Type Ferrous and Banded Ironstone Formation

Vegetation *Corymbia hamersleyana* open low woodland over *Acacia ptychophylla* sparse low shrubland over *Triodia wiseana*, *Triodia epactia* moderately dense hummock grassland over *Cymbopogon ambiguus* soft grassland.

Veg Condition Pristine., no disturbance

Fire > 5 years

Notes Plentiful leaf litter mainly widespread and plentiful woody litter. GPS +/- 5 m. Status: Dry, many annuals not available. Intensity: Very thorough.

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Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia ptychophylla	5 %	0.5 – 1 m	59.2	
Bulbostylis barbata	+		59.7	
Cleome viscosa	+		59.10	
Corchorus aff. *parviflorus* (1)	1 %	< 0.5 m	59.3	
Corchorus sp.	0.5 %	< 0.5 m	59.4	
Corymbia hamersleyana	15 %	< 5 m	1.1	
Cymbopogon ambiguus	0.5%			
Eriachne mucronata (typical form)	0.5 %		59.5	
Euphorbia coghlanii	+		59.15	
Evolvulus alsinoides var. *villosicalyx*	+		59.14	
Gomphrena cunninghamii	0.5 %		8.21	
Indigofera monophylla	0.5 %	< 0.5 m	1.6	
Pterocaulon serrulatum	0.5 %		59.6	
Ptilotus incanus var. *elongatus*	0.5 %	< 0.5 m	59.12	
Rhynchosia minima	0.5 %	< 0.5 m	59.9	
Senna glutinosa subsp. *glutinosa*	1 %	1 – 2 m	59.1	
Sida aff. *cardiophylla* (site 1086)	0.5 %	< 0.5 m	59.13	
Solanum horridum	0.5 %	< 0.5 m	10.15	
Streptoglossa decurrens	0.5 %	< 0.5 m	30.4	
Trachymene oleracea	+		5.2	
Triodia biflora	0.5 %		59.11	
Triodia epactia	15 %		1.7	
Triodia wiseana	20 %		11.4	
Triumfetta clementii	0.5 %	< 0.5 m	59.8	
Triumfetta maconochieana	0.5 %	< 0.5 m	1.9	

Goldsworthy **Site** 60

Described C. SLEE **Date** 5/11/2004 50 by 50

Location Sunrise Hill mining lease south of NIM Access road

Air Photo 306 **on** 2 **Video** N **E Photo**

WGS84 50 197944 mE, 7731214 mN

Habitat Gentle north-west slope on hill crest/scarp plateau

Soil Brown to red-orange sandy clay to loam with coarse gravel and pebbles

Rock Type Ferrous

Vegetation *Acacia inaequilatera* scattered low trees over *Grevillea wickhamii* subsp. *aprica* scattered medium shrubland over *Ptilotus* calostachyus var. calostachyus sparse medium shrubland over *Acacia hilliana* sparse dwarf shrubland over *Triodia epactia* moderately dense hummock grassland over *Goodenia stobbsiana* herbs.

Veg Condition Excellent, minimal disturbance, evidence of old drill pads and tracks overgrown

Fire > 5 years

Notes Moderate leaf litter mainly under shrubs and sparse woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia hilliana	5 %	< 0.5 m	1.16	
Acacia tumida var. *pilbarensis*	1.0 %	>2m	1.2	
Bonamia media var. *villosa*	+		60.4	
Dodonaea coriacea	0.5 %	< 0.5 m	24.2	
Fimbristylis simulans	+		60.1	
Goodenia stobbsiana	0.5 %		1.14	
Grevillea pyramidalis subsp. *pyramidalis*	0.5 %	0.5 – 1 m	60.3	
Grevillea wickhamii subsp. *aprica*	1 %	1 – 2 m	1.4	
Mukia maderaspatana	+		7.7	
Ptilotus calostachyus var. *calostachyus*	2 %	0.5 – 1 m	1.15	
Solanum lasiophyllum	0.5 %	< 0.5 m	60.2	
Triodia epactia	35 %		1.7	

Goldsworthy Site 61

Described C. SLEE **Date** 5/11/2004 50 by 50

Location Sunrise Hill mining lease north west of old pits and railway line

Air Photo 320 **on** 2 **Video** N **E Photo**

WGS84 50 199605 mE, 7730344 mN

Habitat Very broad hill crest with slab outcrops

Soil Brown to red-orange fine sand to loam with coarse gravel, pebbles and slab outcrops

Rock Type Banded metomorphic rock

Vegetation *Grevillea wickhamii* subsp. *aprica* open tall shrubland over *Acacia tumida* var. *pilbarensis* scattered medium shrubland over *Acacia hilliana* sparse dwarf shrubland over *Triodia epactia* open hummock grassland.

Veg Condition Pristine, no disturbance

Fire > 5 years

Notes Moderate leaf litter mainly under shrubs and between rocks and moderate woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	0.5 %	< 0.5 m	1.5	
Acacia hilliana	5 %	<0.5 m	1.16	
Acacia inaequilatera	0.5 %	1 – 2 m	2.1	
Acacia tumida var. *pilbarensis*	0.5 %	1 – 2 m	1.2	
Corchorus aff. *parviflorus* (1)	0.5 %	< 0.5 m	61.2	
Eriachne lanata	+		27.1	
Goodenia stobbsiana	+		1.14	
Grevillea wickhamii subsp. *aprica*	10 %	> 2 m	1.4	
Solanum dioicum	0.5 %	0.5 – 1 m	61.1	
Triodia epactia	25 %		1.7	

Goldsworthy **Site** 62

Described C. SLEE **Date** 5/11/2004 50 by 50

Location Sunrise Hill mining lease north of track

Air Photo 329 **on** 2 **Video** N **E Photo**

WGS84 50 200046 mE, 7729792 mN

Habitat Gentle south-south-east gentle slope of road hill crest/plateau

Soil Fine sand to loam with coarse gravel and pebbles

Rock Type Ferrous

Vegetation *Acacia inaequilatera*, *Grevillea wickhamii* subsp. *aprica*, *Ptilotus calostachyus* var. *calostachyus* scattered low shrubland over *Acacia adoxa* var. *adoxa* scattered dwarf shrubs over *Triodia epactia* moderately dense hummock steppe.

Veg Condition Excellent, minimal disturbance, scattered old drill holes

Fire > 5 years

Notes Moderate to sparse leaf litter mainly under shrubs and between rocks and negligible woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	0.5 %	< 0.5 m	1.5	
Acacia inaequilatera	0.5 %	0.5 – 1 m	2.1	
Goodenia stobbsiana	+		1.14	
Grevillea wickhamii subsp. *aprica*	0.5 %	0.5 – 1 m	1.4	
Ptilotus calostachyus var. *calostachyus*	0.5 %	0.5 – 1 m	1.15	
Triodia epactia	60 %		1.7	

Goldsworthy Site 63

Described C. SLEE **Date** 5/11/2004 50 by 50

Location Sunrise Hill mining lease north of access tracks and railway line

Air Photo 333 **on** 2 **Video** N **E Photo**

WGS84 50 199928 mE, 7729203 mN

Habitat Flat scarp plateau, ridge top

Soil Brown to red-orange sine sand to loam with coarse gravel, pebbles, stones, boulders and rock slab outcroppings

Rock Type Ferrous, Banded Ironstone Formation

Vegetation *Acacia inaequilatera*, *Grevillea wickhamii* subsp. *aprica* sparse medium shrubland over *Acacia ptychophylla* sparse dwarf shrubland over *Triodia epactia* moderately dense hummock grassland with *Bulbostylis barbata* scattered sedges.

Veg Condition Pristine, no disturbance

Fire > 5 years

Notes Moderate to sparse leaf litter mainly under shrubs and moderate woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia ancistrocarpa	0.5 %	< 0.5 m	63.3	
Acacia inaequilatera	2 %	1 – 2 m	2.1	
Acacia ptychophylla	5 – 8 %	< 0.5 m	63.1	
Bulbostylis barbata	+		63.2	
Goodenia stobbsiana	+		1.14	
Grevillea wickhamii subsp. *aprica*	2 %	1 – 2 m	1.4	
Triodia epactia	40 %		1.7	

Goldsworthy **Site** 64

Described C. SLEE **Date** 5/11/2004 50 by 50

Location Sunrise Hill mining lease east of railway line and south of moonscaping waste dumps

Air Photo 334 **on** 2 **Video** N **E Photo**

WGS84 50 198195 mE, 7730096 mN

Habitat Disturbed low gravelly gentle scarp slope

Soil Brown to red-orange sand to sandy clay with fine and coarse gravel and pebbles

Rock Type Ferrous

Vegetation *Acacia tumida* var. *pilbarensis*, *Acacia colei* var. *colei*, *Acacia trachycarpa* open tall shrubland over *Acacia ancistrocarpa, Acacia atkinsiana* sparse medium shrubland over *Acacia bivenosa*, *Acacia stellaticeps* sparse low shrubland over *Triodia wiseana* and other species open hummock grassland.

Veg Condition Degraded, ripped rehabilitation

Fire > 5 years

Notes Moderate to sparse leaf litter mainly under shrubs and plentiful woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia ancistrocarpa	2 %	1 – 2 m	64.2	
Acacia atkinsiana	1 %	0.5 – 1 m	64.5	
Acacia atkinsiana	0.5 %	1 – 2 m	64.6	
Acacia bivenosa	2 %	0.5 – 1 m	64.3	
Acacia colei var. *colei*	5 %	> 2 m	20.2	
Acacia stellaticeps	2 %	< 0.5 m	64.4	
Acacia trachycarpa	5 %	> 2 m	64.1	
Acacia tumida var. *pilbarensis*	10 %	> 2 m	1.2	
Aristida contorta	+		64.23	
Aristida latifolia	+		64.8	
Boerhavia gardneri	0.5 %	< 0.5 m		
Bonamia media var. *villosa*	+		64.13	
Bulbostylis barbata	+		64.11	
Cleome viscosa	+		64.9	
Dysphania rhadinostachya subsp. *rhadinostachya*	+			
Eriachne ciliata	0.5 %		64.10	
Eriachne obtusa	+		64.22	
Eriachne obtusa	+		64.19	
Gomphrena cunninghamii	+		8.21	
Ipomoea muelleri	+		64.24	
Mukia maderaspatana	+		7.7	
Paspalidium rarum	+		64.18	
Polycarpaea holtzei	+		64.12	
Pterocaulon sphaeranthoides	+		7.13	
Ptilotus calostachyus var. *calostachyus*	0.5 %	0.5 – 1m	1.15	
Ptilotus obovatus var. *obovatus*	0.5 %	< 0.5 m	64.16	
Salsola tragus	+			
Senna glutinosa subsp. *pruinosa*	0.5 %	0.5 – 1 m	64.17	
Senna venusta	+	< 0.5 m	1.10	
Solanum cleistogamum	0.5 %	< 0.5 m	38.2	
Solanum lasiophyllum	0.5 %	< 0.5 m	64.7	
Triodia epactia	5 %		1.7	
Triodia wiseana	2 %		64.14	
Triumfetta maconochieana	0.5 %	< 0.5 m	1.9	

Goldsworthy Site 65

Described C. SLEE **Date** 6/11/2004 50 by 50
Location Sunrise Hill mining lease near NIM access tracks and Yarrie road
Air Photo 342 **on** 2 **Video** N **E Photo**
WGS84 50 201220 mE, 7728708 mN
Habitat Wetland swamp near gorge pools
Soil Dark brown peaty to red-orange sand with humus, loose soil, coarse gravel, stones and boulders
Rock Type Ferrous and sections of ?Breccia/conglomerate
Vegetation *Melaleuca argentea* dense tall forest over *Ficus virens* var. *sublanceolata, Eucalyptus victrix* open medium trees over *Atalaya hemiglauca* sparse low trees over *Typha domingensis* sparse rushes over *Cyperus vaginatus* moderately dense sedges.
Veg Condition Excellent, minimal disturbance, evidence of occasional human foot traffic in area
Fire > 5 years
Notes Plentiful leaf litter widespread and plentiful woody litter. GPS +/- 7 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Atalaya hemiglauca	5 – 8%	<5m	17.8	
Carissa lanceolata	+		65.3	
**Cynodon dactylon*	2 %		65.4	
Cyperus vaginatus	55 %		41.4	
Eucalyptus victrix	5 %	5 – 15 m	41.2	
Ficus brachypoda	2 %	> 2 m	65.2	
Ficus opposita var. *indecora*	2 %	> 2 m	41.6	
Ficus virens var. *sublanceolata*	25 %	5 – 15 m	47.3	
Melaleuca argentea	75 %	> 15 m	41.1	
Stemodia grossa	+		65.1	
Typha domingensis	2 %			

Goldsworthy **Site** 66

Described C. SLEE **Date** 6/11/2004 50 by 50

Location Sunrise Hill mining lease north of gorge system

Air Photo 346 **on** 2 **Video** N **E Photo**

WGS84 50 201001 mE, 7728981 mN

Habitat Steep slope of gorge

Soil Pale orange sand with loose soil, fine and coarse gravel, pebbles, stones, boulders and rock outcroppings

Rock Type Ferrous and Banded Ironstone Formation

Vegetation *Ficus brachypoda* scattered low trees over *Cyperus cunninghamii* subsp. *cunninghamii* sparse sedges over *Eriachne tenuiculmis*, *Cymbopogon ambiguus* and others open tussock grassland over *Triodia biflora* sparse hummock grassland.

Veg Condition Pristine, no disturbance

Fire > 5 years

Notes Sparse leaf litter between rocks and sparse woody litter. GPS +/- 5 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia drepanocarpa subsp. ?pilbara form	0.5 %	0.5 – 1 m	20.1	
Acacia tumida var. *pilbarensis*	0.5 %	1 – 2 m	1.2	
Centipeda minima subsp. *macrocephala*	+		66.9	
Cheilanthes brownii	+		66.13	
Cymbopogon ambiguus	5 %		66.3	
Cyperus cunninghamii subsp. *cunninghamii*	5 %		66.1	
Cyperus difformis? (det. uncertain)	0.5 %		66.7	found on sand,
Eragrostis cumingii	+		66.5	
Eriachne ciliata	+		66.6	
Eriachne ciliata	1 %		66.4	
Eriachne tenuiculmis	10 %		66.2	
Eucalyptus victrix	0.5 %	1 – 2 m	41.2	
Ficus brachypoda	1 %	< 5 m	65.2	
Goodenia lamprosperma	+		66.12	
Grevillea wickhamii subsp. *aprica*	0.5 %	0.5 – 1 m	1.4	
Jasminum didymum subsp. *lineare*	0.5 %	< 5 m	17.8	
Oldenlandia galioides	+		66.8	old flowers, rock crevices
Pterocaulon sphaeranthoides	+		7.13	
Solanum cleistogamum	0.5 %	< 0.5 m	38.2	
Solanum horridum	0.5 %	< 0.5 m	10.15	
Solanum lasiophyllum	0.5 %	< 0.5 m	30.14	
Stemodia sp. Shay Gap(GLD(SRH)55.19)	+		66.10	Conservation Signif.
Streptoglossa decurrens	0.5 %	< 0.5 m	30.4	
Triodia biflora	2 %		66.11	
Triumfetta maconochieana	0.5 %	< 0.5 m	1.9	

Goldsworthy Site 67

Described C. SLEE **Date** 6/11/2004 50 by 50

Location Sunrise Hill mining lease north west of access roads and railway line

Air Photo 349 **on** 2 **Video** N **E Photo**

WGS84 50 200573 mE, 7728901 mN

Habitat Broad gully and gorge base with slope from steep to gentle

Soil Brown to red-orange sandy clay to loam with loose soil, coarse gravel, pebbles, stones and boulders

Rock Type Ferrous

Vegetation *Acacia tumida* var. *pilbarensis* open tall shrubland to low woodland with *Grevillea wickhamii* subsp. *aprica*

over *Eucalytpus odontocarpa* open mallee (2.5 m) over *Acacia drepanocarpa* subsp. ?pilbara form, *Sida* sp.A Kimberley Flora(P.A.Fryxell & L.A.Craven 3900) scattered medium shrubs, over *Acacia adoxa* var. *adoxa*, *Triumfetta plumigera* scattered dwarf shrubs over *Triodia biflora* open hummock grassland with *Triodia epactia*.

