Pilbara Flora

Vegetation Surveys
Clearing Permits
Rehabilitation

Flora and Vegetation Survey for Drilling Areas at Juna Downs

and

Native Vegetation Clearing Permit Supporting Information

Prepared for Rio Tinto Iron Ore by Pilbara Flora

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Cover Page: View of the upland valley in Survey Area 4

EXECUTIVE SUMMARY

Rio Tinto Iron Ore's ('RTIO's) Resource Development group is proposing to conduct exploration and evaluation drilling at three different areas on Juna Downs Station and one area near the Marandoo Mine.

The exploration program is to take place across four survey areas located in the central Pilbara Region of Western Australia, between 46km east and 86km east-southeast of Tom Price.

Survey Area 1 is approximately 22.38ha and is located within E47/753, adjacent to the RTIO rail corridor, and approximately 14.8km east-southeast of RTIO's Marandoo Mine. This survey area is located inside Karijini National Park. Survey Area 1 is contained within a Schedule 1 Area and ESA formed by Karijini National Park.

Survey Areas 2 (2 897.72ha), 3 (1115.09ha) and 4 (322.25ha) are located in the southwest corner of Juna Downs Station within a number of different exploration leases (Area 2 E47/584. Area 3 E47/584 and E47/631 and Area 4 E47/584 and E47/1429). The Schedule 1 Area and ESA also partially contain sections of Survey Areas 2, 3 and 4. Survey Area 2 is also contained partially within Red Book Area 8.14.

As the drilling program will involve the clearing of native vegetation for access tracks and drill pads, a Native Vegetation Clearing Permit ('NVCP') will be required. RTIO commissioned Pilbara Flora to undertake a flora and vegetation survey in conjunction with a fauna habitat assessment of Survey Areas 1, 2, 3 and 4.

A field survey was undertaken between 01 to 11 October and 24 to 29 November 2011. The flora and vegetation survey consisted of a Level 1 survey conducted in accordance with the Environmental Protection Authority's Guidance Statement No. 51 '*Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia'* A vertebrate fauna habitat assessment was also conducted as part of the Pilbara Flora survey.

Floristic and vegetation information was undertaken at 110 relevés and 382 GPS mapping points. A summary of the biological information is provided below:

- Four landforms were identified within the Survey Areas:
  - Hills.
  - Plains.
  - Watercourses.
  - Disturbed
- The dominant landform was 'Plains', occupying 1767.38ha or 74.97% of the total survey area.
- No rare, geographically restricted or unique landforms were observed.
- Thirty one Vegetation Associations were identified within the survey areas.
- Vegetation Association 12 'Low Open Woodland Mallee and Shrubland on Stony Plain' was the most common Vegetation Association, covering 35.75% of the total survey area. Vegetation Association 13 '*Low Mulga Woodland on Alluvial Plains'* was the next most common association, covering 17.79% of the total survey area.
- There were no vegetation associations identified that were considered as being rare, restricted or unique. All native vegetation associations were considered to be well represented across the Pilbara region.
- The vegetation associations recorded in the survey areas were assessed against DEC's PEC and TEC listings for the Pilbara. There were no vegetation associations that matched any DEC listed PEC or TEC vegetation community descriptions or federally listed TECs.

- An assessment of vegetation condition by vegetation association was undertaken. The majority of the survey area was considered to be in 'Excellent' or 'Good' condition (89.81% of total survey area). 7.43% of the survey area was considered to be in 'Poor' condition predominantly due to heavy weed infestation on areas of historical overgrazing.
- A total of 304 vascular taxa from 49 families and 139 genera were recorded. Compared to other regional studies, a total count of 304 taxa over the 2357.44ha survey area was considered representative of the typical floristic diversity expected.
- No Threatened species pursuant to the *Wildlife Conservation Act 1950* (*WC Act*) or *EPBC Act* were recorded in the survey areas.
- Five Priority Flora were recorded in the Survey Areas:
    - *Brunonia* sp. long hairs (D.E. Symon 2440) (Priority 1),
    - *Spartothamnella puberula* (Priority 2),
    - *Rhagodia* sp. Hamersley (M.E. Trudgen 17794) (Priority 3),
    - *Triodia* sp. Mt Ella (M.E Trudgen 12739) (Priority 3) and
    - *Eremophila magnifica* subsp. *magnifica* (Priority 4)
- There were no floristic range extensions from the taxa recorded in the survey.
- Six introduced species were recorded, these being:
    - **Cenchrus ciliaris* (Buffel Grass) - DEC Rating 'High'.
    - **Chloris virgata* (Feathertop Rhodes Grass) - DEC Rating 'Low'.
    - **Setaria verticillata* (Whorled Pigeon Grass) - DEC Rating 'Low'.
    - **Bidens bipinnata* (Beggars Ticks) - DEC Rating 'Unrated'.
    - **Malvastrum americanum* (Spiked Malvastrum) - DEC Rating 'Moderate'.
    - **Vachellia farnesiana* (Mimosa Bush) - DEC Rating 'High'
- None of the above introduced species are 'Declared Plants' as listed by the Agricultural Protection Board and pursuant to the *Agricultural and Related Resources Protection Act 1976*. All four introduced species are listed as environmental weeds by DEC. Under DEC's 'Invasive Plant Prioritization Process', Buffel Grass and Mimosa Bush have a 'High' weed risk rating and Spiked Malvastrum has a 'Moderate" risk rating, Feathertop Rhodes Grass and Whorled Pigeon Grass have a 'Low' weed risk rating and Beggars Tick is unrated.
- The proposed Juna Downs drilling program was assessed as being unlikely to have any significant impact on flora and vegetation communities for the following reasons:
    - **No Threatened Flora:** No Threatened Flora listed under the *WC Act* or the *EPBC Act* were recorded at the survey areas.
    - **Few Priority Flora:** All Priority Flora listed by DEC recorded at the survey areas were scattered and in small population sizes except for *Triodia* sp. Mt Ella (M. E. Trudgen 12739) which was recorded extensively in large populations as a co-dominant component of the grass layer. Small scattered populations are easily avoidable by an exploration drilling program. Due to the large population sizes of *Triodia* sp. Mt Ella (M. E. Trudgen 12739) at Juna Downs it is considered that the loss of individuals in the course of the proposed Juna Downs exploration program will have a negligible effect on the conservation status of this species as a whole.

- **No PECs or TECs:** No State listed PECs and State or Federally listed TECs occur at the survey areas and surrounds.
- **No Rare, Restricted or Unique Vegetation Associations:** No vegetation associations were identified that were considered as being rare, restricted or unique. All native vegetation associations were considered to be well represented across the Pilbara region.

A fauna habitat assessment was undertaken to determine which conservation significant fauna could potentially occur in the survey areas in conjunction with an assessment of the likely impacts on these fauna species from the proposed Juna Downs drilling program.

- The survey areas had seven habitat types considered suitable for conservation significant fauna. These habitat types were 'Rock Ledges', 'Sheltered Valleys', 'Caves', 'Large roosting trees', 'Steep elevated cliffs for raptor nesting sites', 'Scree slopes with pebblestones of suitable size for the Western Pebble-mound Mouse' and 'Soil suitable for burrowing and nesting'. These habitat types are widespread throughout the Pilbara. Overall, the survey areas were considered as having a low level of conservation value in regards to the presence of unique or specialised habitat types associated with conservation significant species.
- Twenty eight conservation significant fauna were assessed as having some potential of occurring in the survey areas based on distribution. However, only 13 conservation significant fauna were assessed as having the potential of occurring in the survey areas based on habitat preference. An assessment was undertaken as to the potential impact on these 13 conservation significant species from the proposed Juna Downs drilling program.
- Nineteen active or recently active Western Pebble-mound Mouse mounds were located within the Survey area, the majority on Hillsides in Survey Areas 1 and 4 and a single mound found in Survey Area 2. RTIO is committed to avoidance of conservation significant species and will avoid wherever possible.
- As an overall fauna habitat assessment conclusion, the proposed Juna Downs drilling program was considered as being unlikely to impact upon the conservation status of conservation significant fauna for the following reasons:
  - **Few unique or specialized fauna habitats:** The survey areas had few habitat types considered suitable for conservation significant fauna, and when present these habitat types occurred in small regions of the overall survey area. The habitat types recorded which are associated with conservation significant fauna were 'Rock Ledges', 'Sheltered Valleys', 'Caves', 'Large roosting trees', Steep elevated cliffs for raptor nesting sites', 'Scree slopes with pebblestones of suitable size for the Western Pebble-mound Mouse' and 'Soil suitable for burrowing and nesting'. These habitat types occur throughout the Pilbara and are not considered as being particularly unique or of exceptional conservation value. Additionally several of these habitat types ('Rock Ledges', 'Sheltered Valleys', 'Caves' and 'Steep elevated cliffs for raptor nesting sites') will not be disturbed due to the total inaccessibility of drilling machinery to these areas and RTIO's commitment to minimal disturbance of conservation significant fauna. No highly specialised habitat types such as gorges, vuggy, fractured or pisolitic rocky substrates, mine shafts, closed forests or dense woodlands, trees with nesting hollows, tussock grasslands on cracking clays, waterholes, watering points, sand dunes or dune fields were recorded in the survey areas.
  - **Widespread habitat types:** All habitat types identified in the survey areas are widespread throughout the Pilbara and are not restricted or unique. The proposed disturbance is considered negligible in comparison to the vast areas of similar habitat types remaining in the Pilbara.

- **Low impact nature of the proposed Juna Downs drilling program:** The proposed Juna Downs drilling program is considered as being a low impact disturbance. Exploration disturbances are surficial and do not involve the removal of the underlying landform. At the end of exploration, all areas will be rehabilitated and restored to native vegetation.
- **Regional or national distributions:** No conservation significant fauna are endemic to the survey areas. All of the conservation significant fauna identified as potentially occurring in the survey areas have regional or national distributions. The minimal loss of habitat from the proposed operations in the survey areas is unlikely to have any impact on the overall conservation status of these species.
- **Fauna mobility:** Most of the conservation significant fauna identified as potentially occurring in the survey areas are highly mobile and have the ability to egress from the operational areas.
- **Site Avoidance**: RTIO is committed to creating minimal disturbance for conservation significant species. To this end locations of priority species including the Pebble-mouse mounds are recorded and these sites avoided.

An assessment of the likely impact of the proposed clearing activities was made against the 10 Clearing Principles. The assessment outcome was that the proposed Juna Downs drilling program is at variance with three of the 10 Clearing Principles, Principal B, Principal C and Principal H.

In regards to Principal B, Several habitat types were recorded in the survey areas which potentially support conservation significant species. However the majority of these habitats will not be disturbed due to the total inaccessibility of drilling machinery to these areas. Nineteen Western Pebble-mouse Mounds were recorded within the survey area. RTIO is committed to creating minimal disturbance for conservation significant species. To this end locations of priority species including the Pebble-mouse mounds are recorded and these sites avoided along with habitat areas of conservation significance.

In regards to Principal C, four of the five recorded priority species can be avoided via the implementation of avoidance buffer zones due to small population size and spatial separation between populations. *Triodia* sp. Mt Ella (M.E Trudgen 12739) was so densely distributed through Survey Area 4 that avoidance is not possible. However due to the large population sizes of this species at Juna Downs and its abundance in the region it is considered that the loss of individuals in the course of the proposed Juna Downs exploration program will have a negligible effect on the conservation status of this species as a whole.

In regards to Principal H, the majority of Survey Area 1 is located inside Karijini National Park. The exploration program will have some impact within this area however this is considered to be minimal due to the low impact nature of the activities. Exploration drilling involves the clearing of a minimal amount of vegetation for access tracks and drill pads. Due to the minor surface disturbances involved, the area can be restored easily to its natural contoured landscape and re-vegetated with native species progressively throughout and at the exploration programs end of life. Thus the affected area can be restored to a natural aesthetic similar to that of the surrounding region, resulting in minimal long term impacts.

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1 INTRODUCTION

Rio Tinto Iron Ore's ('RTIO's) Resource Development group is proposing to conduct exploration and evaluation drilling at three different areas on Juna Downs Station and one area near the Marandoo Mine. The regional location of each of these exploration areas is displayed in Figure 1 and the locality in Figure 2. Information on each of the areas is provided in Table 1. In the report, the four areas known collectively as the 'Survey Areas' and individually as 'Survey Area 1' to 'Survey Area 4'. The Survey Areas are located in the central Pilbara Region of Western Australia (Figure 1).

The RTIO 'AR' numbers are provided in Table 1. Surveys Areas 1 to 3 are each linked to individual ARs (AR-10-05678, AR-11-07686 and AR-11-07687). Survey Area 4 combines 2 ARs (AR-10-05776 and AR-11-07685). The locations of each survey area with AR numbers are displayed in Figure 2. General views of each survey area are provided in Plates 1 to 11.

Table 1: Information on the Survey Areas

Survey Area	AR Number	Project	Area (ha)
Survey Area 1	AR-10-05678	Railway 2011 Drill Programme	22.38
Survey Area 2	AR-11-07686	Juna Downs Marra Mamba South - Blanket Survey	897.72
Survey Area 3	AR-11-07687	Juna Downs Marra Mamba North - Blanket Survey	1115.09
Survey Area 4	AR-10-05776	Juna Downs North RC Drilling	319.32
Survey Area 4	AR-11-07685	Juna Downs North - New track outside tenure	2.93
Total			**2357.44**

Pilbara Flora was commissioned by RTIO to undertake a flora and vegetation survey with fauna habitat assessment of the Survey Areas to provide supporting information for a Native Vegetation Clearing Permit ('NVCP') application for the above listed exploration programs.

The survey was conducted in general accordance with the Level 1 requirements of the Environmental Protection Authority's ('EPA's) Guidance Statement 51 "*Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*" (EPA 2004a) and with reference to the EPA's Guidance Statement No. 56 "*Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*" (EPA 2004b) and Position Statement No. 3 "*Terrestrial Biological Surveys as an Element of Biodiversity Protection*" (EPA 2002).

The survey was conducted in October and November 2011 and involved grid and area searches for conservation flora in conjunction with relevé and GPS mapping points to collect floristic and vegetation community data as well as fauna habitat information.

The results of the survey are provided in this report in conjunction with an assessment of the likely impact of the proposed exploration activities against the 10 Principles (specified in Schedule 5 of the *Environmental Protection Act 1986*) and in general accordance with the Department of Mines and Petroleum ('DMP') brochure '*Information required to assess your Clearing Permit Application*' (DMP 2009).

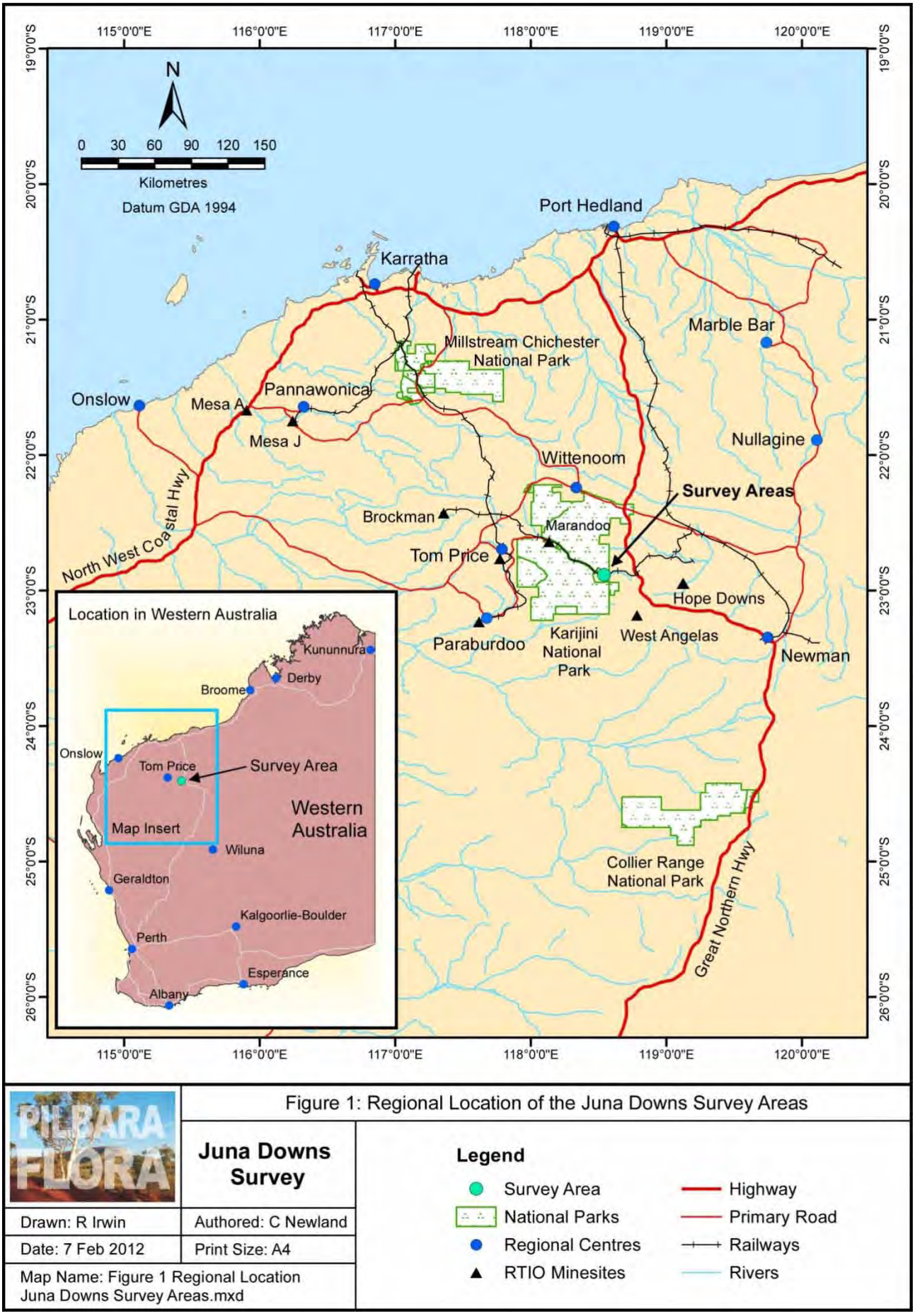


Figure 1: Regional Location of the Juna Downs Survey Area

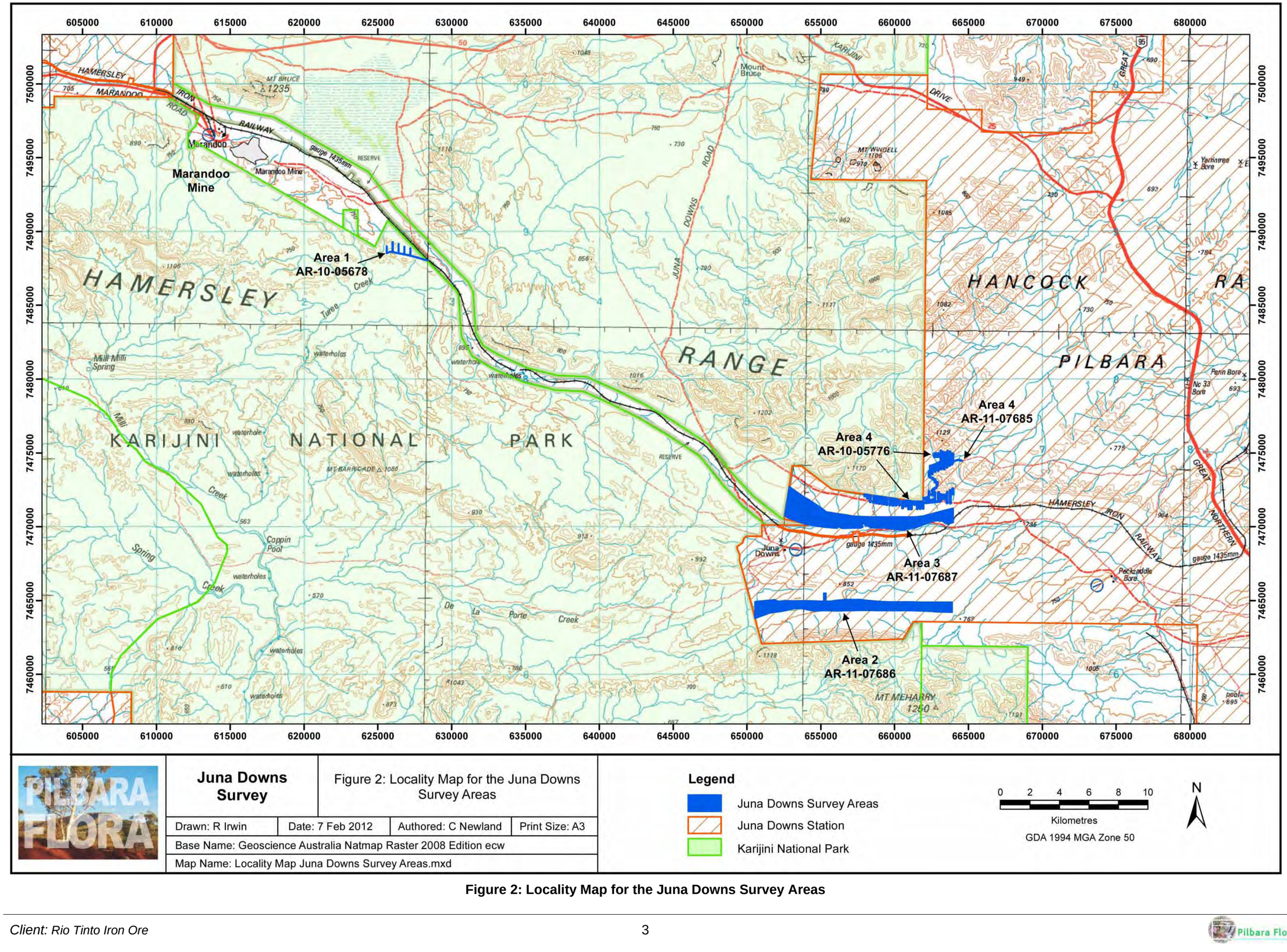


Figure 2: Locality Map for the Juna Downs Survey Areas

2 BACKGROUND INFORMATION

2.1 LOCATION

The Survey Areas are located in the central Pilbara Region of Western Australia, between 46km east and 86km east-southeast of Tom Price (Figure 1). The majority of Survey Area 1 is located inside Karijini National Park, adjacent to the RTIO rail corridor, and approximately 14.8km east-southeast of RTIO's Marandoo Mine (Figure 2). Survey Areas 2, 3 and 4 are located in the southwest corner of Juna Downs Station and abut Karijini National Park (Figure 2). Aerial images for the Survey Areas are provided in Figures 3 to 4.

2.2 TENURE

Information on the primary land tenure for the Survey Areas is provided in Table 2. Pending tenements have been excluded. Most of Survey Area 1 is contained within the Karijini National Park. Survey Areas 2, 3 and 4 are contained entirely within Juna Downs Station.

Table 2: Land Tenure for the Survey Areas

Survey	Area (ha)	Land Tenure and RTIO tenements	Proportion (%)
Area 1	22.38	Karijini National Park	98.23
		E47/753	98.23
		L47/55 and L47/100	1.77
Area 2	897.72	Juna Downs Pastoral Lease (3144/1191)	100
		E47/584	100
Area 3	1115.09	E47/631	65.03
		E47/584	34.97
Area 4	322.25	E47/584 and P47/1600 (pending)	66.31
		E47/1429 (off RTIO tenure – United Iron Pty Ltd)	0.69
Total	**2357.44**		

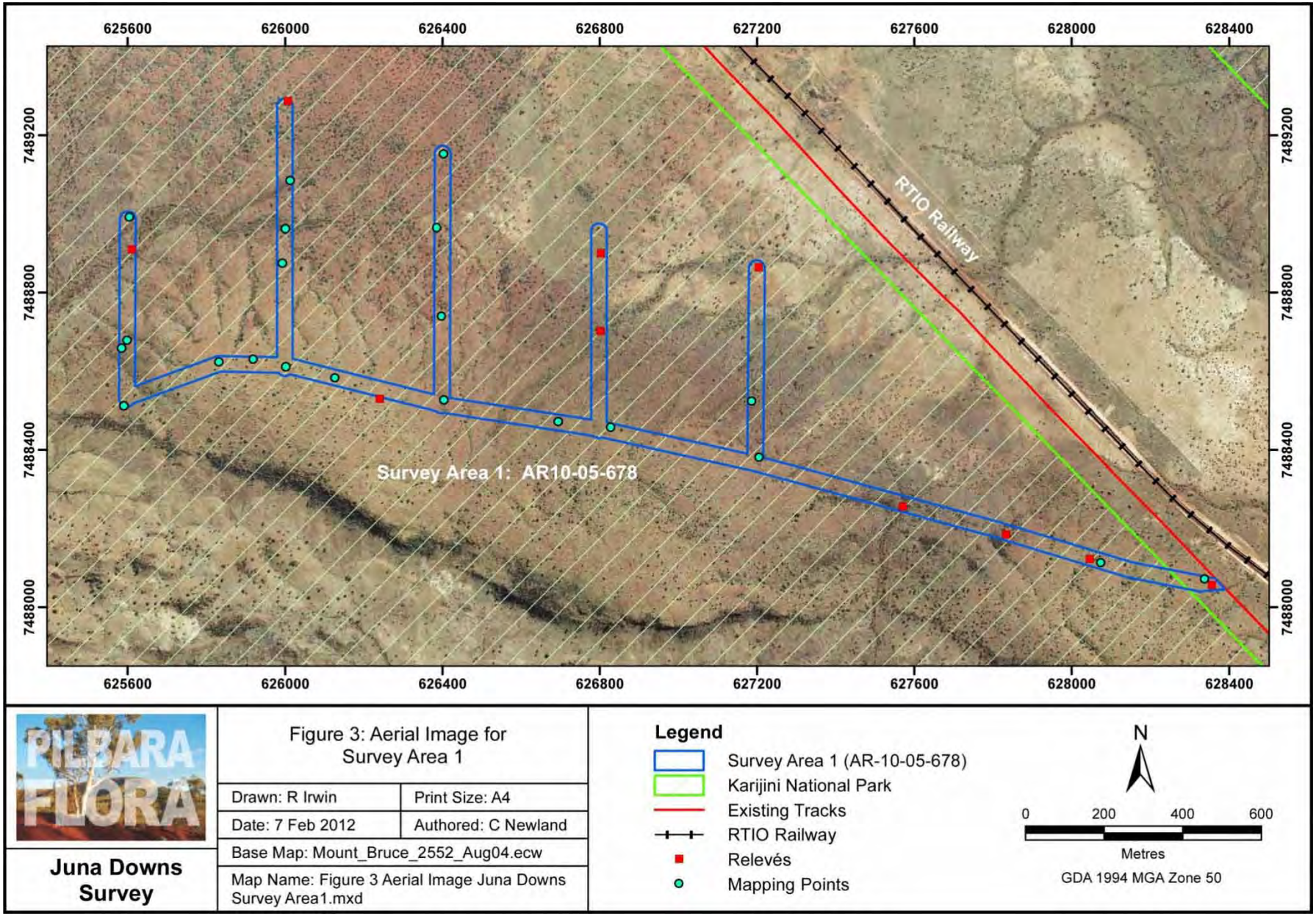


Figure 3: Aerial Image for the Survey Area 1

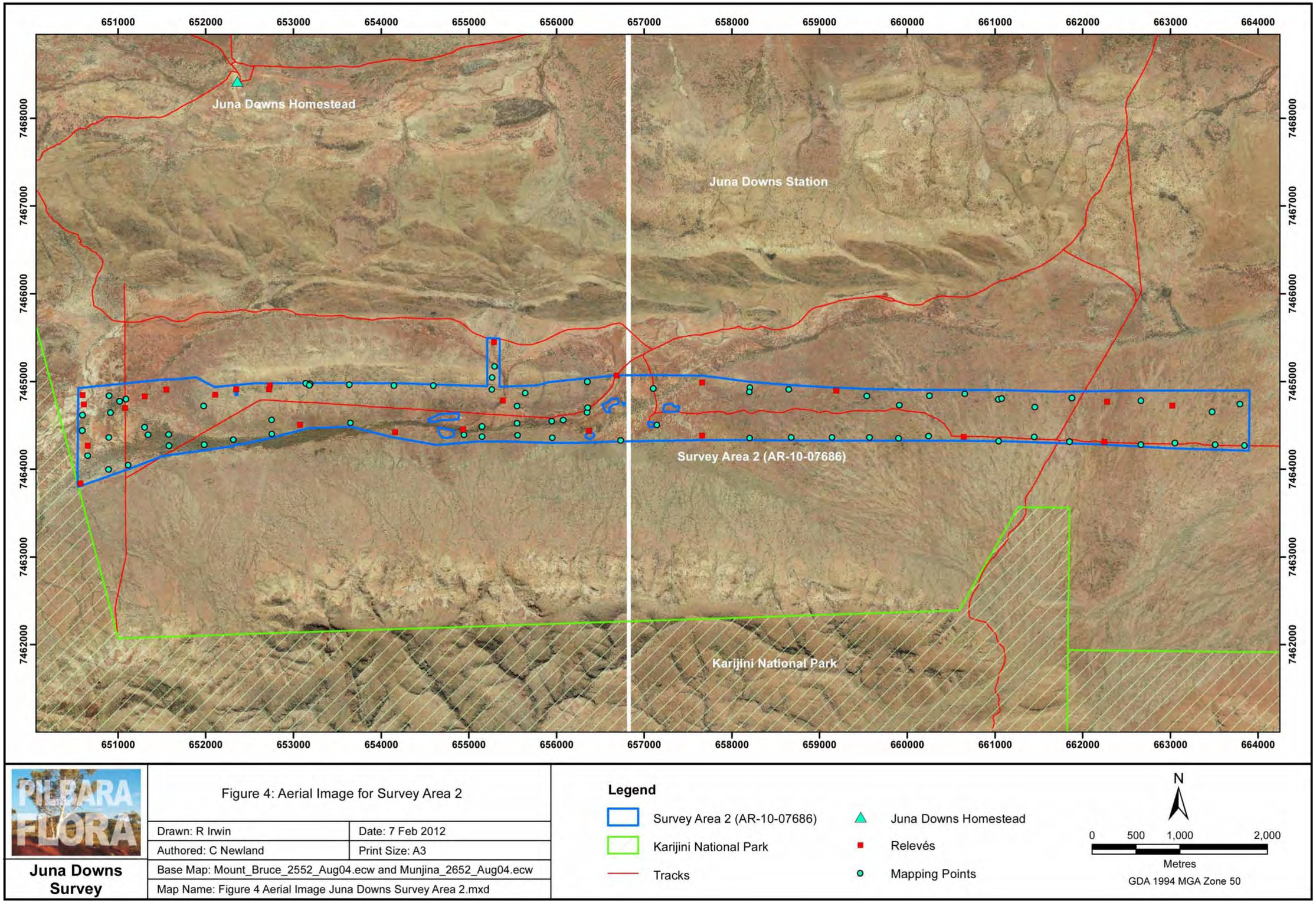
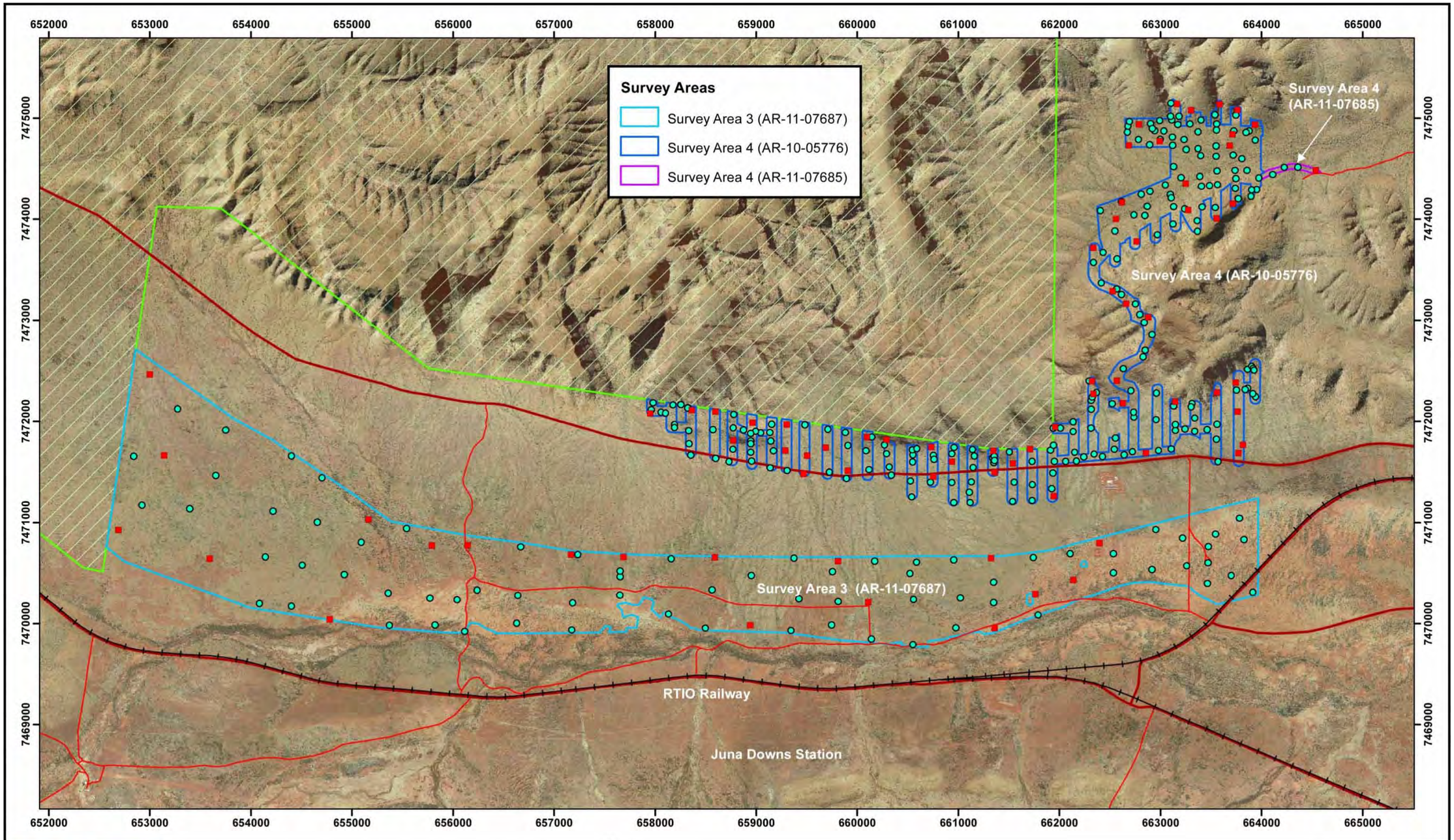


Figure 4: Aerial Image for the Survey Area 2



PILBARA FLORA	Figure 5: Aerial Image for Survey Areas 3 and 4	
	Drawn: R Irwin	Date: 7 Feb 2012
	Authored: C Newland	Print Size: A3
Juna Downs Survey	Base Map: Munjina_2652_Aug04.ecw	
	Map Name: Figure 5 Aerial Image Juna Downs Survey Areas 3 and 4.mxd	

Legend

- Karijini National Park
- RTIO Railway
- Regional Roads
- Tracks
- Relevés
- Mapping Points

N

0 500 1,000 2,000

Metres

GDA 1994 MGA Zone 50

Figure 5: Aerial Image for the Survey Areas 3 and 4

2.3 PROPOSED WORKS

The proposed exploration activities will involve:

- Clearing of access tracks and drill lines;
- Clearing of drill pads and sump areas;
- Clearing of laydown areas; and
- RC drilling.

Specific details on the exploration program will be provided by RTIO as part of the NVCP Application.

2.4 AREA REQUIRED FOR CLEARING

The areas required for clearing will be provided to DMP by RTIO as part of the NVCP Application.

2.5 EXISTING ENVIRONMENT

General views of the Survey Areas are provided in Plates 1 to 11. All survey areas are located in the Hamersley Ranges.

Survey Area 1 is located in upland areas, on low undulating colluvial hills (Plate 1) and stony plains (Plate 2).

Plate 1: Survey Area 1 – Low undulating colluvial hills

Plate 2: Survey Area 1 – Stony plains with Mulga spp.

Survey Area 2 is located on alluvial plains (Plate 3), stony plains (Plate 4) and moderately sized stony hills (Plate 5).

Plate 3: Survey Area 2 – Alluvial plains with Mulga groves

Plate 4: Survey Area 2 – Stony plains with low open woodland

Plate 5: Survey Area 2 – Stony hills

Survey Area 3 is located on stony plains (Plate 6) or alluvial plains (Plate 7).

Plate 6: Survey Area 3 – Stony plains with low open woodland

Plate 7: Survey Area 3 – Alluvial plains with Mulga groves

Survey Area 4 is located primarily on massive ironstone ranges with upland valley fill colluvial plains and colluvial plains at the base of the ranges (Plates 8 and 11).

Plate 8: Survey Area 4 – Large hills

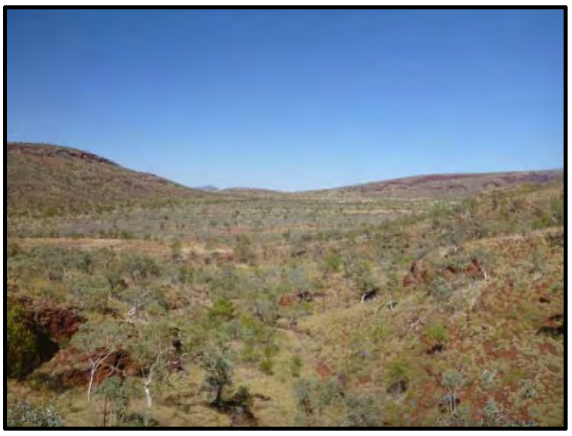


Plate 9: Survey Area 4 – Upland colluvial infill valleys

Plate 10: Survey Area 4 - Breakaway slopes and steep valleys

Plate 11: Area 4 – Colluvial plains with low open woodland

2.6 BIOGEOGRAPHICAL LOCATION

Under the Interim Biogeographical Revision of Australia ('IBRA'), the Pilbara has been divided into four subregions (May and McKenzie 2002). The Survey Areas are situated in the Pilbara 3 - Hamersley Sub-region (DEC 2007, Kendrick 2001). The Pilbara 3 Subregion is described by Kendrick 2001 as consisting of the southern section of the Pilbara Craton, characterised by a mountainous region of basalt, shale and dolerite Proterozoic sedimentary ranges and plateaux, carved with gorges (Kendrick 2001). The vegetation is characterised by low Mulga woodlands over bunch grasses on the valley floors. The skeletal soils of the ranges support *Eucalyptus leucophloia* over *Triodia brizoides* hummock grasses (Kendrick 2001).

