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HPPL Mulga Downs Project: Potential Transport Corridor Detailed Flora and Vegetation Assessment, August 2012




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This document describes the survey and results of a single phase detailed Level 2 flora and vegetation assessment carried out along a potential transport corridor linking Hancock Prospecting Pty Ltd's (HPPL) Mulga Downs Project Area to a point west of Chainage 150 along the Roy Hill Infrastructure (RHI) Railway. The survey was carried out by Maia Environmental Consultancy (Maia) in August 2012.

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Introduction

- Hancock Prospecting Pty Ltd (HPPL) proposes to construct a mine and associated infrastructure on tenements M47/206 (Murrays Hill), E47/1244, L47/675, L47/339 and L45/316 on Mulga Downs Station. A potential transport corridor was considered to link the mine area to the Roy Hill Infrastructure (RHI) Railway.
- HPPL engaged Maia Environmental Consultancy Pty Ltd (Maia) to carry out a detailed single phase (Level 2) flora and vegetation survey to gather information on the flora and vegetation of the proposed corridor.
- Approximately 433 ha of the survey corridor supplied to Maia by HPPl falls within tenement E47/1244, which was surveyed and mapped by Maia in June and July 2012. Therefore the approximately 8,378 ha of the corridor lying north of the boundary of E47/1244 was surveyed (Survey Area).
- The Survey Area extends from tenement E47/1244 on Mulga Downs Station, heads east towards the Great Northern Highway (GNH) where it changes direction and tracks north on the western side of the GNH to just south of Yule River at a point west of Chainage (Ch) 150 along the RHI Railway. A small branch also occurs in the corridor at a point west of Ch 168 along the RHI Railway.

Survey

- A single phase detailed Level 2 survey was carried out by three botanists between August 15-17 and 19-22, 2012.
- Below average rain fell in the general area three months before the survey; however, rainfall from January to August 2012 was 56 mm above the yearly total long-term average.
- Seventy-nine 50 m by 50 m quadrats (or an equivalent area in linear habitats) were assessed, 228.85 linear km of transects were walked within the Survey Area and 7.06% of the Survey Area was assessed by the botanists during the field survey.
- Information was recorded at 'points of interest' while walking transects to capture changes in vegetation or habitat.
- Whenever known or suspected conservation significant or weed species were encountered, their numbers were either counted or estimated (when populations were large) and their locations were recorded on a GPS.
- At least one specimen of each species encountered during the survey was collected. A plant taxonomist verified the identifications of the species collected and liaised with relevant experts at the Western Australian (WA) Herbarium as necessary.

Results - Flora

- A species list of 342 taxa from 48 familes and 139 genera resulted from the survey. The families with the highest number of taxa were Fabaceae (75), Poaceae (56) and Malvaceae (37) and the genera with the highest number of taxa were *Acacia* (35), *Ptilotus* (13) and *Senna* (12). Annual taxa comprised 25.73% of the species list and perennial taxa 74.27%. Flowering specimes were used to identify 38.30% of the species list, fruiting material 29.53% and both flowering and fruiting material 8.48%.
- One range extension species (approximately 150 km) was recorded in the Survey Area - *Acacia robeorum*.
- No flora species protected under the *Environment Protection and Biodiversity Conservation Act 1999* were recorded during the survey.
- No flora species protected under the *Wildlife Conservation Act 1950* were recorded during the survey.
- Two Priority (P) species were located in the Survey Area – *Acacia glaucocaesia* (P3) and *Goodenia nuda* (P4).

- No weeds on any of the national weeds lists were recorded during the survey. One plant declared in WA, *Argemone ochroleuca* (Mexican Poppy) was recorded during the survey; however, *A. ochroleuca* is not declared in the Shire of Ashburton, East Pilbara or Port Hedland.
- Nine environmental weed species were located during the survey: *Aerva javanica* (Kapok Bush), *Argemone ochroleuca* (Mexican Poppy), *Bidens bipinnata* (Bipinnate Beggartick), *Cenchrus ciliaris* (Buffel Grass), *Citrullus lanatus* (Pie Melon), *Flaveria trinervia* (Speedy Weed), *Malvastrum americanum* (Spiked Malvastrum), *Portulaca oleracea* (Purslane), and *Vachellia farnesiana* (Mimosa Bush).

Results - Vegetation

- Sixteen vegetation associations were described for the Survey Area. Of these, four were mapped as mosaics (^{m}), two as sub-associations and two as query (?) sub-associations. The mapped associations were: M**SL**-1, *Tl*/*Ta***HG**-2, *Ac*/*Ml***SL**-3, *At*/*Ac***SL**-4, MA**S**/**WL**-5, ^{m}*Ta*/*Tb*/*Te***HG**-6/7 (mosaic of *Ta*/*Tb***HG**-6 and , *Te*/*Tb***HG**-7), ^{m}*Ta*/*Tw*/*Te***HG**-8/10 (mosaic of *Taw*/*Te***HG**-8 and *Te*/*Taw***HG**-10), *Tab*/*Taw***HG**-9, *Te*/*Tab***HG**-11, *Tae***HG**-12, *Ts*/*Ta*/*Tl***HG**-13, *Tab***HG**-14, M**TG**1-15, ?M**TG**1-15, M**TG**2-15, ?M**TG**2-15 and *Taw***HG**-16.
- Vegetation condition over 62.68% of the Survey Area was rated as Excellent and condition ratings ranged from Completely Degraded to Excellent.
- No vegetation associations mapped in the Survey Area resemble any of the currently-listed Threatened Ecological Communities (TECs).
- One vegetation association mapped in the Survey Area (M**TG**1/2-15) resembles one of the P3 sub-units of the 'Four plant assemblages of the Wona Land System' Priority Ecological Community (PEC), the 'Mitchell grass plains (*Astrebla* spp.) on gilgai' sub-unit.

Ecological Communities, Environmentally Sensitive Areas (ESAs) and Conservation Estates

- A section of the Survey Area lies over the buffer in place around the Priority 1 'Four plant assemblages of the Wona Land System' PEC. The P1 PEC within the buffer is described as: "Cracking clays of the Chichester and Mungaroona Range. This grassless plain of stony gibber community occurs on the table lands with very little vegetative cover during the dry season, however during the wet a suite of ephemerals/annuals and short lived perennials emerge, many of which are poorly known and range-end taxa."
- Sub-associations M**TG**1-15 and M**TG**2-15 were mapped on basalt upland gilgai plains of the Wona Land System (LS) within the PEC buffer. Both sub-associations are broadly described as a Mixed Sparse Tussock Grassland and M**TG**2-15 has a sparse to open tall shrub layer. Following discussions with the DEC, it is believed that the areas mapped within the Wona LS buffer resemble the P3 sub-unit 'Mitchell grass plains (*Astrebla* spp.) on gilgai'.
- The Survey Area does not lie over or in the vicinity of an ESA.
- The Survey Area lies over within the Yandeyarra Reserve (54.4%) and the Abydos-Woodstock Reserve (5.9%).

Conservation Significance - Flora

- *Acacia glaucocaesia* (P3) was recorded at 15 locations in the Survey Area, and between one to 100 plants were recorded at these locations. It was located on the cracking clays of the Wona LS. The populations of *Acacia glaucocaesia* within the Survey Area are rated as having High local conservation significance and, based on the number of FloraBase records (31) and its P3 listing, they are regarded as having Moderate regional significance.

- One population (five plants) of *Goodenia nuda* (P4) was recorded at one location in the Survey Area, on a tributary of the Yule River. This population is rated as having Moderate local conservation significance. Given the number of records on FloraBase (37) and its P4 listing, plus the fact that Maia and other companies have recorded this species in the Pilbara but the records are not on FloraBase, the populations recorded in the Survey Area are regarded as having Moderate-Low regional significance.

Conservation Significance - Vegetation

- Three associations are rated as having Low local significance, one as Moderate-Low, one as ?Moderate, five as Moderate, one as ?High and six as High. Ratings are based on the following criteria; the distribution and area of each vegetation association in the Survey Area, the significance or rarity of a habitat in which the association occurs, the condition of the vegetation in the association and on the presence of any conservation significant species in the association.

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Abbreviations

ANZECC	Australia and New Zealand Environment Conservation Council
BoM	Bureau of Meteorology
BRS	Bureau of Rural Statistics
DAFWA	Department of Agriculture and Food Western Australia
DEC	Department of Environment and Conservation
DPIV	Department of Primary Industry Victoria
DPIRSA	Department of Primary Industry and Regions in South Australia
DRF	Declared Rare Flora
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
EPA	Environmental Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act
ESA	Environmentally Sensitive Area
EWSWA	Environmental Weed Strategy for Western Australia
GDE	Groundwater Dependent Ecosystem
GNH	Great Northern Highway
HPPL	Hancock Prospecting Proprietary Limited
IBRA	Interim Biogeographic Regionalisation for Australia
LS	Land System
MRMSC	Natural Resource Management Standing Committee
NRMC	Natural Resource Management Ministerial Council
NRS	National Reserve System
NVIS	National Vegetation Inventory System
P	Priority
PEC	Priority Ecological Community
RHI	Roy Hill Infrastructure
SPAC	Species accumulation curve
sp.	Species
subsp.	Subspecies
TEC	Threatened Ecological Community
TF	Threatened Flora
var.	Variety
WA	Western Australia
WA Herb / WAH	Western Australian Herbarium
WC Act	Wildlife Conservation Act
WoNS	Weed/s of National Significance

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HPPL Mulga Downs Transport Corridor, Tenement E47/1244

DETAILED FLORA AND VEGETATION ASSESSMENT, AUGUST 2012

1 PROJECT SCOPE AND LOCATION

1.1 PROJECT SCOPE OF WORK

Hancock Prospecting Pty Ltd (HPPL) proposes to construct a mine and associated infrastructure on tenements M47/206 (Murrays Hill), E47/1244, L47/675, L47/339 and L45/316 on Mulga Downs Station in the Pilbara region of Western Australia (WA). A transport corridor was considered to link the mine area to the Roy Hill Infrastructure (RHI) Railway.

Four transport corridor options (O4, O11, O12 and O13) were initially proposed; however, after conducting a review of the options, HPPL selected one of these, option 12 (O12), as the preferred potential transport corridor.

HPPL engaged Maia Environmental Consultancy Pty Ltd (Maia) to carry out a detailed single phase Level 2 flora and vegetation survey to gather information on the flora and vegetation of the O12 corridor.

The survey corridor supplied by HPPL covered approximately 8,811 ha; however, approximately 433 ha of the corridor fell within tenement E47/1244, which was surveyed by Maia in June and July 2012 (Maia, 2012e). Therefore, the area surveyed and discussed in this report (the Survey Area) encompasses the approximately 8,378 ha areas lying to the north of the northern boundary of tenement E47/1244 (Maps 10.1 and 10.2, Section 10).

1.2 LOCATION

The Survey Area extends from tenement E47/1244 on Mulga Downs Station, heads east towards the Great Northern Highway (GNH) where it changes direction and tracks north on the western side of the GNH to just south of Yule River at a point west of Chainage (Ch) 150 along the RHI Railway. A small branch is also included in the corridor at a point west of Ch 168 along the RHI Railway (Maps 10.1 and 10.2, Section 10).

2 BACKGROUND INFORMATION

A literature search was carried out to gather information on the bioregion, climate, geology, landforms and soils, land systems, groundwater dependent ecosystems, vegetation of the Survey Area as well as on any flora and vegetation surveys previously carried out in the Study Area and surrounds. The information gathered is presented in the following subsections of this report.

2.1 REGIONAL SETTING

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies the land surface of Australia into bioregions. IBRA Version 7 defines 89 bioregions and 419 subregions in Australia (Department of Sustainability, Environment, Water, Population and Communities [DSEWPaC], 2012a). The Study Area lies in the Pilbara bioregion in Western Australia. The Pilbara bioregion has been divided into four subregions – Chichester, Fortescue Plains, Hamersley and Roebourne. The Survey Area lies mostly in the Chichester subregion (88.79%) and a small section falls in the Fortescue Plains subregion (11.21%) (Map 10.3, Section 10).

The Chichester subregion is characterised by Archaean granite and basalt plains including significant areas of basaltic ranges (Kendrick and McKenzie, 2001). Vegetation is dominated by *Acacia pyrifolia* over *Triodia pungens* hummock grasslands on plains and *Eucalyptus leucophloia* tree steppes on ranges. The subregion has high species

diversity in hummock grassland, reptile and small mammal communities as well as the cracking clay communities of the Chichester and Mungaroona ranges. Rare features of the Chichester subregion include: Ripon Hills sinkhole; Meentheena carbonate stromatolite fossils; and, the geological complexity of the Marble Bar-Nullagine mineral province.

The Fortescue Plains subregion is dominated by alluvial plains and river frontage and in the east extensive salt marshes, Mulga-bunch grass and short grass communities are dominant on the plains (Kendrick, 2001). River gum woodlands fringe drainage lines and an extensive calcrete aquifer feeds numerous permanent springs thus supporting large wetlands in this subregion. The subregion has high species diversity in the Odonata species at Millstream and stygofaunal crustaceans within the calcrete environments at Millstream and in the upper Fortescue. Rare features of the Fortescue Plains subregion include: Millstream wetlands supporting a very diverse aquatic invertebrate community particularly Odonata and large freshwater fish; Millstream aquifer which is an extensive aquifer known to contain stygofauna; and, Fortescue Marsh, which is an episodically inundated samphire marsh and supports immense water-bird breeding.

The Survey Area does not intersect any of the rare features listed for these subregions.

2.2 Climate

The Survey Area is located in the sub-eremaean – tropical desert climatic class (Beard, 1975). The area receives on average between 250 to 350 mm of rainfall per annum with a greater chance of summer rainfall and dry for 9-11 months (Tille, 2006).

The closest weather station to the Survey Area is Wittenoom, located approximately 23 km south-west of the south-western section of the Survey Area. Wittenoom has been used to provide background rainfall information for the Study Area along with Marillana Station. The Survey Area is approximately 88 km north-west of Marillana Station.

The mean annual maximum temperature at Wittenoom is 32.9˚C while the mean annual minimum temperature is 19.7˚C. The mean maximum daytime temperature is highest in January, 39.6˚C, and the mean minimum winter temperature is lowest in July at 11.5˚C. Average annual areal actual evapotranspiration in the area is 300mm (BoM, 2012).

Long-term average monthly and total annual rainfalls for Wittenoom and Marillana are listed in Table 2.1 along with monthly totals for 2011 and January to August 2012 (BoM, 2012a).

Long-term records show that most rain is received in the summer and autumn months, particularly January, February and March. Rainfall gradually decreases over the following months until it increases once again in December (Table 2.1).

Table 2.1: Rainfall Data for Wittenoom and Marillana

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Tot
Wittenoom (site number 005026, 1949-2012)													
L-t	108.6	110.4	69.7	28.3	27.2	27.8	13.9	8.5	3.3	3.6	9.5	49.4	459.4
2011	79.9	294.0	52.6	27.0	41.3	14.2	6.9	0.0	0.0	0.0	49.3	0.8	566.0
2012	469.8	2.0	28.8	1.8	0.0	13.0	0.0	0.0					515.4
Marillana (site number 005009, 1936-2012)													
L-t	73.2	70.4	49.2	23.0	20.5	18.7	14.0	6.0	3.3	4.8	9.3	27.0	313.9
2011	128.3	95.6	50.4	16.0	11.7	15.0	17.1	0.0	0.0	10.2	52.2	12.2	408.7
2012	340.8	0.0	54.6	0.0	0.0	4.4	0.0						399.8

Information by month for 2011 and 2012 is total rainfall (mm). L-t = long-term mean monthly and annual rainfall (mm).

Total rainfall at Wittenoom for the three months before the August survey was below the long-term average for those months (13.0 mm compared with long-term mean of 68.9 mm). Total rainfall for the first six months of 2012 is above the yearly long-term mean (515.4 mm compared with long-term mean of 459.4 mm) because Wittenoom received 469.8 mm of rain in January 2012, which is well above the long-term mean for the same month (108.6 mm).

Like Wittenoom, total rainfall received at Marillana for the three months before the survey was below the long-term mean for those months (4.4 mm compared with long-term mean of 53.2 mm). Total 2012 rainfall for the first six months of 2012 is well above the yearly total long-term mean (340.8 mm compared with 73.2 mm respectively) because Marillana received 340.8 mm of rain in January, which is well above the long-term mean for January (73.2 mm).

2.3 Geology, Landforms and Soils

Fifteen main geological units are described within the Study Area as part of the Marble Bar 1:250 000 geological series (Department of Mines, 1978) and Roy Hill 1:250 000 geological series (Department of Mines and Energy, 1996).

- AFj – Jerrinah Formation: pelite, chert and thin-bedded metasandstone; intruded by metadolerite sills in the Hamersley Range;
- AFjo – Woodiana Member: metamorphosed quartzitic sandstone, pelite and chert (locally stromatolitic);
- AFm – Medina Basalt: amygdaloidal metabasaltic flows and breccia;
- AFmk – Kurana Member: metamorphosed volcanic sandstone, pelite, chert, and metadolomite;local accretionary lapilli and stromatolites;
- Agm – Fine to coarse, even grained biotite adamellite, biotite granodiorite and less commonly, bioite tonalite. Well foliates, often gneissic and magmatic. Complex of several intrusive episodes. Includes Tambouraf Granodiorite;
- AFto – Meentheena Member: metamorphosed stromatolitic limestone and dolomite, pelite and volcanic sandstone;
- Czl – Lateritic deposits – massive and pisolitic ferruginous duricrust;
- Pbc – Nymerina nasalt- massive and coarse textured with flows of vesicular basalt;
- Pfc – agglomerate and lapilli tuff;
- Pk – Kylena Basalt – vesiculae and amygdaloidal basalt, some pillow and columnae jointed flows;
- Qa – Alluvium – unconsolidates silt, sand and gravel; in drainage channels and on adjacent floodplains;
- Qc – Colluvium – unconsolidated quartz and rock fragments in soil; locally derived soil, and scree and talus deposits;
- Qeg – Eluvium – sand and rock fragments over granitic rocks, partly transported;
- Qk – Kankar - locally underlies poorly consolidated gravel deposits and includes lime-cemented gravel; and
- Qs – Eolian deposit – sand; in sheets and longitudinal dunes.

The surface geology of the Survey Area is mapped into 13 units by Stewart *et al.* (2008):

- Abfm – Maddina Formation - basalt, basaltic andesite, andesite, dacite, volcaniclastic rock;
- Achm – Marra Mamba Formation – chert, mudstone;

- Aep - Metamorphosed ultramafic to mafic rocks; ultramafic schist; metaperidotite, metapyroxenite, serpentinite; komatiitic and boninitic metabasalt, metagabbro, metadolerite, amphibolite; minor metasedimentary rocks, tectonic megabreccia;
- Agz – granodiorite, monzogranite, tonalite, granite, pegmatite;
- Agzc – tonalite, granodiorite monzogranite, pegmatite;
- Antp – felsic gneiss;
- Atp – greenstone, amphibolite, ultramafic schist, sediment, unknown origin;
- Aup – ultramafic schist, komatiite, pyroxenite, peridotite, basalt;
- Awfj – Jeerinah Formation – shale, sandstone, mudstone, crystalline dolostone/dolomite, chert;
- Awft – Tumbiana Formation - tuff, limestone, crystalline dolostone/dolomite, mudstone, shale;
- Awftm – Meethena Carbonate Member - dolostone, limestone, tuff, mudstone, volcaniclastic rock;
- Qa – Alluvium; and
- Qrc – Colluvium.

These units are shown on Map 10.4 (Section 10).

Tille (2006) compiled available detailed mapping information of Western Australia's rangelands and arid interior into a hierarchy of soil-landscape units providing descriptions of soil-landscape regions, provinces and zones.

The Survey Area lies within the boundaries of Tille's Fortescue Soil-Landscape Province (Tille, 2006). This Province is characterised by hills and ranges with some stony plains, alluvial plains and sandplains on the volcanic, granitic and sedimentary rocks of the Pilbara Craton. Stony soils with red loamy earths and red shallow loams are present in the Fortescue Province. The Fortescue Soil-Landscape Province is further divided into 10 zones and the Survey Area occurs in the Fortescue Valley and Chichester Ranges zones.

The Fortescue Valley Zone is described as alluvial plains, hardwash plains and sandplains on alluvial deposits over sedimentary rocks of the Hamersley Ranges. The Chichester Ranges Zone consists of hills and dissected plateaux on basalt and sedimentary rocks of the Hamersley Basin (Tille, 2006).

2.4 Land System Mapping

Land systems (LS) are described as discreet units of land forms, soils, vegetation and geology. LS are an important tool in assessing the potential risks to biodiversity by quantifying the extent and condition of potential habitat for conservation significant species and vegetation complexes. The Department of Agriculture and Food Western Australia (DAFWA) has mapped the LS across a large area of Western Australia. The LS of the Pilbara region have been mapped and sub-divided into land units based on the landforms on which they occur (Van Vreeswyk *et al.,* 2004).

Eight LS are mapped in the Survey Area. Each of these LS and their associated land forms and land types are described in Table 2.2 and and the LS are shown on Map 10.5 (Section 10). The area of each LS mapped in Western Australia is also included in Table 2.2.

Table 2.2: Land Systems, Associated Land Forms and Vegetation of the Survey Area

LS, Area Mapped in WA / Pilbara Bioregion (DAFWA, 2012a) and in Pilbara (Van Vreeswyk *et al*.) (ha)	Land Forms and Vegetation	Land Type and Habitat	Area (%) of LS in Pilbara
Boolgeeda 999,609 / 961,637 774,800	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands and mulga shrublands. Land Type 8: Stony plains with spinifex grassland.	Low hill and rises	4
		Stony slope and upper plain	20
		Stony lower plain	65
		Grove (small drainage foci)	1
		Narrow drainage floor and channel	10
Macroy 1,333,614 / 1,331,610 1,309,500	Stony plains and occasional tor fields based on granite supporting hard or soft spinifex grasslands. Land Type 8: Stony plains with spinifex grassland.	Low hills and ridges	5
		Stony plains and interfluves	70
		Sandy plains	10
		Calcrete plains	3
		Drainage floors and channels	12
McKay 427,471 / 426,145 420,200	Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands. Land Type 1: Hills and ranges with spinifex grassland.	Hills, ridges and plateaux remnants	60
		Breakaways	2
		Lower footslopes	10
		Stony plains	20
		Drainage floors	8
Newman 1,999,771 / 1,993,744 1,458,000	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands. Land Type 1: Hills and ranges with spinifex grassland.	Plateaux, ridges, mountains and hills	70
		Lower slopes	20
		Stony plains	5
		Narrow drainage floors with channels	5
River 591,987 / 482,179 408,800	Active floodplains and major rivers supporting grassy Eucalypt woodlands, tussock grasslands and soft spinifex grasslands. Land Type 17: River plains with grassy woodlands and shrublands, and tussock grasslands.	Sandy levees and sand sheets	15
		Upper terraces	5
		Flood plains and lower terraces	50
		Stony plains	10
		Minor and major channels	20

LS, Area Mapped in WA / Pilbara Bioregion (DAFWA, 2012a) and in Pilbara (Van Vreeswyk *et al.*) (ha)	Land Forms and Vegetation	Land Type and Habitat	Area (%) of LS in Pilbara
Rocklea 2,893,856 / 2,881,897 2,299,300	Basalt hills, plateaux, lowers slopes and minor stony plains supporting hard spinifex (and occasionally soft spinifex) grasslands. Land Type 1: Hills and ranges with spinifex grassland.	Hills, ridges, plateaux and upper slopes	65
		Lower slopes	15
		Stony plains and interfluves	10
		Gilgai plains	1
		Upper drainage lines	4
		Drainage floors and channels	5
White Springs 26,563 / 26,563 26,600	Stony gilgai plains supporting tussock grasslands and hard spinifex grasslands. Land Type 9: Stony gilgai plains with tussock grasslands and spinifex grasslands.	Stony Plains	52
		Gilgai plains	38
		Outer slopes	9
		Drainage lines	1
Wona 194,821 / 194,821 181,500	Basalt upland gilgai plains supporting tussock grasslands and minor hard spinifex grasslands. Land Type 9: Stony gilgai plains with tussock grasslands and spinifex grasslands.	Low basalt hills	52
		Stony gilgai upland plains	38
		Stony plains and slopes	9
		Drainage lines	1

Source: Van Vreeswyk *et al.* (2004). Land system area in WA and Pilbara IBRA bioregion sourced from: DAFWA (2012a).

2.5 Beard's Vegetation Mapping

The vegetation of the Pilbara was mapped at a scale of 1:1,000,000 by J.S. Beard (Beard, 1975). The Survey Area is located within the Fortescue Valley and Chichester Plateau regions of the Fortescue Botanical District within the Eremaean Province of Western Australia. Beard's vegetation mapping has been digitised and updated by DAFWA (2011), and the vegetation of the Survey Area is mapped as five broad structural vegetation associations (Table 2.3). Map 10.6 (Section 10) shows Beard's pre-European vegetation associations and the Survey Area.

The pre-European and current extents of these vegetation associations in the Pilbara IBRA region overall are also listed in Table 2.3 along with the percentage remaining of each, the amount in reserves (Government of Western Australia, 2011) and the prioritisation for reservation for each (Kendrick, 2001; Kendrick & McKenzie, 2001). The areas listed in Table 2.3 are for the vegetation association and not the sub-association e.g. for 619 and 93 and not for 619.1 and 93.4.

The five vegetation associations in the Survey Area are estimated to have more than 99% of their pre-European extent remaining (Table 2.3). One of these vegetation associations has none of its extent protected for conservation (562). Two have a high rating for prioritisation for reservation in the Chichester subregion (175 and 619) and one a high rating for preservation in the Fortescue Plains subregion (175).

Table 2.3: Beard's Vegetation Mapping – Past and Current Extent and Reservation Status

Beard Code	Vegetation Association Code (DAFWA, 2012)	Physiographic Region	Broad Description	Pre-European Extent (ha) by Pilbara IBRA Bioregion and Vegetation Association	Current Extent (ha) by Pilbara IBRA Bioregion and Vegetation Association	Remaining (%)	Current Extent Protected (IUCN 1-4) for Conservation (proportion of pre-European	Prioritisation for Reservation in the Fortescue Plains Subregion (Kendrick, 2001)	Prioritisation for Reservation in the Chichester Subregion (Kendrick & McKenzie, 2001)
a2Srt1Hi	93	Abydos Plain	Hummock grasslands, shrub steppe; kanji over soft spinifex	3,044,114.08	3,038,471.63	99.88	0.42	Moderate	Low
a2Sr t1,3Hi	173	Chichester Plateau	Hummock grasslands, shrub steppe; kanji over soft spinifex and *Triodia wiseana* on basalt	1,752,520.89	1,747,677.63	99.72	7.49	Moderate	Moderate to Low
xGc	175	Chichester Plateau and Fortescue Valley	Short bunch grassland – savanna/grass plain (Pilbara)	507,032.56	506,625.99	99.92	4.38	High	High
a1Li/e16Lr t3Hi	562	Fortescue Valley	Mosaic: Low woodland; mulga in valleys / hummock grasslands, open low tree steppe; snappy gum over *Triodia wiseana*	103,606.82	103,606.82	100.00	0.00	Moderate	Moderate
e18Mi	619	Abydos Plain, Abydos Plain – Chichester, George Ranges	Medium woodland; river gum (*E. camaldulensis*)	118,920.24	118,086.73	99.30	0.20	Not available	High

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2.6 Previous Biological Surveys

Surveys carried out within or in the vicinity of the Survey Area are shown on Map 10.7 (Section 10).

Maia carried out a targeted flora survey on the western section of HPPL's Mulga Downs East tenement E47/1244 in July, 2010 (Maia, 2010). No conservation significant flora species were recorded during the survey and two environmental weed species - *Cenchrus ciliaris* and *Vachellia farnesiana*.

Maia conducted a targeted flora survey in January 2012 on HPPL's Mulga Downs East tenement E47/1244 (Maia, 2012a). One potential priority (P) species was recorded during the survey – *Rhagodia* ? species (sp.) Hamersley (M. Trudgen 17794) (potentially a P3 species) and six environmental weed species - *Bidens bipinnata, Cenchrus ciliaris, Cenchrus setiger, Citrullus colocynthis, Malvastrum americanum* and *Vachellia farnesiana.*

Maia conducted another targeted flora survey at Mulga Downs East (tenement E47/1244) in February 2012 (Maia, 2012b). One priority species was recorded during the survey – *Rostellularia adscendens* variety (var.) *latifolia* (P3) and three environmental weed species - *Bidens bipinnata, Cenchrus ciliaris* and *Portulaca oleracea.*

Another targeted flora survey was carried out on HPPL's Mulga Downs West tenements E47/1315 and E47/2221 during February and April, 2012 (Maia, 2012c). This area is located approximately 24 km west of the south-western end of the Survey Area. One priority species – *Teucrium pilbaranum* (P1) - and six environmental weed species - *Bidens bipinnata*, *Cenchrus ciliaris*, *Citrullus colocynthis*, *Malvastrum americanum*, *Portulaca oleracea* and *Vachellia farnesiana* – were recorded in the area surveyed.

This was followed up in May 2012 by a targeted flora survey at Mulga Downs East (tenement E47/1244) (Maia, 2012d). No conservation significant flora species and eight environmental weed species were located in the area surveyed - *Aerva javanica*, *Bidens bipinnata, Cenchrus ciliaris, Cucumis melo* subspecies (subsp.) *agrestis, Flaveria trinervia, Malvastrum americanum, Portulaca oleracea* and *Tribulus terrestris*.

Maia undertook a single phase Level 2 flora and vegetation assessment within tenement E47/1244, L47/339, L47/675 and L45/316 (Maia, 2012e). A species list of 365 resulted from the 115 quadrats assessed. Two confirmed Priority Flora species were recorded during the surveys – *Teucrium pilbaranum* (P1) and *Goodenia nuda* (P4) and two potential priority species – *Aristida* ?*jerichoensis* subsp. *subspinulifera* (potential P1) and *Goodenia* ?*lyrata* (potential P3). Fifteen environmental weeds were recorded during the survey – *Acetosa vesicaria*, *Aerva javanica*, *Bidens bipinnata*, *Cenchrus ciliaris*, *Cenchrus setiger*, *Cucumis melo* and *Cucumis melo* subsp. *agrestis*, *Echinochloa colona*, *Flaveria trinervia*, *Malvastrum americanum*, *Medicago polymorpha*, *Portulaca oleracea*, *Setaria verticillata*, *Sonchus oleraceus* and *Vachellia farnesiana*.

Thirteen vegetation associations plus one mosaic of two associations were mapped in the area surveyed. Five of these 13 vegetation associations (MDD1, MDD2, MDH1, MDH2 and MDP2) were mapped adjacent to the western 14 km of the Survey Area and these are listed in Table 2.4 and shown on Map 10.8 (Section 10). Figure 10.1, Section 10 shows the detailed legend for Map 10.8. The vegetation associations have been prefixed with "MD" to avoid confusion with similar coding used in other surveys. Vegetation associations MDD1, MDD2 and MDP2 are considered to have high conservation significance.

Table 2.4: Vegetation Associations Mapped Adjacent to the Survey Area (Maia, 2012e)

Vegetation Association	Description
MDD1	Tall mixed Shrubland (*Petalostylis labicheoides*, *Acacia marramamba* and *Grevillea wickhamii*) with an Open Hummock Grassland of *Triodia epactia*.

Vegetation Association	Description
MDD2	Tall Shrubland of *Acacia tumida* and *A. pyrifolia* with a Sparse Tussock Grassland of *Themeda triandra* and Isolated Low Trees of *Corymbia hamersleyana* and/or *Eucalyptus victrix*.
MDH1	Hummock Grassland of *Triodia* aff. *basedowii* +/- *Triodia brizoides* with a Sparse Tall Shrubland of mixed *Acacia* species (*A. atkinsiana*, *A. ancistrocarpa*, *A. bivenosa* and *A. spondylophylla*) with Isolated Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* +/- *Corymbia hamersleyana*.
MDH2	Hummock Grassland of *Triodia* aff. *basedowii* and or *T. epactia* with a Sparse Shrubland of *Acacia aneura* species (*A. aneura*, *A. aptaneura* and *A. incurvaneura*) and Isolated Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* and/or *A. pruinocarpa*.
MDP2	Sparse Tall Shrubland of *Acacia aneura* and *A. xiphophylla* with a Sparse Low Shrubland of *Eremophila cuneifolia* and a Sparse Hummock Grassland of *Triodia epactia* and/or *T.* aff. *basedowii*.

In June 2008, Ecologia conducted a single phase vegetation and flora survey at Murrays Hill (tenement M47/206) (Ecologia, 2008a). One hundred and thirty-nine taxa were recorded from the 24, 50 m x 50 m quadrats assessed during the survey. One P3 flora species, *Rostellularia adscendens* var. *latifolia*, was recorded and eight environmental weed species (*Bidens bipinnata*, *Cenchrus ciliaris*, *C. setiger*, *Echinochloa colona*, *Malvastrum americanum*, *Portulaca oleracea*, *Setaria verticillata* and *Vachellia farnesiana*). Six main vegetation units including three sub-units were mapped within the tenement.

Ecologia considered the mulga units significant as they are at their northern distribution limit in the Pilbara.

In August 2009 G&G Environmental conducted a single phase flora and vegetation assessment along a transport corridor linking HPPL's Murrays Hill tenement (M47/206) to the Great Northern Highway (G&G Environmental, 2009). The survey was carried out over L47/339 and approximately 2 km of L45/316 (east of the boundary of E47/1244). Twenty-two quadrats (50 m x 50 m) were assessed by G&G Environmental and 157 taxa from 35 families and 85 genera were recorded during the survey. One potential priority species, *Gymnanthera* ?*cunninghamii* was recorded during the survey (a potential P3 species). Three weed species were recorded along the corridor – *Bidens bipinnata*, *Cenchrus ciliaris* and *Malvastrum americanum* (G&G Environmental, 2009).

Coffey (2010) conducted a flora and vegetation assessment for FMG's Solomon Rail Project from FMG's Firetail deposit to its Port Hedland-Cloudbreak railway line. The Solomon Rail Project lies to the north of the east-west section of the Survey Area and the two corridors cross within the Chichester Range. Two priority species were recorded - *Aristida jerichoensis* var. *subspinulifera* (P1) and *Paspalidium retiglume* (P2) – and 12 environmental weed species. Fifty-three vegetation types were recorded by Coffey. None of the mapped vegetation types were considered to be of high conservation significance. Coffey (2010) indicated that the Priority Three Priority Ecological Community (PEC) 'Plant assemblages of the Wona Land System' occurred within the project area along with mulga-dominated communities. Seven vegetation types broadly describe the vegetation recorded in the rail project area (Table 2.5).

Table 2.5: Vegetation Types (Coffey, 2010)

Vegetation Type Descriptions
Eucalyptus, Corymbia spp. dominated woodlands over hummock grasslands of *Triodia* species with a variable shrub overstorey on plains, hillslopes and crests.
Tall Open Scrub of *Acacia*, *Hakea* and *Grevillea* spp. over Tussock Grasses on valley floors.
Tall Shrublands of mixed *Acacia* species, usually with an overstorey of *Corymbia/Eucalyptus* in creeklines.
Woodlands of *Eucalyptus camaldulensis* var. *obtusa* (River Red Gum) and/or *E. victrix* (Coolibah) over Tall Shrublands of *Melaleuca argentea* (Cadjeput) and *Acacia* spp. on river banks and beds.
Acacia aneura (Mulga) woodlands and tall shrublands over spinifex or various tussock grasses on the plains.
Acacia spp., *Gossypium robinsonii* dominated Shrublands in drainage lines and gullies.
Tussock Grasslands dominated by *Astrebla pectinata* low rocky rises.

EnviroAgent Services (2011) carried out targeted flora surveys along FMG's Solomon Rail Project alignment. None of the three priority species being targeted (*Goodenia nuda*, *Aristida jerichoensis* var. *subspinulifera* and *Paspalidium retiglume*) were located during the survey.

Ecoscape Australia (2010a) carried out a flora and vegetation survey at Camp 1G along FMG's Solomon Rail corridor. None of the vegetation associations recorded was considered to be conservation significant. No conservation significant species were recorded.

Ecoscape Australia (2010b) carried out a flora and vegetation survey of a re-alignment area along the Solomon Rail corridor. None of the vegetation associations recorded was considered to be conservation significant. No conservation significant flora species were recorded during the survey. Three introduced species were located during the survey: *Cenchrus ciliaris*, *Malvastrum americanum* and *Vachellia farnesiana*.

In March 2011, Maia (2011) carried out a single phase detailed flora and vegetation assessment along the Abydos-Woodstock section of the 2 km wide environmental approval corridor for the RHI Railway. The RHI Railway is located at its closest, approximately 1 km east of the northern-most point of the Survey Area. One priority species was recorded between Ch 150 to 161 along the RHI Railway 2 km wide environmental approvals corridor (the section of the RHI Railway closest to the Survey Area) – *Gymnanthera cunninghamii* (P3) and five environmental weed species (*Aerva javanica*, *Cenchrus ciliaris, C. setiger, Portulaca oleracea* and *Vachellia farnesiana*).

Fourteen vegetation associations were mapped in the chainage 150 to 161 section of the RHI Railway 2 km wide environmental approvals corridor (Maia, 2011). These associations are listed in Table 2.6 and shown on Map 10.9 (Section 10). The legend for the vegetation map is included as Figure 10.2 in Section 10. The associations have been prefixed with "RH" to avoid confusion with other surveys where similar coding has been used.

Table 2.6: Vegetation Associations East of the Survey Area: Ch 150-161 along RHI Railway (Maia, 2011)

Vegetation Association	Association Description
RHP1	Hummock Grassland of *Triodia lanigera* with a Sparse Mid Shrubland of *Acacia ancistrocarpa* and a Low Sparse Shrubland of *Indigofera monophylla*.
RHP2	Open Hummock Grassland of *Triodia longiceps* with a Low Sparse Shrubland of *Acacia bivenosa* and *Pluchea ferdinandi-muelleri*.

Vegetation Association	Association Description
RHP3	Mid Sparse Shrubland of *Acacia ancistrocarpa* with a Sparse Hummock Grassland of *Triodia epactia* and *T. lanigera* and Isolated Low Trees of *Corymbia* species.
RHP4	Low Open Shrubland of *Acacia stellaticeps* and +/- *Pluchea ferdinandi-muelleri* with an Open Hummock Grassland of *Triodia lanigera* and *T. epactia*.
RHP7	Hummock Grassland of *Triodia epactia* with a Mid Open Shrubland of *A. orthocarpa*, a Sparse Tall Shrubland of *Acacia pyrifolia* and Isolated Low Shrubs of *Triumfetta chaetocarpa*.
RHP8	Hummock Grassland of *Triodia angusta* with Low Isolated Shrubs of *Senna notabilis* and *Acacia bivenosa*.
RHH1	Hummock Grassland of *Triodia lanigera* with a Sparse Low Shrubland of *Acacia bivenosa* and Isolated Low Trees of *Corymbia hamersleyana*.
RHH3	Hummock Grassland of *Triodia epactia* with a Mid Open Shrubland of *Acacia orthocarpa* and a Low Sparse Shrubland of *A. bivenosa.*
RHH4	Mid Open Shrubland of *Acacia orthocarpa* and *A. inaequilatera* with an Open Hummock Grassland of *Triodia epactia* and *T. wiseana*.
RHD1	Open Low Woodland of *Eucalyptus camaldulensis* subsp. *obtusa* and or *Melaleuca argentea* with Tall Sparse Shrubland of *Acacia coriacea* subsp. *pendens* and *A. trachycarpa* and an Open Tussock Grassland of **Cenchrus ciliaris*.
RHD2	Tall Open Shrubland of *Acacia trachycarpa* and *A. ampliceps* with an Open Hummock Grassland of *Triodia epactia* and a Sparse Tussock Grassland of **Cenchrus ciliaris*.
RHD3	Open Hummock Grassland of *Triodia epactia* with an Open Tall Shrubland of *Grevillea wickhamii* and *Acacia tumida* var. *pilbarensis* and a Low Open Woodland of *Corymbia hamersleyana*.
RHD4	Tall Open Shrubland of *Acacia trachycarpa* and/or *A. tumida* var. *pilbarensis* with an Open Grassland of **Cenchrus ciliaris* and *Themeda triandra*.
RHH4/D3	Mosaic of H4/D3.

Note: *indicates a weed species.

Of these vegetation associations, Maia considered vegetation association RHD2 to be highly conservation significant because of its relatively small area in the corridor and the presence of four priority species located in that vegetation association along the whole of the corridor surveyed by Maia.

Biota (2004) surveyed approximately 345 km of Fortescue Metals Group's (FMG) Stage A rail corridor in March 2004. At its closest the Survey Area is less than 1 km from Biota's Hope Downs study area mapped in this report (at the diversion to the Great Northern Highway). Sheets 7 and 8 of Biota's vegetation mapping have been used to collate information on the vegetation, weeds and conservation significant flora of the section of the corridor closest to the Survey Area. Four priority species were recorded in this section: *Eremophila spongiocarpa* (P1), *Stylidium weeliwolli* (P2), *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) (P3) and *Bulbostylis burbidgeae* (P4). Four environmental weeds were recorded - *Aerva javanica*, *Cenchrus ciliaris*, *Echinochloa colona* and *Malvastrum americanum*. Thirty-six vegetation associations and 21 mosaics were mapped on sheets 7 and 8 of Biota's Vegetation Mapping (Biota, 2004). Two of these vegetation associations, Ar4 and Cp1, were considered to be of high conservation significance and these are described below:

- Ar4 – *Bulbostylis burbidgeae* sedgeland. This vegetation association appears to be relatively widespread but restricted to the microhabitat of soil pockets under the overhangs of granite boulder rockpiles. It was considered to be of high conservation significance because of the priority status of *Bulbostylis burbidgeae*.

- Cp1 – *Acacia inaequilatera* scattered tall shrubs over *Triodia schinzii* mid-dense hummock grassland on sandplains. Vegetation Cp1 was considered to be highly conservation significant due to the small areas it covered in the central section of the Chichester Range.

In October 2007 and May 2008 Ecologia (2008b) assessed the flora and vegetation along a new section of the BHP Billiton Railway proposed within the Chichester Range known as the Chichester Deviation. The Chichester Deviation is approximately 18 km south-east of the Survey Area at its closest point and deviates to the west of the existing BHP Billiton Railway. One priority species – *Goodenia nuda* (P4) - and six environmental weed species (*Aerva javanica, Bidens bipinnata, Cenchrus ciliaris, Cucumis melo* subsp*. agrestis, Malvastrum americanum* and *Vachellia farnesiana*) were recorded over the two phases of the survey. Nine vegetation types and 15 vegetation subtypes were recorded along the corridor surveyed. Vegetation types 1 and 2 were considered to have high local conservation significance as they occur on cracking clays of the Wona LS and subtype 4b was also considered to be of high significance. These units are described in Table 2.7.

Table 2.7: Vegetation Types and Subtypes Recorded along BHP Billiton's Chichester Deviation (Ecologia, 2008b).

Unit	Vegetation Subtype Descriptions
1	*Hakea lorea* subsp. *lorea* and *Acacia tetragonophylla* scattered shrubs, over *Sida fibulifera* low open shrubland, over *Astrebla pectinata* closed tussock grassland.
2	*Acacia xiphophylla* open scrub, over *Senna sericea* and *Senna artemisioides* subsp. *oligophylla* low open shrubland, over *Astrebla pectinata* open tussock grassland.
4b	*Acacia ayersiana* and *Acacia aneura* var. *aneura* low open forest, over *Acacia marramamba* and *Eremophila forrestii* open shrubland, over *Triodia basedowii* and *Triodia pungens* open hummock grassland.

2.7 Groundwater Dependent Ecosystems

2.7.1 Background

Groundwater dependent ecosystems (GDEs) are important because they have conservation, biodiversity, ecological, social and economic value. Two threats can affect to GDEs – loss of habitat and loss of groundwater resources (Eamus, 2009).

Smith *et al.* (2006) defined GDEs as ecosystems that rely wholly or partially on groundwater to maintain an adequate level of ecosystem function and maintenance of community composition over multiple generations of the longest lived species within the community (as cited in Dresel *et al*., 2010) i.e. groundwater dependent or phreatophytic vegetation that does not rely on the surface expression of water for survival (Sinclair Knight Merz, 2012).

Terrestrial vegetation GDEs are defined as including 'vegetation communities that do not rely on expressions of surface water for survival, but which have seasonal or episodic dependence on groundwater' (Sinclair Knight Merz, 2001). Groundwater systems associated with terrestrial vegetation GDEs may be locally recharged during a pronounced wet season, such as the upland sclerophyll woodlands of northern Australia (Sinclair Knight Merz, 2001). Vegetation that depends to differing degrees on groundwater during its lifecycle is known as phreatophytic vegetation.

Some phreatophytes can be wholly dependent on groundwater for their survival (e.g. *Melaleuca argentea* and herbaceous plants that occur at the fringes of wetlands in the Pilbara), while others have a facultative dependence

e.g. *Eucalyptus victrix* and *E. camaldulensis* and other shrub and herb species that grow near wetlands (Astron, 2011).