Veg Condition Excellent, minimal disturbance, 50 % loss of *Acacia tumida* due to cyclonic winds in 2004

Fire > 5 years

Notes Plentiful leaf litter mainly under shrubs and plentiful woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

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Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	0.5 %	< 0.5 m	1.5	
Acacia drepanocarpa subsp. ?pilbara form	0.5 %	0.5 – 1 m	20.1	
Acacia ptychophylla	0.5 %	0.5 – 1 m	67.4	
Acacia tumida var. *pilbarensis*	10 %	2 – 5 m	1.2	
Atalaya hemiglauca	0.5 %	< 5 m	8.7	
Corchorus aff. *parviflorus* (1)	0.5 %	0.5 – 1 m	67.5	
Corymbia hamersleyana	0.5 %	< 5 m	1.1	
Dampiera candicans	0.5 %	< 0.5 m	10.13	
Eriachne ciliata	+		66.4	
Eucalyptus odontocarpa	25 %	2 – 5 m	67.1	2.5 m mallee
Ficus brachypoda	0.5 %	0.5 – 1 m	14.1	
Ficus opposita var. *indecora*	0.5 %	< 0.5 m	41.6	
Grevillea wickhamii subsp. *aprica*	2 %	> 2 m	1.4	
Indigofera monophylla	1 %	< 0.5 m	1.6	
Pterocaulon sphaeranthoides	+		7.13	
Ptilotus incanus var. elongatus	0.5 %	< 0.5 m	67.6	
Senna venusta	0.5 %	< 0.5 m	1.10	
Sida sp.A Kimberley Flora(P.A.Fryxell & L.A.Craven 3900)	0.5 %	1 – 2 m	26.2	
Solanum horridum	0.5 %	< 0.5 m	10.15	
Templetonia hookeri	0.5 %	> 2 m	67.3	
Triodia biflora	20 %		66.11	
Triodia epactia	2 %		1.7	
Triumfetta maconochieana	0.5 %	< 0.5 m	1.9	
Triumfetta plumigera	0.5 %	< 0.5 m	67.2	

Goldsworthy **Site** 68

Described C. SLEE **Date** 6/11/2004 50 by 50

Location Sunrise Hill mining lease north of Yarrie road

Air Photo 353 **on** 2 **Video** N **E Photo**

WGS84 50 201292 mE, 7728650 mN

Habitat Rocky creekline

Soil Pale orange sand with loose soil, fine and coarse gravel, pebbles, stones and boulders

Rock Type Ferrous

Vegetation *Eucalyptus victrix*, *Corymbia flavescens* moderately dense medium forest over *Acacia tumida* var. *pilbarensis* sparse tall shrubland over *Acacia colei* var. *colei*, *Cajanus cinereus* open tall shrubland over *Cyperus vaginatus* scattered sedges over mixed herbs over *Triodia epactia* scattered hummock grassland.

Veg Condition Excellent, minimal disturbance, some cattle trampling particularly downstream

Fire > 5 years

Notes Plentiful leaf litter mainly under shrubs and plentiful woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia ampliceps	0.5 %	< 5 m	68.25	
Acacia colei var. *colei*	5 %	1 – 2 m	20.2	
Acacia pyrifolia	0.5 %	0.5 – 1 m	1.22	
Acacia tumida var. *pilbarensis*	5 %	> 2 m	1.2	
Ammannia multiflora	+		68.15	
Bonamia pannosa	0.5 %	< 0.5 m	68.18	
Cajanus cinereus	5 %	1 – 2 m	16.2	
Carissa lanceolata	0.5 %	1 – 2 m	39.2	
**Cenchrus ciliaris*	+		68.9	weed
Centaurium minus	0.5 %		68.12	
Chrysopogon fallax	+		68.19	
Corymbia flavescens	1 %	5 – 15 m	68.2	
Cymbopogon ambiguus	5 %		68.11	
Cyperus vaginatus	2 %		41.4	
Eleocharis geniculata	+		68.23	
Eragrostis tenellula	+		68.4	
Eriachne tenuiculmis	5 %		68.10	
Eucalyptus victrix	50 %	5 – 15 m	68.1	fruits = 68.1R
Euphorbia coghlanii	+		68.17	
Goodenia lamprosperma	+		68.14	
Grevillea wickhamii subsp. *aprica*	0.5 %	1 – 2 m	68.8	flowering
Indigofera monophylla	0.5 %	< 0.5 m	1.6	
Marsilea hirsuta	1 %		68.21	fern
Melaleuca argentea	1 %	1 – 2 m	41.1	
Oldenlandia galioides	+		68.5	
Phyllanthus exilis	0.5 %	< 0.5 m	68.22	
Pluchea rubelliflora	+		68.16	
Pterocaulon sphaeranthoides	0.5 %		7.13	
Sesbania cannabina	0.5 %	1 – 2 m	68.24	
Stemodia grossa	+	68.3		
Tephrosia rosea var. *clementii*	0.5 %	0.5 – 1 m	5.4	
Triodia biflora	2 %		66.11	
Triodia epactia	0.5 %		1.7	
Triumfetta johnstonii	0.5 %	< 0.5 m	68.7	
Wahlenbergia tumidifructa	+		68.13	
Waltheria indica	0.5 %	< 0.5 m	68.20	

Goldsworthy Site 69

Described C. SLEE **Date** 7/11/2004 50 by 50

Location Sunrise Hill mining lease north of railway line

Air Photo 362 **on** 2 **Video** N **E Photo**

WGS84 50 200959 mE, 7728359 mN

Habitat Flowing creekline and swamp

Soil Light grey to drak brown fine sand to clay loam to peaty with humus, loose soil and fine gravel

Rock Type Nil

Vegetation *Acacia ampliceps*, *Sesbania formosa*, *Corymbia hamersleyana* open medium trees over *Ficus opposita* var. *indecora* sparse low trees over *Typha domingensis* open rushes over *Cyperus vaginatus* sparse sedges.

Veg Condition Poor, significant disturbance, heavy cattle grazing and trampling

Fire > 5 years

Notes Moderate leaf litter and negligible woody litter. GPS +/- 5 m. Status: Dry, many annuals not available. Intensity: Very thorough. Oleander (**Nerium oleander*) large shrubs and a weed vine (**Merremia dissecta*) present.

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Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia ampliceps	10 %	5 – 15 m	68.25	
Acacia colei var. *colei*	0.5 %	1 – 2 m	20.2	
Atalaya hemiglauca	0.5 %	< 5 m	8.7	
**Cenchrus ciliaris*	5 %		69.9	weed
Chloris virgata	1 %		69.4	
Clerodendrum tomentosum var. *lanceolatum*	0.5 %	1 – 2 m	69.12	
Corchorus aff. *parviflorus* (1)	0.5 %	< 0.5 m	69.7	retained by MET
Corymbia hamersleyana	2 %	5 – 15 m	69.2	
Cyperus vaginatus	2 %		41.4	
Ficus opposita var. *indecora*	5 %	< 5 m	41.6	
Flueggea virosa subsp. *melanthesoides*	0.5 %	0.5 – 1 m	69.8	
**Merremia dissecta*	2 %		69.5	weed
*Nerium oleander	15 %	> 2 m	69.3	introduced
Sesbania formosa	2 %	5 – 15 m	69.1	
Sida rohlenae subsp. *rohlenae*	0.5 %	< 0.5 m	69.6	
**Sonchus oleraceus*	+		69.10	weed
Tinospora smilacina	+		69.11	
Typha domingensis	15 %			

Goldsworthy **Site** 70

Described C. SLEE **Date** 7/11/2004 50 by 50

Location Sunrise Hill mining lease north of railway line and access road

Air Photo 363 & 364 **on** 2 **Video** N **E Photo**

WGS84 50 194520 mE, 7733169 mN

Habitat Moonscaped waste dump steep west slope

Soil Brown to red-orange sand to sandy clay with loose soil, fine and coarse gravel, pebbles, stones and boulders

Rock Type Ferrous

Vegetation *Acacia colei* var. *colei*, *Acacia pyrifolia*, *Acacia maitlandii*, *Acacia tumida* var. *pilbarensis* sparse tall shrubland over *Solanum lasiophyllum, Solanum dioicum* scattered low shrubs over *Ptilotus calostachyus* var. *calostachyus*, *Ptilotus obovatus* var. *obovatus*, *Ptilotus clementii* dwarf shrubs and herbs over mixed soft grasses over *Triodia wiseana* scattered hummock grasses.

Veg Condition Degraded, rehabilitation area

Fire > 5 years

Notes Negligible leaf litter and sparse woody litter. GPS +/- 3 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia colei var. *colei*	5 %	> 2 m	20.2	
Acacia inaequilatera	0.5 %	< 0.5 m	2.1	
Acacia maitlandii	0.5 %	> 2 m	70.2	
Acacia pyrifolia	4 %	> 2 m	70.1	
Acacia tumida var. *pilbarensis*	0.5 %	> 2 m	1.2	
**Aerva javanica*	2 %	0.5 – 1 m	70.5	
Aristida holathera var. *holathera*	0.5 %		70.6	
Atalaya hemiglauca	0.5 %	> 2 m	8.7	
Boerhavia gardneri	0.5 %	< 0.5 m		
Corymbia hamersleyana	0.5 %	0.5 – 1 m	1.1	
Cymbopogon ambiguus	1 %		8.13	
Dysphania rhadinostachya subsp. *rhadinostachya*	+			
Enneapogon caerulescens var. *caerulescens*	+		70.7	
Eriachne obtusa	+		70.11	
Eriachne pulchella	+		70.3	
Gomphrena cunninghamii	+		8.21	
Goodenia stobbsiana	+		1.14	
Hakea lorea subsp. *lorea*	0.5 %	< 0.5 m	70.8	
Mukia maderaspatana	+		7.7	
Pterocaulon sphaeranthoides	+		7.13	
Ptilotus calostachyus var. calostachyus	0.5 %	0.5 – 1 m	1.15	
Ptilotus clementii	+			
Ptilotus obovatus var. *obovatus*	0.5 %	0.5 – 1 m	70.4	
Salsola tragus	+		18.10	
Senna venusta	0.5 %	< 0.5 m	1.10	
Solanum dioicum	0.5 %	< 0.5 m	70.9	
Solanum lasiophyllum	0.5 %	< 0.5 m	30.14	
Triodia wiseana	2 %		64.14	

Goldsworthy Site 71

Described C. SLEE **Date** 7/11/2004 50 by 50

Location Sunrise Hill mining lease east of drainage line

Air Photo 365 **on** 2 **Video** N **E Photo**

WGS84 50 196684 mE, 7731625 mN

Habitat Sheltered gorge/cliff with moderate slope

Soil Mid-brown organic sandy clay with humus and stones and boulders

Rock Type Ferrous

Vegetation *Ficus virens* var. *sublanceolata* dense medium forest over *Ficus brachypoda*, *Atalaya hemiglauca*, *Corymbia flavescens* open low trees over *Ficus opposita* var. *indecora*, *Grevillea pyramidalis* subsp. *pyramidalis* sparse tall shrubs with *Tinospora smilacina* lianas, and *Corymbia* sp. (SRH 71) and *Stemodia* sp. Shay Gap(GLD(SRH)55.19) that are both possibly new species of conservation significance.

Veg Condition Pristine, no disturbance

Fire > 5 years

Notes Plentiful leaf litter widespread and plentiful woody litter. GPS +/- 6 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Atalaya hemiglauca	5 %	< 5 m	8.7	
Corymbia flavescens	2 %	< 5 m	71.3	
Corymbia sp. (SRH 71.8)	0.5 %	< 0.5 m	71.8	Possibly new species
Ficus brachypoda	20 %	< 5 m	71.2	
Ficus opposita var. *indecora*	5 %	> 2 m	71.7	
Ficus virens var. *sublanceolata*	80 %	5 – 15 m	71.1	
Grevillea pyramidalis subsp. *pyramidalis*	1 %	> 2 m	71.4	
Rhodanthe margarethae	+		71.5	
Stemodia sp. Shay Gap(GLD(SRH)55.19)	+		71.9	New Species
Tinospora smilacina	+		71.6	

Goldsworthy **Site** 72

Described C. SLEE **Date** 7/11/2004 50 by 50

Location Sunrise Hill mining lease north of railway line

Air Photo 375 **on** 2 **Video** N **E Photo**

WGS84 50 197709 mE, 7730814 mN

Habitat Steep south scarp slope

Soil Brown to red-orange fine sand to sandy clay with coarse gravel, pebbles, stones and boulders

Rock Type Ferrous

Vegetation *Acacia ptychophylla, Acacia ancistrocarpa, Acacia pyrifolia, Grevillea wickhamii* subsp. *aprica* scattered low shrubland over *Dodonaea coriacea, Acacia colei* var. *colei* scattered dwarf shrubs over mixed scattered soft grasses over *Triodia wiseana* moderately dense hummock grassland.

Veg Condition Pristine, no disturbance

Fire > 5 years

Notes Moderate leaf litter under spinifex and negligible woody litter. GPS +/- 6 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia ancistrocarpa	1 %	0.5 – 1 m	19.1	
Acacia colei var. *colei*	0.5 %	< 0.5 m	20.2	
Acacia ptychophylla	1 %	0.5 – 1 m		
Acacia pyrifolia	0.5 %	0.5 – 1 m	1.22	
Cassytha capillaris	+		16.9	
Cymbopogon ambiguus	+		8.13	
Dodonaea coriacea	1 %	< 0.5 m	24.2	
Eriachne ciliata	+		40.2	
Euphorbia coghlanii	+		58.15	
Grevillea wickhamii subsp. *aprica*	0.5 %	0.5 – 1 m	1.4	
Senna glutinosa subsp. *glutinosa*	0.5 %	0.5 – 1 m	14.9	
Streptoglossa decurrens	0.5 %	< 0.5 m	30.4	
Triodia wiseana	50 %		11.4	
Triumfetta maconochieana	0.5 %	< 0.5 m	1.9	

Goldsworthy Site 73

Described C. SLEE **Date** 3/11/2004 50 by 50

Location Sunrise Hill mining lease north of railway line and west of drainage line

Air Photo 380 & 381 **on** 2 **Video** N **E Photo**

WGS84 50 198565 mE, 7729724 mN

Habitat Undulating granite plain

Soil Pale orange sand to sandy clay

Rock Type Granite

Vegetation *Corymbia hamersleyana* scattered low trees over *Acacia orthocarpa* sparse tall shrubland over *Acacia sphaerostachya* scattered medium shrubs over *Acacia ancistrocarpa* scattered low shrubs over *Acacia stellaticeps* sparse dwarf shrubland over *Triodia epactia*, *Triodia wiseana* open hummock grassland.

Veg Condition Excellent, minimal disturbance, some weeds and dust from road

Fire > 5 years

Notes Sparse leaf litter mainly under shrubs and sparse woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia ancistrocarpa	0.5 %	0.5 – 1 m	73.2	
Acacia orthocarpa	5 %	> 2 m	7.1	
Acacia sphaerostachya	0.5 %	1 – 2 m	73.3	
Acacia stellaticeps	5 %	< 0.5 m	73.1	
Acacia tumida var. *pilbarensis*	0.5 %	< 0.5 m	1.2	
Bulbostylis barbata	+		17.11	
Corchorus aff. *parviflorus* (1)	0.5 %	< 0.5 m	73.8	
Corchorus aff. *parviflorus* (2)	0.5 %	< 0.5 m	73.7	
Corymbia hamersleyana	0.5 %	< 5 m	1.1	
Dampiera candicans	0.5 %	< 0.5 m	10.13	
Eriachne pulchella subsp. *dominii*	+		73.6	
Euphorbia australis	+		73.4	Herb
Evolvulus alsinoides var. *villosicalyx*	+		14.14	
Fimbristylis depauperata	+		73.10	
Gomphrena cunninghamii	+		8.21	
Goodenia microptera	+		73.5	
Grevillea pyramidalis subsp. *pyramidalis*	0.5 %	1 – 2 m	32.8	
Grevillea wickhamii subsp. *aprica*	0.5 %	< 0.5 m	1.4	
Indigofera monophylla	0.5 %	< 0.5 m	1.6	
Mukia maderaspatana	+		7.7	
Polycarpaea holtzei	+			
Polygala isingii	+			
Pterocaulon sphaeranthoides	0.5 %		7.13	
Senna glutinosa subsp. *glutinosa*	0.5 %	1 – 2 m	14.9	
Stemodia grossa	0.5 %		68.3	
Streptoglossa decurrens	0.5 %	< 0.5 m	30.4	
Trachymene oleracea	+		5.2	
Triodia epactia	20 %		1.7	
Triodia wiseana	10 %		11.4	
Triumfetta maconochieana	0.5 %	< 0.5 m	73.11	
Yakirra australiensis	+		73.9	

Goldsworthy **Site** 74

Described C. SLEE **Date** 8/11/2004 50 by 50

Location Sunrise Hill mining lease north of railway line and access roads on drainage line

Air Photo 382 **on** 2 **Video** N **E Photo**

WGS84 50 198650 mE, 7729681 mN

Habitat Minor dry to swampy channel

Soil Dark brown clay loam to peaty with loose soil, stones and boulders

Rock Type Granite

Vegetation *Melaleuca glomerata* sparse medium shrubland with *Ficus opposita* var. *indecora* over *Typha domingensis* open rushes over *Cyperus vaginatus* scattered sedges over *Flaveria australasica* open herbland.