2.7 CLIMATE AND SEASONALITY

Weather data from the Bureau of Meteorology ('BOM') for the Wittenoom Station (BOM Station No 5026) is presented in Table 3. The Wittenoom Station is located approximately 65km to the north of the Survey Areas and is the closest full BOM weather station to the survey areas. A description of the Wittenoom climate is provided below as an indicator of the climatic conditions experienced at the Survey Areas.

Wittenoom experiences a semi-arid to semi-tropical climate with a very hot summer rainfall season and a warm winter dry season. Wittenoom has a higher rainfall than other regional areas in the Pilbara. At 463.3mm, the Wittenoom average rainfall is considerable higher than other regional centres such as Tom Price (402.4mm), Paraburdoo (283.8mm), Karratha (289.7mm), Newman (310.2mm) and Marble Bar (361.7mm) (BOM 2012). Summer temperatures are extreme and can exceed 47°C. Winter temperatures are warm to moderately hot (Table 3).

Rainfall occurs from summer rainfall events dominated by cyclonic activity or thunderstorms however winter rainfall is not uncommon. These large rainfall events can result in flash flooding along watercourses, massive sheet flow and overland flooding. Watercourses are dry for most of the year and only flow after significant rainfall events. Creek flows subside rapidly, often in a few days to a week after rainfall. River systems can flow for a several weeks to a month before drying up. Water is retained, however, in waterholes along watercourses for many months into the dry season. The majority of rainfall occurs between December and April (Figure 6).

Seasonality can have a large bearing on the effectiveness of a vegetation survey. Rainfall data was examined for seasonality trends (Table 4 and Figure 6). Rainfall was well above average for the 12 month period prior to the survey (657.2mm fell as against the average of 463.3mm, Table 4), including massive rain in February 2011 (294mm). However the three months prior to the survey were very dry (Table4).

The assessment was that although the survey area experienced dry conditions in the months preceding the survey, the higher than average rainfall received in the 12 months prior resulted in except able survey conditions. Floristic diversity and comparison with other survey conducted in the region is discussed in Section 3.5.4.

Table 3: Climatic information for Wittenoom

Statistic Element*	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
Mean maximum temperature (°C)	39.7	37.8	36.7	33.1	27.8	24.5	24.2	26.7	31.1	35.3	38.0	39.6	32.9
Highest temperature (°C)	47.6	47.5	43.9	41.3	37.4	33	31.9	34.5	39.5	44	44.7	46.2	47.6
Mean minimum temperature (°C)	26.1	25.3	24.3	21.2	16.1	12.8	11.5	13.2	16.8	20.7	23.6	25.4	19.8
Lowest temperature (°C)	17.2	15.5	12.8	10.2	5.6	4	1.6	3.4	6.7	6.7	12.2	16.8	1.6
Mean rainfall (mm)	108.6	112.2	70.4	28.7	27.7	28	14.1	8.7	3.3	3.6	9.5	49.4	463.3
Highest rainfall (mm)	205.6	257.6	160.4	141	112.8	94	113.6	116.9	33	26.8	51.4	153	597.8
Lowest rainfall (mm)	2.8	0	0	0	0	0	0	0	0	0	0	0	143.2
Highest daily rainfall (mm)	170.4	126.2	170.8	94.4	70	76.5	75.9	40.2	41	25.9	22	313.2	313.2
Mean number of days of rain	8.7	9.2	5.9	3.6	3.5	3	2	1.5	0.8	1	1.9	4.7	45.8

**Data from the Bureau of Meteorology website: www.bom.gov.au for Wittenoom (Station #005026 – 1949 to present).*

Table 4: Wittenoom rainfall 12 months prior to the survey compared to the monthly average

Statistic Element*	2010	2011											Annual
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	
Mean rainfall (mm)	49.4	108.6	112.2	70.4	28.7	27.7	28	14.1	8.7	3.3	3.6	9.5	463.3
Total rainfall in past 12 months (mm)	92	79.9	294	52.6	27	41.3	14.2	6.9	0	0	0	49.3	657.2

**Data from the Bureau of Meteorology website: www.bom.gov.au for Wittenoom (Station #005026 – 1949 to present).*

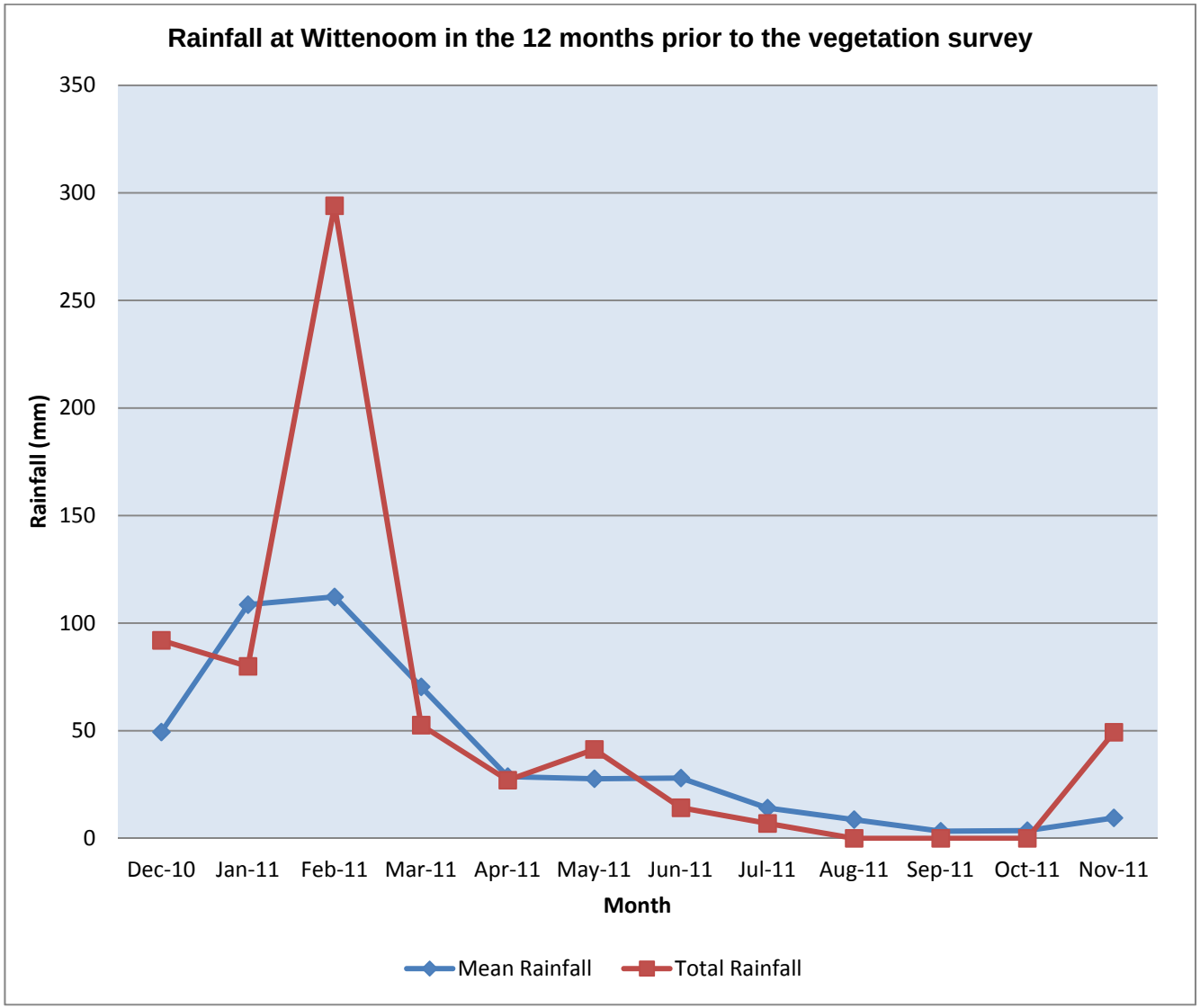


Figure 6: Wittenoom mean rainfall versus 12 months rainfall prior to the vegetation survey

2.8 GEOLOGY

The Pilbara Region surface geology consists of extremely hard rock formations of banded iron, jaspers, chert, granites and granophyres that outcrop to the surface or are covered with veneers of rocky scree and stony mantles. These landscapes are extremely erosion resistant, being the end point of 100's of millions of years of erosion.

The geology of the survey areas was assessed using the Geological Survey of Western Australia's ('GSWA') 1:500,000 interpreted bedrock geology spatial dataset (GSWA 2008). The GSWA geological descriptions for each survey area are provided in Table 5.

Table 5: GSWA geological descriptions for each survey area

Survey Area	Geological Description (GSWA 2008)
Survey Area 1	Wittenoom Formation: thin to medium-bedded dolomite, dolomitic mudstone, chert, and felsic to mafic volcanic sandstone; metamorphosed. Marra Mamba Formation: chert, banded iron-formation, mudstone, and siltstone; metamorphosed.
Survey Area 2	Marra Mamba Formation: chert, banded iron-formation, mudstone, and siltstone; metamorphosed. Wittenoom Formation: thin to medium-bedded dolomite, dolomitic mudstone, chert, and felsic to mafic volcanic sandstone; metamorphosed. Jeerinah Formation: Undivided; mudstone; siltstone; sandstone; chert; massive basaltic flows; basaltic pillow lava; basaltic breccia; and minor felsic volcaniclastic rock; intruded by numerous dolerite sills; metamorphosed.
Survey Area 3	Wittenoom Formation: thin- to medium-bedded dolomite, dolomitic mudstone, chert, and felsic to mafic volcanic sandstone; metamorphosed Marra Mamba Formation chert, banded iron-formation, mudstone, and siltstone; metamorphosed.
Survey Area 4	Brockman Iron Formation: banded iron-formation, chert, mudstone, and siltstone; metamorphosed. Mount McRae Shale Formation: mudstone, siltstone, chert, banded iron-formation, and dolomite; metamorphosed.

2.9 SOILS

The Survey Areas include stony soils, red shallow loams, red loamy earths and red shallow sands as their main soil associations. These soils are summarised below from Van Vreeswyk *et al.* (2004):

- Stony soils - The majority of stony soils occur within the extensive areas of hills, ranges and upper stony plains and are very shallow to shallow and skeletal or poorly developed. The soils vary depending on the nature of the parent rock. A heavy stony mantle mostly protects the stony soils. Stone or rock may comprise 20 to 80% of the soil profile. Outcropping rock is a feature of this soil group and some soils may contain ironstone gravel.
- Red shallow loams - These soils are shallow loams often overlying weathered rock. The thin topsoils range from sandy loam to clay loam and overlie thin to medium

subsoils of sandy clay loam or clay loam. Some soils have uniform textures throughout the soil profile.

- Red loamy earths – These soils exhibit thin to medium loam to clay loam topsoils overlying thick clay loam to light clay subsoils. The soils are deep but occasionally have substrates of red-brown hardpan, granite or banded ironstone at moderate depth. Many soils occurring on footslopes, hillslopes, stony plains and laterite plains, are deep with common to abundant stones or gravels through all or most of the soil profile.
- Red shallow sands – Three sub groups of this soil type exist. The observed type within the Newman land system is Red shallow sands on Basalt. Typical characteristics are; fine clayey sands to sandy loams on a shale, basalt or metamorphic rock base, recording depths of less than 50cm. They often contain high stone or rock content within the soil profile and can occur within red shallow loams. Typical colouring ranges from red to dark reddish brown to yellowish red.

2.10 SURFACE HYDROLOGY

The Survey Areas fall within the 78777km^2 Ashburton River Catchment. Drainage from the survey areas is directed towards Turee Creek, the major local watercourse, which in turn connects with the Ashburton River. The confluence of these two systems is located approximately 132km to the southwest of the Survey Areas. The other major regional watercourse is the Ashburton River, located in a different catchment approximately 65km to the north-northeast of the Survey Areas.

At a local level, Survey Area 1 has no major watercourses but has several minor hillside drainage lines (Figure 3, Plate 1).

Survey Area 2 has a moderate creek system that passes through approximately 6.3km or 131.94ha of this survey area (Figure 4, Plate 3). The creek broadens out into a heavily vegetated Mulga dominated drainage area that is up to 300m across and with numerous smaller braided channels as against a defined central channel.

Survey Area 3 occurs on plains country with few drainage lines and no major watercourses (Figure 5, Plates 6 and 7). A Mulga dominated broad drainage line encroaches onto the southern boundary of this survey area at one location.

Survey Area 4 occurs primarily in mountainous terrain with steeply incised hillsides drainage lines that flow southwards towards the plains below (Figure 5, Plates 8 and 10). Some drainage lines are trapped in enclosed valley catchments. There are no major watercourses, with creek systems being small to moderate but with defined channels. The northern section of Survey Area 4 contains an upland broad flat valley that acts as drainage foci for surrounding hills (Plate 9).

No waterholes or wetlands were observed in any of the Survey Areas. A spatial assessment was conducted for wetlands and waterholes occurring in survey area locality using GIS data from Geoscience Australia (2011). There are no springs, waterholes or wetlands occurring within, or near, the Survey Areas.

Two recognised semi-wetland communities occur regionally:

- Coolibah-lignum flats (Lake Robinson/Coondewanna Flats).
- Coolibah - Lignum (Mt Bruce Flats).

Both are listed as Priority Ecological Communities ('PEC's), refer section 2.15 for further information. The Coolibah-lignum flats (Lake Robinson/Coondewanna Flats) occur

approximately 19km to the southeast of Survey Area 2. The Coolibah - Lignum (Mt Bruce Flats) occur approximately 6km to the north of Survey Area 1. Due to the spatial separation and lack of drainage connectivity, neither of these communities will be affected by the proposed exploration program.

Arcview GIS shapefiles provided by the Department of Water's ('DOW's) Geographic Atlas were examined for Public Drinking Water Source Areas ('PDWSA's) in proximity to the Survey Areas. The nearest PDWSA is the Millstream Water Reserve, located approximately 62km to the northwest of Survey Area 1 (DOW 2011).

2.11 LAND SYSTEMS

The Pilbara Region has been mapped by the Department of Agriculture and Food Western Australia ('DAFWA') into 102 land systems based on geology, topography and soils (Van Vreeswyk *et al.* 2004). The land systems occurring within the Survey Areas were assessed using Arcview land system shapefiles provided by DAFWA (2007).

Seven land systems occur within the survey areas. Information on these land systems is provided in Table 6. The dominate land system is Boolgeeda, with Wannamunna, Newman and Elimunna to a lesser extent. The Paraburdoo, Platform and Table land systems had minimal occurrence.

2.12 REGIONAL VEGETATION

Three of Beard's vegetation associations occur within the Survey Areas; Vegetation Associations 18, 82 and 567 (DAFWA 2006). The Beard descriptions, taken from DAFWA (2006), are provided below:

- **18: '**Low woodland; mulga (*Acacia aneura*)*'*.
- **82: '**Hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*'.
- **567: '**Hummock grasslands, shrub steppe; mulga & kanji over soft spinifex & *Triodia basedowii*.

Beard's Vegetation Associations have been refined and re-mapped by the Department of Agriculture and Food Western Australia ('DAFWA') in sub-associations with the following revised descriptions being applicable to the Survey Areas (DAFWA 2006, Shepherd et al. 2002):

- **18.11 '***Acacia* open shrubland / *Ptilotus* mixed open forbland*'*.
- **82.3: '***Eucalyptus* sparse mallee shrubland / *Senna* mixed sparse shrubland / *Triodia* open hummock grassland'.
- **567.1: '***Acacia* mixed sparse shrubland / *Triodia* open hummock grassland'.

The type, status, pre-European area (based on Beard) and remaining extent of native vegetation for the entire state has been assessed by the DEC and DAFWA using remote sensing techniques and GIS analysis to produce a statistical compendium called the 'Comprehensive, Adequate and Representative' (CAR) Reserves System (Shepherd *et al.* 2002). Data has been updated on a regular basis with the information from the latest update being in 2009 (DAFWA 2009). Information on the extent of Vegetation Sub-associations 18.11, 82.2 and 567.1 occurring within the Survey Area from DAFWA (2009) is provided in Table 7.

All vegetation sub-association have 100% of pre-European vegetation remaining (Table 7) (Shepherd *et al.* 2002) and significant representation within internationally recognised conservation estates (IUCN Reserve classes 1 to 4[1]);19.57% for Vegetation Sub-association 18.11, 12.11% for Vegetation Sub-association 82.3 and 22.34% for Vegetation Sub-association 567.1 (Table 7). All vegetation sub-associations have significant areas of occurrence in Western Australia; 580,556.01ha for Vegetation Sub-association 18.11, 2,169,996.57ha for Vegetation Sub-association 82.3 and 777,187.88ha for Vegetation Sub-association 567.1 (Table 7).

[1]*The International Union of Conservation ('IUCN') reserve classes 1 to 4 are used as an indicator of areas protected under conservation estate.*

Table 6: Information on land systems occurring within the Survey Areas

Land System*	Description**	Survey Area 1 (ha)	Survey Area 2 (ha)	Survey Area 3 (ha)	Survey Area 4 (ha)	Survey Area Total (ha)	Area in Pilbara (ha)*	Extent of Pilbara (%)
Boolgeeda	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands and mulga shrublands.	0.32	600.44	810.85	176.68	1588.29	774800	4.3
Wannamunna	Hardpan plains and internal drainage tracts supporting mulga shrublands and woodlands (and occasionally eucalypt woodlands).	0	0	304.24	0	304.24	57700	0.3
Newman	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	16.74	103.77	0	145.57	266.08	1458000	0.8
Elimunna	Stony plains on basalt supporting sparse acacia and cassia shrublands and patchy tussock grasslands	0	119.24	0	0	119.24	61700	0.3
Paraburdoo	Basalt derived stony gilgai plains and stony plains supporting Snakewood and mulga shrublands with spinifex and tussock grasses.	0	74.27	0	0	74.27	56300	0.3
Platform	Dissected slopes and raised plains supporting hard spinifex grasslands	2.74	0	0	0	2.74	157000	0.9
Table	Low calcrete plateaux, mesas and lower plains supporting mulga and cassia shrublands and minor spinifex grasslands.	2.58	0	0	0	2.58	7700	0.04
Total		**22.38**	**897.72**	**1115.09**	**322.25**	**2357.44**		

*DAFWA (2007). **Van Vreeswyk *et al.* 2004

Table 7: Information on the extent of vegetation sub-associations occurring in the Survey Areas

Vegetation Sub-association*	Pre-European area (ha)	Current Extent (ha)	Percentage Remaining (%)	Percentage Pre-European in IUCN Class I-IV Reserves** (%)	Survey Area 1 (ha)	Survey Area 2 (ha)	Survey Area 3 (ha)	Survey Area 4 (ha)	Total for all Survey Areas (ha)
18.11	580,556.01	580,556.01	100	19.57	0	894.33	852.93	203.03	1950.29
82.3	2,169,996.57	2,169,996.57	100	12.11	16.75	3.39	0	119.22	139.36
567.1	777,187.88	777,187.88	100	22.34	5.63	0	262.16	0	267.79
Total					**22.38**	**897.72**	**1115.09**	**322.25**	**2357.44**

*Data from Shepherd et al. (2002) and DAFWA (2009).

**The International Union of Conservation ('IUCN') reserve classes 1 to 4 are used as an indicator of areas protected under conservation estate.

2.13 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

A search was conducted using the SEWPaC's 'Protected Matters Search Tool' for listings under the *Environmental Protection and Biodiversity Act 1999* ('*EPBC Act*') based on a line extending from Survey Area 1 to Survey Area 2 (-22.7 118.21667 to -22.91667 118.6) with a 10km buffer (SEWPaC2012).

Listings under the *EPBC Act* are determined by SEWPAC against a set of criteria stated under the *EPBC Act*. A description of the *EPBC Act* categories is provided in Appendix A.

The results of the *EPBC Act* search are presented in Appendix B and a summary presented in Table 8.

Table 8: Summary of the *EPBC Act* search results

Matters of National Environmental Significance	**Result**
World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar Sites):	None
Great Barrier Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	None
Threatened Species:	6
Migratory Species:	8
Other Matters Protected by the *EPBC Act*	
Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	5
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves:	None
Extra Information	
Places on the RNE:	1
State and Territory Reserves:	2
Regional Forest Agreements:	None
Invasive Species	4
Nationally Important Wetlands:	1

Of relevance, there were no listings for World Heritage Properties, National Heritage Places, Wetlands of International Importance or Threatened Ecological Communities ('TEC's.)

Under the *EPBC Act*, there were listings for:

- Six Threatened Species.
- Eight Migratory Species.
- Five Listed Marine Species.
- One Place on the Register of National Estate.
- Two State and Territory Reserves.
- Four Invasive Species.
- One Nationally Important Wetland.

Each *EPBC Act* category with listings is discussed in turn below:

Threatened Species

The six threatened species were:

- Night Parrot (*Pezoporus occidentalis*) - *EPBC Act* Endangered.
- Northern Quoll (*Dasyurus hallucatus*) – *EPBC Act* Endangered.
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantius*) - *EPBC Act* Vulnerable.
- Pilbara Olive Python (*Liasis olivaceus barroni*) - *EPBC Act* Vulnerable.
- Hamersley Catapycnon (*Lepidium catapycnon*) – *EPBC Act* Vulnerable.
- Mountain Thryptomene (*Thryptomene wittweri*) - EPBC Act Vulnerable.

Lepidium catapycnon and *Thryptomene wittweri* are discussed in Section 3.5.5. These species were not recorded in the flora survey. The fauna species are discussed in Section 4.3.2.

Eight Migratory Species

There were actually only six Migratory Species due to double listings of the two Egret species under different categories. These species were:

- Fork-tailed Swift (*Apus pacificus*).
- Great Egret, White Egret (*Area alba*).
- Cattle Egret (*Area ibis*).
- Rainbow Bee-eater (*Merops ornatus*).
- Night Parrot (*Pezoporus occidentalis*).
- Oriental Plover (*Charadrius veredus*).

Five Listed Marine Species

The five Listed Marine species are avifauna that are also listed as Migratory Species.

One Place on the Register of National Estate

There is one listed place on the Register of National Estate ('RNE'):

- Hamersley Range National Park (1977) Boundary WA – Registered Place.

In recent times the Hamersley Range National Park has been renamed as Karijini National Park and the boundary has been re-adjusted. Using the current boundary of the Karijini National Park, the majority of Survey Area 1 occurs within the national park boundary and Areas 2, 3 and 4 are located adjacent to, but outside of, the national park boundary (Figures 3 to 6).

Two State and Territory Reserves

The two listed State and Territory Reserves are:

- Karijini National Park
- Unnamed WA41696

The Karijini National Park is discussed above.

'Unnamed WA41696' is a protected place located to the north of Survey Area 1.

Four Invasive Species

The four invasive species were:

- Cat (*Felix catus*)
- Rabbit (*Oryctologus cuniculus*)
- Red Fox (*Vulpes vulpes*)
- Buffel Grass (*Cenchrus ciliaris*)

It is unlikely that the proposed drilling program will favour or promote any of the above invasive species, in excess of their current abundance.

One Nationally Important Wetland

One Nationally Important Wetland is listed:

- Mt Bruce coolibah-lignum flats.

The Mt Bruce coolibah-lignum flats occur approximately 5.8km to the north of Survey Area 1 and will not be impacted by the proposed exploration.

2.14 CONSERVATION AREAS

Significant conservation areas within Western Australia include National Parks, Nature Reserves, Threatened Ecological Communities ('TEC's), Priority Ecological Communities ('PEC's), Red Book Areas and other types of DEC managed lands such as purchased ex-pastoral leases.

The proximity of conservation areas in relation to the survey areas was assessed using:

- Arcview GIS shapefiles purchased from DEC for TECs and PECs occurring in the Pilbara Region (DEC 2011a).
- Arcview GIS shapefiles downloaded from the Landgate State Land Information Platform for Schedule 1 Areas, ESAs, DEC Managed Lands and EPA Red Book Areas (SLIP 2012).
- Tengraph (DMP 2012).
- Natmap Raster Premium Edition (Geoscience Australia 2005).
- Arcview shapefiles provided by SEWPAC for RNE areas (SEWPaC 2011a).

In summary:

- The majority of Survey Area 1 is located inside Karijini National Park. Survey Areas 2, 3 and 4 abut the boundary of Karijini National Park. There are no other national parks or nature reserves near the Survey Areas.
- Survey Area 1 is contained within the Schedule 1 Area and ESA formed by Karijini National Park. This Schedule 1 Area and ESA also partially contain sections of Survey Areas 2, 3 and 4.
- Survey Area 2 is contained partially within Red Book Area 8.14.
- There are no TECs or PECs occurring at the survey areas. PECs and TECs are discussed further in Section 2.15.

2.15 THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

A TEC is listed under one of four categories: presumed totally destroyed, critically endangered, endangered or vulnerable (DEC 2010a). There are two TECs listed for the Pilbara (DEC 2011b);

- **46. *Themeda* grasslands:** *Themeda* grasslands on cracking clays (Hamersley Station).
- **78. Ethel Gorge:** Ethel Gorge aquifer stygobiont community.

A PEC is listed under one of five categories: Priority 1 to Priority 5 (DEC 2010a). Possible TECs that do not strictly meet TEC defined criteria, or are inadequately defined, are listed by DEC as Priority 1, 2 or 3 PECs. Ecological Communities that are adequately known and are considered rare but not threatened, meet criteria for near threatened, or that have been recently removed from the threatened list, are listed by DEC as a Priority 4 PEC. Conservation dependent ecological communities are listed as a Priority 5 PEC (DEC 2010a).

There are 29 PECs listed for the Pilbara (DEC 2011b).

The location of TECs and PECs in relation to the Survey Areas was assessed spatially using shapefiles for Pilbara TECs and PECs purchased from DEC and ground mapping of PECs undertaken by the Pilbara Flora botanists (DEC 2011a). The results are provided in Table 9 and displayed visually in Figure 9.

Table 9: Location of the closest TECs and PECs to the Survey Areas

Type	No	TEC/PEC Name	Approximate distance from Survey Areas
TEC	TEC 18	Ethel Gorge aquifer stygobiont	135km to the southeast of Survey Area 2
TEC	TEC 46	*Themeda* grasslands on cracking clays (Hamersley Station, Pilbara).	42km to the northwest of Survey Area 1
PEC	PEC 20	Coolibah - Lignum (Mt Bruce Flats) Type 3	6km to the north of Survey Area 1
PEC	PEC 20	Coolibah-lignum flats: *Eucalyptus victrix* over *Muehlenbeckia* community (Type 1 – Lake Robinson and Type 2 - Coondewanna Flats and Wanna Munna Flats)	19km to the southeast of Survey Area 2.
PEC	PEC 12	Brockman Iron cracking clay communities of the Hamersley Range	17km to the south of Survey Area 2.
PEC	PEC 1	*West Angelas Cracking Clays*	27km to the south-southeast of Survey Area 2.
PEC	PEC 2	Weeli Wolli Spring Community	55km to the east of Survey Area 2.
PEC	PEC 17	Fortescue Marsh (Marsh Land System)	68km to the northeast of Survey Area 4.

There are no TECs or PECs occurring near the survey areas.

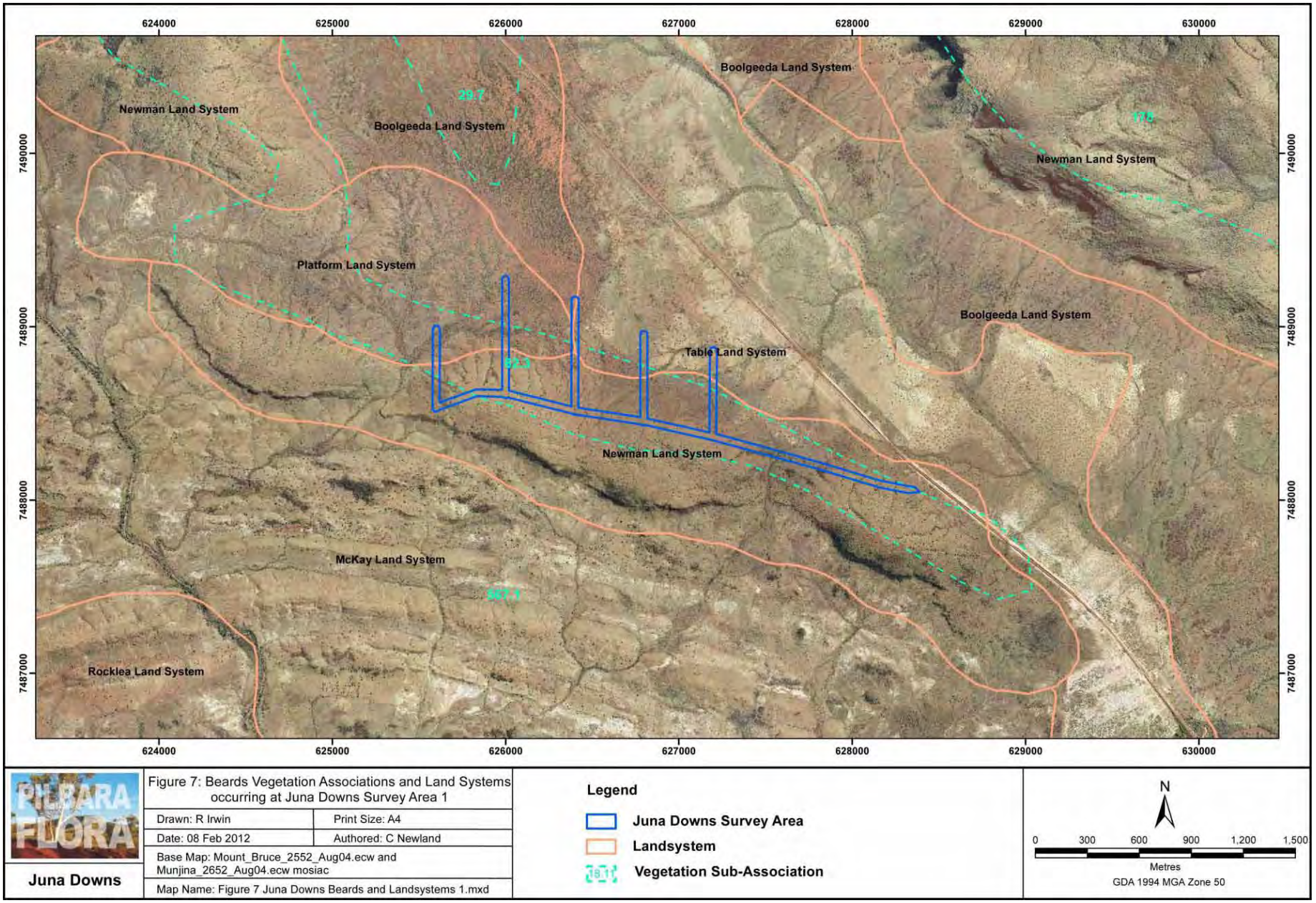


Figure 7: Beard Vegetation Associations and Land Systems occurring at Juna Downs Survey Area 1

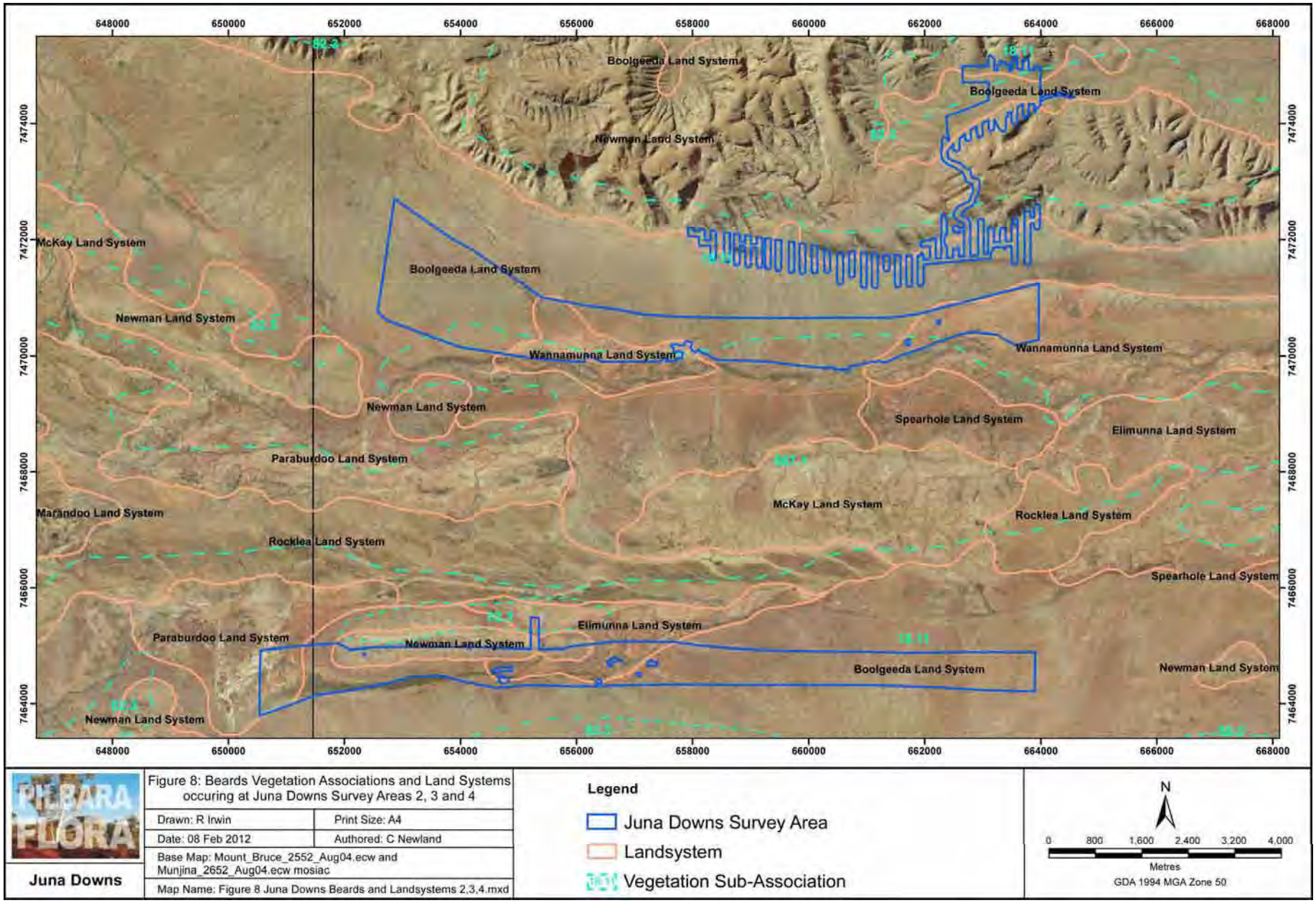


Figure 8: Beard Vegetation Associations and Land Systems occurring at Juna Downs Survey Area 2, 3 and 4

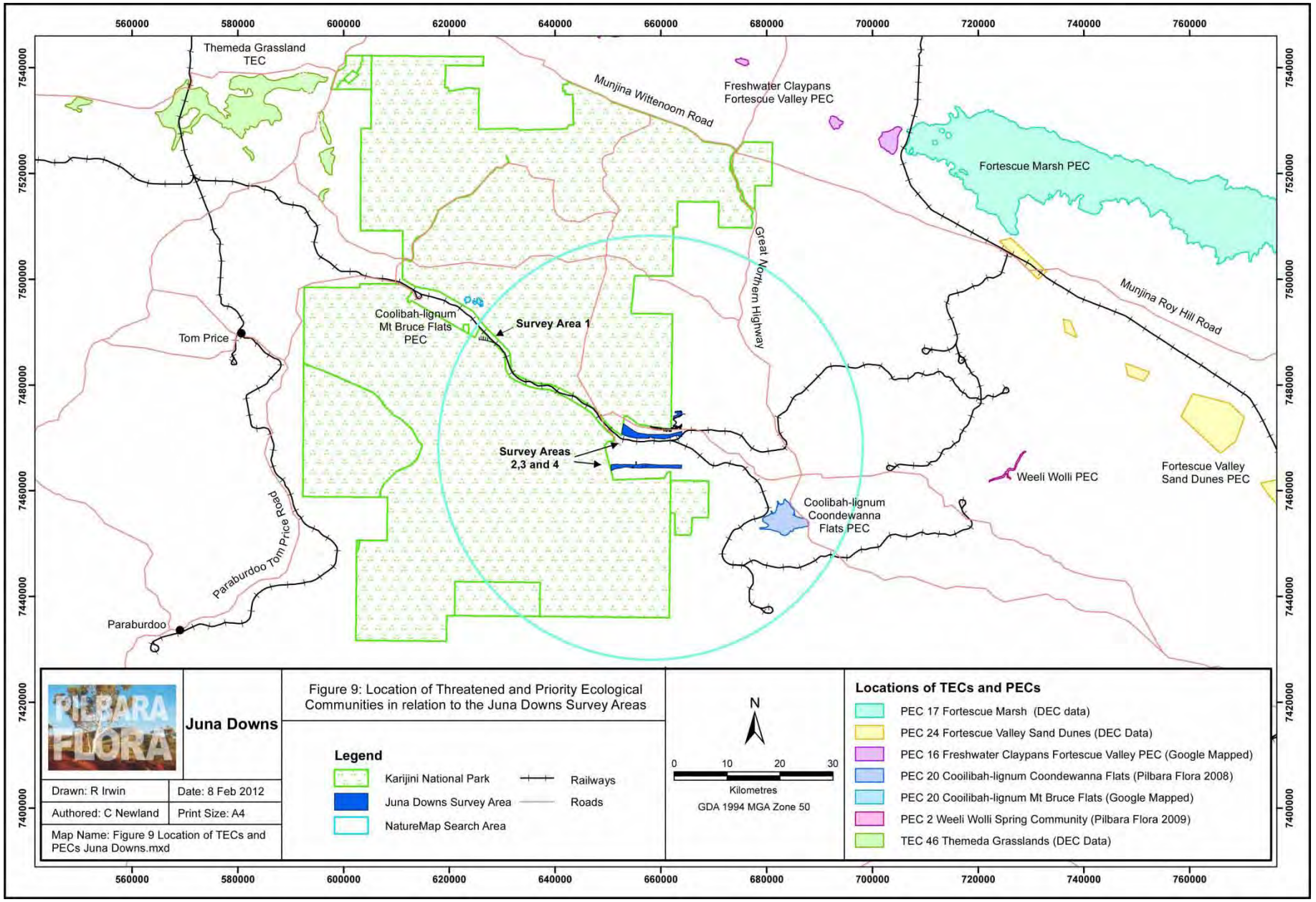


Figure 9: Location of Threatened and Priority Ecological Communities in relation to the Juna Downs Survey Areas

3 FLORA AND VEGETATION SURVEY

Pilbara Flora was commissioned by RTIO to undertake a flora and vegetation survey of the Survey Areas. The purpose of the survey was to provide baseline biological information to support an NVCP application for exploration programs proposed for the Survey Areas.