Phreatophytes can therefore be affected by changes in the physical characteristics and level of groundwater in an area.

Direct impacts from mining and other developments may vary depending on the type of mining, the need for and intensity of groundwater pumping and the distance from a GDE; these impacts can affect the level or pressure, the flux and the quality of groundwater (Sinclair Knight Merz, 2001).

2.7.2 Identification of GDEs

A GDE's presence can be inferred from observations or demonstrated experimentally (Eamus, 2009). Observations relating to ecosystems dependent on surface availability of water could include looking at the length of time a river flows or whether a wetland remains wet in the absence of surface flow of water, or looking at the composition of the vegetation growing in area where surface water is discharged – is it different from vegetation in nearby areas? While observations on ecosystems reliant on sub-surface availability of groundwater could involve looking at the proportion of vegetation that stays green in an area during dry periods – if it stays green it could be using groundwater – or in areas where groundwater discharges to the surface is the vegetation different from vegetation in areas close by?

Experiments that need to be carried out to enable GDEs to be identified include measurement of salinity levels, water flow volumes, water use, water relations, groundwater depth fluctuations, rooting depth and changes in leaf area index (Eamus, 2009).

Land and Water Australia (2007) provides a framework for assessing the environmental water requirements of GDEs. The report presents a set of tools to allow the identification of GDEs and to permit estimation of their environmental water requirements. The simplest tool of 11 included in the document is mapping, which includes tools that map geology and geological structures, water table depth or aquifer pressure and the distribution, composition and/or condition of vegetation as a means of identifying ecosystems that are likely to have access to and use groundwater. This tool is relevant to terrestrial, wetland and baseflow GDEs (Land and Water Australia, 2007).

The National Water Commission has developed a National GDE atlas to create a consistent, nation-wide inventory of GDEs in the form of a web-based tool; the GDE Atlas is now available on the Bureau of Meteorology website (National Water Commission, 2012).

2.7.3 GDEs and the Survey Area

The GDE Atlas (BoM, 2012b) was used to determine the likelihood of GDEs occurring in the Survey Area.

Map 10.10 (Section 10) shows the GDEs predicted to be reliant on subsurface groundwater in the Survey Area. The Survey Area lies over areas predicted to have low potential for groundwater interaction.

3 Database Searches, Survey Methods and Reporting

3.1 Database Searches

In order to gather information on the flora and ecological communities of the Survey Area the following sources were searched:

- the *EPBC Act* Protected Matters Search Tool (DSEWPaC, 2012b);
- the DEC's NatureMap (DEC, 2007 -);
- the DEC's Threatened and Priority Flora database (TPFL) (reference 14-0412FL, April 2012);
- the DEC's Threatened and Priority Flora List (TP) (reference 14-0412FL, April 2012);
- the Western Australian Herbarium (WA Herb) (reference 14-0412FL, April 2012); and
- the DEC's Threatened Ecological Communities database (reference 23-1211EC, December 2011; reference 13-0412EC, April 2012).

These searches were performed over different areas and at different times in 2011 and 2012 for a number of HPPL and Roy Hill projects worked on by Maia. The areas over which these searches were carried out are shown on Map 10.11 (Section 10).

In addition to the database searches Maia sourced priority plant locations from flora and vegetation reports produced on project areas in the surrounding the Survey Area.

Locations for the priority species produced by the NatureMap searches were sourced from FloraBase (WAH, 1998 -).

Locations of conservation significant species recorded during botanical surveys carried out by Biota (2004), Coffey (2010), Ecologia (2008a and b) and Maia (2010; 2011; 2012a-e) were also collated.

The following databases and lists were searched / referenced to determine whether any weeds identified in the NatureMap searches were any of the following:

- Weeds of National Significance (Australian Government, 2012);
- National Environmental Alert List (Australian Government, 2000);
- Sleeper Weed List (Bureau of Rural Sciences, 2003);
- Species Targeted for Eradication (NRMMC, 2012);
- Species Targeted for Biological Control (NRMSC, 2012); and
- Declared Plants of Western Australia (DAFWA, 2012b).

The following shape files were sourced from the Department of Agriculture and Food Western Australia (DAFWA) and mapped using ArcGIS:

- Land System Mapping (DAFWA 2012a); and
- Pre-European Vegetation (DAFWA, 2011).

Information from the following sources was downloaded from Landgate's Shared Land Information Platform (SLIP Enabler) (Landgate, 2012) and mapped using ArcGIS:

- DEC Managed Lands and Waters (DEC, 2011a);
- Environmentally Sensitive Areas (DEC, 2011c);

- EPA Redbook Areas (EPA, 2010);
- Schedule One Areas (DEC, 2007); and
- Surface Geology of Australia (Stewart, Sweet, Needham, Raymond, Whitaker, Liu, Phillips, Retter, Connolly & Stewart, 2008).

The results of the database searches are discussed in Section 4 of this report. A list of conservation significant flora collated from the different database searches is included as Table A1.1 (Appendix 1).

3.2 Survey Methodology, Team and Limitations

3.2.1 Survey Methodology

The survey methodology was designed to comply with the following:

- Environmental Protection Authority (EPA) Guidance Statement 51, Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA, 2004);
- EPA Position Statement 3, Terrestrial Biological Surveys as an element of Biodiversity Protection (EPA, 2002);

Before undertaking the survey the botanists familiarised themselves with the conservation significant species produced by the database searches.

The single phase detailed Level 2 survey was carried out by three botanists from August 15-17 and 19-22 (21 person days). Below average rain fell in the general area three months before the survey, however, rainfall from January to August 2012 was 56 mm above the yearly total long-term average (Table 2.1).

The botanists carried out targeted flora surveys over the Survey Area when walking between quadrats, and each botanist surveyed a band of vegetation approximately 25 m wide while walking. Conservation significant species known to occur in the area and surrounds, any novel species and introduced species were targeted while walking from site to site.

In order to map the vegetation of the Survey Areas, the botanists assessed the vegetation and flora at 79 50 m by 50 m quadrats (or the equivalent area in habitats such as creeklines and rivers).

Quadrat locations were chosen before the survey using aerial imagery, the Survey Area boundary, land system mapping and geology mapping. Quadrats were positioned in each land system and dominant geological units occurring in the Survey Area. The final placement of the quadrats was selected by the botanists while at site. The following parameters were recorded at each quadrat:

- Location details including GPS co-ordinates.
- Site parameters such as soil description, topography and general habitat description, rock type and cover.
- A photograph of the site.
- Vegetation condition using the scale and criteria developed by Trudgen (1988) and modified by Keighery (1994) (as described in Table 3.4).
- Notes on any disturbance to the vegetation of the Survey Areas.
- Fire history.
- A description of the vegetation structure including the height, percentage cover and dominant species within each stratum within the quadrat.
- The name, height, percentage cover and any other significant details for species located around the site outside the boundaries of the quadrat.

While walking transects over the Survey Area, the botanists also recorded information when any apparently different vegetation association was encountered. Coordinates for these 'points of interest' were recorded along with the following:

- Notes on the vegetation association of the area including any changes in habitat. (These notes were used to help define vegetation association boundaries when mapping the vegetation of the Survey Area.)
- Changes in vegetation condition and notes on any disturbance to the vegetation.
- Changes in landform, rock type and soil type.
- Any taxa not already collected at the relevé sites.
- Locations of known or suspected conservation significant species or weeds.

Whenever known or suspected conservation significant or weed species were encountered their numbers were either counted or estimated (when populations were large) and their locations were recorded on a GPS.

At least one specimen of each species encountered during the survey was collected. A plant taxonomist verified the identifications of the species collected and liaised with relevant experts at the WA Herbarium as necessary.

Coordinates for each quadrat are listed in Table A2.1 (Appendix 2). Transects walked and quadrats assessed are shown on Map 10.12 (Section 10).

A total of 7.06% (591.88 ha) of the Survey Area was covered while walking transects (572.13 ha; 228.85 linear km at 25 m wide) and assessing the 79 quadrats (19.75 ha).

3.2.2 Project Team

The botanists listed in Table 3.1 contributed to this flora and vegetation assessment.

Table 3.1: Project Team

Project Team			
Name	**Qualification**	**Project Role**	**DEC Flora License Number**
Christina Cox	PhD	Botanist –report	Not applicable
Scott Hitchcock	BSc	Botanist – field survey & report	SL009969 (exp. April 2013)
Rochelle Haycock	BSc	Botanist – field survey & report	SL009968 (exp. April 2013)
Pali Jayasekara	PhD	Botanist and taxonomist – field survey and plant identifications	SL0099666 (exp. April 2013)

3.2.3 Survey Limitations

Guidance Statement 51 (EPA, 2004) states that reports produced on flora and vegetation surveys for environmental impact assessment in Western Australia should contain a section describing the limitations of the survey methods used. A suggested list of constraints that these may cover is provided in Guidance Statement 51. Each of these constraints is discussed with respect to the survey in Table 3.2.

Table 3.2: Survey Limitations

Limitation	Comment
Sources of information and availability of contextual information (i.e. pre-existing background versus new material)	Some information is publicly available on detailed flora and vegetation surveys conducted in the vicinity of the Survey Area. Land systems mapping and Beard's vegetation mapping are also available for the Survey Areas. Searches of the DEC's databases and NatureMap were carried out.
The scope (i.e. what life forms, etc., were sampled)	Vascular flora species were sampled during the survey.
Proportion of flora collected and identified (based on sampling, timing and intensity)	Three hundred and forty-two taxa from 48 families and 139 genera were recorded from the Survey Area. Of these, 25.73% were annuals and 74.27% perennials. Eleven taxa could not be identified beyond genus and two could not be confirmed beyond family. Flowering material was used to identify 38.30% of the species list, fruiting material 29.53% and both flowering and fruiting material 8.48% of the species list. The survey was carried out in August after a summer when high rainfall was recorded in the area as a result of tropical cyclones. Seventy-nine quadrats were assessed within the 8,377.76 ha Survey Area and approximately 228.85 linear km of transects. This amounts to 7.06% (591.88 ha) coverage of the area which is excellent for a single phase Level 2 survey. The August survey was a little late in the season for the flora of the Wona land system as many of the annual species that occur on the upland gilgai plains post the summer rains were not present at the time of the survey.
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed?)	The Survey Area was accessible via station tracks and an existing east-west track through the Survey Area and the Great Northern Highway. Two sections of the Survey Area were quite a distance (4 km) away from existing tracks or the Great Northern Highway and access was therefore poor in these two sections. The botanists surveyed 7.06% of the 8,377.76 ha Survey Area during this single phase Level 2 survey. While the coverage achieved over the Survey Area was good, the section of the corridor in the Wonda LS should be surveyed after summer rains because the vegetation was not in peak condition in August 2012.

Limitation	Comment
Mapping reliability	The vegetation was mapped at a scale of 1:5,000 using aerial imagery supplied by HPPL and taken in 2004 and 2005. Along with information collected at quadrats any vegetation association boundaries and habitat changes were noted while traversing the Survey Areas. Large areas of the Yandeyarra Reserve are regularly burnt by the land holders to encourage regeneration of spinifex for cattle grazing. At the time of the survey spot fires were observed and large areas within the Survey Area had been burnt within 1-2 weeks of the survey. It was not possible to collect reliable data in these recently burnt areas and, as a result, some of the mapping boundaries in these areas are relatively broad and may not be representative of the actual vegetation associations in the area. Approximately 8 km of the Survey Area could not be surveyed due to access issues. These areas were not ground-truthed and have been mapped using the aerial imagery. As 7.06%% of the Survey Area was assessed the mapping reliability in the areas accessed by the botanists is considered to be very good.
Timing, weather, season, cycle	Wittenoom received 13.0 mm of rain over May, June and July 2012. This total is well below the long-term average total monthly rainfall for the same three months at Wittenoom (68.9 mm) (BoM, 2012). However, the total rainfall for Wittenoom from January to July 2012 is above the long-term average total for the same months (515.4 mm compared with long-term average of 459.4 mm) because Wittenoom received 469.8 mm of rainfall in January 2012 and that is well above the long-term average for January (108.6 mm). The August survey was a little late in the season for flora and vegetation of the Wona LS as many of the annual species that occur on the upland gilgai plains post the summer rains were not present at the time of the survey.
Disturbances (fire, flood, accidental human intervention etc.)	Small spot fires were noted within the Yandeyarra Reserve on a daily basis and areas within the corridor had been burnt within 1 – 2 weeks of the survey.
Intensity (in retrospect, was the intensity adequate?)	A total of 7.06% of the Survey Area was sampled over 21 person days during this single phase Level 2 survey. Of the 7.06%, 6.83% was covered while walking transects in the Survey Area. This coverage is more than adequate.
Resources	Adequate resources were employed during the survey. Twenty-one person days were spent at site by three botanists from August 15 to 22. Each botanist has excellent experience of the flora and vegetation of the Pilbara and of carrying out this type of survey.
Access problems	Two sections of the Survey Area were more than 4 km from the closest access track or road and this meant that 8 km would have to be walked just to get to and from the Survey Area. Because of this, one 5 km section between the Chichester Ranges and FMG's Solomon rail corridor and another 2.4 km long section crossing the Wona landsystem could not be accessed.

Limitation	Comment
Experience levels (e.g. degree of expertise in plant identification to taxon level)	Scott Hitchcock, Rochelle Haycock and Pali Jayasekara have conducted numerous surveys in the Pilbara region over the past five years. At least one specimen of all species recorded during the survey was collected. The specimens were identified by Dr. P. Jayasekara, a taxonomist with more than four years of experience in the taxonomy of the flora of the Pilbara. Dr. Jayasekara also liaised with staff at the WA Herbarium as necessary.

3.3 Taxonomy and Nomenclature

At least one specimen of every taxon encountered during the survey was collected for taxonomic verification in Perth. In many cases multiples of flowering or fruiting specimens were collected to assist with identification. Most specimens collected were identified by Dr. Palitha Jayasekara using taxonomic keys and reference specimens at the WA Herbarium. Specialists at the WA Herbarium were consulted as necessary and the following taxonomists assisted with the identification of some taxa:

Mr Malcolm Trudgen provided a second opinion on the conservation significant species, selected *Triodia* and other Poaceae specimens.

Mr Bruce Maslin confirmed the identifications of *Acacia glaucocaesia* and *A*. aff. *grasbyi*.

Species names used in this report are those adopted by the WA Herbarium and they have been checked against current FloraBase records (WAH, 1998 -).

3.4 Statistical Analysis

Version 3.12 of the multivariate statistical analysis package PATN (Belbin, 1989; Belbin, 2004) was used to analyse the floristic data collected at quadrats. Two analyses were run:

(1) Maia quadrat data collected during this survey; and,

(2) Maia quadrat data collected during this survey combined with selected quadrat data collected by Maia during its survey of the RHI Railway (Maia, 2011) and of Mulga Downs (Maia, 2012e).

The presence and absence of perennial taxa and Pearson complete linkage analysis with the Bray Curtis association measure was used to group sites with similar species composition and to define the floristic communities. The height and cover of each species were then used to describe the vegetation associations. As per the methodology followed by the DEC, annual, singleton and weed species were removed from the data before running both analyses. These are not usually representative of a floristic community as they are influenced by factors such as disturbance and rainfall. Other species were combined before both analyses based on their similarity, the number of subspecies or due to current taxonomic uncertainty (Table 3.3).

Table 3.3: Taxa Combined before PATN Analysis

Taxa Combined	Combined Name – Maia and Ecologia Analysis	Reasoning
Acacia aneura and *Acacia incurvaneura.*	*Acacia aneura*	Until recently *Acacia incurveaneura* was a variety of *Acacia aneura* (*Acacia aneura* var. *microcarpa*) and both share the same habitats.

Taxa Combined	Combined Name – Maia and Ecologia Analysis	Reasoning
Acacia pyrifolia, Acacia pyrifolia var. *morrisonii, Acacia pyrifolia* var. *pyrifolia*	*Acacia pyrifolia*	These subspecies occur in similar habitats and sterile material was only identified to species level.
Corchorus lasiocarpus subsp. *lasiocarpus, Corchorus lasiocarpus* subsp. *parvus*	*Corchorus lasiocarpus*	Both subspecies occur on hills and rocky slopes.
Triodia epactia, Triodia pungens	*Triodia epactia/pungens*	As there is still some debate regarding these two species of *Triodia*, these were combined into a complex.

PC-Ord (McCune & Mefford, 2010) was used to run an indicator species analysis on the quadrat data and the Dufrêne and Legendre (1997) analysis option was used to determine indicator species for each vegetation community. A Monte Carlo Permutation Test was used to determine the significance of the indicator species resulting from this test and is included as Table A3.2, Appendix 3.

Species accumulation curves (SPAC) are used to measure the estimated sampling adequacy of an area. In essence, as sampling intensity increases the incidence of new taxa recorded will decrease and eventually all species in a survey area will be recorded. This is represented by the total records (vertical axis) becoming asymptotic (levelling out) and remaining level as new sample sites are added. A species accumulation curve was generated for the data collected from the Survey Area using the methodology outlined in Colwell (2006). The SPAC was generated using the information collected only at quadrats.

3.5 Vegetation Mapping

Aerial photography captured in 2004, 2005 and using Bing Maps was used to map the vegetation at a scale of 1:5,000. Vegetation descriptions and the presence and absence of taxa recorded at sites assessed by Maia in the Survey Area were used to describe the vegetation associations. Statistical analyses were carried out on quadrat data and the results of the floristic analysis were used to define and map the boundaries of the vegetation associations of the Survey Area.

The growth form, height classes and cover characteristics of vegetation are described using the current National Vegetation Inventory System (NVIS) methodology at the association level. At this level up to three strata and a maximum of three taxa per stratum are used to describe the association (ESCAVI, 2003).

3.6 Vegetation Condition

Vegetation condition was mapped using data collected from quadrats, relevés and transects and is based on the scale developed by Trudgen (1988) and modified and adapted by Keighery (1994). A summary of the vegetation scale and criteria is provided in Table 3.4.

Table 3.4: Vegetation Condition Scale and Criteria Used

Condition Scale (Keighery, 1994)	Description
(E) Excellent	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
(VG) Very Good	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
(G) Good	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
(P) Poor	Still retains basic vegetation structure or ability to regenerate to it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
(VP) Very Poor	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
(D) Completely Degraded	Areas that are completely or almost completely without native species in the structure of their vegetation; ie areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

Source: Trudgen (1988) modified and adapted by Keighery (1994).

4 Database Search Results

4.1 Conservation Significant Flora

4.1.1 Environment Protection and Biodiversity Act 1999

Some flora species are protected by Australian Government legislation based on the perceived levels of threat to the species population at a national level. These species are placed within one of six conservation categories (Table A5.1, Appendix 5) and four of these categories are specially protected under the *Environment Protection and Biodiversity Conservation Act* (*EPBC Act*) (DSEWPaC, 2012c). *Lepidium catapycnon* (Vulnerable) and *Thryptomene wittweri* (Vulnerable) occur in the Pilbara and are listed under the *EPBC Act*.

The results of the search carried out using the *EPBC Act* Protected Matters Search Tool (DSEWPaC, 2012b) indicated that no flora species listed under the *EPBC Act* are currently known to occur within 10 km of the Survey Area.

4.1.2 Wildlife Conservation Act 1950

All flora species native to WA are protected under the State's *Wildlife Conservation Act*. Under this act, the Minister for the Environment may declare species of flora to be protected if they are considered to be in danger of extinction, rare or otherwise in need of special protection: Schedules 1 and 2 list species that are threatened or presumed extinct respectively (DEC, 2012a).

In Western Australia the term Threatened Flora is applied to extant declared rare flora (DRF) and Presumed Extinct Flora to extinct declared rare flora (DEC, 2012a and defined in Table A5.2, Appendix 5). The most recent DRF list was published 6th November 2012 (Government of Western Australia, 2012). Three Threatened Flora species are currently listed for the Pilbara – *Aluta quadrata*, *Lepidium catapycnon* and *Thryptomene wittweri* (WAH, 1998 -).

The results of the search carried out using NatureMap (DEC, 2007 -) indicated that no flora species listed under the *WC Act* are currently known to occur within 10 km of the Survey Area.

4.1.3 Priority Flora

Because of the large Western Australian flora, many species are known from only a few collections, or a few sites, and have not been adequately surveyed. Species that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are added to the Priority Flora List under priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Conservation Dependent species are placed in Priority 5 (DEC, 2012a).

Definitions for each of the categories discussed above are included in Table A5.3 (Appendix 5). The most recent Priority Flora List was published in April 2012 (Smith, 2012).

Results from the DEC database and NatureMap searches identified seven Priority Flora species that have either been recorded in the vicinity of the Survey Area or are typically found in habitats that could occur in the Survey Area. Those occurring within 20 km of the Survey Area follow: *Acacia glaucocaesia*, *Euphorbia stevenii*, *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727), *Gymnanthera cunninghamii*, *Indigofera gilesii* subsp. *gilesii*, *Nicotiana umbratica* and *Rostellularia adscendens* var. *latifolia* (all P3).

Eight additional Priority Flora were recorded during other biological surveys carried out within 20 km of the Survey Area: *Cochlospermum* sp. Pilbara, *Teucrium pilbaranum* (both P1), *Paspalidium retiglume*, *Stylidium weeliwolli* (both P2), *Rhagodia* sp. Hamersley and *Themeda* sp. Hamersley (both P3), *Bulbostylis burbidgeae* and *Goodenia nuda* (both P4).

A search of FloraBase records (WAH 1998-) indicated that two other species occur within 20 km of the Survey Area: *Adiantum capillus-veneris* (P2) and *Elatine macrocalyx* (P3).

Additional information on the flowering period, typical habitat and recorded locations for these species is listed in Table A1.1 (Appendix 1). Eleven of these species could possibly occur in the Survey Area based on the habitat in which they typically occur and the distance of known records from Survey Area.

Locations of each of these species are shown on Map 10.14, Section 10.

FloraBase (WAH, 1998 -) lists 160 Priority Flora species occurring in the Pilbara bioregion, of which 69 and 44 occur in the Chichester and Fortescue Plains IBRA subregions, respectively.

4.2 Introduced Flora

A weed is defined in the Australian Weeds Strategy (DEWR, 2007) as 'a plant which has, or has the potential to have, a detrimental effect on economic, social or conservation values'. Weeds can include species that have proliferated in bushland without direct human intervention or assistance (referred to as naturalised alien species).

4.2.1 Weeds of National Significance

A number of 'lists' of weeds of national interest are currently recognised. The nature of the weeds and the resulting actions required determine on which list a species may appear. Some weeds are of particular concern and, as a result, have been listed for priority management or in legislation. These lists are described in Table 4.1.

Table 4.1: National Weeds Lists

National Weeds Lists	Description	Any Produced by Searches
Weeds of National Significance (WoNS)	In 1998, Australian governments endorsed a framework to identify which weed species could be considered to be Weeds of National Significance (WoNS) within an agricultural, forestry and environmental context. Twenty WoNS were listed (DEC, 2012b). The criteria used to determine WoNS were: the invasiveness of the weed species, the weed's impact, the potential spread of the species, and the socio-economic and environmental values of the weed (Australian Government, 2012). In April 2012 another 12 WoNS were added to this list (Australian Weeds Committee, 2012).	No
National Environmental Alert List	In 2000, the then Department of Environment and Heritage worked with the Cooperative Research Centre for Australian Weed Management and identified 28 introduced flora species that have the potential to become a significant threat to biodiversity of they are not managed. The three criteria for these species includes: posing a high or serious potential threat to the environment, having limited distribution within Australia at present and being responsive to successful eradication or containment programs (Australian Government, 2000).	No
Sleeper Weeds	In 2003 the Bureau of Rural Sciences (BRS), through consultation with the Australian Weeds Committee, short-listed 17 potential agricultural	No

National Weeds Lists	Description	Any Produced by Searches
	sleeper weeds which have currently established only small wild populations but have the potential to spread widely and affect agricultural or natural environments (BRS, 2003)	
Species Targeted for Eradication	Six species are targeted for national eradication under the Natural Resource Management Ministerial Council's (NRMMC) eradication program (NRMMC, 2012).	No
Species Targeted for Biological Control	Sixty-four weed species have been approved to be targeted for biological control by the Australian Weeds Committee and subsequently the Natural Resource Management Standing Committee (NRMSC, 2012).	Yes - **Tribulus terrestris*

The search using the *EPBC Act* Protected Matters Search Tool (DSEWPaC, 2012b) produced none of these weeds, while the NatureMap (DEC, 2007 -) search listed *Tribulus terrestris* as having been recorded within 20 km of the Survey Area. Maia (2012d) also recorded *T. hirsutus* within 20 km of the Survey Area. It is a declared noxious weed in Victoria (DPIV, 2012) and a declared plant in South Australia (DPIRSA, 2010).

4.2.2 Agriculture and Related Resources Protection Act 1976

Plants which adversely affect agriculture (or have the potential to) are known as Declared Plants and are listed as one or more of five priority category weeds under the *Agriculture and Related Resources Protection Act* 1976 (DAFWA, 2012c). The priority categories define the control mechanisms for these weeds (Appendix 6).

A Declared Plants search (DAFWA, 2012b) indicated that 87 are listed for the East Pilbara.

No plants declared in WA were listed in the results of the NatureMap and *EPBC Act* Protected Matters Search Tool searches.

4.2.3 Environmental Weeds

Environmental weeds are not known to pose a threat to agriculture, but are known to be invasive colonisers that can threaten the health of native vegetation.

The *EPBC Act* Protected Matters Search Tool search results indicated that one invasive species (weed) could occur in the area: *Cenchrus ciliaris* (Buffel Grass).

The NatureMap searches listed eight weed species that have been recorded within 20 km of the Survey Area: *Aerva javanica* (Kapok Bush), *Cenchrus ciliaris* (Buffel Grass), *Crotalaria juncea* (Sunnhemp), *Cucumis melo* (Ulcardo Melon), *Flaveria trinervia* (Speedy Weed), *Leptochloa fusca* subsp. *uninervia*, *Setaria verticillata* (Whorled Pigeon Grass) and *Tribulus terrestris* (Caltrop).

The following 17 weed species have been recorded in the vicinity of the Survey Area during previous surveys: *Acetosa vesicaria* (Ruby Dock), *Aerva javanica* (Kapok Bush), *Bidens bipinnata* (Bipinnate Beggartick), *Cenchrus ciliaris* (Buffel Grass), *Cenchrus setiger* (Birdwood Grass), *Citrullus colocynthis*, *Cucumis melo* and *Cucumis melo* subsp. *agrestis* (Ulcardo Melon), *Echinochloa colona* (Awnless Barnyard Grass), *Flaveria trinervia* (Speedy Weed), *Malvastrum americanum* (Spiked Malvastrum), *Medicago polymorpha* (Burr Medic), *Portulaca oleracea* (Purslane), *Setaria verticillata* (Whorled Pigeon Grass), *Sonchus oleraceus* (Common Sowthistle), *Tribulus terrestris* (Caltrop) and *Vachellia farnesiana* (Mimosa Bush).

In Western Australia the Environmental Weed Strategy for Western Australia (EWSWA) (CALM, 1999) provides details of management priorities and general control measures and monitoring for environmental weeds. While

the EWSWA is still relevant, Appendix 3 of the document - the 'List of Environmental Weed Species of Actual and Potential Significance in WA' is now out of date and the Invasive Plant Prioritisation Process for DEC has been developed (DEC, 2012c). Each DEC Region has prioritised weed species according to their threat to the natural environment. Most of the weeds listed are rated for their invasiveness, distribution and ecological (environmental) impacts (DEC, 2012c) among other attributes.

The Pilbara region weed assessment spread-sheet (DEC, 2012d) lists 84 environmental weeds for the Pilbara bioregion while FloraBase (WAH, 1998 -) lists 106 weeds generally (including Declared Plants).

4.3 Ecological Communities, Environmentally Sensitive Areas, Schedule One Areas, EPA Redbook Areas and Conservation Areas / Reserves

Some ecological communities are protected by Commonwealth and / or WA legislation (Threatened Ecological Communities – TECs). Others are listed as Priority Ecological Communities (PECs) while their significance is being assessed prior to being listed as a TEC. The conservation significance rankings for these TECs and PECs are listed in Appendix 5.

No TECs protected by Commonwealth legislation are listed for the Pilbara bioregion (DSEWPaC, 2012d). The most recent list of TECs endorsed by the Minister of Environment in Western Australia was released in April 2012 and includes two TECs in the Pilbara bioregion – the Themeda grasslands TEC (Vulnerable A)) and the Ethel Gorge stygobiont community TEC (Endangered B) ii)) (DEC, 2012e).

The most recent PEC list was released on April 4, 2012 and 30 PECs are listed for the Pilbara bioregion (DEC, 2012f).

The results of the Threatened Ecological Communities database search for any TECs and PECs occurring in the vicinity of Survey Area are shown on Map 10.14 (Section 10).

- The edge of the buffer around the Themeda Grasslands TEC is approximately 61 km west of the south-western-most section of the survey area.
- Some of the Survey Area is located within a 20 km buffer around the P1 ecological community 'Four plant assemblages of the Wona Land System' mapped in the area (approximately 4,170 ha of the Survey Area lies within this buffer).
- The edge of the next closest PEC buffers, around occurrences of the P1 ecological community 'Freshwater claypans of the Fortescue Valley', are approximately 4 km to the south-west, 14.3 km south, 10.8 km south-east and 27 km south-east of the Survey Area.
- The edge of the P1 ecological community 'Fortescue Marsh' is approximately 26 km to the south-east of the Survey Area.

Some areas in WA are listed as environmentally sensitive areas (ESAs) - these are areas requiring special protection because of rare or threatened flora, sites that have high conservation, scientific or aesthetic values and/or Aboriginal or European cultural sites.

- The Survey Area does not occur within or in the vicinity of an ESA.
- The nearest ESA is the Fortescue Marses ESA located approximately 4.2 km south of the Survey Area (Map 10.15, Section 10). The *EPBC Act* Protected Matters Search Tool results list the Fortescue Marsh as occurring within a 10 km buffer around the Survey Area. The Fortescue Marsh is listed as a nationally important wetland.

The National Reserve System (NRS) is a network of protected areas managed for conservation under international guidelines. Conservation Parks have regional or local significance and are set aside to conserve wildlife and the

landscape for scientific study and to preserve features of archeological, historical or scientific interest (DEC, 2012g).

- The Survey Area does not occur within or in the vicinity of a conservation estate but 54.4% of it lies within the Yandeyarra Reserve and 5.9% within the Abydos-Woodstock Reserve.
- The nearest conservation estate, Mungaroona Nature Reserve, is located approximately 14 km north of the Survey Area at its closest point (Map 10.15, Section 10). Mungaroona Nature Reserve is also listed as an ESA, a Schedule One Area and EPA Redbook Area.
- Karijini National Park is approximately 21 km to the south-west of the Survey Area at its closest point. Karijini National Park is also listed as a Schedule One area, an ESA, and is listed under the *EPBC Act* as a State and Territory Reserve and on the Register for National Estate (formerly known as Hamersley Range National Park).

A Schedule One Area requires a permit for vegetatation clearing resulting from low impact mineral or petroleum activities.

- Karijini National Park and Mungaroona Nature Reserve are the nearest Schedule One Areas (Map 10.15, Section 10).

Former Leasehold areas were previously pastoral leases or parts of pastoral leases that have been acquired for conservation and are managed under interim arrangements prior to their reservation as conservation reserves (DEC, 2012g).

- The closest former leasehold area proposed for conservation - ex Mt Florence Station - is located approximately 32 km south-west of the Survey Area (Map 10.15, Section 10).

An EPA Redbook Area is an area recommended by the EPA for conservation (EPA, 2010).

- The nearest EPA Redbook Area, Mungaroona Nature Reserve, is located approximately 13.8 km to the west of the northern boundary of the Survey Area (Map 10.15, Section 10). It is also listed as a Schedule One Area and ESA.

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5 Survey Results - Flora

5.1 General Flora

Three hundred and forty-two taxa from 48 families and 139 genera were recorded from the Survey Area. The identities of 11 of these taxa could not be confirmed beyond genus due to a lack of flowering or fruiting material: *Aristida* sp., *Calandrinia* sp., *Corchorus* sp., *Heliotropium* sp., *Maireana* sp., *Maireana ?villosa, Operculina ?aequisepala, Sclerolaena* sp., *Sida* sp. 1, *Sida* sp. 2 and *Triodia ?pungens*. These taxa have been included in the counts because they are different from the confirmed taxa already in the species list.

The families with the highest number of taxa were Fabaceae (75), Poaceae (56) and Malvaceae (37). The genera with the highest number of taxa were *Acacia* (35), *Ptilotus* (13) and *Senna* (12).

Annual taxa comprised 25.73% of the species list and perennial taxa 74.27%.

At least one specimen of each species on the species list was collected during the surveys. Flowering specimens were used to identify 38.30% of the species list, fruiting material 29.53% and both flowering and fruiting material 8.48%. Flowering and fruiting specimens are indicated in the species list (Table A4.2, Appendix 4).

The species accumulation analysis indicates that 80% of the flora estimated to be in the Survey Area was recorded. However, this estimation is based on the 327 taxa recorded in the 79 quadrats assessed and does not include the 15 additional taxa recorded opportunistically while walking transects. A species by vegetation association and site matrix is included as Table A3.1 (Appendix 3).

The species accumulation curve result is based on the actual number of taxa recorded (Sobs [Mao Tau]) and compared with the Chao2 Mean, which is the estimated number of taxa expected to be recorded. The results for the analysis are included in Table A4.1 (Appendix 4) and are illustrated in Figure 5.1.

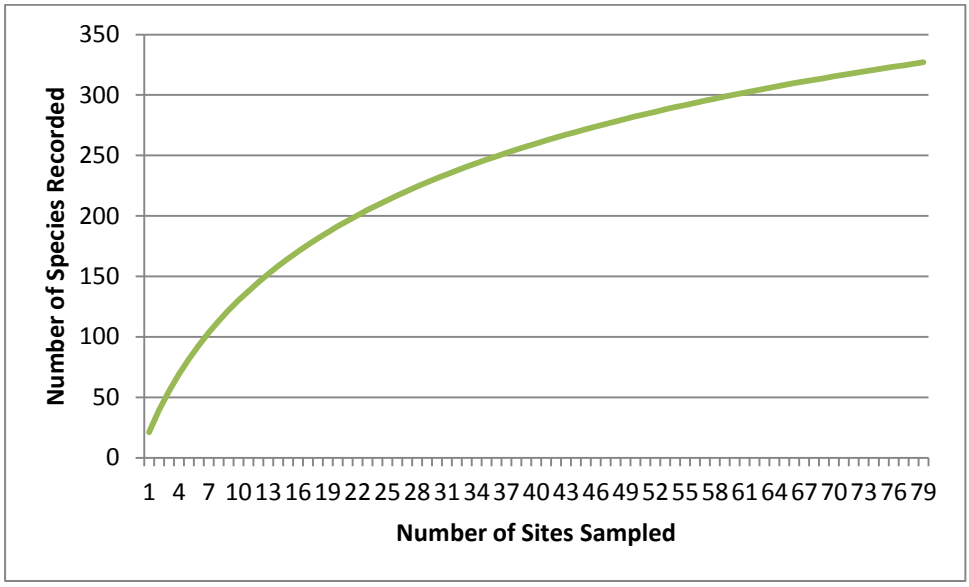


Figure 5-1: Species Accumulation Curve Produced using Quadrat Data

A comparison of the flora recorded during Maia's single phase detailed Level 2 survey with that recorded in other surveys carried out in the vicinity is included in Table 5.1. Based on this comparison the sample effort for the Survey Area was good.

Table 5.1: Taxa Collected during this and Previous Biological Surveys

Survey Location	Survey Type	Taxa	Survey Timing	No. Quadrats	Area in Quadrats Surveyed (ha)	Reference
Transport Corridor - Maia	Level 2 – single phase	342	August 2012	79	19.8	This report
Mulga Downs East	Level 2 – single phase	365	June/July 2012	115	27.3	Maia (2012e)
RHI Railway Corridor, Abydos-Woodstock section	Level 2 – single phase	398	March/April 2011	128	32.0	Maia (2011)
Murrays Hill Transport Corridor	Level 2 – single phase	157	August 2009	22	5.5	G & G Environmnetal (2009)
Murrays Hill	Level 2 – single phase	139	June 2008	24	6.0	Ecologia (2008)
Solomon Rail Project	Level 2 – multiple surveys	388	May/June 2008 and October/November 2009	104	26.0	Coffey (2010)

5.2 Range Extensions

Species have a typical range which is indicated by their known distribution records. Sometimes species are recorded in areas where they have not been found previously and these species are described as range extensions. A range extension can reflect a paucity of surveys in a particular area or non-lodgement of flora records to the WA Herbarium.

One species collected from the Survey Area is a range extension (Table 5.2).

Table 5.2: Range Extension Species Located in the Survey Area

Species	Closest WAH (1998 -) Record from Survey Area	Distance and Direction from Survey Area
Acacia robeorum	Port Hedland (Pilbara bioregion)	147 km north

5.3 Taxonomically Interesting Taxa

The following five taxa could not be fully identified to species level due to small differences in reproductive and/or vegetative characters and the complexity of some of the *Triodia* taxa. While taxonomically interesting, it is unlikely that they will be conservation significant.

One specimen of *Acacia* aff. *grasbyi* was collected during the survey. The phyllodes and bark match *Acacia grasbyi*, however, it differs from *A. grasbyi* in that the peduncles are shorter and the flower spikes also appear to be shorter than those of *A. grasbyi* (pers. comm. Bruce Maslin, WA Herbarium, October 2012). The closest *A. grasbyi* FloraBase record to the Survey Area is Coolbro Creek (Little Sandy Desert bioregion) located 345 km east of the Survey Area.

Triumfetta aff. *ramosa* was collected from one location. The specimen is similar to *T. ramosa* in that similar length hairs cover the spines of the fruit; however, the specimen of *T.* aff *ramosa* has a hooked tip on the spines of the fruit and *T. ramosa* does not have hooked tips. Another similar species, *T. chaetocarpa*, has a hooked tip on the spines, but the length of the hairs on the spines differs from those on the specimen of *T*. aff. *ramosa*.

The genus *Triodia* is currently undergoing taxonomic revision and it is well known that a number of undescribed entities occur in the Pilbara (pers. comm. Mr Malcolm trudgen, October 2012). Following discussions with Mr Malcolm Trugden and Mr Steve Dillon, specimens of certain species of *Triodia* collected from the Survey Area that had reproductive material differing from the type specimens at the WA Herbarium were grouped together using similar characters and listed as separate taxa. This was done for the following specimens:

Triodia lanigera and *T. basedowii*:

There is some confusion surrounding these two species and it appears that there is some hybridisation occurring between them in the Pilbara. Both *T. lanigera* and *T. basedowii* have three lemma lobes and the distinguishing characteristic is lobe shape. *T. lanigera* has acute lobes and the middle lobe is longer than the outer two, while *T. basedowii* has obtuse lobes of equal length. The specimens collected from the Survey Area generally have acute lobes of equal length; however, some specimens had a longer acute middle lobe more similar to *T. lanigera*. All of these specimens have been combined into a single complex, *Triodia* aff. *basedowii*.

Triodia aff. *basedowii* was identified from 47 collections with fruiting material.

Triodia aff. *wiseana:*

There are at least two taxonomically different entities of *T. wiseana* in the Pilbara (pers. comm. Mr Malcolm Trudgen). *T. wiseana* can have three either minutely or deeply lobed lemmas which are variable in size. The specimens collected from the Survey Area had three consistently longer than usual lobes that curved at the tip. Prior to a revision of *Triodia* (Lazarides, 1997) there were two varieties of *T. wiseana* (*T. wiseana* var. *brevifolia* and *T. wiseana* var. *wiseana*). The specimens collected in the Survey Area share affinities with the collections of *T. wiseana* var. *brevifolia* in the main collection at the Western Australian Herbarium.

Triodia aff. *wiseana* was identified from 30 collections all of which had fruiting material.

Triodia epactia:

T. epactia is known to be an undescribed complex based on numerous variations in the reproductive material (pers. comm Mr Malcolm Trudgen). Specimens collected during this survey that were similar to but in some ways different from *Triodia epactia* were grouped with *T. epactia*. One specimen, *Triodia* aff. *epactia*, was similar to *T. epactia* but different enough to be separated out. It was recorded on low, shale hills and undulating plains. Mr Malcolm Trudgen is currently looking at this and two other specimens of the same entity that were collected at

and close to the Survey Area in August 2012. Dr Matt Barrett from the Western Australian Herbarium will also look at these specimens.

The *Triodia epactia* group was identified from 33 collections with reproductive material.

5.4 Conservation Significant Flora

5.4.1 Commonwealth Environment Protection and Biodiversity Act 1999

No species listed under the *EPBC Act* were located in the Survey Area.

5.4.2 Western Australia Wildlife Conservation Act 1950

No species listed under the *WC Act* were located in the Survey Area.

5.4.3 Priority Flora

Two Priority Flora species were recorded during the survey – *Acacia glaucocaesia* (P3) and *Goodenia nuda* (P4).

***Acacia glaucocaesia* (Priority 3)**

A. glaucocaesia is a dense, glabrous tree or shrub (Plate 5.1). The phyllodes (leaves) are short and broad. The yellow globular flowers are produced from July to September (Plate 5.2). It is typically found growing on cracking-clay soils and floodplains (WAH, 1998 -).

A. glaucocaesia was recorded at 15 locations in the Survey Area on the cracking clays of the Wona Land System (Map 10.16, Section 10).

Plate 5.1: Growth habit

Plate 5.2: Close-up of inflorescence and leaves

***Goodenia nuda* (Priority 4)**

G. nuda is a prostrate or erect annual herb growing up to 0.5 m high (Plate 5.3). The basal leaves are sometimes serrated and are prominently three-veined from the base. The yellow flowers have a maroon centre and are produced from April to August (Plate 5.4). It is typically found growing on seasonally inundated clay soils and drainage lines. It is also recorded on scoured river beds and on hill sides (WAH, 1998 -).

G. nuda was recorded at one location in the Survey Area (Map 10.16, Section 10).

Plate 5.3: Growth habit

Plate 5.4: Close-up of flower

5.5 Introduced Flora

5.5.1 Weeds of National Significance

No weeds on any of the national weeds lists were recorded during the survey.

5.5.2 Agriculture and Related Resources Protection Act 1976

One Declared Plant was recorded during the survey – *Argemone ochroleuca* (Mexican Poppy). However, *A. ochroleuca* is not declared in the Shire of Ashburton, East Pilbara or Port Hedland (DAFWA, 2012b).

5.5.3 Environmental Weeds

Nine environmental weed species were located during the survey: *Aerva javanica* (Kapok Bush), *Argemone ochroleuca* (Mexican Poppy), *Bidens bipinnata* (Bipinnate Beggartick), *Cenchrus ciliaris* (Buffel Grass), *Citrullus lanatus* (Pie Melon), *Flaveria trinervia* (Speedy Weed), *Malvastrum americanum* (Spiked Malvastrum), *Portulaca oleracea* (Purslane), and *Vachellia farnesiana* (Mimosa Bush).

Descriptions for and photographs of these environmental weed species follow (Table 5.3) and their locations are shown on Map 10.17 (Section 10).

A map showing the known distribution of each weed species is also included in Table 5.3. Eight of the nine weed species have a wide distribution in the Pilbara region, while records for *Citrullus lanatus* are fewer in the Pilbara but its distribution is generally widespread in WA.

The invasiveness, distribution and environmental impact rankings (DEC, 2011b) for the weed species recorded in the Survey Area are listed in Table 5.4 along with an EWSWA rating (CALM, 1999) when available.