Veg Condition Good to poor, moderate to significant disturbance, heavy/moderate cattle grazing and trampling

Fire > 5 years

Notes Moderate leaf litter mainly under shrubs and moderate woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Chloris virgata	+		74.5	
Cyperus vaginatus	2 %		41.4	
Dysphania plantaginella	+		74.3	herb
Ficus opposita var. *indecora*	0.5 %	1 – 2 m	41.6	
Flaveria australasica	15 %		74.2	
Ipomoea muelleri	+		74.4	
Melaleuca glomerata	5 %	1 – 2 m	74.1	
Sporobolus australasicus	+		36.5	
Typha domingensis	20 %			

Goldsworthy Site 75

Described C. SLEE **Date** 8/11/2004 50 by 50

Location Sunrise Hill mining lease north west of railway line and access roads

Air Photo 383 **on** 2 **Video** N **E Photo**

WGS84 50 199458 mE, 7729566 mN

Habitat Scarp plateau/ridge plateau

Soil Brown to red-orange sandy clay to loam with coarse gravel, pebbles, stones, boulders and slab outcroppings

Rock Type Ferrous

Vegetation *Acacia inaequilatera* sparse low trees over *Grevillea wickhamii* subsp. *aprica* scattered medium shrubland over *Acacia ptychophylla, Acacia ancistrocarpa, Acacia colei* var. *colei* sparse low shrubland over *Acacia adoxa* var. *adoxa, Acacia hilliana* scattered dwarf shrubs over *Triodia epactia* open hummock grassland.

Veg Condition Pristine, no disturbance

Fire > 5 years

Notes Sparse leaf litter mainly under shrubs and sparse woody litter. GPS +/- 4 m. Status: Dry, many annuals not available. Intensity: Very thorough.

.

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia adoxa var. *adoxa*	0.5 %	< 0.5 m	1.5	
Acacia ancistrocarpa	0.5 %	0.5 – 1 m	19.1	
Acacia colei var. *colei*	0.5 %	0.5 – 1 m	20.2	
Acacia hilliana	0.5 %	< 0.5 m	4.16	
Acacia inaequilatera	3 %	< 5 m	2.1	
Acacia ptychophylla	5 %	0.5 – 1 m	75.1	
Corchorus aff. *parviflorus* (1)	0.5 %	< 0.5 m	4.3	
Dampiera candicans	0.5 %	< 0.5 m	10.13	
Grevillea wickhamii subsp. *aprica*	1 %	1 – 2 m	1.4	
Pterocaulon sphaeranthoides	+		7.13	
Scaevola amblyanthera var. *centralis*	0.5 %	< 0.5 m		
Triodia epactia	25 %		1.7	

Goldsworthy Nimingarra

Described C.SLEE **Date** Various

Location Nimingarra opportunistic collections

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia bivenosa				WP013
Acacia colei var. *colei*	0.5%	1-2m		WP043
Acacia colei var. *colei*	1%	1-2m		WP028
Acacia trachycarpa				WP008
**Aerva javanica*				WP033
Aristida contorta				WP008
Cajanus cinereus				WP004
Cassytha filiformis				WP043
Clerodendrum tomentosum var. *lanceolatum*	0.5%	<0.5m		WP011
Corchorus aff. *parviflorus* (2)	5%	<0.5m		WP060,
Corchorus sidoides aff. subsp. *vermicularis* (GLD(NIM)17.16)	0.5%	<0.5m		WP047
Corymbia flavescens				WP043
Corymbia flavescens				WP028
Corymbia hamersleyana				WP035
Corymbia zygophylla				WP126
Cymbopogon ambiguus				WP008
Cymbopogon ambiguus				WP013
Dysphania rhadinostachya subsp. *rhadinostachya*	+			WP021
Enneapogon oblongus				WP007
Eriachne ciliata				WP007
Eriachne mucronata (typical form)				WP007
Eriachne mucronata (typical form)				WP013
Eriachne obtusa				WP039
Eucalyptus leucophloia subsp. *leucophloia*				WP019
Eucalyptus leucophloia subsp. *leucophloia*				WP031
Euphorbia sp. (PAN5-15)	+			WP024
Evolvulus alsinoides var. *villosicalyx*				WP013
Ficus brachypoda				WP007
Ficus opposita var. *indecora*	2%	1-2m		WP013
Flueggea virosa subsp. *melanthesoides*				WP013
Flueggea virosa subsp. *melanthesoides*				WP013
Gomphrena cunninghamii				WP011
Hibiscus leptocladus				WP013
Ipomoea muelleri				WP021
Jasminum didymum subsp. lineare				WP017
Melaleuca glomerata				WP130
Mukia maderaspatana				WP011
Nicotiana benthamiana				WP007
Paspalidium tabulatum (Whim Creek form)				WP013
Polycarpaea holtzei				WP046
Pterocaulon serrulatum				WP013
Ptilotus exaltatus var. *exaltatus*				WP002
Ptilotus fusiformis var. *fusiformis*				WP022
Ptilotus incanus var. *elongatus*				WP022
Salsola tragus				WP039
Salsola tragus				WP038
Senna glutinosa subsp. *pruinosa*				WP060
Sida rohlenae subsp. *rohlenae*				WP007
Sida rohlenae subsp. *rohlenae*				WP013
Solanum diversiflorum				WP034
Solanum horridum				WP007
Stemodia grossa				WP014

Streptoglossa decurrens			WP013
Swainsona formosa			WP022
Templetonia hookeri			WP032
Terminalia canescens			WP013
Terminalia canescens			WP013
Tinospora smilacina			WP013
Tribulus suberosus			WP029
Tribulus suberosus			WP004
Triodia wiseana			WP020
Triodia wiseana			WP045
Triodia wiseana			WP041
Triumfetta clementii	0.5%	<0.5m	WP007
Waltheria indica			WP013

Goldsworthy Sunrise Hill

Described C. SLEE **Date** Various

Location Sunrise Hill Opportunistic Collections

Species List:

Species Name	% Cover	Height	Specimen #	Notes
Acacia trachycarpa				WP077
Atalaya hemiglauca				WP076
Boerhavia gardneri				WP076
Bulbostylis barbata				WP072
**Cenchrus ciliaris*				WP079
Codonocarpus cotinifolius				WP102
Cullen stipulaceum				WP099
Cynanchum floribundum				WP082A
Cyperus cunninghamii subsp. *cunninghamii*				WP076
Eriachne ciliata				WP072
Eucalyptus odontocarpa				WP121
Euphorbia aff. wheeleri (GLD(SRH)WP076)	1%			WP076
Gossypium australe (Whim Creek form)				WP076
Hakea chordophylla				WP115
Ipomoea muelleri				WP082B
Phyllanthus exilis	0.5%	<0.5m		WP074
Ptilotus clementii				WP113
Senna notabilis				WP021
Tephrosia rosea var. *clementii*				WP063
Themeda triandra				WP122
Trichosanthes cucumerina var. *cucumerina*				WP080
Triodia longiceps				WP069
Typha domingensis				WP070

Appendix C:

Priority Flora Report Forms

Note:

No Priority Flora were found specifically during the 2004 surveys of Cattle Gorge, Nimingarra and Sunrise Hill. Therefore, no Priority Flora Report Forms have been lodged. Forms for the 1998 Yarrie survey were lodged subsequent to the survey.

Appendix D:

Fauna species by site matrices for

Yarrie, Cattle Gorge, Nimingarra and Sunrise Hill

APPENDIX D1 **Fish species observed at each site of the Goldsworthy Extension Project Area, families presented in taxonomic order. SH = Sunrise Hill, NIM = Nimingarra, CG = Cattle Gorge, YAR = Yarrie.**

Family	Species	Common Name	SH	NIM	CG	YAR
PLOTOSIDAE						
	Neosilurus hyrtili	Hyrtl's Tandan	X			
MELANOTAENIIDAE						
	Melanotaenia sp.	Rainbowfish	X			
TETRAPONTIDAE						
	Leiopotherapon unicolor	Spangled Perch	X		X	X
TOTAL FISH SPECIES			**3**	**0**	**1**	**1**

APPENDIX D2 **Herpetofauna species observed at each site of the Goldsworthy Extension Project Area, families presented in taxonomic order. SH = Sunrise Hill, NIM = Nimingarra, CG = Cattle Gorge, YAR = Yarrie.**

Family	Field Id.	SH	NIM	CG	YAR
HYLIDAE					
	Cyclorana maini				X
	Litoria rubella	X	X	X	X
MYOBATRACHIDAE					
	Limnodynastes spenceri			X	X
	Uperoleia glandulosa	X		X	
TOTAL AMPHIBIAN SPECIES		**2**	**1**	**3**	**3**
CHELUIDAE					
	Chelodina steindachneri		X		
GEKKONIDAE					
	Crenadactylus ocellatus 'horni'	X			
	Diplodactylus conspicillatus	X	X	X	X
	Diplodactylus savagei	X	X	X	
	Diplodactylus stenodactylus		X	X	
	Diplodactylus wombeyi		X	X	
	Gehyra punctata	X	X	X	X
	Gehyra purparescens				X
	Gehyra variegata	X	X	X	
	Gehyra ?punctata	X			
	Heteronotia binoei			X	X
	Heteronotia spelea	X	X	X	X
	Rhynchoedura ornata	X			
	Nephrurus levis pilbarensis	X	X		
	Strophurus ciliaris abberans	X	X		
PYGOPODIDAE					
	Delma elegans		X		
	Delma tincta		X	X	
	Delma pax (desert pax)	X			
	Lialis burtonis	X			X
AGAMIDAE					
	Ctenophorus c. caudicinctus	X	X	X	X
	Ctenophorus isolepis				X
	Ctenophorus nuchalis	X		X	
	Diporiphora winneckei		X		
	Lophognathus longirostris			X	X
	Pogona mitchelli			X	
VARANIDAE					
	Varanus acanthurus		X	X	
	Varanus caudolineatus		X		

Family	Field Id.	SH	NIM	CG	YAR
	Varanus eremius		X		
	Varanus giganteus	X	X	X	
	Varanus gouldii	X			
	Varanus panoptes		X		X
	Varanus pilbarensis	X			X
	Varanus tristis	X		X	
SCINCIDAE					
	Carlia munda	X	X	X	X
	Carlia triacantha	X		X	
	Cryptoblepharus plagiocephalus				X
	Ctenotus rubicundus	X	X		
	Ctenotus helenae		X		
	Ctenotus pantherinus				X
	Ctenotus piankai			X	
	Ctenotus rubicundus		X		
	Ctenotus saxatilis	X	X	X	X
	Cyclodomorphus melanops				X
	Egernia depressa	X	X		X
	Lerista bipes	X	X	X	X
	Lerista muelleri	X	X	X	
	Lerista vermicularis				X
	Menetia greyii		X		
	Morethia ruficauda				X
	Eremiascincus sp.		X		
TYPHLOPIDAE					
	Ramphotyphlops grypus				X
BOIDAE					
	Antaresia perthensis	X		X	
	Antaresia stimsoni	X	X	X	
	Liasis olivaceous barroni			X	
ELAPIDAE					
	Acanthophis pyrrhus			X	
	Brachyurophis approximans		X		
	Demansia psammophis	X	X		X
	Demansia rufescens	X			
	Pseudechis australis			X	X
	Pseudonaja modesta	X			
	Pseudonaja nuchalis			X	
	Furina ornata		X		X
	Simoselaps anomalus		X		
TOTAL REPTILE SPECIES		**30**	**34**	**28**	**24**

APPENDIX D3 **Bird species observed at each site of the Goldsworthy Extension Project Area, families presented in taxonomic order.** **SH = Sunrise Hill, NIM = Nimingarra, CG = Cattle Gorge, YAR = Yarrie.**

Family	Species	Common Name	SH	NIM	CG	YAR
PHASIANIDAE						
	Coturnix ypsilophora	Brown Quail	X	X	X	X
TURNICIDAE						
	Turnix velox	Little Button-quail		X		X
PELECANIDAE						
	Pelecanus conspicillatus	Australian Pelican			X	
PHALACROCORACIDAE						
	Phalacrocorax melanoleucos	Little Pied Cormorant			X	
	Phalacrocorax sulcirostris	Little Black Cormorant				
ANATIDAE						
	Anas gracilis	Grey Teal			X	
	Anas superciliosa	Pacific Black Duck			X	
	Aythya australis	Hardhead			X	
RALLIDAE						
	Gallirallus philippensis	Buff-banded Rail			X	
	Porzana fluminea	Spotted Crake	X			
ARDEIDAE						
	Ardea alba	Great Egret			X	
	Ardea pacifica	White-necked Heron		X	X	
	Egretta novaehollandiae	White-faced Heron		X	X	X
THRESKIORNITHIDAE						
	Platalea flavipes	Yellow-billed Spoonbill			X	
	Platalea regia	Royal Spoonbill			X	
	Plegadis falcinellus	Glossy Ibis			X	
	Threskiornis spinicollis	Straw-necked Ibis			X	
CICONIIDAE						
	Ephippiorhynchus asiaticus	Black-necked Stork			X	
OTIDIDAE						
	Ardeotis australis	Australian Bustard			X	
SCOLOPACIDAE						
	Actitis hypoleucos	Common Sandpiper			X	
	Gallinago sp.	*Gallinago* Snipe sp.			X	
	Tringa glareola	Wood Sandpiper			X	
	Tringa nebularia	Common Greenshank			X	
	Tringa stagnatilis	Marsh Sandpiper		X	X	
BURHINIDAE						

Family	Species	Common Name	SH	NIM	CG	YAR
	Burhinus grallarius	Bush Stone-curlew		X	X	
CHARADRIIDAE						
	Charadrius ruficapillus	Red-capped Plover			X	
	Elseyornis melanops	Black-fronted Dotterel			X	X
	Erythrogonys cinctus	Red-kneed Dotterel			X	
ACCIPITRIDAE						
	Accipiter fasciatus	Brown Goshawk		X	X	
	Aquila audax	Wedge-tailed Eagle	X			
	Circus assimilis	Spotted Harrier	X	X	X	
	Elanus axillaris	Black-shouldered Kite		X		X
	Haliastur sphenurus	Whistling Kite	X	X	X	
	Hieraaetus morphnoides	Little Eagle	X		X	
	Pandion haliaetus	Osprey			X	
FALCONIDAE						
	Falco berigora	Brown Falcon	X	X	X	X
	Falco cenchroides	Australian Kestrel	X	X	X	X
	Falco longipennis	Australian Hobby	X		X	
COLUMBIDAE						
	Geopelia cuneata	Diamond Dove	X	X	X	X
	Geopelia striata	Peaceful Dove		X	X	
	Geophaps plumifera	Spinifex Pigeon	X	X	X	X
	Ocyphaps lophotes	Crested Pigeon	X	X	X	X
	Phaps chalcoptera	Common Bronzewing	X	X		
CACATUIDAE						
	Cacatua roseicapilla	Galah	X	X	X	X
	Cacatua sanguinea	Little Corella	X	X	X	X
PSITTACIDAE						
	Barnardius zonarius	Australian Ringneck				X
CUCULIDAE						
	Chrysococcyx basalis	Horsfield's Bronze-Cuckoo		X	X	X
CENTROPODIDAE						
	Centropus phasianinus	Pheasant Coucal	X	X	X	
STRIGIDAE						
	Ninox boobook	Southern Boobook			X	
AEGOTHELIDAE						
	Aegotheles cristatus	Owlet Nightjar	X	X		
CAPRIMULGIDAE						
	Eurostopodus argus	Spotted Nightjar	X	X	X	X
HALCYONIDAE						
	Dacelo leachii	Blue-winged Kookaburra	X	X	X	