The survey was conducted in general accordance with the Level 1 requirements of the EPA's Guidance Statement 51 "Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia" (EPA 2004a).

With reference to Guidance Statement 51, the survey consisted of a desktop study followed by the field survey. A vertebrate fauna habitat assessment was also undertaken (refer Section 4).

3.1 OBJECTIVES

The objectives of the flora and vegetation survey were to:

- Conduct a desktop study that involved assessing previous flora studies and examining various flora databases.
- Conduct a Level 1 flora and vegetation survey of the survey areas that included mapping vegetation communities and recording the locations of any observed Threatened Flora, Priority Flora or introduced species.

3.2 THREATENED AND PRIORITY FLORA

Under the *Wildlife Conservation Act 1950* ('*WC Act*'), the Minister for the Environment may declare species considered to be in danger of extinction, are rare or otherwise in need of special protection as Threatened Flora (FloraBase 2012). DEC also maintains a Priority Flora list for flora that may be threatened or endangered but are not formally protected under the *WC Act 1950* (FloraBase 2012). Priority Flora are listed under five categories by DEC.

Under Section 179 of the *EPBC Act*, SEWPAC releases a list of threatened flora species. Listings under the *EPBC Act* are determined by SEWPAC against a set of criteria stated under the *EBPCA*.

Threatened Flora and Priority Flora definitions are provided in Appendix A.

3.3 DESKTOP STUDY

Prior to the field survey, a desktop study was undertaken that involved the following:

- Review of the other relevant flora reports.
- Threatened and Priority Flora database searches'

3.3.1 Review of Other Relevant Flora Reports

Six flora and vegetation reports were reviewed:

- Biota (2008a). Marandoo Phase 2, Project Vegetation Flora Survey. Unpublished report prepared by Biota Environmental Sciences Pty Ltd for Rio Tinto Iron Ore, June 2008.
- Biota (2008b). Wildflower Rail Construction Camp: Native Vegetation Clearing Permit Report. Unpublished report prepared by Biota Environmental Sciences Pty Ltd for Rio Tinto Iron Ore, June 2008.
- Biota (2008c). A Vegetation and Flora Survey of the RTIO Rail Duplication – Bellbird Siding to Juna Downs. Unpublished report prepared by Biota Environmental Sciences Pty Ltd for Rio Tinto Iron Ore, August 2008.
- Biota (2009). A Vegetation and Flora Survey of the RTIO Rail Duplication – Bellbird Siding to Juna Downs: Additional Eastern Corridor. Unpublished report prepared by Biota Environmental Sciences Pty Ltd for Rio Tinto Iron Ore, May 2009.
- RTIO (2009). Botanical Survey for an Evaluation Drilling Program at Juna Downs and Supporting Document to a Native Vegetation Clearing Permit Application. Unpublished report prepared by RTIO, September 2009.
- RTIO (2011). Botanical Survey for an Exploration Drilling Program at Juna Downs South, E47/1943 and Supporting Document to a Native Vegetation Clearing Permit Application. Unpublished report prepared by RTIO, January 2011.

Biota (2008a). Marandoo Phase 2, Project Vegetation Flora Survey.

Biota Environmental Sciences Pty Ltd ('Biota') was commissioned to undertake a flora and vegetation survey of planned expansions to the Marandoo Mine. The Marandoo Mine is located approximately 14.8km northwest of Survey Area 1. The vegetation and flora of the Marandoo lease area and various rail corridors were assessed in 1991 for the Environmental Review and Management Programme prepared for the Marandoo Iron Ore Mine and proposed transport corridors undertaken by Mattiske and Associates. The Mattiske and Associates data and mapping was updated and included in the Biota report. Although not specifically stated in the Biota report, the survey area totals 5453.98ha by adding up the vegetation community areas. A summary is provided below:

- Twenty eight vegetation types were defined which broadly comprised:
  - Scattered to moderately dense Mulga (*Acacia aneura*) woodlands over an understory of mixed tussock and or hummock grasses on broad drainage areas/basins and flats.
  - Eucalypt and/or Mulga woodlands in major creeklines.
  - Mixed Acacia shrublands in minor flowlines.
  - Sparse to moderately dense mixed shrublands (mostly of Mulga or other Acacia species) over hummock grasslands of various *Triodia* species depending on topographic position on ridges/erosional spurs and low foothills/escarpments.
- No PECs or TECs were recorded.
- Based on the current survey and previous studies, a total of 536 taxa of native vascular flora from 177 genera and 60 families were recorded in the survey area. Biota considered that, taking into account the probable slight over-estimation of species due to historical taxonomic issues, the Marandoo survey appears to be higher than would be expected for a study area of this size in this locality. The

apparent species richness could be due to the diversity of habitats in the study area.

- No Threatened Flora, as listed under the *WC Act* or *EPBC Act*, were recorded.
- Eight Priority Flora species were recorded in total for the survey area from the Biota survey and from previous surveys. However, DEC has revised the conservation status and taxonomy of some of these species with the result that only seven Priority Flora species are now current:
  - *Calotis squamigera* (Priority 1).
  - *Josephinia* sp. Marandoo (M.E. Trudgen 1554) (Priority 1).
  - *Indigofera ixocarpa (*Priority 2).
  - *Goodenia lyrata (*Priority 3).
  - *Rostellularia adscendens* var*. latifolia* (Priority 3).
  - *Goodenia nuda* (Priority 4).
  - *Eremophila magnifica* subsp*. magnifica* (Priority 4).
- Twenty introduced species were recorded:
  - **Acetosa vesicaria* (Ruby Dock).
  - **Bassia scoparia* (no common name).
  - **Bidens bipinnata* (Beggars Ticks).
  - **Bougainvillea* sp. (planted).
  - **Cucumis melo* subsp. *agrestis* (Ulcardo Melon).
  - **Euphorbia hirta* (Asthma Plant)
  - **Euphorbia peplus* (Petty Spurge)
  - **Cenchrus ciliaris* (Buffel Grass).
  - **Cenchrus setiger* (Birdwood Grass).
  - **Chloris virgata* (Feathertop Rhodes Grass).
  - **Cynodon dactylon* (C*ouch*)
  - **Echinochloa colona* (Awnless Barnyard Grass*).*
  - **Datura leichhardtii* (Native Thornapple).
  - **Malvastrum americanum* (Spiked Malvastrum).
  - **Portulaca oleracea* (Pigweed).
  - **Setaria verticillata* (Whorled Pigeon Grass).
  - **Sigesbeckia orientalis* (Indian Weed).
  - **Solanum nigrum* (Black Berry Nightshade).
  - **Sonchus oleraceus* (Common Sowthistle).
  - **Vachellia farnesiana* (Mimosa Bush).
- None of the introduced species were Declared Plants under the *Agriculture and Related Resources Protection Act 1976*.

Biota (2008b). Wildflower Rail Construction Camp: Native Vegetation Clearing Permit Report.

Biota was commissioned to undertake a flora, vegetation and fauna habitat assessment survey for the Wildflower construction camp and village. The Wildflower construction camp and village is located in Survey Area 3 and has since been rehabilitated. The survey area was 144ha. A summary is provided below:

- Three vegetation types were mapped from five identified units:
  - *Eucalyptus gamophylla* low open mallee woodland over *Acacia dictyophleba, A. steedmanii* subsp*. borealis, A. bivenosa* tall open shrubland over *Triodia* sp. Shovelanna Hill hummock grassland occurring generally over the low stony plains of the Boolgeeda Land System in the northern half of the study area.
  - *Acacia dictyophleba (A. steedmanii* subsp*. borealis)* tall open shrubland over *Triodia pungens* hummock grassland in lower-lying sections of the same low stony plains.
  - Three Mulga vegetation types on the clayey plains of the Wannamunna Land System in the southern half of the study area, comprising *Acacia aneura* tall open shrubland to low open forest over a variable understorey dominated by either *a* mixed open tussock grassland or an open hummock grassland of *Triodia melvillei* or *T. pungens*.
- No PECs or TECs were recorded.
- A total of 138 taxa from 79 genera and 30 families were recorded in the survey area.
- No Threatened Flora, as listed under the *WC Act* or *EPBC Act*, were recorded.
- No Priority Flora species were recorded.
- Five introduced species were recorded:
  - **Bidens bipinnata* (Beggars Ticks).
  - **Cenchrus ciliaris* (Buffel Grass).
  - **Malvastrum americanum* (Spiked Malvastrum).
  - **Melinis repens (Red Natal).*
  - **Portulaca oleracea* (Pigweed).
- None of the introduced species were Declared Plants under the *Agriculture and Related Resources Protection Act 1976*.

Biota (2008c). A Vegetation and Flora Survey of the RTIO Rail Duplication – Bellbird Siding to Juna Downs

Biota was commissioned to undertake a flora and vegetation survey of a planned section of rail duplication from Bellbird Siding to Juna Downs, a distance of approximately 120 km. A portion of the Biota survey area occurred in close proximity to Survey Area 3. The survey area was 8982ha. A summary is provided below:

- Twenty nine vegetation types were defined which broadly comprised:
  - Limestone Spinifex (*Triodia wiseana*) and/or *Triodia melvillei* hummock grasslands (less commonly *Triodia angusta* or *Triodia* sp. Shovelanna Hill)

with a scattered to moderately dense shrub overstorey dominated by varying proportions of *Acacia aneura*, *A. ancistrocarpa*, *A. atkinsiana*, *A. bivenosa* and/or *A. pruinocarpa* on stony plains and low stony rises.

- Tall shrublands of Snakewood (*Acacia xiphophylla*) or Mulga (*A. aneura*) over various spinifex species on stony plains and low rises with a higher clay content.
- Open woodlands to forests of Coolibah (*E. victrix*) over mixed shrubs and tussock grasslands in major creeks.

- No PECs or TECs were recorded.
- Based on the current survey and previous records, a total of 331 taxa of native vascular flora from 136 genera and 46 families were recorded in the survey area.
- No Threatened Flora, as listed under the *WC Act* or *EPBC Act*, were recorded.
- Eight Priority Flora species were recorded in total for the survey area from the Biota survey and from previous surveys. However, DEC has revised the conservation status and taxonomy of some of these species with the result that only five Priority Flora species are now current:
  - *Calotis squamigera* (Priority 1).
  - *Astrebla lappacea* (Priority 3).
  - *Goodenia lyrata (*Priority 3).
  - *Rhagodia* sp. Hamersley (M. Trudgen 17794) (Priority 3).
  - *Rostellularia adscendens* var*. latifolia* (Priority 3).
- Eleven introduced species were recorded:
  - **Acetosa vesicaria* (Ruby Dock).
  - **Bidens bipinnata* (Beggars Ticks).
  - **Cenchrus ciliaris* (Buffel Grass).
  - **Cenchrus setiger* (Birdwood Grass).
  - **Chloris virgata* (Feathertop Rhodes Grass).
  - **Datura leichhardtii* (Native Thornapple).
  - **Malvastrum americanum* (Spiked Malvastrum).
  - **Portulaca oleracea* (Pigweed).
  - **Setaria verticillata* (Whorled Pigeon Grass).
  - **Sonchus oleraceus* (Common Sowthistle).
  - **Vachellia farnesiana* (Mimosa Bush).
- None of the introduced species were Declared Plants under the *Agriculture and Related Resources Protection Act 1976*.

Biota (2009). A Vegetation and Flora Survey of the RTIO Rail Duplication – Bellbird Siding to Juna Downs: Additional Eastern Corridor.

Biota was commissioned to undertake a flora and vegetation survey of a 22km length of the new railway corridor to complement the existing survey of the Bellbird Siding to Juna Downs

area. The 819ha survey area occurred from near Survey Area 3 and extending eastwards into Juna Downs Station. A summary is provided below:

- Eighteen vegetation types were defined which broadly comprised:
  - Low woodlands to tall shrublands of Mulga (*Acacia aneura*) over hummock grasslands dominated by various spinifex species, including *Triodia epactia*, *T. melvillei*, *T. pungens*, *T. wiseana* on stony plains.
  - Scattered low trees to low open woodlands of *Eucalyptus leucophloia, E. gamophylla* and/or *E. trivalva* over mixed open shrublands of other species than Mulga over hummock grasslands of various spinifex species, including *T. pungens*, *T. brizoides*, *T. wiseana* and *T*. sp. Shovelanna Hill (S. van Leeuwen 3835) on stony hills and plains.
  - Low open woodlands of *Corymbia hamersleyana*, *Eucalyptus gamophylla* and/or *E. xerothermica* over mixed tall shrublands to tall open scrub over Soft Spinifex (*Triodia epactia* or *T. pungens*) hummock grasslands or perennial tussock grasslands in drainage areas.
- No PECs or TECs were recorded.
- Based on previous studies and historical recorded, a total of 241 taxa of native vascular flora from 105 genera and 40 families were recorded in the survey area.
- No Threatened Flora, as listed under the *WC Act* or *EPBC Act*, were recorded.
- One Priority Flora species was recorded:
  - *Rhagodia* sp. Hamersley (M. Trudgen 17794) (Priority 3).
- One Priority Flora species was recorded nearby in a previous study:
  - *Indigofera gilesii* subsp. *gilesii* ms (Priority 3).
- Seven introduced species were recorded:
  - **Bidens bipinnata* (Beggars Ticks)
  - **Cenchrus ciliaris* (Buffel Grass)
  - **Chloris virgata* (Feathertop Rhodes Grass)
  - **Cucumis myriocarpus*
  - **Malvastrum americanum* (Spiked Malvastrum)
  - **Sigesbeckia orientalis* (Indian Weed)
  - **Vachellia farnesiana* (Mimosa Bush).
- None of the introduced species were Declared Plants under the *Agriculture and Related Resources Protection Act 1976*.

RTIO (2009). Botanical Survey for an Evaluation Drilling Program at Juna Downs and Supporting Document to a Native Vegetation Clearing Permit Application.

A flora and vegetation survey was conducted by Rio Tinto in 2009 of Survey Area 3 to provide information botanical and fauna habitat information for an NVCP application. The survey targeted specific drill lines and was approximately 147ha in area. A summary is provided below:

- Eight vegetation types were defined in three landform types:

  - Vegetation from plains and flats with Mulga Flats, Clay Flats, Open Mulga Clay Plains.
  - Vegetation from hillslopes with Lower Slight Slope 1, Lower Slight Slope 2, Slightly Stony Slope 1 and Slightly Stony Slope 2.
  - Vegetation from Minor Drainage Lines with Slight Slope Shallow Drainage.
- No PECs or TECs were recorded.
- The vegetation types identified in the study area are considered to be of low conservation significance, representing units that are likely to be more widely distributed and relatively well represented in the Hamersley subregion and within Karijini National Park.
- A total of 147 taxa of native vascular flora from 70 genera and 33 families were recorded in the survey area.
- No Threatened Flora, as listed under the *WC Act* or *EPBC Act*, were recorded.
- One Priority Flora species was recorded:
  - *Rhagodia* sp. Hamersley (M. Trudgen 17794) (Priority 3).
- Three introduced species were recorded:
  - **Bidens bipinnata* (Beggars Ticks).
  - **Malvastrum americanum* (Spiked Malvastrum).
  - **Conyza bonariensis* (Flaxleaf Fleabane).
- None of the introduced species were Declared Plants under the *Agriculture and Related Resources Protection Act 1976*.

RTIO (2011). Botanical Survey for an Exploration Drilling Program at Juna Downs South, E47/1943 and Supporting Document to a Native Vegetation Clearing Permit Application.

A flora and vegetation survey was conducted by Rio Tinto in 2011 directly south of Survey Area 2 to provide information botanical and fauna habitat information for an NVCP application. The survey targeted specific drill lines and was approximately 181ha in area. A summary is provided below:

- Eighteen vegetation types were identified from three broad landform types:
  - Stony Hillslopes.
  - Slight Slopes.
  - Minor Drainage Lines.
- No PECs or TECs were recorded.
- The vegetation types identified in the study area were considered as being relatively typical of the locality and are widely represented throughout the Pilbara bioregion.
- A total of 225 taxa of native vascular flora from 97 genera and 35 families were recorded in the survey area.
- No Threatened Flora, as listed under the *WC Act* or *EPBC Act*, were recorded.
- Two Priority Flora species was recorded:

  - *Sida* sp. Barlee Range (S. van Leeuwen 1642) (Priority 3
  - *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (Priority 3).
- Three introduced species were recorded:
  - **Bidens bipinnata* (Beggars Ticks).
  - **Malvastrum americanum* (Spiked Malvastrum).
  - **Vachellia farnesiana* (Mimosa Bush).
- None of the introduced species were Declared Plants under the *Agriculture and Related Resources Protection Act 1976*.

3.3.2 Threatened and Priority Flora Database Searches

A search was conducted for the recorded locations of Threatened and Priority Flora in the vicinity of the Survey Areas using:

- DEC's NatureMap centred on the equi-distant middle of the Survey Areas with a 40km search radius.
- SEWPAC's Protected Matters Search Tool based on a line extending from Survey Area 1 to Survey Area 2 with a 10km buffer.
- RTIO Rare and Priority Flora Database.

DEC NatureMap Search

The NatureMap search was undertaken for conservation taxa within a 40km radius centred on a point equidistant between the survey areas (118°24' 00" E, 22°49' 00" S). The search results are provided in Appendix C. Thirty six conservation taxon were listed in the NatureMap search area and have been included in the combined listings below (NatureMap 2011).

SEWPaC's Protected Matters Search Tool

The two threatened species listed in the *EPBC Act* search in Section 2.13 (*Lepidium catapycnon* and *Thryptomene wittweri*) were also included in the NatureMap search results.

RTIO Database Search

RTIO maintains a spatial database of all recorded locations of Threatened and Priority Flora from its botanical surveys (Rowe 2011). This database has been complied over many years and is comprehensive and extensive in its coverage of the Pilbara Region. The database was examined for Threatened and Priority Flora occurring near the Survey Areas. Eleven Priority Flora were listed in the RTIO Database, including two not listed by NatureMap (Appendix D) that have been added to the combined listings below. No Threatened Flora were recorded. Of RTIO's 11 Priority Flora, one species, *Rhagodia sp. Hamersley (M. Trudgen 17794)* has previously been recorded in Survey Area 3.

Combined Threatened and Priority Flora Listing

The combined listings of Threatened and Priority Flora from the NatureMap and the RTIO Database searches are provided in Appendix D. In total, two Threatened Flora and 36 Priority Flora have been recorded in the Survey Areas and surrounding locality. An

assessment of the possible occurrence of these species within the Survey Areas was conducted based on known habitat and distribution. Due to the diversity of habitat types, 32 out of 38 conservation listed taxa were assessed as having the potential of occurring within the Survey Areas (Appendix D). There were, however, no populations of conservation taxa that appeared to have any particular localised specificity for the Survey Areas.

3.4 VEGETATION SURVEY METHODOLOGY

The field survey was undertaken between 01 to 11 October 2011 and 24 to 29 November 2011 by:

- Charles Newland – Flora Licence SL009474.
- Rob Irwin – Flora Licence SL009475.

The survey involved approximately 15 days of field survey time or 30 days of person time (excluding travel).

Prior to the survey, the two botanists familiarised themselves with conservation listed flora that were identified in the desktop using previously collected specimens and Western Australian State Herbarium material.

The flora and vegetation survey consisted of either relevés or mapping points. At each relevé, a 50mx 50m area (estimated) was surveyed. For creeklines where a 50m x 50m relevé was not possible, traverses were made for approximately 100m along the creek. Information was recorded for all plant taxa present with heights and foliage cover, descriptions of landforms, soils, vegetation structure, a 'north-east-south-west and ground' series of photos as well as fauna habitat data. Other flora species occurring in the vicinity of the relevé were also recorded but were noted as occurring outside of the relevé. At mapping points, a search was conducted specifically for potential conservation flora in an area of approximately 50m x 50m. Information on dominant species, landforms, fauna habitat and a 'north-east-south-west and ground' series of photos were also taken. Biological information was recorded from 110 relevés and 382 mapping points. At locations where priority species had been located in previous surveys, targeted searches were conducted to locate individuals and establish population sizes The locations of the relevés and mapping points are displayed in Figures 3 to 5. The flora and vegetation survey results are presented in Section 3.5.

A total botanical collection was made for all taxa encountered during the survey with reference specimens matched in a field herbarium. All specimens were forwarded to Pilbara specialist taxonomists (Sharnya Thomson and Andrew Mitchell) for determination. Taxonomic determinations were made using reference material at the Western Australian State Herbarium and the current names listed by FloraBase (2012) based on the phylogeny of the Angiosperm Phylogeny Group (APGIII).

Vegetation associations were mapped in accordance with vegetation classifications based on Specht with modification by Aplin and Trudgen (Appendix E, Trudgen 1988). Vegetation condition was mapped in accordance with vegetation condition scale developed by Trudgen for the Pilbara (Appendix E).

3.4.1 Limitations of Vegetation Survey

Various factors can limit the effectiveness of a vegetation survey. Pursuant to EPA Guidance Statement 51 (EPA 2004a), these factors have been identified and their potential impact on the effectiveness of the survey has been assessed (Table 10).

Table 10: Potential limitations affecting the vegetation survey

Potential limitations	Constraint	Comment
Competency and experience of the	No	The survey team included one senior botanist with comprehensive knowledge of Pilbara vegetation. Both

Potential limitations	Constraint	Comment
Botanists undertaking the survey		botanists have worked extensively in the Central Pilbara region.
Spatial uncertainty	No	Shapefiles of relevant land features and the survey areas were used to create a GPS screen map using Mobile Mapper™ software. This enables the location of the botanist to be viewed in real-time on the GPS screen map, thus removing any spatial uncertainty. The field personnel are very experienced in the use of this system for field work.
Seasonality	No	Rainfall data was examined for seasonality trends (Table 4 and Figure 6). . Rainfall data was examined for seasonality trends (Table 4 and Figure 6). Rainfall was well above average for the 12 month period prior to the survey (657.2mm fell as against the average of 463.3mm, Table 4), including massive rain in February 2011 (294mm). The assessment was that rainfall conditions were ideal for surveys being conducted during 2011.
Adequate ground coverage and intensity of survey effort	No	The **2357.44ha** survey area was traversed on foot. It is considered the 110 relevés and 382 mapping points provided adequate ground coverage (4.79ha / relevé or mapping point).
Burn Cycle	No	Some areas had been burnt in the previous 2 years. However, vegetation had recovered sufficiently to undertake a meaningful survey.
Resources	No	Adequate resources were available to conduct the survey.
Access restrictions	No	There were no access restrictions and all requisite areas were visited. All areas were accessible.
Taxonomic uncertainty	No	The flora of the Pilbara region has a number of taxonomic uncertainties. All conservation taxa and indeterminate taxonomies were checked by WA Herbarium specialist botanists. To the best abilities of all parties concerned, there will always be some taxonomic uncertainty but this uncertainty is part of the modus operandi and hence not listed as a constraint.

There were no factors identified that were considered as being likely to limit the effectiveness of the vegetation survey.

3.5 SURVEY RESULTS

3.5.1 Landforms

Four landforms were identified within the Survey Areas:

- Hills.
- Plains.
- Watercourses.
- Disturbed.

Information on the extent of each landform is provided in Table 11. The dominant landform was 'Plains', occupying 1767.38ha or 74.97% of the total survey area and was the most common landform in Survey Areas 2 and 3. Survey Areas 1 and 4 were predominately 'Hills'. The 'Disturbed' area consisted of main roads in Survey Areas 3 and 4. It should be noted that minor tracks were not mapped as polygons but have been displayed as polylines in Figures 3 to 5. No rare, geographically restricted or unique landforms were observed in any of the Survey Areas.

Table 11: Summary of landforms occurring in the surveys areas

Landform	Survey Area 1 (ha)	Survey Area 2 (ha)	Survey Area 3 (ha)	Survey Area 4 (ha)	Total (ha)
Hills	13.56	128.54	0	296.2	438.3
Plains	5.91	667.23	1094.24	0	1767.38
Drainage	2.91	101.94	19.69	24.18	148.72
Disturbed*	0	0	1.16	1.88	3.04
Total	**22.38**	**897.71**	**1115.09**	**322.26**	**2357.44**

**Main roads*

3.5.2 Vegetation Associations

A total of 31 vegetation associations were identified within the survey areas (Table 12). Vegetation associations were initially differentiated visually and then by examining floristic and structural composition. A detailed description of each Vegetation Association is provided in Appendix F and maps of vegetation associations are provided in Figures 11 to 14.

All vegetation associations in the survey areas have been observed extensively throughout the Pilbara region by Pilbara Flora botanists. There were no vegetation associations identified that were considered as being rare, restricted or unique. All vegetation associations are considered to be well represented across the Pilbara region.

The vegetation associations recorded in the survey areas were assessed against DEC's PEC and TEC listings for the Pilbara (DEC 2011b and DEC 2010b). There were no vegetation associations that matched any DEC listed PEC or TEC vegetation community descriptions. Additionally, from the *EPBCA Act* search in Section 2.13, there were no Federal TEC's occurring in the survey areas or 40km buffer.

3.5.3 Condition of Vegetation

An assessment of vegetation condition by vegetation association was undertaken using the vegetation condition scale implemented by Trudgen (1988) for Northern Australia (Refer Appendix E). The 'predominant' condition for each vegetation associations was used for the assessment.

Results from the vegetation condition assessment are provided in Table 13 and maps of the vegetation condition are displayed in Figures 19 to 22.

The Trudgen (1988) condition scale for Northern Australia has been used by botanists undertaking Pilbara and Kimberley surveys for a number of years as an interim measure as DEC is still in the process of developing a state-wide vegetation classification system, hence the use of the Trudgen system. The condition scale assesses vegetation condition based on signs of damage caused by the activities of European man, including:

- Damage by grazing.
- Damage by repeated fire.
- Damage to vegetation structure by clearing and grazing.
- Presence of weed species.

The majority of the survey area was considered to be in 'Excellent' (1676.68ha or 71.12%) or 'Good' (440.60ha or 18.69%) condition with little to no damage due to any of the above factors. One Vegetation Association, Association 21, was considered to be in Good condition after very successful site rehabilitation.

A small proportion of the survey area was in a 'Poor' (61.96ha or 2.63%) or 'Very Poor' (175.14ha or 7.43%) condition. This was predominantly due to weed infestation and erosion creating scalded clay plains due to historical overgrazing. One area, Vegetation Association 22, was considered to be in Poor condition due to historical disturbance and a poor success rate of rehabilitation.

Only 3.06ha or 0.13% of the survey area was classified as disturbed as they consisted of cleared roads. Throughout the survey area there were more minor tracks cleared. However these were not classified as disturbed due to the difficulty mapping them visually with the resources available.

Table 12: Vegetation Associations recorded in the Survey Areas

No	Landform	Vegetation Association	Area 1	Area 2	Area 3	Area 4	Total
1	Hills	Low Open Woodland on Low Colluvial Hills	13.23	118.76			131.99
2	Hills	Low Open Woodland Mallee and Shrubland on Lower Slopes				94.49	94.49
3	Hills	Low Open Woodland on Breakaway Slopes and Steep Valleys		2.66		59.75	62.40
4	Hills	Low Open Woodland on Hills		7.13		47.75	54.88
5	Hills	Open Mallee and Open Shrubland on Upland Colluvial Valley				56.57	56.57
6	Hills	Low Open Woodland and Shrubland on Hills				24.14	24.14
7	Hills	Low Open Woodland and Tussock Grassland on Upland Alluvial Valley				7.91	7.91
8	Hills	Hummock Grassland on Low Colluvial Hills				4.45	4.45
9	Hills	Mulga Grove on Hillsides	0.34			1.81	2.15
10	Hills	Low Open Woodland on Breakaway Slopes and Steep Valleys - Weed Infested				0.79	0.79
11	Hills	Low Woodland on Steep Valleys				0.22	0.22
12	Plains	Low Open Woodland Mallee and Shrubland on Stony Plain		308.80	534.18		842.97
13	Plains	Low Mulga Woodland on Alluvial Plains		103.80	315.06		418.86
14	Plains	Low Open Mulga Woodland on Stony Alluvial Plains		179.13			179.13
15	Plains	Low Open Woodland and Triodia on Colluvial Plains			114.90		114.90
16	Plains	Low Open Mulga Woodland on Scalded Plains		22.61	87.94		110.54
17	Plains	High Shrubland on Colluvial Plains		36.57			36.57
18	Plains	Scattered Low Trees and Mallee on Alluvial Plains			22.52		22.52
19	Plains	Barren Cracking Loams		16.33			16.33

No	Landform	Vegetation Association	Area 1	Area 2	Area 3	Area 4	Total
20	Plains	Low Mulga Woodland on Stony Plains	4.62		10.66		15.28
21	Plains	Rehabilitation Shrubland on Colluvial Plains			6.46		6.46
22	Plains	Rehabilitation Shrubland on Alluvial Plains			2.52		2.52
23	Plains	Woodland Shrubland on Calcrete	1.29				1.29
24	Drainage	Mulga Grove on Broad Drainage		59.43			59.43
25	Drainage	Mulga Grove on Broad Drainage - Weed Infestation		38.14	4.96		43.11
26	Drainage	Low Open Woodland on Minor Drainage Line	0.30		11.92	8.06	20.28
27	Drainage	Low Open Woodland on Moderate Drainage Line				8.76	8.76
28	Drainage	Low Open Woodland on Upland Drainage Line				4.63	4.63
29	Drainage	High Shrubland on Minor Drainage Line	0.68		2.81	1.01	4.51
30	Drainage	Mimosa Shrubland on Minor Drainage Line		4.37			4.37
31	Drainage	Low Woodland and Dense Shrubland on Minor Drainage Line	1.92				1.92
0	Disturbed	Disturbed			1.16	1.90	3.06
Totals			**22.38**	**897.72**	**1115.09**	**322.25**	**2357.44**

Table 13: Vegetation Condition of Vegetation Associations recorded in the Survey Areas

No	Vegetation Association Description	Area (ha)	Condition Rating	Area 1		Area 2		Area 3		Area 4		Total Area	
				(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)
1	Low Open Woodland on Low Colluvial Hills	**131.99**											
2	Low Open Woodland Mallee and Shrubland on Lower Slopes	**94.49**											
3	Low Open Woodland on Breakaway Slopes and Steep Valleys	**62.40**											
4	Low Open Woodland on Hills	**54.88**											
5	Open Mallee and Open Shrubland on Upland Colluvial Valley	**56.57**											
6	Low Open Woodland and Shrubland on Hills	**24.14**											
7	Low Open Woodland and Tussock Grassland on Upland Alluvial Valley	**7.91**											
8	Hummock Grassland on Low Colluvial Hills	**4.45**											
9	Mulga Grove on Hillsides	**2.15**											
11	Low Woodland on Steep Valleys	**131.99**											
12	Low Open Woodland Mallee and Shrubland on Stony Plain	**94.49**	**Excellent**	17.76	79.34	653.04	72.74	686.33	61.55	319.56	99.16	**1676.68**	**71.12**
14	Low Open Mulga Woodland on Stony Alluvial Plains	**62.40**											
15	Low Open Woodland and Triodia on Colluvial Plains	**54.88**											
17	High Shrubland on Colluvial Plains	**56.57**											
18	Scattered Low Trees and Mallee on Alluvial Plains	**24.14**											
23	Woodland Shrubland on Calcrete	**2.52**											
26	Low Open Woodland on Minor Drainage Line	**20.28**											
27	Low Open Woodland on Moderate Drainage Line	**8.76**											
28	Low Open Woodland on Upland Drainage Line	**4.63**											
29	High Shrubland on Minor Drainage Line	**4.51**											
31	Low Woodland and Dense Shrubland on Minor Drainage Line	**1.92**											

13	Low Mulga Woodland on Alluvial Plains	**62.40**	**Good**	4.62	20.66	103.80	11.56	332.18	29.79	-	-	**440.60**	**18.69**
20	Low Mulga Woodland on Stony Plains	**15.28**											
21	Rehabilitation Shrubland on Colluvial Plains	**6.46**											
10	Low Open Woodland on Breakaway Slopes and Steep Valleys - Weed Infested	**0.79**	**Very Poor**	-	-	81.45	9.07	92.90	8.33	0.79	0.25	**175.14**	**7.43**
16	Low Open Mulga Woodland on Scalded Plains	**24.14**											
19	Barren Cracking Loams	**2.15**											
25	Mulga Grove on Broad Drainage - Weed Infestation	**43.11**											
30	Mimosa Shrubland on Minor Drainage Line	**4.37**											
22	Rehabilitation Shrubland on Alluvial Plains	**2.52**	**Poor**	-	-	59.43	6.62	2.52	0.23	-	-	**61.96**	**2.63**
24	Mulga Grove on Broad Drainage	**59.43**											
0	Disturbed	**3.06**	**Disturbed**	-	-	-	-	1.16	0.10	1.90	0.59	**3.06**	**0.13**
Totals				**22.38**	**100.00**	**897.72**	**100.00**	**1115.09**	**100.00**	**322.25**	**100.00**	**2357.44**	**100.00**

** The condition ratings are in accordance with the vegetation condition scale, refer to Appendix E.*

3.5.4 Floristics

The survey recorded a total of 304 vascular taxa from 139 genera 49 families (Table 14). Three families were dominant in terms of taxa and genera numbers; Fabaceae, Poaceae and Malvaceae (Table 14). A total list of botanical taxa by survey area is provided in Appendix G and by Vegetation Association is provided in Appendix H

Table 14: Floristic summary for the Survey Areas

Sequence No.	Family name	Genera	Taxa
201	Fabaceae	11	56
163	Poaceae	23	48
309	Malvaceae	12	37
460	Asteraceae	14	18
458	Goodeniaceae	5	14
357	Amaranthaceae	4	14
428	Scrophulariaceae	1	10
358	Chenopodiaceae	5	9
281	Myrtaceae	3	9
416	Convolvulaceae	6	6
432	Lamiaceae	4	6
175	Proteaceae	2	6
417	Solanaceae	2	6
299	Sapindaceae	2	5
415	Boraginaceae	3	4
409	Rubiaceae	3	4
330	Capparaceae	1	4
242	Euphorbiaceae	1	4
338	Santalaceae	3	3
339	Loranthaceae	1	3
413	Apocynaceae	2	2
472	Araliaceae	2	2
229	Celastraceae	2	2
433	Phrymaceae	2	2
437	Acanthaceae	1	2
332	Brassicaceae	1	2
355	Caryophyllaceae	1	2
224	Cucurbitaceae	1	2
156	Cyperaceae	1	2
263	Thymelaeaceae	1	2
438	Bignoniaceae	1	1
450	Campanulaceae	1	1
331	Cleomaceae	1	1
52	Cupressaceae	1	1
328	Gyrostemonaceae	1	1
196	Haloragaceae	1	1
130	Hemerocallidaceae	1	1
80	Lauraceae	1	1

Sequence No.	Family name	Genera	Taxa
16	Marsileaceae	1	1
169	Menispermaceae	1	1
211	Moraceae	1	1
367	Nyctaginaceae	1	1
301	Oleaceae	1	1
247	Phyllanthaceae	1	1
427	Plantaginacea	1	1
29	Pteridaceae	1	1
208	Rhamnacea	1	1
261	Violaceae	1	1
199	Zygophyllaceae	1	1
Total	**49**	**139**	**304**

The flora survey was considered to be moderate in size when compared to the common large area surveys being undertaken in the Pilbara for resource development projects. A regional comparison was undertaken using other smaller sized surveys over similar habitat in the Hamersley Ranges. The results are presented in Table 15.

Compared to other regional studies, a total count of 304 taxa over the 2357.44ha survey area was considered representative of the typical floristic diversity expected within the region. The survey was primarily a Level 1 targeted flora survey whereas the surveys which are used as comparison are Level 2 surveys and as expected display a higher botanical diversity in terms of taxa numbers. A total taxa count of 304 however is considered to be comparable given that a Level 2 survey was not undertaken and the differences in size of surveys in the region.