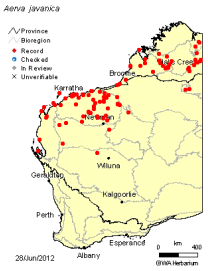
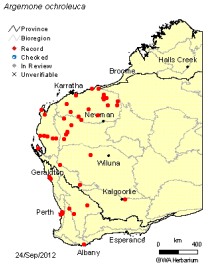
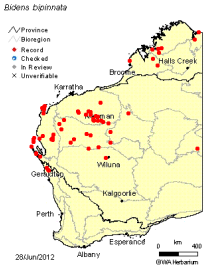
Table 5.3. Ecological Ratings for Weeds Recorded in the Survey Area

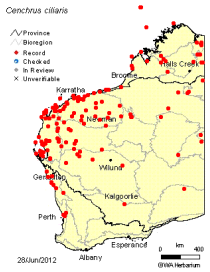
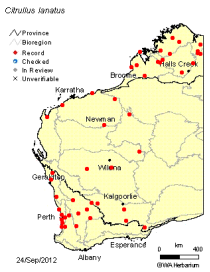
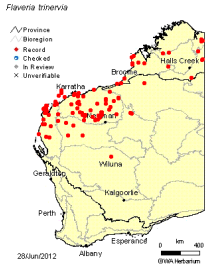
Species	Invasiveness	Distribution	Environmental Impact	EWSWA Rating
Aerva javanica	Rapid	Low	High	High
Argemone ochroleuca	Rapid	High	Low	Mild
Bidens bipinnata	Rapid	High	Unknown	Not rated
Cenchrus ciliaris	Rapid	High	High	High
Citrullus lanatus	Rapid	Low	Low	Low
Flaveria trinervia	Not rated	Not rated	Not rated	Not rated

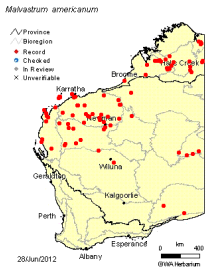
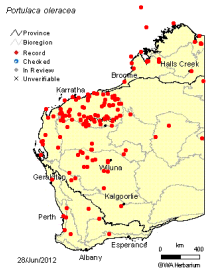
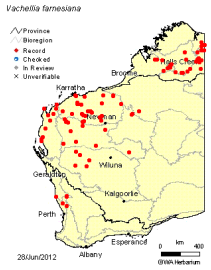
Species	Invasiveness	Distribution	Environmental Impact	EWSWA Rating
Malvastrum americanum	Rapid	High	High	Moderate
Portulaca oleracea	Not rated	Not rated	Not rated	Not rated
Vachellia farnesiana	Rapid	High	High	High

Three of the nine weed species recorded in the Survey Area are listed as having a high EWSWA rating and have a rapid invasiveness – *Aerva javanica* (Kapok Bush), *Cenchrus ciliaris* (Buffel Grass) and *Vachellia farnesiana* (Mimosa Bush).

Table 5.4: Environmental Weed Species Recorded within the Survey Area

Weed	Description	Habitat	Known WA Distribution	Distribution in the Survey Area	Photograph
Aerva javanica	Erect, much-branched perennial herb growing to 1.6 m high. White flowers are produced from January to October.	Often on sandy soils. Along drainage lines.		*A. javanica* was recorded at 31 locations along creek lines, minor drainage lines, on floodplains and disturbed areas.	
Argemone ochroleuca	Erect, glaucous annula herb growing to 1 m high. It has spiny leaves with yellow latex. The white-cream-yellow flowers are produced from February to March or July to November.	Creek edges, riverbanks and roadsides.		*A. ochroleuca* was recorded at 15 locations along drainage lines within the Survey Area and at one location outside the Survey Area.	
Bidens bipinnata	*B. bipinnata* is an upright, annual herb growing to 0.9 m high. Yellow flowers are produced from March to September.	Rivers and creeks, coastal areas, rocky hillsides and mulga groves.		*B. bipinnata* was recorded at three locations on clay pans underneath mulga or in minor drainage lines and sometimes on the banks of creeks.	

Weed	Description	Habitat	Known WA Distribution	Distribution in the Survey Area	Photograph
Cenchrus ciliaris	A tufted, erect or spreading perennial grass growing to 1.5 m high. It produces a cylindrical flower stalk with purple flowers between February and October.	White, red or brown sand, stony red loam and black cracking clay.		*C. ciliaris* was recorded at 49 locations and was recorded on banks of drainage channels and creeklines and on floodplain areas.	
Citrullus lanatus	A trailing annual herb or climber with deeply lobed leaves. The yellow flowers are produced from January to December	Plains, riverbanks, dry lakes, drainage areas, disturbed areas.		*C. lanatus* was recorded at 27 locations along drainage lines within the Survey Area and at one location outside the Survey Area.	
Flaveria trinervia	Annual herb, with yellow flowers. Leaves with three nerves.	Creeklines, sand, clay plains, floodplains.		*F. trinervia* was recorded at 36 locations on floodplains and along drainage lines within the Survey area and at one location outside the Survey Area.	

Weed	Description	Habitat	Known WA Distribution	Distribution in the Survey Area	Photograph
Malvastrum americanum	Erect, hairy perennial herb or shrub growing to 1.5 m high. The flowers are yellow to orange and are produced from April to July.	Stony ridges and hillsides, floodplains and along drainage lines.		*M. americanum* was recorded at eight locations on the floodplains of the Survey Area.	
Portulaca oleracea	A succulent, prostrate to decumbent annual herb growing to 0.2 m high. Flowers are yellow and are produced from April to May.	Clay loam and sand and often in disturbed areas.		*P. oleracea* was recorded at three locations on clay pans in the Survey Area.	
Vachellia farnesiana	Erect, spreading, thicket-forming, thorny tree or shrub, to 4 m high. Flowers are yellow, occurring from June to August.	Stony sandy, clay or loam soils, gravel. Low-lying areas, river and creek banks, disturbed sites.		*V. farnesiana* was recorded at 43 locations on areas of cracking clay and floodplains within the Survey Area and at two locations outside the Survey Area.	

Descriptions and habitats from WAH (1998 -) and Hussey *et al.* (2007). Map showing known WA Distributions from WAH (1998 -). WA weed Mapping by Paul Gioia. Images used with the permission of the Western Australian Herbarium, Department of Environment and Conservation (http://florabase.dec.wa.gov.au/help/copyright). Accessed on Wednesday, 29 August 2012. Descriptions by the Western Australian Herbarium, Department of Environment and Conservation. Text used with permission (http://florabase.dec.wa.gov.au/help/copyright). Accessed on Wednesday, 29 August 2012. Unless otherwise indicated photographs are by Maia

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6 SURVEY RESULTS – VEGETATION

6.1 VEGETATION ASSOCIATIONS

The Survey Area analysis and not the combined analysis has been used to to define the vegetation associations. The combined analysis was primarily used to compare outlier sites or associations with few quadrats, with associations mapped outside the corridor. It has also been used to discuss the conservation significance of the vegetation of the Survey Area.

Pattern analysis divided the quadrat data into two broad groups at the 1.24 similarity scale. It further divided the data into 20 groups at the 0.72 similarity scale. The final stress value is 0.24, which is considered adequate for this level of analysis. Of the 20 groups, one site was considered to be a true outlier (HR59) and it was removed from the vegetation association descriptions. Two small groups were merged with neighbouring groups based on disturbance and/or burn history. Sites HRO3 and HR10 were merged with *TabTb***HG**-6 and site HR78, which is a minor outlier, was merged into *TeTab***HG** -11.

The Survey Area and combined overall dendrograms produced by PATN analysis are included as Figures A3.1 and A3.2 and the group dendrogram (based on the 0.72 similarity scale) for the Survey Area in Figure A3.3 (Appendix 3). The statistical methodology (PATN recipes) used to generate the site by species classification is included as Figures A3.4 and A3.5 (Appendix 3).

PATN analysis defined 16 floristic communities in the Survey Area. The PATN analysis groupings along with the growth forms, height classes and cover characteristics of the vegetation have been used to describe 16 vegetation associations using the current NVIS methodology at the association level (ESCAVI, 2003). This methodology is outlined in Appendix 7 and the Information collected at each quadrat, Appendix 8, is included as a separate document.

The vegetation associations in Table 6.2 are listed in dendrogram order to highlight their similarities / differences.

The vegetation associations of the Survey Area are shown on Maps 10.18 to 10.22 (Section 10). Figure 10.3, Section 10 provides the detailed legend for these associations.

The vegetation association descriptions used in this report include the dominant cover class as the indicator, and not the highest stratum, to correlate with the broad floristic formation description. An example of a description used is Hummock Grassland of *Triodia* spp. with Isolated Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia*.

The codes used in the report and on the maps include the first letter of the genus and species of the dominant taxa in the association/community along with the first letter of the dominant stratum of the broad floristic formation in bold font e.g. *Taw***HG** is *Triodia* aff. *wiseana* Hummock Grassland. These codes have also been suffixed with a number based on the position in the dendrogram of the association from top to bottom (Figures A3.1 and A3.2, Appendix 3) (e.g M**SL**-1 is at the top of the dendrogram and *Taw***HG**-16 at the bottom).

Some associations have been mapped as a mosaic and are prefixed with ^{m} (e.g ^{m}*TabTbTe***HG**-6/7). It was difficult to differentiate the boundaries of four associations on the aerial photograph and they have been mapped as two mosaics (*TabTb***HG**-6 and *TeTb***HG**-7 mapped as ^{m}*TabTbTe***HG**-6/7 and *TawTe***HG**-8 and *TeTaw***HG**-10 mapped as ^{m}*TawTe***HG**-8/10). One association (M**TG**-15) has been mapped as two sub-associations (M**TG**1-15 and M**TG**2-15) based on the presence/absence and density of *Acacia* species. These sub-associations have also been mapped in two areas that could not be accessed and ground-truthed and in these areas they have been mapped as ?M**TG**1 15 and ?M**TG**2-15.

Areas already cleared within the Survey Area (for tracks and roads) have been mapped as **CL** (cleared).

The area and cover of the associations mapped in the Survey Area (11 associations, two mosaics, two sub-associations, two queried sub-associations and areas cleared for infrastructure) are listed in Table 6.1 and the 16 vegetation associations are described in Table 6.2.

The regional and local significance of these vegetation associations is discussed in Section 7.

The results of the Indicator Species Analysis are included as Table A3.2 (Appendix 3) and the indicator species resulting from the analysis are in bold font in Table 6.2.

The area of each of the vegetation associations mapped within the Survey Area is listed in Table 6.1.

The smallest associations (not including the two ?M**TG** associations or already cleared areas) are *AcMl***SL**-3 which was mapped on drainage lines of the Wona LS and *Tae***HG**-12 which was mapped on shale (approximately 34 ha and 64 ha respectively). The most widespread associations mapped are the mosaic ^{m}*TabTwTe***HG**-8/10 and *TeTab***HG**-11, both mapped on low rolling hills, undulating plains and granitic sand plains of the Survey Area (approximately 2,394 ha and 1,054 ha respectively).

Table 6.1: Area and Percent Cover of Vegetation Associations Mapped in the Survey Area

Vegetation Association / Sub-association Code	Total Area Mapped within Survey Area (ha)	Percentage of Total Area Mapped
M**SL**-1	356.54	4.26
*TlTa***HG**-2	617.78	7.37
*AcMl***SL**-3	34.26	0.41
*AtAc***SL**-4	332.47	3.97
M*A***S/WL**-5	521.26	6.22
^{m}*TabTbTe***HG**-6/7	956.49	11.42
^{m}*TabTwTe***HG**-8/10	2,393.64	28.57
*TabTaw***HG**-9	672.70	8.03
*TeTab***HG**-11	1,053.51	12.58
*Tae***HG**-12	64.19	0.77
*TsTaTl***HG**-13	129.07	1.54
*Tab***HG**-14	250.61	2.99
M**TG**1-15	179.50	2.14
?M**TG**1-15	7.66	0.09
M**TG**2-15	101.33	1.21
?M**TG**2-15	47.39	0.57
*Taw***HG**-16	633.34	7.56
CL	26.04	0.31
Total	8,377.80	100.00

Table 6.2: Vegetation Associations of the Survey Area

M**SL**-1: Mixed Low Shrubland

This association occurs on gullies, minor channels, creek systems and floodplains between the low rolling and steeper hills of the Survey Area. It also occurs on a gully-fed semi-permanent drainage pool between the basalt slopes of the Chichester Ranges. The group splits into two, however, it has been mapped as a single association. The floristics of the vegetation of drainage systems can vary and often reflects the surrounding vegetation rather than the vegetation association itself. The presence or absence of the species from the surrounding associations more than likely resulted in the secondary split.

Vegetation condition ranged from Excellent (62%) to Very Good (38%) and the main disturbances were from weeds and cattle grazing.

Association Description	Associated Species/Species Richness	Sites
Mixed Low Shrubland (*A. bivenosa, Tephrosia densa,* and *Indigofera monophylla*) with a Hummock Grassland of *Triodia epactia* and/or *T. wiseana* with Isolated Low Trees of *Corymbia hamersleyana* and/or *Eucalyptus victrix*.	*Acacia coriacea* subsp. *pendens*, *Cyperus vaginatus*, *Eragrostis cumingii*, *Eremophila longifolia*, *Flueggea virosa* subsp. *melanthesoides*, *Gossypium australe*, *Grevillea pyramidalis* subsp. *leucadendron*, *Hybanthus aurantiacus*, *Jasminum didymum* subsp. *lineare* and *Stemodia grossa*. The average species richness is 35.8 (+/- 7.74).	HR01, HR06, HR29, HR30, HR34, HR38, HR41 and HR49.

*TlTa***HG**-2: *Triodia* Hummock Grassland.

This association occurs on flood plains, minor depressions and minor channels generally with a calcrete/quartz surface layer. This association ranged from a Hummock Grassland on floodplains and minor depressions to a Shrubland on minor channels.

Vegetation condition ranged from Excellent (50%) to Good (25%) and 25% of the sites were rated as Very Good. The main disturbance was grazing and soil compaction from cattle and feral donkeys, both of which were relatively common in the Yandeyarra Reserve.

Association Description	Associated Species/Species Richness	Sites
Sparse Hummock Grassland to Hummock Grassland of *Triodia longiceps* +/-*T. angusta* with a Sparse to Open Mixed Shrubland (*Acacia trachycarpa*, *A. stellaticeps* and/or *A. bivenosa*).	*Acacia ancistrocarpa*, *A. bivenosa*, *Corymbia hamersleyana*, *Chrysopogon fallax*, *Indigofera monophylla*, *Pluchea ferdinandi-muelleri*, *Pterocaulon sphacelatum*, *Senna notabilis*, *Sporobolus australasicus* and *Triodia epactia*. The average species richness is 25 (+/- 7.87).	HR53, HR70, HR71, HR72 and HR74.

*AcMl***SL**-3: *Acacia* and *Melaleuca* Tall Open Shrubland.

This association occurs on major flow lines of the Wona LS. Site HR31 grouped as an outlier from Association *AtAc***SL**-4 at the 0.78 scale (the association deciding scale was 0.72) and occurred between low basalt hills and upland gilgai plains. *Acacia trachycarpa* which is the dominant species in *AtAc***SL**-4 was not present at this site, it was dominated instead by *A. coriaceae* subsp. *pendens* and *Melaleuca linophylla*.

Vegetation condition was rated as Very Good and the main disturbances noted were cattle grazing and weeds.

Association Description	Associated Species/Species Richness	Sites
Tall Open Shrubland of *Acacia coriacea* subsp. *pendens* and *Melaleuca linophylla* with a Low Open Woodland of *Eucalyptus victrix* with a mixed Sparse Tussock Grassland (*Eulalia aurea*, *Eriachne benthamii* and *Leptochloa fusca* subsp. *fusca*).	*Acacia colei*, *A. pyrifolia* var. *pyrifolia*, *Amaranthus undulatus*, *Atalaya hemiglauca*, *Citrullus lanatus*, **Flaveria trinervia*, **Malvastrum americanum*, *Pluchea dentex*, *Rhynchosia minima*, *Sesbania cannabina*, *Stemodia viscosa*, *Themeda triandra* and *Triodia epactia.* Species richness is 29.	HR31
		

*indicates a weed species.

*AtAc***SL**-4: *Acacia* Tall Open Shrubland.

This association occurs on major flow lines (Yule River and sandy creeks). It was also noted in relevées on floodplains and broad drainage flats within the Yandeyarra Reserve. Quadrats were not sampled in these habitats because of the recent fires in these areas.

Vegetation condition ranged from Excellent (17%) to Poor (17%) most sites were rated as Very Good (66%). The main disturbances were from cattle and weeds. Large numbers of cattle were seen grazing in the sandy creeks in Yandeyarra Reserve. **Argemone ochroleuca* (often in high numbers) was only recorded in this association.

Association Description	Associated Species/Species Richness	Sites
Tall Open Shrubland of *Acacia trachycarpa* and/or *A. coriacea* supsp. *Pendens* with Scattered Mid Trees of *Eucalyptus camaldulensis* subsp. *obtusa* and/or *E. victrix*.	*Acacia pyrifolia* var. *morrisonii*, *Atalaya hemiglauca*, **Cenchrus ciliaris*, *Chrysopogon fallax*, *Citrullus lanatus*, *Cleome viscosa*, *Cyperus vaginatus*, *Euphorbia australis*, *Senna notabilis* and *Stemodia viscosa*. The average species richness is 21.8 (+/- 5.6).	HR46, HR56, HR75, HR80 and HR82.

*indicates a weed species.

MA**S/WL-**5: *Acacia* Tall Shrubland/Low Woodland

This association occurs on the elevated stony plains and low lying areas between the low rolling ironstone hills withiin the south-western section of the Survey Area.

Vegetation condition ranged from Excellent (80%) to Very Good (20%) and the main disturbance was from grazing.

Association Description	Associated Species/Species Richness	Sites
Tall Shrubland/Low Woodland of ***Acacia aneura***, *A. aptaneura* and +/- *A. xiphophylla* with a Sparse Mid Shrubland of *A. tetragonophylla* and/or *A. atkinsiana* and a Sparse Hummock Grassland of *Triodia* aff. *basedowii.*	*Enneapogon polyphyllus*, *Paraneurachne muelleri*, *Polycarpaea holtzei*, ***Psydrax suaveolens***, *Pterocaulon sphacelatum*, *Ptilotus obovatus*, *Sporobolus australasicus* and *Triodia epactia*. The average species richness is 34.4 (+/- 8.41).	HR02, HR04, HR05, HR11 and HR12.

*TabTb***HG**-6: *Triodia* Hummock Grassland.

This association occurs on the low rolling ironstone hills in the south-west of the Survey Area. The *Acacia* species recorded in the mixed mid stratum often alternated. The dominant *Triodia* was generally *Triodia* aff. *basedowii* but some areas were dominated by *T. brizoides*. The minor drainage channels between the low rolling hills were often dominated by the *Acacia* species of the surrounding hills or by *Acacia maitlandii* in thin but dense groves. This association could not be distinguished from *TeTb***HG**-7 on the aerial photograph and they have been mapped as a mosaic ^{m}*TabTbTe***HG**-6/7.

Vegetation condition ranged from Excellent (80%) to Very Good (20%) and the main disturbances were exploration tracks and minor grazing.

Association Description	Associated Species/Species Richness	Sites
Hummock Grassland of *Triodia* aff. *basedowii +/- Triodia brizoides* with a Sparse Low Shrubland of mixed *Acacia* species (*A. bivenosa, A. adoxa* var. *adoxa* and *A. hilliana*) with Isolated Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia*.	*Goodenia stobbsiana*, *Polycarpaea holtzei*, *Ptilotus calostachyus*, *Senna glutinosa* subsp. *glutinosa*, S. *glutinosa* subsp. *pruinosa* and *S. glutinosa* subsp. x *luerssenii.* The average species richness is 15.8 (+/- 5.7).	HR03, HR08, HR09, HR10 and HR14.

*TeTb***HG**-7: *Triodia* Hummock Grassland.

This association occurs on the low rolling hills and the minor gullies/drainage channels between the hills in the south-west of the Survey Area. Sites sampled in gullies and drainage channels were often dominated by a mid shrub layer as opposed to the hummock grass layer. This association is similar to *TabTb***HG**-6 and cannot be distinguished on the aerial photograph and therefore the two associations have been mapped as ^{m}*TabTbTe***HG**-6/7.

Vegetation condition was rated as Excellent at all sites and there was no evidence of disturbance.

Association Description	Associated Species/Species Richness	Sites
Hummock Grassland of *Triodia epactia* +/- *Triodia brizoides* with a Sparse Mid Shrubland of *Acacia maitlandii* and *Senna glutinosa* subsp. *glutinosa* with Isolated Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia*.	*Acacia adoxa* var. *adoxa*, *Eriachne mucronata*, *Hybanthus aurantiacus*, *Indigofera monophylla*, *Jasminum didymum* subsp. *lineare* and *Paraneurachne muelleri*. The average species richness is 18.75 (+/- 6.18).	HR07, HR13, HR17 and HR18.

*TawTe***HG**-8: *Triodia* Hummock Grassland.

This association occurs mainly on the low rolling basalt, granite and/or quartz hills of the Survey Area. A mosaic of these different rock types occurs in the north section of the Survey Area. It was also recorded with association *TeTaw***HG**-10 on the crests of the hills of the Chichester Ranges. The two associations could not be distinguished on the aerial photograph and therefore they have been mapped as a mosaic ^{m}*TabTwTe***HG**-8/10.

Site HR26 is located on the Wona LS and is at the top of the dendrogram group order and appears to be an outlier from the other sites.

Vegetation condition ranged from Excellent (50%) to Very Good (50%) and the main disturbances were cattle tracks and grazing.

Association Description	Associated Species/Species Richness	Sites
Hummock Grassland of *Triodia* aff. *wiseana* and/or *T. epactia* with a Sparse Tall Shrubland of *Acacia inaequilatera* with Isolated Low Shrubs of *Indigofera monophylla*.	*Bonamia* sp. Dampier (A.A. Mitchell PRP 217), *Enneapogon polyphyllus*, *Eriachne pulchella* subsp. *dominii*, *Mollugo molluginea*, *Pluchea tetranthera*, *Polycarpaea holtzei*, *Pterocaulon sphacelatum* and *Sporobolus australasicus*. The average species richness is 24.5 (+/- 5.1).	HR26, HR33, HR47, HR58, HR67 and HR68.

*TabTaw***HG**-9: *Triodia* Hummock Grassland.

This association occurs on a variety of habitats including low rolling hills of quartz, granite and basalt and the minor drainage channels inbetween. Site HR71, a broad drainage flat dominated by *Triodia longiceps* and *Eucalyptus xerothermica,* grouped with these sites; however, it has been mapped with *TlTa***HG**-2 because of its occurrence on broad drainage flats rather than on the low rolling hills and the dominance of *T. longiceps*.

Vegetation condition ranged from Excellent (60%) to Very Good (40%) and the main disturbances were cattle grazing and trampling.

Association Description	Associated Species/Species Richness	Sites
Hummock Grassland of *Triodia* aff. *basedowii* and *Triodia* aff. *wiseana* with a mixed Mid Shrubland (*Acacia bivenosa*, *A. orthocarpa*, *A. acradenia*) and Sparse Low Shrubland of *Ptilotus astrolasius*.	*Corymbia hamersleyana*, *Corchorus incanus* subsp. *lithophilus*, *Indigofera monophylla*, *Paraneurachne muelleri*, *Ptilotus calostachyus*, *Sporobolus australasicus* and *Triodia epactia*. The average species richness is 22.2 (+/- 5.97).	HR45, HR62, HR64 and HR69.

*Te*T*a*w**HG**-10: *Triodia* Hummock Grassland.

This association occurs on low rolling hills and the slopes and crests of hills in the Chichester Ranges. It occurs on a variety of rock types (ironstone, granite, basalt and quartz). It is superficially similar to association *Ta*w*Te***HG**-8; however, the associated species differ and scattered *Corymbia hamersleyana* trees occur in the upper stratum. Two sites, HR43 and HR85, pulled out to the bottom of this association at the 0.77 similarity scale but they have been grouped with this association as they had been burnt recently and the associated species probably reflected the burn history.

This association has been mapped as a mosaic with *Ta*w*Te***HG**-8 as ^{m}*Ta*b*Ta*w*Te***HG**-8/10 as the two associations cannot be distinguished on the aerial photograph.

Vegetation condition ranged from Excellent (86.33%) to Very Good (16.67%) and the main disturbance was cattle grazing.

Association Description	Associated Species/Species Richness	Sites
Hummock Grassland of *Triodia epactia* and/or *Triodia* aff *wiseana* with a Sparse Tall Shrubland of *Acacia inaequilatera* and +/- Isolated Trees of *Corymbia hamersleyana*.	*Goodenia stobbsiana*, *Gossypium australe*, *Hakea lorea* subsp. *lorea*, *Indigofera monophylla*, *Ptilotus calostachyus*, *Senna glutinosa* subsp. *glutinosa*, *Senna glutinosa* subsp. *pruinosa*, *Sida* sp. Pilbara (A.A. Mitchell PRP 1543), *Solanum phlomoides* and *Sporobolus australasicus*. The average species richness is 17.83 (+/- 5.64).	HR32, HR37, HR39, HR40, HR42 HR43, HR55 and HR85.

*TeTab***HG** -11: *Triodia* Hummock Grassland.

This association occurs on granitic sandplains and low rolling hills of quartz and granite. It was also recorded on a minor drainage gully between the low rolling hills. Site HR78 is an outlier from this group and may have pulled out due to a well used station track adjacent to the site or it may have been established in a habitat/vegetation transitional zone. Site HR35 grouped to the top of this association adjacent to sites grouped in *TeTaw***HG**-10 and it has been mapped in the ^{m}*TabTwTe***HG**-8/10 mosaic as it could not be distinguished on the aerial photograph.

Vegetation condition ranged from Excellent (64%) to Very Good (36%) and the main disturbance was cattle grazing.

Association Description	Associated Species/Species Richness	Sites
Hummock Grassland of *Triodia epactia* and/or *T.* aff. *basedowii* with a Sparse Tall Shrubland of *Acacia* species (*Acacia ancistrocarpa*, *A. inaequilatera* and *A. orthocarpa*) and a Sparse Low Shrubland of *Indigofera monophylla*.	*Acacia acradenia*, *Bonamia erecta*, *Eragrostis eriopoda*, *Goodenia microptera*, *Goodenia stobbsiana*, *Mollugo molluginea*, *Paraneurachne muelleri*, *Rhynchosia minima*, *Senna notabilis*, *Tephrosia* sp. Bungaroo Creek (M.E. Trudgen 11601), *Triodia* aff. *wiseana*. The average species richness is 16.91 (+/- 7.09).	HR35, HR48, HR51, HR57, HR60, HR63, HR73, HR76, HR77, HR78, HR79 and HR84.

*Tae***HG**-12: *Triodia* Hummock Grassland.

This association occurs on shale flats and rolling hills in the south-western section of the Survey Area to the north and north-east of tenement E47/1244. It was relatively species poor and restricted to areas of shale. The geology and association trended in a general north-easterly direction and occurred as a band through the corridor between the rolling ironstone hills. This site divided at the 0.77 similarity scale; however, HR59 was a true outlier and has been excluded from this association.

A similar association, MDH4, was described but could not be mapped due to its small area at Mulga Downs (Maia, 2012e) and it too was represented by a single site. This association was also recorded on shale habitats in the north of the tenement. Both associations are dominated by *Triodia* aff. *epactia*; however, species richness at MDH4 was 22 and it had a sparse shrubland layer, which was lacking from *Tae***HG**-12.

Vegetation condition was rated as Excellent and there was no evidence of disturbance in the area.

Association Description	Associated Species/Species Richness	Sites
Hummock Grassland of *Triodia* aff. *epactia* with Isolated Mid Shrubs (*Acacia atkinsiana*, *A. marramamba* and *Exocarpos sparteus*).	*Sida* sp. 2, *Trianthema glossostigma*, and *Cassytha capillaris*. The species richness is 7.0.	HR15

*TsTaTl***HG**-13: *Triodia* Open Hummock Grassland.

This association occurs on the low broad drainage flats and floodplains of major drainage channels. It was recorded in the central and northern sections of the Survey Area north of the Chichester Ranges. This association was also noted at a number of relevées walked in the Survey Area.

Vegetation condition ranged from Excellent (50%) to Very Good (50%) and the main disturbances were cattle and feral donkey grazing.

Association Description	Associated Species/Species Richness	Sites
Triodia secunda, *T. angusta* and/or *T. longiceps* Open Hummock Grassland with Isolated Mid Shrubs of *Pluchea ferdinandii-muelleri*.	**Cenchrus ciliaris*, *Eragrostis cumingii*, *E. dielsii*, *E. pergracilis*, *Eriachne aristidea*, *Sporobolus actinocladus*, *S. australasicus*, *Trianthema triquetra*, and *Triodia* aff. *basedowii*. The average species richness is 10.5 (+/- 4.95).	HR50 and HR52.

*Tab***HG**-14: *Triodia* Hummock Grassland.

This association occurs on the low rolling hills of quartz and calcrete (+/- basalt) and was mainly recorded on Yandeyarra Station in the the northern section of the Survey Area.

Vegetation condition ranged from Excellent (80%) to Very Good (20%) and the main disturbances were station tracks and cattle grazing.

Association Description	Associated Species/Species Richness	Sites
Hummock Grassland of *Triodia* aff. *basedowii* and/or *T. longiceps* with mixed isolated Low Shrubs (*Acacia bivenosa*, *Melaleuca eleuterostachya* and *Pluchea ferdinandii-muelleri*) +/- Isolated Low Trees of *Corymbia hamersleyana*.	*Polycarpaea holtzei*, *Scaevola amblyanthera* var. *centralis*, *Sporobolus actinocladus*, *S. australasicus* and *Triodia* aff. *wiseana.* The average species richness is 9.6 (+/- 3.85).	HR54, HR61, HR65, HR66 and HR81.

M**TG**1/2-15**:** Mixed Sparse Tussock Grassland.

This association occurs on the upland gilgai plains and associated hills of the Wona LS. This association has been mapped as two units (M**TG**1-15 and M**TG**2-15) based on the density of the shrub layer. MT**G1**-15 has little to no shrub layer and M**TG**2-15 has an open shrub layer. If cover analysis had been performed on the data, those sites with an Open Shrubland of *Acacia xiphophylla* and/or *A. glaucocaesia* may have split into a sub-association from the tussock grassland association. This association occurs within the 'Four plant assemblages of the Wona Land System' PEC buffer boundary. Site HR21 was located on a low basalt hill and was dominated by *Triodia* aff. *wiseana* and appears to be in a transitional zone between between M**TG**1/2-15 and the mosaic of ^{m}*TabTwTe***HG**-8/10.

Vegetation condition ranged from Very Good (60%) to Good (40%) and the main disturbances was cattle and feral donkey grazing in the area. The weed species **Flaveria trinerva* was consistently recorded in this area.

Association Description	Associated Species/Species Richness	Sites
Mixed Sparse Tussock Grassland of *Aristida latifolia,* ***Astrebla pectinata*** and *Eriachne obtusa* +/- a Mid Open Shrubland of *Acacia xiphophylla* and/or *A. glaucocaesia* (**P3**) with Isolated Low Shrubs of **Flaveria trinervia* and *Sida fibulifera*.	*Cleome viscosa*, *Operculina* ?*aequisepala*, *Ptilotus gomphrenoides* var. *gomphrenoides*, *Senna artemisioides* subsp. *oligophylla*, *Sporobolus australasicus* and *Streptoglossa bubakii*. The average species richness is 22.6. (+/- 5.64).	HR21, HR24, HR25, HR28 and HR36.

*indicates a weed species.

*Taw***HG**-16: *Triodia* Hummock Grassland.

This association occurs on minor depressions between low rolling hills of mixed geology (quartz and basalt). It was represented by only two sites in the north of the Survey Area. This association was noted in relevées as occuring in relatively small areas that were not possible to distinguish between the surrounding associations on the aerial photograph. Although this association was mapped over a relatively small area it is probably more widespread but occurs in small and discreet patches.

Vegetation condition ranged from Excellent (50%) to Very Good (50%) and the main disturbance was grazing.

Association Description	Associated Species/Species Richness	Sites
Hummock Grassland of *Triodia* aff. *wiseana* and/or *T. angusta* with a Sparse Mid Shrubland of *Acacia bivenosa* and *Senna artemisioides* subsp. *oligophylla*.	*Acacia synchronicia*, *Eragrostis xerophila*, *Eriachne aristidea*, *Goodenia microptera*, *Maireana* ?*villosa*, *Rhynchosia minima*, *Salsola australis*, *Sida fibulifera*, *Sporobolus australasicus* and *Triodia epactia*. The average species richness is 12.0 (+/- 5.7).	HR44 and HR83.

6.2 Vegetation Condition

Based on field observations the overall condition of the vegetation of the Survey Area is Excellent (Maps 10.23 to 10.26, Section 10). Approximately 30% of the Survey Area is rated as Excellent/Very Good, and 7.35% is rated as Very Good. Completely Degraded areas constitute 0.31% of the Survey Area. Additional information on vegetation condition and the Survey Area is included in Table 6.3.

Table 6.3: Vegetation Condition of the Survey Area

Vegetation Condition	Cover in Survey Area (%)	Comment
Excellent	62.68	Areas rated as Excellent were generally associated with the hills or ranges less accessible to cattle and donkeys. There was evidence of cattle in some areas that were rated as Excellent because the vegetation did not appear to be grazed or trampled.
Excellent/Very Good	29.66	Areas that had an equal Excellent and Very Good rating were mapped as Excellent/Very Good.
Very Good	7.35	Areas associated with the Wona LS or the low lying areas of Yandeyarra Reserve were generally rated as Very Good due to heavy cattle and feral donkey grazing/trampling. Major flow lines within the Yandeyarra Reserve conatained a number of weed species including *Flaveria trinervia*, *Cenchrus ciliaris* and *Argemone ochroleuca* in the lower stratum. The weed species *Citrullus lanatus*, *Flaveria trinervia*, *Malvastrum americanum* and *Vachellia farnesiana* occurred on drainage areas located between the upland gilgai plains of the Wona LS.
Completely Degraded	0.31	Major cleared access and station tracks are mapped as Completely Degraded.

6.3 Ecological Communities

No vegetation associations mapped in the Survey Area resembles any of the currently-listed TECs.

One vegetation association mapped within the buffer around the P1 PEC in the Survey Area (M**TG**1/2-15) resembles one of the sub-units of the 'Four plant assemblages of the Wona Land System' PEC because it is dominated by annual tussock grasses of *Aristida latifolia*, *Astrebla pectinata* and *Eriachne obtusa* and occurs on the upland stony gilgai plains in the Wona LS. Its habitat is not the same as the description for that of the PEC that the buffer surrounds i.e.'Cracking clays of the Chichester and Mungaroona Range'. The broad floristic formation describing M**TG**1/2-15 is a Mixed Sparse Tussock Grassland and it therefore resembles the P3 sub-unit of the 'Four plant assemblages of the Wona Land System', the 'Mitchell grass plains (*Astrebla* spp.) on gilgai'.

After supplying the vegetation description and photographs of the area to the DEC Species and Communities Branch, it was concluded that because of the tussock grasses the M**TG**1/2-15 association falls into one of the two P3 grassland sub-types of the 'Four plant assemblages of the Wona Land System' PEC (pers. comm. Jill Pryde, A/Senior Ecologist, Species and Communities Branch, DEC, November 2012).

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7 DISCUSSION

The conservation significance of the flora and vegetation of the Survey Area is discussed below. As per Guidance Statement 51 (EPA, 2004) significance is assessed at both regional and local scales.

7.1 FLORA OF CONSERVATION SIGNIFICANCE

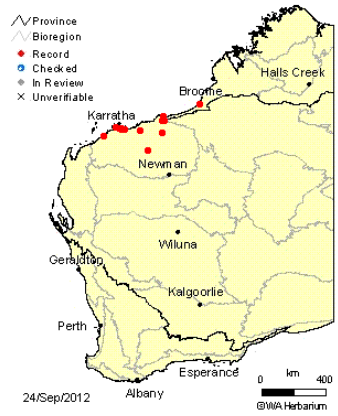
The regional conservation significance of the two priority species recorded in the Survey Area is discussed below. Significance ratings (Low, Moderate or High) are based on the regional distribution and the number and spread of FloraBase records for each.

7.1.1 Regional Significance

Acacia glaucocaesia (P3) has 31 records on FloraBase. They are from the Pilbara, Dampierland and Great Sandy Desert bioregions. Most records are from the Pilbara and its distribution is widespread across the coastline of the Pilbara bioregion with fewer inland records. The number of plants at recorded locations varies from one plant to locally abundant.

Given the number of records on FloraBase and its P3 listing, the populations recorded in the Survey Area are regarded as having Moderate regional significance.

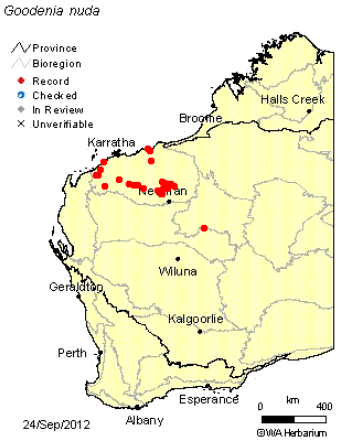
Acacia glaucocaesia



Goodenia nuda (P4) has 37 records on FloraBase. They are from the Pilbara and Gascoyne bioregions. Most records are from the Pilbara and its distribution is widespread from the north to south and west to east in the bioregion. The number of plants at recorded location varies from one to 23 and frequency from occasional to frequent.

Given the number of records on FloraBase and its P4 listing, plus the fact that Maia and other companies have recorded this species in the Pilbara but the records are not on FloraBase, the populations recorded in the Survey Area are regarded as having Moderate-Low regional significance.

Goodenia nuda



7.1.2 Local Significance

The local conservation significance of the two priority species recorded in the Survey Area is discussed below. Significance ratings (Low, Moderate or High) are based on the number of populations recorded, their distribution within the Survey Area (limited or widespread) and the number or cover of plants in each population.

Acacia glaucocaesia (P3) was recorded at 15 locations in the Survey Area (Map 10.16, Appendix 10) and between one to 100 plants were recorded at these locations. It was found on the cracking clays of the Wona LS. It occurs

in vegetation association M**TG**1/2 and the mosaic ^{m}*TabTwTe***HG**-8/10 in the Wona LS**.** The Survey Area populations of *Acacia glaucocaesia* are rated as having High local conservation significance.

One population (five plants) of *Goodenia nuda* (P4) was recorded at one location in the Survey Area (Map 10.16, Appendix 10). It was located on a tributary of the Yule River. It occurs in vegetation association *AtAc***SL**-4. This population of *G. nuda* is rated as having Moderate local conservation significance.

7.1.3 Summary of Regional and Local Significance

The regional and local conservation significance assessment is summarised in Table 7.1.

Table 7.1: Summary of Regional and Local Significance – Conservation Significant Flora

Species (Priority Rank)	Regional Significance	Local Significance
Acacia glaucocaesia (P3)	Moderate	High
Goodenia nuda (P4)	Moderate to Low	Moderate

7.2 VEGETATION

The regional and local significance of the vegetation of the Survey Area is discussed in the following sub-sections.

7.2.1 Regional Significance

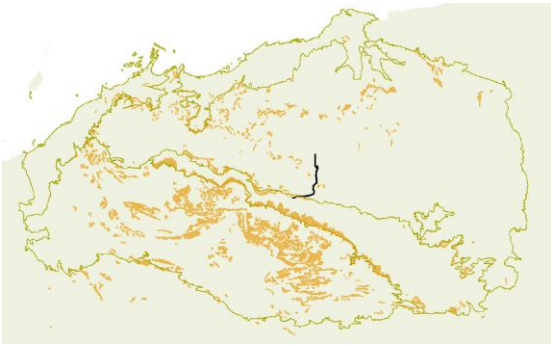
Conservation significance of the vegetation of the Survey Area at a regional level is based on the representation of species and habitats recorded within the Survey Area at a bioregion level i.e. the Pilbara bioregion. Beard's vegetation mapping and LS mapping have been used to assess the significance of vegetation of the area at this level.

7.2.1.1 LAND SYSTEMS

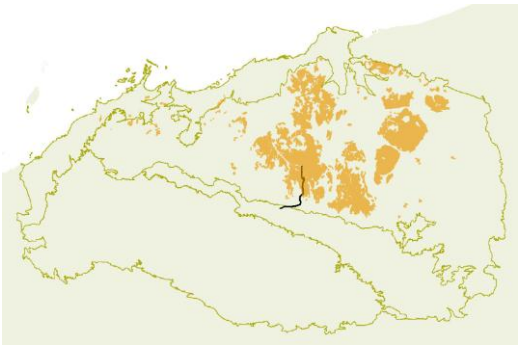
Eight LS are mapped in the Survey Area and the significance assessment for the LS in the following paragraphs is based on the total extent and distribution of the LS in the Pilbara bioregion. The distribution and extent of each of these LS in the Survey Area is shown in Table 7.3 along with the vegetation associations mapped in each LS.

The maps below show the Survey Area in black and the extent of the LS in the Pilbara bioregion (with subregions) and surrounds in orange. The smallest LS mapped in the Pilbara bioregion is 3,100 ha and the largest is 2,299,300 ha. The total area of LS mapped in the Pilbara is 18,167,400 ha and 102 LS were mapped. The mean LS area is therefore 178,112 ha and the median is 59,400 ha.

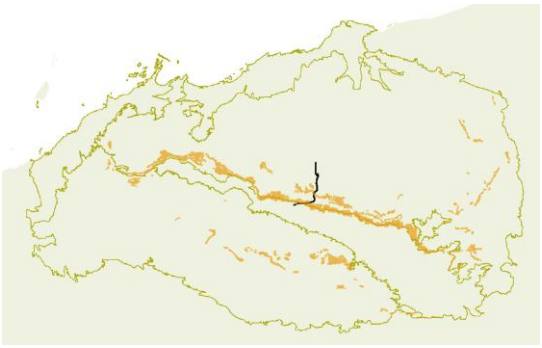
At 961,637 ha the **Boolgeeda** LS is one of the larger and more widespread LS mapped in the Pilbara. It is mapped in all four Pilbara subregions. By size it is ranked 6th largest of the 102 mapped in the Pilbara. As a result the area occurring in the Survey Area is rated as being of Low regional significance.



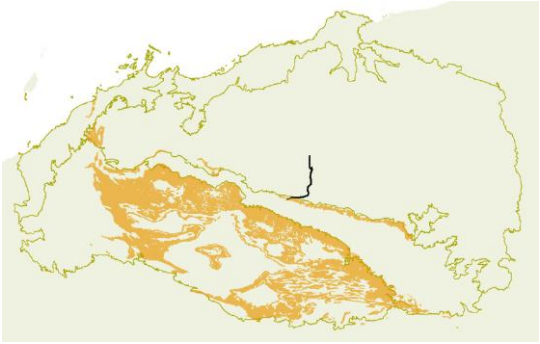
At 1,331,610 ha the **Macroy** LS is large and its distribution is relatively widespread in the Chichester subregion while a small area is mapped in the Roebourne subregion. By size it is ranked 4th largest of the 102 mapped in the Pilbara. As a result the area occurring in the Survey Area is rated as having Low regional significance.



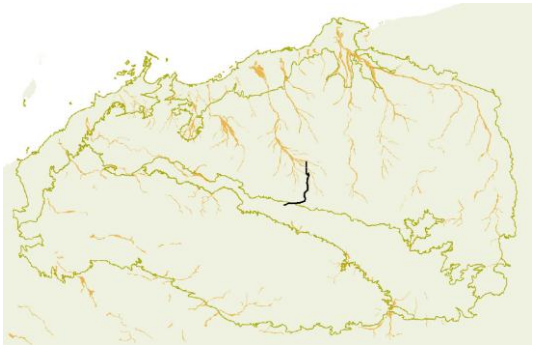
At 426,145 ha the **McKay** LS is large and its distribution is relatively widespread. It is mapped in the Chichester, Fortescue Plains and Hamersley subregions. By size it is ranked 10th largest of the 102 mapped in the Pilbara. As a result the area occurring in the Survey Area is rated as having Low regional significance.



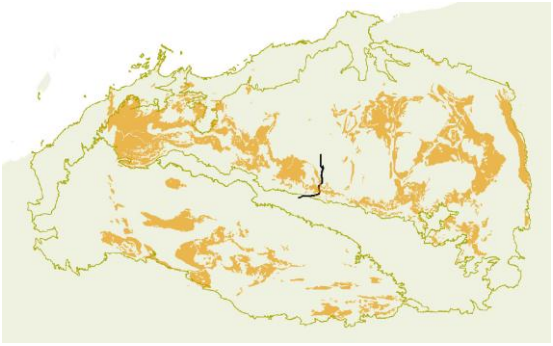
At 1,993,744 ha the **Newman** LS is large and its distribution is relatively widespread. It is mapped mostly in the Hamersley subregion with much smaller areas occurring in the other three subregions. By size it is ranked 2nd largest of the 102 LS mapped in the Pilbara. As a result the area occurring in the Survey Area is rated as having Low regional significance.



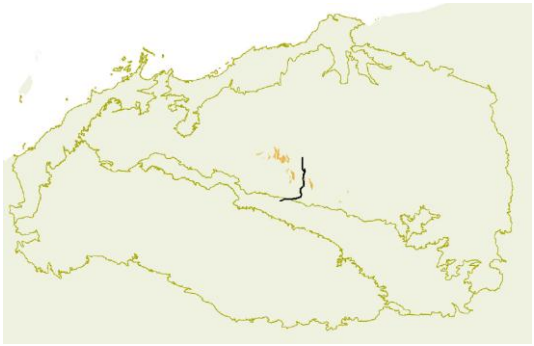
At 482,179 ha the **River** LS is moderately sized and its distribution is relatively widespread. It is restricted to large drainage systems and is mapped mostly in the Chichester subregion with much smaller areas occurring in the three other subregions. By size it is ranked 11th largest of the 102 mapped in the Pilbara. As a result the area occurring in the Survey Area is rated as having Moderate regional significance.