Family	Species	Common Name	SH	NIM	CG	YAR
	Todiramphus pyrrhopygia	Red-backed Kingfisher	X	X	X	X
	Todiramphus sanctus	Sacred Kingfisher		X	X	
MEROPIDAE						
	Merops ornatus	Rainbow Bee-eater	X	X	X	X
MALURIDAE						
	Amytornis striatus	Striated Grasswren	X	X	X	X
	Malurus lamberti	Variegated Fairy-wren		X	X	X
	Malurus leucopterus	White-winged Fairy-wren	X			
PARDALOTIDAE						
	Pardalotus rubricatus	Red-browed Pardalote	X	X	X	
	Pardalotus striatus	Striated Pardalote				X
MELIPHAGIDAE						
	Lichenostomus keartlandi	Grey-headed Honeyeater	X	X	X	X
	Lichenostomus ornatus	Yellow-plumed Honeyeater			X	
	Lichenostomus penicillatus	White-plumed Honeyeater	X	X	X	X
	Lichenostomus plumulus	Grey-fronted Honeyeater				X
	Lichenostomus virescens	Singing Honeyeater	X	X	X	X
	Lichmera indistincta	Brown Honeyeater	X	X	X	X
	Manorina flavigula	Yellow-throated Miner	X		X	X
	Melithreptus gularis	Black-chinned Honeyeater	X	X	X	X
POMATOSTOMIDAE						
	Pomatostomus temporalis	Grey-crowned Babbler			X	
PACHYCEPHALIDAE						
	Colluricincla harmonica	Grey Shrike-thrush	X	X	X	X
	Pachycephala rufiventris	Rufous Whistler				X
DICRURIDAE						
	Grallina cyanoleuca	Magpie Lark	X	X	X	X
	Rhipidura leucophrys	Willie Wagtail	X	X	X	X
PTILONORHYNCHIDAE						
	Chlamydera guttata	Western Bowerbird	X	X	X	X
CAMPEPHAGIDAE						
	Coracina novaehollandiae	Black-faced Cuckoo-Shrike	X	X	X	X
	Lalage tricolor	White-winged Triller	X	X	X	
ARTAMIDAE						
	Artamus cinereus	Black-faced Woodswallow	X	X	X	X
	Artamus minor	Little Woodswallow	X	X	X	X
	Cracticus nigrogularis	Pied Butcherbird	X	X	X	X
CORVIDAE						
	Corvus orru	Torresian Crow	X	X	X	X

Family	Species	Common Name	SH	NIM	CG	YAR
HIRUNDINIDAE						
	Hirundo ariel	Fairy Martin	X	X	X	X
	Hirundo nigricans	Tree Martin		X		
MOTACILLIDAE						
	Anthus novaeseelandiae	Australian Pipit	X		X	X
ALAUDIDAE						
	Cincloramphus mathewsi	Rufous Songlark			X	
	Cincloramphus cruralis	Brown Songlark		X		
	Mirafra javanica	Singing Bushlark		X	X	
SYLVIIDAE						
	Eremiornis carteri	Spinifexbird	X	X	X	X
ESTRILDIDAE						
	Emblema pictum	Painted Firetail	X	X	X	X
	Heteromunia pectoralis	Pictorella Mannikin			X	
	Neochmia ruficauda	Star Finch			X	
	Taeniopygia guttata	Zebra Finch	X	X	X	X
DICAEIDAE						
	Dicaeum hirundinaceum	Mistletoe Bird				X
TOTAL BIRD SPECIES			**45**	**52**	**77**	**43**

APPENDIX D4 **Mammal species observed at each site of the Goldsworthy Extension Project Area, families presented in taxonomic order.** SH = Sunrise Hill, NIM = Nimingarra, CG = Cattle Gorge, YAR = Yarrie.

Family	Field Id.	SH	NIM	CG	YAR
TACHYGLOSSIDAE					
	Tachyglossus aculeatus				X
DASYURIDAE					
	Dasycercus cristicauda			X	
	Dasykaluta rosamondae				X
	Dasyurus hallucatus	X	X	X	X
	Ningaui timealeyi				X
	Planigale sp.	X	X		
	Sminthopsis youngsoni				X
	Sminthopsis macroura		X		
MACROPODIDAE					
	Macropus robustus	X	X	X	X
	Macropus rufus			X	X
	Petrogale rothschildi	X	X		
EMBALLONURIDAE					
	Saccolaimus flaviventris		X		
	Taphozous georgianus	X	X	X	
	Taphozous hilli				X
HIPPOSIDERIDAE					
	Rhinonicteris aurantius		X	X	
VESPERTILIONIDAE					
	Chalinolobus gouldii	X	X	X	
	Nyctophilus geoffroyi		X	X	
	Scotorepens greyii	X	X	X	
	Vespadelus baverstocki	X			
	Vespadelus finlaysoni	X	X	X	
MOLOSSIDAE					
	Chaerophon jobensis			X	
MURIDAE					
	Leggadina lakedownensis				X
	**Mus musculus*		X	X	X
	Pseudomys chapmani				X
	Pseudomys delicatulus				X
	Pseudomys desertor			X	X
	Pseudomys hermannsburgensis			X	X
	Pseudomys delicatulus		X		
	Zyzomys argurus	X	X	X	X
CANIDAE					

Family	Field Id.	SH	NIM	CG	YAR
	Canis lupus dingo		X		
FELIDAE					
	**Felis catus*	X			X
BOVIDAE					
	**Bos Taurus*	X	X		X
TOTAL MAMMAL SPECIES		**12**	**17**	**15**	**17**

Appendix E:

Explanation of Conservation Codes

APPENDIX E1 Explanation of Conservation Codes for vascular flora.

Environment Protection and Biodiversity Conservation Act 1999

At a National level, flora and fauna are protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Act contains a list of species that are considered Critically Endangered, Endangered, Vulnerable, Conservation Dependent, Extinct or Extinct in the Wild (Table E1.1).

Table E1.1 Definition of categories described under the EPBC Act.

Conservation Category	Definition
Extinct	A species is extinct if there is no reasonable doubt that the last member of the species has died.
Extinct in the wild	A species is categorised as extinct in the wild if it is only known to survive in cultivation, in captivity or as a naturalised population well outside its past range; or if it has not been recorded in its known/expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered	The species is facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	The species is likely to become extinct unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate; or its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction.
Vulnerable	Within the next 25 years, the species is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate.
Conservation Dependent	The species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

Wildlife Conservation Act 1950

Rare flora is also protected under the *Western Australian Wildlife Conservation (Rare Flora) Notice 2003* of the *Wildlife Conservation Act 1950*. The notice lists protected flora taxa that are extant and considered likely to become extinct or rare. Generally speaking, species of flora are considered as being of Declared Rare Flora (DRF) or Priority conservation status where their populations are restricted geographically or threatened by local processes. CALM maintains a list of all DRF and Priority flora taxa within Western Australia (Atkins, 2004). Definitions of categories of DRF and Priority flora are provided in Table E1.2. Priority flora are either poorly known, believed to be uncommon, rare or under threat but have not been designated as DRF and thereby legally protected because the detailed survey work to justify this has not been carried out. Priority species are maintained on a "Reserve List" and assigned to one of four Priority categories (Atkins, 2004).

Table E1.2 Definition of Declared Rare and Priority flora categories.

Code	Definition
DRF	Declared Rare Flora - Extant Taxa. Taxa which 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.
P1: Priority One	Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations which are under threat.
P2: Priority Two	Poorly Known Taxa. Taxa which are known from one or a few (generally <5) population, at least some of which are not believed to be under immediate threat.
P3: Priority Three	Poorly Known Taxa. Taxa which are known from several populations, at least some of which are not believed to be under immediate threat.
P4: Priority Four	Rare Taxa. Taxa which are considered to have been adequately surveyed and which whilst being rare, are not currently threatened by any identifiable factors.

(From Atkins, K.J., Declared Rare and Priority Flora List 2004, Dept CALM)

APPENDIX E2 Explanation of Conservation Codes for Declared Weeds.

Table E2.1 Explanation of codes for Declared Weeds in Western Australia.

Priority	Requirements
P1 Prohibits movement	The movement of plants or their seeds is prohibited within the State. This prohibits the movement of contaminated machinery and produce including livestock and fodder.
P2 Aim is to eradicate infestation	Treat all plants to destroy and prevent propagation each year until no plants remain. The infested area must be managed in such a way that prevents the spread of seed or plant parts on or in livestock, fodder, grain, vehicles and/or machinery.
P3 Aims to control infestation by reducing area and/or density of infestation	The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set for all plants:- • Within 100 metres inside of the boundaries of the infestation. • within 50 metres of roads and high-water mark on waterways. • within 50 metres of sheds, stock yards and houses. • Treatment must be done prior to seed set each year. Of the remaining infested area:- • Where plant density is 1-10 per hectare treat 100% of infestation. • Where plant density is 11-100 per hectare treat 50% of infestation. • Where plant density is 101-1000 per hectare treat 10% of infestation. Properties with less than 2 hectares of infestation must treat the entire infestation. Additional areas may be ordered to be treated.
P4 Aims to prevent infestation spreading beyond existing boundaries of infestation	The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set all plants:- • within 100 metres inside of the boundaries of the infested property • within 50 metres of roads and high-water mark on waterways • within 50 metres of sheds, stock yards and houses • Treatment must be done prior to seed set each year. Properties with less than 2 hectares of infestation must treat the entire infestation. Additional areas may be ordered to be treated. Special considerations In the case of P4 infestations where they continue across property boundaries there is no requirement to treat the relevant part of the property boundaries as long as the boundaries of the infestation as a whole are treated. There must be agreement between neighbours in relation to the treatment of these areas.
P5	Infestations on public lands must be controlled

APPENDIX E3 Explanation of Conservation Codes for Fauna.

Commonwealth EPBC Act

Schedule 1 of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* contains a list of species that are considered Critically Endangered, Endangered, Vulnerable, Extinct, Extinct in the wild and Conservation Dependent.

Table E3.1 Explanation of codes for fauna under the Commonwealth EPBC Act.

Conservation Category	Definition
Critically Endangered	The species is facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	The species is likely to become extinct unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate; or its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction.
Vulnerable	Within the next 25 years, the species is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate.
Extinct	A species is presumed extinct if it has not been located in the last 50 years, or it has not been located in the last 10 years despite thorough searching.
Extinct in the wild	The species is only known to survive in cultivation, in captivity or as a naturalised population well outside its past range or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a timeframe appropriate to its life cycle and form.
Conservation Dependent	The species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

WA *Wildlife Conservation Act 1950 (Specially Protected Fauna) Notice 2003*

Classification of rare and endangered fauna under the WA *Wildlife Conservation (Specially Protected Fauna) Notice 2003*, recognises four distinct Schedules.

Table E3.2 Explanation of codes under the WA *Wildlife Conservation Act 1950 (Specially Protected Fauna) Notice 2003.*

Code	Definition
Schedule 1	"fauna which are rare or likely to become extinct, are declared to be fauna that is in need of special protection"
Schedule 2	"fauna which are presumed to be extinct, are declared to be fauna that is in need of special protection";
Schedule 3	"birds which are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction, are declared to be fauna that is in need of special protection";
Schedule 4	"declared to be fauna that is in need of special protection, otherwise than for the reasons mentioned in paragraphs (a), (b) and (c)."

CALM Priority Fauna

Species on the CALM Priority fauna list include those removed from the Scheduled fauna list and other species known from only a few populations or in need of monitoring. Four Priority Codes are recognised.

Table E3.3 Explanation of CALM Priority Fauna categories.

Priority Catogory	Definition
Priority One Taxa with few, poorly known populations on threatened lands.	Taxa which are known from few specimens or sight records from one or a few localities, on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority Two Taxa with few, poorly known populations on conservation lands.	Taxa which are known from few specimens or sight records from one or a few localities, on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant crown land, water reserves, etc. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna
Priority Three Taxa with several, poorly known populations, some on conservation lands.	Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority Four Taxa in need of monitoring	Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could if present circumstances change. These taxa are usually represented on conservation lands.

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Table E3.4 Explanation of IUCN fauna categories.

Category	Definition
EXTINCT (EX)	A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
EXTINCT IN THE WILD (EW)	A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
CRITICALLY ENDANGERED (CR)	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.
ENDANGERED (EN)	A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.
VULNERABLE (VU)	A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.
NEAR THREATENED (NT)	A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
LEAST CONCERN (LC)	A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
DATA DEFICIENT (DD)	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.
NOT EVALUATED (NE)	A taxon is Not Evaluated when it is has not yet been evaluated against the criteria.

IUCN categories are further classified based on the following criteria:

CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing an extremely high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of 90% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:

(a) direct observation
(b) an index of abundance appropriate to the taxon
(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
(d) actual or potential levels of exploitation
(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of 80% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

3. A population size reduction of 80%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of 80% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 100 km², and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at only a single location.

b. Continuing decline, observed, inferred or projected, in any of the following:

(i) extent of occurrence
(ii) area of occupancy
(iii) area, extent and/or quality of habitat
(iv) number of locations or subpopulations
(v) number of mature individuals.

c. Extreme fluctuations in any of the following:

(i) extent of occurrence
(ii) area of occupancy
(iii) number of locations or subpopulations
(iv) number of mature individuals.

2. Area of occupancy estimated to be less than 10 km², and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at only a single location.

b. Continuing decline, observed, inferred or projected, in any of the following:

(i) extent of occurrence
(ii) area of occupancy
(iii) area, extent and/or quality of habitat
(iv) number of locations or subpopulations
(v) number of mature individuals.

c. Extreme fluctuations in any of the following:

(i) extent of occurrence
(ii) area of occupancy
(iii) number of locations or subpopulations
(iv) number of mature individuals.

C. Population size estimated to number fewer than 250 mature individuals and either:

1. An estimated continuing decline of at least 25% within three years or one generation, whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following a-b:

a. Population structure in the form of one of the following:

(i) no subpopulation estimated to contain more than 50 mature individuals, OR
(ii) at least 90% of mature individuals in one subpopulation.

b. Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 50 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or three generations, whichever is the longer (up to a maximum of 100 years).

ENDANGERED (EN)

A taxon is Endangered when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing a very high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of 70% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:

(a) direct observation
(b) an index of abundance appropriate to the taxon
(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
(d) actual or potential levels of exploitation
(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of 50% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of a-e under A1.

3. A population size reduction of 50%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of b-e under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of 50% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of a-e under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 5000 km², and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at no more than five locations.

b. Continuing decline, observed, inferred or projected, in any of the following:

(i) extent of occurrence
(ii) area of occupancy
(iii) area, extent and/or quality of habitat
(iv) number of locations or subpopulations
(v) number of mature individuals.

c. Extreme fluctuations in any of the following:

(i) extent of occurrence
(ii) area of occupancy
(iii) number of locations or subpopulations
(iv) number of mature individuals.

2. Area of occupancy estimated to be less than 500 km², and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at no more than five locations.

b. Continuing decline, observed, inferred or projected, in any of the following:

(i) extent of occurrence
(ii) area of occupancy
(iii) area, extent and/or quality of habitat
(iv) number of locations or subpopulations
(v) number of mature individuals.

c. Extreme fluctuations in any of the following:

(i) extent of occurrence
(ii) area of occupancy
(iii) number of locations or subpopulations
(iv) number of mature individuals.

C. Population size estimated to number fewer than 2500 mature individuals and either:

1. An estimated continuing decline of at least 20% within five years or two generations, whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following a-b:

a. Population structure in the form of one of the following:

(i) no subpopulation estimated to contain more than 250 mature individuals, OR
(ii) at least 95% of mature individuals in one subpopulation.

b. Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 250 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is the longer (up to a maximum of 100 years).