Table 15: Comparison of vegetation survey results in the Pilbara

Survey	Area (ha)	Families Recorded	Genera Recorded	Taxa Recorded
Marandoo Phase 2, Project Vegetation Flora Survey (Biota 2008a).	5453.98	60	177	536
Wildflower Rail Construction Camp: Native Vegetation Clearing Permit Report (Biota 2008b).	144	30	79	138
A Vegetation and Flora Survey of the RTIO Rail Duplication – Bellbird Siding to Juna Downs (Biota 2008c)	8982	46	136	331
A Vegetation and Flora Survey of the RTIO Rail Duplication – Bellbird Siding to Juna Downs: Additional Eastern Corridor (Biota 2009).	819	40	105	241
Botanical Survey for an Evaluation Drilling Program at Juna Downs and Supporting Document to a Native Vegetation Clearing Permit Application (RTIO 2009).	147	33	70	147

Botanical Survey for an Exploration Drilling Program at Juna Downs South, E47/1943 and Supporting Document to a Native Vegetation Clearing Permit Application (RTIO 2011).	181	35	97	225
This Survey	2357.44	49	319	304

3.5.5 Conservation Taxa

No Threatened Flora pursuant to Section 23F(2) of the *WC Act* or listed under the *EPBC Act* were recorded in the Survey Areas.

Five Priority Flora were recorded in the Survey Areas:

- *Brunonia* sp. long hairs (D.E. Symon 2440) (Priority 1),
- *Spartothamnella puberula* (Priority 2),
- *Rhagodia* sp. Hamersley (M.E. Trudgen 17794) (Priority 3),
- *Triodia* sp. Mt Ella (M.E Trudgen 12739) (Priority 3) and
- *Eremophila magnifica* subsp. *magnifica* (Priority 4)

Photographs of each of these species taken in the field are displayed below in Plates 12 to 19. The recorded locations of these species are presented in Appendix I and displayed in Figures 23 to 27.

Brunonia sp. long hairs (D.E. Symon 2440) (Priority 1) was located in two locations, one plant within survey area 1 in vegetation association 9 'Mulga Grove on Hillsides' and two plants in the same quadrat within survey area 2 in vegetation association 12 'Low Open Woodland Mallee and Shrubland on Stony Plain'. Due to the low numbers of this species recorded it does not appear that there is any significant population of this species in the area. It is recommended that recorded locations of this species be avoided by any exploration activities. Due to the very low incidence of this species impacts from the exploration activities can be kept to a minimum through the implementation of avoidance buffer zones around recorded locations.

Spartothamnella puberula (Priority 2) was recorded in just one location within Survey area 4. One individual was located in vegetation association 10 'Low open Woodland on Breakaway Slopes and Steep Valleys – Weed infested.' Due to the difficult terrain associated with its location in a steep valley (Figure 26), this species is not likely to be impacted by the proposed activities due to the inaccessibility of drilling machinery to its location.

Rhagodia sp. Hamersley (M.E. Trudgen 17794) (Priority 3) was recorded in nine locations in numbers ranging from one to eight individuals. Eight of the recorded locations were in Survey Area 3 and the last was in Survey Area 2. This species was found in two vegetation associations, 12 'Low Open Woodland Mallee and Shrubland on Stony Plain' and vegetation association 13 'Low Mulga Woodland on Alluvial Plains.' This species appears to have a habitat preference for alluvial floodplains supporting Mulga. The specimens found also appeared to be heavily grazed suggesting it was preferred by cattle. Locations where this species had been found in previous studies were the subject of extensive targeted flora searches. No individuals were found at these locations. It is recommended that avoidance buffer zones be implemented around recorded individuals and continued monitoring be conducted.

Triodia sp. Mt Ella (M.E. Trudgen 17794) was found extensively through Survey Area 4 in large populations. This species was recorded at 25 out of 35 survey sites within Vegetation Association 3 with foliage cover ranging between 10 and 30%. It was considered to be a co-dominant component of the grass layer within this vegetation association. Observations suggest that this species flourishes in areas of steep drainage on breakaway slope and within steep valleys. Figure 26 illustrates the wide spread distribution of this species within Survey Area 4. Extrapolating the wide spread distribution of this species recorded in this survey over areas of similar habitat in the region suggests that the frequency of occurrence of this species may be much higher than previously believed. The Pilbara Flora Botanists have observed this species in previous reports conducted in the region. It has been recorded from a range of landforms including gorges, hill slopes and drainage lines. Taxonomically *Triodia* sp. Mt Ella (M.E. Trudgen 17794) is morphologically similar to another non-conservation listed Spinifex species *Triodia bitextura* (Sharnya Thompson pers. comm.) Sharnya Thompson recommends that further work is required to determine whether these two species are in fact different. Due to the large population sizes of this species at Juna Downs it is considered that the loss of individuals in the course of the proposed Juna Downs exploration program will have a negligible effect on the conservation status of this species as a whole.

Eremophila magnifica subsp. *magnifica* (Priority 4) was found in four vegetation associations within Survey Area 4. It was recorded in vegetation association 3 'Low Open Woodland on Breakaway Slopes and Steep Valleys,' vegetation association 4 'Low open Woodland on Hills,' vegetation association 6 'Low Open Woodland and Shrubland on Hills' and 28 'Low Open Woodland on Upland Drainage Line.' Population sizes ranged from 6 to 100 individuals. This species is found through the Hamersley Range (FloraBase 2012). Where possible this species should be avoided by the proposed Juna Downs exploration activities. However due to the localized distribution of this plant and the large population sizes observed disturbance to individuals of the species is unlikely to have an adverse effect on its overall conservation status.

Plate 12: *Brunonia* sp. long hairs (D.E. Symon 2440) (Priority 1)

Plate 13: *Brunonia* sp. long hairs (D.E. Symon 2440) (Priority 1)

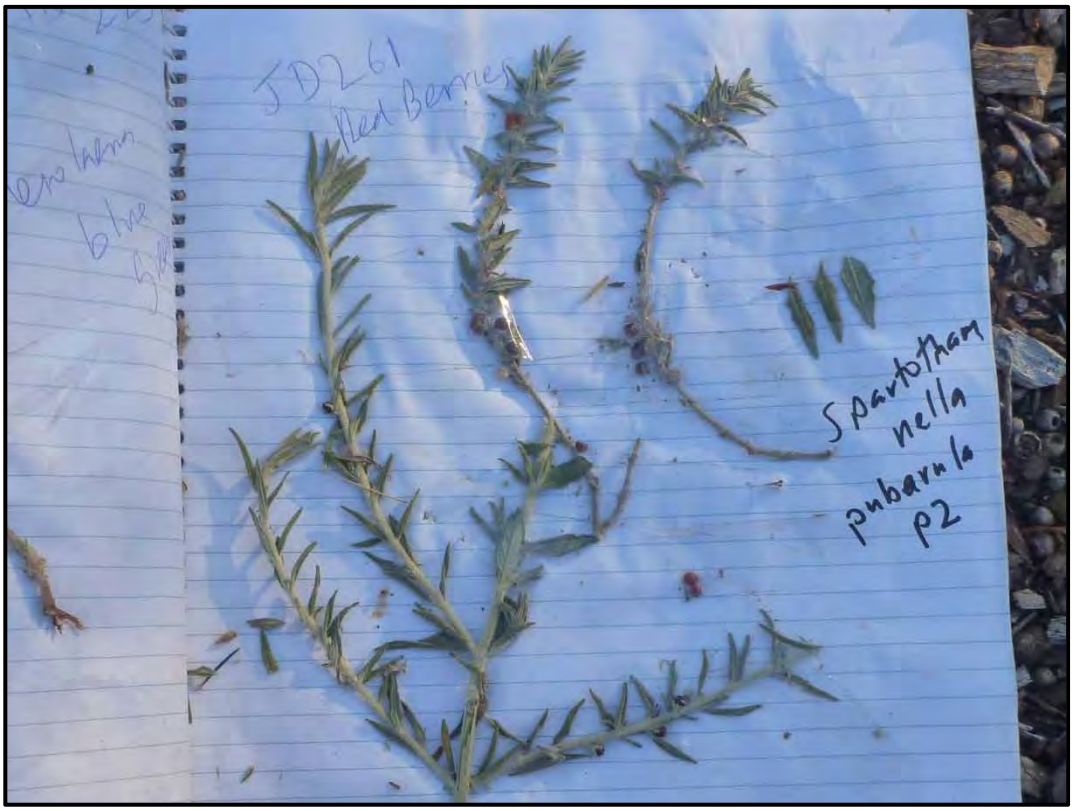


Plate 14: *Spartothamnella puberula* (Priority 2)

Plate 15: *Rhagodia* sp. Hamersley (M.E. Trudgen 17794) (Priority 3)

Plate 16: *Triodia* sp. Mt Ella (M.E Trudgen 12739) (Priority 3)

Plate 17: Triodia sp. Mt Ella (M.E Trudgen 12739) (Priority 3)

Plate 18: *Triodia* sp. Mt Ella (M.E Trudgen 12739) (Priority 3)

Plate 19: *Eremophila magnifica* subsp. *magnifica* (Priority 4)

3.5.6 Range Extension Taxa

There were no range extensions from the taxa recorded in the survey.

3.5.7 Introduced Species

Six introduced species were recorded in the Survey Areas:

- **Cenchrus ciliaris* (Buffel Grass) - DEC Rating 'High'.
- **Chloris virgata* (Feathertop Rhodes Grass) - DEC Rating 'Low'.
- **Setaria verticillata* (Whorled Pigeon Grass) - DEC Rating 'Low'.
- **Bidens bipinnata* (Beggars Ticks) - DEC Rating 'Unrated'.
- **Malvastrum americanum* (Spiked Malvastrum) - DEC Rating 'Moderate'.
- **Vachellia farnesiana* (Mimosa Bush) - DEC Rating 'High'.

The recorded locations of these species are presented in Appendix J and displayed in Figures 27 to 30.

All six introduced species are rated as environmental weeds under DECs '*Environmental Weed Strategy of Western Australia*' (CALM 1999*).* Under DEC's 'Invasive Plant Prioritization Process', **Cenchrus ciliaris* and **Vachellia farnesiana* have a 'High' weed risk **Malvastrum americanum* has a 'Moderate' risk rating and the others are either 'Low' or 'Unrated'.

None of these introduced species are 'Declared Plants' as listed by the Agricultural Protection Board and pursuant to the *Agricultural and Related Resources Protection Act 1976 (*DAFWA 2011).

Two weed species occurred at some locations in 'infestation' levels of vegetation dominance. **Bidens bipinnata* was the dominant understory species in Vegetation Associations 10 and 25 and also occurred extensively in Vegetation Association 24. **Vachellia farnesiana* (Mimosa) was the dominant species in the upper strata layer in Vegetation Association 30. These population areas are displayed visually in Figures 28, 29 and 30.

As mentioned in Section 3.5.3, 175.14ha or 7.43% of the total survey area was considered as being in a 'Very Poor' condition. This was primarily due to the infestations of **Bidens bipinnata* and **Vachellia farnesiana* within the above Vegetation Associations.

3.6 IMPACT FROM THE PROPOSED JUNA DOWNS DRILLING PROGRAM

The proposed Juna Downs drilling program was assessed as being unlikely to have any significant impact on flora and vegetation communities for the following reasons:

- **No Threatened Flora:** No Threatened Flora listed under the *WC Act* or the *EPBC Act* were recorded at the survey areas.
- **Few Priority Flora:** All Priority Flora listed by DEC recorded at the survey areas were scattered and in relatively small population sizes except for Triodia sp. Mt Ella (M. E. Trudgen 12739) which was recorded extensively in large populations

as a co-dominant component of the grass layer. Small scattered populations are easily avoidable by an exploration drilling program.

- **No PECs or TECs:** No State listed PECs and State or Federally listed TECs occur at the survey areas and surrounds.
- **No Rare, Restricted or Unique Vegetation Associations:** No vegetation associations were identified that were considered as being rare, restricted or unique. All native vegetation associations were considered to be well represented across the Pilbara region.

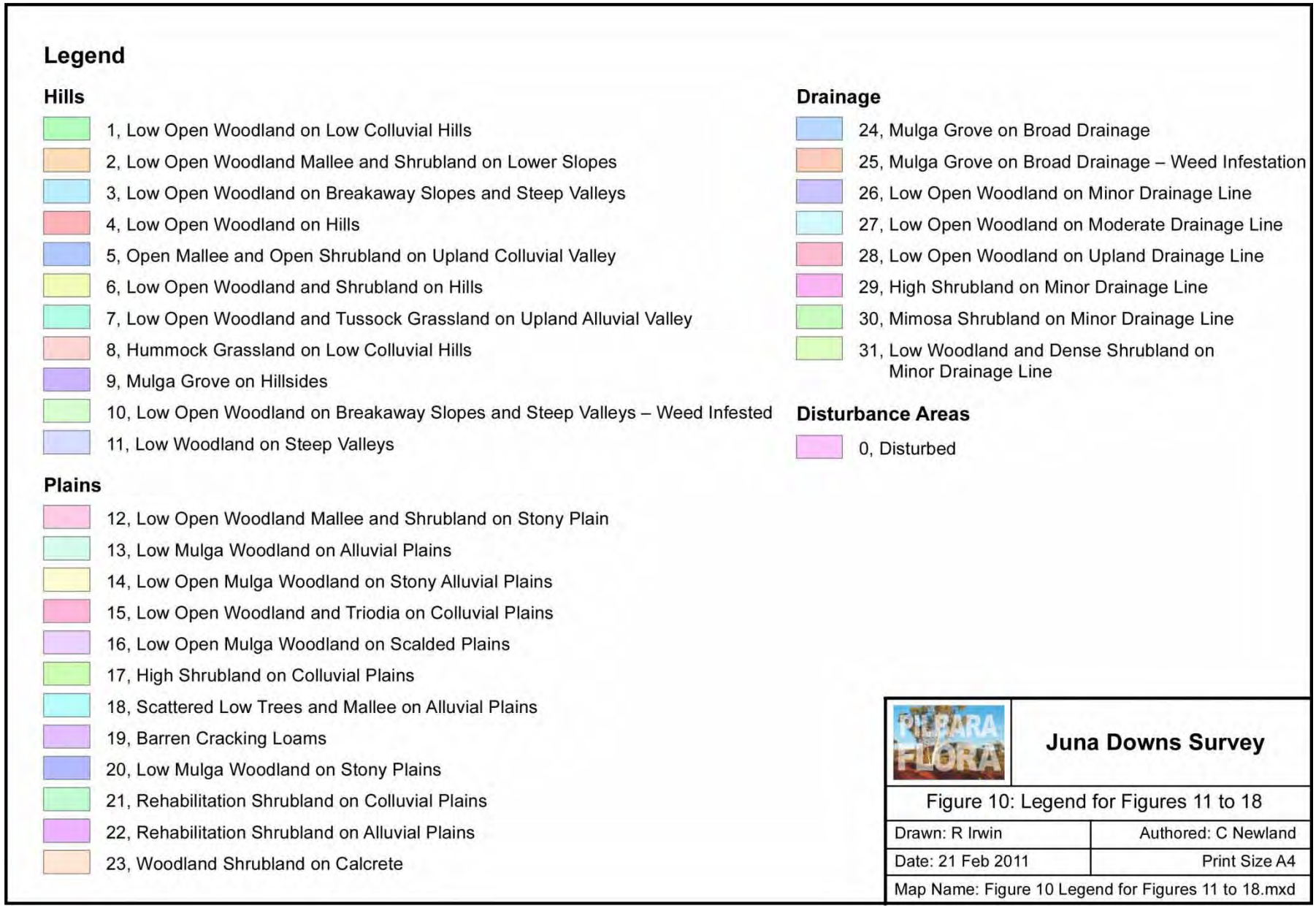


Figure 10: Legend for Figures 11 to 18 - Vegetation Associations

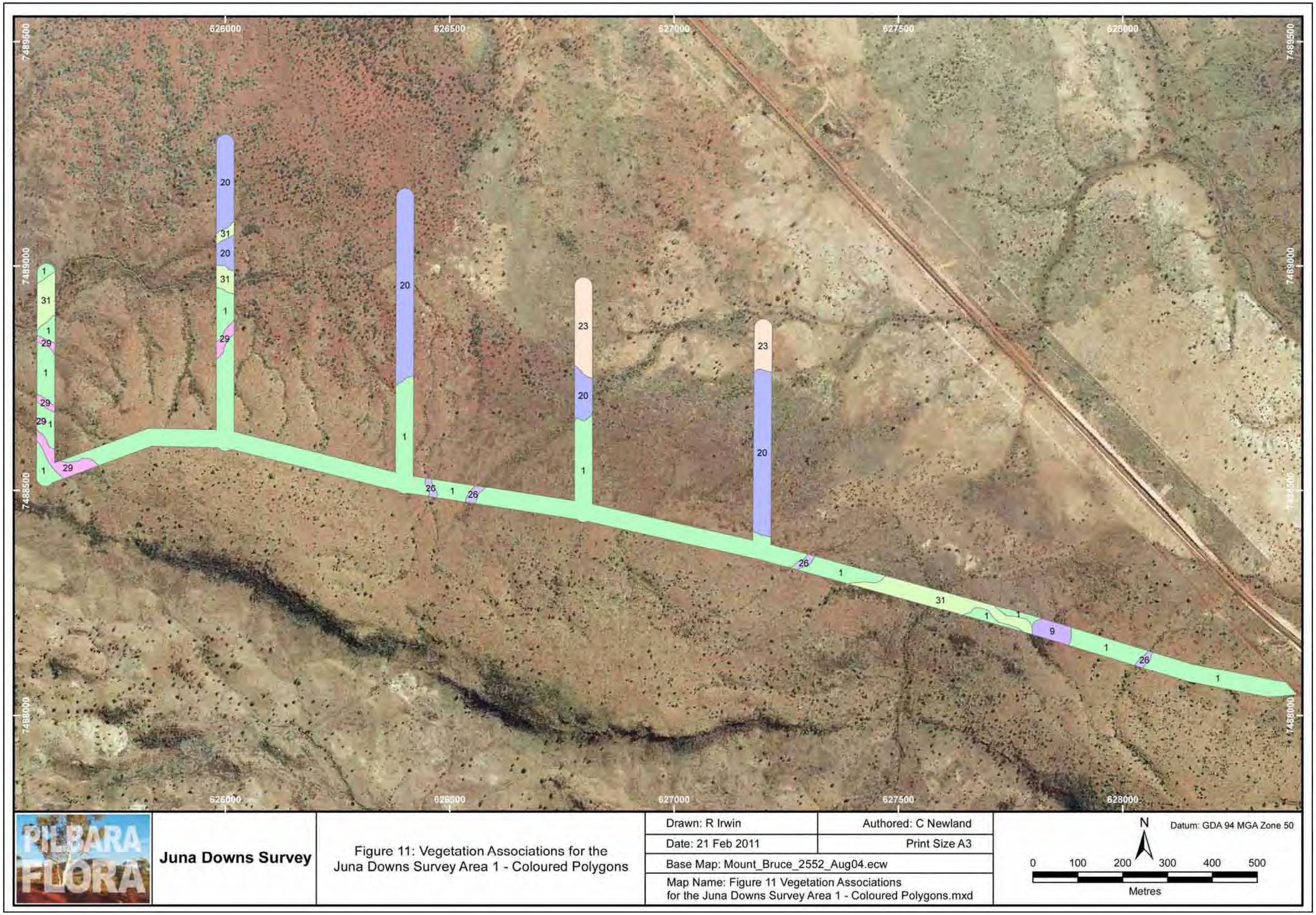


Figure 11: Vegetation Associations for the Juna Downs Survey Area 1 – Coloured Polygons

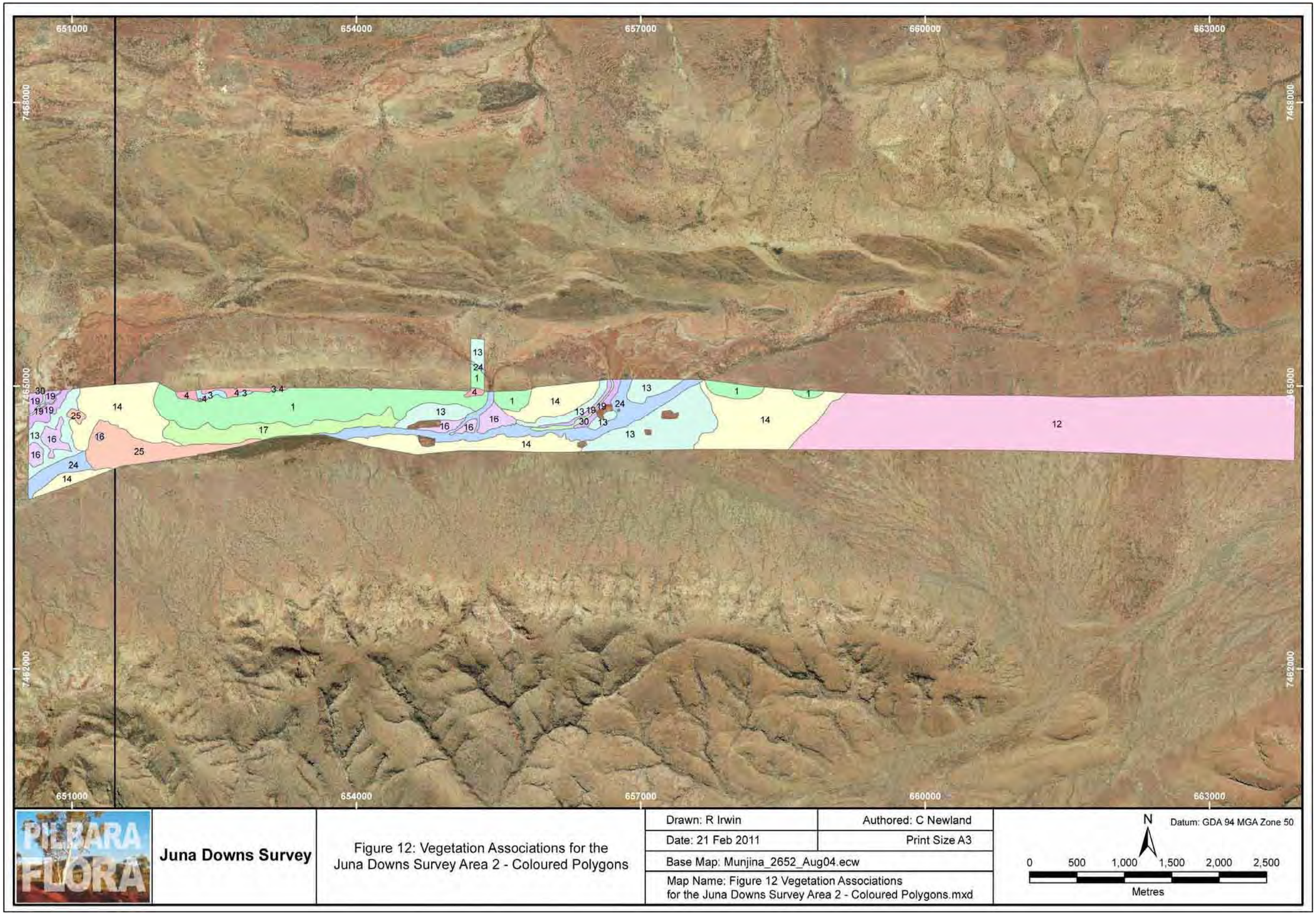


Figure 12: Vegetation Associations for the Juna Downs Survey Area 2 – Coloured Polygons

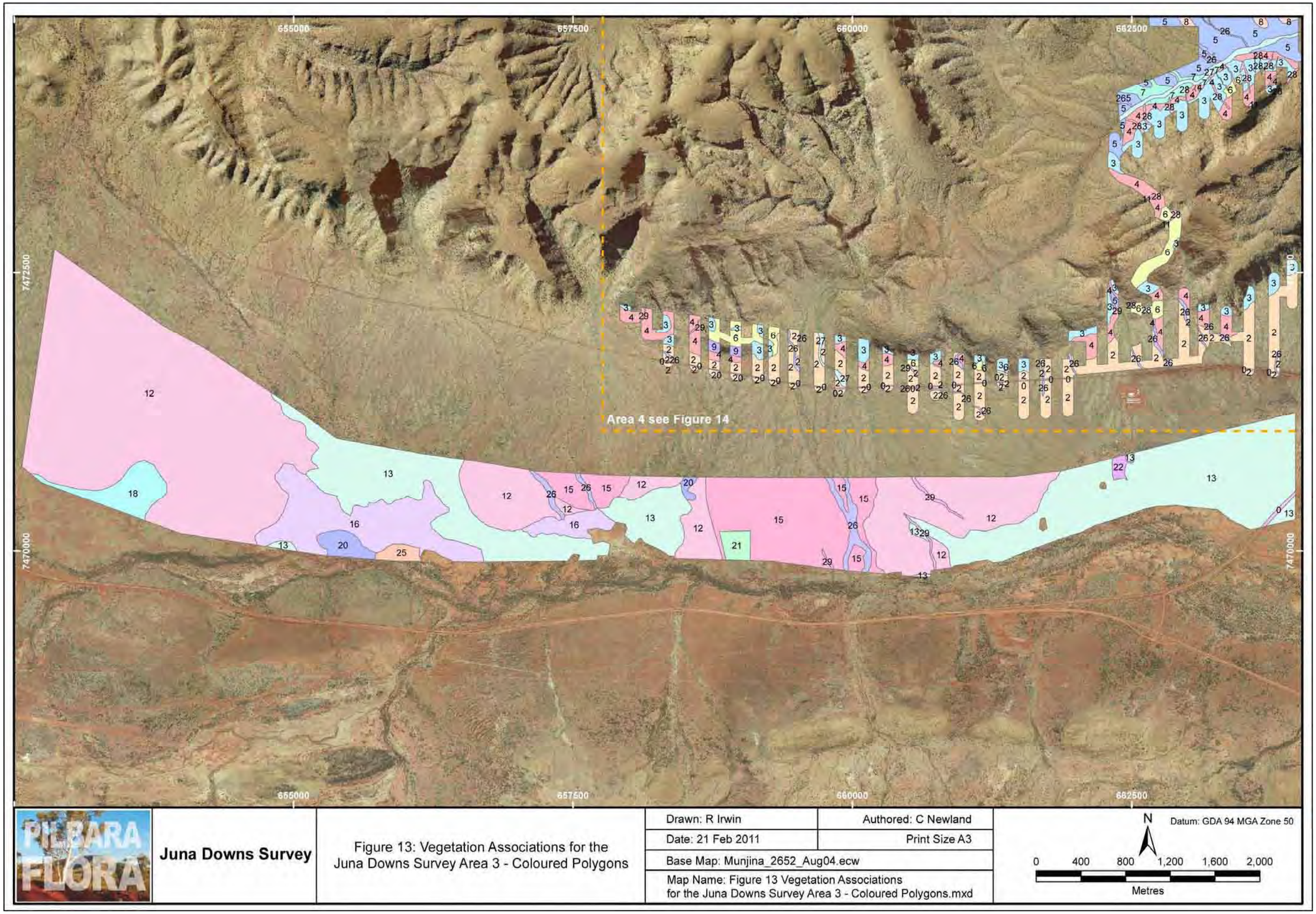


Figure 13: Vegetation Associations for the Juna Downs Survey Area 3 – Coloured Polygons

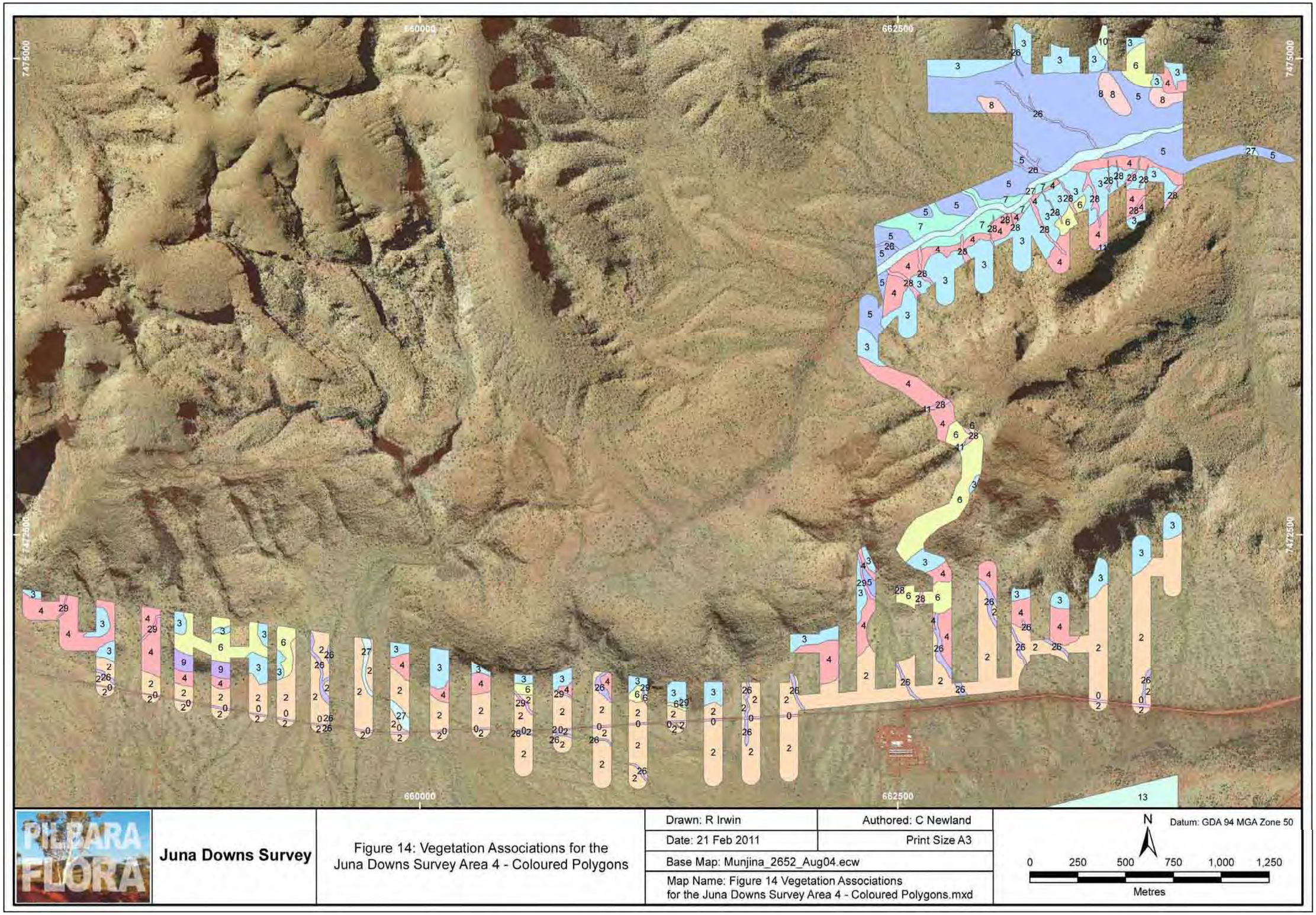


Figure 14: Vegetation Associations for the Juna Downs Survey Area 4 – Coloured Polygons

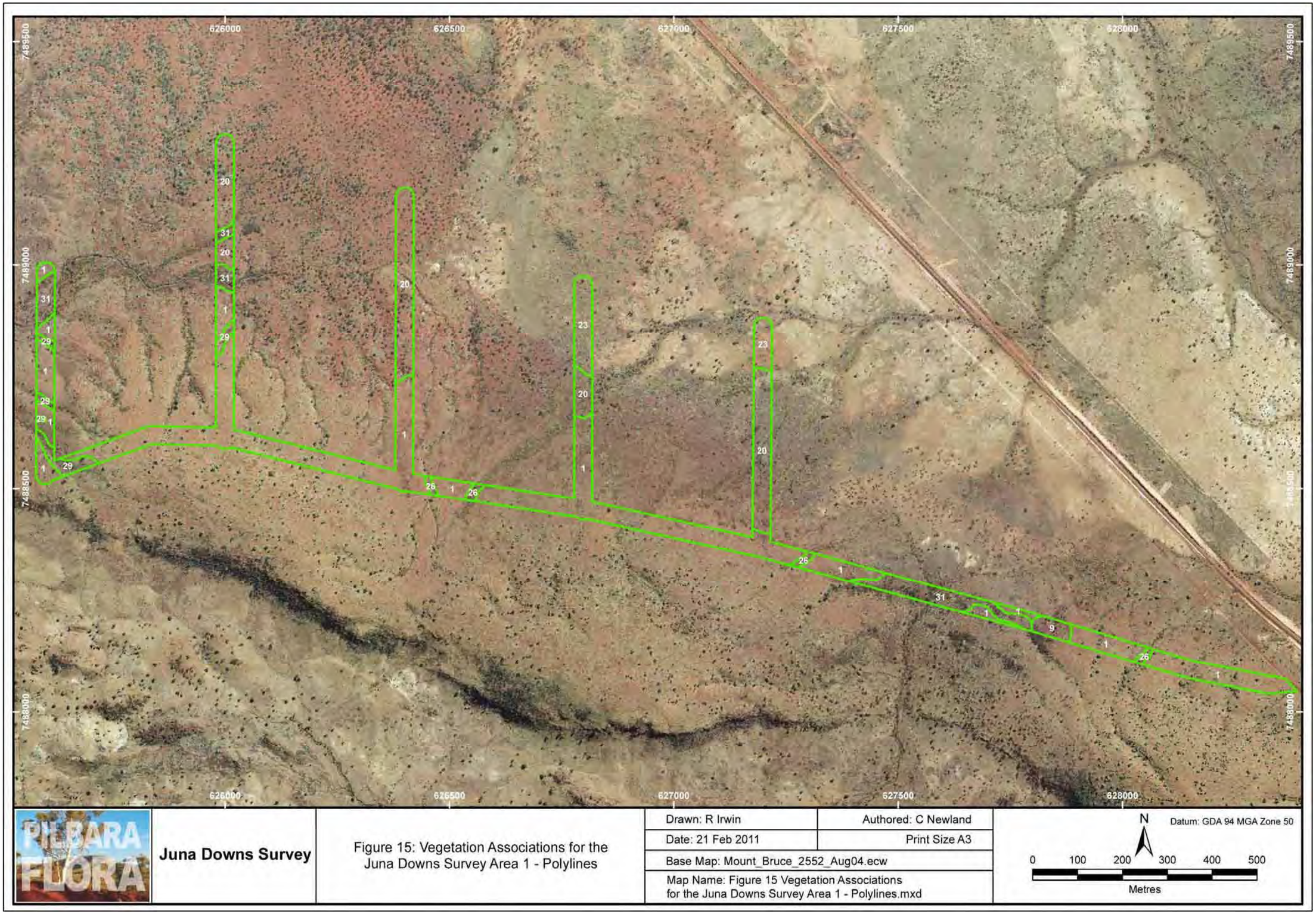


Figure 15: Vegetation Associations for the Juna Downs Survey Area 1 – Polylines

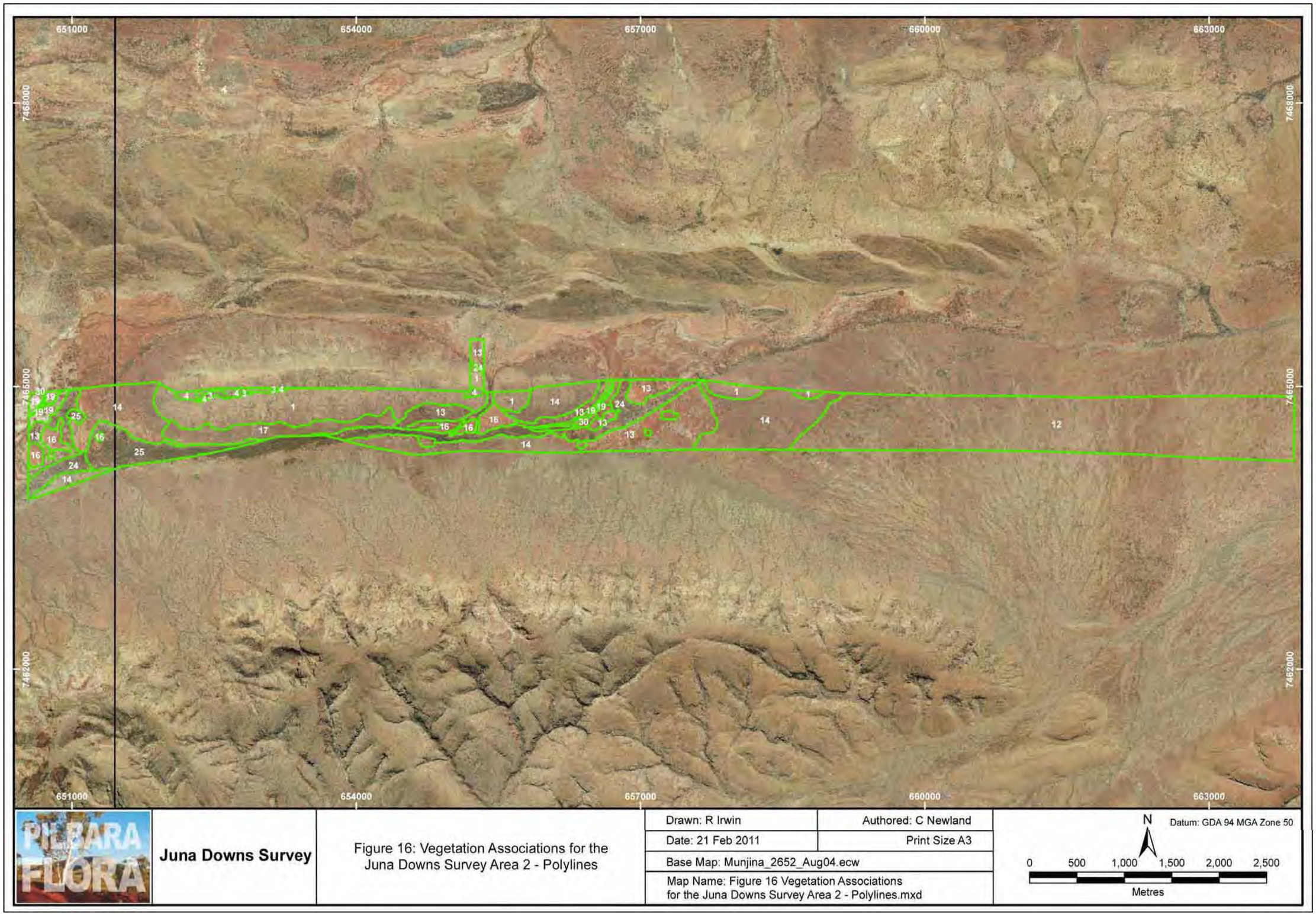


Figure 16: Vegetation Associations for the Juna Downs Survey Area 2 – Polylines

655000
657500
660000
662500
7472500
7470000
Area 4 see Figure 18

PILBARA FLORA	Juna Downs Survey	Figure 17: Vegetation Associations for the Juna Downs Survey Area 3 - Polylines	Drawn: R Irwin	Authored: C Newland
			Date: 21 Feb 2011	Print Size A3
			Base Map: Munjina_2652_Aug04.ecw	
			Map Name: Figure 17 Vegetation Associations for the Juna Downs Survey Area 3 - Polylines.mxd	