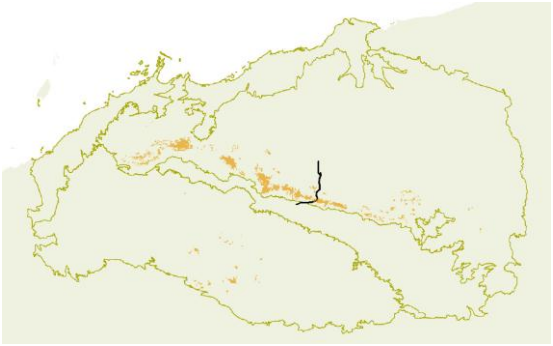
At 2,881,897 ha the **Rocklea** LS is large and its distribution is relatively widespread. It is mapped mostly in the Chichester subregion and much smaller areas are mapped in the three other subregions. By size it is ranked the largest of the 102 mapped in the Pilbara. As a result the area occurring in the Survey Area is rated as having Low regional significance.



At 26,563 ha the **White Springs** LS is small and is mapped only within the Chichester subregion. By size it is ranked 73rd largest of the 102 mapped in the Pilbara. As a result the area occurring in the Survey Area is rated as having High regional significance.



At 194,821 ha the **Wona** LS is of moderate size. It is mapped mostly in the Chichester subregion with much smaller areas occurring in the Hamersley subregion. By size it is ranked 21st largest of the 102 mapped in the Pilbara. The area within the Survey Area also lies inside the buffer around a PEC and, as a result, the area occurring in the Survey Area is rated as having High regional significance.

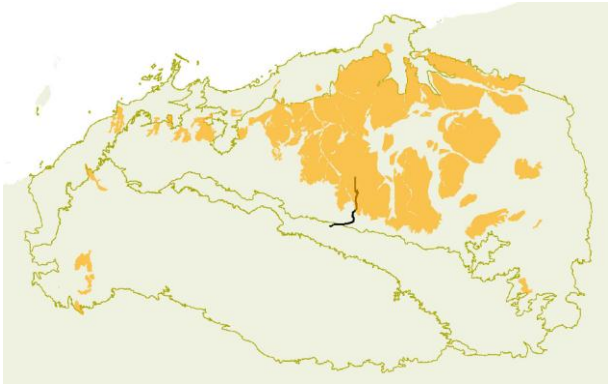


7.2.1.2 BEARD'S VEGETATION MAPPING

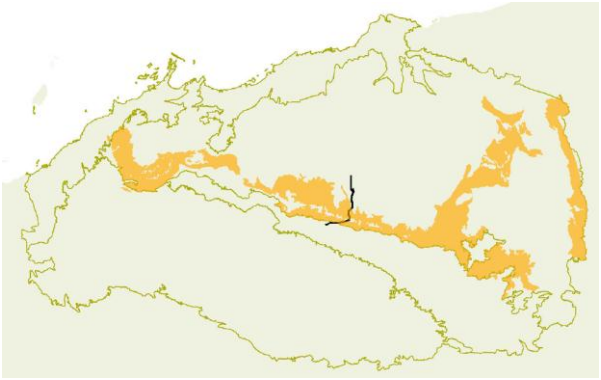
The extent, distribution and protection of the five vegetation associations mapped by Beard in the Survey Area are listed in Table 7.4 along with the Maia vegetation associations mapped in each.

The maps below show the Survey Area in black and the extent of the Beard vegetation associations in the Pilbara bioregion (and subregions) and surrounds in orange.

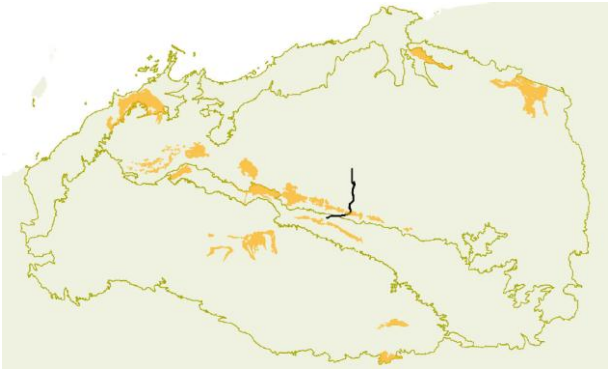
Beard's vegetation association **93** is mapped in all four subregions but mostly in the Chichester subregion. Currently, 99.88% of it still remains and 0.42% is protected for conservation. Kendrick and McKenzie (2001) consider Beard vegetation association 93.4 as low priority for reservation in the Chichester subregion and Kendrick (2001) lists the unit as moderate priority for reservation within the Fortescue Plains subregion. As all of the 93.4 association in the Survey Area falls within the Chichester subregion it is regarded as having Low regional conservation significance in the Survey Area.



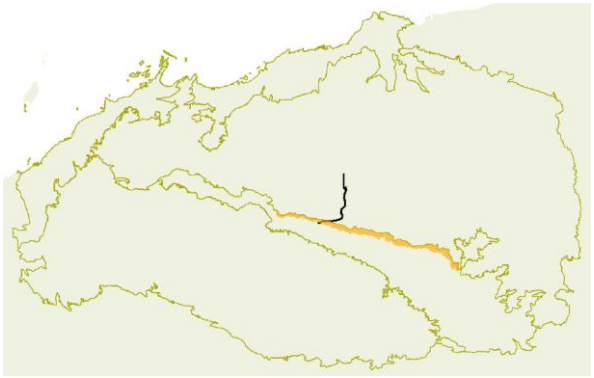
Beard's vegetation association **173** is mapped in all four subregions but mostly in the Chichester subregion. Currently, 99.72% of it still remains and 7.49% is protected for conservation. Kendrick and McKenzie (2001) consider Beard vegetation association 173 to be of moderate to low priority for reservation in the Chichester subregion and Kendrick (2001) lists the unit as moderate priority for reservation within the Fortescue Plains subregion. As all of association 173 in the Survey Area falls in the Chichester subregion it is regarded as having Low regional conservation significance in the Survey Area.



Beard's vegetation association **175** is mapped in all four subregions with most in the Chichester and least in the Fortescue Plains. Currently, 99.92% of it still remains and 4.38% is protected for conservation. Kendrick and McKenzie (2001) consider Beard vegetation association 175 to be of high priority for reservation in the Chichester subregion and Kendrick (2001) lists the unit as high priority for reservation within the Fortescue Plains subregion. Association 175 is in the Chichester subregion in the Survey Area and is therefore regarded as having High regional conservation significance.



Beard's vegetation association **562** is mapped over a relatively small and restricted area in the Chichester (least) and Fortescue Plains subregions. Currently, 100% of it still remains and 0% is protected for conservation. Kendrick and McKenzie (2001) consider Beard vegetation association 562 to be of moderate priority for reservation in the Chichester subregion and Kendrick (2001) lists the unit as moderate priority for reservation within the Fortescue Plains subregion. Because of this, association 562 in the Survey Area is regarded as having Moderate regional conservation significance.



Beard's vegetation association **619** is mapped in the Chichester and Roebourne subregions, most in the Chichester. Currently, 99.30% of it still remains and 0.20% is protected for conservation. Kendrick and McKenzie (2001) consider Beard vegetation association 619 to be of high priority for reservation in the Chichester subregion. As association 619 in the Survey Area falls in the Chichester subregion it is regarded as having High regional conservation significance in the Survey Area.

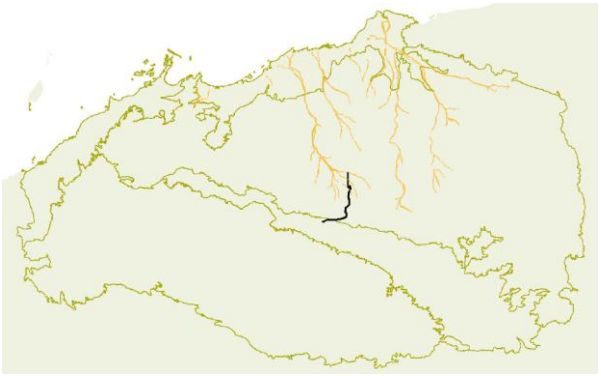


Table 7.2 summarises the regional significance of the LS and Beard associations of the Survey Area.

Table 7.2: Summary of Regional Significance – Vegetation

Vegetation	Regional Significance
Land System	
Boolgeeda	Low
Macroy	Low
McKay	Low
Newman	Low
River	Moderate
Rocklea	Low
White Springs	High
Wona	High
Beard Association (Code)	
a2Sr t1Hi (93)	Low
a2Sr t1,3Hi (173)	Low
xGc (175)	High
a1Li/e16Lr t3Hi (562)	Moderate
E18Mi (619)	High

7.2.2 Local Significance – Vegetation

The local significance of the vegetation associations mapped by Maia is considered in the following sections. Local significance is based on the cover of each land system and vegetation association occurring in the Survey Area and surrounds.

7.2.2.1 LAND SYSTEMS

Five of the eight LS comprise less than 10% of the Survey Area (Boolgeeda, Newman, River, White Springs and Wona). The Macroy covers the greatest area (46.58%), followed by McKay (16.04%) and Rocklea (14.32%) (Table 7.3). The extent of each of these LS in the Survey Area - relative to the mapped extent in the Pilbara - is small and all except for the White Springs LS (1.097%) comprise less than 0.5% of the Pilbara extent. Although the cover of the Wona LS in the Survey Area is relatively small (0.379%) all of it lies within the PEC buffer and much of it could be the PEC. The local significance of the Wona LS is therefore rated as High, the White Springs as Moderate and the remaining LS as Low.

7.2.2.2 BEARD'S VEGETATION ASSOCIATIONS

Approximately 51% of the Survey Area has been mapped as Beard's a2Srt1Hi (93), 30.39% as a2Sr t1,3Hi (173) and 11.58% as a1Li/e16Lr t3Hi (562) (Table 7.4). The remaining two associations cover 5.90% (xGc (175)) and 1.29% (e18Mi (619)) of the Survey Area. The proportion of the Pilbara extent of the first three of these associations in the Survey Area is 0.14%, 0.15% and 0.94% respectively and the last two 0.10% and 0.09% respectively. As a result, association 562 is rated as having Moderate local significance and the remaining four associations as having a Low local significance rating.

Table 7.3: Distribution and Extent of Land Systems Recorded in the Survey Area

LS	Area Mapped by Van Vreeswyk *et al.* (2004) in Pilbara (ha)	Area in Survey Area (ha)	Pilbara Extent in Survey Area (%)	Cover of Survey Area (%)	Maia Vegetation Associations Within LS
BGD	961,637	701.37	0.073	8.37	M**SL-1,** *AtAc***SL**-4**,** M*A***S/WL**-5, and [m]*TabTbTe***HG**-6/7**.**
MAC	1,333,610	3902.73	0.293	46.58	M**SL**-1, *TlTa***HG**-2, *AtAc***SL**-4, [m]*TabTbTe***HG**-6/7, [m]*TabTwTe***HG**-8/10, *TabTaw***HG**-9, *TeTab***HG**-11, TsTaTl**HG**-13, *Tab***HG**-14 and *Taw***HG**-16.
MCK	426,145	1343.46	0.315	16.04	M**SL**-1, *AtAc***SL**-4, M*A***S/WL**-5**,** [m]*TabTbTe***HG**-6/7, [m]*TabTwTe***HG**-8/10, *TabTaw***HG**-9 and *Tae***HG**-12.
NEW	1,993,744	15.56	0.001	0.19	M*A***S/WL**-5 and [m]*TabTbTe***HG**-6/7.
RIV	482,179	186.03	0.039	2.22	*TlTa***HG**-2, *AtAc***SL**-4, [m]*TabTbTe***HG**-6/7, *TabTaw***HG**-9, *TeTab***HG**-11, *TsTaTl***HG**-13 and *Taw***HG**-16.
ROC	2,881,897	1199.49	0.042	14.32	?M**TG**1/2, M**SL**-1, *TlTa***HG**-2, *AcMi***SL**-3, *AtAc***SL**-4, [m]*TabTbTe***HG**-6/7, [m]*TabTwTe***HG**-8/10, *TabTaw***HG**-9, *TeTab***HG**-11 and *Tab***HG**-14.
WHI	26,563	291.48	1.097	3.48	*TlTa***HG**-2, *AtAc***SL**-4, [m]*TabTwTe***HG**-8/10, *TabTaw***HG**-9, *TeTab***HG**-11, *TsTaTl***HG**-13 and *Tab***HG**-14.

LS	Area Mapped by Van Vreeswyk *et al.* (2004) in Pilbara (ha)	Area in Survey Area (ha)	Pilbara Extent in Survey Area (%)	Cover of Survey Area (%)	Maia Vegetation Associations Within LS
WON	194,821	737.61	0.379	8.80	M**SL**-1, *Tl*/*Ta***HG**-2, *AcMi***SL**-3, [m]*TabTwTe***HG**-8/10, M**TG**1/2-15 and *Taw***HG**-16.
Totals		8,377.73		100	

Note re land systems: BGD = Boolgeeda, MAC = Macroy, MCK = McKay, NEW = Newman, RIV = River, ROC = .Rocklea, WHI = White Springs, WON = Wona.

Notes: Area in Pilbara data in column two is sourced from Van Vreeswyk *et al*. (2004).

Table 7.4: Distribution and Extent of Beard's Vegetation Associations in the Survey Area

Beard Vegetation Association (Code)	Current Extent in Pilbara (ha)	Area in Survey Area (ha)	Pilbara Extent in Survey Area (%)	Cover in Survey Area (%)	Maia Vegetation Associations Within Beard Associations
a2Srt1Hi (93)	3,038,471.63	4259.39	0.14	50.84	M**SL**-1, *Tl*/*Ta***HG**-2, *AtAc***SL**-4, [m]*TabTbTe***HG**-6/7, [m]*TabTwTe***HG**-8/10, *TabTaw***HG**-9, *TeTab***HG**-11, *TsTaTl***HG**-13, *Tab***HG**-14 and *Taw***HG**-16.
a2Sr t1,3Hi (173)	1,747,677.63	2545.73	0.15	30.39	M**SL**-1, *Tl*/*Ta***HG**-2, *AcMi***SL**-3, *AtAc***SL**-4, M*A***S/WL**-5, [m]*TabTbTe***HG**-6/7, [m]*TabTwTe***HG**-8/10, *TeTab***HG**-11, *Tae***HG**-12, *Tab***HG**-14, M**TG**1/2-15 and *Taw***HG**-16.
xGc (175)	506,625.99	494.12	0.10	5.90	*Tl*/*Ta***HG**-2, *AcMi***SL**-3, M**TG**1/2-15, *Taw***HG**-16 and [m]*TabTwTe***HG**-8/10.
a1Li/e16Lr t3Hi (562)	103,606.82	970.26	0.94	11.58	M**SL**-1, *AtAc***SL**-4, M*A***S/WL**-5 and [m]*TabTbTe***HG**-6/7.
e18Mi (619)	118,086.73	108.24	0.09	1.29	*Tl*/*Ta***HG**-2, *AtAc***SL**-4, [m]*TabTwTe***HG**-8/10, *TeTab***HG**-11 and *Taw***HG**-16.
Totals		8,377.74		100.0	

Notes: Government of Western Australia (2011) CAR assessment of IBRA subregions and vegetation associations used for current extent in Pilbara; these statistics are for the associations and not the sub-associations i.e. for 93 and not for 93.4.

Table 7.5 summarises the local significance ratings for the LS and Beard vegetation associations of the Survey Area.

Table 7.5: Summary of Local Significance - Vegetation

Vegetation	Regional Significance
Land System	
Boolgeeda	Low
Macroy	Low
McKay	Low
Newman	Low
River	Low

Vegetation	Regional Significance
Rocklea	Low
White Springs	Moderate
Wona	High
Beard Vegetation Association Code	
a2Srt1Hi (93)	Low
a2Sr t1,3Hi (173)	Low
xGc (175)	Low
a1Li/e16Lr t3Hi (562)	Moderate
e18Mi (619)	Low

7.2.2.3 VEGETATION ASSOCIATIONS MAPPED BY MAIA

The area and proportion of the vegetation associations mapped by Maia in the Survey Area is summarised in Table 7.6.

The following attributes were considered during the assessment of local conservation significance of the vegetation associations mapped in these areas; the distribution and area of each vegetation association in the Survey Area, the significance or rarity of a habitat in which the association occurs, the condition of the vegetation in the association and the presence of conservation significant species in the association.

The associations in brackets in column eight of Table 7.6 indicate those from adjacent survey areas (Maia, 2011 and 2012e) with which the data from this survey grouped when the combined pattern analysis was carried out.

Six of the mapped associations are rated as having High local conservation significance, one as ?High, five as Moderate, one as ?Moderate, one as Moderate-Low and three as Low.

Sub-associations M**TG**1-15 and M**TG**2-15 are dominated by tussock grasses and are mapped on the stony upland gilgai plains of the Wona LS within the buffer around an area of the 'Four Plant Assemblages of the Wona Land system' PEC. M**TG**1-15 resembles the description for the Priority 3 PEC 'Mitchell grass plains (*Astrebla* spp.) on gilgai with little to no shrub layer', which is a sub-unit of the 'Four Plant Assemblages of the Wona Land system' PEC. M**TG**2-15 has the same tussock grass species but also has an *Acacia xiphophylla* and/or *A. glaucocaesia* shrub layer. Both sub-associations have been heavily grazed by cattle and donkeys. M**TG**1-15 and M**TG**2-15 are rated as having High conservation significance based on the likelihood that the M**TG**1-15 sub-association is the Priority 3 PEC and M**TG**2-15 is the sub-association in which the P3 species *Acacia glaucocaesia* was recorded.

Sub-associations ?M**TG**1-15 and ?M**TG**2-15 have been mapped separately using the aerial photograph. To confirm that they are M**TG**1-15 and M**TG**2-15 these inaccessible areas of the corridor will need to be ground truthed. If they are confirmed as these sub-associations they will be significant also.

*Tae***HG**-12 is mapped over a small area (64.19 ha, 0.77%). This association occurs only on the shale dominated undulating plains and low rolling hills north of tenement E47/1244 on Mulga Downs Station and the habitat appears to be restricted to a relatively small area: *Triodia* aff. *epactia,* an uncommon taxon, was the dominant spinifex in this association. Because of its small area and apparently restricted habitat, this association is rated as having High local conservation significance.

Associations *AcMl***SL**-3 and *AtAc***SL**-4 are mapped along major and minor drainage systems and associated lower lying areas. Association *AcMl***SL**-3 was recorded only between the low rolling basalt hills and on the upland stony cracking clays of the Wona LS and over a relatively small area (34.26 ha). This association had been heavily grazed by cattle and there are scattered weeds throughout (*Citrullus lanatus*, *Flaveria trinervia*, *Malvastrum americanum*

and *Vachellia farnesiana*). It has been rated as having High conservation significance because it occurs along drainage lines in the Wona LS.

Association *AtAc***SL**-4 is mapped on the major drainage lines of the Survey Area over a moderate area (300.38 ha). The P4 species, *Goodenia nuda,* was recorded at a single location in this association. Many cattle and feral donkeys were observed in this association and this is reflected in the large number of weed species recorded in the association (*Aerva javanica*, *Argemone ochroleuca*, *Bidens bipinnata*, *Cenchrus ciliaris*, *Citrullus lanatus Flaveria trinervia*, *Malvastrum americanum* and *Vachellia farnesiana*). *Cenchrus ciliaris*, *Argemone ochroleuca* and *Flaveria trinervia* occurred in large numbers and were a dominant species in some areas.

Association M*A***S/WL-**5 grouped with association MDP2 mapped during the Mulga Downs survey. MDP2 was rated as having High conservation significance based on the presence of mulga, its relatively small mapped area (1,018.41 ha) and a potential Priority 1 species (*Aristida* ?*jerichoensis* subsp. *subspinulifera*) recorded in it. It was also noted as occurring on the slopes of low hills and low mesa formations. No conservation significant flora were recorded in M*A***S/WL-**5, it occurs only on stony plains and is mapped over a relatively small area (521.26 ha) in the south-west section of the Survey Area, which lies in the Fortescue Valley. Because of its small area, presence of mulga and occurrence in the Fortescue Valley it is considered to be of High local conservation significance.

Associations *TlTa***HG**-2, *TsTaTl***HG**-13 and *Taw***HG**-16 are associated with low lying areas that are dependant on seasonal run-on from the surrounding hills and creeks. These areas would be highly susceptible to changes in drainage and have been rated as moderately conservation significant because of this.

Ta*b***HG**-14 has been mapped over only 2.99% of the Survey Area and has therefore been rated as having Moderate local significance.

M**SL**-1 is rated as having moderate local significance because it is mapped along drainage lines which feed into semi-permanent pools in the Chichester Range which provide aquatic refugia in arid landscapes.

Association ^{m}*TabTwTe***HG**-8/10 is rated as Moderate because some of it is mapped within the Wona LS.

Table 7.6: Extent, Condition and Local Significance of Vegetation Associations of the Survey Area

Vegetation Association	Total Area Mapped (ha)	Cover in Survey Area (%)	Conservation Significant Flora in Vegetation Association	Vegetation Condition	Any Other Key Attributes Increasing Conservation Value?	Local Conservation Significance	Occurs Outside Survey Area
M**SL**-1	356.54	4.26	None	Excellent	Drainage, feeding into semi-permanent pools in Chichester Ranges	Moderate	Yes (MDD2, Maia 2012e))
*TlTa***HG**-2	617.78	7.37	None	Excellent	Run on dependant	Moderate	Yes (RHP4, Maia 2011)
*AcMl***SL**-3	34.26	0.41	None	Very Good	Drainage in Wona LS	High	Yes
*AtAc***SL**-4	300.38	3.59	*Goodenia nuda* (P4)	Very Good	Drainage	High	Yes (RHD1, Maia 2011)
M*A***S/WL**-5	521.26	6.22	None	Excellent	Mulga and Fortescue Valley	High	Yes (MDP2, Maia 2012e)
[m]*TaTbTe***HG**-6/7	963.41	11.50	None	Excellent	No	Low	Yes (MDH1, Maia 2012e)
[m]*TabTwTe***HG**-8/10	2,381.38	28.42	*Acacia glaucocaesia* (P3)	Excellent/Very Good	Some mapped in the Wona LS	Moderate	Yes, visible on aerial photograph
*TbTaw***HG**-9	672.70	8.03	None	Excellent	No	Low	Yes, visible on aerial photograph
*TeTab***HG**-11	1,068.57	12.75	None	Excellent	No	Low	Yes (RHH3, Maia 2011)
*Tae***HG**-12	64.19	0.77	*Triodia* aff. *epactia*	Excellent	Geologically restricted (shale) and Fortescue Valley	High	Small areas to the north of the Survey Area
*TsTaTl***HG**-13	129.07	1.54	None	Excellent/Very Good	Run on dependant	Moderate	Yes (RHP2, Maia 2011)
*Tab***HG**-14	250.61	2.99	None	Excellent	No	Moderate	Yes (RHH1, Maia 2011)
M**TG**1-15	179.50	2.14	*Acacia glaucocaesia* (P3)	Very Good	Wona LS, probable P3 PEC	High	Yes
?M**TG**1-15	7.66	0.09	None	Not Rated	? probable PEC	?High	Not known, needs ground truthing
M**TG**2-15	101.33	1.21	*Acacia glaucocaesia* (P3)	Very Good	Wona LS	High	Yes
?M**TG**2-15	47.39	0.57	None	Not Rated	? Priority flora *Acacia glaucocaesia*	?Moderate	Not known, needs ground truthing

Vegetation Association	Total Area Mapped (ha)	Cover in Survey Area (%)	Conservation Significant Flora in Vegetation Association	Vegetation Condition	Any Other Key Attributes Increasing Conservation Value?	Local Conservation Significance	Occurs Outside Survey Area
*Taw***HG**-16	655.71	7.83	None	Excellent/Very Good	Run on dependant	Moderate-Low	Yes
CL	26.04	0.31	None	Completely Degraded		Not applicable	
Total	8377.80						

7.3 Ecological Communities and Ecosystems

The Survey Area does not fall within or close to a currently-listed TEC.

One association resembling a P3 sub-unit of the 'Four plant assemblages of the Wona Land System' PEC occurs within the boundaries of the Survey Area:

Some of the Survey Area lies within the 40 km diameter buffer placed around one of the P1 occurrences of the 'Four plant assemblages of the Wona Land System' PEC. Approximately 738 ha of the Survey Area intersects the Wona LS within the buffer and it is possible that the PEC falls within the Survey Area; however, the centre of the buffer lies east of the Survey Area and if the occurrence of the PEC is at the centre of the buffer then the Survey Area will not cross it.

Sub-associations M**TG**1-15 and M**TG**2-15 were mapped on basalt upland gilgai plains of the Wona LS within the PEC buffer. The P1 sub-unit of the PEC buffer that occurs in the Survey Area is described as "Cracking clays of the Chichester and Mungaroona Range. This grassless plain of stony gibber community occurs on the table lands with very little vegetative cover during the dry season, however during the wet a suite of ephemerals/annuals and short lived perennials emerge, many of which are poorly known and range-end taxa."

M**TG**1-15 is dominated by perennial grass species which form a sparse ground layer and is broadly described as a Mixed Sparse Tussock Grassland and M**TG**2-15 has a sparse to open tall shrub layer. After discussions with the DEC, it is believed that the areas mapped within the Survey Area resemble the P3 sub-unit 'Mitchell grass plains (*Astrebla* spp.) on gilgai' (pers. comm. Jill Pryde, A/Senior Ecologist, Species and Communities Branch, DEC November 2012).

The cracking clay communities of the Chichester Range and Mungaroona Range are listed as an ecosystem at risk in Kendrick (2001). This community is now classified as the 'Four plant assemblages of the Wona Land System' PEC.

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8 CONCLUSIONS

Two priority species (*Acacia glaucocaesia* (P3) and *Goodenia nuda* (P4)) and one range extension species (*Acacia robeorum*) were recorded in the Survey Area.

Five taxonomically interesting taxa were collected from the Survey Area: *Acacia* aff. *grasbyi, Triumfetta* aff. *ramosa, Triodia* aff. *basedowii, Triodia* aff. *wiseana* and *Triodia* aff. *epactia.* While taxonomically interesting, it is unlikely that these will be conservation significant.

Nine weed species were recorded in the Survey Area three of which are listed as having a high EWSWA rating and rapid invasiveness - *Aerva javanica* (Kapok Bush), *Cenchrus ciliaris* (Buffel Grass) and *Vachellia farnesiana* (Mimosa Bush).

Vegetation condition over 62.68% of the Survey Area was rated as Excellent and condition ratings ranged from Completely Degraded to Excellent. Vegetation of the hills and ranges was generally rated as Excellent as these areas are less accessible to cattle and donkeys. Areas in the Wona LS, low lying areas within Yandeyarra Reserve and major flow lines were generally heavily grazed and weedy and vegetation condition was rated as Very Good.

Based on the results of statistical analysis and data collected in the field, 16 vegetation associations have been described for the Survey Area. Of these 16, four have been mapped as mosaics, one as two sub-associations and two as queried sub-associations. The local conservation significance of three of these associations is rated as Low, one as Moderate-Low, one as ?Moderate, five as Moderate, one as ?High and six as High.

No vegetation associations mapped in the Survey Area resemble any of the currently-listed TECs. One vegetation association mapped in the Survey Area resembles one of the sub-units of the 'Four plant assemblages of the Wona Land System' PEC. Although it is mapped within the buffer around a P1 sub-unit of this PEC ('Cracking clays of the Chichester and Mungaroona Range'), the vegetation described resembles the P3 sub-unit 'Mitchell grass plains (*Astrebla* spp.) on gilgai'.

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10 MAPS

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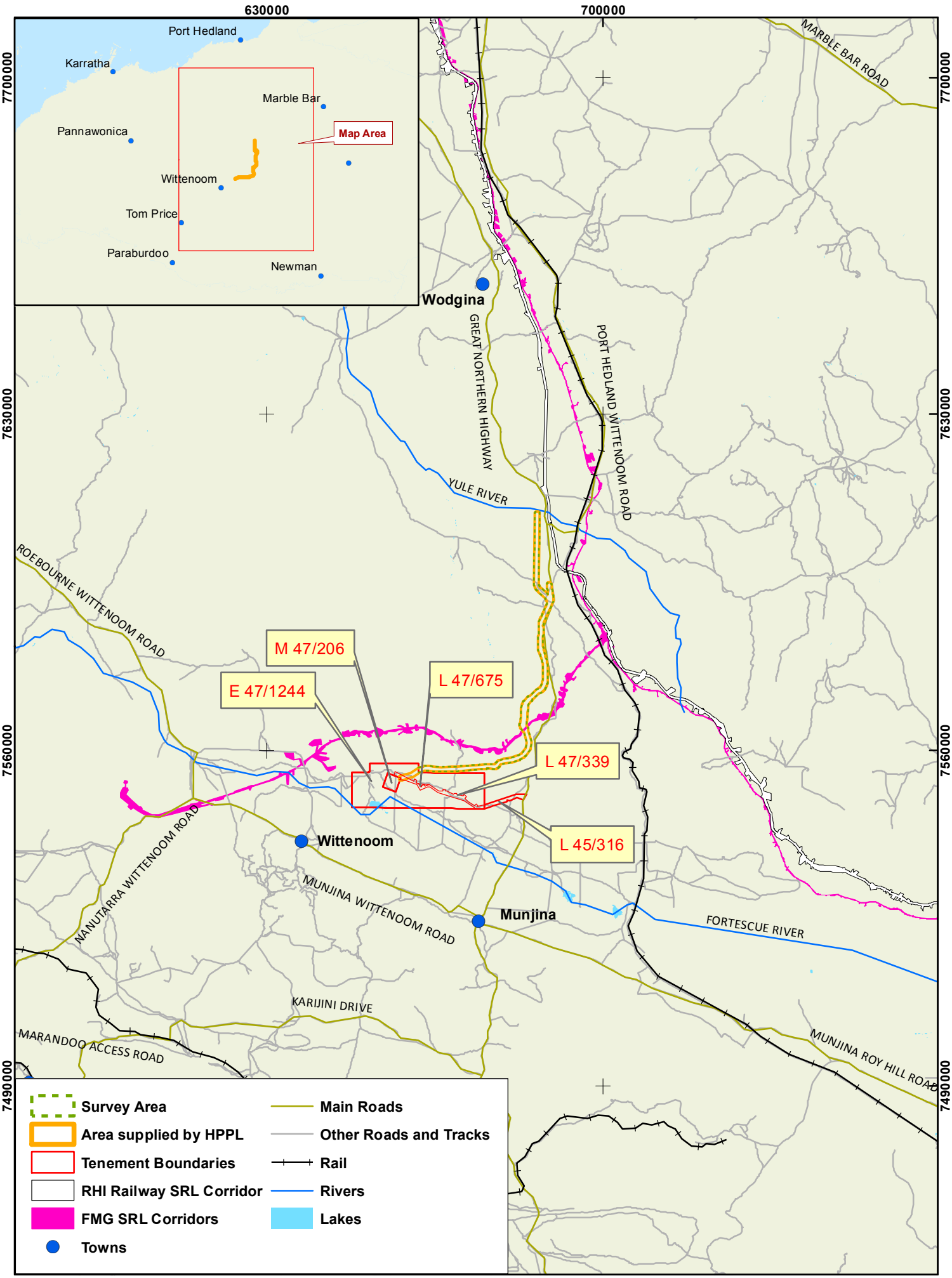

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Prepared for: HPPL
Drawn by: RH
Version: 1

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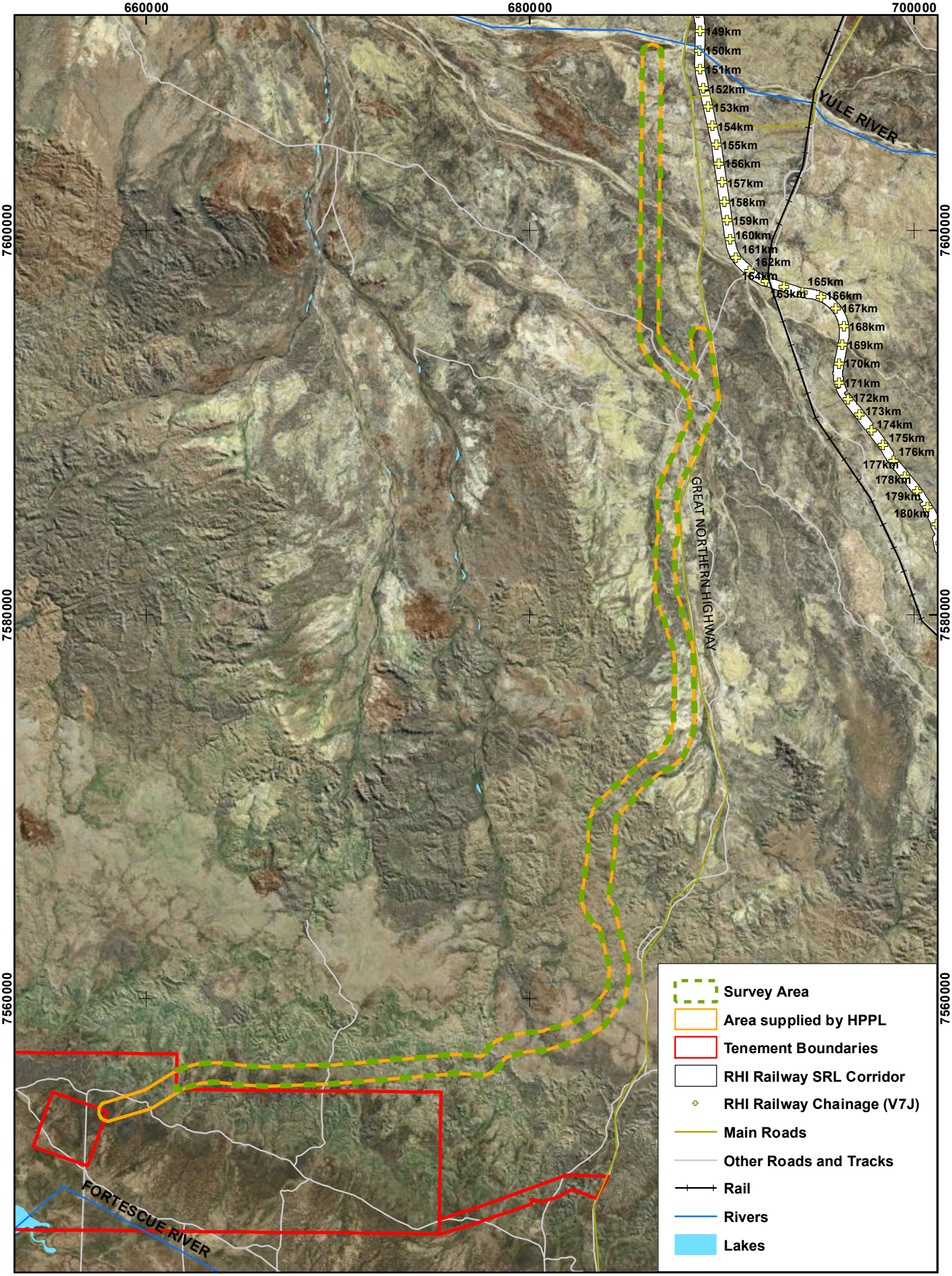

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Version: 1

The Survey Area

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Kilometres

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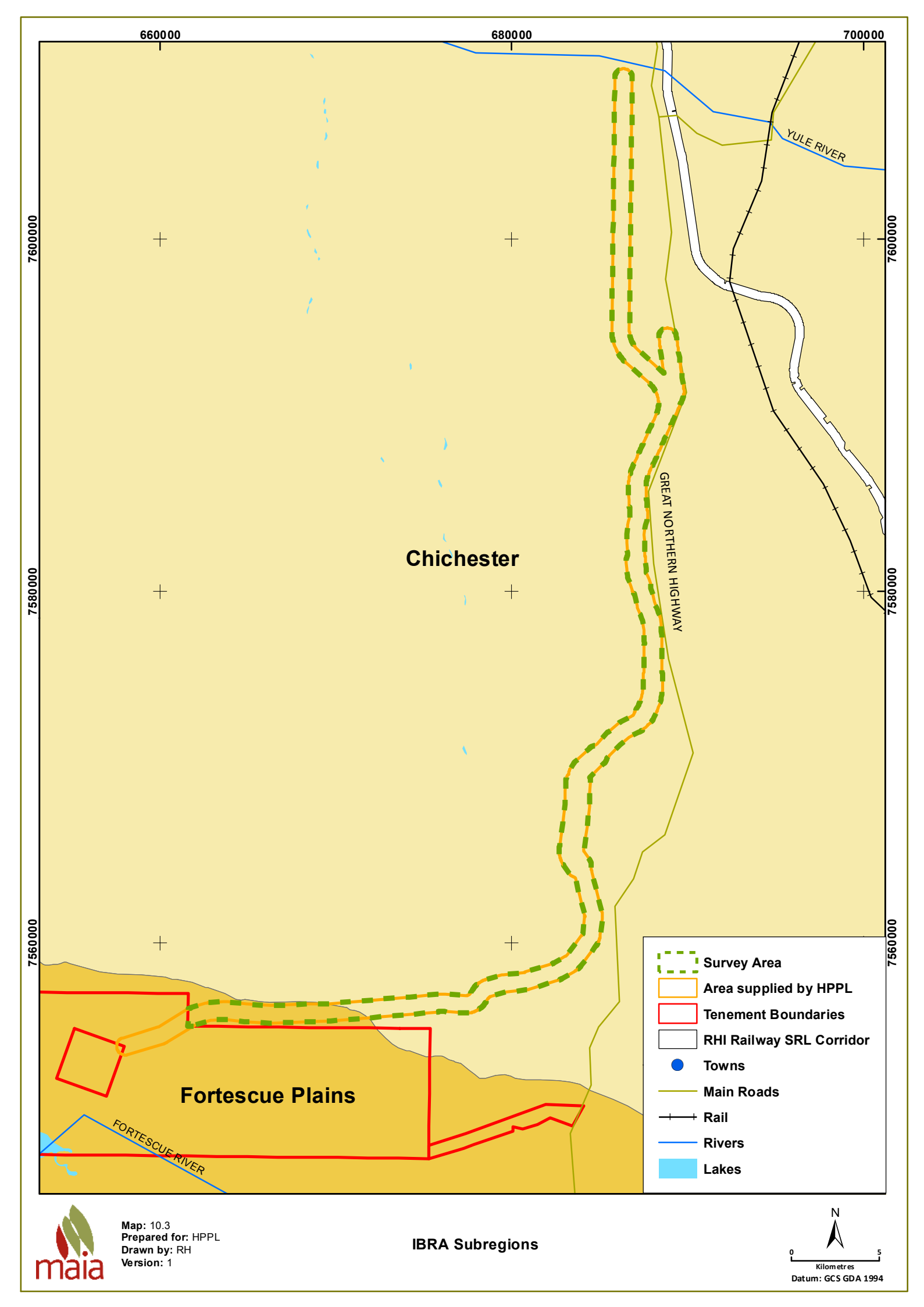

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IBRA Subregions

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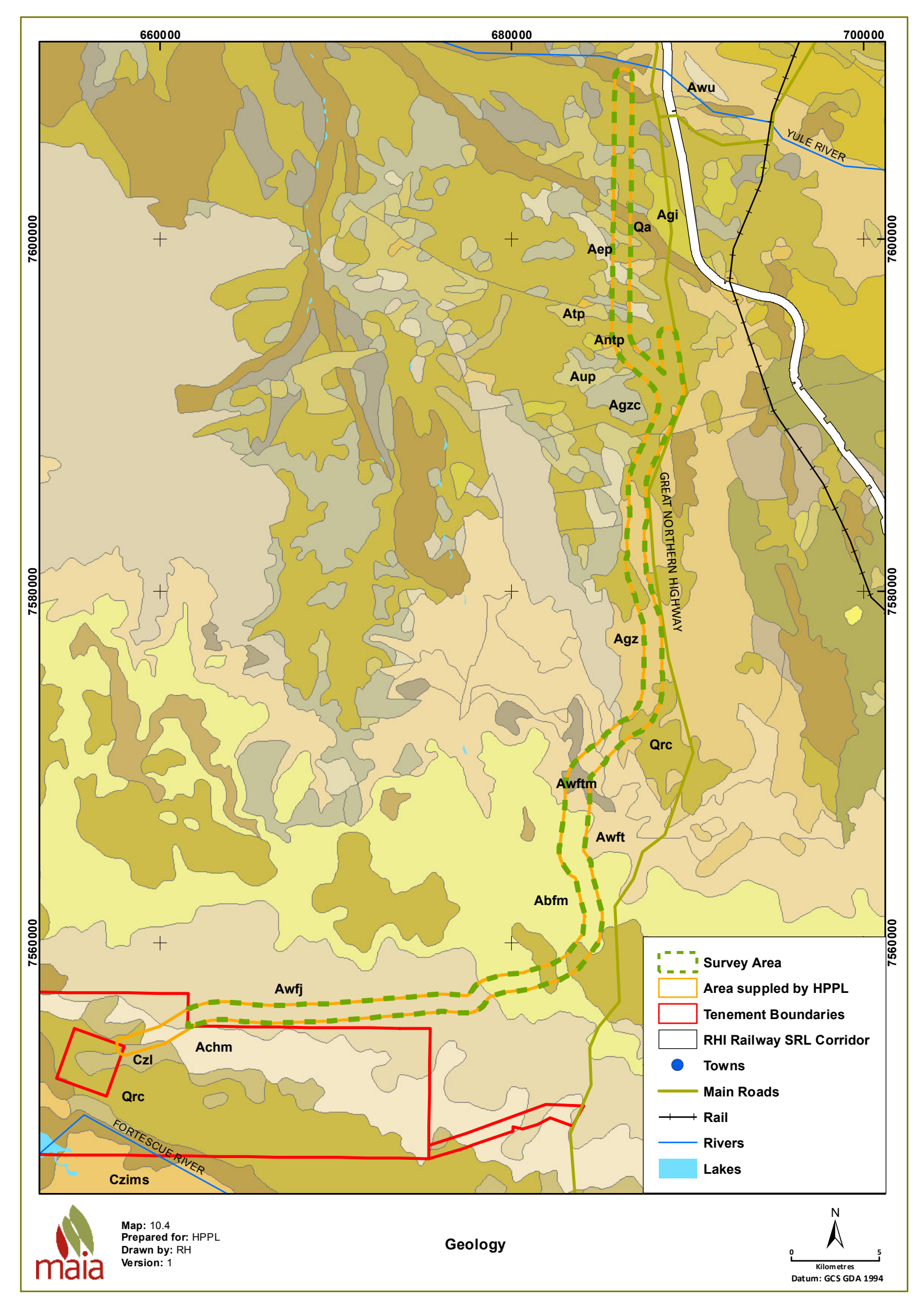

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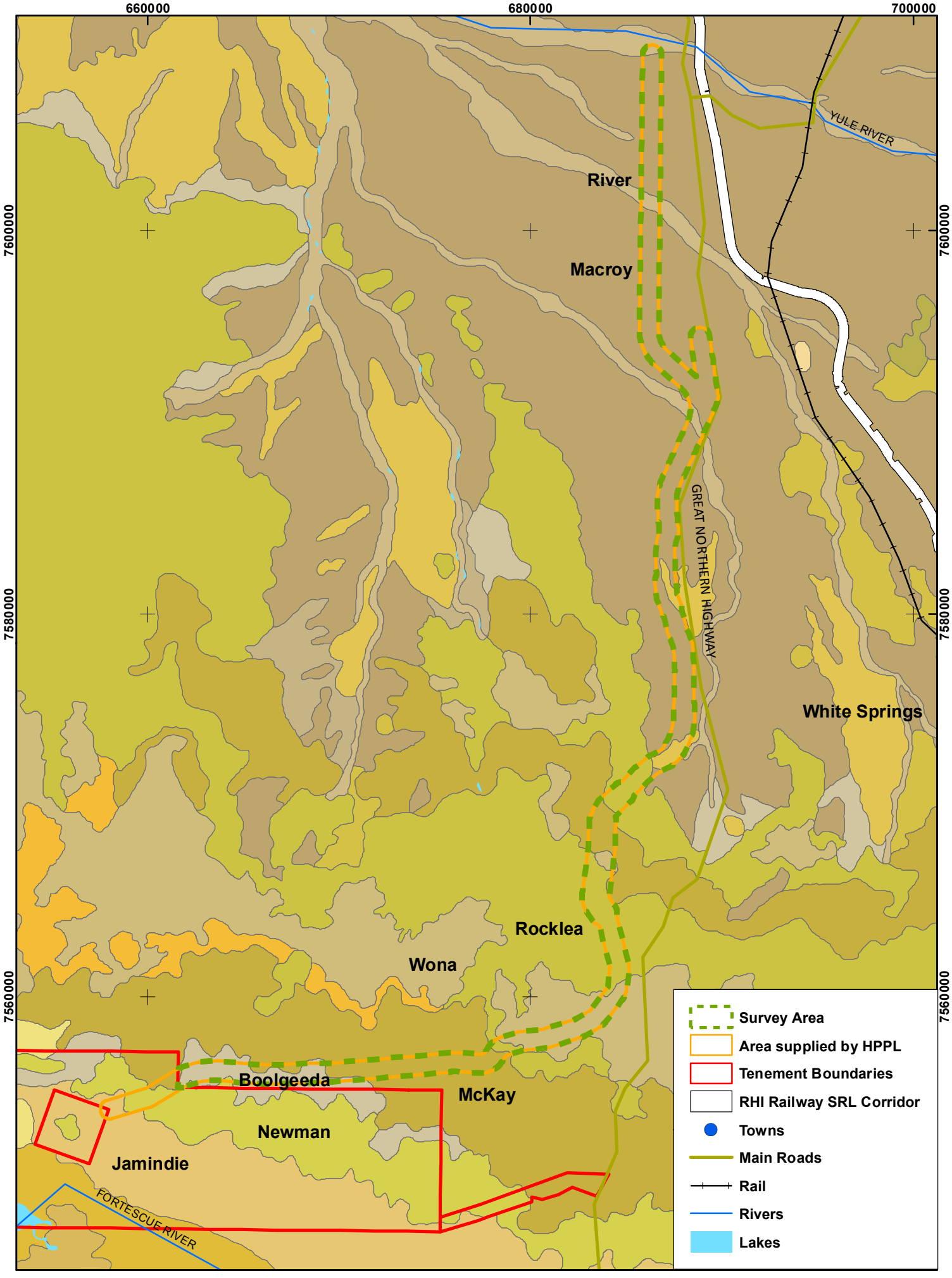