VULNERABLE (VU)

A taxon is Vulnerable when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing a high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of 50% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are: clearly reversible AND understood AND ceased, based on (and specifying) any of the following:

(a) direct observation
(b) an index of abundance appropriate to the taxon
(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
(d) actual or potential levels of exploitation
(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of 30% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

3. A population size reduction of 30%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of 30% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 20,000 km^2, and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at no more than 10 locations.

b. Continuing decline, observed, inferred or projected, in any of the following:

(i) extent of occurrence
(ii) area of occupancy
(iii) area, extent and/or quality of habitat
(iv) number of locations or subpopulations
(v) number of mature individuals.

c. Extreme fluctuations in any of the following:

(i) extent of occurrence
(ii) area of occupancy
(iii) number of locations or subpopulations
(iv) number of mature individuals.

2. Area of occupancy estimated to be less than 2000 km², and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at no more than 10 locations.

b. Continuing decline, observed, inferred or projected, in any of the following:

(i) extent of occurrence
(ii) area of occupancy
(iii) area, extent and/or quality of habitat
(iv) number of locations or subpopulations
(v) number of mature individuals.

c. Extreme fluctuations in any of the following:

(i) extent of occurrence
(ii) area of occupancy
(iii) number of locations or subpopulations
(iv) number of mature individuals.

C. Population size estimated to number fewer than 10,000 mature individuals and either:

1. An estimated continuing decline of at least 10% within 10 years or three generations, whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following a-b:

a. Population structure in the form of one of the following:

(i) no subpopulation estimated to contain more than 1000 mature individuals, OR
(ii) all mature individuals are in one subpopulation.

b. Extreme fluctuations in number of mature individuals.

D. Population very small or restricted in the form of either of the following:

1. Population size estimated to number fewer than 1000 mature individuals.

2. Population with a very restricted area of occupancy (typically less than 20 km²) or number of locations (typically five or fewer) such that it is prone to the effects of human activities or stochastic events within a very short time period in an uncertain future, and is thus capable of becoming Critically Endangered or even Extinct in a very short time period.

E. Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years.

Appendix F:
Floristic sub-regional analysis of the survey areas in the north east Pilbara bioregion.

1.0 INTRODUCTION

1.1 Purpose of this report

This report presents the results and a discussion of floristic analyses carried out to provide a sub-regional overview of the floristic variation present in vegetation quadrat data recorded by *Ecologia* Environmental Consulting in vegetation in survey areas at Nimingarra, Cattle Gorge, Yarrie and Sunrise Hill.

The analyses carried out provide a classification of the floristic variation of the vegetation at Nimingarra, Sunrise Hill, Cattle Gorge and Yarrie in combination with similar data from adjacent to the Shaw River and in the Gorge Range (from Trudgen *et al* 2001). The latter data has been included in the analysis to provide a comparison to other vegetation in the region the four *Ecologia* survey areas are located in. The combined dataset has a wider geographic distribution and a larger number of sites than any one of the areas surveyed by *Ecologia*, allowing a context to be provided for each of the *Ecologia* survey areas.

The classification presented of the floristic data can be interpreted to provide a sub-regional overview of the significance of the vegetation types present in the Nimingarra and Sunrise Hill survey areas.

1.2 Levels of classification provided

While a classification of the site data was a fundamental part of the analysis, no attempt was made to prepare a classification in which the individual groups were meaningful in the field. That is, the levels of the groups in the 20 group and 80 group classifications presented are well above the plant community concept, and the groups defined are at a higher, largely abstract level.

It was not possible in the scope of this report to define their levels closely, but the 80 group level would be a similar level of synthesis to the vegetation association level (although based only on floristics, not on a combination of structure and floristics as is usual for the vegetation association level) and the 20 group level would be similar to (or a bit lower than) the vegetation formation level (although based only on floristics, not only on structure as is usual for the vegetation formation level). For comparison to

the 20 group and 80 group levels of classification, the complete dendrogram showing all 221 sites in the combined dataset is given in Appendix 2.

1.3 Location

All the data used in the analyses are from survey areas in the north-eastern part of the Pilbara Bioregion (Environment Australia 2000). The survey areas are all east or south east of Port Hedland, within a maximum extent of about 150 kilometres. In fact, most of the survey areas are within about 80 kilometres of each other, with the sites from the Shaw River and Gorge Range (from the Trudgen *et al* 2002 survey for the Panorama project) the most south-westerly, and the furtherest from the others). For simplicity, the Shaw River and Gorge Range data will be referred to by the Panorama project name.

1.4 Data provided by *Ecologia*

The data from the Nimingarra and Sunrise Hill survey areas was provided in a standard database (prepared in Microsoft Access). This data was imported into another copy of the same database. The data from the Yarrie and Cattle Gorge surveys was provided in a combination of spreadsheet and document files. These were transformed into an appropriate form and imported into the Microsoft Access database.

The quadrats recorded at Yarrie and Cattle Gorge were 100 by 100 metres, while the quadrats recorded at Nimingarra and Sunrise Hill were 50 by 50 metres.

M.E. Trudgen identified the Nimingarra and Sunrise Hill plant specimens. *Ecologia* staff identified the Yarrie and Cattle Gorge specimens.

1.5 The data from the Panorama project

This data was already available in the standard Microsoft Access database. The quadrats recorded were 50 x 50 metres and M.E. Trudgen carried out the identification of the plant specimens, adding to the consistency of the naming of flora species between the datasets.

The Panorama dataset samples a granitic plain, major creeks, a gorge and a range of hills, including some quite large hills. Eighty-one sites from Panorama were used in

the analysis including sites from a wide range of habitats and a significant range of geology, but not iron-rich rocks.

2.0 METHODS

2.1 Data Preparation

The data from the five projects were extracted into a separate database called "Goldsworthy.mdb". All the data used for preparing the analysis and the products of the PATN analyses were incorporated into that database. The queries used to carry out the analysis are also incorporated in "Goldsworthy.mdb".

The data from the five projects was reviewed to exclude incomplete sites from the analysis. The sites that were used are identified in the database table "Site_lookup" in "Goldsworthy.mdb". Several sites that were later found to be located in rehabilitation areas were inadvertently included in the analyses.

A process of reconciliation of flora species names used in the different surveys was then undertaken. This step was necessary because of changes in nomenclature over the last few years and the potential of survey specific variations in application of names. The reconciliation involved combining some infra-specific names under the relevant species name, combining some taxa where confusion is likely to have occurred in field observations and the identifications, and omitting some names (mostly, where a taxon had only been identified to genus). The product of this reconciliation process is contained in the database table "Yarrie_reconcill_Lookup" (in "Goldsworthy.mdb") in which some species were considered equivalent to another and some were marked for omission for the analyses. The table in Appendix 1 is a summary of the species that were treated in either of these ways.

2.2 Comparability of datasets

As it was intended to include in the analysis datasets recorded from several surveys, the compatibility of these datasets in terms of the sizes of quadrats recorded (as well as the naming issues discussed above) is an important issue.

The different datasets used come from a combination of 50 x 50 metre quadrats (Nimingarra, Sunrise Hill, Panorama) and 100 by 100 metre quadrats (Yarrie and Cattle Gorge).

The initial impression of the results of the site classification was that there was significant influence of the project on the classification. Of particular concern, was that in the analysis almost all the Cattle Gorge sites grouped together at the top of the dendrogram produced by the analysis. Such clustering of one part of a dataset produced by combining several datasets is of concern, for it can indicate that an artefact of the data collection, such as the season of recording, quadrat size or the nomenclature used is distorting the analysis. Consequently, a number of aspects of the combined data set being used were examined to evaluate whether or not this was actually happening.

Firstly, the number of species recorded for sites was examined to see if the larger sites recorded at Cattle Gorge could be the cause of the sites from this survey area predominantly occurring together through having larger numbers of species recorded. However, the sites from Cattle Gorge were neither especially rich nor poor in species compared to the sites from Nimingarra and Sunrise Hill, and species number did not appear to have a large impact on the classification. Therefore, the clustering of the Cattle Gorge sites at the beginning of the analysis was not likely to be caused by the differences in quadrat size between Cattle Gorge and Nimingarra, Sunrise Hill and Panorama. The fact that the Yarrie sites (also 100 by 100 metres) did not cluster either with Cattle Gorge, or in such a discrete block also supported the conclusion that quadrat size was not significantly affecting the classification.

The classification was then examined to see what might be driving the grouping of sites. When this was done, it was apparent that habitat appeared to be having a major influence on the classification (through affecting species presence) with wetter sites at the bottom of the dendrogram produced by the classification, and what appeared to be the drier sites at the top. However, this is likely to be simplistic and geology is also likely to be a very significant influence.

With species number at sites (due to larger sites) unlikely to be the cause of the clustering of the Cattle Gorge sites at the top of the dendrogram and a reasonable cause (habitat variation, with probable modification by underlying geology) for the clustering it was considered appropriate to continue with the analysis using all the data as originally compiled.

2.3 Comparisons made

The data assembled were run as a single dataset with the species being considered as either presence or absent from a site (ie, cover values were not considered). This has proven appropriate for assessing the regional nature of the variation in site composition of quadrat data in earlier analyses of Pilbara bioregion data. Data including the cover of species at sites tends to be more useful when analysing datasets from smaller areas.

No attempt was made to relate the classification from the current dataset to that prepared for the Panorama area (which included data from a wider part of the Pilbara Bioregion).

2.4 PATN analyses carried out

Several modules of the numerical classification package PATN (Belbin 1987) were used for the analyses. The default parameter settings were used.

The PATN modules used were ASO (calculation of similarity matrix), FUSE (classification), DEND (representation of classification) and NNB (determination of sites most similar to each site). The results of the analyses were imported into a database so that site characteristics and vegetation could be joined with the groups formed in the analysis.

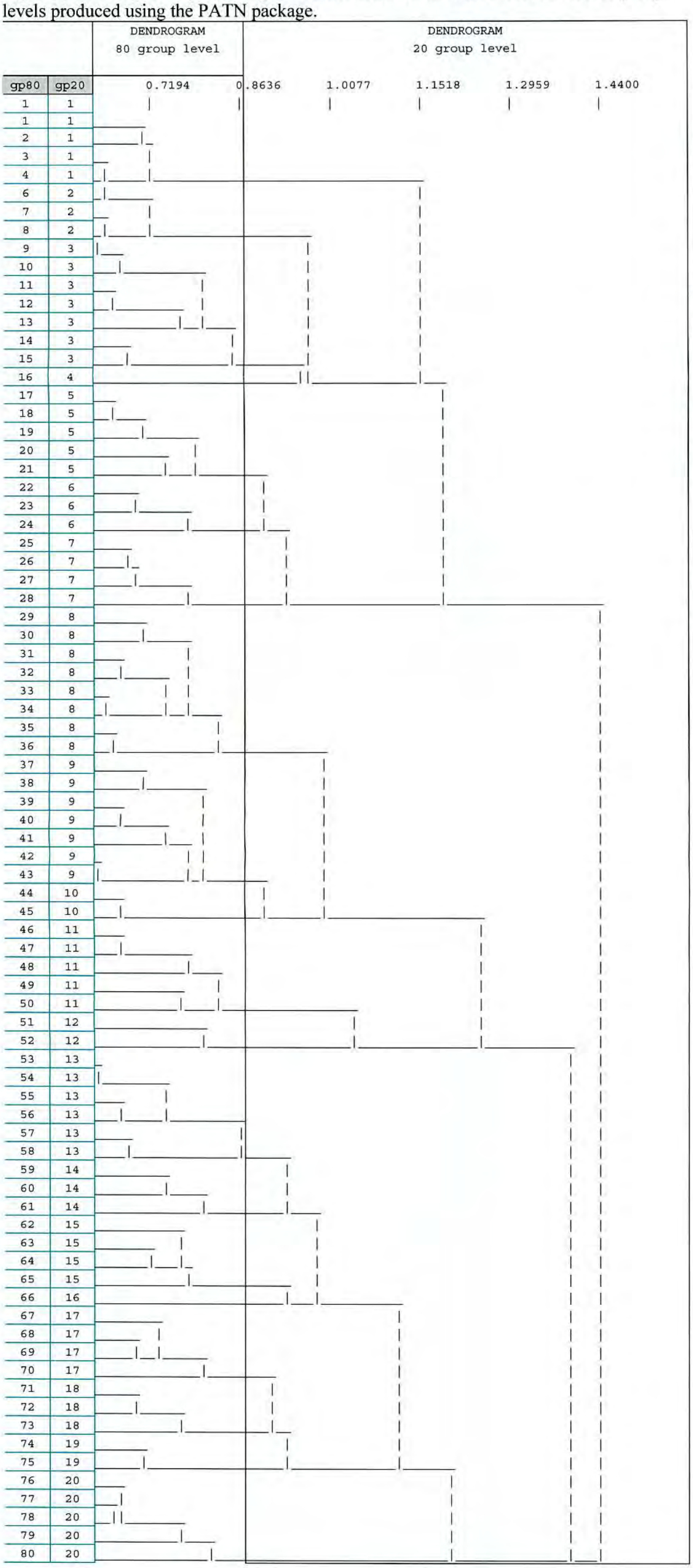
The modules were run twice, first with the sites as the classified objects (ie the species as the attributes), and then with the species as the classified objects (ie the sites as the attributes). In this way both site groups and species groups were generated. The whole data matrix can be presented with the rows being ordered by the site groupings and the species ordered by the species groupings. Most of the interpretation is made from the classification of sites (which are treated as floristic groups and sometimes referred to as floristic community types). The species groups are used to support the interpretations made, more than to identify species that may be expected to occur in similar habitats.

The dendrogram represents the way the classified rows (sites or species) fuse. This can be used to construct groups of rows by "cutting" at a particular value or cutting to obtain a particular number of groups. For the purpose of this study, two "cuts" were made for each of the site and species classifications to form a "20 group" and an "80 group" level of analysis for both. While this is arbitrary, it provides an opportunity to make interpretations of the nature of the classification.

In addition to the classifications described above, an ordination of the site data was carried out using the SSH (semi-strong hybrid multidimensional scaling) module of the PATN package (Belbin 1987). This was performed to diagrammatically present some of the relationships between sites.

The ordination did not produce a result of much use for interpreting the differences between projects. The pair-wise plots of the three vectors calculated showed only that the wettest sites occupied one end of several vectors and the other sites were forced into the middle. This gives a false impression that there was little distinction between the other sites. Such a result is typical of an ordination where there is a large disparate dataset with perhaps many factors controlling the variation. Consequently, the ordination results will not be considered further in this report.

Figure 1: Dendrogram representing the classification of the sites for the 20 and 80 group levels produced using the PATN package.



NOTES:

The column headed gp80 shows the group number at this level.

The column headed gp20 shows the group number at this level.

The DENDROGRAM occupies the remaining two columns. The horizontal lines represent a floristic group or group of floristic groups. The vertical lines show how the floristic groups and groups of groups join (relate) to each other. The numbers across the two columns occupied by the dendrogram show the level of dissimilarity at which the joins between floristic groups occur (higher numbers indicate greater dissimilarity).

The dendrogram can be read as a whole, with all the joins for the 80-group level shown, or just the last column can be read, to give the dendrogram for the 20-group level.

3.0 LIMITATIONS

While a significant effort has been made (by *Ecologia*) to standardise the collection of the more recent site data used in the analysis, it is inevitable that some difference in data quality will have occurred due to the different levels of expertise of the different workers involved in the different surveys, as well as the two quadrat sizes used and difference in seasonal factors.

However, after reviewing the classification produced (see above), it is considered that any such differences that have occurred are not large enough to materially affect the results obtained.

Although the combined dataset is not small, it is restricted to a particular part of the Pilbara Bioregion and this limits the conclusions that can be made from the analysis presented.

The dataset for the four *Ecologia* survey areas is also biased towards areas that are potential iron-ore mines. That is, the dataset does not represent the full range of environments within the overall area that it samples.

4.0 RESULTS

4.1 General results

In the dendrogram representing the floristic classification of the sites, most of the sites were placed adjacent to sites from the same project area (see Appendix 2 for the complete dendrogram with all sites, and Figure1 for the dendrogram showing the 20 and 80 group levels). From this, it is clear that there are significant differences in the floristic composition of the plant communities in the different project areas. In fact, seventy of the groups defined at the 80-group level are restricted to individual project areas in the combined dataset (see Table 1). Of the remaining ten groups at this level, six are found in both of the Nimingarra and Sunrise Hill project areas, one in both Cattle Gorge and Yarrie, one in both Cattle Gorge and Panorama, one in both Nimingarra and Panorama and the remaining one in both Sunrise Hill and Yarrie.