N
Datum: GDA 94 MGA Zone 50
0 400 800 1,200 1,600 2,000
Metres

Figure 17: Vegetation Associations for the Juna Downs Survey Area 3 – Polylines

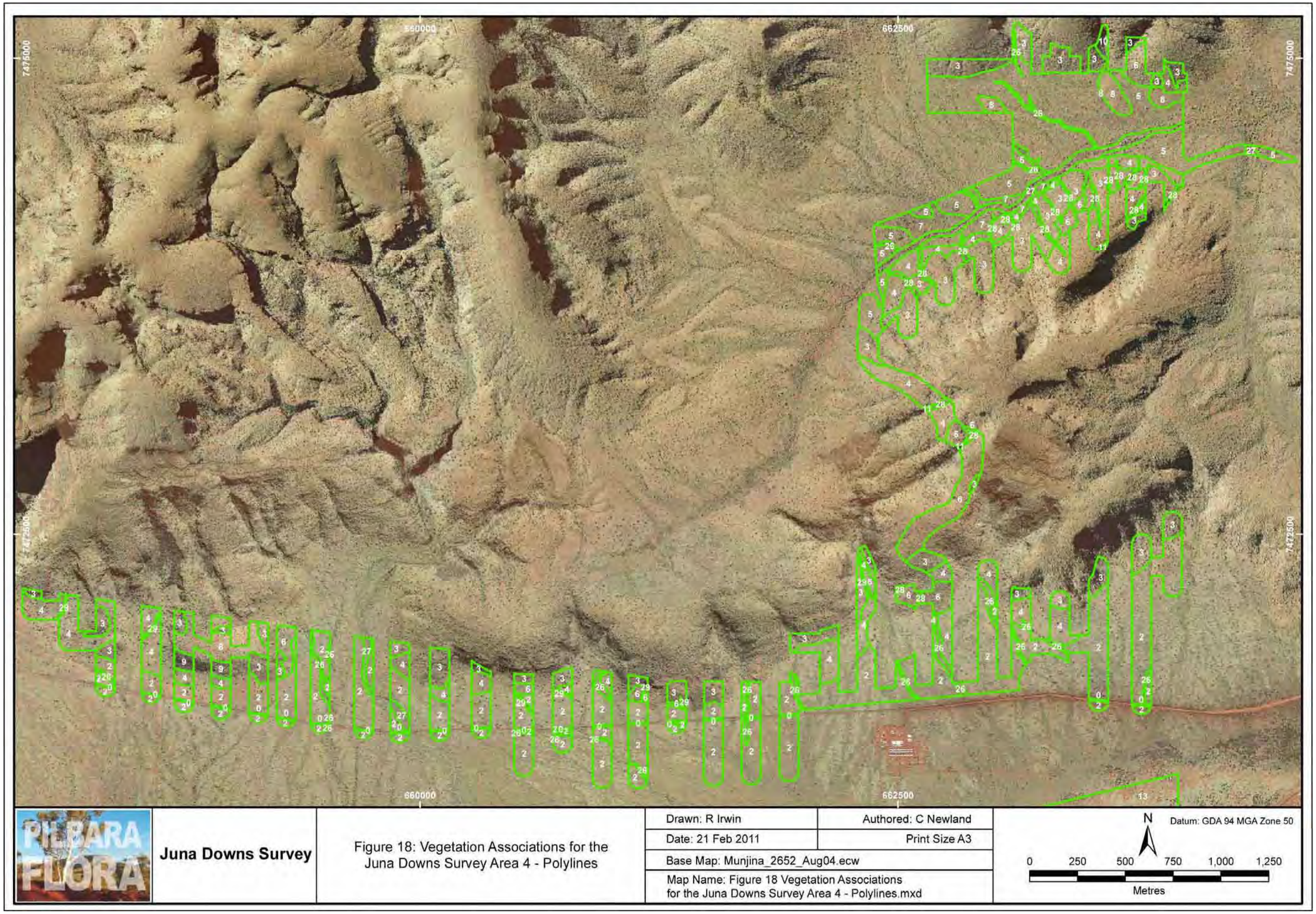


Figure 18: Vegetation Associations for the Juna Downs Survey Area 4 – Polylines

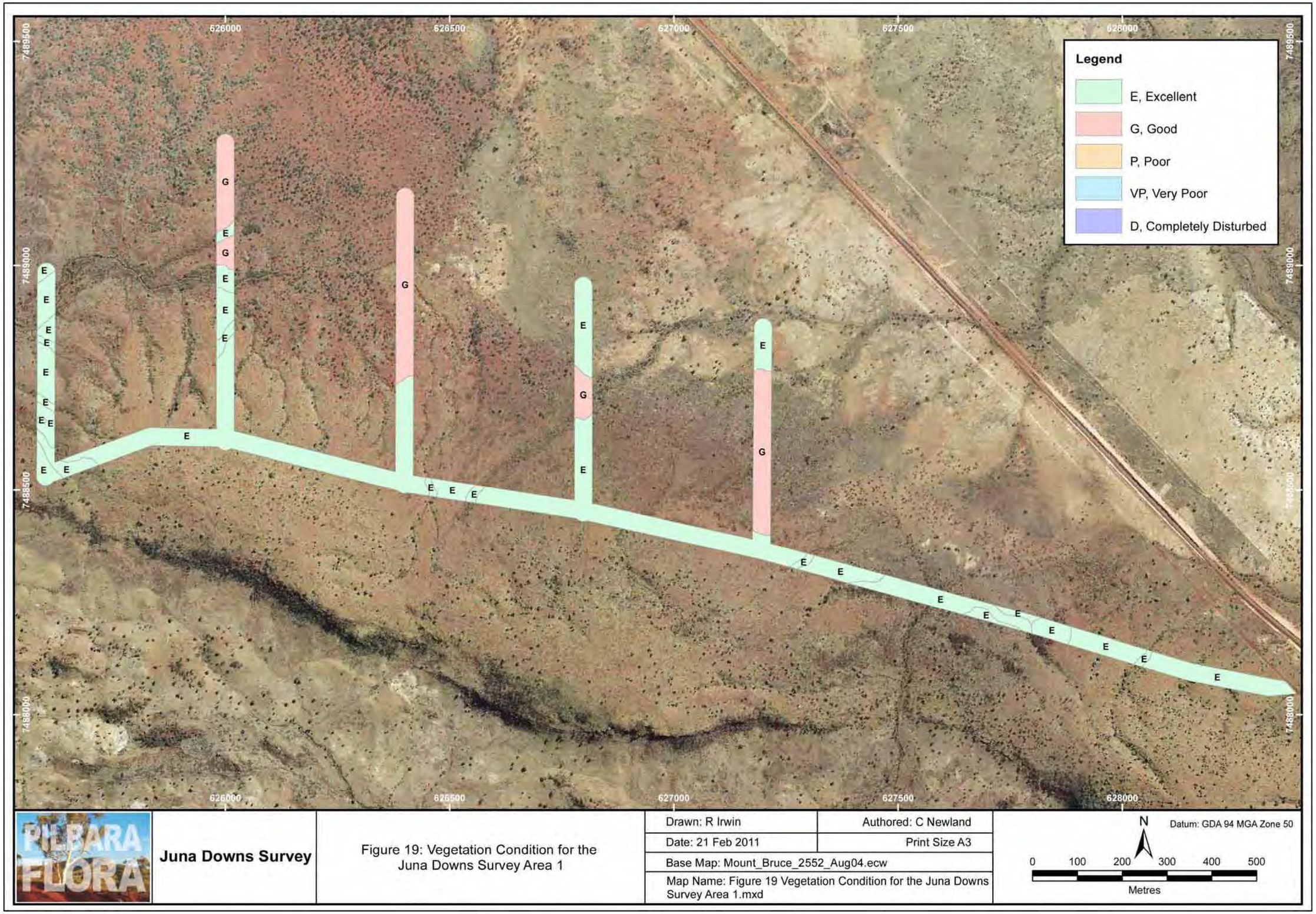


Figure 19: Vegetation Condition for the Juna Downs Survey Area 1

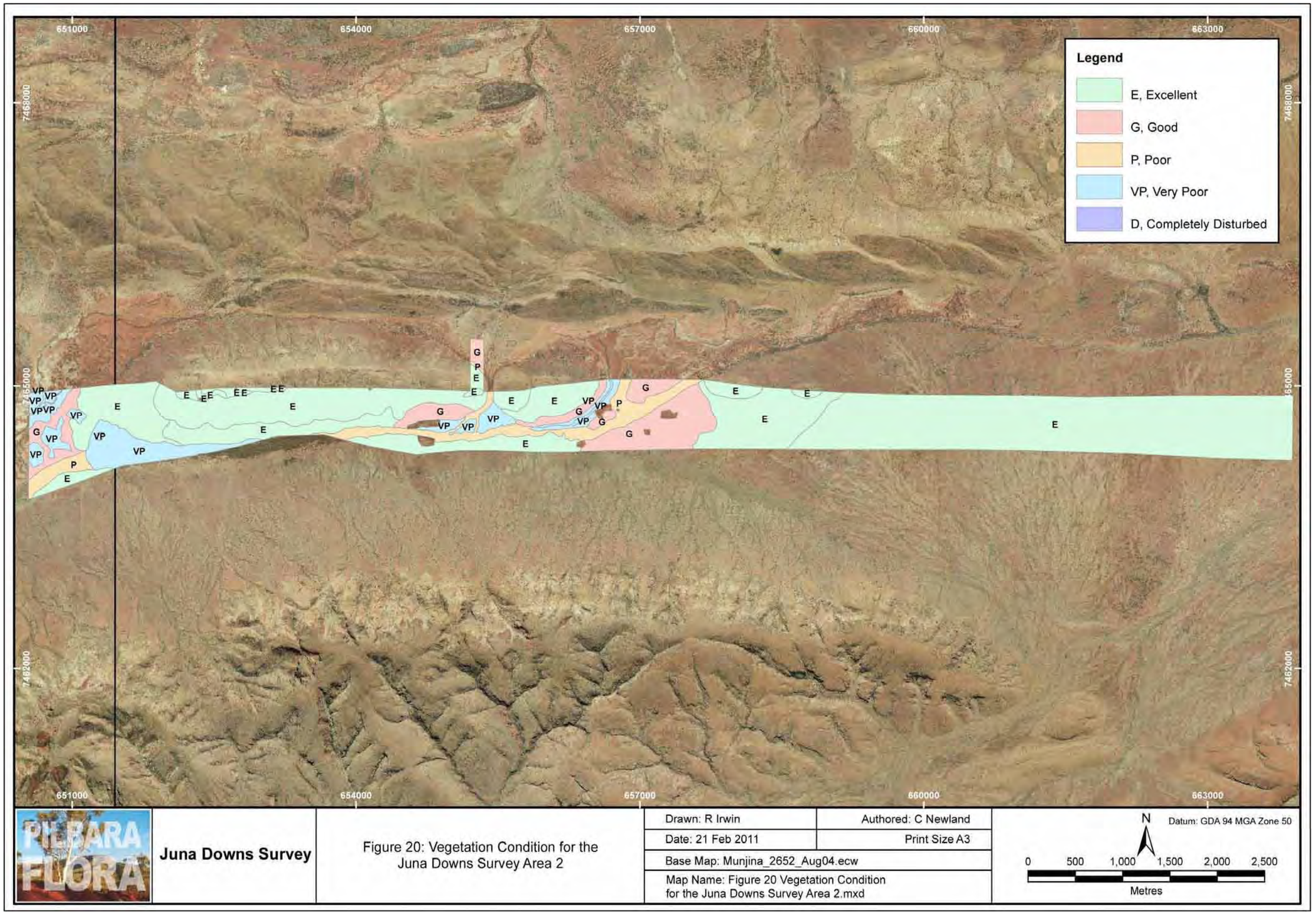


Figure 20: Vegetation Condition for the Juna Downs Survey Area 2

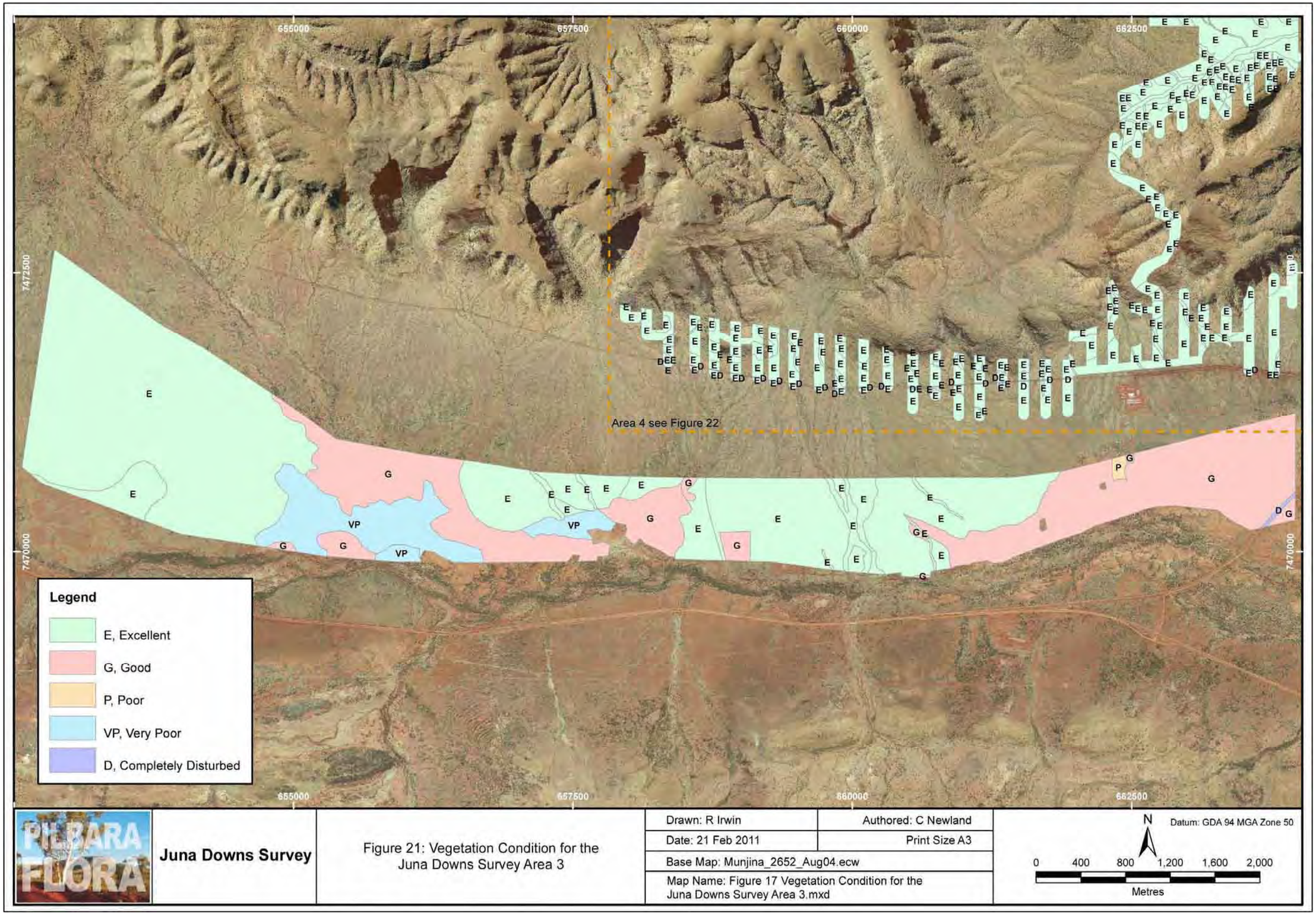


Figure 21: Vegetation Condition for the Juna Downs Survey Area 3

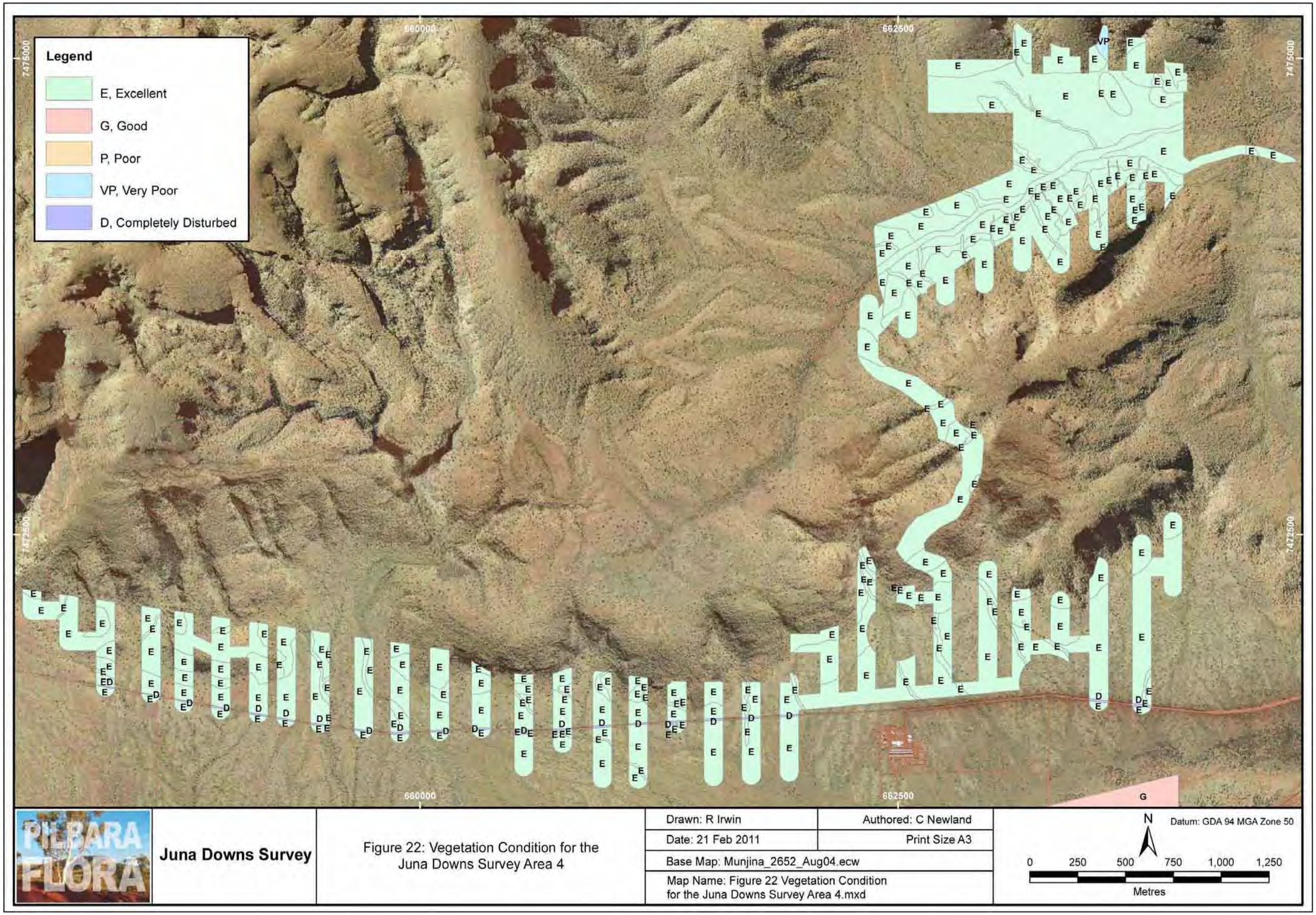


Figure 22: Vegetation Condition for the Juna Downs Survey Area 4

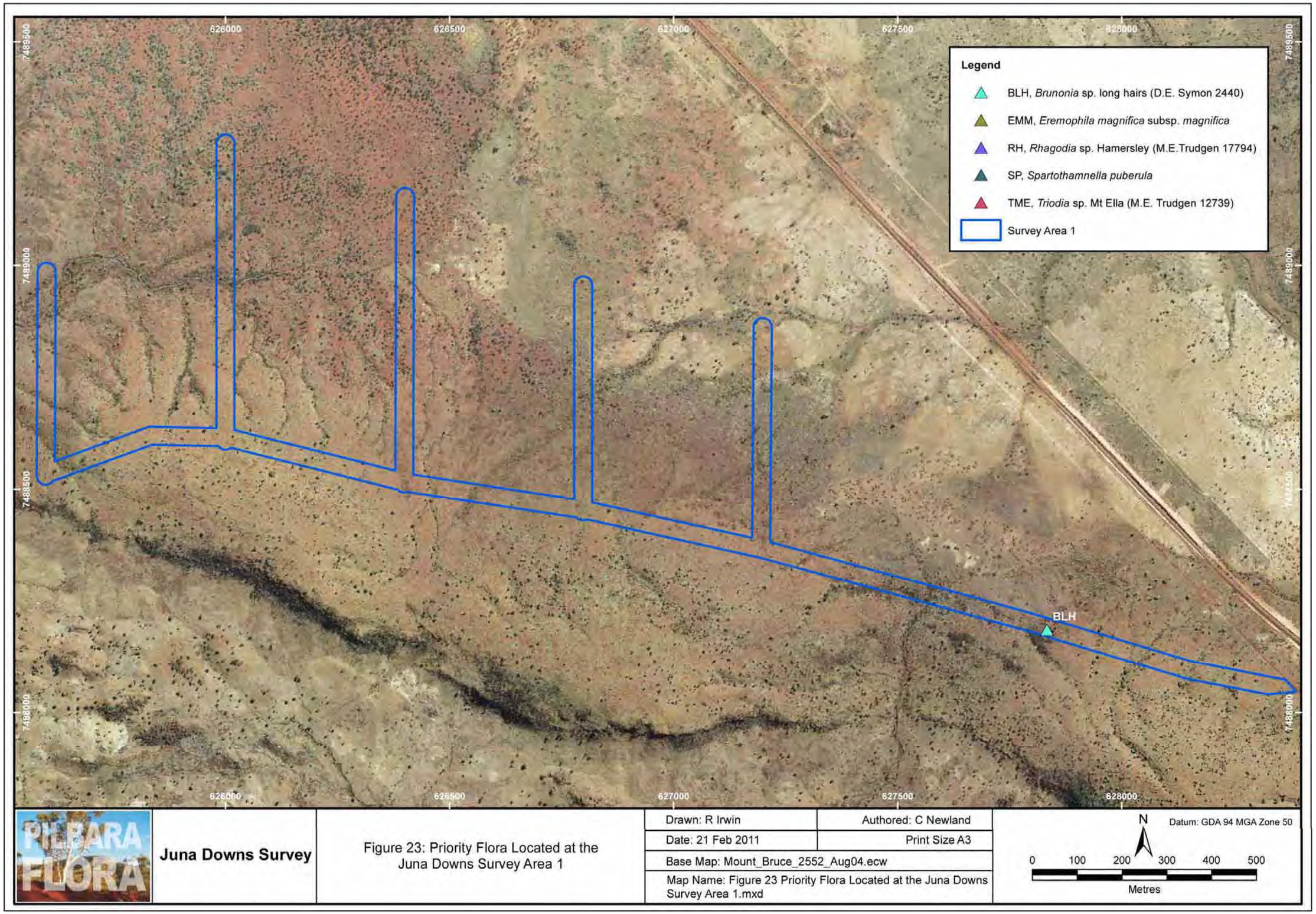


Figure 23: Priority Flora Located at the Juna Downs Survey Area 1

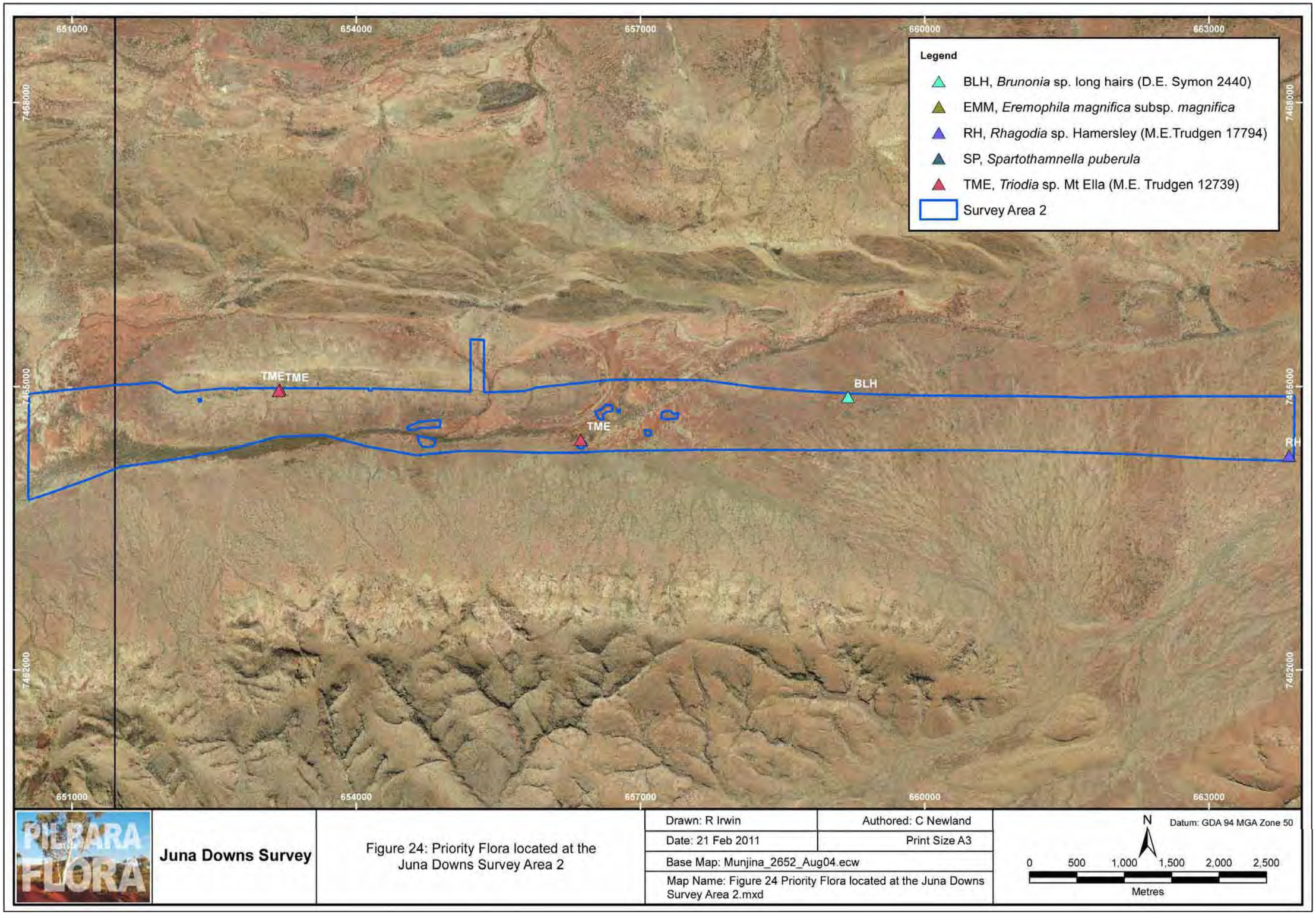


Figure 24: Priority Flora Located at the Juna Downs Survey Area 2

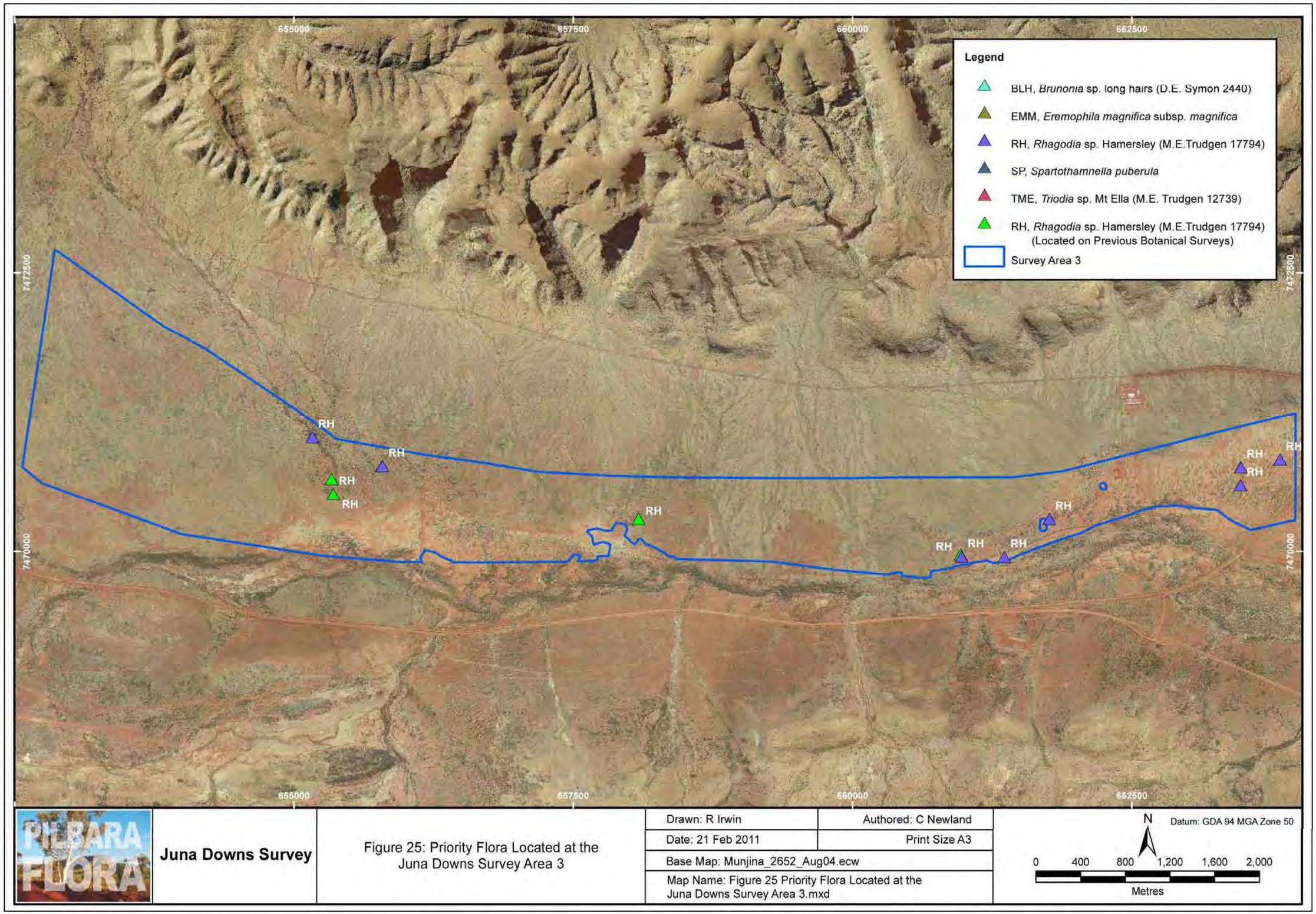


Figure 25: Priority Flora Located at the Juna Downs Survey Area 3

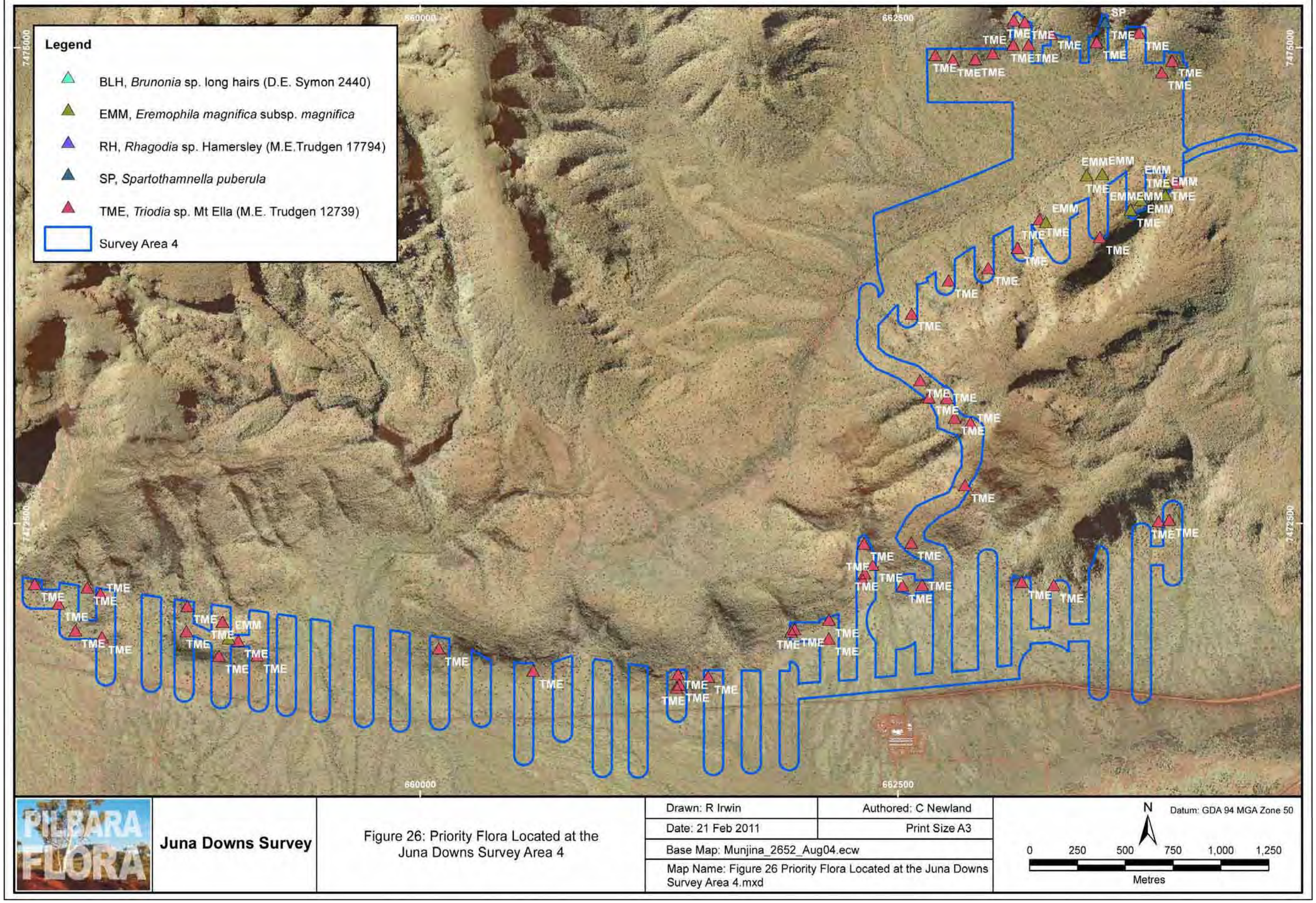


Figure 26: Priority Flora Located at the Juna Downs Survey Area 4

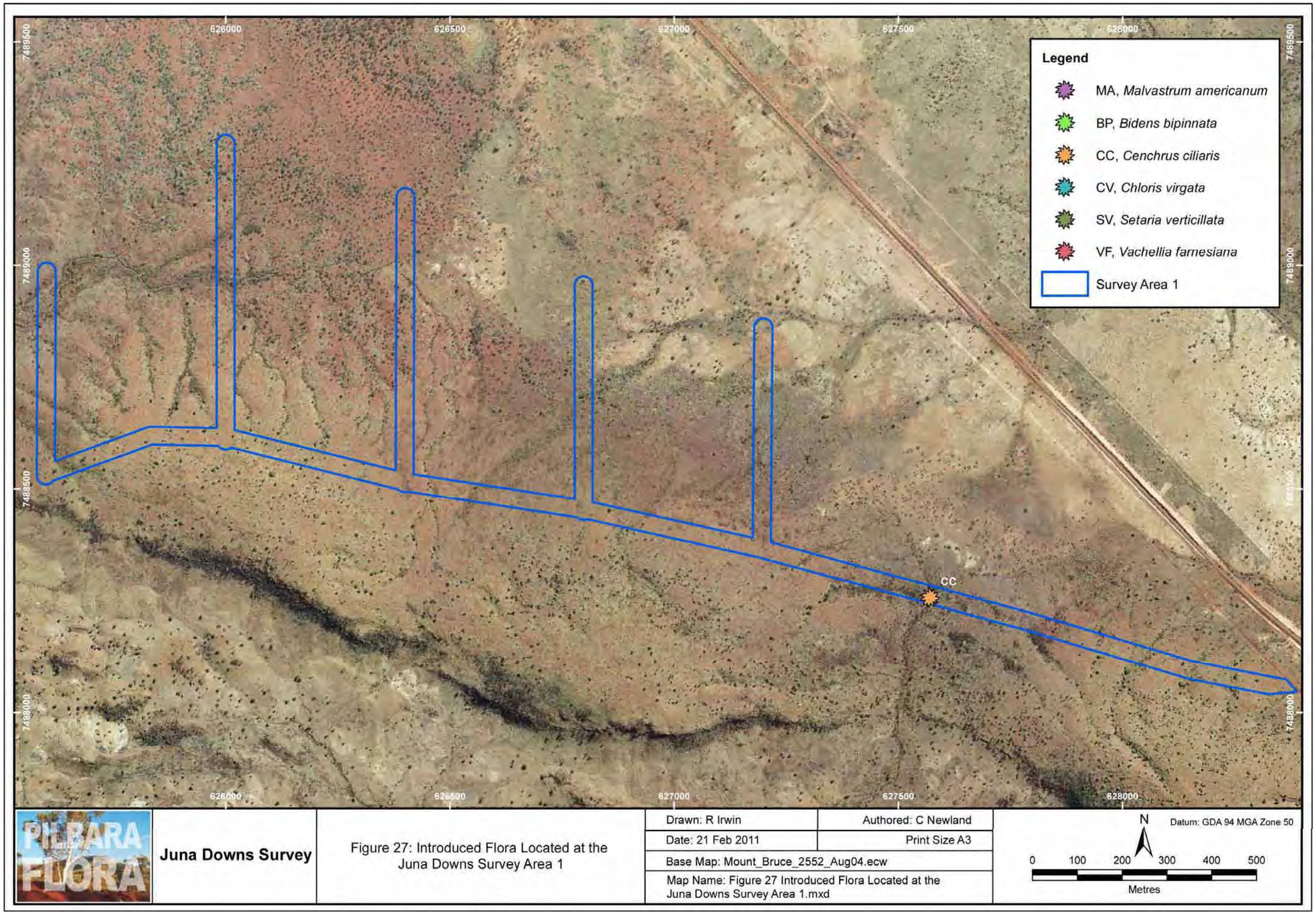


Figure 27: Introduced Flora Located at the Juna Downs Survey Area 1

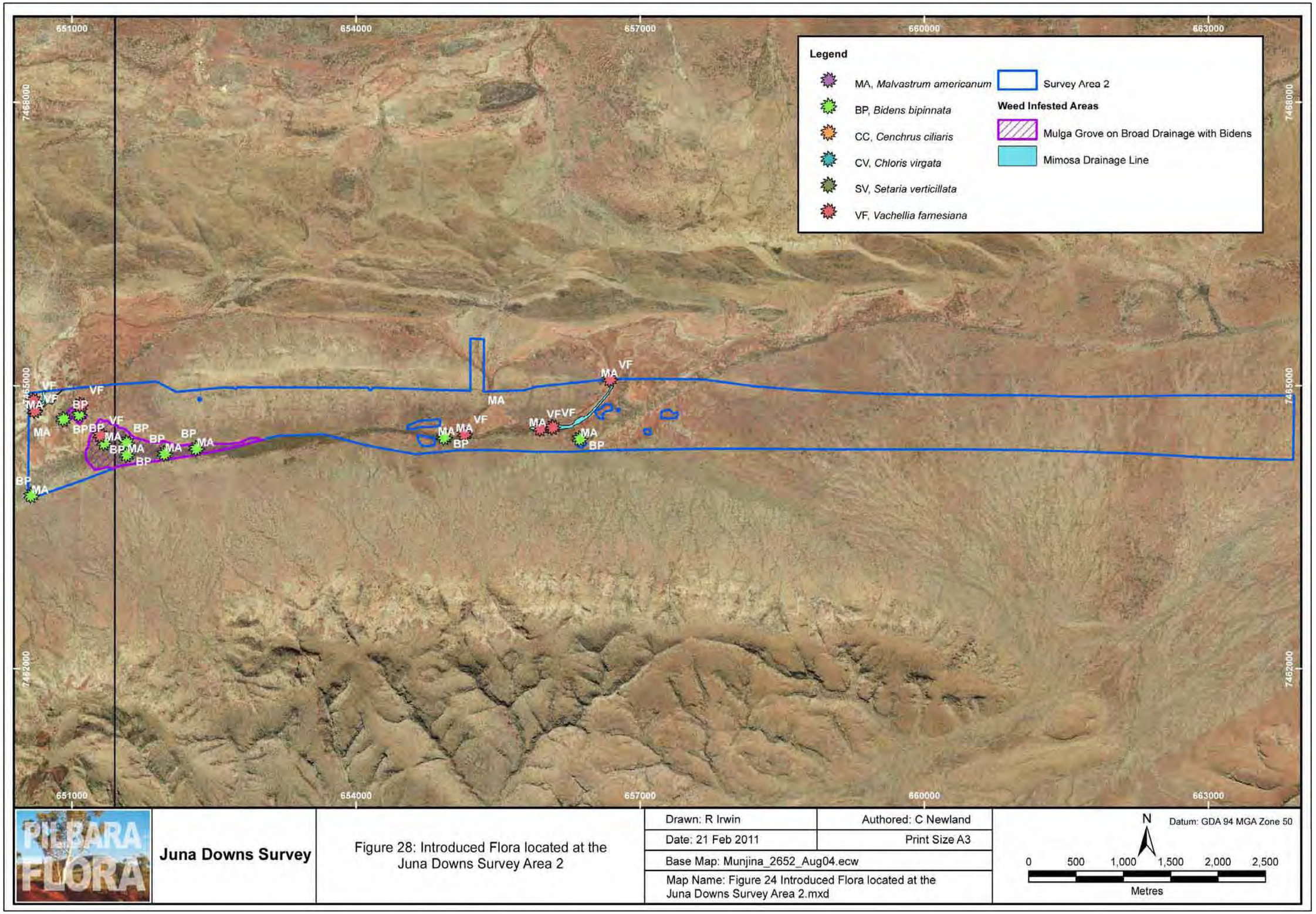


Figure 28: Introduced Flora Located at the Juna Downs Survey Area 2

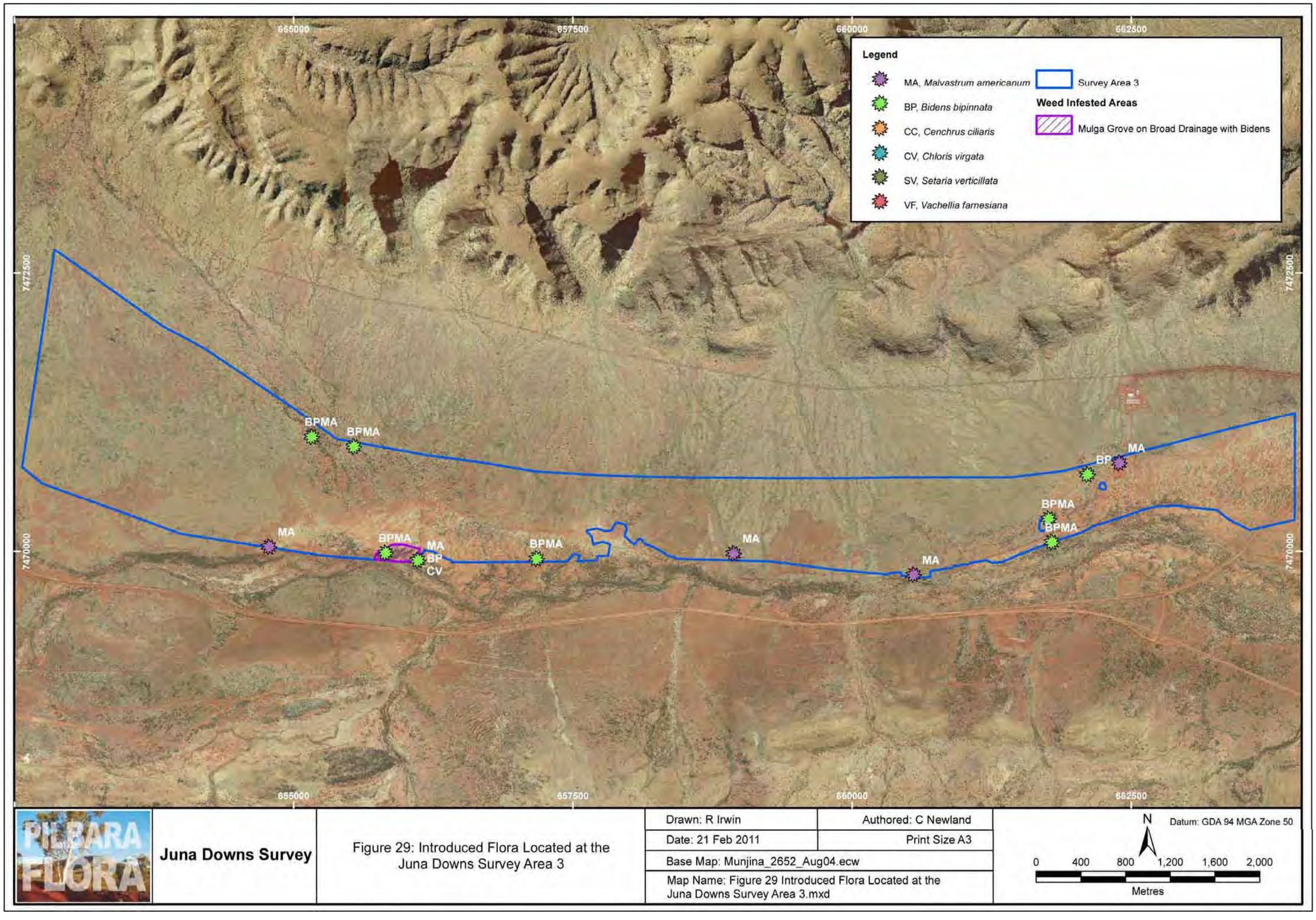


Figure 29: Introduced Flora Located at the Juna Downs Survey Area 3

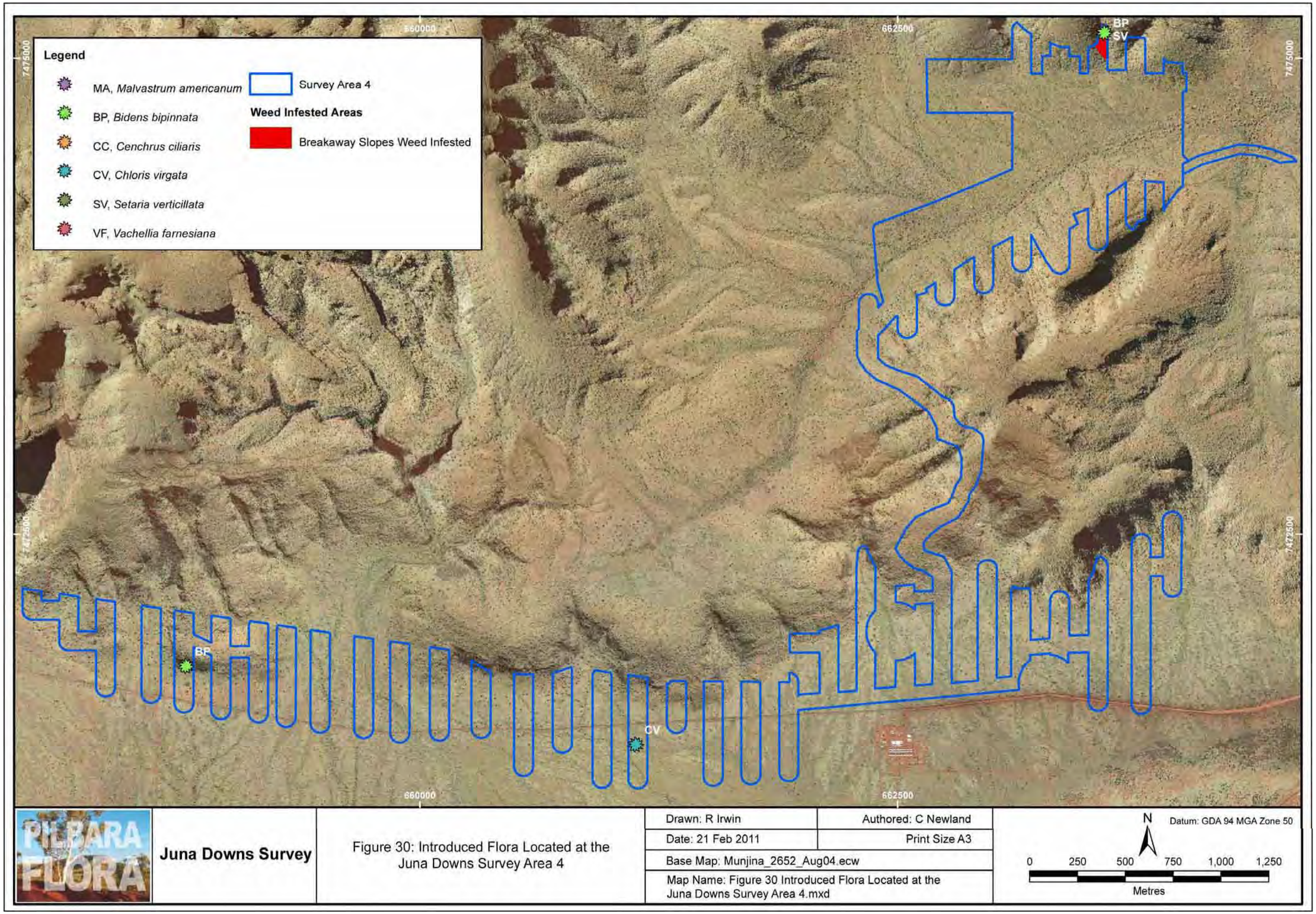


Figure 30: Introduced Flora Located at the Juna Downs Survey Area 4

4 VERTEBRATE FAUNA HABITAT ASSESSMENT

A vertebrate fauna habitat assessment was undertaken to provide supporting information for the NVCP application. The vertebrate fauna habitat assessment involved a desktop study in conjunction with a field assessment, in general accordance with the Level 1 Survey requirements of the Environment Protection Authority's Guidance Statement No. 56 '*Terrestrial Fauna Surveys for Environment Impact Assessment in Western Australia*' (EPA 2004b). The field assessment occurred in conjunction with the vegetation survey.

The results of the vertebrate fauna habitat assessment are provided in this report as supporting documentation for the NVCP application.

The survey was conducted in general accordance with the Level 1 requirements of the EPA's Guidance Statement 51 "Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia" (EPA 2004a) and with reference to the EPA's Guidance Statement No. 56 "Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia" (EPA 2004b) and Position Statement No. 3 "Terrestrial Biological Surveys as an Element of Biodiversity Protection" (EPA 2002).

4.1 OBJECTIVES

The objectives of the fauna habitat assessment were to:

- Conduct a desktop study to determine which vertebrate fauna could occur in the survey areas through a review of previous fauna reports and database searches.
- Conduct a field survey for habitat types that are associated with vertebrate fauna of conservation significance.
- Determine which of the vertebrate fauna of conservation significance could potentially occur within the survey areas.
- Conduct an assessment of the likely impacts from the proposed developments on vertebrate fauna of conservation significance.

4.2 CONSERVATION SIGNIFICANT FAUNA CATEGORIES

The conservation significance of fauna in Western Australia is determined at a number of different levels.

Under the *EPBC Act*, SEWPaC releases a list of threatened species. Listings under the *EPBC Act* are determined by SEWPaC against a set of criteria stated under the *EBPC Act*.

Under the *WC Act,* the Minister for the Environment produces a gazetted notice of threatened or endangered fauna that are classified from Schedule 1 through to Schedule 4 according to their relative need for protection. DEC also produces a list of Priority Fauna that have not been assigned statutory protection under the *WC Act* but may be under some degree of threat. DEC recognises four Priority Fauna levels.

Australia is also party to various international treaties and agreements for the protection of migratory species. These agreements include the:

- Japan-Australia Migratory Bird Agreement ('JAMBA');
- China-Australia Migratory Bird Agreement ('CAMBA');
- Republic of Korea-Australia Migratory Bird Agreement ('ROKAMBA'); and
- Bonn Convention for the conservation of migratory species ('BONN').

Information on acts and agreements related to the conservation and protection of fauna in Western Australia is provided in Appendix A.

4.3 DESKTOP STUDY

A desktop study was conducted by Pilbara Flora and involved:

- Reviewing other fauna similar studies undertaken in the Central Pilbara Region;
- A database search of vertebrate fauna that could potentially occur in the survey areas region; and
- An evaluation of conservation significant fauna that could potentially occur in the survey areas.

Previous Fauna Studies

Two survey reports were examined from the Juna Downs Survey Area:

- Biota (2008d). Rio Tinto Rail Duplication Fauna Assessment: Bellbird Siding to Juna Downs. Unpublished report prepared by Biota Environmental Sciences Pty Ltd for Rio Tinto Iron Ore Pty, July 2008; and
- Biota (2008e). Marandoo Mine Phase 2 Seasonal Fauna Survey. Unpublished report prepared by Biota Environmental Sciences Pty Ltd for Rio Tinto Iron Ore, August 2008.

A summary from Biota (2008d) is provided below:

- The survey area covered 8,981.8ha and was located across 15 landsystems within the Hamersley Ranges.
- Seven primary fauna habitat types were identified:
  - *Acacia xiphophylla* (Snakewood) over grasses on cracking clay;
  - *Acacia* and *Eucalypt* over *Triodia* on a stony slope;
  - scattered *Eucalypts* over grasses on loam;
  - *Acacia aneura* (Mulga) over *Triodia* on loam;
  - creek line with *Acacia* and *Eucalypts* over grasses;
  - *Acacia* shrubland over *Triodia* on loam; and
  - *Themeda* grassland on loam.
- A total of 120 vertebrate species were recorded in the survey area. This total included 67 avifauna species, 11 non-volant mammal species, 5 bat species and 35 herpetofauna species.
- Five conservation significant species were recorded in the survey:
  - Peregrine Falcon (*Falco peregrinus*) – *WC Act* Schedule 4;
  - Australian Bustard (*Ardeotis australis*) – DEC Priority 4;
  - Star Finch (*Neochmia ruficauda subsp. clarescens*) - DEC Priority 4;
  - Western Pebble-mound Mouse (*Pseudomys chapmani*) - DEC Priority 4; and
  - Rainbow Bee-eater *(Merops ornatus*) – *EPBC Act* – Migratory.

- A further ten conservation significant species were assessed by Biota as potentially occurring in the survey area:
  - Night Parrot (*Pezoporus occidentalis*) - *WC Act* Schedule 1, *EPBC Act* Endangered;
  - Northern Quoll (*Dasyurus hallucatus*) – *WC Act* Schedule 1, *EPBC* Act Endangered;
  - Bilby *(Macrotis lagotis)* - *WC Act* Schedule 1, *EPBC* Act Vulnerable;
  - Pilbara Orange Leaf-nosed Bat *(Rhinonicteris aurantius)* - *WC Act* Schedule 1, *EPBC* Act Vulnerable;
  - Pilbara Olive Python (*Liasis olivaceus barroni*) - *WC Act* Schedule 1, *EPBC* Act Vulnerable;
  - Long-tailed Dunnart (*Sminthopsis longicaudata*) - DEC Priority 3;
  - Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*) - DEC Priority 3;
  - Grey Falcon (*Falco hypoleucos*) - DEC Priority 4;
  - Ghost bat (Macroderma gigas) – DEC Priority 4; and
  - Short-tailed Mouse (*Leggadina lakedownensis*) - DEC Priority 4.

A summary from Biota (2008e) is provided below:

- The survey area covered approximately 5000 ha and was located across 6 land systems within the Hamersley Ranges.
- Four primary fauna habitat types were identified:
  - Small drainage lines vegetated with *Acacia aneura* over tussock grasses on loams;
  - Stony hillslopes vegetated with *Acacia* shrubs over *Triodia* on stony loam substrates;
  - Flat outwash plains vegetated with *Acacia* shrubs on loamy substrates; and
  - Rocky gorges.
- A total of 125 vertebrate species were recorded in the survey area. This total included 54 avifauna species, 15 non-volant mammal species, 7 bat species and 51 herpetofauna species.
- Four conservation significant species were recorded in the survey:
  - Northern Quoll (*Dasyurus hallucatus*) – *WC Act* Schedule 1, *EPBC* Act Endangered;
  - Western Pebble-mound Mouse (*Pseudomys chapmani*) - DEC Priority 4;
  - Ghost bat (Macroderma gigas) – DEC Priority 4; and
  - Rainbow Bee-eater *(Merops ornatus*) – *EPBC Act* – Migratory.
- A further thirteen conservation significant species were assessed by Biota as potentially occurring in the survey area:
  - Night Parrot (*Pezoporus occidentalis*) - *WC Act* Schedule 1, *EPBC Act* Endangered;

- Pilbara Orange Leaf-nosed Bat *(Rhinonicteris aurantius)* - *WC Act* Schedule 1, *EPBC* Act Vulnerable;
- Bilby *(Macrotis lagotis)* - *WC Act* Schedule 1, *EPBC* Act Vulnerable;
- Pilbara Olive Python (*Liasis olivaceus barroni*) - *WC Act* Schedule 1, *EPBC* Act Vulnerable;
- Peregrine Falcon (*Falco peregrinus*) – *WC Act* Schedule 4;
- Little North-western Mastiff Bat *(Mormopterus loriae cobourgiana)* – DEC Priority 1;
- Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*) - DEC Priority 3;
- Short-tailed Mouse (*Leggadina lakedownensis*) - DEC Priority 4;
- Australian Bustard (*Ardeotis australis*) – DEC Priority 4;
- Bush Stone-curlew *(Burhinus grallarius)* – DEC Priority 4;
- Star Finch (*Neochmia ruficauda subsp. clarescens*) - DEC Priority 4; and
- Fork-tailed Swift *(Apus pacificus)* – *EPBC Act* Migratory and Marine.

Vertebrate Fauna Database Search

A search was conducted for vertebrate fauna species that could potentially occur in the survey areas from the following sources:

- A search for listings under the *EPBC Act*.
- A DEC NatureMap search centred on the Juna Downs Survey Area with a 40km search radius (NatureMap 2011).
- A search using the Birds Australia 'Bird Data' online database (Birds Australia 2011).

EPBC Act

Refer to Section 2.13 for *EPBC Act* listed fauna species.

DEC NatureMap Search

The NatureMap search was undertaken for all species within a 40km radius centred on a point central to the survey areas (118°24' 00" E, 22°49' 00" S). The search area is displayed in Figure 7. The search results are provided in Appendix C.

Birds Australia Search

A search was undertaken using the Birds Australia 'Bird Data' online database for the 'degree' block containing the survey areas (Birds Australia 2011). The search results are provided in Appendix K.

Conservation Significant Fauna Listings

Using data from the *EPBC Act* search, NatureMap search, the Birds Australia search and Biota 2008d and 2008e, a combined list of conservation significant species that could potentially occur in the survey areas was compiled (Table 16).

Twenty eight conservation significant fauna were listed for the survey areas, of which twelve are migratory and marine *EPBC Act* listings (Table 16).

The likelihood of these conservation significant fauna actually occurring in the survey areas and an assessment of the potential impacts from the proposed Juna Downs drilling program on these fauna species is discussed in Section 4.5.

Table 16: Conservation significant fauna listed in the database searches for the survey areas

Fauna Species	Common Name	Listing		Source				
		***WC Act* & DEC**	***EPBC Act***	**Biota 2008d**	**Biota 2008e**	***EPBC Act***	**NatureMap**	**Birds Australia**
Dasyurus hallucatus	Northern Quoll	Schedule 1	Endangered	Y	Y	Y	Y	
Macrotis lagotis	Bilby	Schedule 1	Vulnerable	Y	Y			
Rhinonicteris aurantius	Pilbara Orange Leaf-nosed Bat	Schedule 1	Vulnerable	Y	Y	Y		
Liasis olivaceus subsp. *barroni*	Pilbara Olive Python	Schedule 1	Vulnerable	Y	Y	Y	Y	
Pezoporus occidentalis	Night Parrot	Schedule 1	Endangered	Y	Y	Y		
Falco peregrinus	Peregrine Falcon	Schedule 4		Y	Y		Y	
Mormopterus loriae cobourgiana	Little North-western Mastiff Bat				Y			
Lagorchestes conspicillatus subsp. *leichardti*	Spectacled Hare-wallaby	Priority 3		Y	Y			
Macroderma gigas	Ghost Bat	Priority 4		Y	Y			
Pseudomys chapmani	Western Pebble-mound Mouse	Priority 4		Y	Y		Y	
Sminthopsis longicaudata	Long-tailed Dunnart	Priority 4		Y				
Leggadina lakedownensis	Short-tailed Mouse	Priority 4		Y	Y		Y	
Ardeotis australis	Australian Bustard	Priority 4		Y	Y		Y	
Falco hypoleucos	Grey Falcon	Priority 4		Y			Y	
Neochmia ruficauda subsp. *clarescens*	Star Finch (Western)	Priority 4		Y	Y			
Burhinus grallarius	Bush Stone-curlew	Priority 4			Y			
Apus pacificus	Fork-tailed Swift		Migratory and Marine		Y	Y		
Area alba	Great Egret, White Egret		Migratory and Marine			Y		
Area ibis	Cattle Egret		Migratory and Marine			Y		
Merops ornatus	Rainbow Bee-eater		Migratory and	Y	Y	Y		Y

			Marine					
Charadrius veredus	Oriental Plover		Migratory and Marine			Y		
Accipiter fasciatus	Brown Goshawk		Migratory and Marine					Y
Haliastur sphenurus	Whistling Kite		Migratory and Marine					Y
Coracina novaehollandiae	Black-faced Cuckoo-shrike		Migratory and Marine					Y
Eurostopodus argus	Spotted Nightjar		Migratory and Marine					Y
Falco cenchroides	Australian Kestrel		Migratory and Marine					Y
Coturnix pectoralis	Stubble Quail		Migratory and Marine					Y
Ninox novaeseelandiae	Boobook Owl		Migratory and Marine					Y

4.4 FAUNA HABITAT ASSESSMENT FIELD SURVEY

The fauna habitat assessment was conducted by Pilbara Flora during the field on 01 to 11 October 2011 and 24 to 29 November 2011.

4.4.1 Fauna Habitat Assessment Methodology

The fauna habitat assessment was targeted at locating habitat types associated with conservation significant fauna species.