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Land Systems

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Kilometres

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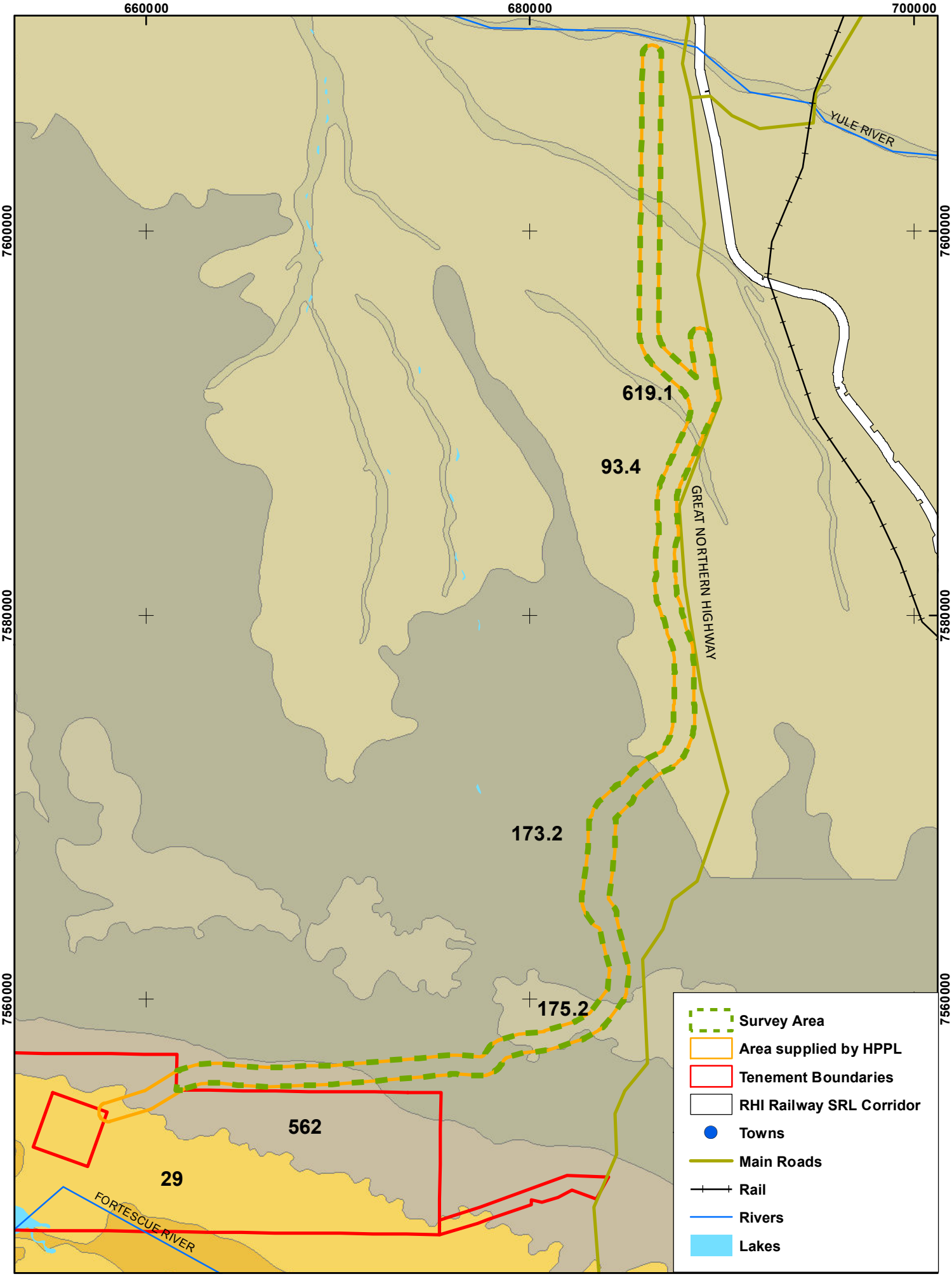

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Prepared for: HPPL
Drawn by: RH
Version: 1

Beard's Vegetation Mapping
(Pre-European Vegetation)

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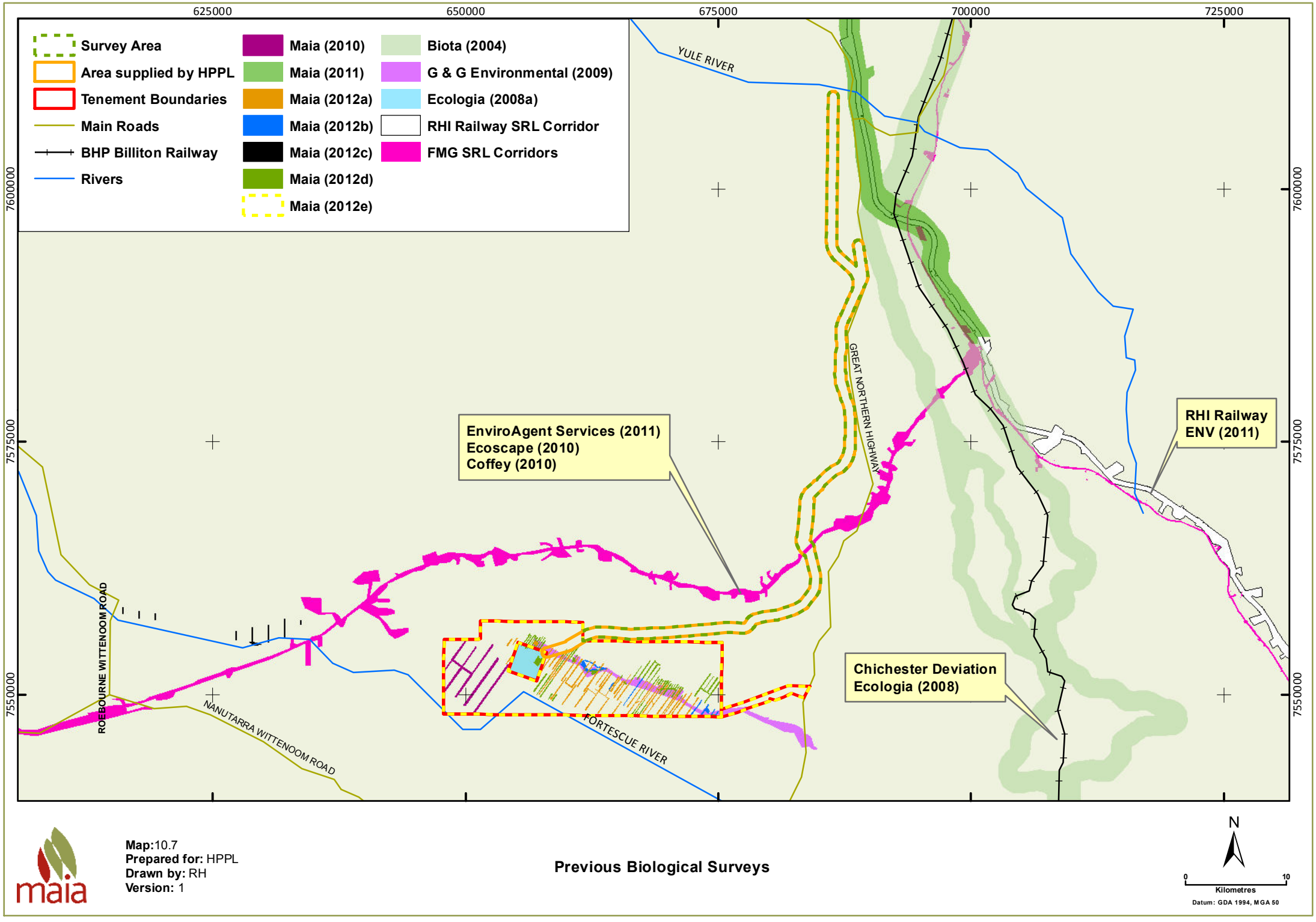

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Version: 1

Previous Biological Surveys

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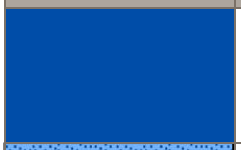
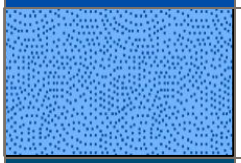
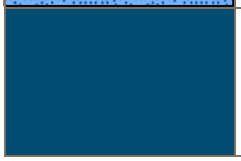
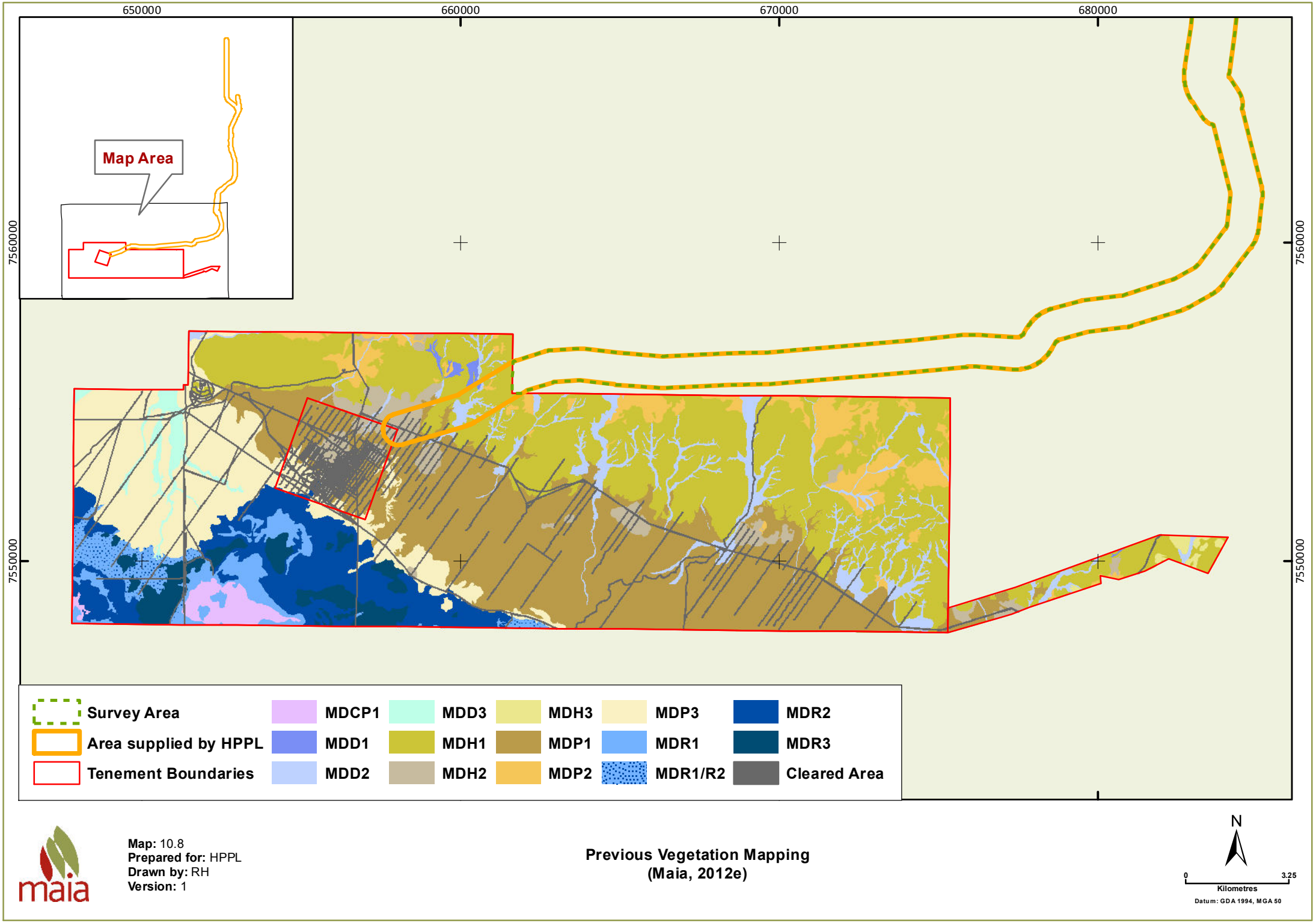
Figure 10.1: Vegetation Map Legend (Maia 2012e)

Colour / Pattern	Code	Vegetation Association Description
	Cleared	Cleared areas
	MDCP1	Tussock Grassland of *Eriachne flaccida* and *E. benthamii* with Isolated Trees of *Eucalyptus victrix*.
	MDD1	Tall mixed Shrubland (*Petalostylis labicheoides*, *Acacia marramamba* and *Grevillea wickhamii*) with an Open Hummock Grassland of *Triodia epactia*.
	MDD2	Tall Shrubland of *Acacia tumida* and *A. pyrifolia* with a Sparse Tussock Grassland of *Themeda triandra* and Isolated Low Trees of *Corymbia hamersleyana* and/or *Eucalyptus victrix*.
	MDD3	Tussock Grassland of *Eragrostis xerophila* with a Sparse Tall Shrubland of *Acacia coriacea* subsp. *pendens* and *A. tetragonophylla* with a Sparse Low Shrubland of *Pluchea rubelliflora* and *Pterocaulon sphacelatum*.
	MDH1	Hummock Grassland of *Triodia* aff. *basedowii* +/- *Triodia brizoides* with a Sparse Tall Shrubland of mixed *Acacia* species (*A. atkinsiana*, *A. ancistrocarpa*, *A. bivenosa* and *A. spondylophylla*) with Isolated Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* +/- *Corymbia hamersleyana*.
	MDH2	Hummock Grassland of *Triodia* aff. *basedowii* and or *T. epactia* with a Sparse Shrubland of *Acacia aneura* species (*A. aneura*, *A. aptaneura* and *A. incurvaneura*) and Isolated Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* and/or *A. pruinocarpa*.
	MDH3	Hummock Grassland of *Triodia brizoides* with an Open Low Woodland of *Eucalyptus leucophloia* susbsp. *leucophloia* with Isolated Low Shrubs of *Ptilotus obovatus*.
	MDP1	Low Woodland/Tall Shrubland to Isolated Low Trees/Shrubs of *Acacia aneura* (complex) with a mixed Sparse Low Shrubland (*Dodonaea petiolaris*, *Eremophila forrestii* and *Abutilon otocarpum*) and Isolated Low Trees of *A. pruinocarpa*.
	MDP2	Sparse Tall Shrubland of *Acacia aneura* and *A. xiphophylla* with a Sparse Low Shrubland of *Eremophila cuneifolia* and a Sparse Hummock Grassland of *Triodia epactia* and/or *T.* aff. *basedowii*.
	MDP3	Sparse Tall Shrubland of *Acacia xiphophylla* and/or *A. synchronicia* with a mixed Sparse Chenopod Shrubland (*Sclerolaena tetragona*, *S. bicornis*, *S. densiflora*) and a Sparse Tussock Grassland of *Eragrostis xerophila*.
	MDR1	Open Low Woodland to Low Woodland of *Eucalyptus victrix* with a Mid Shrubland of *Muehlenbeckia florulenta.*

Colour / Pattern	Code	Vegetation Association Description
	**MDR2**	Open Low Woodland to Low Woodland of *Eucalyptus victrix* and *Acacia distans* with a mixed Sparse Mid Shrubland of *A. tetragonophylla*, *Melaleuca glomerata* and *Muehlenbeckia florulenta*.
	**MDR1/R2**	Mosaic of MDR1 and MDR2
	**MDR3**	Sparse mixed Mid Shrubland (*Melaleuca glomerata*, *Eremophila longifolia* and *Acacia synchronicia*) with either a Hummock Grassland of *Triodia epactia* or a Tussock Grassland of annual *Eragrostis pergracilis* and Isolated Trees of *Eucalyptus victrix*.



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Version: 1

Previous Vegetation Mapping
(Maia, 2012e)

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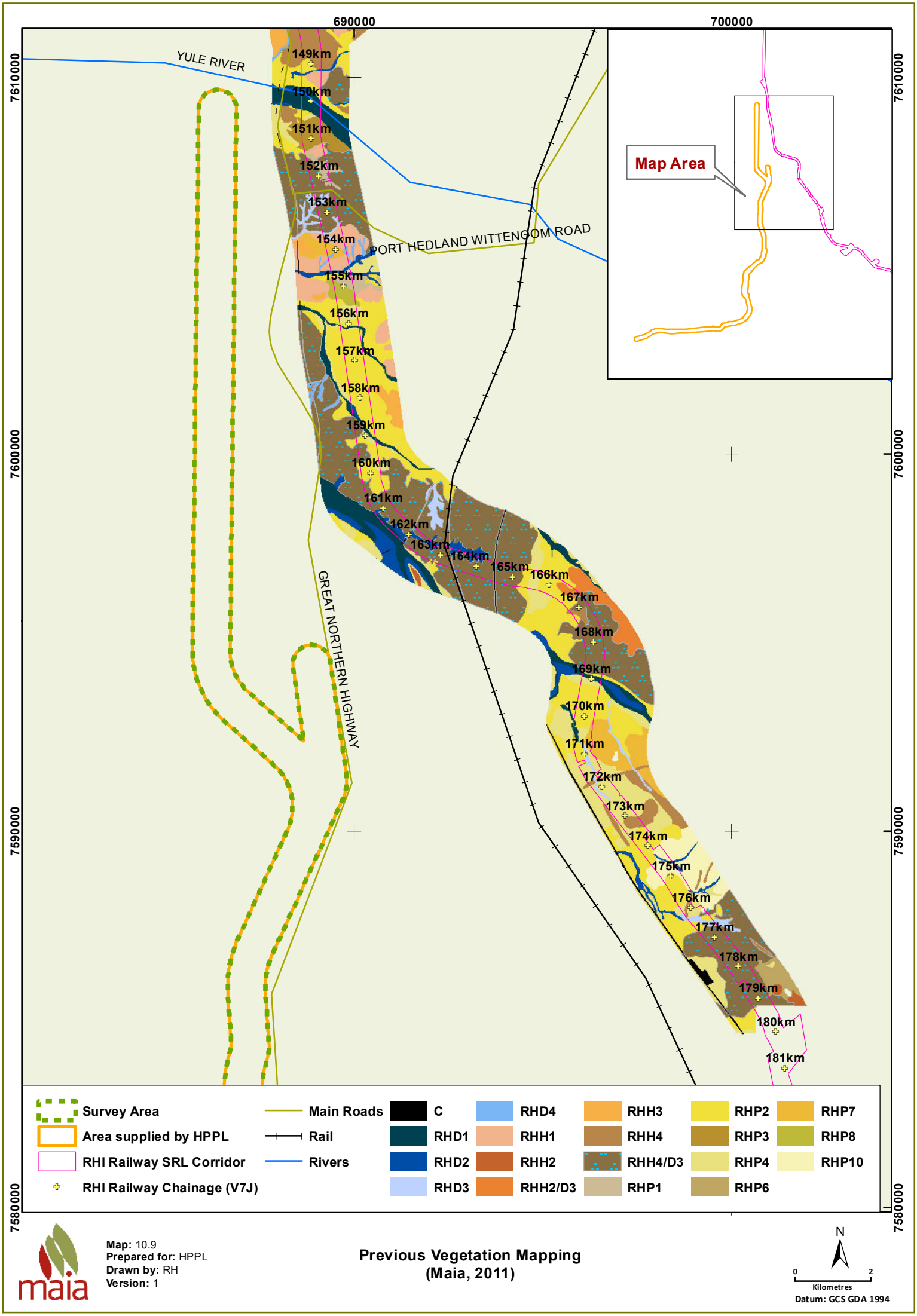
Figure 10.2: Vegetation Map Legend (Maia 2011)

Colour/Pattern	Code	Vegetation Association Description
	RHD1	Open Low Woodland of *Eucalyptus camaldulensis* subsp. *obtusa* and or *Melaleuca argentea* with Tall Sparse Shrubland of *Acacia coriacea* subsp. *pendens* and *A. trachycarpa* and an Open Tussock Grassland of **Cenchrus ciliaris*.
	RHD2	Tall Open Shrubland of *Acacia trachycarpa* and *A. ampliceps* with an Open Hummock Grassland of *Triodia epactia* and a Sparse Tussock Grassland of **Cenchrus ciliaris*.
	RHD3	Open Hummock Grassland of *Triodia epactia* with an Open Tall Shrubland of *Grevillea wickhamii* and *Acacia tumida* var. *pilbarensis* and a Low Open Woodland of *Corymbia hamersleyana*.
	RHD4	Tall Open Shrubland of *Acacia trachycarpa* and/or *A. tumida* var. *pilbarensis* with an Open Grassland of **Cenchrus ciliaris* and *Themeda triandra*.
	RHH1	Hummock Grassland of *Triodia lanigera* with a Sparse Low Shrubland of *Acacia bivenosa* and Isolated Low Trees of *Corymbia hamersleyana*.
	RHH2	Hummock Grassland of *Triodia lanigera* with a Tall Sparse Shrubland of *Acacia inaequilatera*.
	RHH2/D3	Mosaic of RHH2 and RHD3
	RHH3	Hummock Grassland of *Triodia epactia* with a Mid Open Shrubland of *Acacia orthocarpa* and a Low Sparse Shrubland of *A. bivenosa.*
	RHH4	Mid Open Shrubland of *Acacia orthocarpa* and *A. inaequilatera* with an Open Hummock Grassland of *Triodia epactia* and *T. wiseana*.
	RHH4/D3	Mosaic of RHH4 and RHD3
	RHP1	Hummock Grassland of *Triodia lanigera* with a Sparse Mid Shrubland of *Acacia ancistrocarpa* and a Low Sparse Shrubland of *Indigofera monophylla*.
	RHP10	Hummock Grassland of *Triodia epactia* with a Mid Shrubland of *Acacia orthocarpa* +/- *Acacia maitlandii*.

Colour/Pattern	Code	Vegetation Association Description
	RHP2	Open Hummock Grassland of *Triodia longiceps* with a Low Sparse Shrubland of *Acacia bivenosa* and *Pluchea ferdinandi-muelleri*.
	RHP3	Mid Sparse Shrubland of *Acacia ancistrocarpa* with a Sparse Hummock Grassland of *Triodia epactia* and *T. lanigera* and Isolated Low Trees of *Corymbia* spp.
	RHP4	Low Open Shrubland of *Acacia stellaticeps* and +/- *Pluchea ferdinandi-muelleri* with an Open Hummock Grassland of *Triodia lanigera* and *T. epactia*.
	RHP6	Hummock Grassland of *Triodia lanigera* and *Triodia wiseana* with a Low Open Shrubland of *Acacia bivenosa*.
	RHP7	Hummock Grassland of *Triodia epactia* with a Mid Open Shrubland of *Acacia orthocarpa*, a Sparse Tall Shrubland of *Acacia pyrifolia* and Isolated Low Shrubs of *Triumfetta chaetocarpa*.
	RHP8	Hummock Grassland of *Triodia angusta* with Low Isolated Shrubs of *Senna notabilis* and *Acacia bivenosa*.



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Map: 10.9
Prepared for: HPPL
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Version: 1

Previous Vegetation Mapping (Maia, 2011)

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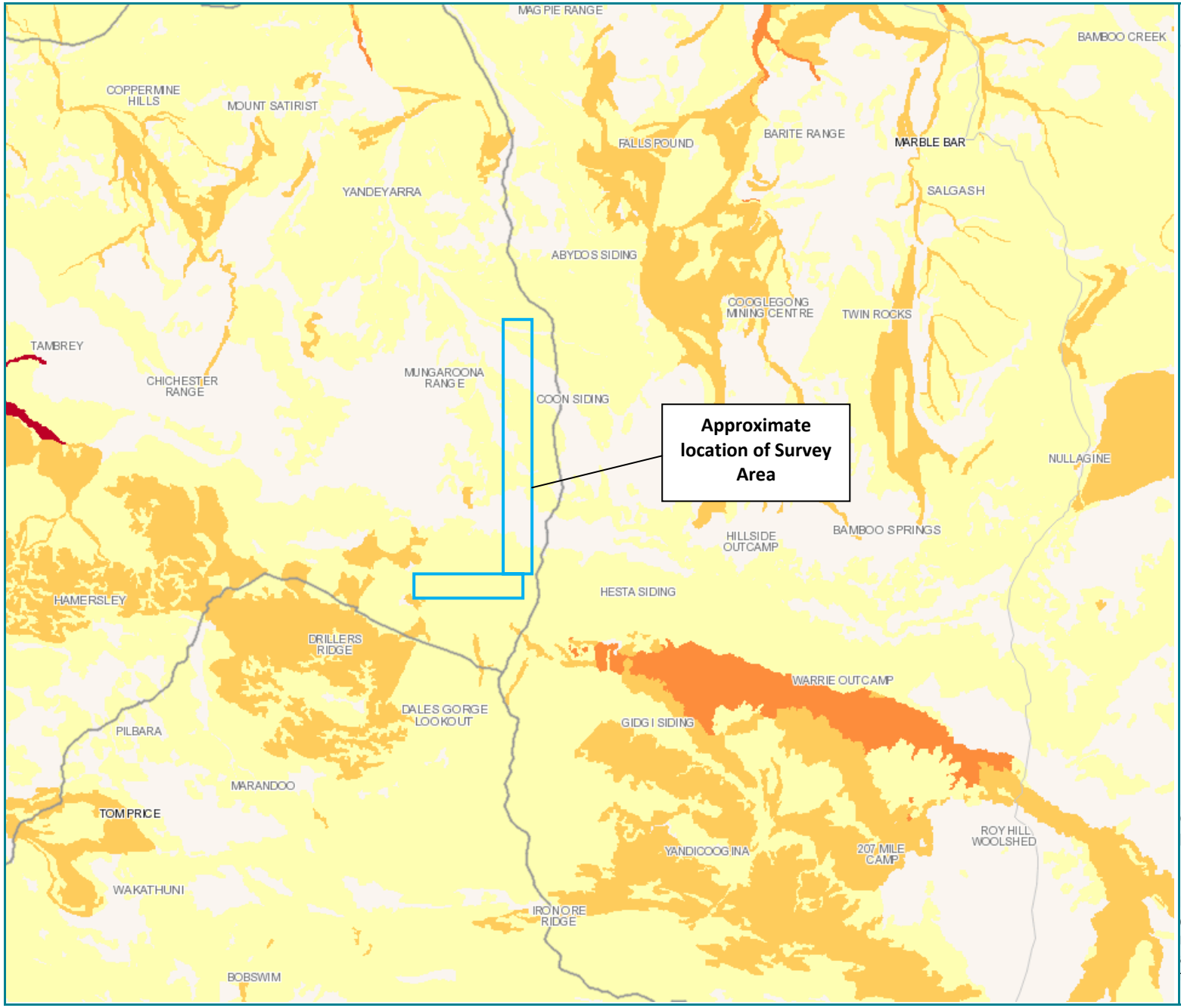
Australian Government
Bureau of Meteorology

Map 10.10: Groundwater Dependent Ecosystems



N

HPPL: MD Potential Transport Corridor

GDE, Reliant on surface expression of groundwater (rivers, springs, wetlands)

- Identified in previous study: fieldwork
- Identified in previous study: desktop
- High potential for groundwater interaction
- Moderate potential for groundwater interaction
- Low potential for groundwater interaction

GDE, Reliant on subsurface groundwater (vegetation)

- Identified in previous study: fieldwork
- Identified in previous study: desktop
- High potential for groundwater interaction
- Moderate potential for groundwater interaction
- Low potential for groundwater interaction
- No Ecosystems analysed

GDE, Subterranean (Cave & Aquifers)

- Identified in previous study: fieldwork
- Identified in previous study: desktop
- No Ecosystems analysed

1:1,559,004

Metres 20,000 40,000 60,000 80,000 100,000 120,000

Data source - Data are assumed to be correct as supplied from Commonwealth, State and Territory data suppliers or referenced projects.

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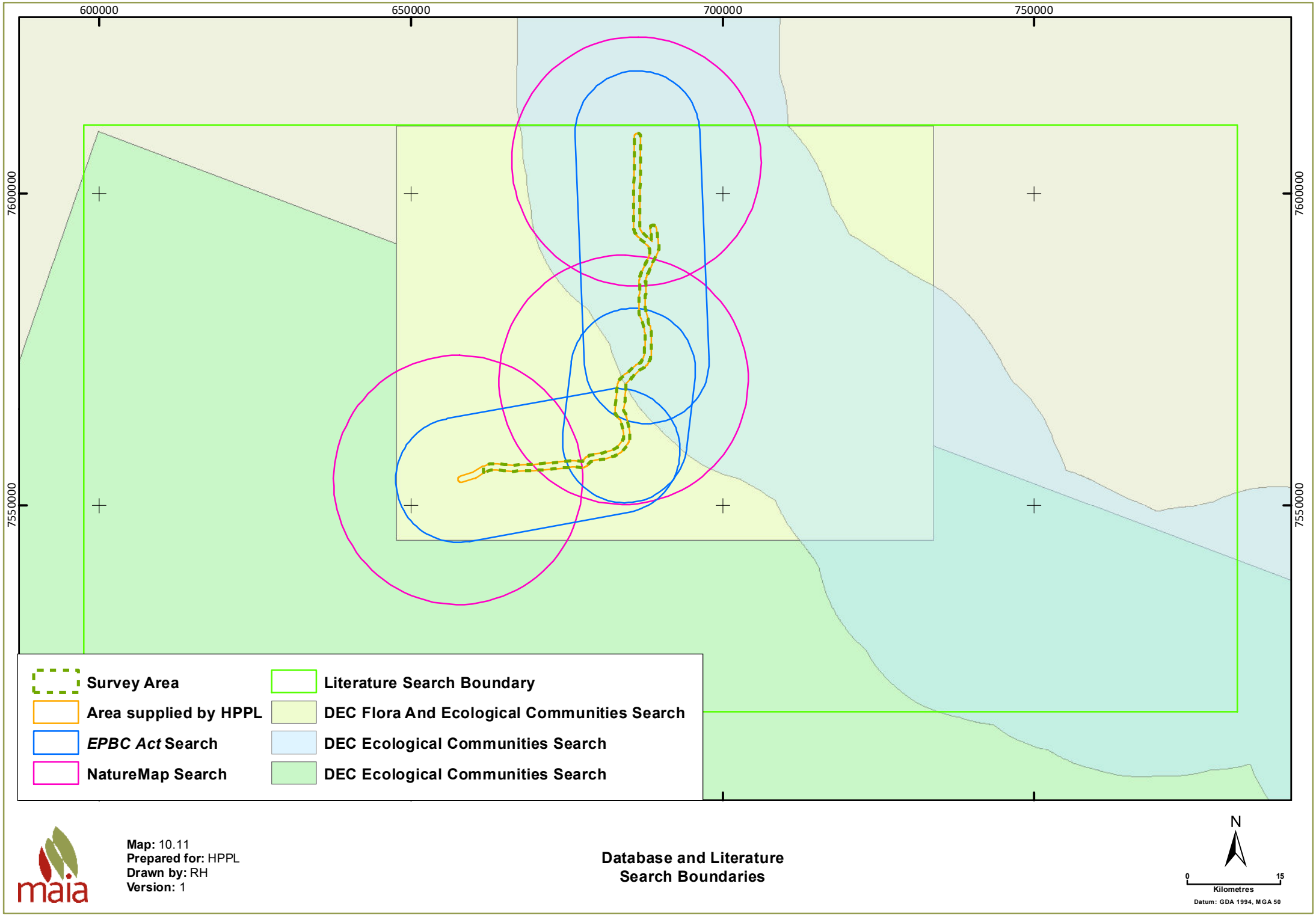

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Version: 1

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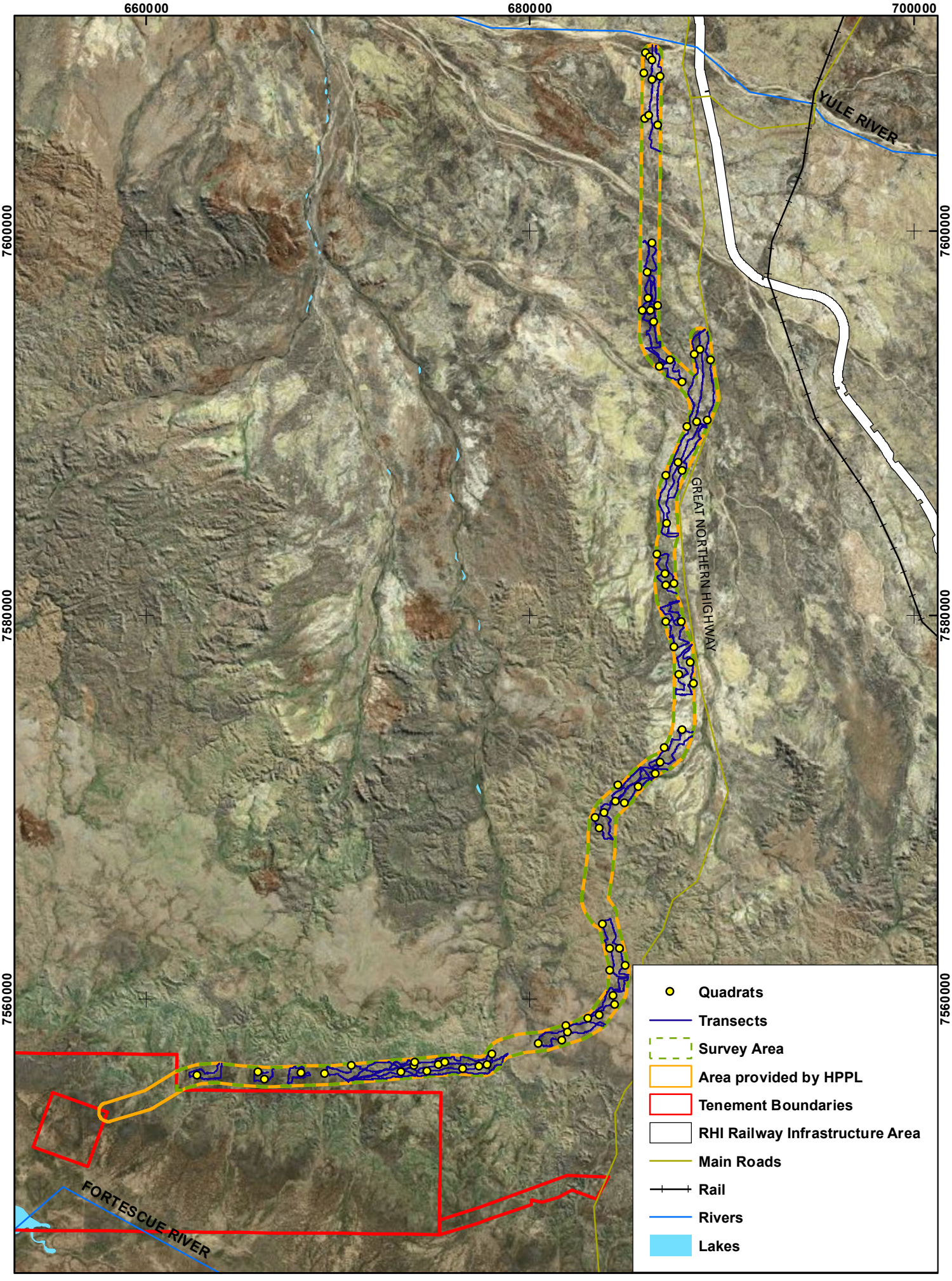

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Map: 10.12
Prepared for: HPPL
Drawn by: RH
Version: 1

Quadrats and Transects Surveyed

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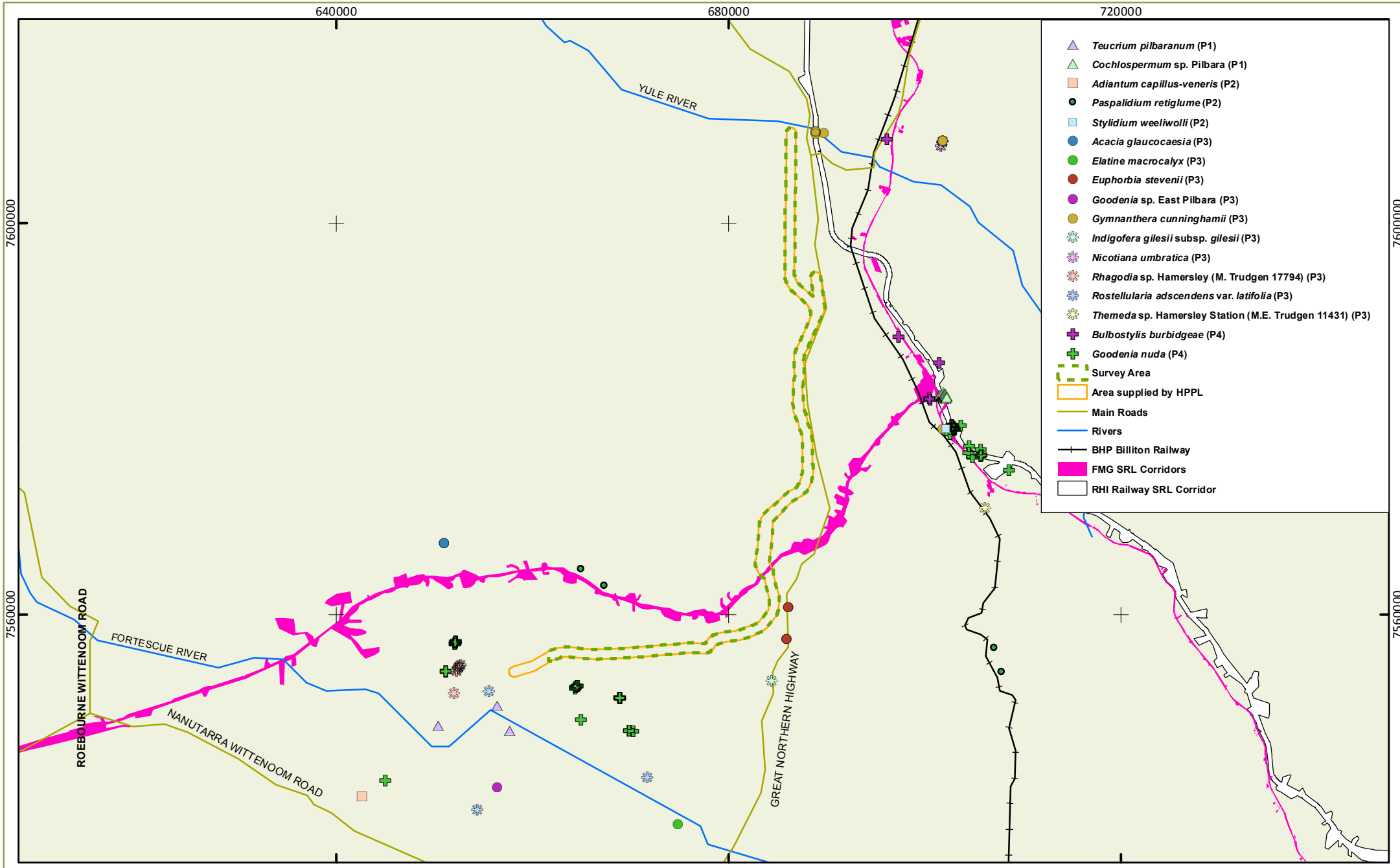

Map: 10.13
Prepared for: HPPL
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Version: 1

Conservation Significant Flora Located within 20 km of the Survey Area

N

0 10
Kilometres

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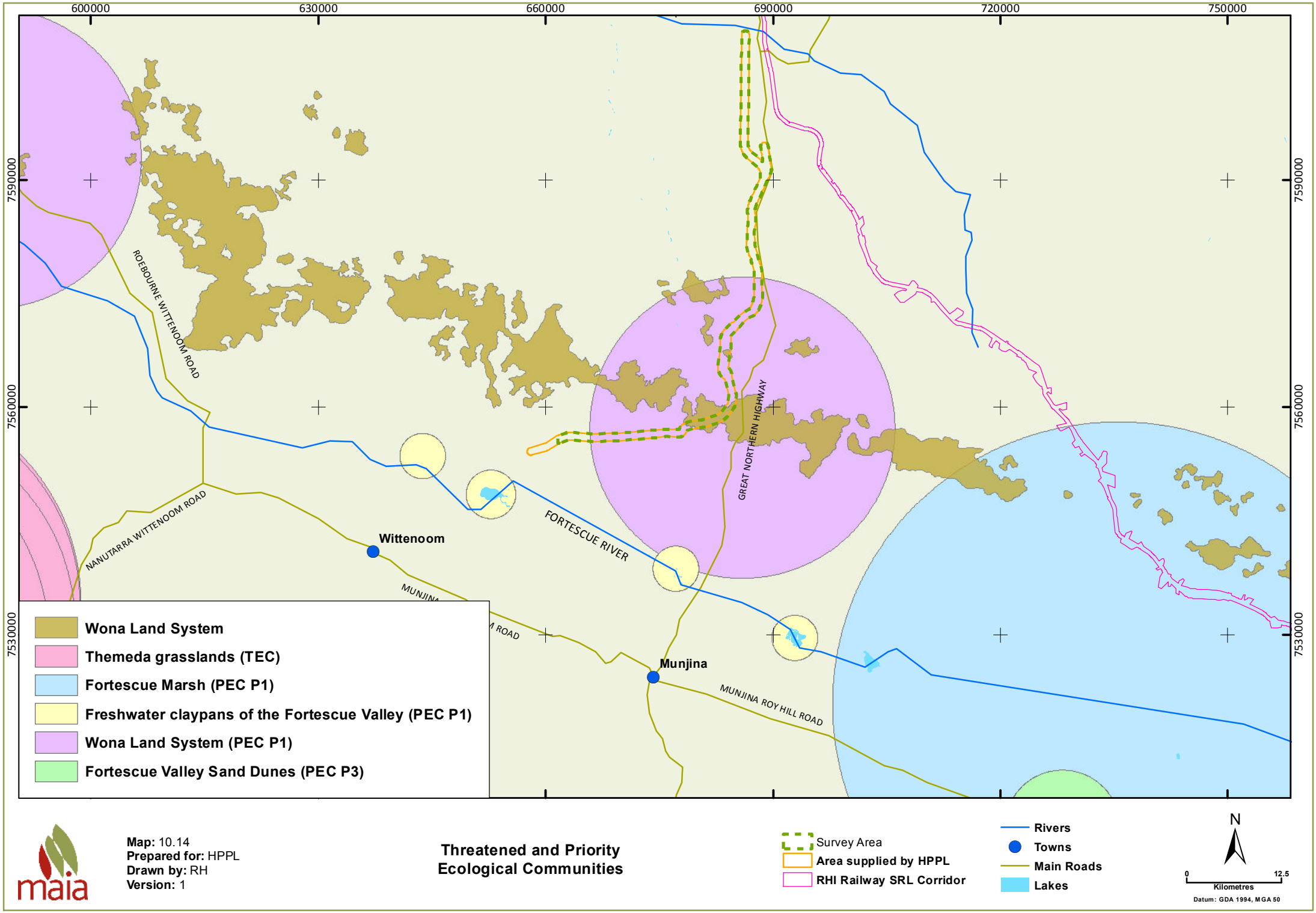

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Prepared for: HPPL
Drawn by: RH
Version: 1