A similar pattern is also found in the higher order groups defined in the analysis, with ten of the groups defined at the 20-group level at least predominantly from one of the survey areas (Table 2), giving a further indication that the regional groupings are quite strong.

There is significant evidence that these regional groupings are real, rather than an artefact of the survey methodologies, or of the analysis carried out. Over 50% of the flora species present in the total dataset were recorded from no more than one of the project areas (Table 4). A further nearly 20% of the flora species in the total dataset were recorded from only two project areas. From these figures, it can be seen that a high proportion of the flora species in the dataset is restricted in occurrence between the five project areas in the dataset. From this, it is easy to understand why the floristic groups defined in the analysis are mostly restricted to particular survey areas within the dataset.

It is also noteworthy that the Panorama data (the largest single block of quadrats in the survey area) includes data from a wide range of positions in the landscape (from plains to the tops of large hills). However, there are few floristic groups shared between Panorama and the other survey areas, suggesting that landscape position (habitat) is not the main driver of differences between the different survey areas.

Table 1: Number of groups at the 80 group level in the survey areas

gp20	si80	NIM	SRH	CG	YAR	PAN
1	1			13		
1	2			3		
1	3			6		
1	4			1		
2	5	5	4			
2	6	4	9			
2	7	2	2			
2	8	2				
3	9	1	2			
3	10	2				
3	11	1	1			
3	12		2			
3	13		2			
3	14	1				
3	15		1			
4	16	1				
5	17			1		
5	18			1	1	
5	19		1			
5	20				2	
5	21				2	
6	22		2			
6	23				2	
6	24				13	
7	25				5	
7	26				1	
7	27				2	
7	28				1	
8	29			1		2
8	30					5
8	31					5
8	32					2
8	33					1
8	34					2
8	35					6
8	36					3
9	37		1			
9	38					2
9	39					1
9	40					2

gp20	si80	NIM	SRH	CG	YAR	PAN
9	41					4
9	42					1
9	43					1
10	44					2
10	45					2
11	46	1				1
11	47	2				
11	48					2
11	49					12
11	50					6
12	51	2				
12	52	1				
13	53	2				
13	54		1			
13	55		1			
13	56		1			
13	57				2	
13	58				3	
14	59	1	2			
14	60					3
14	61					2
15	62	1				
15	63		2			
15	64		1			
15	65		1		1	
16	66		4			
17	67					2
17	68					3
17	69					1
17	70					5
18	71					1
18	72				1	
18	73				2	
19	74					1
19	75					1
20	76		3			
20	77		1			
20	78				1	
20	79		1			
20	80		1			

4.2 Comparisons between the survey areas

While the results of the analysis indicate that there is strong regionalisation in the floristic composition of the vegetation of the survey areas in the dataset, it is not straightforward to assess the relationships between the project areas. This is because:

- The numbers of quadrats are different in the different project areas;
- The variations in the ranges of landscape types in the different projects areas.
- Different parts of the landscape appear to have been sampled in the different projects.

Bearing in mind these points, some comments can be made comparing the number of floristic groups at the 20-group level and the number of species that the projects share respectively using the data presented in Figures 2 and 3.

Table 2: Number of groups (20 group level) in projects

Site Group #					
si20	NIM	SRH	CG	YAR	PAN
1			23		
2	13	15			
3	5	8			
4	1				
5		1	2	5	
6		2		15	
7				9	
8			1		26
9		1			11
10					4
11	3				21
12	3				
13	2	3		5	
14	1	2			5
15	1	4		1	
16		4			
17					11
18				3	1
19					2
20		6		1	

Nimingarra

Nimingarra and Sunrise Hill share about half of the floristic groups at the 20-group level that they each have (eight and ten respectively). They also share more than half

their total species. On the other hand, Nimingarra and Cattle Gorge have no floristic groups at the 20-group level in common, although Nimingarra has two groups in common with Yarrie and one with Panorama. Nimingarra and Sunrise Hill have 106 species in common out of 153 and 185 species (in the quadrat data) respectively, or more than half. Nimingarra has a much smaller proportion of its flora in common with any of the other survey areas, even Panorama, which has many more species (294) recorded.

Clearly on both floristic groups at the 20 group level and species composition, Nimingarra has more in common with Sunrise Hill than any of the other projects in the combined dataset and has least in common with Cattle Gorge. The last point seems to be due to a combination of the occurrence at Cattle Gorge of floristic groups that are of restricted occurrence in the dataset (and possibly regionally) and the small range of habitat sampled there. Of particular interest is that two of the eight floristic groups at the 20-group level from Nimingarra were restricted (in the data set) to that survey area. All the other survey areas only had one group at this level restricted to them

Sunrise Hill

As noted above, Sunrise Hill has significant similarities to Nimingarra. It also shares four floristic groups at the 20-group level with Yarrie and just under half its species with Yarrie. So while Sunrise Hill is most similar to Nimingarra, it also has much in common with Yarrie. In contrast, while Panorama has about two-thirds of the species present in Sunrise Hill, it shares only two of the floristic groups defined at the 20-group level. Somewhat surprisingly, while Sunrise Hill has ten of the floristic groups defined at the 20-group level (more than even Panorama), it only has one in common with Cattle Gorge and has only 54 species in common as well. This obviously is partly due to the smaller number of floristic groups recorded from Cattle Gorge, but also seems to be reflecting differences in habitat (and probably the underlying geology).

Cattle Gorge

With only three floristic groups at the 20-group level, Cattle Gorge has significantly less diversity at this level of definition of groups. This probably partly reflects the

range of habitat sampled, as Cattle Gorge had 26 quadrats while Nimingarra had 29, but had eight floristic groups at the 20-group level. There is an alternative possibility, this is that floristic group 1 at the 20-group level is widespread at Cattle Gorge on the hills largely sampled there. Certainly this group has significant floristic variation within it (see the top part of the dendrogram in Appendix 2) and contains 23 of the 26 quadrats recorded at Cattle Gorge. The other two floristic groups at the 20-group level occurring at Cattle Gorge were sampled only once and twice respectively, but it is these two groups that are shared with other survey areas..

Another interesting aspect is that the vegetation at Cattle Gorge seems to be less species diverse, with only 75 species recorded, although this may partly reflect sampling of fewer habitats. For comparison, with only three more quadrats Nimingarra had 153 species and Sunrise hill with 46 quadrats had 185.

The reasonable conclusion seems to be that much of the vegetation at Cattle Gorge is referrable to one floristic type (group 1 at the 20-group level) that is not represented in the other survey areas. This would fit with the description of much of Cattle Gorge as thinly vegetated hills that are unlike other places in the surrounding areas by *Ecologia* staff. This vegetation may be very restricted regionally.

Yarrie

Yarrie has seven of the floristic groups defined at the 20-group level with one restricted to it in the dataset. It shares four of these groups with Sunrise Hill, two with Nimingarra and one each with Panorama and Cattle Gorge. It shares only about one fifth of its species with Cattle Gorge (which had much fewer species recorded) and about one third to one half with the other survey areas. It's vegetation is obviously most similar floristically to Sunrise Hill, has similarities to Nimingarra and little in common with either Cattle Gorge or Panorama.

Panorama

While Panorama has been included in the analysis to provide a comparison for the other survey areas, it is interesting to make a few comments on this survey as well. With 85 quadrats recorded, it has only eight floristic groups at the 20-group level, less than Sunrise Hill, which has ten but only had 46 quadrats recorded. As habitat variation was targeted for sampling during the Panorama survey, it seems that habitat

variation is not the main driver of floristic variation in the vegetation of the region although it is undoubtedly important. In fact, it seems likely that underlying geology is a (or the) major determinant of the distribution of floristic groups, with habitat being a significant modifier.

Table 3. Number of species in combinations of projects

GNIM	GSRH	CG	YAR99	PAN	#	%	sum%
		+			7	2	
+					21	5	
	+				25	6	
				+	114	26	
			+		62	14	51
+		+			2	0	
	+	+			2	0	
		+	+		0	0	
		+		+	4	1	
+			+		11	2	
+				+	0	0	
+					16	4	
	+		+		7	2	
	+			+	19	4	
			+	+	24	5	19
+	+	+			8	2	
+		+	+		0	0	
+		+		+	3	1	
	+	+	+		1	0	
	+	+		+	4	1	
		+	+	+	4	1	
+	+		+		3	1	
+	+			+	17	4	
+			+	+	4	1	
	+		+	+	19	4	14
+	+	+	+		4	1	
+	+	+		+	10	2	
+		+	+	+	1	0	
	+	+	+	+	2	0	
+	+		+	+	30	7	11
+	+	+	+	+	23	5	5
GNIM	GSRH	CG	YAR99	PAN			

Figure 2: Network diagram of number of site groups shared between projects

Values in large boxes are number of the site groups (at 20-group level) in project with number in only that project in brackets.

Other boxes are number of site groups shared

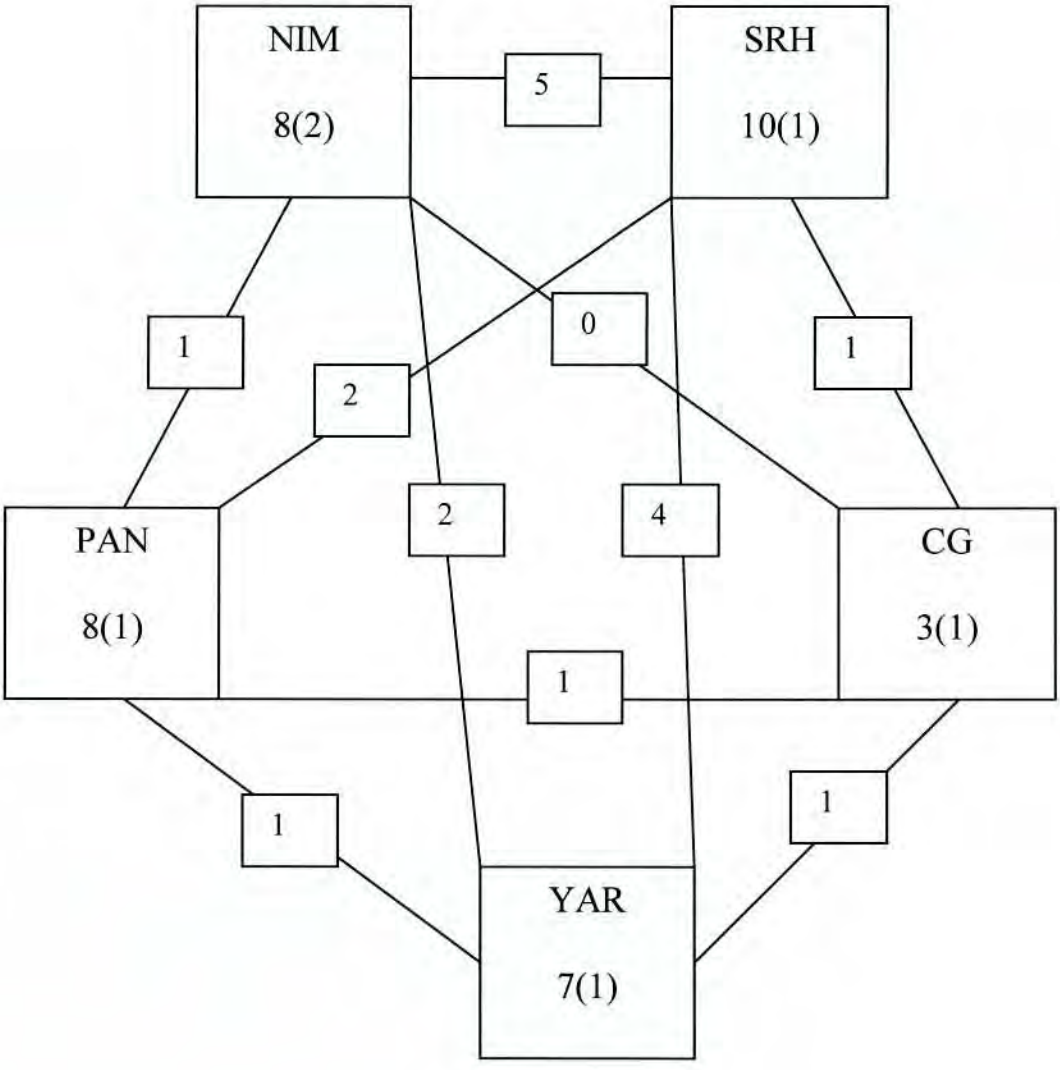
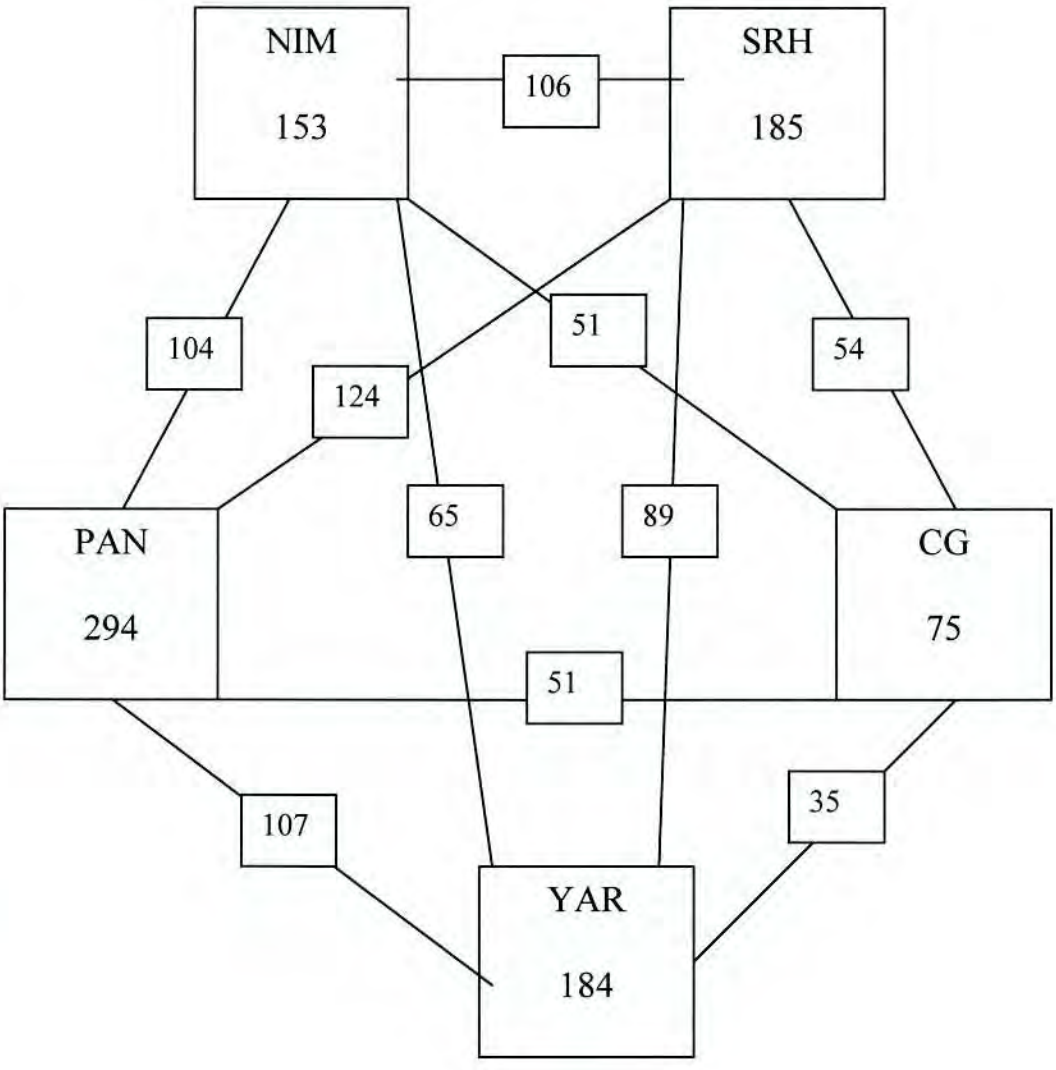


Figure 3: Network diagram of number of species shared between projects

Values in large boxes are number of species in the project.