A fauna habitat assessment was conducted at each site for the presence of unique or specialised habitat types associated with conservation significant species. The types of habitat considered as being unique or specialised included:

- Gorges;
- Rock ledges;
- Sheltered valleys;
- Vuggy, fractured or pisolitic rocky substrates;
- Caves;
- Mine shafts;
- Closed forests or dense woodlands;
- Large roosting trees;
- Trees with nesting hollows;
- Tussock grasslands on cracking clays;
- Steep elevated cliffs for raptor nesting sites;
- Waterholes;
- Watering points;
- Sand dunes or dunefields;
- Scree slopes with pebblestones of suitable size for the Western Pebble-mound Mouse; and
- Soil suitable for burrowing and nesting.

Information was recorded from 110 relevés and 382 GPS mapping points. Additionally any conservation significant fauna observed throughout the survey were recorded with a GPS location to assist avoidance in the future. The fauna habitat assessment results are provided in Table 18.

4.4.2 Fauna Habitat Assessment Results

The only conservation significant fauna observed during the habitat assessment was the Western Pebble-mound Mouse (*Pseudomys chapmani*), which was identified due to the presence of its characteristic pebble mounds. All Pebble-mouse mounds recorded were assessed as being active or recently active.

Locations of these mounds are listed in Table 17 and displayed visually in Figure 31. Western Pebble-mouse Mounds were recorded in survey areas 1, 2 and 4. Previous studies from the region also located the Western Pebble-mound Mouse (Biota 2008d, Biota 2008e). The mouse mounds were located on colluvial scree slopes and plains with the greatest quantity being recorded on mid-slopes.

Table 17: Pebble-mound Mouse Locations (Active or recently active)

Site ID	Easting	Northing
S1-WP7	628338	7488071
S1-WP12	626829	7488457
S1-WP29	625920	7488630
S1-WP30	626127	7488583
R11	626241	7488529
S1-WP139	663375	7474862
S1-WP150	664113	7474439
S1-WP231	663478	7464650
S1-WP251	663753	7472306
R63	663744	7472380
S1-WP260	663840	7472313
S2-WP37	658955	7471604
R73	659286	7471710
S2-WP60	660549	7471595
S2-WP66	660761	7471622
S2-WP76	661148	7471540
S2-WP137	662738	7472087
S2-WP151	662569	7473307
R107	662992	7474769

Table 18: Assessment of fauna habitat types associated with conservation significant fauna

Habitat Types	Present in survey areas	Comments
Gorges	No	
Rock ledges	Yes	Occurring in Area 4
Sheltered valleys	Yes	Occurring in Area 4
Vuggy, fractured or pisolitic rocky substrates	No	
Caves	Yes	Occurring in Area 4
Mine shafts	No	
Closed forests or dense woodlands	No	

Habitat Types	Present in survey areas	Comments
Large roosting trees	Yes	Occasional moderately sized roosting trees
Trees with nesting hollows	No	
Tussock grasslands on cracking clays	No	
Steep elevated cliffs for raptor nesting sites	Yes	Occurring in Area 4
Waterholes	No	
Watering points	No	
Sand dunes or dunefields	No	
Scree slopes with pebblestones of suitable size for the Western Pebble-mound Mouse	Yes	Colluvial scree plains suitable for the Western Pebble-mound Mouse present to some extent in all areas.
Soil suitable for burrowing and nesting	Yes	Loamy sandy soils.
Other unique habitat	No	

The survey areas had few habitat types considered suitable for conservation significant fauna. These habitat types were 'Rock Ledges', 'Sheltered Valleys', 'Caves', 'Large roosting trees', Steep elevated cliffs for raptor nesting sites', 'Scree slopes with pebblestones of suitable size for the Western Pebble-mound Mouse' and 'Soil suitable for burrowing and nesting'. These habitat types are widespread throughout the Pilbara.

Additionally the habitat types found within the survey area (Drainage Channels, Alluvial Plains, Colluvial Plains, Colluvial Slopes and Breakaway Slopes) are common to the region and the impact on the regional scale on these habitat types from the Juna Downs Drilling Program will be minimal.

The NatureMap and Birds Australia faunal lists in Appendices D and J were examined in regards to faunal diversity. Overall, there were no habitat types that were considered as supporting high levels of fauna biodiversity and no indication that the survey areas were particularly diverse in regards to its fauna assemblage.

Overall, the survey areas were considered as having a low level of conservation value in regards to the presence of unique or specialised habitat types associated with conservation significant species.

4.5 ASSESSMENT OF CONSERVATION SIGNIFICANT FAUNA IN THE SURVEY AREAS

Twenty eight conservation significant fauna were listed for the survey areas of which twelve are migratory and marine *EPBC Act* listings.

An assessment was undertaken of the likelihood of these conservation significant fauna occurring in the survey areas and the potential impacts from the proposed Juna Downs drilling program on these fauna species. Highly mobile species listed as migratory which are highly unlikely to be dependent on the Survey area and thus will experience minor if any impact from the proposed Juna Downs Drilling Program have been excluded from this assessment. The exception was the Rainbow Bee-eater which was assessed as having the

possibility of occurring within the survey area. The assessment results of the remaining 17 species are presented in Table 19. Additionally any species listed as marine species have been excluded due the distance of the survey area from the coast.

Table 19: Assessment of the likelihood of occurrence of conservation significant fauna and potential impacts from the proposed Juna Downs drilling program in the survey areas

Threatened Taxa	Status	Distribution and Habitat	Likelihood of occurrence and potential impacts from the proposed Juna Downs drilling program
Dasyurus hallucatus Northern Quoll	*WC Act* Schedule 1 and *EPBC Act* Endangered	The Northern Quoll was once found throughout the northern half of Australia but has suffered significant range contraction and numbers decline in recent times (SEWPaC 2005). Grazing, altered fire regimes and the cane toad have been significant factors in its decline (SEWPaC 2005). This species is now distributed with disjunct populations, occurring in a wide range of habitats, but mostly associated with rocky areas and broken rocky country with sparse vegetation (Van Dyck and Strahan 2008).	This species is typically associated with rocky areas and broken rocky country with sparse vegetation. These habitat types are present to some extent in Area 4 of the survey area however they occur extensively throughout the region. Due to the total inaccessibility of drilling equipment to these areas and RTIO's commitment to avoiding conservation significant fauna habitat areas, it is unlikely that the proposed Juna Downs Drilling program will have any impact on this species. **Assessment outcome:** This species is likely to occur within the survey region based on habitat preference and distribution, however the habitat which potentially supports this species constitutes a minor proportion of the survey area (2.69%). Due to the total inaccessibility of drilling equipment to these areas and RTIO's commitment to avoiding conservation significant fauna habitat areas, it is unlikely that the proposed Juna Downs Drilling program will have any impact on this species.
Macrotis lagotis Bilby	*WC Act* Schedule 1, *EPBC* Act Vulnerable	Historically, the Bilby occupied a vast area of Australia over a large variety of habitat types (Pavey 2006). However, the current range has significantly contracted and fragmented, with populations in arid or semi-arid areas of Queensland, Northern Territory and Northwest Western Australia (Pavey 2006). Known and potential threatening processes include predation by introduced carnivores (red fox, feral cat);	Similar habitat to which the Bilby is known to occupy does exist within the survey area. However, there are no previous records of the Bilby occurring within the Juna Downs Survey Area (Biota 2008d). As the current population of the Bilby is greatly restricted and fragmented it is unlikely that the Bilby would occur within the survey area. Additionally the habitat types found within the survey area are common to the region and the impact on the regional scale of these habitat types from the Juna Downs Drilling Program will be minimal.

Threatened Taxa	Status	Distribution and Habitat	Likelihood of occurrence and potential impacts from the proposed Juna Downs drilling program
		competition with introduced/exotic herbivores; habitat degradation and destruction resulting from feral and domestic herbivores, unsuitable fire regimes, mining and other development; drought; and road mortality (Pavey 2006). Remaining populations occupy three major vegetation types; open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas.	**Assessment outcome:** It is considered unlikely that the Bilby would occur within the Juna Downs Survey Area application area.
Rhinonicteris aurantius Pilbara Leaf-nosed Bat	*WC Act* Schedule 1 and *EPBC Act* Vulnerable	The Pilbara Leaf-nosed Bat has been recorded in three discrete subpopulations; in the East Pilbara in abandoned underground mines and granites, in the Central Pilbara in the Hamersley Ranges and in the Upper Gascoyne (SEWPaC 2011b). This species is restricted to specialised cave and abandoned underground mine habitat types that provide stable, warm and humid microclimates to assist thermoregulation and to avoid desiccation (SEWPaC 2008a). The roosts can be deep in mines and cave systems, often associated with underground water pools (SEWPaC 2011b).	This species is typically associated with caves and abandoned underground mine workings and needs humid roost conditions found in deep caves and extensive underground workings. Some caves were present within the survey area. However due to the total inaccessibility of drilling equipment to these areas and RTIO's commitment to avoiding conservation significant fauna habitat areas, it is unlikely that the proposed Juna Downs Drilling program will have any impact on this species. **Assessment outcome:** This species is likely to occur within the survey region based on habitat preference and distribution, however the habitat which potentially supports this species constitutes a minor proportion of the survey area (2.69%). Due to the total inaccessibility of drilling equipment to these areas and RTIO's commitment to avoiding conservation significant fauna habitat areas, it is unlikely that the proposed Juna Downs Drilling program will have any impact on this species.
Liasis olivaceus subsp. barroni	*WC Act* Schedule 1 and *EPBC Act*	The Pilbara Olive Python is restricted to ranges within the Pilbara region but is generally	The Pilbara Olive Python is associated with deep gorges, caves, crevices and water holes that commonly occur in the

Threatened Taxa	Status	Distribution and Habitat	Likelihood of occurrence and potential impacts from the proposed Juna Downs drilling program
Pilbara Olive Python	Vulnerable	widespread due to the broad occurrence of this habitat type (NatureMap 2011, SEWPaC 2011b). The species inhabits caves, escarpments, gorges, water holes, rocky outcrops, rockpiles and old underground mine workings, and is known to enter active mining areas (SEWPaC 2008b). Radio-telemetry has shown that individuals spend the cooler winter months sheltering in caves and rock crevices away from water sources but move to locations near water and rocky outcrops (i.e. gorges) in summer (SEWPaC 2008b).	hills and ranges of the Pilbara region. These habitat types occurred minimally within in the survey areas and no permanent water sources were present within the study area. Due to the total inaccessibility of drilling equipment to these areas and RTIO's commitment to avoiding conservation significant fauna habitat areas, it is unlikely that the proposed Juna Downs Drilling program will have any impact on this species. **Assessment outcome:** This species is likely to occur within the survey region based on habitat preference and distribution, however the habitat which potentially supports this species constitutes a minor proportion of the survey area (2.69%). On the basis of inaccessibility of drilling equipment to possible habitat areas and RTIO's commitment to avoiding conservation significant fauna habitat areas, it is unlikely that the proposed Juna Downs Drilling program will have any impact on this species.
Pezoporus occidentalis Night Parrot	*WC Act* Schedule 1 and *EPBC Act* Endangered	The current distribution of the Night Parrot is very poorly understood with a small number of confirmed records from arid and semi-arid regions of Queensland, South Australia, Western Australia and the Northern Territory (SEWPaC 2011b). The Night Parrot inhabits arid and semi-arid areas that are characterised by having dense, low vegetation (SEWPaC 2011b). Based on accepted records, the habitat of the Night Parrot is variable, from *Triodia* grasslands in stony or sandy environments, samphire and chenopod shrublands, including genera such as *Atriplex*, *Bassia* and *Maireana*, on floodplains and	The Night Parrot is associated with dense, low vegetation and in particular with *Triodia* grasslands and samphire communities. Although *Triodia* grasslands were present in the survey areas, the grasslands were not particularly dense. **Assessment outcome:** On the basis of lack of suitable habitat types and its rarity, it is considered unlikely that the Night Parrot would occur in the survey areas.