Threatened and Priority Ecological Communities

Survey Area
Area supplied by HPPL
RHI Railway SRL Corridor

Rivers
Towns
Main Roads
Lakes

N

0 12.5
Kilometres

Datum: GDA 1994, MGA 50

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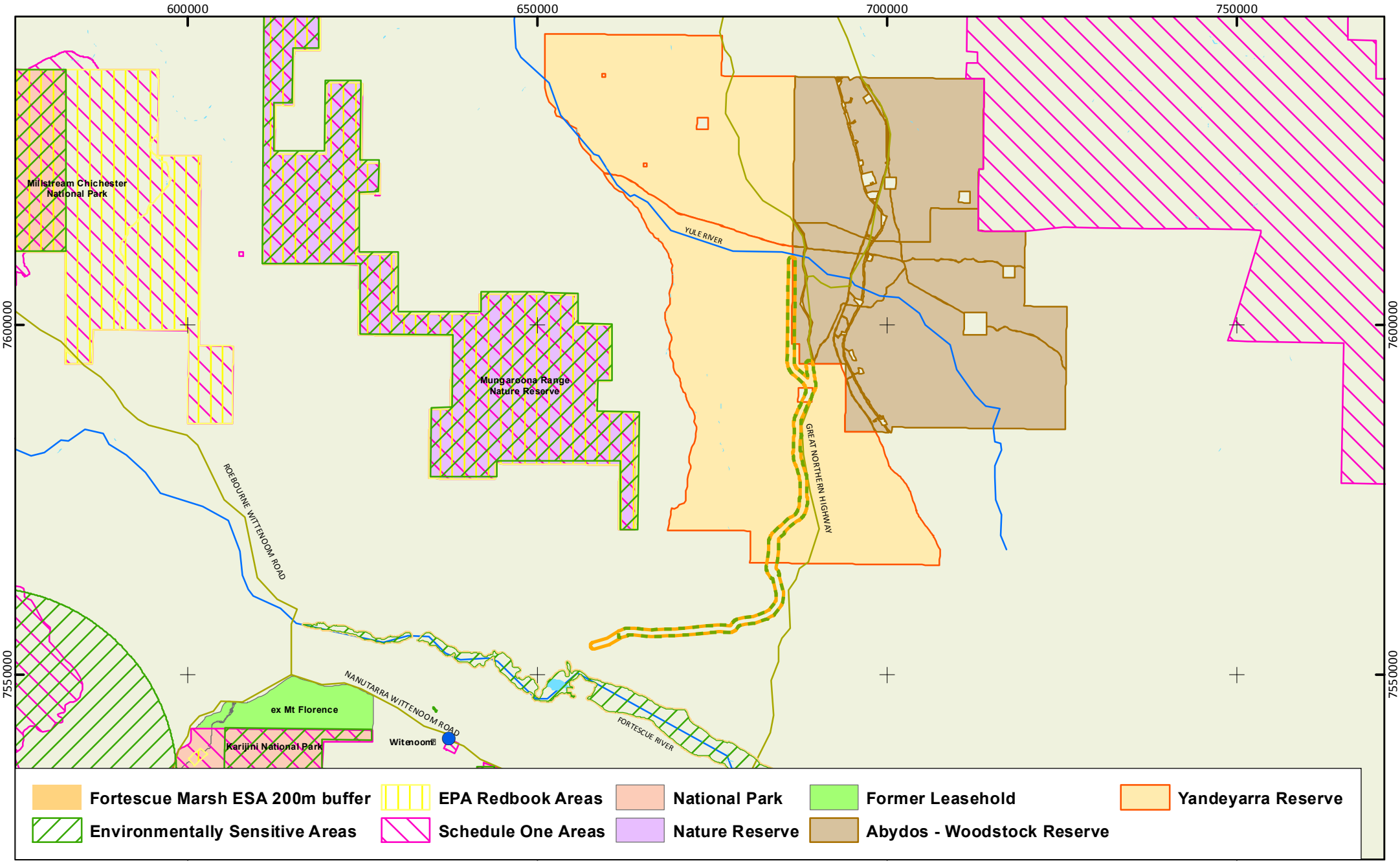

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Drawn by: RH
Version: 1

Environmentally Sensitive Areas, Conservation Estates, Schedule One, Areas and EPA Redbook Areas

Survey Area
Area supplied by HPPL

Towns
Main Roads
Rivers
Lakes

N

0 15
Kilometres

Datum: GDA 1994, MGA 50

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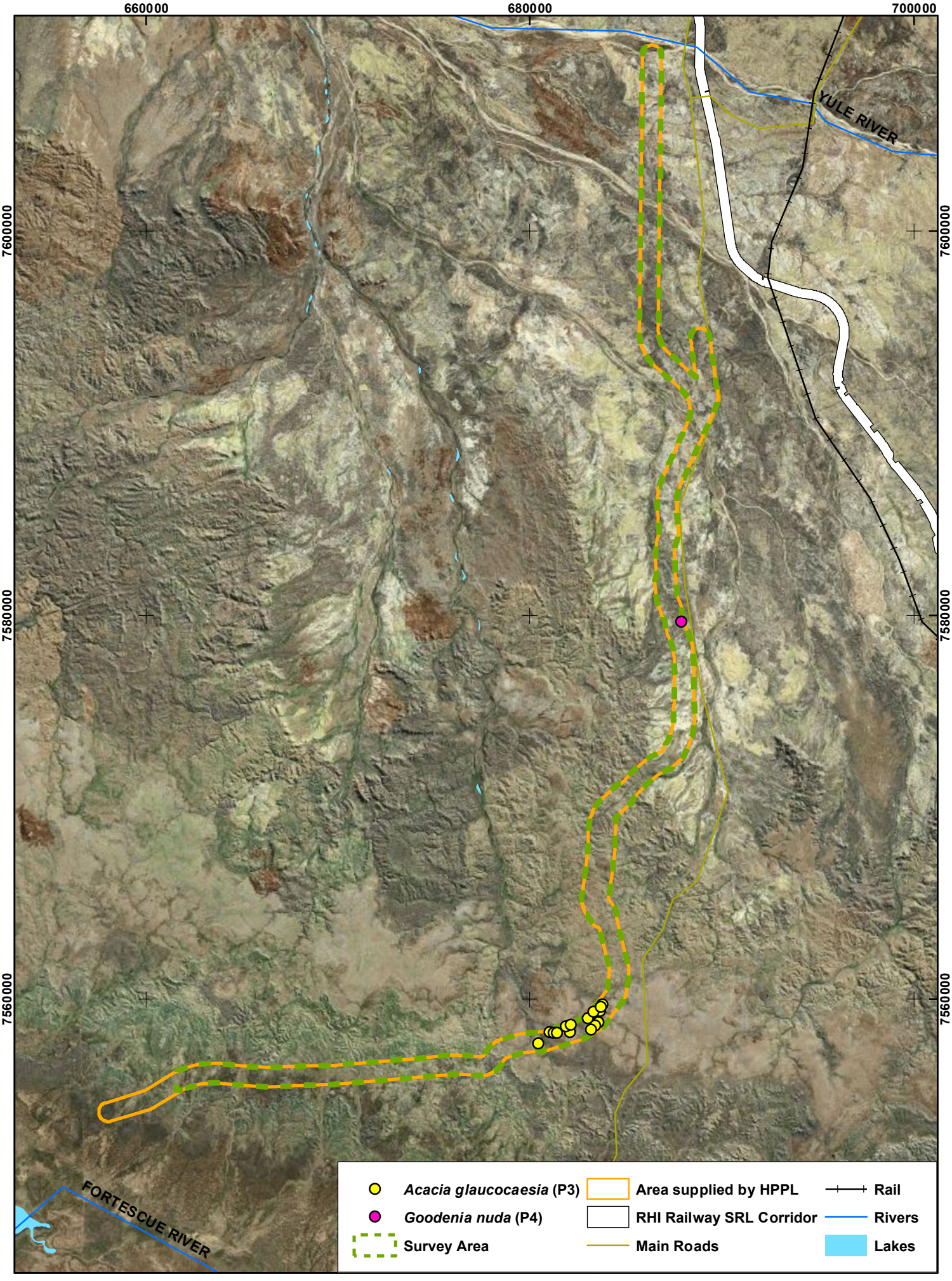

Map: 10.16
Prepared for: HPPL
Drawn by: RH
Version: 1

Priority Flora Locations

N

0 5
Kilometres

Datum: GCS GDA 1994

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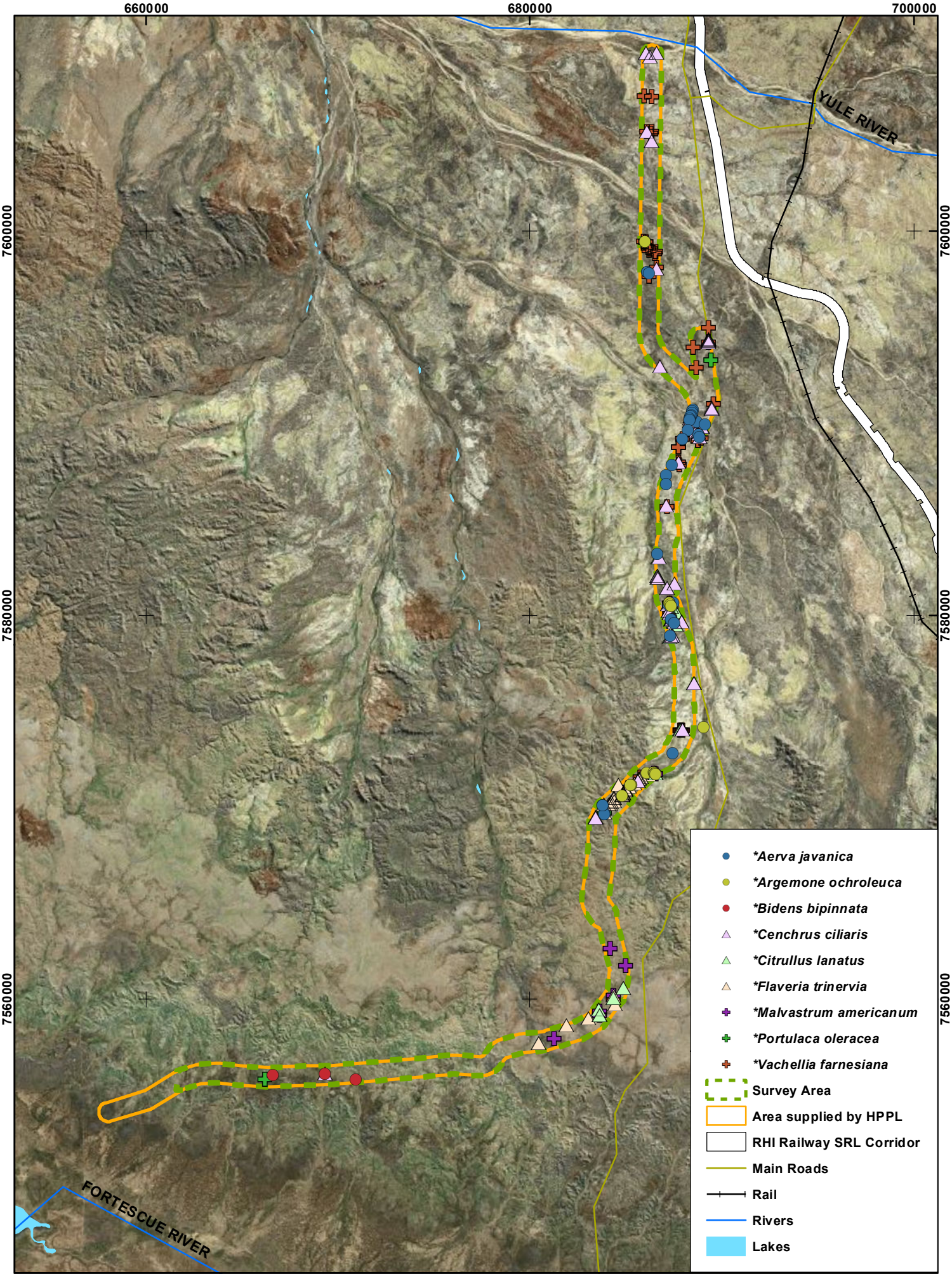

Map: 10.17
Prepared for: HPPL
Drawn by: RH
Version: 1

Weed Locations

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Kilometres

Datum: GCS GDA 1994

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Figure 10.3: Vegetation Associations Map Legend.

Symbol	Code	Vegetation Association Description
	M**SL**-1	Mixed Low Shrubland (*A. bivenosa, Tephrosia densa,* and *Indigofera monophylla*) with a Hummock Grassland of *Triodia epactia* and/or *T. wiseana* with Isolated Low Trees of *Corymbia hamersleyana* and/or *Eucalyptus victrix*.
	*Tl*Ta**HG**-2	Sparse Hummock Grassland to Hummock Grassland of *Triodia longiceps* +/-*T. angusta* with a Sparse to Open Mixed Shrubland (*Acacia trachycarpa*, *A. stellaticeps* and/or *A. bivenosa*).
	*AcMl***SL**-3	Tall Open Shrubland of *Acacia coriacea* subsp. *pendens* and *Melaleuca linophylla* with a Low Open Woodland of *Eucalyptus victrix* with a mixed Sparse Tussock Grassland (*Eulalia aurea*, *Eriachne benthamii* and *Leptochloa fusca* subsp. *fusca*).
	*AtAc***SL**-4	Tall Open Shrubland of *Acacia trachycarpa* and/or *A. coriacea* supsp. *Pendens* with Scattered Mid Trees of *Eucalyptus camaldulensis* subsp. *obtusa* and/or *E. victrix*.
	M*A***S/WL**-5	Tall Shrubland/Low Woodland of *Acacia aneura*, *A. aptaneura* and +/- *A. xiphophylla* with a Sparse Mid Shrubland of *A. tetragonophylla* and/or *A. atkinsiana* and a Sparse Hummock Grassland of *Triodia* aff. *basedowii.*
	*[m]*Ta*bTbTe***HG**-6/7	Mosaic of Hummock Grassland of *Triodia* aff. *basedowii* +/- *Triodia brizoides* with a Sparse Low Shrubland of mixed *Acacia* species (*A. bivenosa, A. adoxa* var. *adoxa* and *A. hilliana*) with Isolated Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia (*Ta*Tb***HG**-6*)*and *Hummock Grassland of Triodia epactia +/- Triodia brizoides with a Sparse Mid Shrubland of Acacia maitlandii and Senna glutinosa subsp. glutinosa with Isolated Low Trees of Eucalyptus leucophloia subsp. leucophloia*(*TeTb***HG**-7).
	*[m]*Ta*bTwTe***HG**-8/10	Mosaic of Hummock Grassland of *Triodia* aff. *wiseana* and/or *T. epactia* with a Sparse Tall Shrubland of *Acacia inaequilatera* with Isolated Low Shrubs of *Indigofera monophylla* (Ta*wTe***HG**-8) and Hummock Grassland of *Triodia epactia* and/or *Triodia* aff *wiseana* with a Sparse Tall Shrubland of *Acacia inaequilatera* and +/- Isolated Trees of *Corymbia hamersleyana* (*TeTaw***HG**-10).
	*TabTaw***HG**-9	Hummock Grassland of *Triodia* aff. *basedowii* and *Triodia* aff. *wiseana* with a mixed Mid Shrubland (*Acacia bivenosa*, *A. orthocarpa*, *A. acradenia*) and Sparse Low Shrubland of *Ptilotus astrolasius*.
	*TeTab***HG**-11	Hummock Grassland of *Triodia epactia* and/or *T.* aff. *basedowii* with a Sparse Tall Shrubland of *Acacia* species (*Acacia ancistrocarpa*, *A. inaequilatera* and *A. orthocarpa*) and a Sparse Low Shrubland of *Indigofera monophylla*.
	*Tae***HG**-12	Hummock Grassland of *Triodia* aff. *epactia* with Isolated Mid Shrubs (*Acacia atkinsiana*, *A. marramamba* and *Exocarpos sparteus*).
	*TsTaTl***HG**-13	*Triodia secunda*, *T. angusta* and/or *T. longiceps* Open Hummock Grassland with Isolated Mid Shrubs of *Pluchea ferdinandii-muelleri*.

Symbol	Code	Vegetation Association Description
	*T*ab**HG**-14	Hummock Grassland of *Triodia* aff. *basedowii* and/or *T. longiceps* with mixed isolated Low Shrubs (*Acacia bivenosa*, *Melaleuca eleuterostachya* and *Pluchea ferdinandii-muelleri*) +/- Isolated Low Trees of *Corymbia hamersleyana*.
	M**TG**1-15	Mixed Sparse Tussock Grassland of *Aristida latifolia, Astrebla pectinata* and *Eriachne obtusa* +/- a Mid Open Shrubland of *Acacia xiphophylla* and/or *A. glaucocaesia* (**P3**) with Isolated Low Shrubs of **Flaveria trinervia* and *Sida fibulifera*.
	?M**TG**1-15	
	M**TG**2-15	
	?M**TG**2-15	
	Ta*w***HG**-16	Hummock Grassland of *Triodia* aff. *wiseana* and/or *T. angusta* with a Sparse Mid Shrubland of *Acacia bivenosa* and *Senna artemisioides* subsp. *oligophylla*.
	CL	Cleared for Tracks and Infrastructure.

665000

670000

675000

7560000

7555000

Map

Survey Area

Area Supplied by HPPL

E 47/1244

RHI Railway SRL Corridor

5

4

3

2

1

Map Area

E47/1244

Cleared Area

M**SL**-1

*AcMi***SL**-3

AtAcSL-4

MA**S/WL**-5

M**TG**1-15

M**TG**2-15

?M**TG**1-15

?M**TG**2-15

*TlTa***HG**-2

*TsTaTl***HG**-13

*Taw***HG**-16

*Tae***HG**-12

*Tab***HG**-14

*TabTaw***HG**-9

*TeTab***HG**-11

^{m}*TabTbTe***HG**-6/7

^{m}*Taw/bTwTe***HG**-8/10

Map: 10.18
Prepared for: HPPL
Drawn by: RH
Version: 1

Vegetation Mapping (Map 1 of 5)

N

0 0.75
Kilometres

Datum: GCS GDA 1994

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680000

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4

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1

Map Area

E47/1244

Map

Survey Area

Area Supplied by HPPL

E 47/1244

RHI Railway SRL Corridor

Cleared Area

M**SL**-1

*AcMi***SL**-3

AtAcSL-4

MA**S/WL**-5

M**TG**1-15

M**TG**2-15

?M**TG**1-15

?M**TG**2-15

*TlTa***HG**-2

*TsTaTl***HG**-13

*Taw***HG**-16

*Tae***HG**-12

*Tab***HG**-14

*TabTaw***HG**-9

*TeTab***HG**-11

^{m}*TabTbTe***HG**-6/7

^{m}*Taw/bTwTe***HG**-8/10

Map: 10.19
Prepared for: HPPL
Drawn by: RH
Version: 1

maia

Vegetation Mapping (Map 2 of 5)

N

0 0.75
Kilometres

Datum: GCS GDA 1994

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680000
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7570000

5
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Map Area
E47/1244

Cleared Area
MSL-1
*AcMi*SL-3
AtAcSL-4
MAS/WL-5
MTG1-15
MTG2-15
?MTG1-15
?MTG2-15
*Tl/Ta*HG-2
*TsTaTl*HG-13
*Taw*HG-16
*Tae*HG-12
*Tab*HG-14
*TabTaw*HG-9
*TeTab*HG-11
m*TabTbTe*HG-6/7
m*Taw/bTwTe*HG-8/10

Map
Survey Area
Area Supplied by HPPL
E 47/1244
RHI Railway SRL Corridor

maia

Map: 10.20
Prepared for: HPPL
Drawn by: RH
Version: 1

Vegetation Mapping (Map 3 of 5)

N
0 1
Kilometres
Datum: GCS GDA 1994

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680000
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7585000

Map Area

5
4
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1

E47/1244

Cleared Area
M**SL**-1
*AcMi***SL**-3
AtAcSL-4
MA**S/WL**-5
M**TG**1-15
M**TG**2-15
?M**TG**1-15
?M**TG**2-15
*Tl/Ta***HG**-2
*TsTaTl***HG**-13
*Taw***HG**-16
*Tae***HG**-12
*Tab***HG**-14
*TabTaw***HG**-9
*TeTab***HG**-11
^{m}*TabTbTe***HG**-6/7
^{m}*Taw/bTwTe***HG**-8/10

Map
Survey Area
Area Supplied by HPPL
E 47/1244
RHI Railway SRL Corridor

Map: 10.21
Prepared for: HPPL
Drawn by: RH
Version: 1

Vegetation Mapping (Map 4 of 5)

N
0 1
Kilometres
Datum: GCS GDA 1994

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680000

685000

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7605000

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7595000

Map Area

5

4

3

2

1

E47/1244

Map

Survey Area

Area Supplied by HPPL

E 47/1244

RHI Railway SRL Corridor

Cleared Area

M**SL**-1

*AcMi***SL**-3

AtAcSL-4

MA**S/WL**-5

M**TG**1-15

M**TG**2-15

?M**TG**1-15

?M**TG**2-15

Tl/*Ta***HG**-2

*TsTaTl***HG**-13

*Taw***HG**-16

*Tae***HG**-12

*Tab***HG**-14

*TabTaw***HG**-9

*TeTab***HG**-11

m*TabTbTe***HG**-6/7

m*Taw/bTwTe***HG**-8/10

Map: 10.22
Prepared for: HPPL
Drawn by: RH
Version: 1

Vegetation Mapping (Map 5 of 5)

N

0 1

Kilometres

Datum: GCS GDA 1994

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660000
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7560000
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7550000

Map Area

Excellent
Excellent/Very Good
Very Good
Completely Degraded

Survey Area
Area supplied by HPPL
E 47/1244
RHI Railway SRL Corridor

maia

Map: 10.23
Prepared for: HPPL
Drawn by: RH
Version: 1

Vegetation Condition (Map 1 of 4)

N
0
1.5
Kilometres
Datum: GCS GDA 1994

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675000
680000
685000
7570000
7565000
7560000
7555000

Map Area

Excellent
Excellent/Very Good
Very Good
Completely Degraded
Survey Area
Area supplied by HPPL
E 47/1244
RHI Railway SRL Corridor

maia

Map: 10.24
Prepared for: HPPL
Drawn by: RH
Version: 1

Vegetation Condition (Map 2 of 4)

N
0 1.5
Kilometres
Datum: GCS GDA 1994

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680000
685000
690000
7590000
7585000
7580000
7575000
Map Area
Excellent
Excellent/Very Good
Very Good
Completely Degraded
Survey Area
Area supplied by HPPL
E 47/1244
RHI Railway SRL Corridor
maia
Map: 10.25
Prepared for: HPPL
Drawn by: RH
Version: 1
Vegetation Condition (Map 3 of 4)
N
0
1.5
Kilometres
Datum: GCS GDA 1994

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680000
685000
690000
7605000
7600000
7595000
7590000

Map Area

Excellent
Excellent/Very Good
Very Good
Completely Degraded
Survey Area
Area supplied by HPPL
E 47/1244
RHI Railway SRL Corridor

Map: 10.26
Prepared for: HPPL
Drawn by: RH
Version: 1

Vegetation Condition (Map 4 of 4)

N
0 1.5
Kilometres
Datum: GCS GDA 1994

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Appendix 1: Database and Literature Search Results

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Table A1. 1: Conservation Significant Flora Species Recorded within 20 km of the Survey Area

Species	Rank	Flowering	Habitat	Recorded Locations (FloraBase, 2012)	Possibility of Occurrence	Source
Cochlospermum sp. Pilbara (D. Brassington, E. Ager & J. Macknay LCH 31756)	P1	NA	Granite dome (sheet granite).	Between Port Hedland and Newman.	Unlikely	Records supplied by RHI
Teucrium pilbaranum	P1	May or September	Crab hole plain in a river floodplain, margin of calcrete table.	Newman, Millstream Nation Park, Wittenoom, 30 km west of Mulga Downs	Unlikely	Maia (2012e)
Adiantum capillus-veneris	P2	NA	Moist, sheltered sites in gorges and on cliff walls.	Dales Gorge, Kalamina Gorge, Hamersley Gorge, Fortescue Falls, Wittenoom Gorge.	Unlikely	WAH (1998 -)
Paspalidium retiglume	P2	April	Clay soils.	Millstream-Chichester National Park, Hamersley Ranges, Mount Florence Station, Moola Bulla.	Possible	Coffey (2010)
Stylidium weeliwolli	P2	Aug to Sept	Gritty sand soil, sandy clay. Edges of watercourses.	Mount Augustus National Park, Spring Creek, Barlee Range Nature Reserve, Weeli Wolli Springs.	Possible	Biota (2004)
Acacia glaucocaesia	P3	Jul to Sept	Red loam, sandy loam, clay. Floodplains.	Streely Creek, Shaw River, Karratha, Anna Plains Station, Roebourne, De Grey River Crossing, Cleaverville, West Peawah River, Goldsworthy, Salt Creek, Mardie Station, Dampier.	Possible – and located during survey	NM, WAH (1998 -), WA Herb
Elatine macrocalyx	P3	May to October	Shallow sands over clay. Margins of playa lakes and clay pans.	Charles Darwin Nature Reserve, Lake Cohen, Goongarrie Station, Fortescue Valley, Lake Cronin.	Unlikely	WAH (1998 -)
Euphorbia stevenii	P3	?Mar to Jul	Clay sandy soils	Cooletha Hill, Ord River Irrigation Area, North of Munjina, Kununurra.	Possible	NM, WAH (1998 -), WA Herb

Species	Rank	Flowering	Habitat	Recorded Locations (FloraBase, 2012)	Possibility of Occurrence	Source
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)	P3	?Mar to Sept	Red-brown clay soil, calcrete pebbles. Low undulating plain, swampy plains.	Bakers South (Newman), East Angeles, Newman, Noreena Downs Station, Mulga Downs Station.	Possible	NM, WAH (1998 -)
Gymnanthera cunninghamii	P3	January to December	Sandy soils and drainage areas	FMG Stage A Corridor, Mandora Marsh, Caves Creek, Port Hedland, Boodarie Station, Mooka Station, Enderby Island, Eighty Mile Beach and Woodstock Station	Possible	Biota (2004), Maia (2011), NM, WAH (1998)-, WA Herb
Indigofera gilesii subsp. *gilesii*	P3	May or Aug	Pebbly loam amongst boulders & outcrops. Hills.	Newman, Rhodes Ridge, Rawlinson Range, Bedford Ranges, Ophthalmia Range, Bramall Hills, Hamersley Ranges, Packsaddle Hill, Coondewanna Hill, West Angeles, Walter James Range.	Possible	NM, TPFL
Nicotiana umbratica	P3	Apr to Jun	Shallow soils, rocky outcrops	Spear Hill, Nullagine, Hancock Gorge, Abydos Station, Woodstock Station, Eginbah Station.	Unlikely	NM, WAH (1998 -), WA Herb
Rhagodia sp. Hamersley (M. Trudgen 17794)	P3	May to December	Clay plains, valley floors, stony plains, slopes, floodplain, minor drainage.	Christmas Creek, Spearhole Creek, Roy Hill Station, Mount Robinson, Tom Price, East Angelas, Opthalmia Range, Mount Hilditch.	Possible	Maia (2010)
Rostellularia adscendens var. *latifolia*	P3	April to May	Ironstone soils. Near creeks, rocky hills.	Christmas Creek Mining Lease, Tom Price, Mount Bruce, Hamersly Ranges, Mt Hyogo, Karijini National Park, Juna Downs, Kalamina Gorge, Warrawagine Station, Oakover River.	Possible	Ecologia (2008a), NM, WAH (1998 -)

Species	Rank	Flowering	Habitat	Recorded Locations (FloraBase, 2012)	Possibility of Occurrence	Source
Themeda sp. Hamersley (M.E. Trudgen 11431)	P3	August	Red clay, Clay pan, grass plains.	Tom Price, Mount Sheila, Newman, Nullagine, Karratha, Millstream Station, Hamersley Station, East Angelas, West Angelas.	Possible	Biota (2004)
Bulbostylis burbidgeae	P4	March or June to August	Granitic soils. Granite outcrops, cliff bases	FMG Stage A Rail, Lalla Rookh Station, Hillside Station, Gorge Range, Mount Edgar Station, Central Reserve Area.	Unlikely	Biota (2004), Maia (2011)
Goodenia nuda	P4	April to August	Plains of sand and loam, floodplains	Robe River, Christmas Creek Mining Tenement, West-north-west of Pannawonica, Port Hedland (20 km south), Jinayri, Cloudbreak Minesite, Yandi Minesite, Roy Hill Mine Site, Mount Bruce, Roy Hill Station, Mardie Station, FMG Stage B Rail Corridor, Marillana Station and Lake Auld, Weeli Wolli Creek	Possible (located during survey)	Maia (2012e), ENV (2011)

Note: P1-P4 = Priority 1 to Priority 4 species; NA = information not available; NM = NatureMap database result; TPFL = Threatened and Priority Flora database; WA Herb = WA Herbarium database; WAH (1998-) = Western Australian Herbarium FloraBase.

DEC Threatened Flora Database search reference numbers: TP, TPFL and WA Herb-1 = search reference 14-0412FL; DEFL, WA Herb-2 = search reference 47-0211FL.

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Appendix 2: Quadrat Locations

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Table A2. 1: Quadrat Locations (GDA94, MGA50)

Site	Easting (mE)	Northing (mN)	Site	Easting (mE)	Northing (mN)
HR01	684466	7570286	**HR47**	686148	7597848
HR02	662695	7556020	**HR48**	686182	7596475
HR03	665871	7556197	**HR49**	686235	7606018
HR04	666196	7555803	**HR50**	686267	7609053
HR05	668127	7556173	**HR51**	686310	7595852
HR06	669351	7556107	**HR52**	686382	7599345
HR07	670726	7556545	**HR53**	686395	7608861
HR08	673320	7556212	**HR54**	686411	7607856
HR09	674005	7556539	**HR55**	686484	7595238
HR10	674050	7556688	**HR56**	686550	7571744
HR11	674652	7556260	**HR57**	686656	7583169
HR12	675265	7556562	**HR58**	686689	7596108
HR13	675608	7556706	**HR59**	686689	7605481
HR14	676542	7556354	**HR60**	686772	7592910
HR15	677364	7556514	**HR61**	686811	7572323
HR17	677795	7556567	**HR62**	686815	7608022
HR18	678063	7557116	**HR63**	687005	7573063
HR21	680482	7557671	**HR64**	687076	7582121
HR24	681679	7557847	**HR65**	687096	7581525
HR25	681906	7558612	**HR66**	687105	7579637
HR26	681997	7558264	**HR67**	687124	7587268
HR28	683034	7559001	**HR68**	687151	7584746
HR29	683434	7569432	**HR69**	687332	7593276
HR30	683634	7568885	**HR70**	687531	7578313
HR31	683656	7559163	**HR71**	687543	7581634
HR32	683799	7563901	**HR72**	687760	7587913
HR33	683880	7569692	**HR73**	687791	7576882
HR34	684172	7562618	**HR74**	687934	7579619
HR35	684202	7561497	**HR75**	687936	7574000
HR36	684359	7560155	**HR76**	687972	7592101
HR37	684441	7559721	**HR77**	687973	7587528
HR38	684620	7571118	**HR78**	688202	7589809
HR39	684692	7562630	**HR79**	688396	7577538
HR40	684964	7570207	**HR80**	688528	7576443
HR41	685003	7561726	**HR81**	688591	7593563
HR42	685660	7571034	**HR82**	688732	7590043
HR43	685880	7595824	**HR83**	688877	7593809
HR44	685963	7608190	**HR84**	689284	7590112
HR45	686019	7605848	**HR85**	689442	7593284
HR46	686047	7609276			

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Appendix 3: Statistical Analysis Inputs and Outputs

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Table A3. 1: Species by Vegetation Association and Site Matrix

Code	MSH	AaAapAxWL	TabTbHG	AaAapAxWL	AaAapAxWL	MSH	TeTbHG	TabTbHG	TabTbHG	TabTbHG	AaAapAxWL	AaAapAxWL	TeTbHG	TabTbHG	TaeHG	TeTbHG	TeTbHG	MTG1/2	MTG1/2	MTG1/2
Species	HR01	HR02	HR03	HR04	HR05	HR06	HR07	HR08	HR09	HR10	HR11	HR12	HR13	HR14	HR15	HR17	HR18	HR21	HR24	HR25
Abutilon otocarpum/fraserii	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Abutilon trudgenii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia acradenia	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia adoxa var. adoxa	0	0	0	1	0	0	1	1	1	0	0	0	0	1	0	1	1	0	0	0
Acacia ancistrocarpa	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia aneura/incurveaneura	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Acacia aptaneura	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Acacia atkinsiana	0	0	1	1	1	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0
Acacia bivenosa	1	0	1	1	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0
Acacia colei var. colei	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia coriacea subsp. pendens	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia glaucocaesia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Acacia hilliana	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Acacia inaequilatera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia maitlandii	0	0	0	0	0	1	1	0	0	0	0	1	1	0	0	1	1	0	0	0
Acacia marramamba	0	0	0	1	0	0	0	1	0	0	1	0	0	1	1	0	0	0	0	0
Acacia monticola	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Acacia orthocarpa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia pruinocarpa	0	1	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Acacia pyrifolia	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia robeorum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia stellaticeps	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia synchronicia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia tenuissima	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Acacia tetragonophylla	0	1	1	1	1	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0
Acacia trachycarpa	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia tumida	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Acacia xiphophylla	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Alternanthera nana	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Amaranthus cuspidifolius	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Aristida latifolia	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1
Astrebla pectinata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Atalaya hemiglauca	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bonamia linearis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bonamia media	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bonamia rosea/erecta	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0
Bonamia sp. Dampier (A.A. Mitchell PRP 217)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Capparis lasiantha	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0
Cassytha capillaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Chrysocephalum apiculatum	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chrysopogon fallax	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clerodendrum floribundum var. angustifolium	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corchorus incanus subsp. lithophilus	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Corchorus laniflorus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corchorus lasiocarpus	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	1	0	0	0
Corchorus parviflorus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corymbia hamersleyana	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crotalaria cunninghamii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cucumis maderaspatanus	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cullen lachnostachys	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cymbopogon ambiguus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
Cymbopogon obtectus	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Cymbopogon procerus	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Cyperus vaginatus	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Code	MSH	AaAapAxWL	TabTbHG	AaAapAxWL	AaAapAxWL	MSH	TeTbHG	TabTbHG	TabTbHG	TabTbHG	AaAapAxWL	AaAapAxWL	TeTbHG	TabTbHG	TaeHG	TeTbHG	TeTbHG	MTG1/2	MTG1/2	MTG1/2
Species	HR01	HR02	HR03	HR04	HR05	HR06	HR07	HR08	HR09	HR10	HR11	HR12	HR13	HR14	HR15	HR17	HR18	HR21	HR24	HR25
Dodonaea coriacea	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
Dodonaea petiolaris	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Duperreya commixta	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enneapogon caerulescens	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enneapogon polyphyllus	0	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Eragrostis desertorum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eragrostis eriopoda	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Eragrostis xerophila	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eremophila forrestii	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eremophila latrobei subsp. filiformis	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0
Eremophila longifolia	1	0	0	0	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0
Eriachne benthamii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eriachne mucronata	0	0	1	0	0	0	1	0	0	0	1	1	1	0	0	0	1	0	0	0
Eriachne obtusa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
Eucalyptus camaldulensis subsp. obtusa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eucalyptus leucophloia subsp. leucophloia	0	0	1	1	0	0	1	1	1	1	1	0	1	1	0	1	1	0	0	0
Eucalyptus victrix	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eucalyptus xerothermica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eulalia aurea	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exocarpos sparteus/Anthobolus leptomerioides	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Fimbristylis dichotoma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Flueggea virosa subsp. melanthesoides	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gompholobium oreophilum	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
Goodenia cusackiana	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
Goodenia lamprosperma	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goodenia microptera	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0
Goodenia stobbsiana	0	0	0	0	0	0	0	1	1	0	1	0	0	1	0	0	0	0	0	0
Gossypium australe	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grevillea pyramidalis subsp. leucadendron	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grevillea wickhamii	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
Hakea chordophylla	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0
Hakea lorea subsp. lorea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heliotropium chrysocarpum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heliotropium pachyphyllum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hibiscus burtonii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hibiscus coatesii	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hibiscus sturtii	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	1	0	0	0
Hybanthus aurantiacus	1	0	0	0	0	1	1	0	0	0	1	0	0	0	0	1	1	0	0	0
Indigofera monophylla	1	0	1	0	1	1	1	0	0	0	0	0	1	1	0	1	1	0	0	0
Isotropis atropurpurea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jasminum didymum subsp. lineare	1	0	0	0	0	1	1	0	0	0	1	0	1	0	0	1	0	0	0	0
Keraudrenia nephrosperma	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Maireana villosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melaleuca eleuterostachya	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melaleuca glomerata	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melaleuca linophylla	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melhania oblongifolia	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollugo molluginea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraneurachne muelleri	0	1	0	1	1	0	1	0	0	0	1	0	1	0	0	0	1	0	0	0
Petalostylis labicheoides	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Phyllanthus erwinii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Phyllanthus exilis	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Pluchea dentex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pluchea ferdinandi-muelleri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pluchea rubelliflora	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pluchea tetranthera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Code	MSH	AaAapAxWL	TabTbHG	AaAapAxWL	AaAapAxWL	MSH	TeTbHG	TabTbHG	TabTbHG	TabTbHG	AaAapAxWL	AaAapAxWL	TeTbHG	TabTbHG	TaeHG	TeTbHG	TeTbHG	MTG1/2	MTG1/2	MTG1/2
Species	HR01	HR02	HR03	HR04	HR05	HR06	HR07	HR08	HR09	HR10	HR11	HR12	HR13	HR14	HR15	HR17	HR18	HR21	HR24	HR25
Polycarpaea corymbosa	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polycarpaea longiflora	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Polymeria calycina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psydrax latifolia	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Psydrax suaveolens	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Pterocaulon sphacelatum	0	1	0	1	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Ptilotus astrolasius	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Ptilotus calostachyus	0	0	1	1	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0
Ptilotus nobilis var. nobilis	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ptilotus obovatus	0	1	0	1	1	0	0	0	1	0	0	1	0	1	0	1	1	0	0	0
Ptilotus rotundifolius	0	0	0	0	1	0	0	0	0	1	0	o 0	0	1	0	0	0	0	0	0
Rhagodia eremaea	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Rhynchosia minima	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0
Salsola australis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scaevola amblyanthera var. centralis / browniana	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Senna artemisioides subsp. helmsii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senna artemisioides subsp. oligophylla	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	1	1	0
Senna artemisioides subsp. x sturtii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senna glutinosa subsp. glutinosa	0	0	1	1	1	0	1	1	0	0	0	0	1	1	0	1	1	0	1	0
Senna glutinosa subsp. pruinosa	0	1	1	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Senna glutinosa subsp. x luerssenii	0	0	0	1	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0
Senna notabilis	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Senna symonii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senna venusta	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sida arenicola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sida echinocarpa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sida rohlenae subsp. rohlenae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
Sida sp. dark green fruits (S. van Leeuwen 2260)	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Solanum ashbyae/gabrielae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solanum diversiflorum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solanum ellipticum	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Solanum phlomoides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stemodia grossa	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stemodia viscosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Streptoglossa bubakii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
Streptoglossa decurrens	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Streptoglossa liatroides	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Streptoglossa odora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tephrosia densa	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tephrosia sp. Bungaroo Creek (M.E. Trudgen 11601)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Themeda triandra	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0
Tribulus suberosus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichodesma zeylanicum var. zeylanicum	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0
Triodia angusta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Triodia brizoides	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0	0	1	0	0	0
Triodia aff epactia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Triodia epactia/pungens complex	1	1	0	1	1	1	0	0	0	0	1	1	1	0	0	1	1	1	0	0
Triodia aff. basedowii	0	1	1	1	1	0	0	1	1	0	1	1	0	1	0	0	1	0	0	0
Triodia longiceps	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Triodia secunda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Triodia wiseana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Triumfetta chaetocarpa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Code	TawTeHG	MTG1/2	MSH	MSH	AtAcSL	TeTawHG	TawTeHG	MSH	TeTabHG	MTG1/2	TeTawHG	MSH	TeTawHG	TeTawHG	MSH	TeTawHG	TeTawHG	TawHG	TabTawHG	AtAcSL
Species	HR26	HR28	HR29	HR30	HR31	HR32	HR33	HR34	HR35	HR36	HR37	HR38	HR39	HR40	HR41	HR42	HR43	HR44	HR45	HR46
Abutilon otocarpum/fraserii	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Abutilon trudgenii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Acacia acradenia	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
Acacia adoxa var. adoxa	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Acacia ancistrocarpa	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0
Acacia aneura/incurveaneura	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia aptaneura	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia atkinsiana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia bivenosa	0	0	1	1	0	0	1	1	0	0	0	1	0	0	0	0	0	1	0	0
Acacia colei var. colei	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia coriacea subsp. pendens	0	0	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Acacia glaucocaesia	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia hilliana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia inaequilatera	1	0	0	0	0	1	1	0	1	0	1	0	1	1	0	1	1	0	0	0
Acacia maitlandii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia marramamba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia monticola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Acacia orthocarpa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia pruinocarpa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia pyrifolia	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Acacia robeorum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia stellaticeps	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia synchronicia	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Acacia tenuissima	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0
Acacia tetragonophylla	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Acacia trachycarpa	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1
Acacia tumida	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Acacia xiphophylla	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Alternanthera nana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Amaranthus cuspidifolius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aristida latifolia	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Astrebla pectinata	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Atalaya hemiglauca	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Bonamia linearis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bonamia media	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bonamia rosea/erecta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bonamia sp. Dampier (A.A. Mitchell PRP 217)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capparis lasiantha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cassytha capillaris	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Chrysocephalum apiculatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chrysopogon fallax	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	1
Clerodendrum floribundum var. angustifolium	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corchorus incanus subsp. lithophilus	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Corchorus laniflorus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
Corchorus lasiocarpus	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
Corchorus parviflorus	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Corymbia hamersleyana	0	0	1	0	0	0	1	1	0	0	1	1	1	0	1	1	0	0	0	0
Crotalaria cunninghamii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Cucumis maderaspatanus	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cullen lachnostachys	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
Cymbopogon ambiguus	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Cymbopogon obtectus	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
Cymbopogon procerus	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0
Cyperus vaginatus	0	0	1	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1