Other boxes are number of species shared



5.0 OTHER SUMMARY DATA PROVIDED

The accompanying excel file contains a number of sheets that were used to examine or interpret the data.

The dendrogram is provided along with vegetation and habitat descriptions plus the site by species matrix. This is split over two sheets labelled. Site by Species 1 and Site by Species 2. The species are ordered according to the species classification. This table helped give confidence to the results.

The site and species groups were used to examine the constancy of the species for site groups. This was done at two levels, the 20-group level and the 80-group level. This helps to identify how consistently the groups of species occur in specific site groups. Clearly at the 20-group level (sheet sites gp20 summary) the constancy in any group is never high. Many of the site groups have some species groups with a high constancy at the 80-group level (sheet sites gp80 summary). These suggest that the 80-level site groups are close to real plant communities or between this and the vegetation association level.

The number of occurrences of species present in each project is summarised in two sheets. Species by sites 1 has the species ordered the species classification. Species by sites 2 has the species ordered by name.

The Ordination sheet has the ordination vector scores for all sites. Some example charts indicate that the ordination was not able to partition the data at all usefully.

6.0 ACKNOWLEDGEMENTS

Ecologia Environmental Consulting provided the data from Nimingarra, Sunrise Hill, Yarrie and Cattle Gorge.

The data from Panorama is from a project carried out for Astron Environmental (acting as consultants to Otokumpu).

7.0 REFERENCES

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Environment Australia (2000). Revision of the interim biogeographic regionalisation for Australia (IBRA) and development of version 5.1. Environment Australia, Canberra, November 2000.

Trudgen, M.E., Morgan, B.R and Griffin E.A. (2002). A flora and vegetation survey of the proposed mine areas and access road for the Panorama Project. Unpublished report prepared for Astron Environmental by M.E. Trudgen & Associates.

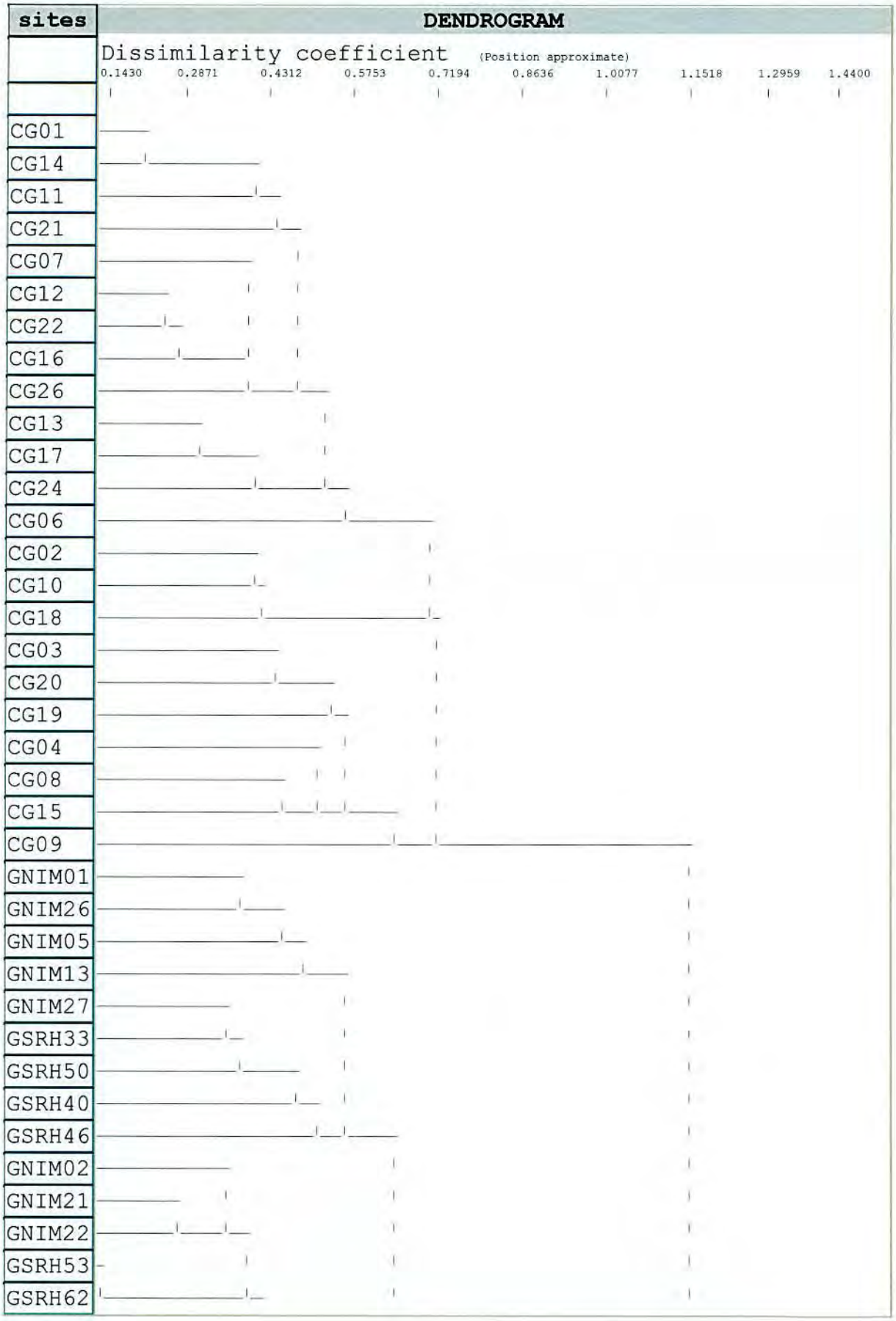
APPENDIX 1: Species reconciliation table

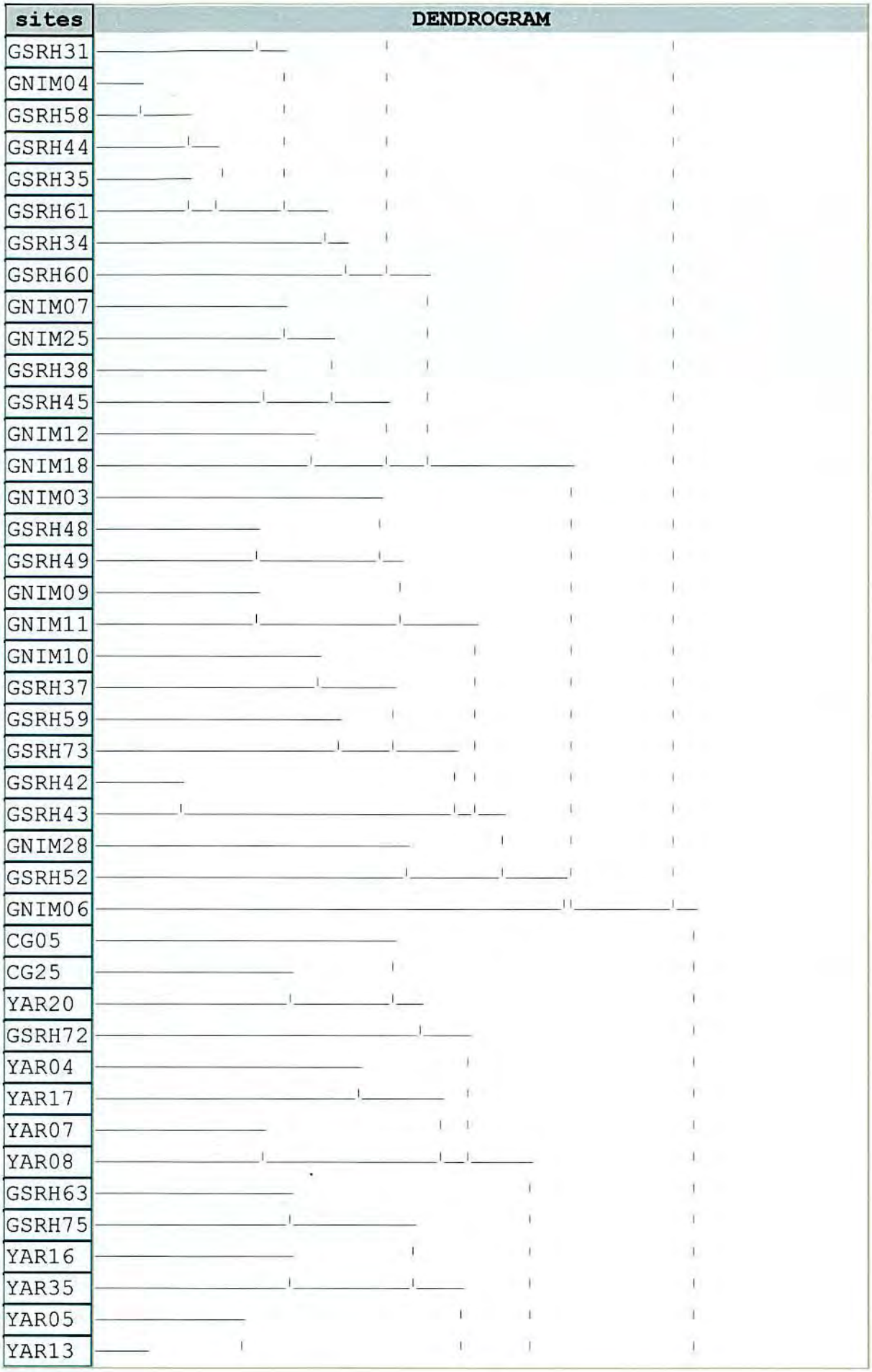
Names in the left hand column were omitted if there is no name in the right hand column. If there is a name in the right hand column, the name in the left hand column is treated as equivalent in the analyses.

Name	Renamed
Abutilon lepidum	Abutilon aff. lepidum (4)
Abutilon sp.	
Acacia ?hilliana x stellaticeps (GLD(NIM)23.28)	
Acacia ?trachycarpa (PAN12-4)	Acacia drepanocarpa subsp. ?pilbara form
Acacia ancistrocarpa x trachycarpa	
Acacia colei	Acacia colei var. colei
Acacia hamersleyensis	
Acacia sp.	
Acacia tumida	Acacia tumida var. pilbarensis
Acacia tumida subsp. ?pilbarensis x ?	
Acacia tumida var. pilbarensis	Acacia tumida var. pilbarensis
Ammannia multiflora	Ammannia baccifera
Aristida holathera	Aristida holathera var. holathera
Bonamia sp.	
Bothriochloa sp.	
Bridelia tomentosa	Flueggea virosa subsp. melanthesoides
Cajanus sp.	Cajanus cinereus
Cassia oligophylla x helmsii	
Cassia sp.	
Cassytha capillaris	Cassytha filiformis
Centipeda minima	Centipeda minima subsp. macrocephala
Cleome uncifera subsp. uncifera	Cleome uncifera
Clerodendrum floribundum	Clerodendrum floribundum var. angustifolium
Clerodendrum tomentosum	Clerodendrum tomentosum var. lanceolatum
Corchorus aff laniflorus (PAN 76)	Corchorus laniflorus
Corchorus sp.	
Corymbia aspera	Corymbia flavescens
Corymbia lenziana	Corymbia hamersleyana
Corymbia sp.	
Crotalaria sp.	
Enneapogon sp.	
Eragrostis basedowii	
Eriachne mucronata	Eriachne mucronata (typical form)
Eriachne pulchella	Eriachne pulchella subsp. dominii
Eriachne pulchella subsp. pulchella	Eriachne pulchella subsp. dominii
Eucalyptus camaldulensis	Eucalyptus camaldulensis var. obtusa
Eucalyptus leucophloia	Eucalyptus leucophloia subsp. leucophloia
Eulalia fulva	Eulalia aurea
Euphorbia biconvexa	Euphorbia coghlanii
Euphorbia boophthona	Euphorbia tannensis ssp. eremophila (Panorama form)
Euphorbia drummondii	
Euphorbia sp.	
Evolvulus alsinoides var. decumbens	Evolvulus alsinoides
Evolvulus alsinoides var. villosicalyx	Evolvulus alsinoides
Ficus opposita	Ficus opposita var. indecora
Ficus platypoda	Ficus brachypoda
Ficus platypoda var. D	Ficus brachypoda
Fimbristylis sp.	
Gen.Nov.[Aff.Melichrus] sp.Bungalbin Hill(F.H.& M.P.Mollemans 3069)	
Genista canariensis	
Genus sp. Unnamed	
Goodenia sp.	
Gossypium australe	
Grevillea pyramidalis subsp. leucadendron	Grevillea pyramidalis
Grevillea pyramidalis subsp. pyramidalis	Grevillea pyramidalis
Grevillea sp.	
Grevillea wickhamii subsp. aprica	Grevillea wickhamii

Name	Renamed
Hakea coriacea	Acacia coriacea subsp. sericophylla
Heliotropium sp.	
Hibiscus sp.	
Indigofera monophylla	Indigofera monophylla (small calyx form)
Jasminum didymum	Jasminum didymum subsp. lineare
Lolium sp.	
Melaleuca argentea	Melaleuca leucadendra
Mukia sp.	Mukia maderaspatana
Mukia sp. Panorama	Mukia maderaspatana
Paratephrosia sp.	
Phyllanthus maderaspatensis var. angustifolius	Phyllanthus maderaspatensis
Phyllanthus trachygyne	Phyllanthus exilis
Pluchea sp.	
Polycarpaea sp.	
Polygala aff. isingii	Polygala isingii
Polymeria aff. ambigua (PAN 26B-20)	Polymeria ambigua
Polymeria sp.	
Pterocaulon sp.	
Pterocaulon sphaeranthoides	Pterocaulon sphacelatum
Pterocaulon sphaeranthoides x sphacelatum	Pterocaulon sphacelatum
Ptilotus astrolasius	Ptilotus astrolasius var. astrolasius
Ptilotus calostachyus var. calostachyus	Ptilotus calostachyus
Ptilotus exaltatus	Ptilotus exaltatus var. exaltatus
Ptilotus fusiformis	Ptilotus fusiformis var. fusiformis
Ptilotus obovatus	Ptilotus obovatus var. obovatus
Rhynchosia minima	Rhynchosia minima var. australis
Salsola kali	Salsola tragus
Securinega melanthesoides	Flueggea virosa subsp. melanthesoides
Senna artemisioides subsp. oligophylla	Cassia oligophylla
Senna glutinosa subsp. glutinosa	Cassia glutinosa
Senna glutinosa subsp. pruinosa	Cassia pruinosa
Senna notabilis	Cassia notabilis
Senna venusta	Cassia venusta
Sida ?cardiophylla (juvenile)	Sida cardiophylla
Sida rohlenae	Sida rohlenae subsp. rohlenae
Sida sp.	
Solanum sp.	
Solanum terraneum	Solanum horridum
Spergularia sp.	
Stemodia sp.	Stemodia sp. Shay Gap(GLD(SRH)55.19)
Stylobasium sp.	Stylobasium spathulatum
Tephrosia rosea	Tephrosia rosea var. clementii
Tephrosia rosea var. clementii	Tephrosia rosea var. clementii
Tephrosia sp.	
Themeda australis	Themeda aff. triandra (MET 16,046)
Themeda triandra	Themeda aff. triandra (MET 16,046)
Trachymene aff. oleracea (B61)	Trachymene oleracea
Trianthema sp.	
Tribulus cistoides	
Tribulus suberosus	Tribulus suberosus
Trichodesma zeylanicum	Trichodesma zeylanicum var. zeylanicum
Triodia wiseana var. wiseana	Triodia wiseana
Triumfetta sp.	
Yakirra australiensis	Yakirra australiensis var. australiensis

APPENDIX 2: Complete dendrogram with all sites from Nimingarra, Sunrise Hill, Cattle Gorge, Yarrie and Panorama