Threatened Taxa	Status	Distribution and Habitat	Likelihood of occurrence and potential impacts from the proposed Juna Downs drilling program
		claypans, and on the margins of saltlakes, creeks or other sources of water (SEWPaC 2011b).	
Falco peregrinus Peregrine Falcon	*WC Act* Schedule 4	The Peregrine Falcon, although uncommon, occurs in all parts of Australia (Pizzey and Knight 2007). It occurs in a wide range of habitats, from timbered watercourses, cliffs, wetlands, plains and woodlands (Pizzey and Knight 2007).	The Peregrine Falcon could potentially occur in the survey areas. The taller trees and cliffs could provide roosting sites for this species. The Peregrine Falcon has the ability to egress from areas being disturbed. The habitat that could potentially be associated with this species also occurs extensively throughout the Pilbara. The proposed Juna Downs drilling program will have negligible impact on the overall extent of suitable Peregrine Falcon habitat remaining regionally. **Assessment outcome:** One the basis of mobility and suitable habitat elsewhere, the proposed Juna Downs drilling program is unlikely to impact either directly on individual animals, or on the overall conservation status of the Peregrine Falcon.
Mormopterus loriae cobourgiana Little North-western Mastiff Bat	Priority 1	The Little North-western Mastiff Bat occurs on the north west coast and is known to roost in mangroves. This species has been recorded as roosting in crevices in the dead branches of *Avicennia marina*. Swarms of up to 100 individuals may be seen flying above the canopy of the mangrove after sunset, later dispersing to forage as individuals or in pairs (Churchill, 2008).	As this species is a mangrove specialist it is highly unlikely that this species will occur within the survey area. The records stated within the Biota report 2008e are considered to be a misidentification. **Assessment outcome:** Due to the lack of suitable habitat it is considered highly unlikely that this species will occur within the survey area.
Lagorchestes conspicillatus subsp. *leichardti* Spectacled Hare-wallaby	Priority 3	The Spectacled Hare-wallaby formerly occupied almost half of the Australian continent (Maxwell *et al.* 1996). It is still relatively widespread in Queensland and the Northern Territory. In Western Australia, this species is now extremely rare and reduced to a few isolated populations in	On the basis of habitat types, the Spectacled Hare-wallaby could potentially occur in survey areas. However, suitable habitat types for this species also occur extensively throughout Northern Australia. The proposed Juna Downs drilling program is unlikely to have any impact on the overall extent of suitable habitat for the Spectacled Hare-wallaby

Threatened Taxa	Status	Distribution and Habitat	Likelihood of occurrence and potential impacts from the proposed Juna Downs drilling program
		the Pilbara and Kimberley Regions (Maxwell *et al.* 1996). The Spectacled Hare-wallaby has been recorded in the Pilbara, Kimberley and the Tanami Desert (NatureMap 2011). It is associated with wide variety of habitat types including; open forests, open woodland, tall shrublands, tussock grasslands and hummock grasslands (Maxwell *et al.* 1996, Van Dyck and Strachan 2008).	remaining regionally and nationally. This species has the ability to egress from areas being disturbed. **Assessment outcome:** One the basis of mobility and suitable habitat elsewhere, the proposed Juna Downs drilling program is unlikely to impact either directly on individual animals, or on the overall conservation status of the Spectacled Hare-wallaby.
Macroderma gigas Ghost Bat	Priority 4	The Ghost Bat occurs across Northern Australia (Environment Australia 1999) with a broad distribution in the Pilbara region (NatureMap 2011). This species is known to roost in caves, crevices, deep overhangs, and artificial roosts such as abandoned underground mines (Environment Australia 1999, Van Dyck and Strachan 2008). It occurs in a wide range of habitat types; rainforest, monsoon and vine scrub, open woodlands and arid areas (Environment Australia 1999).	The Ghost Bat has been recorded extensively in the Pilbara (NatureMap 2011). This species typically roost in caves, crevices, deep overhangs and abandoned underground mines. A few caves which were assessed as being deep enough to support Ghost Bat Populations are present in Survey Area 4 however they occur extensively throughout the region. Due to the total inaccessibility of drilling equipment to these areas and RTIO's commitment to avoiding conservation significant fauna habitat areas, it is unlikely that the proposed Juna Downs Drilling program will have any impact on this species. Additionally the mobile nature of this species allows it egress to a wide range of suitable habitat abundantly available adjacent to the survey area. **Assessment outcome:** This species is likely to occur within the survey region based on habitat preference and distribution, however the habitat which potentially supports this species constitutes a minor proportion of the survey area (2.69%). It is unlikely that the proposed Juna Downs Drilling program will have any impact on this species on the basis of: • minimal quantity of suitable habitat within the survey area;

Threatened Taxa	Status	Distribution and Habitat	Likelihood of occurrence and potential impacts from the proposed Juna Downs drilling program
			• abundance of alternative suitable habitat within the region; • total inaccessibility of drilling equipment to these habitat areas and • RTIO's commitment to avoiding conservation significant fauna habitat areas.
Pseudomys chapmani Western Pebble-mound Mouse	DEC Priority 4	The Western Pebble-mound Mouse is distributed over much of the Pilbara and extends into the Gascoyne and Murchison (NatureMap 2011). This species is well-known for the characteristic pebble-mounds which it constructs over underground burrow systems (Van Dyck and Strahan 2008). The Western Pebble-mound Mouse inhabits *Triodia* open hummock grasslands over colluvial 'pebble sized' scree material with skeletal soils (Van Dyck and Strahan 2008). The conservation status of this species has been downgraded by DEC from Schedule 1 to Priority 4 as active pebble mounds have been recorded recently over extensive areas of the Pilbara region.	The pebble mounds are distinctive and easily recognisable during field survey. Several active pebble mounds were observed during the survey. It is likely that the Western Pebble-mound Mouse is wide spread in the survey area and surrounds due to the extensive areas of suitable scree material on low rolling spinifex covered hills. RTIO is committed to creating minimal disturbance for conservation significant species. To this end, locations of the Pebble-mouse mounds are recorded and these sites avoided. The habitat be associated with this species also occurs extensively throughout the Pilbara. The proposed Juna Downs drilling program will have negligible impact on the overall extent of suitable Western Pebble-mound Mouse habitat remaining regionally. There are vast expanses of suitable habitat occurring elsewhere in Pilbara. **Assessment outcome:** Recorded during the field survey. Due to the extensive distribution of this species, the comparatively minimal loss of suitable habitat and the avoidance of all identified sites, the proposed Juna Downs drilling program is unlikely to impact on the conservation status of this species.
Sminthopsis longicaudata Long-tailed Dunnart	Priority 4	The Long-tailed Dunnart appears to be a specialist of rocky habitats. This species has been recorded in the Newman area from rocky ridges (NatureMap 2011). The Long-tailed	The Long-tailed Dunnart is known to prefer rocky habitats provided by ledges, gorges, cliffs and caves. These habitat types are present to some extent in Area 4 of the survey area however they occur extensively throughout the region.

Threatened Taxa	Status	Distribution and Habitat	Likelihood of occurrence and potential impacts from the proposed Juna Downs drilling program
		Dunnart has a known distribution from the Central Deserts to the Gascoyne and Pilbara Regions.	Due to the total inaccessibility of drilling equipment to these areas, RTIO's commitment to avoiding conservation significant fauna habitat areas and the abundance of suitable habitat in the surrounding region it is unlikely that the proposed Juna Downs Drilling program will have any impact on this species. **Assessment outcome:** This species is likely to occur within the survey region based on habitat preference and distribution, however the habitat which potentially supports this species constitutes a minor proportion of the survey area (2.69%). Due to the total inaccessibility of drilling equipment to these areas, RTIO's commitment to avoiding conservation significant fauna habitat areas, and the abundance of suitable habitat in the surrounding region it is unlikely that the proposed Juna Downs Drilling program will have any impact on this species.
Leggadina lakedownensis Short-tailed Mouse	DEC Priority 4	The Lakeland Downs Mouse occurs across northern Australia, from Cape York to the Pilbara with a population on Thevenard Island (DEC 2002). It has been recorded extensively throughout the Pilbara and Kimberley (NatureMap 2011). It appears to be associated with cracking clays and adjacent habitats, in open grassland with pockets of savannah woodland and tropical grasslands or savannah woodlands in Queensland (DEC 2002, Van Dyck and Strachan 2008). The present known distribution of this species is across much of the northern half of Australia.	The Lakeland Downs Mouse is associated with cracking clays and adjacent habitats, in open grassland with pockets of savannah woodland and tropical grasslands or savannah woodlands. These habitat types are not present in the survey areas. **Assessment outcome:** On the basis of lack of suitable habitat types, it is considered unlikely that Lakeland Downs Mouse would occur in the Survey areas.
Ardeotis australis	DEC Priority 4	The Australian Bustard occurs throughout much of	Due to its ubiquitous distribution and occurrence in a wide

Threatened Taxa	Status	Distribution and Habitat	Likelihood of occurrence and potential impacts from the proposed Juna Downs drilling program
Australian Bustard		mainland Australia and extends into New Guinea (Pizzey and Knight 2007). It occupies an array of habitats that includes spinifex and tussock grasslands, grassy woodland, low shrublands, sand hills and artificial habitats such as pastures and golf-courses (Pizzey and Knight 2007).	range of habitat types, the Australian Bustard could occur in the survey areas. The habitat associated with this species also occurs extensively throughout the Pilbara. The proposed Juna Downs drilling program will have negligible impact on the overall extent of suitable Australian Bustard habitat remaining regionally. There are vast expanses of suitable habitat occurring elsewhere in Western Australia. The Australian Bustard is a highly mobile species with the ability to egress from areas being disturbed by exploration activities. **Assessment outcome:** This species is likely to occur within the survey region based on habitat preference and distribution. On the basis of mobility and suitable habitat elsewhere, the proposed Juna Downs Drilling Program is unlikely to impact either directly on individual animals, or on the overall conservation status of the Australian Bustard.
Falco hypoleucos Grey Falcon	DEC Priority 4	The Grey Falcon is an Australian endemic, occurring in every State but is usually confined to the arid inland (Pizzey and Knight 2007). It inhabits lightly timbered plains and tree-lined watercourses, *Acacia* shrublands, open country and *Triodia* hummock grasslands (Environment Australia 2000, Pizzey and Knight 2007).	The Grey Falcon could potentially occur in the survey areas. The cliffs in Survey Area 4 could provide roosting sites for this species. The Grey Falcon has the ability to egress from areas being disturbed. The habitat that could potentially be associated with this species also occurs extensively throughout the Pilbara. The proposed Juna Downs drilling program will have negligible impact on the overall extent of suitable Grey Falcon habitat remaining regionally. **Assessment outcome:** On the basis of mobility and suitable habitat elsewhere, the proposed Juna Downs drilling program is unlikely to impact either directly on individual animals, or on the overall conservation status of the Grey Falcon.

Threatened Taxa	Status	Distribution and Habitat	Likelihood of occurrence and potential impacts from the proposed Juna Downs drilling program
Neochmia ruficauda subsp. *clarescens* Star Finch (Western)	DEC Priority 4	The Star Finch (Western) occurs in the Pilbara, Kimberley and Northern Territory (Environment Australia 2000, Pizzey and Knight 2007). This sub-species inhabits grasslands, Eucalypt woodlands, pastures and reedbeds, always proximate to permanent water (Environment Australia 2000, Pizzey and Knight 2007, Biota 2008f)).	The Star Finch favours a broad range of habitats which are always in close proximity to permanent water. No permanent water sources were observed within the survey area. This highly mobile species has the ability to egress from areas being disturbed however is unlikely to occur within the survey area due to lack of a permanent water source. The proposed Juna Downs drilling program will have negligible impact on the overall extent of suitable Star Finch habitat remaining regionally. **Assessment outcome:** On the basis of mobility and lack of suitable habitat, the proposed Juna Downs drilling program is unlikely to impact either directly on individual animals, or on the overall conservation status of the Star Finch.
Burhinus grallarius Bush Stone-curlew	DEC Priority 4	The Bush Stone-curlew inhabits dry open woodlands with groundcover of small sparse shrubs, grass or litter of twigs. It tends to avoid dense forest, closed-canopy habitats (Morcombe 2000). The species generally occurs near a watercourse or swamp (Geering *et al.* 2007). Bush Stone-curlews are locally rare because of predation by foxes, the main concern for their regional decline (Johnstone and Storr 1998).	Although some habitat loss could occur from the proposed Juna Downs Drilling program, this loss is considered negligible compared to the expansive area of undisturbed suitable habitat remaining within the Bush Stone Curlew's national distribution. **Assessment outcome:** It is considered highly unlikely that the proposed Juna Downs Drilling program will have any impact on the overall conservation status of the Bush Stone Curlew as this highly mobile species is capable of evacuating from areas being disturbed and the loss of habitat from the proposed drilling program is considered negligible compared to other suitable habit remaining within its national distribution
Merops ornatus	*EPBC Act* Migratory	The Rainbow Bee-eater is distributed throughout Southeast Asia and Australia (Pizzey and Knight	Suitable areas for borrowing could occur along the

Threatened Taxa	Status	Distribution and Habitat	Likelihood of occurrence and potential impacts from the proposed Juna Downs drilling program
Rainbow Bee-eater	and Marine, JAMBA	2007). It occurs throughout mainland Australia although it is thinly distributed in the arid central regions (SEWPaC 2011b). The Rainbow Bee-eater occurs in a range of habitat types; open forests, woodlands, shrublands, coastal dunes, mangroves, grasslands and in various cleared or semi-cleared habitats, including farmland and areas of human habitation (SEWPaC 2011b). The Rainbow Bee-eater breeds in Australia and nests in burrows.	creeklines. The proposed areas of suitable burrowing habitat that could be disturbed by the proposed Juna Downs drilling program are considered negligible in comparison to the global distribution of this species. The Rainbow Bee-eater has the ability to egress from areas being disturbed by exploration activities. **Assessment outcome:** This species is likely to occur within the survey region based on habitat preference and distribution. On the basis of mobility and suitable habitat elsewhere, the proposed Juna Downs drilling program is unlikely to impact the overall conservation status of the Rainbow Bee-eater.

In summary from Table 19, the proposed Juna Downs drilling program is unlikely to impact on the majority of the conservation significant fauna for the following reasons:

- The low impact nature of the exploration program.
- The habitat that is associated with the above species occurs extensively elsewhere.
- All avifauna and a large number of the other species assessed are highly mobile and are able to egress from areas being disturbed.

The Western Pebble-mound Mouse is the species most likely to be impacted by the proposed exploration drilling at Juna Downs. However RTIO is committed to avoidance of conservation significant species wherever possible. Western Pebble-mouse Mound locations have been plotted and exploration activities will be planned accordingly. This species has been recorded in the region (Biota 2008d, Biota2008e) and during this survey was recorded in nineteen locations (Table 17). There is abundant suitable habitat for this species in the region including a large area within conservation estates directly adjacent to Survey Areas 1 and 4.

4.6 FAUNA HABITAT ASSESSMENT SUMMARY

As an overall fauna habitat assessment summary, the proposed Juna Downs drilling program was considered as being unlikely to impact upon the conservation status of conservation significant fauna for the following reasons:

- **Small areas of unique or specialized fauna habitats:** The survey areas had seven habitat types considered suitable for conservation significant fauna, these habitat types occurred in small regions of the overall survey area. The habitat types recorded which are associated with conservation significant fauna were 'Rock Ledges', 'Sheltered Valleys', 'Caves', 'Large roosting trees', Steep elevated cliffs for raptor nesting sites', 'Scree slopes with pebblestones of suitable size for the Western Pebble-mound Mouse' and 'Soil suitable for burrowing and nesting'. These habitat types occur throughout the Pilbara and are not considered as being particularly unique or of exceptional conservation value. Additionally several of these habitat types ('Rock Ledges', 'Sheltered Valleys', 'Caves' and 'Steep elevated cliffs for raptor nesting sites') will not be disturbed due to the total inaccessibility of drilling machinery to these areas and RTIO's commitment to minimal disturbance of conservation significant fauna. Areas which should be avoided are the Western Pebble-mound Mouse locations and any deep caves which may support bat populations. No highly specialised habitat types such as gorges, vuggy, fractured or pisolitic rocky substrates, mine shafts, closed forests or dense woodlands, trees with nesting hollows, tussock grasslands on cracking clays, waterholes, watering points, sand dunes or dunefields were recorded in the survey areas.
- **Widespread habitat types:** All habitat types identified in the survey areas are widespread throughout the Pilbara and are not restricted or unique. The proposed disturbance is considered negligible in comparison to the vast areas of similar habitat types remaining in the Pilbara.
- **Low impact nature of the proposed Juna Downs drilling program:** The proposed Juna Downs drilling program is considered as being a low impact disturbance. Exploration disturbances are surficial and do not involve the removal of the underlying landform. At the end of exploration, all areas will be rehabilitated and restored to native vegetation.

- **Regional or national distributions:** No conservation significant fauna are endemic to the survey areas. All of the conservation significant fauna identified as potentially occurring in the survey areas have regional or national distributions. The minimal loss of habitat from the proposed operations in the survey areas is unlikely to have any impact on the overall conservation status of these species.
- **Fauna mobility:** Most of the conservation significant fauna identified as potentially occurring in the survey areas are highly mobile and have the ability to egress from disturbance areas.

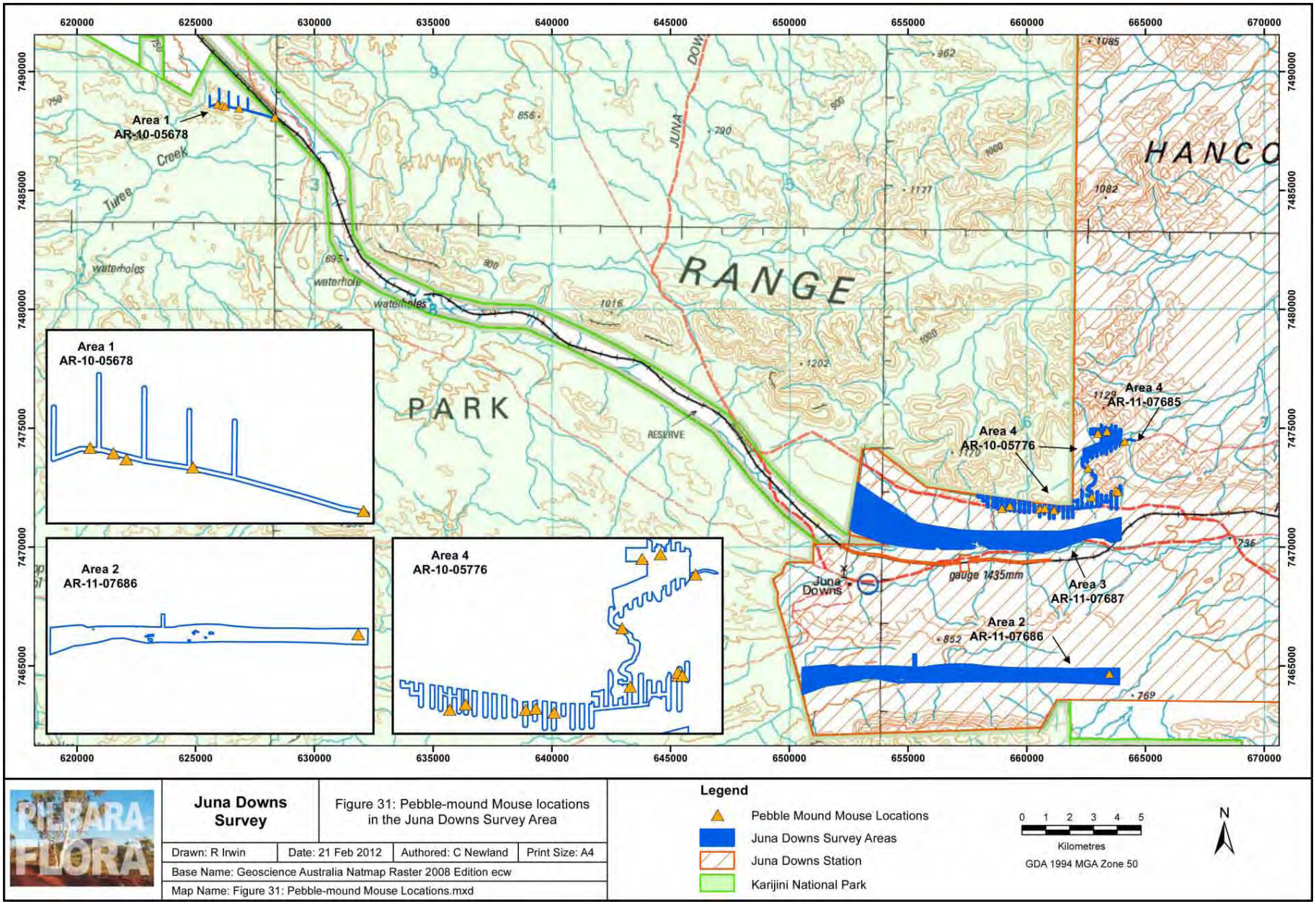


Figure 31: Western Pebble-mound mouse locations

5 ASSESSMENT OF THE 10 CLEARING PRINCIPLES

An assessment of the likely impact of the proposed clearing activities associated with the infrastructure developments proposed for the survey areas was made against the 10 Clearing Principles. The assessment outcome is provided below:

5.1 PRINCIPLE A

NATIVE VEGETATION SHOULD NOT BE CLEARED IF IT COMPRISES A HIGH LEVEL OF BIOLOGICAL DIVERSITY

The Survey Areas are situated in the Pilbara 3 - Hamersley Sub-region (DEC 2007, Kendrick 2001). The Pilbara 3 Subregion is described by Kendrick 2001 as consisting of the southern section of the Pilbara Craton, characterised by a mountainous region of basalt, shale and dolerite Proterozoic sedimentary ranges and plateaux, carved with gorges (Kendrick 2001). The vegetation is characterised by low Mulga woodlands over bunch grasses on the valley floors. The skeletal soils of the ranges support *Eucalyptus leucophloia* over *Triodia brizoides* hummock (Kendrick 2001). Kendrick (2001) lists various areas of conservation importance within the Pilbara 3 Subregion, including 'rare features', 'refugia sites;' 'areas of high species and ecosystem diversity', 'wetlands of national significance', 'wetlands of subregional significance', 'ecosystems at risk' and 'species at risk'. None of these areas of conservation importance were observed appeared to relate to the survey areas.

Pilbara Flora was commissioned by RTIO to conduct a flora and vegetation survey and a vertebrate fauna habitat assessment of the survey areas (refer Sections 3 and 4). A total of 304 vascular taxa from 49 families and 139 genera were recorded from the survey areas (Table 14). Compared to other regional studies, a total count of 304 taxa over the 2357.44ha survey area was considered representative of the typical floristic diversity expected (Table 15).

No Threatened Flora pursuant to Section 23F(2) of the *WC Act* or Threatened Flora pursuant to the *EPBC Act* were recorded in the survey areas.

Five Priority Flora were recorded in the Survey Areas:

- *Brunonia* sp. long hairs (D.E. Symon 2440) (Priority 1),
- *Spartothamnella puberula* (Priority 2),
- *Rhagodia* sp. Hamersley (M.E. Trudgen 17794) (Priority 3)'
- *Triodia* sp. Mt Ella (M.E Trudgen 12739) (Priority 3) and
- *Eremophila magnifica* subsp. *magnifica* (Priority 4)

A total of 31 Vegetation Associations were identified within the survey areas (Table 12, Appendix F). All Vegetation Associations in the survey areas have been observed extensively throughout the Pilbara region by Pilbara Flora botanists. There were no Vegetation Associations identified that were considered as being rare, restricted or unique.

A fauna habitat assessment was conducted in Section 4. Fauna is discussed in detail in Principle B. Overall, there were no habitat types that were considered as supporting high levels of fauna biodiversity and no indication that the survey areas were particularly diverse in regards to its fauna assemblage.

In summary, the survey areas are unlikely to have a higher biodiversity than the surrounding areas and the proposed clearing is unlikely to have any significant impact on the biodiversity.

Assessment outcome: Based on the above, the proposed clearing is not likely to be at variance with this Principle.

5.2 PRINCIPLE B

NATIVE VEGETATION SHOULD NOT BE CLEARED IF IT COMPRISES THE WHOLE OR A PART OF, OR IS NECESSARY FOR THE MAINTENANCE OF, A SIGNIFICANT HABITAT FOR FAUNA INDIGENOUS TO WESTERN AUSTRALIA

A fauna habitat assessment was undertaken in Section 4 to determine which conservation significant fauna could potentially occur in the survey areas in conjunction with an assessment of the likely impacts on these fauna species from the proposed Juna Downs drilling program (Tables 18 and 19).

The survey areas had very few habitat types considered suitable for conservation significant fauna. The habitat types which were recorded included 'Rock Ledges', 'Sheltered Valleys', 'Caves', 'Large roosting trees', Steep elevated cliffs for raptor nesting sites', 'Scree slopes with pebblestones of suitable size for the Western Pebble-mound Mouse' and 'Soil suitable for burrowing and nesting'. These habitat types are widespread throughout the Pilbara.

Overall, the survey areas were considered as having a low level of conservation value in regards to the presence of unique or specialised habitat types associated with conservation significant species.

Using data from the *EPBC Act* search, NatureMap search, Birds Australia and previous fauna studies in the region (Biota 200d and Biota 2008e), a combined list of conservation significant species that could potentially occur in the survey areas was compiled (Table 16). Twenty eight conservation significant fauna were listed for survey areas, of which twelve are migratory and marine *EPBC Act* listings. An assessment was undertaken of the likelihood of these conservation significant fauna occurring in the survey areas and the potential impacts from the proposed Juna Downs drilling program on these fauna species. The assessment results are presented in Table 19. Thirteen conservation significant fauna were assessed as having the potential of occurring in the survey areas based on habitat preference (refer to Section 4.5 for the species listing). Additionally eight species were considered likely to occur based on habitat preference and known distribution (Table 19). Of those species likely to occur five are dependant on a specific habitat type. This habitat characterised by rocky broken hillsides and caves, constitutes a minor proportion of the survey area (2.69%).

Several habitat types ('Rock Ledges', 'Sheltered Valleys', 'Caves' and 'Steep elevated cliffs for raptor nesting sites') were recorded in the survey area which support conservation significant species. However the majority of these habitats will not be disturbed due to the total inaccessibility of drilling machinery to these areas and RTIO's commitment to minimal disturbance of conservation significant fauna.

The Western Pebble-mound Mouse was recorded at 19 locations within the survey area. The mounds of this species are distinctive and easily recogniseable. RTIO is committed to creating minimal disturbance for conservation significant species. To this end locations of priority species including the Pebble-mouse mounds are recorded and these sites avoided.

Assessment outcome: Based on the above, the proposed clearing is likely to be at variance with this Principle due to the presence of the Western Pebble-mound Mouse and the steep sheltered valley and rocky breakaway habitats which could support priority species.

5.3 PRINCIPLE C

NATIVE VEGETATION SHOULD NOT BE CLEARED IF IT INCLUDES, OR IS NECESSARY FOR THE CONTINUED EXISTENCE OF, RARE FLORA

Pilbara Flora was commissioned by RTIO to conduct a flora and vegetation survey of the survey areas. The flora and vegetation survey results are discussed in detail in Section 3.5.

No Threatened Flora pursuant to Section 23F(2) of the *WC Act* or the *EPBC Act* were recorded in the survey areas.

Five Priority Flora were recorded in the Survey Areas:

- *Brunonia* sp. long hairs (D.E. Symon 2440) (Priority 1),
- *Spartothamnella puberula* (Priority 2),
- *Rhagodia* sp. Hamersley (M.E. Trudgen 17794) (Priority 3),
- *Triodia* sp. Mt Ella (M.E Trudgen 12739) (Priority 3) and
- *Eremophila magnifica* subsp. *magnifica* (Priority 4)

The majority of these flora species were found in small populations which were spatially scattered (Section 3.5.5, Figures 23 – 26). This spatial separation of priority species populations allows for the implementation of avoidance buffer zones to allow exploration activities without disturbance to these individuals. RTIO is committed to avoiding conservation significant species wherever possible.

Triodia sp. Mt Ella (M.E Trudgen 12739) (Priority 3) was found extensively through Survey Area 4 in large populations. Avoidance of this species is not possible using the above methods. However due to the large population sizes of this species at Juna Downs and its abundance in the region it is considered that the loss of individuals in the course of the proposed Juna Downs exploration program will have a negligible effect on the conservation status of this species as a whole.

Assessment outcome: Based on the above, the proposed clearing is likely to be at variance with this Principle.

5.4 PRINCIPLE D

NATIVE VEGETATION SHOULD NOT BE CLEARED IF IT COMPRISES THE WHOLE OR A PART OF, OR IS NECESSARY FOR THE MAINTENANCE OF A THREATENED ECOLOGICAL COMMUNITY

TECs and PECs are discussed in Section 2.15. The location of TECs and PECs in relation to the survey areas were checked using Arcview shapefiles purchased from DEC for the

Pilbara Region (DEC 2011b). The location of TECs or PECs in relation to the survey areas are provided in Table 9 and presented in Figure 9. Federal TECs were checked using the Protected Matters Search Tool for listings under the *EPBC Act* (Section 2.13).

There are no State listed PECs and State or Federally listed TECs occurring at, or near, the survey areas.

Assessment outcome: Based on the above, the proposed clearing is not likely to be at variance with this Principle.

5.5 PRINCIPLE E

NATIVE VEGETATION SHOULD NOT BE CLEARED IF IT IS SIGNIFICANT AS A REMNANT OF NATIVE VEGETATION IN AN AREA THAT HAS BEEN EXTENSIVELY CLEARED

The extent of remaining vegetation was assessed in Section 2.12 using the CAR database (DAFWA 2009, Shepherd *et al.* 2002). The results are presented in Table 7. Three vegetation associations occur in the survey areas, these being:

- **18: '**Low woodland; mulga (*Acacia aneura*)*'*.
- **82: '**Hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*'.
- **567: '**Hummock grasslands, shrub steppe; mulga & kanji over soft spinifex & *Triodia basedowii*.

These Vegetation Associations have been further refined by the DAFWA into Vegetation Sub-association 18.11, 82.3 and 567.1. (DAFWA 2006), description below:

- **18.11 '***Acacia* open shrubland / *Ptilotus* mixed open forbland*'*.
- **82.3: '***Eucalyptus* sparse mallee shrubland / *Senna* mixed sparse shrubland / *Triodia* open hummock grassland'.
- **567.1: '***Acacia* mixed sparse shrubland / *Triodia* open hummock grassland'.

All vegetation sub-association have 100% of pre-European vegetation remaining (Table 8) (Shepherd *et al.* 2002) and significant representation within internationally recognised conservation estates (IUCN Reserve classes 1 to 4[2]);19.57% for Vegetation Sub-association 18.11, 12.11% for Vegetation Sub-association 82.3 and 22.34% for Vegetation Sub-association 567.1 (Table 8). All vegetation sub-associations have significant areas of occurrence in Western Australia; 580,556.01ha for Vegetation Sub-association 18.11, 2,169,996.57ha for Vegetation Sub-association 82.3 and 777,187.88ha for Vegetation Sub-association 567.1 (Table 8).

The proposed Juna Downs drilling program is therefore considered unlikely to affect remnant vegetation.

Assessment outcome: Based on the above, the proposed clearing is not likely to be at variance with this Principle.

[2]*The International Union of Conservation ('IUCN') reserve classes 1 to 4 are used as an indicator of areas protected under conservation estate.*

5.6 PRINCIPLE F

NATIVE VEGETATION SHOULD NOT BE CLEARED IF IT IS GROWING IN, OR IN ASSOCIATION WITH, AN ENVIRONMENT ASSOCIATED WITH A WATERCOURSE OR WETLAND

The survey areas receive runoff from the nearby tall hillsides, colluvial slopes and valleys of the Hamersley Ranges. Drainage from the survey areas is directed towards Turee Creek, the major local watercourse that in turn connects with the Ashburton River. The confluence of these two systems is located approximately 132km to the southwest of the Survey Areas. The other major regional watercourse is the Ashburton River, located in a different catchment approximately 65km to the north-northeast of the Survey Areas.

At a local level, Survey Area 1 has no major watercourses but has several minor hillside drainage lines (Figure 3, Plate 1).

Survey Area 2 has a moderate creek system that passes through approximately 6.3km of this survey area (Figure 4, Plate 3). The creek broadens out into a heavily vegetated Mulga dominated drainage area that is up to 300m across and with numerous smaller braided channels as against a defined central channel.

Survey Area 3 occurs on plains country with few drainage lines and no major watercourses (Figure 5, Plates 6 and 7). A Mulga dominated broad drainage line encroaches onto the southern boundary of this survey area at one location.

Survey Area 4 occurs primarily in mountainous terrain with steeply incised hillsides drainage lines that flow southwards towards the plains below (Figure 5, Plates 8 and 10). Some drainage lines are trapped in enclosed valley catchments. There are no major watercourses, with creek systems being small to moderate but with defined channels. The northern section of Survey Area 4 contains an upland broad flat valley that acts as drainage foci for surrounding hills (Plate 9).

No waterholes or wetlands were observed in any of the Survey Areas. A spatial assessment was conducted for wetlands and waterholes occurring in survey area locality using GIS data from Geoscience Australia (2011). There are no springs, waterholes or wetlands occurring within, or near, the Survey Areas.

In summary, there are:

- No named watercourses occurring within the survey areas.
- No named or un-named watercourse areas, springs or waterholes occurring within survey areas.

From the *EPBC Act* search, there are no 'Wetlands of International Importance' occurring near the survey areas or in the 40km buffer zone.

Two recognised semi-wetland communities occur regionally:

- Coolibah-lignum flats (Lake Robinson/Coondewanna Flats) - 19km to the southeast of Survey Area 2.
- Coolibah - Lignum (Mt Bruce Flats) - 6km to the north of Survey Area 1.

Due to the spatial separation and lack of drainage connectivity, neither of these communities will be affected by the proposed exploration program.

No PDWSA occur in the Survey Areas with the nearest PDWSA, Millstream Water Reserve, located approximately 62km to the northwest of Survey Area 1 (DOW 2011).

The proposed Juna Downs drilling program activities are considered as being low impact and temporary with cleared areas being rehabilitated at the end of the exploration program. These activities will not impact on the underlying landform and will not significantly alter surface drainage or create any potential waterborne pollution emissions.

Assessment outcome: Based on the above, the proposed clearing is not likely to be at variance with this Principle.

5.7 PRINCIPLE G

NATIVE VEGETATION SHOULD NOT BE CLEARED IF THE CLEARING OF THE VEGETATION IS LIKELY TO CAUSE APPRECIABLE LAND DEGRADATION

This Principle is interpreted in the Pilbara context as clearing of vegetation creating channelised runoff with the capacity to cause degradation from erosion.

The Pilbara surface geology consists of extremely hard rock formations of banded iron, jaspers, chert, granites and granophyres that outcrop to the surface or are covered with veneers of rocky scree and stony mantles. These landscapes are extremely erosion resistant, being the end point of 100's of millions of years of erosion.

Seven land systems occur within the survey areas. The predominate land system is Boolgeeda, with Wannamunna, Newman and Elimunna to a lesser extent. The Paraburdoo, Platform and Table land systems had minimal occurrence. A description of these land systems is provided in Table 6. These land systems occur extensively throughout the Pilbara (Vreeswyk et al. 2004). The Newman, Boolgeeda, Wannaumunna, Paraburdoo and Platform Land Systems have rocky, stony or hardpan surfaces that are erosion resistant (Van Vreeswyk *et al*. 2004).

In regards to the Boolgeeda Land System, Van Vreeswyk *et al.* (2004) states; '*Vegetation is generally not prone to degradation and the system is not susceptible to erosion*'. The erosion resistance is due to the ironstone pebble scree mantle and the underlying bedded banded iron formations.

In regards to the Elimunna Land System, Van Vreeswyk *et al.* (2004) states '*Some drainage floors are slightly susceptible to erosion but most of the system is inherently resistant.'*

Given the robust nature of these land systems and the low impact nature of the proposed ground disturbing activities, it is considered that the proposed exploration activities are unlikely to have any significant overall environmental impact on these land systems.

The probability of acid sulphate soils occurring within the survey areas is considered remote and clearing is unlikely to result in an increased risk of salinity.

The proposed exploration activities are low impact and will result in minor disturbances to vegetation and soils. The primary source of land degradation will be the clearing of vegetation for access tracks and minor earthmoving for drill pad construction. Secondary sources of land degradation that have potential to occur within the survey areas include soil compaction and erosion. The proposed clearing will not be contiguous, consisting of widely spaced discrete drill pads and access tracks. RTIO will make use of existing tracks as far as practicable. Upon completion of exploration activities, all exploration disturbances will be rehabilitated in accordance with RTIO's internal procedures.

Six introduced species were recorded in the Survey Areas:

- **Cenchrus ciliaris* (Buffel Grass) - DEC Rating 'High'.
- **Chloris virgata* (Feathertop Rhodes Grass) - DEC Rating 'Low'.
- **Setaria verticillata* (Whorled Pigeon Grass) - DEC Rating 'Low'.
- **Bidens bipinnata* (Beggars Ticks) - DEC Rating 'Unrated'.
- **Malvastrum americanum* (Spiked Malvastrum) - DEC Rating 'Moderate'.
- **Vachellia farnesiana* (Mimosa Bush) - DEC Rating 'High'.

None of these species are Declared Weed species listed under the *Agriculture and Related Resources Protection Act 1976.*

Two weed species occurred at some locations in 'infestation' levels of vegetation dominance. **Bidens bipinnata* was the dominant understory species in Vegetation Associations 10 and 25 and also occurred extensively in Vegetation Association 24. **Vachellia farnesiana* was the dominant species in the upper strata layer in Vegetation Association 30.

As mentioned in Section 3.5.3, 7.43% of the total survey area was considered as being in a 'Very Poor' condition, primarily due to the infestations of *Bidens bipinnata* and *Vachellia farnesiana*.

Measures to prevent the introduction and spread of weeds to other areas within the survey areas will be implemented as required under RTIO's internal weed management procedures.

Assessment outcome: Based on the above, the proposed clearing is not likely to be at variance with this Principle.