Code	TawTeHG	MTG1/2	MSH	MSH	AtAcSL	TeTawHG	TawTeHG	MSH	TeTabHG	MTG1/2	TeTawHG	MSH	TeTawHG	TeTawHG	MSH	TeTawHG	TeTawHG	TawHG	TabTawHG	AtAcSL
Species	HR26	HR28	HR29	HR30	HR31	HR32	HR33	HR34	HR35	HR36	HR37	HR38	HR39	HR40	HR41	HR42	HR43	HR44	HR45	HR46
Dodonaea coriacea	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Dodonaea petiolaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Duperreya commixta	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Enneapogon caerulescens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Enneapogon polyphyllus	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Eragrostis desertorum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eragrostis eriopoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eragrostis xerophila	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Eremophila forrestii	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Eremophila latrobei subsp. filiformis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eremophila longifolia	0	0	0	0	0	0	1	1	0	1	0	1	0	0	1	0	0	0	0	0
Eriachne benthamii	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0
Eriachne mucronata	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Eriachne obtusa	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Eucalyptus camaldulensis subsp. obtusa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Eucalyptus leucophloia subsp. leucophloia	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Eucalyptus victrix	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0
Eucalyptus xerothermica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eulalia aurea	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Exocarpos sparteus/Anthobolus leptomerioides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fimbristylis dichotoma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Flueggea virosa subsp. melanthesoides	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Gompholobium oreophilum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goodenia cusackiana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goodenia lamprosperma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Goodenia microptera	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1	0	1
Goodenia stobbsiana	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	1	0	0	0
Gossypium australe	0	0	1	1	0	1	1	1	1	0	0	1	0	1	1	1	0	0	0	0
Grevillea pyramidalis subsp. leucadendron	0	0	1	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0
Grevillea wickhamii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hakea chordophylla	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hakea lorea subsp. lorea	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0	1	0	0	0	0
Heliotropium chrysocarpum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Heliotropium pachyphyllum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hibiscus burtonii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hibiscus coatesii	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
Hibiscus sturtii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hybanthus aurantiacus	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1
Indigofera monophylla	1	0	1	0	0	0	1	1	0	0	1	1	1	0	1	1	0	0	1	1
Isotropis atropurpurea	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Jasminum didymum subsp. lineare	0	0	1	1	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0
Keraudrenia nephrosperma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maireana villosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melaleuca eleuterostachya	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melaleuca glomerata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melaleuca linophylla	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Melhania oblongifolia	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Mollugo molluginea	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	1	0	1	0
Paraneurachne muelleri	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0
Petalostylis labicheoides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phyllanthus erwinii	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phyllanthus exilis	0	0	0	1	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0
Pluchea dentex	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Pluchea ferdinandi-muelleri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pluchea rubelliflora	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pluchea tetranthera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Code	TawTeHG	MTG1/2	MSH	MSH	AtAcSL	TeTawHG	TawTeHG	MSH	TeTabHG	MTG1/2	TeTawHG	MSH	TeTawHG	TeTawHG	MSH	TeTawHG	TeTawHG	TawHG	TabTawHG	AtAcSL
Species	HR26	HR28	HR29	HR30	HR31	HR32	HR33	HR34	HR35	HR36	HR37	HR38	HR39	HR40	HR41	HR42	HR43	HR44	HR45	HR46
Polycarpaea corymbosa	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Polycarpaea longiflora	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Polymeria calycina	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0
Psydrax latifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psydrax suaveolens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pterocaulon sphacelatum	1	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
Ptilotus astrolasius	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0
Ptilotus calostachyus	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	1	0	1	0
Ptilotus nobilis var. nobilis	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Ptilotus obovatus	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0
Ptilotus rotundifolius	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Rhagodia eremaea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhynchosia minima	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
Salsola australis	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Scaevola amblyanthera var. centralis / browniana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senna artemisioides subsp. helmsii	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Senna artemisioides subsp. oligophylla	0	1	1	1	0	0	1	0	1	1	0	0	0	0	1	0	0	1	0	0
Senna artemisioides subsp. x sturtii	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Senna glutinosa subsp. glutinosa	0	0	1	0	0	0	0	1	0	0	0	0	1	1	0	1	0	0	0	0
Senna glutinosa subsp. pruinosa	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0
Senna glutinosa subsp. x luerssenii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Senna notabilis	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Senna symonii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senna venusta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sida arenicola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sida echinocarpa	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sida rohlenae subsp. rohlenae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Sida sp. dark green fruits (S. van Leeuwen 2260)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0
Solanum ashbyae/gabrielae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solanum diversiflorum	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
Solanum ellipticum	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Solanum phlomoides	0	0	0	1	0	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0
Stemodia grossa	0	0	1	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
Stemodia viscosa	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Streptoglossa bubakii	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0
Streptoglossa decurrens	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Streptoglossa liatroides	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Streptoglossa odora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Tephrosia densa	0	0	1	0	0	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0
Tephrosia sp. Bungaroo Creek (M.E. Trudgen 11601)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Themeda triandra	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
Tribulus suberosus	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichodesma zeylanicum var. zeylanicum	1	0	0	1	0	0	0	1	1	0	1	0	0	0	1	0	0	0	1	0
Triodia angusta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Triodia brizoides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Triodia aff epactia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Triodia epactia/pungens complex	0	0	1	1	1	1	1	1	1	0	0	0	1	1	1	1	0	1	1	0
Triodia aff. basedowii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
Triodia longiceps	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Triodia secunda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Triodia wiseana	1	0	1	1	0	1	1	1	1	0	1	0	1	1	0	0	0	1	1	0
Triumfetta chaetocarpa	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Code	TawTeHG	TeTabHG	MSH	TsTaTlHG	TeTabHG	TsTaTlHG	TlTaHG	TabHG	TeTawHG	AtAcSL	TeTabHG	TawTeHG	Outlier	TeTabHG	TabHG	TabTawHG	TeTabHG	TabTawHG	TabHG	TabHG
Species	HR47	HR48	HR49	HR50	HR51	HR52	HR53	HR54	HR55	HR56	HR57	HR58	HR59	HR60	HR61	HR62	HR63	HR64	HR65	HR66
Abutilon otocarpum/fraserii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Abutilon trudgenii	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia acradenia	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	0
Acacia adoxa var. adoxa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia ancistrocarpa	0	1	1	0	1	0	1	0	0	0	1	0	0	1	0	0	1	0	0	0
Acacia aneura/incurveaneura	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia aptaneura	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia atkinsiana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia bivenosa	0	0	1	0	0	0	1	1	0	1	0	0	0	0	1	1	0	1	0	1
Acacia colei var. colei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia coriacea subsp. pendens	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Acacia glaucocaesia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia hilliana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia inaequilatera	1	1	0	0	1	0	0	0	1	0	1	1	0	0	0	0	1	1	0	0
Acacia maitlandii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia marramamba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia monticola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia orthocarpa	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0
Acacia pruinocarpa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia pyrifolia	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Acacia robeorum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia stellaticeps	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia synchronicia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia tenuissima	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia tetragonophylla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia trachycarpa	0	0	1	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0
Acacia tumida	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia xiphophylla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alternanthera nana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amaranthus cuspidifolius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aristida latifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Astrebla pectinata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Atalaya hemiglauca	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Bonamia linearis	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bonamia media	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Bonamia rosea/erecta	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Bonamia sp. Dampier (A.A. Mitchell PRP 217)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Capparis lasiantha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cassytha capillaris	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
Chrysocephalum apiculatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chrysopogon fallax	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0
Clerodendrum floribundum var. angustifolium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corchorus incanus subsp. lithophilus	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0
Corchorus laniflorus	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Corchorus lasiocarpus	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0
Corchorus parviflorus	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corymbia hamersleyana	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	1
Crotalaria cunninghamii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cucumis maderaspatanus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cullen lachnostachys	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cymbopogon ambiguus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cymbopogon obtectus	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
Cymbopogon procerus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyperus vaginatus	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0

Code	TawTeHG	TeTabHG	MSH	TsTaTlHG	TeTabHG	TsTaTlHG	TlTaHG	TabHG	TeTawHG	AtAcSL	TeTabHG	TawTeHG	Outlier	TeTabHG	TabHG	TabTawHG	TeTabHG	TabTawHG	TabHG	TabHG
Species	HR47	HR48	HR49	HR50	HR51	HR52	HR53	HR54	HR55	HR56	HR57	HR58	HR59	HR60	HR61	HR62	HR63	HR64	HR65	HR66
Dodonaea coriacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dodonaea petiolaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Duperreya commixta	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Enneapogon caerulescens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Enneapogon polyphyllus	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
Eragrostis desertorum	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Eragrostis eriopoda	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
Eragrostis xerophila	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Eremophila forrestii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eremophila latrobei subsp. filiformis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eremophila longifolia	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eriachne benthamii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eriachne mucronata	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
Eriachne obtusa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eucalyptus camaldulensis subsp. obtusa	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Eucalyptus leucophloia subsp. leucophloia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eucalyptus victrix	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eucalyptus xerothermica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Eulalia aurea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exocarpos sparteus/Anthobolus leptomerioides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fimbristylis dichotoma	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0
Flueggea virosa subsp. melanthesoides	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Gompholobium oreophilum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goodenia cusackiana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goodenia lamprosperma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goodenia microptera	0	1	1	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
Goodenia stobbsiana	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0
Gossypium australe	0	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0
Grevillea pyramidalis subsp. leucadendron	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Grevillea wickhamii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hakea chordophylla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Hakea lorea subsp. lorea	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Heliotropium chrysocarpum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Heliotropium pachyphyllum	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1
Hibiscus burtonii	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hibiscus coatesii	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Hibiscus sturtii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hybanthus aurantiacus	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Indigofera monophylla	1	1	1	0	1	0	0	0	1	0	0	1	0	1	0	1	1	1	0	0
Isotropis atropurpurea	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Jasminum didymum subsp. lineare	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Keraudrenia nephrosperma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maireana villosa	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melaleuca eleuterostachya	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
Melaleuca glomerata	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Melaleuca linophylla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melhania oblongifolia	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollugo molluginea	1	0	1	0	1	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0
Paraneurachne muelleri	0	1	1	0	1	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0
Petalostylis labicheoides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phyllanthus erwinii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phyllanthus exilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pluchea dentex	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Pluchea ferdinandi-muelleri	0	0	0	1	0	1	1	0	0	0	0	1	0	0	1	0	0	0	0	1
Pluchea rubelliflora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pluchea tetranthera	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0

Code	TawTeHG	TeTabHG	MSH	TsTaTlHG	TeTabHG	TsTaTlHG	TlTaHG	TabHG	TeTawHG	AtAcSL	TeTabHG	TawTeHG	Outlier	TeTabHG	TabHG	TabTawHG	TeTabHG	TabTawHG	TabHG	TabHG
Species	HR47	HR48	HR49	HR50	HR51	HR52	HR53	HR54	HR55	HR56	HR57	HR58	HR59	HR60	HR61	HR62	HR63	HR64	HR65	HR66
Polycarpaea corymbosa	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
Polycarpaea longiflora	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Polymeria calycina	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Psydrax latifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psydrax suaveolens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pterocaulon sphacelatum	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Ptilotus astrolasius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
Ptilotus calostachyus	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Ptilotus nobilis var. nobilis	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Ptilotus obovatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ptilotus rotundifolius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhagodia eremaea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhynchosia minima	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Salsola australis	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Scaevola amblyanthera var. centralis / browniana	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1
Senna artemisioides subsp. helmsii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Senna artemisioides subsp. oligophylla	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Senna artemisioides subsp. x sturtii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senna glutinosa subsp. glutinosa	0	1	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0
Senna glutinosa subsp. pruinosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Senna glutinosa subsp. x luerssenii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senna notabilis	0	1	0	0	1	0	1	0	0	1	1	0	0	1	0	1	1	1	0	0
Senna symonii	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senna venusta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sida arenicola	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sida echinocarpa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sida rohlenae subsp. rohlenae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sida sp. dark green fruits (S. van Leeuwen 2260)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Solanum ashbyae/gabrielae	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Solanum diversiflorum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solanum ellipticum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solanum phlomoides	0	1	0	0	1	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0
Stemodia grossa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stemodia viscosa	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0
Streptoglossa bubakii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Streptoglossa decurrens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Streptoglossa liatroides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Streptoglossa odora	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Tephrosia densa	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Tephrosia sp. Bungaroo Creek (M.E. Trudgen 11601)	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Themeda triandra	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Tribulus suberosus	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Trichodesma zeylanicum var. zeylanicum	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Triodia angusta	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Triodia brizoides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Triodia aff epactia	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Triodia epactia/pungens complex	1	1	1	0	1	0	0	0	1	0	1	1	0	1	0	0	1	1	0	0
Triodia aff. basedowii	0	0	0	1	0	0	0	1	0	0	0	0	0	1	1	1	0	1	1	0
Triodia longiceps	0	0	1	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	1
Triodia secunda	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Triodia wiseana	1	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	0	1	1	1
Triumfetta chaetocarpa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Code	TawTeHG	TawTeHG	TabTawHG	TlTaHG	TabTawHG	TlTaHG	TeTabHG	TlTaHG	AtAcSL	TeTabHG	TeTabHG	Outlier	TeTabHG	AtAcSL	TabHG	AtAcSL	TawHG	TeTabHG	TeTawHG
Species	HR67	HR68	HR69	HR70	HR71	HR72	HR73	HR74	HR75	HR76	HR77	HR78	HR79	HR80	HR81	HR82	HR83	HR84	HR85
Abutilon otocarpum/fraserii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Abutilon trudgenii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia acradenia	0	0	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Acacia adoxa var. adoxa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia ancistrocarpa	0	0	0	0	0	1	1	1	0	1	1	0	1	0	0	0	0	0	0
Acacia aneura/incurveaneura	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia aptaneura	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia atkinsiana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia bivenosa	1	0	0	1	1	0	0	1	0	0	0	0	0	0	1	0	1	0	0
Acacia colei var. colei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia coriacea subsp. pendens	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0
Acacia glaucocaesia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia hilliana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia inaequilatera	1	1	0	1	0	0	1	0	0	1	1	0	1	0	0	0	0	1	1
Acacia maitlandii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia marramamba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia monticola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia orthocarpa	0	0	0	0	0	0	0	0	0	1	말	0	1	0	0	0	0	1	1
Acacia pruinocarpa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia pyrifolia	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	1	0	0	0
Acacia robeorum	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
Acacia stellaticeps	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Acacia synchronicia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1
Acacia tenuissima	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia tetragonophylla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia trachycarpa	0	0	0	0	0	1	0	1	1	1	0	0	0	1	0	1	0	0	0
Acacia tumida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia xiphophylla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alternanthera nana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amaranthus cuspidifolius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aristida latifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Astrebla pectinata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Atalaya hemiglauca	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	1	0	0	0
Bonamia linearis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bonamia media	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bonamia rosea/erecta	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1
Bonamia sp. Dampier (A.A. Mitchell PRP 217)	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capparis lasiantha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cassytha capillaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chrysocephalum apiculatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chrysopogon fallax	0	0	0	0	0	1	0	1	1	1	0	0	0	1	0	0	0	0	0
Clerodendrum floribundum var. angustifolium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corchorus incanus subsp. lithophilus	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Corchorus laniflorus	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corchorus lasiocarpus	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Corchorus parviflorus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corymbia hamersleyana	1	0	1	1	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0
Crotalaria cunninghamii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Cucumis maderaspatanus	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0
Cullen lachnostachys	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cymbopogon ambiguus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cymbopogon obtectus	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Cymbopogon procerus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyperus vaginatus	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0

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Species	HR67	HR68	HR69	HR70	HR71	HR72	HR73	HR74	HR75	HR76	HR77	HR78	HR79	HR80	HR81	HR82	HR83	HR84	HR85
Dodonaea coriacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dodonaea petiolaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Duperreya commixta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Enneapogon caerulescens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enneapogon polyphyllus	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Eragrostis desertorum	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eragrostis eriopoda	1	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0
Eragrostis xerophila	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Eremophila forrestii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eremophila latrobei subsp. filiformis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eremophila longifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eriachne benthamii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eriachne mucronata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eriachne obtusa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eucalyptus camaldulensis subsp. obtusa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Eucalyptus leucophloia subsp. leucophloia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eucalyptus victrix	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0
Eucalyptus xerothermica	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eulalia aurea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exocarpos sparteus/Anthobolus leptomerioides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fimbristylis dichotoma	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Flueggea virosa subsp. melanthesoides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gompholobium oreophilum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goodenia cusackiana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goodenia lamprosperma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goodenia microptera	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Goodenia stobbsiana	1	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1
Gossypium australe	1	0	0	0	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0
Grevillea pyramidalis subsp. leucadendron	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grevillea wickhamii	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Hakea chordophylla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hakea lorea subsp. lorea	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Heliotropium chrysocarpum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Heliotropium pachyphyllum	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hibiscus burtonii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Hibiscus coatesii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Hibiscus sturtii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hybanthus aurantiacus	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0
Indigofera monophylla	1	1	0	1	1	1	1	1	0	1	0	0	0	0	0	0	0	1	0
Isotropis atropurpurea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jasminum didymum subsp. lineare	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Keraudrenia nephrosperma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maireana villosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Melaleuca eleuterostachya	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melaleuca glomerata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Melaleuca linophylla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melhania oblongifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollugo molluginea	1	1	0	0	0	1	1	0	0	1	0	1	0	0	0	0	0	0	1
Paraneurachne muelleri	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1
Petalostylis labicheoides	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
Phyllanthus erwinii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phyllanthus exilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pluchea dentex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pluchea ferdinandi-muelleri	1	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Pluchea rubelliflora	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0
Pluchea tetranthera	1	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0

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Species	HR67	HR68	HR69	HR70	HR71	HR72	HR73	HR74	HR75	HR76	HR77	HR78	HR79	HR80	HR81	HR82	HR83	HR84	HR85
Polycarpaea corymbosa	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Polycarpaea longiflora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polymeria calycina	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Psydrax latifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psydrax suaveolens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pterocaulon sphacelatum	1	1	0	1	1	1	0	1	0	0	0	0	0	1	0	0	0	0	0
Ptilotus astrolasius	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ptilotus calostachyus	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Ptilotus nobilis var. nobilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Ptilotus obovatus	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ptilotus rotundifolius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhagodia eremaea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhynchosia minima	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Salsola australis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Scaevola amblyanthera var. centralis / browniana	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Senna artemisioides subsp. helmsii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senna artemisioides subsp. oligophylla	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Senna artemisioides subsp. x sturtii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senna glutinosa subsp. glutinosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Senna glutinosa subsp. pruinosa	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Senna glutinosa subsp. x luerssenii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senna notabilis	0	1	0	1	0	1	1	1	1	0	1	0	0	1	0	1	0	0	1
Senna symonii	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senna venusta	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Sida arenicola	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Sida echinocarpa	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Sida rohlenae subsp. rohlenae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sida sp. dark green fruits (S. van Leeuwen 2260)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Solanum ashbyae/gabrielae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solanum diversiflorum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solanum ellipticum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solanum phlomoides	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Stemodia grossa	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Stemodia viscosa	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0
Streptoglossa bubakii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Streptoglossa decurrens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Streptoglossa liatroides	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Streptoglossa odora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Tephrosia densa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tephrosia sp. Bungaroo Creek (M.E. Trudgen 11601)	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Themeda triandra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tribulus suberosus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichodesma zeylanicum var. zeylanicum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Triodia angusta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
Triodia brizoides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Triodia aff epactia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Triodia epactia/pungens complex	0	0	0	1	1	1	1	1	0	1	1	1	1	0	0	0	0	1	0
Triodia aff. basedowii	1	0	1	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0
Triodia longiceps	0	0	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Triodia secunda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Triodia wiseana	1	1	1	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	1
Triumfetta chaetocarpa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure A3. 1: Dendrogram Produced from PATN Analysis – This Survey Data Only

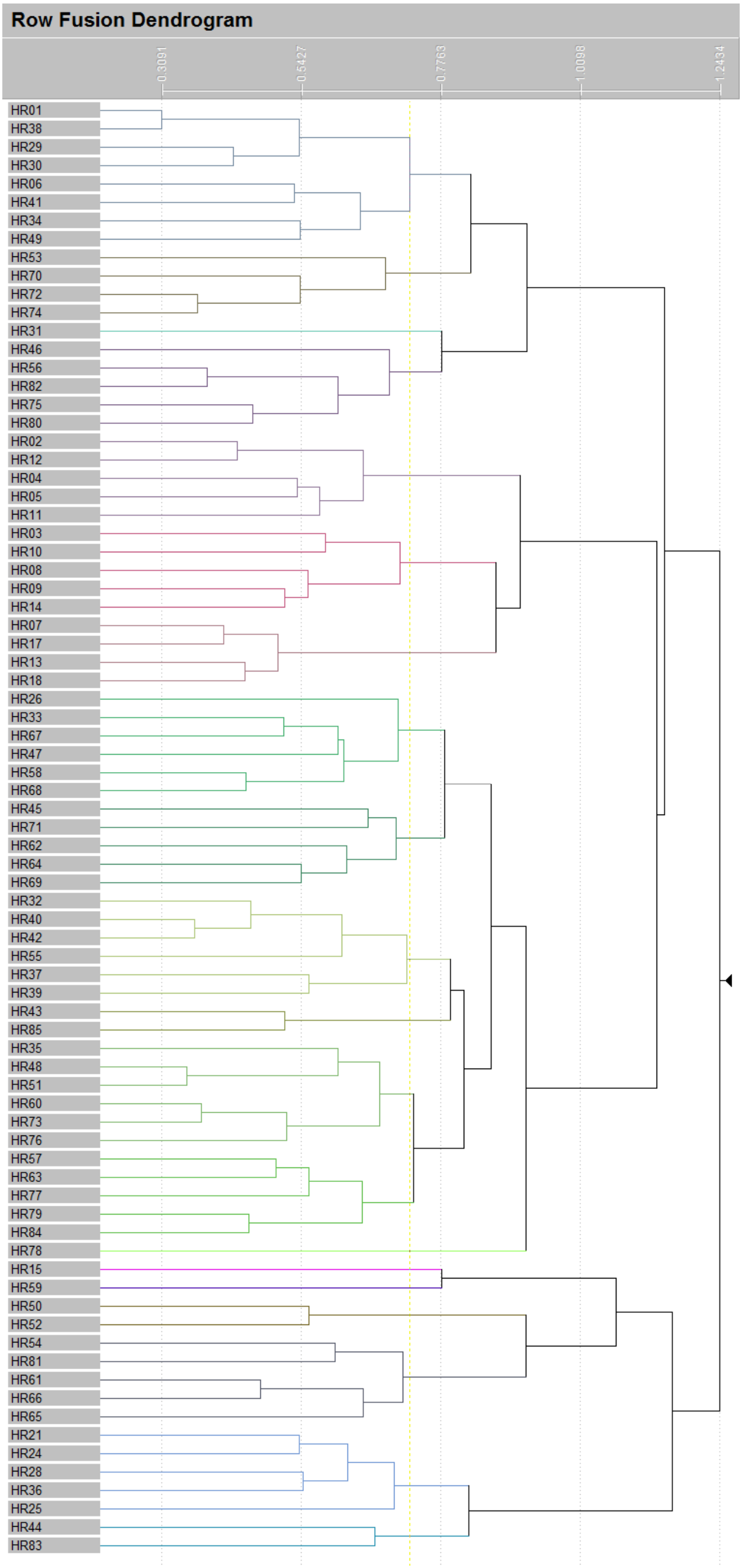
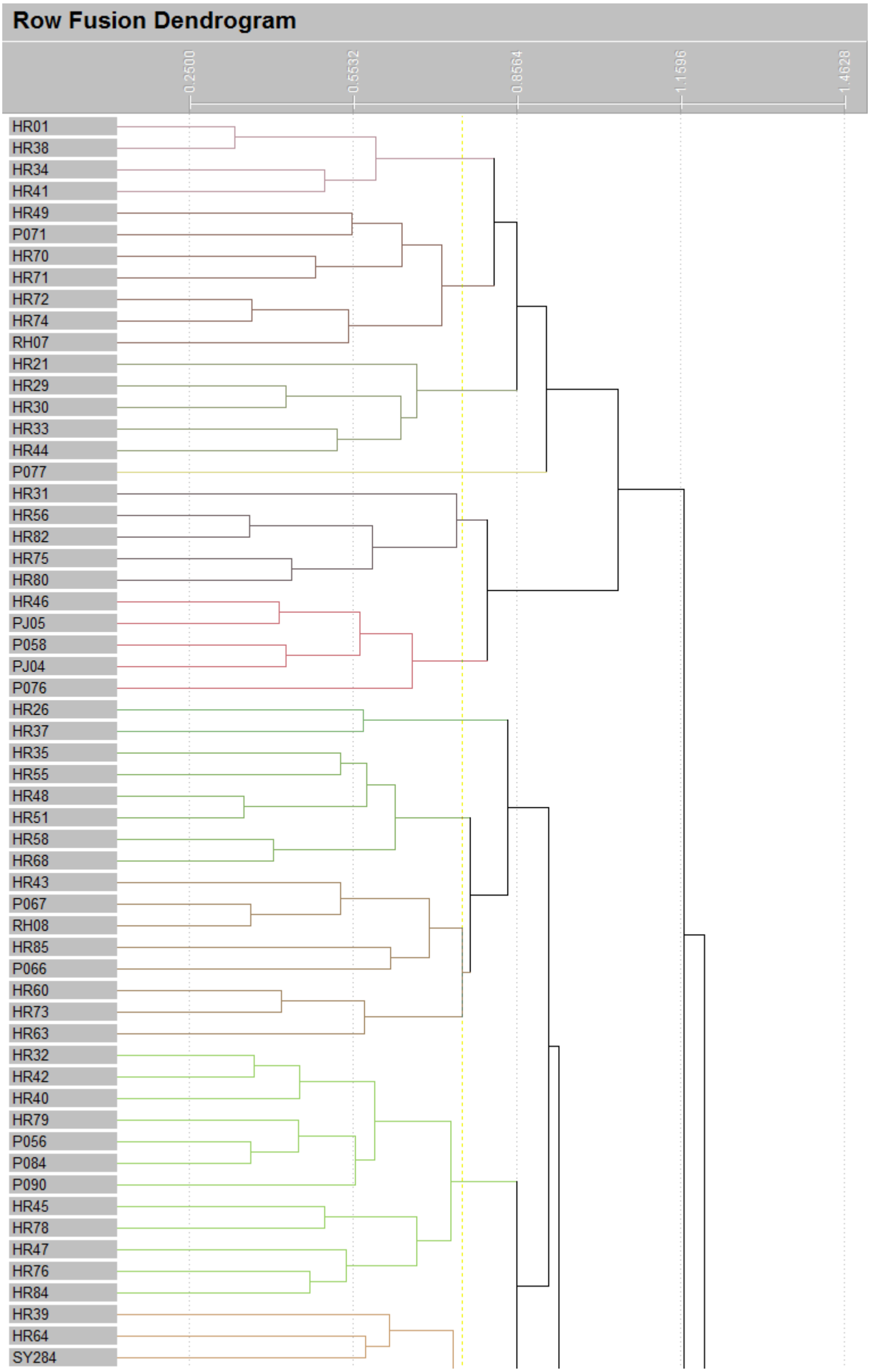
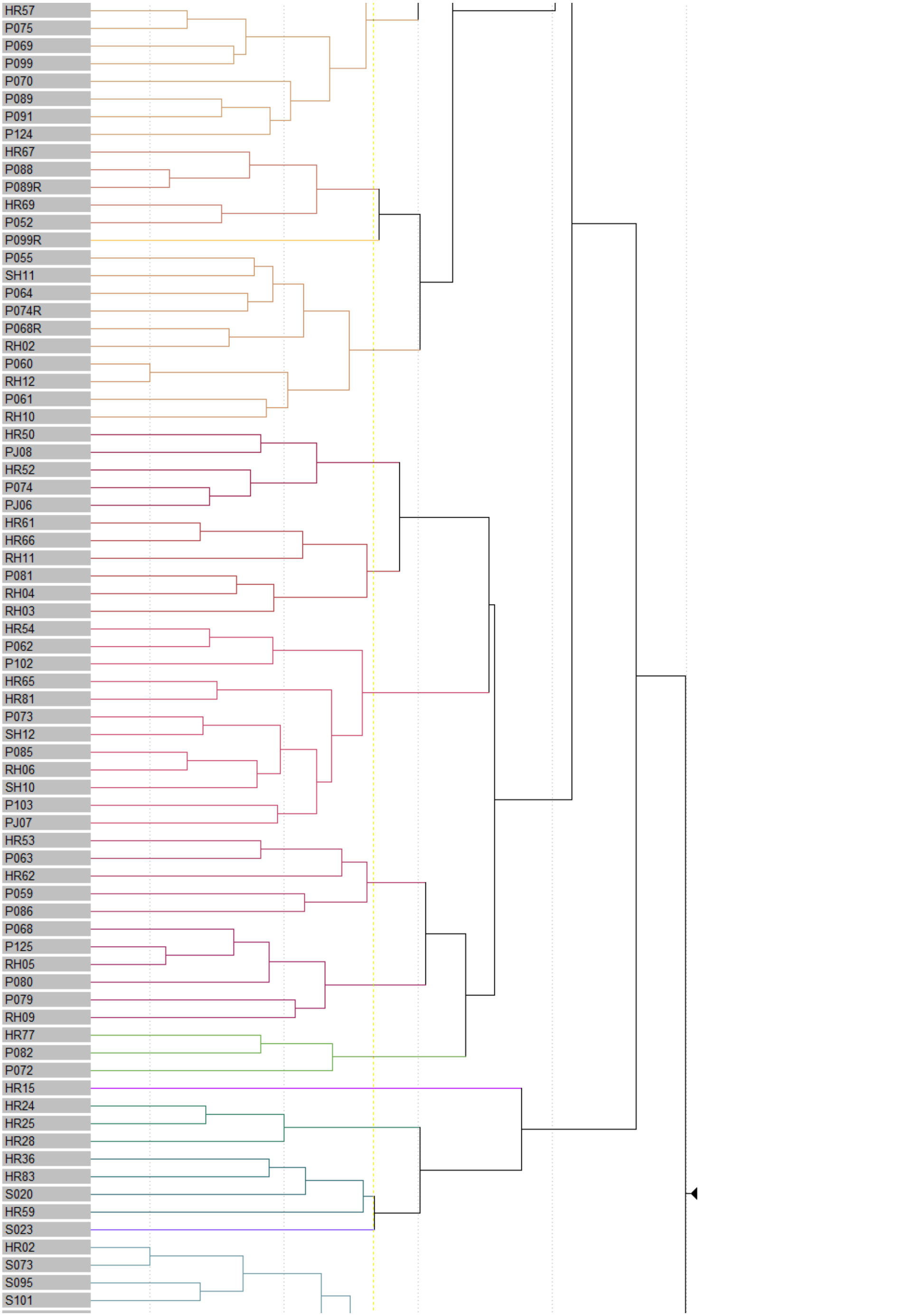


Figure A3. 2: Dendrogram Produced from PATN Analysis – Combined Survey Data

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P069
P099
P070
P089
P091
P124
HR67
P088
P089R
HR69
P052
P099R
P055
SH11
P064
P074R
P068R
RH02
P060
RH12
P061
RH10
HR50
PJ08
HR52
P074
PJ06
HR61
HR66
RH11
P081
RH04
RH03
HR54
P062
P102
HR65
HR81
P073
SH12
P085
RH06
SH10
P103
PJ07
HR53
P063
HR62
P059
P086
P068
P125
RH05
P080
P079
RH09
HR77
P082
P072
HR15
HR24
HR25
HR28
HR36
HR83
S020
HR59
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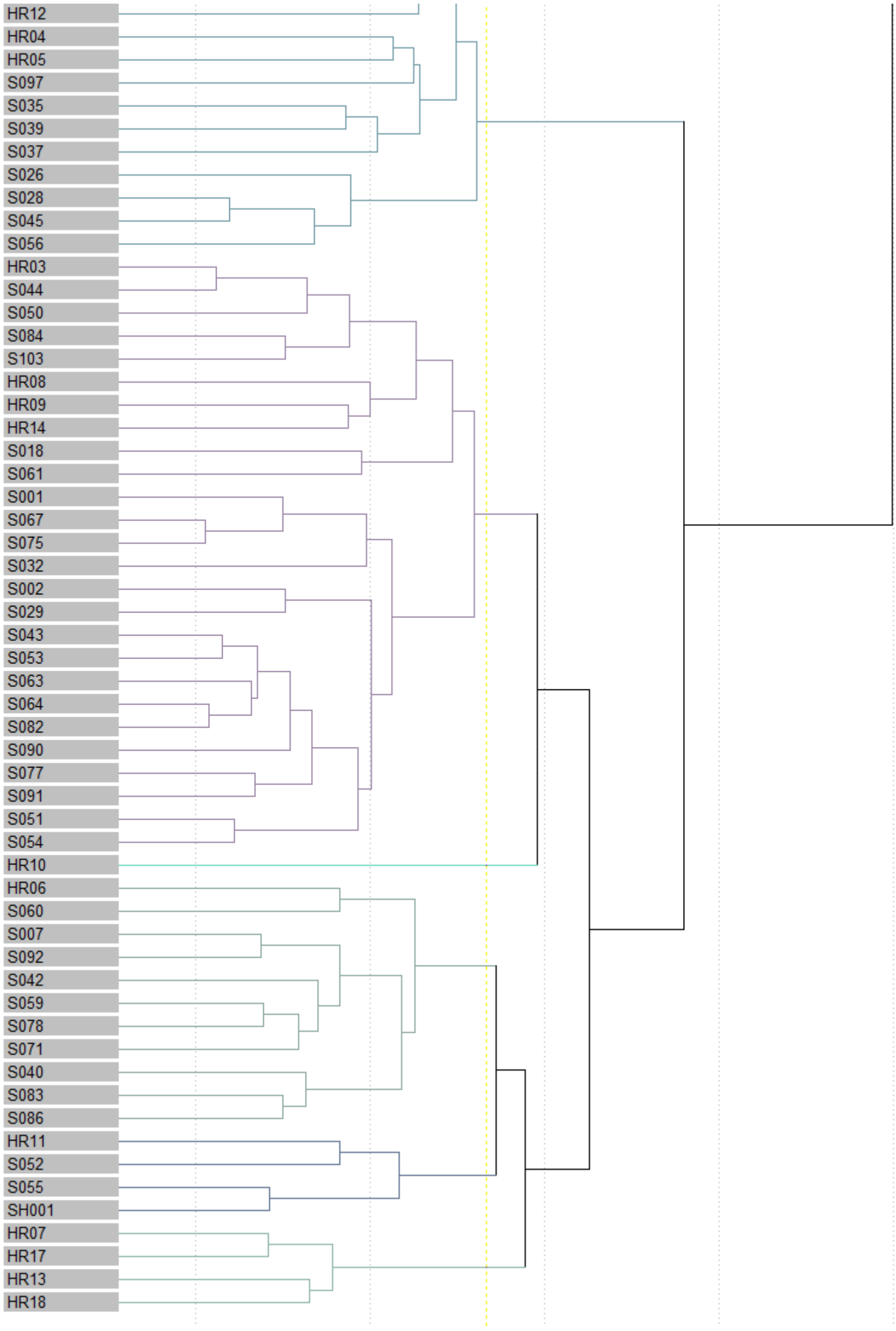
HR02
S073
S095
S101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S056
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HR08
HR09
HR14
S018
S061
S001
S067
S075
S032
S002
S029
S043
S053
S063
S064
S082
S090
S077
S091
S051
S054
HR10
HR06
S060
S007
S092
S042
S059
S078
S071
S040
S083
S086
HR11
S052
S055
SH001
HR07
HR17
HR13
HR18

Figure A3. 3: Group Dendrogram Produced from PATN Analysis – This Survey Data Only

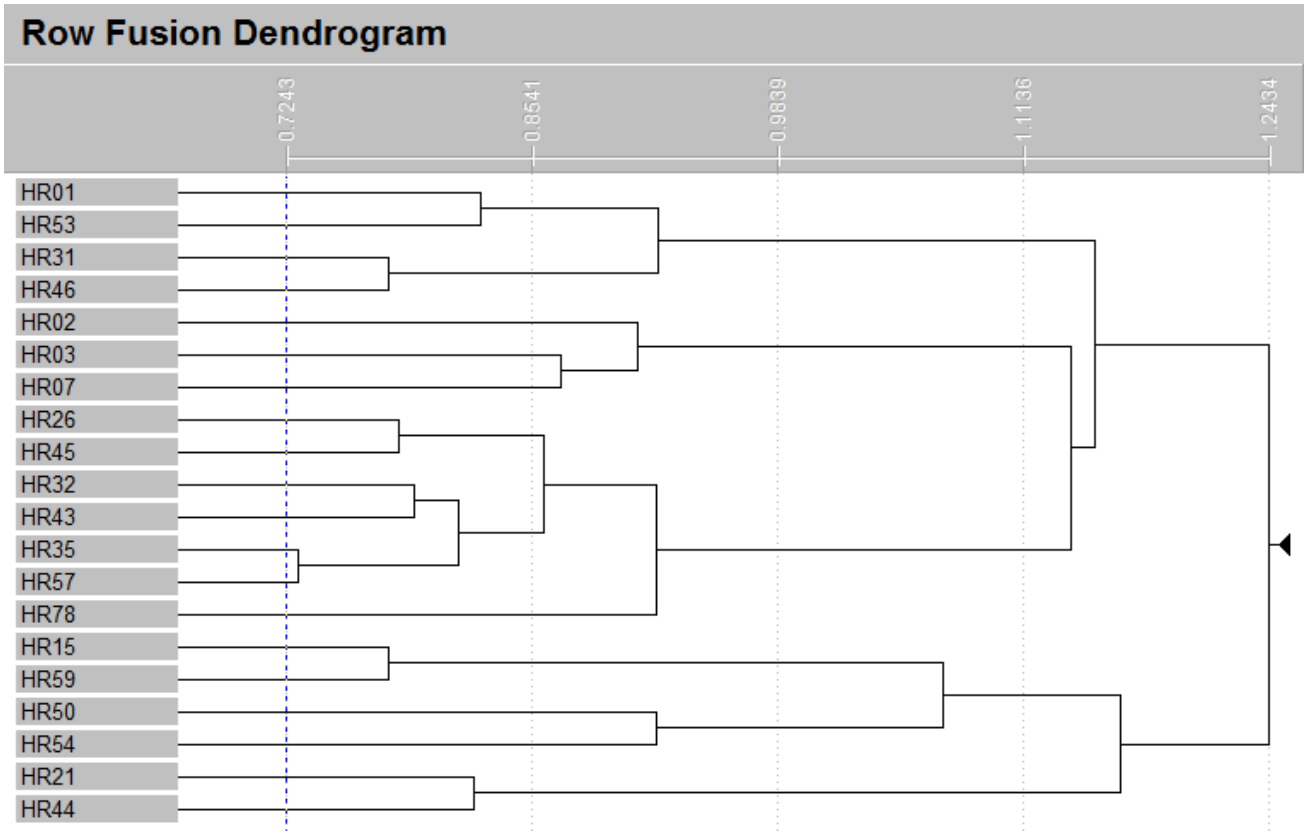

Figure A3. 4: PATN Recipe of Statistical Analysis – This Survey Data Only

PATN Recipe of Analysis

Analysis based on rows -
Association Measure: Bray Curtis
Classification Strategy: Agglomerative Hierarchical Fusion
Technique: Flexible UPGMA
Beta: -0.1000
Number of groups to produce: 20
Ordination Method: SSH
CutOff = 0.900
3 Dimensions
Number of random starts: 1000
Max iterations: 50
Random Seed Value: 1235

Analysis based on columns -
Association Measure: Bray Curtis
Classification Strategy: Agglomerative Hierarchical Fusion
Technique: Flexible UPGMA
Beta: -0.1000
Number of groups to produce: 20

Figure A3. 5: PATN Recipe of Statistical Analysis – Combined Surveys

PATN Recipe of Analysis

Analysis based on rows -
Association Measure: Bray Curtis
Classification Strategy: Agglomerative Hierarchical Fusion
Technique: Flexible UPGMA
Beta: -0.1000
Number of groups to produce: 30
Ordination Method: SSH
CutOff = 0.900
3 Dimensions
Number of random starts: 1000
Max iterations: 50
Random Seed Value: 1235

Analysis based on columns -
Association Measure: Bray Curtis
Classification Strategy: Agglomerative Hierarchical Fusion
Technique: Flexible UPGMA
Beta: -0.1000
Number of groups to produce: 30

Table A3. 2: Indicator Species for Vegetation Associations Recorded in the Survey Area

Species	AaAapAxWL	AtAcSL	MSH	MTG1/2	TawHG	TeTawHG	TeTbHG	TeTabHG	TabTawHG	TabTbHG	TlTaHG	TsTaTlHG
***Acacia aneura/incurveaneura*	•											
***Acacia aptaneura*	•											
***Acacia pruinocarpa*	•											
***Eremophila latrobei* subsp. *filiformis*	•											
***Keraudrenia nephrosperma*	•											
***Psydrax latifolia*	•											
***Psydrax suaveolens*	•											
***Pterocaulon sphacelatum*	•											
***Triodia epactia/pungens* complex	•											
**Abutilon otocarpum/fraserii*	•											
**Acacia atkinsiana*	•											
**Acacia tetragonophylla*	•											
***Eucalyptus camaldulensis* subsp. *obtusa*		•										
***Stemodia viscosa*		•										
**Acacia coriacea* subsp. *pendens*		•										
**Acacia pyrifolia*		•										
**Atalaya hemiglauca*		•										
****Tephrosia densa*			•									
**Cyperus vaginatus*			•									
**Eremophila longifolia*			•									
**Eucalyptus victrix*			•									
**Flueggea virosa* subsp. *melanthesoides*			•									
**Grevillea pyramidalis* subsp. *leucadendron*			•									
**Phyllanthus exilis*			•									
**Stemodia grossa*			•									
****Aristida latifolia*				•								
***Astrebla pectinata*				•								
***Eriachne obtusa*				•								
***Sida rohlenae* subsp. *rohlenae*				•								
**Senna artemisioides* subsp. *oligophylla*					•							
**Streptoglossa bubakii*					•							
****Acacia inaequilatera*						•						
****Acacia maitlandii*							•					

Species	AaAapAxWL	AtAcSL	MSH	MTG1/2	TawHG	TeTawHG	TeTbHG	TeTabHG	TabTawHG	TabTbHG	TlTaHG	TsTaTlHG
***Indigofera monophylla*							•					
****Senna glutinosa* subsp. *glutinosa*							•					
***Dodonaea coriacea*							•					
***Acacia ancistrocarpa*								•				
****Triodia wiseana*									•			
**Ptilotus astrolasius*									•			
**Eucalyptus leucophloia* subsp. *leucophloia*										•		
**Triodia brizoides*										•		
****Senna notabilis*											•	
**Pluchea tetranthera*											•	
**Triodia longiceps*											•	
***Triodia secunda*												•
**Pluchea ferdinandi-muelleri*												•

Note: Indicator values are shown only for taxa which were significant at p<0.05 (Monte Carlo Permutation Tests); * = p<0.05, ** = p<0.01, *** = p<0.001.