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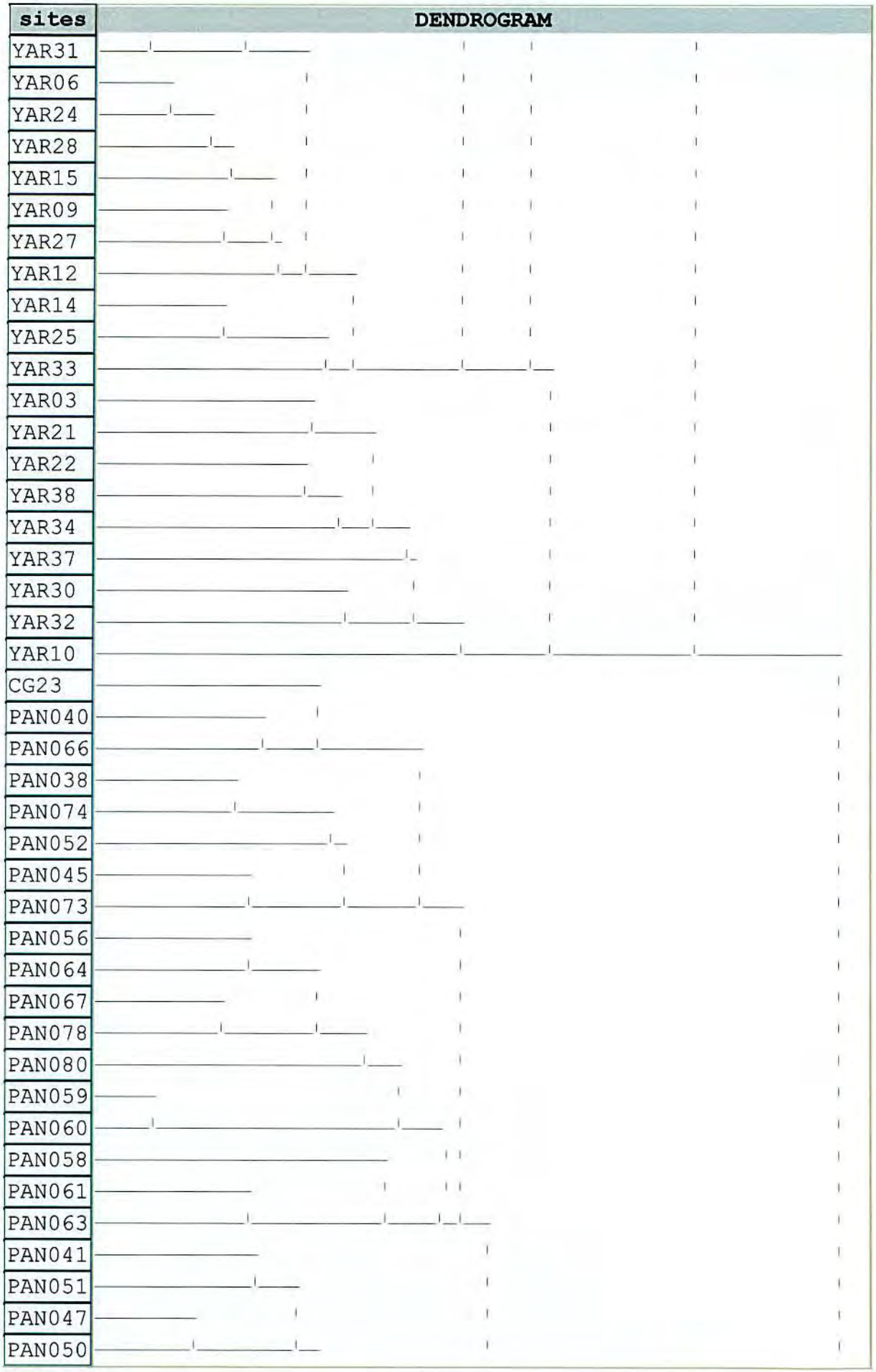
DENDROGRAM
GSRH31
GNIM04
GSRH58
GSRH44
GSRH35
GSRH61
GSRH34
GSRH60
GNIM07
GNIM25
GSRH38
GSRH45
GNIM12
GNIM18
GNIM03
GSRH48
GSRH49
GNIM09
GNIM11
GNIM10
GSRH37
GSRH59
GSRH73
GSRH42
GSRH43
GNIM28
GSRH52
GNIM06
CG05
CG25
YAR20
GSRH72
YAR04
YAR17
YAR07
YAR08
GSRH63
GSRH75
YAR16
YAR35
YAR05
YAR13


sites
DENDROGRAM
YAR31
YAR06
YAR24
YAR28
YAR15
YAR09
YAR27
YAR12
YAR14
YAR25
YAR33
YAR03
YAR21
YAR22
YAR38
YAR34
YAR37
YAR30
YAR32
YAR10
CG23
PAN040
PAN066
PAN038
PAN074
PAN052
PAN045
PAN073
PAN056
PAN064
PAN067
PAN078
PAN080
PAN059
PAN060
PAN058
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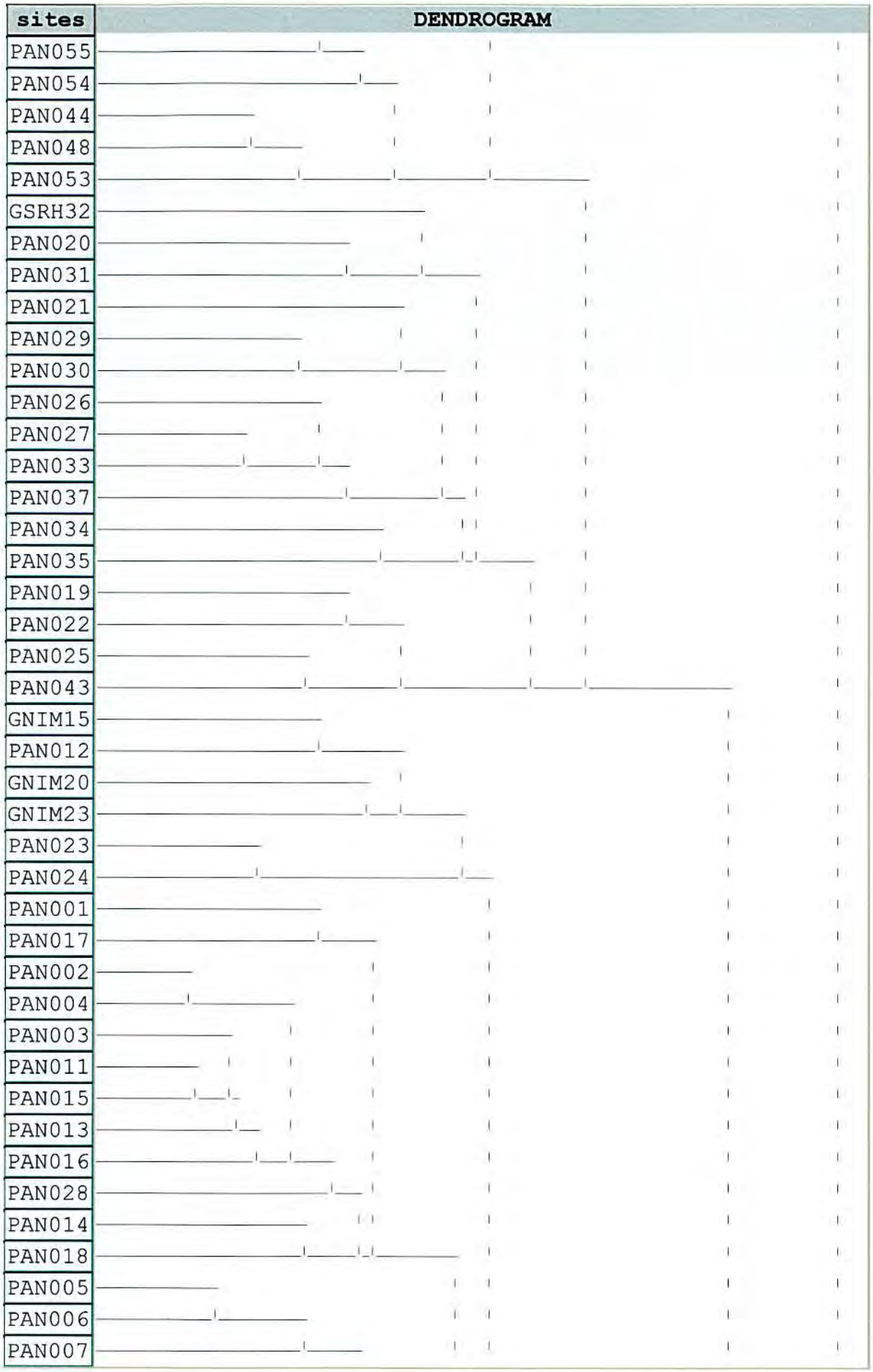
PAN063
PAN041
PAN051
PAN047
PAN050


sites
DENDROGRAM
PAN055
PAN054
PAN044
PAN048
PAN053
GSRH32
PAN020
PAN031
PAN021
PAN029
PAN030
PAN026
PAN027
PAN033
PAN037
PAN034
PAN035
PAN019
PAN022
PAN025
PAN043
GNIM15
PAN012
GNIM20
GNIM23
PAN023
PAN024
PAN001
PAN017
PAN002
PAN004
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PAN013
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PAN028
PAN014
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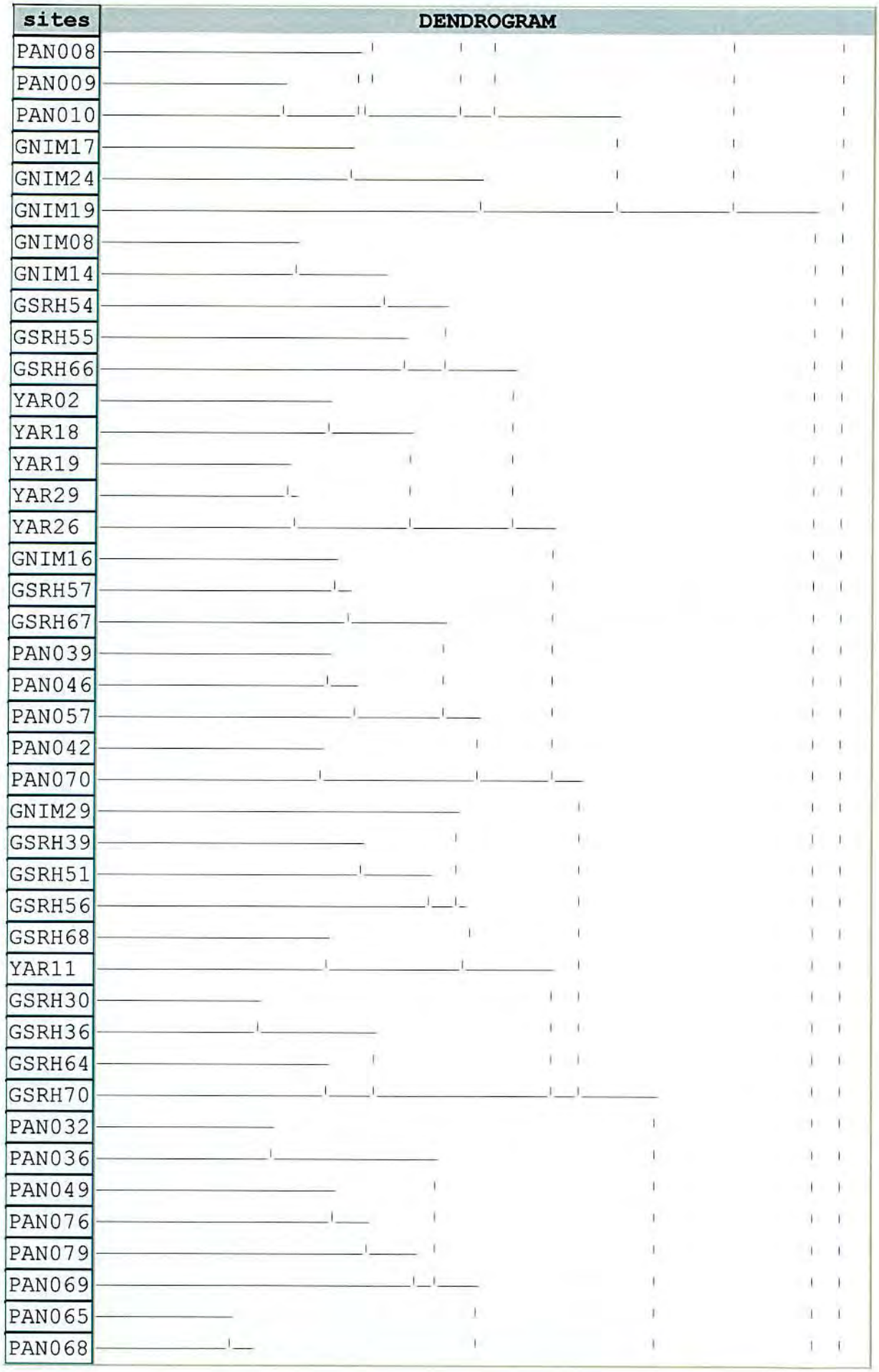
PAN006
PAN007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PAN009
PAN010
GNIM17
GNIM24
GNIM19
GNIM08
GNIM14
GSRH54
GSRH55
GSRH66
YAR02
YAR18
YAR19
YAR29
YAR26
GNIM16
GSRH57
GSRH67
PAN039
PAN046
PAN057
PAN042
PAN070
GNIM29
GSRH39
GSRH51
GSRH56
GSRH68
YAR11
GSRH30
GSRH36
GSRH64
GSRH70
PAN032
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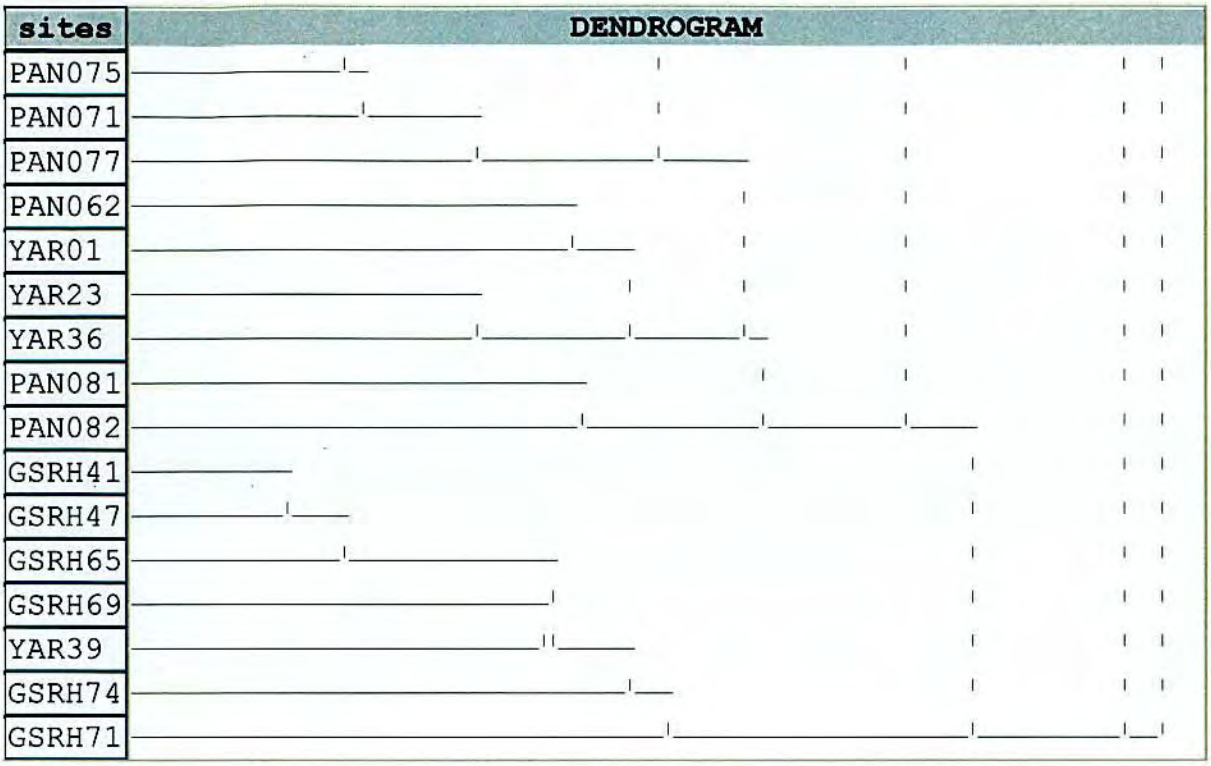
PAN049
PAN076
PAN079
PAN069
PAN065
PAN068



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