Appendix 4: Species Accumulation Analysis and Species List

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Table A4. 1: Results from EstimateS Species Accumulation Analysis*

Samples	Individuals (computed)	Sobs (Mao Tau)	Sobs 95% CI Lower Bound	Sobs 95% CI Upper Bound	Sobs SD (Mao Tau)	Sobs Mean (runs)	Singletons Mean	Singletons SD (runs)	Doubletons Mean	Doubletons SD (runs)	Uniques Mean	Uniques SD (runs)	Duplicates Mean	Duplicates SD (runs)	ACE Mean	ACE SD (runs)	ICE Mean	ICE SD (runs)	Chao 1 Mean	Chao 1 95% CI Lower Bound	Chao 1 95% CI Upper Bound	Chao 1 SD (analytical)
1	21.16	21.16	18.22	24.11	1.5	21.34	21.34	10.02	0	0	21.34	10.02	0	0	288.45	252.98	285.07	249.9	288.45	150.54	584.93	104.4
2	42.33	39.21	34.22	44.19	2.54	39.49	36.33	11.87	3.17	2.85	36.33	11.87	3.17	2.85	405.46	322.8	676.63	586.72	286.75	142.01	658.02	120.58
3	63.49	54.94	48.45	61.43	3.31	55.56	47.82	12.54	6.94	3.96	47.82	12.54	6.94	3.96	311.19	228.65	420.49	316.35	251.68	138.87	525.66	91.33
4	84.66	68.9	61.24	76.56	3.91	69.14	56.03	12.72	10.69	4.47	56.03	12.72	10.69	4.47	250.35	121.58	309.46	155.26	227.3	141.76	416.71	65.9
5	105.82	81.45	72.86	90.05	4.39	81.75	63.25	12.68	13.96	4.95	63.25	12.68	13.96	4.95	244.6	99.11	288.48	117.82	234.53	156.77	395.03	57.69
6	126.99	92.85	83.49	102.21	4.78	92.85	68.63	12.49	17.08	5.32	68.63	12.49	17.08	5.32	241.53	70.97	276.16	84.04	234.92	165.5	371.75	50.26
7	148.15	103.29	93.29	113.28	5.1	103.18	73.33	12.53	19.85	5.63	73.33	12.53	19.85	5.63	246.26	61.33	275.52	70.88	241.2	176.09	365.17	46.29
8	169.32	112.9	102.37	123.44	5.37	112.88	77.43	12.14	22.46	5.89	77.43	12.14	22.46	5.89	253.71	55.36	279.13	62.65	248	185.98	363.17	43.51
9	190.48	121.82	110.83	132.82	5.61	122.06	80.75	11.63	25.19	6.39	80.75	11.63	25.19	6.39	260.84	51.08	283.23	56.99	253.62	194.48	361.51	41.1
10	211.65	130.13	118.75	141.52	5.81	130.19	83.45	11.27	27.46	6.54	83.45	11.27	27.46	6.54	268.07	48.8	288.19	53.83	258.68	201.96	360.58	39.11
11	232.81	137.91	126.18	149.64	5.98	137.97	85.8	10.89	29.52	6.52	85.8	10.89	29.52	6.52	274.72	44.93	292.97	49.07	263.77	209.06	360.82	37.46
12	253.97	145.22	133.19	157.24	6.14	145.16	87.86	10.43	31.19	6.44	87.86	10.43	31.19	6.44	281.85	42.32	298.62	45.87	269.57	216.12	363.47	36.42
13	275.14	152.1	139.81	164.39	6.27	152.07	89.64	10.22	32.94	6.51	89.64	10.22	32.94	6.51	288.18	40.12	303.67	43.21	274.69	222.55	365.56	35.38
14	296.3	158.61	146.09	171.13	6.39	158.64	91.34	10.05	34.38	6.49	91.34	10.05	34.38	6.49	294.88	38.36	309.32	41.1	280.44	229.12	369.28	34.7
15	317.47	164.77	152.05	177.5	6.49	164.92	92.87	9.88	35.84	6.49	92.87	9.88	35.84	6.49	300.67	36.46	314.16	38.85	285.51	235.12	372.2	33.96
16	338.63	170.63	157.73	183.54	6.59	170.75	94.12	9.85	37.18	6.51	94.12	9.85	37.18	6.51	305.69	35.61	318.31	37.78	290.3	240.69	375.19	33.34
17	359.8	176.21	163.14	189.28	6.67	176.4	95.21	9.8	38.29	6.57	95.21	9.8	38.29	6.57	310.01	34.81	321.84	36.81	295.18	246.17	378.74	32.87
18	380.96	181.54	168.32	194.75	6.74	181.75	96.08	9.53	39.51	6.6	96.08	9.53	39.51	6.6	313.28	33.03	324.35	34.8	298.85	250.79	380.46	32.17
19	402.13	186.62	173.27	199.97	6.81	187.02	97.13	9.44	40.42	6.75	97.13	9.44	40.42	6.75	317.45	32.39	327.91	34.04	304.28	256.37	385.36	32.01
20	423.29	191.49	178.02	204.96	6.87	192.16	97.97	9.22	41.42	6.54	97.97	9.22	41.42	6.54	321.07	31.18	330.94	32.68	308.24	261.03	387.89	31.49
21	444.46	196.16	182.59	209.74	6.93	196.84	98.55	9.28	42.39	6.71	98.55	9.28	42.39	6.71	324.01	31.11	333.34	32.54	311.87	265.25	390.36	31.06
22	465.62	200.65	186.97	214.32	6.98	201.26	99.04	8.99	43.11	6.59	99.04	8.99	43.11	6.59	326.45	29.7	335.27	30.99	315.14	269.11	392.47	30.64
23	486.78	204.96	191.2	218.72	7.02	205.61	99.59	8.88	43.87	6.53	99.59	8.88	43.87	6.53	329.46	28.62	337.85	29.8	318.64	273.09	394.99	30.28
24	507.95	209.11	195.26	222.95	7.06	209.65	100.07	8.79	44.43	6.55	100.07	8.79	44.43	6.55	332.39	27.83	340.39	28.93	322.37	277.05	398.21	30.1
25	529.11	213.11	199.19	227.02	7.1	213.58	100.39	8.99	45.13	6.63	100.39	8.99	45.13	6.63	334.97	27.97	342.6	29.03	325.38	280.53	400.34	29.77
26	550.28	216.96	202.98	230.95	7.13	217.37	100.69	8.97	45.71	6.41	100.69	8.97	45.71	6.41	337.53	27.63	344.83	28.63	328.22	283.84	402.3	29.44
27	571.44	220.69	206.64	234.74	7.17	221.1	100.93	8.84	46.39	6.43	100.93	8.84	46.39	6.43	340.08	26.85	347.07	27.79	330.91	287.02	404.08	29.09
28	592.61	224.29	210.19	238.4	7.2	224.6	101.11	8.95	46.97	6.41	101.11	8.95	46.97	6.41	342.5	26.64	349.2	27.54	333.47	290.02	405.83	28.79
29	613.77	227.78	213.62	241.93	7.22	228.13	101.15	8.94	47.7	6.53	101.15	8.94	47.7	6.53	344.51	26.03	350.93	26.88	335.6	292.75	406.91	28.38
30	634.94	231.15	216.95	245.36	7.25	231.45	101.31	8.91	48.12	6.36	101.31	8.91	48.12	6.36	346.84	25.71	353.02	26.52	338.19	295.68	408.88	28.14
31	656.1	234.42	220.17	248.67	7.27	234.81	101.38	8.85	48.68	6.36	101.38	8.85	48.68	6.36	348.89	25.04	354.82	25.81	340.48	298.44	410.36	27.82
32	677.27	237.59	223.3	251.88	7.29	238.08	101.54	8.77	49.15	6.37	101.54	8.77	49.15	6.37	351.3	24.45	357.02	25.18	343.08	301.34	412.4	27.61
33	698.43	240.67	226.34	255	7.31	241.06	101.61	8.78	49.53	6.29	101.61	8.78	49.53	6.29	353.35	24.28	358.87	25	345.41	303.96	414.21	27.41
34	719.59	243.66	229.29	258.03	7.33	244.04	101.75	8.85	49.91	6.19	101.75	8.85	49.91	6.19	355.5	24.17	360.83	24.86	347.79	306.63	416.08	27.22
35	740.76	246.56	232.16	260.97	7.35	246.9	101.85	8.7	50.22	6.1	101.85	8.7	50.22	6.1	357.43	23.66	362.58	24.32	350.08	309.16	417.92	27.04
36	761.92	249.39	234.95	263.82	7.37	249.83	101.82	8.64	50.76	6.04	101.82	8.64	50.76	6.04	359.26	23.35	364.23	23.98	351.76	311.37	418.73	26.7
37	783.09	252.14	237.67	266.6	7.38	252.6	101.84	8.5	50.96	6.04	101.84	8.5	50.96	6.04	361.12	22.76	365.93	23.36	354.13	313.9	420.8	26.58
38	804.25	254.81	240.32	269.31	7.4	255.19	101.76	8.4	51.28	5.98	101.76	8.4	51.28	5.98	362.54	22.32	367.2	22.89	355.87	315.98	421.99	26.36
39	825.42	257.42	242.89	271.95	7.41	257.79	101.75	8.41	51.46	5.87	101.75	8.41	51.46	5.87	364.16	22.3	368.67	22.85	357.95	318.27	423.7	26.22
40	846.58	259.96	245.41	274.51	7.43	260.39	101.87	8.21	51.71	5.85	101.87	8.21	51.71	5.85	366.13	21.79	370.5	22.31	360.25	320.71	425.75	26.12
41	867.75	262.44	247.86	277.02	7.44	262.87	101.82	8.15	51.91	5.77	101.82	8.15	51.91	5.77	367.62	21.55	371.86	22.06	362.16	322.85	427.28	25.97
42	888.91	264.85	250.25	279.46	7.45	265.18	101.54	8.1	52.2	5.75	101.54	8.1	52.2	5.75	368.6	21.31	372.7	21.79	363.37	324.47	427.82	25.7
43	910.08	267.21	252.58	281.84	7.47	267.51	101.3	7.97	52.53	5.75	101.3	7.97	52.53	5.75	369.66	21.05	373.64	21.51	364.56	326.09	428.34	25.42
44	931.24	269.51	254.86	284.17	7.48	269.81	101.25	7.85	52.66	5.74	101.25	7.85	52.66	5.74	371.2	20.53	375.06	20.97	366.52	328.19	430.08	25.34
45	952.41	271.76	257.08	286.44	7.49	272.21	101.27	7.87	52.87	5.72	101.27	7.87	52.87	5.72	372.88	20.53	376.64	20.96	368.53	330.36	431.81	25.23
46	973.57	273.96	259.25	288.67	7.5	274.39	101	7.72	53.15	5.7	101	7.72	53.15	5.7	373.93	19.98	377.58	20.39	369.63	331.86	432.27	24.97
47	994.73	276.11	261.38	290.84	7.52	276.58	101	7.65	53.22	5.59	101	7.65	53.22	5.59	375.51	19.77	379.07	20.16	371.59	333.91	434.07	24.91
48	1015.9	278.21	263.46	292.97	7.53	278.59	100.84	7.46	53.33	5.58	100.84	7.46	53.33	5.58	376.63	19.23	380.09	19.61	373.06	335.58	435.23	24.78
49	1037.06	280.27	265.49	295.05	7.54	280.57	100.7	7.26	53.52	5.58	100.7	7.26	53.52	5.58	377.77	18.56	381.13	18.91	374.4	337.16	436.19	24.63
50	1058.23	282.28	267.48	297.09	7.55	282.52	100.49	7.16	53.69	5.52	100.49	7.16	53.69	5.52	378.81	18.21	382.08	18.55	375.6	338.63	436.96	24.45
51	1079.39	284.25	269.42	299.08	7.57	284.55	100.46	7	53.79	5.49	100.46	7	53.79	5.49	380.22	17.64	383.42	17.96	377.36	340.5	438.55	24.38
52	1100.56	286.18	271.33	301.04	7.58	286.47	100.32	6.82	53.82	5.5	100.32	6.82	53.82	5.5	381.4	17.09	384.52	17.39	378.97	342.21	440.01	24.32
53	1121.72	288.08	273.19	302.96	7.59	288.28	100.16	6.75	53.9	5.44	100.16	6.75	53.9	5.44	382.48	16.7	385.52	16.99	380.33	343.73	441.13	24.21
54	1142.89	289.93	275.02	304.84	7.61	290.11	100.01	6.61	54.02	5.44	100.01	6.61	54.02	5.44	383.59	16.26	386.56	16.54	381.65	345.23	442.15	24.09
55	1164.05	291.75	276.81	306.68	7.62	291.87	99.89	6.53	54.06	5.46	99.89	6.53	54.06	5.46	384.74	15.97	387.64	16.25	383.1	346.79	443.44	24.03
56	1185.22	293.53	278.56	308.49	7.64	293.72	99.76	6.41	54.2	5.4	99.76	6.41	54.2	5.4	385.97	15.58	388.8	15.83	384.43	348.32	444.47	23.9
57	1206.38	295.28	280.28	310.27	7.65	295.43	99.59	6.32	54.2	5.4	99.59	6.32	54.2	5.4	386.96	15.27	389.73	15.52	385.84	349.82	445.73	23.84

Samples	Individuals (computed)	Sobs (Mao Tau)	Sobs 95% CI Lower Bound	Sobs 95% CI Upper Bound	Sobs SD (Mao Tau)	Sobs Mean (runs)	Singletons Mean	Singletons SD (runs)	Doubletons Mean	Doubletons SD (runs)	Uniques Mean	Uniques SD (runs)	Duplicates Mean	Duplicates SD (runs)	ACE Mean	ACE SD (runs)	ICE Mean	ICE SD (runs)	Chao 1 Mean	Chao 1 95% CI Lower Bound	Chao 1 95% CI Upper Bound	Chao 1 SD (analytical)
58	1227.54	296.99	281.97	312.02	7.67	297.22	99.46	6.16	54.28	5.37	99.46	6.16	54.28	5.37	388.11	14.74	390.82	14.97	387.25	351.38	446.93	23.75
59	1248.71	298.68	283.62	313.73	7.68	298.97	99.43	6.07	54.31	5.29	99.43	6.07	54.31	5.29	389.41	14.53	392.06	14.76	388.84	353.02	448.42	23.72
60	1269.87	300.33	285.24	315.42	7.7	300.66	99.29	5.94	54.33	5.15	99.29	5.94	54.33	5.15	390.49	14.12	393.08	14.34	390.19	354.49	449.6	23.64
61	1291.04	301.95	286.83	317.07	7.71	302.28	99.17	5.78	54.29	5.06	99.17	5.78	54.29	5.06	391.5	13.55	394.04	13.75	391.62	355.98	450.94	23.6
62	1312.2	303.55	288.4	318.7	7.73	303.83	98.91	5.66	54.4	5.04	98.91	5.66	54.4	5.04	392.23	13.09	394.72	13.28	392.51	357.1	451.47	23.46
63	1333.37	305.12	289.93	320.3	7.75	305.4	98.8	5.45	54.47	4.97	98.8	5.45	54.47	4.97	393.27	12.7	395.7	12.88	393.73	358.45	452.49	23.37
64	1354.53	306.66	291.43	321.88	7.77	306.94	98.63	5.25	54.42	4.97	98.63	5.25	54.42	4.97	394.19	12.07	396.57	12.25	395.01	359.81	453.67	23.33
65	1375.7	308.18	292.92	323.44	7.79	308.34	98.3	5.06	54.58	4.87	98.3	5.06	54.58	4.87	394.79	11.61	397.12	11.78	395.52	360.64	453.69	23.13
66	1396.86	309.78	294.48	325.08	7.81	309.81	98.11	4.9	54.68	4.66	98.11	4.9	54.68	4.66	395.62	11.32	397.9	11.48	396.41	361.74	454.24	22.99
67	1418.03	311.13	295.79	326.47	7.83	311.21	97.9	4.74	54.69	4.5	97.9	4.74	54.69	4.5	396.33	10.92	398.56	11.07	397.36	362.85	454.97	22.89
68	1439.19	312.57	297.19	327.95	7.85	312.68	97.74	4.51	54.76	4.38	97.74	4.51	54.76	4.38	397.21	10.28	399.39	10.42	398.38	364.03	455.75	22.79
69	1460.35	313.99	298.57	329.41	7.87	314.14	97.6	4.3	54.81	4.28	97.6	4.3	54.81	4.28	398.09	9.86	400.23	9.99	399.47	365.25	456.62	22.71
70	1481.52	315.38	299.92	330.84	7.89	315.57	97.43	4.22	54.9	4.18	97.43	4.22	54.9	4.18	398.93	9.6	401.03	9.73	400.43	366.37	457.32	22.6
71	1502.68	316.75	301.24	332.26	7.91	316.92	97.21	3.99	54.91	4.04	97.21	3.99	54.91	4.04	399.66	8.9	401.72	9.01	401.34	367.44	458.01	22.51
72	1523.85	318.1	302.55	333.66	7.94	318.28	97.08	3.79	54.94	3.88	97.08	3.79	54.94	3.88	400.54	8.44	402.56	8.54	402.35	368.57	458.83	22.43
73	1545.01	319.43	303.83	335.04	7.96	319.53	96.94	3.58	54.97	3.55	96.94	3.58	54.97	3.55	401.34	7.95	403.33	8.05	403.22	369.57	459.48	22.34
74	1566.18	320.74	305.09	336.39	7.99	320.87	96.8	3.29	54.93	3.21	96.8	3.29	54.93	3.21	402.2	7.4	404.15	7.5	404.27	370.73	460.39	22.28
75	1587.34	322.03	306.33	337.73	8.01	322.1	96.64	2.98	54.94	2.97	96.64	2.98	54.94	2.97	402.93	6.67	404.85	6.76	405.12	371.71	461.04	22.19
76	1608.51	323.3	307.54	339.06	8.04	323.43	96.53	2.51	54.97	2.56	96.53	2.51	54.97	2.56	403.87	5.57	405.75	5.64	406.12	372.82	461.85	22.12
77	1629.67	324.55	308.74	340.36	8.07	324.64	96.3	2.07	55.06	2.19	96.3	2.07	55.06	2.19	404.5	4.5	406.35	4.56	406.72	373.64	462.12	21.98
78	1650.84	325.78	309.92	341.65	8.1	325.84	96.13	1.5	55.11	1.63	96.13	1.5	55.11	1.63	405.21	3.19	407.03	3.23	407.45	374.54	462.58	21.87
79	1672	327	311.07	342.93	8.13	327	96	0	55	0	96	0	55	0	405.93	0	407.72	0.01	408.43	375.58	463.49	21.84

*All variables beyond the Chao 2 Mean have been removed as they are not relevant.

Table A4. 2: Vascular Flora Species List

Family	Species	FlFr	Quadrat	Opp Coll
Acanthaceae	*Dipteracanthus australasicus* subsp. *australasicus*		•	
Aizoaceae	*Trianthema cussackiana*	Fr	•	
Aizoaceae	*Trianthema glossostigma*	Fl	•	•
Aizoaceae	*Trianthema triquetra*		•	•
Amaranthaceae	****Aerva javanica***	Fl	•	•
Amaranthaceae	*Alternanthera nana*	Fl	•	
Amaranthaceae	*Alternanthera nodiflora*	Fl	•	•
Amaranthaceae	*Amaranthus cuspidifolius*	FlFr	•	
Amaranthaceae	*Amaranthus undulatus*	Fl	•	•
Amaranthaceae	*Gomphrena cunninghamii*	Fl	•	
Amaranthaceae	*Gomphrena kanisii*	Fl	•	
Amaranthaceae	*Ptilotus aervoides*	Fl	•	
Amaranthaceae	*Ptilotus astrolasius*	Fl	•	•
Amaranthaceae	*Ptilotus auriculifolius*	Fl	•	
Amaranthaceae	*Ptilotus axillaris*	Fl	•	•
Amaranthaceae	*Ptilotus calostachyus*	Fl	•	•
Amaranthaceae	*Ptilotus clementii*	Fl	•	•
Amaranthaceae	*Ptilotus fusiformis*	Fl	•	
Amaranthaceae	*Ptilotus gomphrenoides* var. *gomphrenoides*	Fl	•	
Amaranthaceae	*Ptilotus helipteroides*	Fl	•	
Amaranthaceae	*Ptilotus incanus*	Fl	•	
Amaranthaceae	*Ptilotus nobilis* var. *nobilis*	Fl	•	•
Amaranthaceae	*Ptilotus obovatus*	Fl	•	•
Amaranthaceae	*Ptilotus rotundifolius*	Fl	•	•
Apocynaceae	*Sarcostemma viminale*		•	
Araliaceae	*Trachymene oleracea* subsp. *oleracea*	FlFr	•	
Asteraceae	****Bidens bipinnata***	Fr	•	•
Asteraceae	*Blumea tenella*	Fl	•	
Asteraceae	*Centipeda minima* subsp. *macrocephala*	Fl	•	•
Asteraceae	*Chrysocephalum apiculatum*	Fl	•	•
Asteraceae	****Flaveria trinervia***	Fl	•	
Asteraceae	*Pentalepis trichodesmoides*	Fl	•	
Asteraceae	*Peripleura virgata*	Fr	•	
Asteraceae	*Pluchea dentex*	Fl	•	•
Asteraceae	*Pluchea ferdinandi-muelleri*	Fl	•	•
Asteraceae	*Pluchea rubelliflora*	Fl	•	•
Asteraceae	*Pluchea tetranthera*	Fl	•	•
Asteraceae	*Pterocaulon serrulatum*	Fl	•	•
Asteraceae	*Pterocaulon sphacelatum*	Fl	•	•
Asteraceae	*Streptoglossa bubakii*	Fl	•	
Asteraceae	*Streptoglossa decurrens*	Fl	•	
Asteraceae	*Streptoglossa liatroides*	Fl	•	
Asteraceae	*Streptoglossa macrocephala*			•
Asteraceae	*Streptoglossa odora*	Fl	•	•
Boraginaceae	*Heliotropium ammophilum*	Fl		•
Boraginaceae	*Heliotropium chrysocarpum*	Fl	•	
Boraginaceae	*Heliotropium heteranthum*	Fl	•	
Boraginaceae	*Heliotropium pachyphyllum*	Fl	•	
Boraginaceae	*Heliotropium* sp.		•	
Boraginaceae	*Heliotropium tanythrix*		•	

Family	Species	FlFr	Quadrat	Opp Coll
Boraginaceae	*Trichodesma zeylanicum* var. *zeylanicum*	Fl	•	•
Brassicaceae	*Lepidium pedicellosum*	Fl		•
Brassicaceae	*Lepidium pholidogynum*	FlFr		•
Campanulaceae	*Lobelia arnhemiaca*	Fl	•	•
Campanulaceae	*Wahlenbergia tumidifructa*	Fl		•
Capparaceae	*Capparis lasiantha*		•	•
Caryophyllaceae	*Polycarpaea corymbosa*	Fl	•	•
Caryophyllaceae	*Polycarpaea holtzei*	Fl	•	•
Caryophyllaceae	*Polycarpaea longiflora*	Fl	•	
Celastraceae	*Stackhousia intermedia*	Fl	•	
Chenopodiaceae	*Dysphania kalpari*	Fr	•	
Chenopodiaceae	*Dysphania rhadinostachya*		•	
Chenopodiaceae	*Dysphania rhadinostachya* subsp. *rhadinostachya*	FlFr	•	•
Chenopodiaceae	*Dysphania sphaerosperma*	Fl	•	
Chenopodiaceae	*Maireana ?villosa*		•	
Chenopodiaceae	*Maireana georgei*	Fr	•	
Chenopodiaceae	*Maireana* sp.		•	
Chenopodiaceae	*Rhagodia eremaea*		•	
Chenopodiaceae	*Salsola australis*	Fr	•	•
Chenopodiaceae	*Sclerolaena cornishiana*	Fr	•	
Chenopodiaceae	*Sclerolaena densiflora*	Fl	•	
Chenopodiaceae	*Sclerolaena* sp.		•	
Cleomaceae	*Cleome viscosa*		•	•
Convolvulaceae	*Bonamia erecta*	Fl	•	
Convolvulaceae	*Bonamia linearis*		•	
Convolvulaceae	*Bonamia media*	Fl	•	•
Convolvulaceae	*Bonamia rosea*	Fl	•	•
Convolvulaceae	*Bonamia* sp. Dampier (A.A. Mitchell PRP 217)	Fl	•	
Convolvulaceae	*Duperreya commixta*		•	•
Convolvulaceae	*Evolvulus alsinoides* var. *villosicalyx*		•	•
Convolvulaceae	*Ipomoea muelleri*		•	
Convolvulaceae	*Operculina ?aequisepala*		•	
Convolvulaceae	*Polymeria ambigua*	Fl	•	•
Convolvulaceae	*Polymeria calycina*		•	•
Cucurbitaceae	****Citrullus lanatus***	Fl	•	•
Cucurbitaceae	*Cucumis maderaspatanus*	Fr	•	•
Cyperaceae	*Bulbostylis barbata*	Fr	•	
Cyperaceae	*Bulbostylis turbinata*	Fr	•	
Cyperaceae	*Cyperus ixiocarpus*	Fr	•	
Cyperaceae	*Cyperus squarrosus*	Fr	•	
Cyperaceae	*Cyperus vaginatus*	Fl	•	•
Cyperaceae	*Fimbristylis dichotoma*	Fr	•	
Cyperaceae	*Fimbristylis simulans*	Fr	•	•
Elatinaceae	*Bergia pedicellaris*	Fl	•	
Euphorbiaceae	*Euphorbia alsiniflora*	Fr	•	
Euphorbiaceae	*Euphorbia australis*	Fr	•	•
Euphorbiaceae	*Euphorbia biconvexa*	Fr	•	
Euphorbiaceae	*Euphorbia schultzii*	Fr	•	
Euphorbiaceae	*Euphorbia tannensis* subsp. *eremophila*	Fr	•	•
Fabaceae	*Acacia acradenia*	Fr	•	•
Fabaceae	*Acacia adoxa* var. *adoxa*	FlFr	•	•
Fabaceae	***Acacia* aff. *grasbyi* (TOI)**	Fl		•

Family	Species	FlFr	Quadrat	Opp Coll
Fabaceae	*Acacia ampliceps*			•
Fabaceae	*Acacia ancistrocarpa*	Fr	•	•
Fabaceae	*Acacia aneura*	Fr	•	•
Fabaceae	*Acacia aptaneura*		•	•
Fabaceae	*Acacia arida*	Fr	•	•
Fabaceae	*Acacia atkinsiana*		•	•
Fabaceae	*Acacia bivenosa*	Fl	•	•
Fabaceae	*Acacia colei*	Fr	•	
Fabaceae	*Acacia coriacea subsp. pendens*	Fr	•	•
Fabaceae	*Acacia cowleana*	Fr	•	•
Fabaceae	***Acacia glaucocaesia* (P3)**	FlFr	•	•
Fabaceae	*Acacia hilliana*	Fr	•	•
Fabaceae	*Acacia inaequilatera*	Fr	•	•
Fabaceae	*Acacia incurvaneura*		•	
Fabaceae	*Acacia maitlandii*	Fr	•	•
Fabaceae	*Acacia marramamba*	Fr	•	•
Fabaceae	*Acacia monticola*		•	•
Fabaceae	*Acacia orthocarpa*		•	
Fabaceae	*Acacia pruinocarpa*		•	•
Fabaceae	*Acacia pyrifolia* var. *morrisonii*	FlFr	•	•
Fabaceae	*Acacia pyrifolia* var. *pyrifolia*	Fr	•	
Fabaceae	***Acacia robeorum* (RE)**	Fl	•	•
Fabaceae	*Acacia sclerosperma* subsp. *sclerosperma*	FlFr		•
Fabaceae	*Acacia stellaticeps*	Fr	•	
Fabaceae	*Acacia synchronicia*	Fl	•	•
Fabaceae	*Acacia tenuissima*	Fr	•	•
Fabaceae	*Acacia tetragonophylla*	Fl	•	•
Fabaceae	*Acacia trachycarpa*	Fr	•	•
Fabaceae	*Acacia trudgeniana*		•	
Fabaceae	*Acacia tumida* var. *pilbarensis*	FlFr	•	
Fabaceae	*Acacia victoriae*	Fl		•
Fabaceae	*Acacia xiphophylla*		•	
Fabaceae	*Alysicarpus muelleri*		•	•
Fabaceae	*Cajanus pubescens*	Fr	•	•
Fabaceae	*Crotalaria cunninghamii*	Fl	•	
Fabaceae	*Crotalaria medicaginea* var. *neglecta*	FlFr	•	
Fabaceae	*Cullen lachnostachys*		•	
Fabaceae	*Cullen leucanthum*	Fl	•	
Fabaceae	*Cullen leucochaites*	Fl		•
Fabaceae	*Dichrostachys spicata*		•	
Fabaceae	*Gastrolobium grandiflorum*	Fl	•	
Fabaceae	*Gompholobium oreophilum*	Fl	•	•
Fabaceae	*Indigastrum parviflorum*	Fr	•	
Fabaceae	*Indigofera monophylla*	Fr	•	•
Fabaceae	*Indigofera rugosa*	Fr	•	•
Fabaceae	*Isotropis atropurpurea*	FlFr	•	•
Fabaceae	*Leptosema chambersii*	Fl	•	
Fabaceae	*Neptunia dimorphantha*		•	
Fabaceae	*Petalostylis labicheoides*	Fl	•	•
Fabaceae	*Rhynchosia minima*	Fl	•	•
Fabaceae	*Senna artemisioides* subsp. *helmsii*		•	
Fabaceae	*Senna artemisioides* subsp. *oligophylla*	Fl	•	•

Family	Species	FlFr	Quadrat	Opp Coll
Fabaceae	*Senna artemisioides* subsp. *oligophylla* x *helmsii*	Fl	•	
Fabaceae	*Senna artemisioides* subsp. x *sturtii*		•	
Fabaceae	*Senna glutinosa* subsp. *glutinosa*	Fl	•	•
Fabaceae	*Senna glutinosa* subsp. *pruinosa*	Fl	•	•
Fabaceae	*Senna glutinosa* subsp. x *luerssenii*	Fl	•	•
Fabaceae	*Senna notabilis*	Fl	•	•
Fabaceae	*Senna sericea*		•	•
Fabaceae	*Senna* sp. Meekatharra (E. Bailey 1-26)		•	
Fabaceae	*Senna symonii*	Fl	•	•
Fabaceae	*Senna venusta*	FlFr	•	
Fabaceae	*Sesbania cannabina*	FlFr	•	•
Fabaceae	*Swainsona formosa*	Fl		•
Fabaceae	*Swainsona stenodonta*	FlFr	•	•
Fabaceae	*Tephrosia densa*	FlFr	•	•
Fabaceae	*Tephrosia rosea* var. *glabrior*	Fl	•	•
Fabaceae	*Tephrosia* sp. Bungaroo Creek (M.E. Trudgen 11601)	Fl	•	•
Fabaceae	*Tephrosia* sp. clay soils (S. van Leeuwen et al. PBS 0273)	Fr	•	
Fabaceae	*Tephrosia* sp. Pilbara (A.L. Payne PRP 1393)	Fr	•	•
Fabaceae	*Tephrosia supina*		•	•
Fabaceae	****Vachellia farnesiana***		•	
Goodeniaceae	*Dampiera candicans*	Fl	•	•
Goodeniaceae	*Goodenia cusackiana*	Fl	•	
Goodeniaceae	*Goodenia forrestii*	Fl	•	•
Goodeniaceae	*Goodenia lamprosperma*	Fl	•	•
Goodeniaceae	*Goodenia microptera*	Fl	•	
Goodeniaceae	***Goodenia nuda* (P4)**	Fl	•	
Goodeniaceae	*Goodenia stobbsiana*	Fl	•	•
Goodeniaceae	*Goodenia tenuiloba*	Fl	•	
Goodeniaceae	*Goodenia triodiophila*	Fl	•	•
Goodeniaceae	*Scaevola amblyanthera* var. *centralis*		•	
Goodeniaceae	*Scaevola spinescens*		•	
Gyrostemonaceae	*Codonocarpus cotinifolius*	Fr		•
Haloragaceae	*Haloragis gossei var. gossei*	Fr	•	
Haloragaceae	*Haloragis maierae*	Fr	•	
Lamiaceae	*Clerodendrum floribundum* var. *angustifolium*	Fr	•	
Lauraceae	*Cassytha capillaris*		•	
Lythraceae	*Ammannia baccifera*	Fr	•	
Malvaceae	*Abutilon fraseri*	FlFr	•	•
Malvaceae	*Abutilon lepidum*	FlFr	•	
Malvaceae	*Abutilon otocarpum*	Fr	•	
Malvaceae	*Abutilon trudgenii*	Fr	•	
Malvaceae	*Corchorus incanus* subsp. *lithophilus*	Fl	•	
Malvaceae	*Corchorus laniflorus*	Fl	•	•
Malvaceae	*Corchorus lasiocarpus* subsp. *lasiocarpus*	Fl	•	
Malvaceae	*Corchorus lasiocarpus* subsp. *parvus*	Fl	•	•
Malvaceae	*Corchorus parviflorus*	Fl	•	
Malvaceae	*Corchorus* sp.		•	
Malvaceae	*Corchorus trilocularis*	Fl	•	
Malvaceae	*Gossypium australe*	Fl	•	•
Malvaceae	*Hibiscus brachysiphonius*	Fr	•	
Malvaceae	*Hibiscus burtonii*		•	
Malvaceae	*Hibiscus coatesii*	FlFr	•	

Family	Species	FlFr	Quadrat	Opp Coll
Malvaceae	*Hibiscus gardneri*	Fl	•	
Malvaceae	*Hibiscus sturtii* var. *campylochlamys*	Fr	•	
Malvaceae	*Hibiscus sturtii* var. *platychlamys*	Fl	•	
Malvaceae	*Hibiscus sturtii* var. *truncatus*	Fr	•	
Malvaceae	*Keraudrenia nephrosperma*	Fl	•	•
Malvaceae	***Malvastrum americanum**		•	
Malvaceae	*Melhania oblongifolia*	Fl	•	
Malvaceae	*Sida arenicola*	Fl	•	•
Malvaceae	*Sida echinocarpa*	Fl	•	
Malvaceae	*Sida ectogama*	Fl	•	•
Malvaceae	*Sida fibulifera*	Fl	•	•
Malvaceae	*Sida rohlenae* subsp. *rohlenae*	FlFr	•	
Malvaceae	*Sida* sp. 1		•	
Malvaceae	*Sida* sp. 2		•	
Malvaceae	*Sida* sp. Articulation below (A.A. Mitchell PRP 1605)	Fl	•	•
Malvaceae	*Sida* sp. dark green fruits (S. van Leeuwen 2260)	Fr	•	
Malvaceae	*Sida* sp. Excedentifolia (J.L. Egan 1925)	Fr	•	
Malvaceae	*Sida* sp. Pilbara (A.A. Mitchell PRP 1543)	Fl	•	•
Malvaceae	***Triumfetta* aff. *ramosa* (TOI)**	Fr	•	
Malvaceae	*Triumfetta chaetocarpa*	FlFr	•	•
Malvaceae	*Triumfetta clementii*	Fr	•	
Malvaceae	*Triumfetta maconochieana*	Fr	•	
Menispermaceae	*Tinospora smilacina*		•	
Molluginaceae	*Glinus lotoides*	Fr	•	•
Molluginaceae	*Mollugo molluginea*	Fl	•	•
Myrtaceae	*Corymbia deserticola* subsp. *deserticola*	Fr	•	•
Myrtaceae	*Corymbia hamersleyana*	Fr	•	•
Myrtaceae	*Eucalyptus camaldulensis* subsp. *obtusa*	Fr	•	•
Myrtaceae	*Eucalyptus leucophloia* subsp. *leucophloia*	Fr	•	•
Myrtaceae	*Eucalyptus victrix*	Fr	•	•
Myrtaceae	*Eucalyptus xerothermica*	Fr	•	•
Myrtaceae	*Melaleuca argentea*			•
Myrtaceae	*Melaleuca eleuterostachya*	Fr	•	•
Myrtaceae	*Melaleuca glomerata*	Fr	•	•
Myrtaceae	*Melaleuca linophylla*	Fr	•	•
Nyctaginaceae	*Boerhavia coccinea*	FlFr	•	
Nyctaginaceae	*Boerhavia repleta*	FlFr	•	
Oleaceae	*Jasminum didymum* subsp. *lineare*	Fr	•	•
Orobanchaceae	*Striga curviflora*		•	
Papaveraceae	***Argemone ochroleuca**	Fl	•	•
Pedaliaceae	*Josephinia eugeniae*	Fr	•	
Phyllanthaceae	*Flueggea virosa* subsp. *melanthesoides*		•	
Phyllanthaceae	*Notoleptopus decaisnei*	Fr	•	
Phyllanthaceae	*Phyllanthus erwinii*		•	
Phyllanthaceae	*Phyllanthus exilis*	Fr	•	
Phyllanthaceae	*Phyllanthus maderaspatensis*	Fr	•	
Plantaginaceae	*Stemodia grossa*	Fl	•	•
Plantaginaceae	*Stemodia viscosa*	Fl	•	•
Poaceae	*Amphipogon caricinus*	Fl	•	
Poaceae	*Aristida contorta*	Fr	•	
Poaceae	*Aristida holathera* var. *holathera*	Fr	•	•
Poaceae	*Aristida inaequiglumis*	Fr	•	•

Family	Species	FlFr	Quadrat	Opp Coll
Poaceae	*Aristida latifolia*	Fr	•	•
Poaceae	*Aristida* sp.			•
Poaceae	*Astrebla pectinata*	Fr	•	•
Poaceae	*Brachyachne convergens*	Fr	•	
Poaceae	****Cenchrus ciliaris***	Fl	•	•
Poaceae	*Chrysopogon fallax*		•	•
Poaceae	*Cymbopogon ambiguus*	Fr	•	
Poaceae	*Cymbopogon obtectus*	Fr	•	
Poaceae	*Cymbopogon procerus*	Fr	•	
Poaceae	*Dactyloctenium radulans*		•	
Poaceae	*Digitaria brownii*		•	
Poaceae	*Enneapogon caerulescens*	Fr	•	•
Poaceae	*Enneapogon intermedius*	Fl	•	
Poaceae	*Enneapogon polyphyllus*	FlFr	•	•
Poaceae	*Eragrostis cumingii*	Fl	•	•
Poaceae	*Eragrostis desertorum*	Fl	•	
Poaceae	*Eragrostis dielsii*	Fr	•	
Poaceae	*Eragrostis eriopoda*	Fr	•	•
Poaceae	*Eragrostis pergracilis*	Fl	•	
Poaceae	*Eragrostis tenellula*	Fr	•	
Poaceae	*Eragrostis xerophila*		•	
Poaceae	*Eriachne aristidea*	Fl	•	
Poaceae	*Eriachne benthamii*	Fl	•	•
Poaceae	*Eriachne ciliata*		•	
Poaceae	*Eriachne mucronata*	Fl	•	•
Poaceae	*Eriachne obtusa*	Fr	•	
Poaceae	*Eriachne pulchella* subsp. *dominii*	Fr	•	•
Poaceae	*Eriachne tenuiculmis*		•	
Poaceae	*Eulalia aurea*	Fr	•	
Poaceae	*Iseilema eremaeum*	Fr	•	
Poaceae	*Iseilema vaginiflorum*	Fr	•	
Poaceae	*Leptochloa fusca subsp. fusca*		•	
Poaceae	*Panicum decompositum*	Fr	•	•
Poaceae	*Paraneurachne muelleri*		•	
Poaceae	*Paspalidium basicladum*	Fr	•	
Poaceae	*Paspalidium clementii*	Fr	•	
Poaceae	*Perotis rara*	Fr		•
Poaceae	*Schizachyrium fragile*	Fl	•	
Poaceae	*Sporobolus actinocladus*	Fl	•	•
Poaceae	*Sporobolus australasicus*	Fl	•	•
Poaceae	*Themeda triandra*	Fl	•	•
Poaceae	*Triodia ?pungens*		•	
Poaceae	***Triodia* aff. *basedowii* (TOI)**	Fl/Fr	•	•
Poaceae	***Triodia* aff. *epactia* (TOI)**	Fl	•	
Poaceae	***Triodia* aff. *wiseana* (TOI)**	Fl	•	•
Poaceae	*Triodia angusta*	Fr	•	
Poaceae	*Triodia brizoides*	Fl	•	•
Poaceae	*Triodia epactia*	Fl	•	•
Poaceae	*Triodia longiceps*	Fl	•	•
Poaceae	*Triodia pungens*	Fr	•	
Poaceae	*Triodia secunda*		•	•
Poaceae	*Yakirra australiensis* var. *australiensis*	Fr	•	

Family	Species	FlFr	Quadrat	Opp Coll
Portulacaceae	*Calandrinia* sp.		•	
Portulacaceae	***Portulaca oleracea***		•	
Proteaceae	*Grevillea pyramidalis* subsp. *leucadendron*		•	•
Proteaceae	*Grevillea wickhamii*	FlFr	•	
Proteaceae	*Hakea chordophylla*		•	
Proteaceae	*Hakea lorea subsp. lorea*		•	•
Pteridaceae	*Cheilanthes austrotenuifolia*		•	
Pteridaceae	*Cheilanthes sieberi* subsp. *sieberi*		•	
Rubiaceae	*Oldenlandia crouchiana*	FlFr	•	
Rubiaceae	*Psydrax latifolia*		•	•
Rubiaceae	*Psydrax suaveolens*		•	•
Rubiaceae	*Synaptantha tillaeacea* var. *tillaeacea*	Fr	•	
Santalaceae	*Exocarpos sparteus*	Fr	•	
Santalaceae	*Santalum spicatum*		•	
Sapindaceae	*Atalaya hemiglauca*		•	•
Sapindaceae	*Dodonaea coriacea*	Fr	•	
Sapindaceae	*Dodonaea petiolaris*	Fr	•	•
Scrophulariaceae	*Eremophila cuneifolia*	Fl	•	•
Scrophulariaceae	*Eremophila forrestii*		•	
Scrophulariaceae	*Eremophila latrobei* subsp. *filiformis*		•	•
Scrophulariaceae	*Eremophila longifolia*		•	•
Solanaceae	*Nicotiana benthamiana*	Fl	•	•
Solanaceae	*Solanum ashbyae*		•	
Solanaceae	*Solanum diversiflorum*	Fr	•	•
Solanaceae	*Solanum cleistogamum*		•	•
Solanaceae	*Solanum gabrielae*		•	•
Solanaceae	*Solanum phlomoides*	FlFr	•	•
Thymelaeaceae	*Pimelea ammocharis*	Fl	•	•
Violaceae	*Hybanthus aurantiacus*	FlFr	•	•
Zygophyllaceae	*Tribulus macrocarpus*	Fr	•	
Zygophyllaceae	*Tribulus platypterus*	FlFr	•	•
Zygophyllaceae	*Tribulus suberosus*		•	•

P3-P4 = Priority 3 to Priority 4, * = environmental weed, RE = range extension, TOI = taxonomically interesting species. Fl = Flowering material, Fr = Fruiting material. OppColl = Opportunistic collections. Nomenclature based on current Western Australian Herbarium terminology and confirmed on FloraBase (WAH, 1998 -).

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Appendix 5: Conservation Significance – Flora and Ecological Communities

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Commonwealth *Environment Protection and Biodiversity Act 1999*

Table A5. 1: Categories and Definitions for Rare Flora

Category	Definition
Extinct*	A native species is eligible to be included in the extinct category if there is no reasonable doubt that the last member of the species has died.
Extinct in the wild	A native species is eligible to be included in the extinct in the wild category if: a) it is only known to survive in cultivation, in captivity or as a naturalized population well outside its past range; or b) if 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 time frame appropriate to its life cycle and form.
Critically endangered	A native species is eligible to be included in the critically endangered category if it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	A native species is eligible to be included in the endangered category if: a) if it is not critically endangered; and b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable	A native species is eligible to be included in the vulnerable category if: a) if it is not critically endangered or endangered; and b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation dependent*	A native species is eligible to be included in the conservation dependent category if: a) 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; or b) the following subparagraphs are satisfied; (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.
*Note: Species listed as 'conservation dependent' and 'extinct' are not matters of national environmental significance and therefore do not trigger the *EPBC Act*.	

Source: DSEWPaC (2012c)

Western Australian *Wildlife Conservation Act 1950*

Table A5. 2: Categories and Definitions for Rare Flora

Category	Definition
T: Threatened Flora (Declared Rare Flora – Extant)	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, and have been gazetted as such (Schedule 1 under the Wildlife Conservation Act 1950). Threatened Flora (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List criteria: • CR: Critically Endangered – considered to be facing an extremely high risk of extinction in the wild • EN: Endangered – considered to be facing a very high risk of extinction in the wild • VU: Vulnerable – considered to be facing a high risk of extinction in the wild.
X: Presumed Extinct Taxa (Declared Rare Flora – Extinct)	Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such (Schedule 2 under the Wildlife Conservation Act 1950).

Source: DEC (2012a)

Table A5. 3: Categories and Definitions for Priority Flora

Category	Definition
1: Priority One: Poorly-known species	Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
2: Priority Two: Poorly-known species	Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
3: Priority Three: Poorly-known species	Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
4: Priority Four: Rare, Near Threatened and other species in need of monitoring	a. Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. b. Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. c. Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
5: Priority Five: Conservation Dependent species	Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Source: DEC (2012a)

Table A5. 4: Categories, Definitions and Criteria for Threatened Ecological Communities (TECs)

Category	Definition and Criteria
Presumed Totally Destroyed (PD)	An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B): A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats; or B) All occurrences recorded within the last 50 years have since been destroyed.
Critically Endangered (CR)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C): A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii): • (i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years); • (ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated. B) Current distribution is limited, and one or more of the following apply (I, ii or iii): • (i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years); • (ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes; • (iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

Category	Definition and Criteria
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future. An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C): A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii): • (i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years); • (ii) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated. B) Current distribution is limited, and one or more of the following apply (i, ii or iii): • (i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years); • (ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes; • (iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes. C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range. An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C): A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated. B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.

Category	Definition and Criteria
	C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community Lists under Priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as threatened ecological communities. Ecological Communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

Table A5. 5: Categories, Definitions and Criteria for Priority Ecological Communities (PECs)

Category	Definition and Criteria
Priority One: Poorly-known ecological communities	Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority Two: Poorly-known ecological communities	Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Priority Three: Poorly-known ecological communities	(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) Communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Category	Definition and Criteria
Priority Four: Adequately known ecological communities	Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened or that have been recently removed from the threatened list. These communities require regular monitoring. (a) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. (b) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority Five: Conservation Dependent ecological communities	Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Source for Table A5.4 and Table A5.5: DEC (2010)

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Appendix 6: Declared Plants Codes and Controls

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Table A6. 1: Codes and Controls for Declared Plants

Code	Controls
Priority One – 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.
Priority Two – Aims 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.
Priority Three - 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 all plants: • within 100 m inside of the boundaries of the infestation; • within 50 m of roads and high water mark on waterways; • within 50 m 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 ha treat 100% of infestation. • Where plant density is 11-100 per ha treat 50% of infestation. • Where plant density is 101-1000 per ha treat 10% of infestation. Properties with less than 2 ha of infestation must treat the entire infestation. Additional areas may be ordered to be treated.
Priority Four - 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 m inside of the boundaries of the infested property; • within 50 m of roads and high water mark on waterways; • within 50 m of sheds, stock yards and houses. Treatment must be done prior to seed set each year. Properties with less than 2 ha of infestation must treat the entire infestation. Additional areas may be ordered to be treated.
Priority Five - Control on public land	Infestations on public land must be controlled.

Source: DAFWA (2012c)

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Appendix 7: National Vegetation Information System Vegetation Classification

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Table A7. 1: NVIS Methodology used to Describe Vegetation Associations

Height Range (m)	Tree	Shrub	Mallee	Grass
>30	tall			
10-30	mid		tall	
<10	low		mid	
<3			low	
>2		tall		tall
1-2		mid		tall
0.5-1		low		mid
<0.5		low		low

		Structural Formation Classes					
		Foliage cover % (cover #)					
Growth Form	**Height (m)**	**70-100% (5)**	**30-70% (4)**	**10-30% (3)**	**<10% (2)**	**0-5% (1)**	**≈0% (N)**
Tree	**<10,10-30, >30**	closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of trees
Tree mallee	**<3, <10, 10-30**	closed mallee forest	open mallee forest	mallee woodland	open mallee woodland	isolated mallee trees	isolated clumps of mallee trees
Shrub	**<1,1-2,>2**	closed shrubland	shrubland	open shrubland	sparse shrubland	isolated shrubs	isolated clumps of shrubs
Mallee shrub	**<3, <10, 10-30**	closed mallee shrubland	mallee shrubland	open mallee shrubland	sparse mallee shrubland	isolated mallee shrubs	isolated clumps of mallee shrubs
Heath shrub	**<1,1-2,>2**	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs	isolated clumps of heath shrubs
Chenopod shrub	**<1,1-2,>2**	closed chenopod shrubland	chenopod shrubland	open chenopod shrubland	sparse chenopod shrubland	isolated chenopod shrubs	isolated clumps of chenopod shrubs
Samphire shrub	**<0.5,>0.5**	closed samphire shrubland	samphire shrubland	open samphire shrubland	sparse samphire shrubland	isolated samphire shrubs	isolated clumps of samphire shrubs
Hummock grass	**<2,>2**	closed hummock grassland	hummock grassland	open hummock grassland	sparse hummock grassland	isolated hummock grasses	isolated clumps of hummock grasses
Tussock grass	**<0.5,>0.5**	closed tussock grassland	tussock grassland	open tussock grassland	sparse tussock grassland	isolated tussock grasses	isolated clumps of tussock grasses
Sedge	**<0.5,>0.5**	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges
Rush	**<0.5,>0.5**	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes

Source: ESCAVI (2003).

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Appendix 8: Site Sheets

Site sheets supplied as a separate document.

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