5.8 PRINCIPLE H

NATIVE VEGETATION SHOULD NOT BE CLEARED IF THE CLEARING OF THE VEGETATION IS LIKELY TO HAVE AN IMPACT ON THE ENVIRONMENTAL VALUES OF ANY ADJACENT OR NEARBY CONSERVATION AREA

The majority of Survey Area 1 is located inside Karijini National Park. Survey Areas 2, 3 and 4 abut the boundary of Karijini National Park. There are no other national parks or nature reserves near the Survey Areas.

Survey Area 1 is contained within the Schedule 1 Area and ESA formed by Karijini National Park. This Schedule 1 Area and ESA also partially contain sections of Survey Areas 2, 3 and 4.

Survey Area 2 is contained partially within Red Book Area 8.14.

There are no TECs or PECs occurring at the survey areas. PECs and TECs are discussed further in Section 2.15.

Three of the four areas will not have any effect on Karijini national park. Area 1, being that it is contained entirely within the national park, will have some impact however this is considered to be minimal due to the low impact nature of the activities. Exploration drilling involves the clearing of a minimal amount of vegetation for access tracks and drill pads. Due to the minor surface disturbances involved, the area can be restored easily to its natural contoured landscape and re-vegetated with native species progressively throughout and at

the exploration programs end of life. Thus the affected area can be restored to a natural aesthetic similar to that of the surrounding region resulting in minimal long term impacts.

Assessment outcome: Based of the above the proposed clearing is likely to be at variance with this principal in only one of the areas. Minor surface disturbance and rehabilitation programs implemented both progressively and at the exploration program end of life results in a minimal long term impact on the area.

5.9 PRINCIPLE I

NATIVE VEGETATION SHOULD NOT BE CLEARED IF THE CLEARING OF THE VEGETATION IS LIKELY TO CAUSE DETERIORATION IN THE QUALITY OF SURFACE OR UNDERGROUND WATER

Hydrology is discussed in detail in Section 2.10 and Principle F above.

In summary from previous discussions:

- The proposed Juna Downs drilling program will not impact on the underlying landform and will not significantly alter surface drainage or create any waterborne pollution emissions.
- There are no named and/or significant watercourses, lakes or waterholes in the survey areas. The proposed Juna Downs drilling program will have negligible to minimal impact on local watercourses.
- There are no 'Wetlands of International Importance' occurring near the survey areas.
- There are no PDWSA near the survey areas.

The proposed Juna Downs drilling program is therefore considered unlikely to cause any deterioration to the quality of surface or underground water.

Assessment outcome: Based on the above, the proposed clearing is not likely to be at variance with this Principle.

5.10 PRINCIPLE J

NATIVE VEGETATION SHOULD NOT BE CLEARED IF CLEARING THE VEGETATION IS LIKELY TO CAUSE, OR EXACERBATE, THE INCIDENCE OR INTENSITY OF FLOODING

This Principle is interpreted in the Pilbara context as clearing creating channelised water flows with the capacity to create flood damage.

As discussed in Principle G, seven land systems occur within the survey areas. The predominate land system is Boolgeeda, with Wannamunna, Newman and Elimunna to a lesser extent. The Paraburdoo, Platform and Table land systems had minimal occurrence.

In regards to the Boolgeeda Land System, Van Vreeswyk *et al.* (2004) states that '*Vegetation is generally not prone to degradation and the system is not susceptible to erosion*'. The erosion resistance is due to the ironstone pebble scree mantle and the underlying bedded banded iron formations.

The exploration activities consist of widely spaced access tracks and drill pads, interspersed by broad areas of erosion resistant natural environment. The catchment area that could potentially be formed from the widely spaced, narrow tracks and small drill pads is considered negligible when compared to the overall catchment area and surface hydrology of the surrounding natural environment. The natural environment consists of watercourses, stony plains with shrublands over tussock and hummock grasslands that will act to attenuate water velocities and runoff. It is therefore considered highly improbable that runoff from the proposed clearing would generate sufficient concentrated water volumes to create even a localised flood event. The incidence or intensity of flooding is unlikely to be significantly influenced by the proposed exploration program.

Assessment outcome: Based on the above, the proposed clearing is not likely to be at variance with this Principle.

5.11 CONCLUSION

An assessment of the likely impact of the proposed clearing activities was made against the 10 Clearing Principles. The assessment outcome was that the proposed Juna Downs drilling program is at variance with three of the 10 Clearing Principles, Principal B, Principal C and Principal H.

In regards to Principal B, Several habitat types were recorded in the survey areas which potentially support conservation significant species. However the majority of these habitats will not be disturbed due to the total inaccessibility of drilling machinery to these areas. Nineteen Western Pebble-mouse Mounds were recorded within the survey area. RTIO is committed to creating minimal disturbance for conservation significant species. To this end locations of priority species including the Pebble-mouse mounds are recorded and these sites avoided along with habitat areas of conservation significance.

In regards to Principal C, four of the five recorded priority species can be avoided via the implementation of avoidance buffer zones due to small population size and spatial separation between populations. *Triodia* sp. Mt Ella (M.E Trudgen 12739) was so densely distributed through Survey Area 4 that avoidance is not possible. However due to the large population sizes of this species at Juna Downs and its abundance in the region it is considered that the loss of individuals in the course of the proposed Juna Downs exploration program will have a negligible effect on the conservation status of this species as a whole.

In regards to Principal H, the majority of Survey Area 1 is located inside Karijini National Park. The exploration program will have some impact within this area however this is considered to be minimal due to the low impact nature of the activities. Exploration drilling involves the clearing of a minimal amount of vegetation for access tracks and drill pads. Due to the minor surface disturbances involved, the area can be restored easily to its natural contoured landscape and re-vegetated with native species progressively throughout and at the exploration programs end of life. Thus the affected area can be restored to a natural aesthetic similar to that of the surrounding region, resulting in minimal long term impacts.

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Appendices

Appendix A: Information on acts and agreements related to the conservation and protection of flora and fauna in Western Australia

Appendix B: Protected Matters Search Tool listings under the *Environment Protection Biodiversity Conservation Act 1999* for the survey areas

Appendix C: Department of Environment and Conservation NatureMap fauna and flora search centred on the survey areas

Appendix D: Combined listing of Threatened and Priority Flora for the Juna Downs Region

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Appendix G: List of all botanical taxa by Survey Area

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APPENDIX A

Information on acts and agreements related to the conservation and protection of flora and fauna in Western Australia

The conservation significance of flora and fauna in Western Australia can be determined at a number of different levels. A species may be included in one or a number of determinations at a commonwealth, international or state level. These levels include:

- Commonwealth Listed Threatened Species - Flora and Fauna
- International Treaties - Primarily Migratory Avifauna
- State Listed Species – Flora
- State Listed Species - Fauna

Each level is discussed in turn.

Commonwealth Listed Threatened Species

Under Section 179 of the *Environment Protection and Biodiversity Conservation Act 1999* ('*EPBC Act*'), the Department of Sustainability, Environment, Populations and Community ('SEWPAC') releases a list of threatened flora and fauna species. Listings under the *EPBC Act* are determined by SEWPAC against a set of criteria stated under the *EBPCA*. Threatened fauna and flora may be listed in any one of the following categories as described in the following table.

***EPBC Act* Category**	**SEWPAC Definition**
Extinct	A native species is eligible to be included in the extinct category at a particular time if, at that time, 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 at a particular time if, at that time: (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) 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 at a particular time if, at that time, 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 at a particular time if, at that time (a) 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 at a particular time if, at that time: (a) 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 at a particular time if, at that time: (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:

- The Conservation in subsection (6), fish includes all species of bony fish, sharks, rays, crustaceans, molluscs and other marine organisms, but does not include marine mammals or marine reptiles.

- Species listed as 'conservation dependent' and 'extinct' are not matters of national environmental significance and therefore do not trigger the *EPBC Act.*

International Level Treaties

Many migratory species are listed under international conventions and agreements that Australia is party to and are protected under the *EPBC Act*.

Japan-Australia Migratory Bird Agreement ('JAMBA'): Australia has an agreement with Japan relating to the conservation and protection of terrestrial, water and shorebird species that migrate between Australia and Japan.

China-Australia Migratory Bird Agreement ('CAMBA'): Australia has an agreement with the People's Republic of China relating to the conservation and protection of terrestrial, water and shorebird species that migrate between Australia and China.

Republic of Korea-Australia Migratory Bird Agreement ('ROKAMBA'). Australia has an agreement with the Republic of Korea relating to the conservation and protection of migratory terrestrial, water, and shorebird species which migrate between Australia and Republic of Korea.

Bonn Convention ('BONN'): The Convention on the Conservation of Migratory Species of Wild Animals aims to improve the status of all threatened migratory species through national action and international agreements. This includes mammal, bird, retile and fish species.

Department of Environment and Conservation's Categories and Definitions for Conservation Listed Flora

Under the *Wildlife Conservation Act 1950* ('*WC Act*'), the Minster for the Environment produces a gazetted '*Wildlife Conservation (Rare Flora) Notice*' that lists Declared Rare Flora under two Schedules; extant and presumed extinct. DEC also produces a list of Priority Flora that have not been assigned statutory protection under the *WC Act* but may be under some degree of threat. DEC recognises five Priority Flora levels.

Category	DEC Definition
Schedule 1—Extant Flora **T: Threatened Flora (Declared Rare Flora – Extant)** Taxa that are extant and considered likely to become extinct or rare and therefore in need of special protection (*WC Act*)	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
Schedule 2—Extinct Flora **X: Presumed Extinct Flora (Declared Rare Flora - Extinct)** Taxa that are presumed to be extinct in the wild and therefore in need of special protection (*WC Act*)	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*). 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.
P1: Priority One: Poorly Known (DEC Priority List)	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.
P2: Priority Two: Poorly Known (DEC Priority List)	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

Category	DEC Definition
	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.
P3: Priority Three: Poorly Known (DEC Priority List)	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.
P4: Priority Four: Rare, Near Threatened and other species in need of monitoring (DEC Priority List)	**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.
P5: Priority Five: Conservation Dependent Species (DEC Priority List)	**P5: 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.

Department of Environment and Conservation's Categories and Definitions for Conservation Listed Fauna

Under the *Wildlife Conservation Act 1950* ('*WC Act*'), the Minster for the Environment produces a gazetted '*Wildlife Conservation (Specially Protected Fauna) Notice*' of threatened or endangered fauna that are classified from Schedule 1 through to Schedule 4 according to their relative need for protection. DEC also produces a list of Priority Fauna that have not been assigned statutory protection under the *WC Act* but may be under some degree of threat. DEC recognises five Priority Fauna levels.

Category	DEC Definition
Schedule 1: Fauna that is rare or is likely to become extinct. (*WC Act*)	Fauna that is rare or likely to become extinct are declared to be fauna that is in need of special protection.
Schedule 2: Fauna presumed to be extinct (*WC Act*)	Fauna that is presumed to be extinct, are declared to be fauna that is in need of special protection.
Schedule 3: Migratory birds protected under an international agreement (*WC Act*)	Birds that are subject to an agreement between the government of Australia and the governments of Japan, China and the Republic of Korea relating to the protection of migratory birds, are declared to be fauna that is in need of special protection.
Schedule 4: Other specially protected fauna (*WC Act*)	Fauna that is in need of special protection, otherwise than for the reasons mentioned in Schedules 1 to 3.
Priority 1: Taxa with few, poorly known populations on threatened lands. (DEC Priority List)	Taxa which are known from few specimens or sight records from one or a few localities on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 2: Taxa with few, poorly known populations on conservation lands. (DEC Priority List)	Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 3: Taxa with several, poorly known populations, some on conservation lands. (DEC Priority List)	Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 4: Taxa in need of monitoring. (DEC Priority List)	Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands.
Priority 5: Taxa in need of monitoring (conservation dependent). (DEC Priority List)	Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Appendix B

Protected Matters Search Tool listings under the *Environment Protection and Biodiversity Conservation Act 1999* for the Survey Areas

Search results using the Department of Sustainability, Environment, Water, Population and Communities 'Protected Matters Search Tool' for listings under the *Environmental Protection and Biodiversity Conservation Act 1999* based on a line extending from Survey Area 1 to Survey Area 2 (-22.7 118.21667 to -22.91667 118.6) with a 10km buffer.

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information about the EPBC Act including significance guidelines, forms and application process details can be found at http://www.environment.gov.au/epbc/assessmentsapprovals/index.html

Report created: 05/02/12 14:18:38

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Coordinates
Buffer: 10.0Km

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	None
Threatened Species:	6
Migratory Species:	8

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

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National Heritage Places:	None
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Australian Government
Department of Sustainability, Environment, Water, Population and Communities

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Report created: 05/02/12 14:18:38

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World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	None
Threatened Species:	6
Migratory Species:	8

Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Hamersley Range National Park (1977 boundary)	WA	Registered

State and Territory Reserves [Resource Information]

Name	State
Karijini	WA
Unnamed WA41696	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit,

Name	Status	Type of Presence
Mammals		
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State

Name	State
Mt. Bruce coolibah-lignum flats	WA

Coordinates

-22.7 118.21667,-22.91667 118.6

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium

-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix C

Department of Environment and Conservation NatureMap search for Conservation Listed Flora centred on the Survey Areas (118°24' 00" E, 22°49' 00" S) with a 40km buffer

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Charles Newland on 14/10/2011

Kingdom Plantae
Conservation Status Conservation Taxon (T, X, IA, S, P1-P5)
Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 118°24' 00" E,22°49' 00" S
Buffer 40km
Group By Kingdom

Kingdom	Species	Records
Plantae	36	121
TOTAL	**36**	**121**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Plantae					
1.	29571	*Acacia bromilowiana*		P4	
2.	3286	*Acacia daweana*		P3	
3.	3316	*Acacia effusa*		P3	
4.	23528	*Acacia subtiliformis*		P3	
5.	34810	*Amaranthus centralis*		P3	
6.	11512	*Aristida calycina var. calycina*		P2	
7.	216	*Aristida lazaridis*		P2	
8.	20427	*Brachyscome sp. Wanna Munna Flats (S. van Leeuwen 4662)*		P1	
9.	20381	*Dampiera anonyma*		P3	
10.	20378	*Dampiera metallorum*		P3	
11.	20768	*Eremophila forrestii subsp. Pingandy (M.E. Trudgen 2662)*		P2	
12.	14893	*Eremophila magnifica subsp. magnifica*		P4	
13.	14894	*Eremophila magnifica subsp. velutina*		P3	
14.	20432	*Euphorbia sp. Mt Bruce flats (S. van Leeuwen 3861)*		P2	Y
15.	4482	*Geijera salicifolia*		P3	
16.	12529	*Goodenia lyrata*		P3	
17.	7530	*Goodenia nuda*		P4	
18.	29381	*Goodenia sp. East Pilbara (A.A. Mitchell PRP 727) (O'Meara's Goodenia)*		P3	
19.	17715	*Indigofera gilesii subsp. gilesii*		P3	
20.	14329	*Indigofera ixocarpa*		P2	
21.	14322	*Josephinia sp. Marandoo (M.E. Trudgen 1554)*		P1	
22.	3022	*Lepidium catapycnon (Hamersley Lepidium)*		T	
23.	30374	*Oxalis sp. Pilbara (M.E. Trudgen 12725)*		P2	
24.	20311	*Pilbara trudgenii*		P2	
25.	2744	*Ptilotus mollis*		P4	
26.	20168	*Rhagodia sp. Hamersley (M. Trudgen 17794)*		P3	
27.	13290	*Rhodanthe ascendens*		P1	
28.	11556	*Rostellularia adscendens var. latifolia*		P3	
29.	20263	*Scaevola sp. Hamersley Range basalts (S. van Leeuwen 3675)*		P2	
30.	16616	*Sida sp. Barlee Range (S. van Leeuwen 1642)*		P3	
31.	6826	*Spartothamnella puberula*		P2	
32.	17030	*Swainsona sp. Hamersley Station (A.A. Mitchell 196)*		P3	
33.	38511	*Tecticornia medusa*		P3	
34.	6069	*Thryptomene wittweri*		T	
35.	20671	*Vigna sp. central (M.E. Trudgen 1626)*		P2	
36.	33026	*Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684)*		P1	

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4

NatureMap is a collaborative project of the Department of Environment and Conservation, Western Australia, and the Western Australian Museum.

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Appendix D

Combined listing of Threatened and Priority Flora for the Juna Downs Region

Sources:

- NatureMap (2011)
- RTIO Rare and Priority Flora Database

Taxa	DEC Status	Nature Map search	RTIO Database	Likelihood of occurrence in survey areas (FloraBase Habitat)	Y/N
Acacia bromilowiana	P4	Y		Red skeletal stony loam, orange-brown pebbly, gravel loam, laterite, banded ironstone, basalt. Rocky hills, breakaways, scree slopes, gorges, creek beds	Yes
Acacia daweana	P3	Y		Stony red loamy soils. Low rocky rises, along drainage lines	Yes
Acacia effusa	P3	Y		Stony red loam. Scree slopes of low ranges	Yes
Acacia subtiliformis	P3	Y		Looks very similar to *Acacia maitlandii*. Occurs on rocky calcrete plateaus. Unlikely to occur except on calcrete area.	No
Amaranthus centralis	P3	Y		Low in landscape, flat terrain, alluvial flat, gritty red damp clay loam.	Yes
Aristida calycina var. calycina	P2	Y		Red earths, sands, alluvial soils	Yes
Aristida lazaridis	P2	Y		Occurring on sand or loam.	Yes
Brachyscome sp. Wanna Munna Flats (S. van Leeuwen 4662)	P1	Y		Gentle slope on undulating plains country. Soil red brown clayey loam with abundant small to medium sized gravels	Yes
Dampiera anonyma	P3	Y		Skeletal red-brown to brown gravelly soil over banded ironstone, basalt, shale and jaspilite. Hill summits, upper slopes (above 1000m).	Yes
Dampiera metallorum	P3	Y		Skeletal red-brown gravelly soil over banded ironstone. Steep slopes, summits of hills	Yes
Eremophila forrestii subsp. Pingandy (M.E. Trudgen 2662)	P2	Y		Flat terrain, low in landscape, base of broad valley, stony gibber plain above shallow drainage line, red clay-loam	Yes
Eremophila magnifica subsp*. magnifica*	P4	Y	Y	Skeletal soils over ironstone, rocky screes and hillsides. Unlikely to occur in the survey areas.	Recorded in survey
Eremophila magnifica subsp*. velutina*	P3	Y		Skeletal soil over and summits.	Yes
Euphorbia sp. Mt Bruce flats (S. van Leeuwen 3861)	P2	Y		Sump, low in landscape, alluvial cracking clay loamy soil, gritty with ironstone fragments, some sinkholes present	No

Taxa	DEC Status	Nature Map search	RTIO Database	Likelihood of occurrence in survey areas (FloraBase Habitat)	Y/N
Geijera salicifolia	P3	Y		Skeletal soils, stony soils. Massive rock scree, gorges	Yes
Goodenia lyrata	P3	Y	Y	Red sandy loam. Near claypan	Yes
Goodenia nuda	P4		Y	Sandy loamy soils.	Yes
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)	P3	Y	Y	Red-brown clay soil, calcrete pebbles. Low undulating plain, swampy plains	Yes
Indigofera gilesii subsp. *gilesii*	P3	Y	Y	Pebbly loam amongst boulders & outcrops. Hills	Yes
Indigofera ixocarpa	P2	Y	Y	Skeletal red soils over massive ironstone	Yes
Josephinia sp. Marandoo (M.E. Trudgen 1554)	P1			Gritty soil, granite. Plains	Yes
Lepidium catapycnon	Threatened	Y		Skeletal soils. Hillsides	Yes
Oxalis sp. Pilbara (M.E. Trudgen 12725)	P2	Y		Skeletal, red stony soil over ironstone. Hill summits, steep slopes, screes, cliff faces	Yes
Pilbara trudgenii	P2	Y		Steep scree slope. Soil: Red-brown and black angular gravel, pebbles, cobbles and rocks	Yes
Ptilotus mollis	P4	Y		Stony hills and screes	Yes
Rhagodia sp. Hamersley (M. Trudgen 17794)	P3	Y	Y	Alluvial plains in Mulga area.	Recorded in survey
Rhodanthe ascendens	P1	Y		Clay. Roadside verge	Yes
Rostellularia adscendens var. *latifolia*	P3	Y	Y	Ironstone soils. Near creeks, rocky hills	Yes
Scaevola sp. Hamersley Range basalts (S. van Leeuwen 3675)	P2	Y		High in landscape, summit of hill and on adjacent steep slopes, skeletal brown soil over basaltic rock	Yes
Sida sp. Barlee Range (S. van Leeuwen 1642)	P3	Y	Y	Skeletal red soils pockets. Steep slope	Recorded in survey by RTIO

Taxa	DEC Status	Nature Map search	RTIO Database	Likelihood of occurrence in survey areas (FloraBase Habitat)	Y/N
Spartothamnella puberula	P2	Y		Rocky loam, sandy or skeletal soils, clay. Sandplains, hills.	Recorded on site
Swainsona sp. Hamersley Station (A.A. Mitchell 196)	P3	Y		Flat crabholed plain.	No
Tecticornia medusa	P3	Y		Growing on the lake bed a few 100 m from the shoreline. Red clayey sand	No
Themeda sp. Hamersley Station (M.E. Trudgen 11431)	P3		Y	Clay pan, grass plain	No
Triodia sp. Mt Ella (M.E. Trudgen 12739)			Y	Light orange-brown, pebbly loam. Amongst rocks & outcrops, gully slopes	Recorded in survey
Thryptomene wittweri	Threatened	Y		Skeletal red stony soils. Breakaways, stony creek beds.	Yes
Vigna sp. central (M.E. Trudgen 1626)	P2	Y		Claypan of fine cracking clays. Basalt hills	No
Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684)	P1	Y		Flat plain. Red sandy clay-loam. Flat terrain, low in landscape, red clay loam with some stone	Yes

Appendix E

Vegetation Condition Scale and Vegetation Structural Classification System

Vegetation Condition Scale implemented by Trudgen (1988) for Northern Australia*

E = Excellent (= Pristine of BushForever)** Pristine or nearly so; no obvious signs of damage caused by the activities of European man.
VG = Very Good (= Excellent of BushForever) Some relatively slight signs of damage caused by the activities of European man. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds such as **Ursinia anthemoides* or **Briza* spp., or occasional vehicle tracks.
G = Good (= Very Good of BushForever) More obvious signs of damage caused by the activities of European man, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or by selective logging. Weeds as above, possibly plus some more aggressive ones such as **Ehrharta* spp.
P = Poor (= Good of BushForever) Still retains basic vegetation structure or ability to regenerate to it after very obvious impacts of activities of European man, such as grazing, partial clearing (chaining) or frequent fires. Weeds as above, probably plus some more aggressive ones such as **Ehrharta* spp.
VP = Very Poor (= Degraded of BushForever) 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 including very aggressive species.
D = Completely Degraded (= Completely Degraded of BushForever) Areas that are completely or almost completely without native species in the structure of their vegetation; i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

* *Based on Trudgen M.E. (1988). A Report on the Flora and Vegetation of the Port Kennedy Area. Unpublished report prepared for Bowman Bishaw and Associates, West Perth.*

** *'Bushforever' condition rating, from 'Bush Forever Volume 2 Directory of Bush Forever Sites' (Government of WA 2000).*

Vegetation Classifications for the Pilbara based on Specht with modification by Aplin &Trudgen

Life form	**Canopy Cover**				
Height Class	**100 - 70%**	**70 - 30%**	**30 - 10%**	**10 - 2%**	**< 2%**
Trees > 30m	High Closed Forest	High Open Forest	High Woodland	High Open Woodland	Scattered Tall Trees
Trees 10-30m	Closed Forest	Open Forest	Woodland	Open Woodland	Scattered Trees
Trees < 10m	Low Closed Woodland	Low Open Forest	Low Woodland	Low Open Woodland	Scattered Low Trees
Mallee	Closed Mallee	Mallee	Open Mallee	Very Open Mallee	Scattered Mallees
Shrubs > 2m	Closed Scrub	Open Scrub	High Shrubland	High Open Shrubland	Scattered Tall Shrubs
Shrubs 1-2m	Closed Heath	Open Heath	Shrubland	Open Shrubland	Scattered Shrubs
Shrubs < 1m	Low Closed Heath	Low Open Heath	Low Shrubland	Low Open Shrubland	Low Scattered Shrubs
Hummock Grass **Tussock Grass** **Bunch Grass**	Closed Hummock Grassland Closed Tussock Grassland Closed Bunch Grassland	Hummock Grassland Tussock Grassland Bunch Grassland	Open Hummock Grassland Open Tussock Grassland Open Bunch Grassland	Very Open Hummock Grassland Very Open Tussock Grassland Very Open Bunch Grassland	Scattered Hummock Grass Scattered Tussock Grass Scattered Bunch Grass
Sedges	Closed Sedges	Sedges	Open Sedges	Very Open Sedges	Scattered Sedges
Herbs	Closed Herbs	Herbs	Open Herbs	Very Open Herbs	Scattered Herbs

Appendix F

Description of vegetation associations occurring at the Survey Areas

Vegetation Association 1:	**Low Open Woodland on Low Colluvial Hills**		
Landform Overview:	Hills	**Area (ha):**	131.98
Landform Type:	Low rolling colluvial scree hills		
Vegetation Status:	Native vegetation		
Surface/Rock Type:	Ironstone colluvial scree		
Soil Types:	Red sandy silts		
RTIO Landform Type:	Hills		
RTIO Map Symbol Type:	Hillslopes		
Conservation Taxa:	None recorded		
Introduced Species:	None recorded		
Condition:	Excellent		
Typical Vegetation Description:	*Eucalyptus leucophloia* subsp*. leucophloia* and *Corymbia deserticola* subsp*. deserticola* Low Open Woodland over *Acacia atkinsiana, A. maitlandii, A. trudgenii and Senna glutinosa* subsp*. glutinosa* over Tall Scattered Shrubs over *Triodia wiseana* Open Hummock Grassland.		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
6	5	Low Open Woodland	*Eucalyptus leucophloia* subsp*. leucophloia* *Corymbia deserticola* subsp*. deserticola*
2-3	1	Scattered Tall Shrubs	*Acacia atkinsiana* *Acacia maitlandii* *Acacia trudgenii* *Senna glutinosa* subsp*. glutinosa*
0.3	25	Open Hummock Grassland	*Triodia wiseana*

Vegetation Association 2:	**Low Open Woodland Mallee and Shrubland on Lower Slopes**		
Landform Overview:	Hills	**Area (ha):**	94.52
Landform Type:	Footslopes		
Vegetation Status:	Native vegetation		
Surface/Rock Type:	Ironstone colluvial scree		
Soil Types:	Red sandy silts		
RTIO Landform Type:	Hills		
RTIO Map Symbol Type:	Base of Slopes		
Conservation Taxa:	*Triodia* sp. Mt Ella (M.E. Trudgen 12739)(P3) – not common, but extending into this vegetation along drainage lines from above hillsides.		
Introduced Species:	None recorded		
Condition:	Excellent		
Typical Vegetation Description:	*Eucalyptus leucophloia* subsp*. leucophloia* and *Corymbia deserticola* subsp*. deserticola* Low Open Woodland over *Eucalyptus gamophylla* Very Open Mallee over *Acacia steedmanii* subsp*. borealis. A. bivenosa, A. cowleana* and *A. trudgenii* over High open Shrubland over *Triodia wiseana and T. epactia* Open Hummock Grassland.		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
6	2	Low Open Woodland	*Eucalyptus leucophloia* subsp*. leucophloia* *Corymbia deserticola* subsp*. deserticola*
4	3	Very Open Mallee	*Eucalyptus gamophylla*
2 - 3	5	High open Shrubland	*Acacia steedmanii* subsp*. borealis* *Acacia bivenosa* *Acacia cowleana* *Acacia trudgenii*
0.3	20	Open Hummock Grassland	*Triodia wiseana* *Triodia epactia*

Vegetation Association 3:	**Low Open Woodland on Breakaway Slopes and Steep Valleys**		
Landform Overview:	Hills	**Area (ha):**	62.42
Landform Type:	Breakaway slopes and steep sided valleys		
Vegetation Status:	Native vegetation		
Surface/Rock Type:	Rock outcropping with Ironstones, BIF, cherts, colluvial pebblestones		
Soil Types:	Red sandy silts		
RTIO Landform Type:	Hills		
RTIO Map Symbol Type:	Gorges and Gullies		
Conservation Taxa:	*Triodia* sp. Mt Ella (M.E. Trudgen 12739) very common. Recorded at 25 out of 35 survey sites with between 10 and 35% foliage cover, associated with steep drainage areas. Co-dominant component of the grass layer.		
Introduced Species:	None recorded		
Condition:	Excellent		
Typical Vegetation Description:	*Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* Low Open Woodland over *Acacia maitlandii, A. hamersleyensis, A bivenosa* and *Gossypium robinsonii* High Open Shrubland over *Triodia wiseana* and *T.* sp. Mt Ella (M.E. Trudgen 12739) Hummock Grassland with *Cymbopogon ambiguus, Themeda* sp. Mt Barricade (M.E. Trudgen 2471) and *Eriachne mucronata* Tussock Grassland.		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
6	5	Low Open Woodland	*Eucalyptus leucophloia* subsp. *leucophloia* *Corymbia hamersleyana*
2	5	High Open Shrubland	*Acacia maitlandii* *Acacia hamersleyensis* *Acacia bivenosa* *Gossypium robinsonii*
0.4	30	Hummock Grassland	*Triodia wiseana* *Triodia* sp. Mt Ella (M.E. Trudgen 12739)
0.4	10 -40	Tussock Grassland	*Cymbopogon ambiguus* *Themeda* sp. Mt Barricade (M.E. Trudgen 2471) *Eriachne mucronata*

Vegetation Association 4:	**Low Open Woodland on Hills**		
Landform Overview:	Hills	**Area (ha):**	54.87
Landform Type:	Stony hills		
Vegetation Status:	Native vegetation		
Surface/Rock Type:	Colluvial scree with some outcropping		
Soil Types:	Red sandy silts		
RTIO Landform Type:	Hills		
RTIO Map Symbol Type:	Hillslopes		
Conservation Taxa:	*Triodia* sp. Mt Ella (M.E. Trudgen 12739)(P3) *Eremophila magnifica* subsp*. magnifica* (P4)		
Introduced Species:	None recorded		
Condition:	Excellent		
Typical Vegetation Description:	*Eucalyptus leucophloia* subsp*. leucophloia and Corymbia hamersleyana* Low Open Woodland over *Acacia bivenosa, A. maitlandii* and *Sida* sp. Pilbara (A. A. Mitchell PRP 1543) Open Shrubland over *Triodia wiseana and T. epactia* Hummock Grassland with *Themeda* sp. Mt Barricade (M.E. Trudgen 2471) and *Eriachne mucronata* Very Open Tussock Grassland.		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
7	4	Low Open Woodland	*Eucalyptus leucophloia* subsp*. leucophloia* *Corymbia hamersleyana*
1.5 - 2	2	Open Shrubland	*Acacia bivenosa* *Acacia maitlandii* *Sida* sp. Pilbara (A. A. Mitchell PRP 1543)
0.3	30	Hummock Grassland	*Triodia wiseana* *Triodia epactia*
03	5	Very Open Tussock Grassland	*Themeda* sp. Mt Barricade (M.E. Trudgen 2471) *Eriachne mucronata*

Vegetation Association 5:	**Open Mallee and Open Shrubland on Upland Colluvial Valley**		
Landform Overview:	Hills	**Area (ha):**	54.83
Landform Type:	Upland colluvial flat valley		
Vegetation Status:	Native vegetation		
Surface/Rock Type:	Ironstone colluvial scree		
Soil Types:	Red sandy silts		
RTIO Landform Type:	Hills		
RTIO Map Symbol Type:	Hilltops		
Conservation Taxa:	None recorded		
Introduced Species:	None recorded		
Condition:	Excellent		
Typical Vegetation Description:	*Corymbia hamersleyana* Scattered Low Trees over *Eucalyptus gamophylla* Very Open Mallee *Acacia trudgenii, A. steedmanii* subsp. *borealis and Hakea chordophylla over Senna artemisioides* subsp. *oligophylla x helmsii, Ptilotus rotundifolius, Keraudrenia velutina* subsp. *elliptica and Acacia adoxa* var. *adoxa* Low Open Shrubland over *Triodia epactia* and *T. wiseana* Open Hummock Grassland.		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
5	1	Scattered Low Trees	*Corymbia hamersleyana*
3 - 4	5	Very Open Mallee	*Eucalyptus gamophylla*
2 - 3	5	High Open Shrubland	*Acacia trudgenii* *Acacia steedmanii* subsp. *borealis* *Hakea chordophylla*
0.5 - 1	5	Low Open Shrubland	*Senna artemisioides* subsp. *oligophylla x helmsii* *Ptilotus rotundifolius* *Keraudrenia velutina* subsp. *elliptica* *Acacia adoxa* var. *adoxa*
0.4	20	Open Hummock Grassland	*Triodia epactia* *Triodia wiseana*

Vegetation Association 6:	**Low Open Woodland and Shrubland on Hills**		
Landform Overview:	Hills	**Area (ha):**	24.15
Landform Type:	Stony hills		
Vegetation Status:	Native vegetation		
Surface/Rock Type:	Colluvial scree with some outcropping		
Soil Types:	Red sandy silts		
RTIO Landform Type:	Hills		
RTIO Map Symbol Type:	Hillslopes		
Conservation Taxa:	*Triodia* sp. Mt Ella (M.E. Trudgen 12739)(P3) *Eremophila magnifica* subsp*. magnifica* (P4)		
Introduced Species:	None recorded		
Condition:	Excellent		
Typical Vegetation Description:	*Eucalyptus leucophloia* subsp*. leucophloia and Corymbia hamersleyana* Low Open Woodland over *Acacia bivenosa, A. maitlandii* and *Senna glutinosa* subsp*. glutinosa* Shrubland over *Mirbelia viminalis and Acacia adoxa var. adoxa* Low Shrubland over *Triodia wiseana and T. wiseana* Hummock Grassland.		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
7	7	Low Open Woodland	*Eucalyptus leucophloia* subsp*. leucophloia* *Corymbia hamersleyana*
1 - 2	7	Shrubland	*Acacia bivenosa* *Acacia maitlandii* *Senna glutinosa* subsp*. glutinosa*
0.5 - 1	5	Low Shrubland	*Mirbelia viminalis* *Acacia adoxa var. adoxa*
0.3	30	Hummock Grassland	*Triodia wiseana* *Triodia wiseana*

Vegetation Association 7	**Low Open Woodland and Tussock Grassland on Upland Alluvial Valley**		
Landform Overview:	Hills	**Area (ha):**	7.92
Landform Type:	Upland alluvial flat valley		
Vegetation Status:	Native vegetation		
Surface/Rock Type:	Alluvium		
Soil Types:	Red y silts		
RTIO Landform Type:	Hills		
RTIO Map Symbol Type:	Hilltops		
Conservation Taxa:	None recorded		
Introduced Species:	None recorded		
Condition:	Excellent		
Typical Vegetation Description:	*Eucalyptus xerothermica and Corymbia hamersleyana* Low Open Woodland over *Eucalyptus gamophylla* Very Open Mallee over *Themeda triandra* Tussock Grassland		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
8	4	Low Open Woodland	*Eucalyptus xerothermica* *Corymbia hamersleyana*
3	4	Very Open Mallee	*Eucalyptus gamophylla*
0.5	60	Tussock Grassland	*Themeda triandra*

Vegetation Association 8:	**Hummock Grassland on Low Colluvial Hills**		
Landform Overview:	Hills	**Area (ha):**	4.45
Landform Type:	Low rolling colluvial scree hills		
Vegetation Status:	Native vegetation		
Surface/Rock Type:	Ironstone colluvial scree		
Soil Types:	Red sandy silts		
RTIO Landform Type:	Hills		
RTIO Map Symbol Type:	Hillslopes		
Conservation Taxa:	None recorded		
Introduced Species:	None recorded		
Condition:	Excellent		
Typical Vegetation Description:	*Corymbia hamersleyana* and *Corymbia deserticola* subsp. *deserticola* Scattered Low Trees over *Ptilotus calostachyus, Exocarpos sparteus, Gompholobium* sp. Pilbara (N.F. Norris 908) Low Open Shrubland over *Triodia wiseana* Open Hummock Grassland with *Amphipogon sericeus, Schizachyrium fragile* and *Eulalia aurea* Very Open Tussock Grassland.		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
6	2	Scattered Low Trees	*Corymbia hamersleyana* *Corymbia deserticola* subsp. *deserticola*
0.5 - 1	2	Low Open Shrubland	*Ptilotus calostachyus* *Exocarpos sparteus* *Gompholobium* sp. Pilbara (N.F. Norris 908)
0.3	20	Open Hummock Grassland	*Triodia wiseana*
0.3	5	Very Open Tussock Grassland	*Amphipogon sericeus* *Schizachyrium fragile* *Eulalia aurea*

Vegetation Association 9:	**Mulga Grove on Hillsides**		
Landform Overview:	Hills	**Area (ha):**	2.15
Landform Type:	Stony hills		
Vegetation Status:	Native vegetation		
Surface/Rock Type:	Rock outcropping with Ironstones, BIF, ferrocrete and colluvial pebblestones		
Soil Types:	Brown sandy silts		
RTIO Landform Type:	Hills		
RTIO Map Symbol Type:	Gorges and Gullies		
Conservation Taxa:	*Triodia* sp. Mt Ella (M.E. Trudgen 12739)(P3) *Brunonia* sp. long hairs (D.E. Symon 2440) (P1)		
Introduced Species:	*Bidens bipinnata* in low levels		
Condition:	Excellent		
Typical Vegetation Description:	*Acacia aptaneura and Acacia pteraneura* ? over *Senna glutinosa* subsp*. x luerssenii, Eremophila forrestii* subsp*. forrestii and Rhagodia eremaea* Low Shrubland over *Eriachne mucronata* and *Themeda* sp. Mt Barricade (M.E. Trudgen 2471) Tussock Grassland with *Triodia epactia and T.* sp. Mt Ella (M.E. Trudgen 12739) Very Open Hummock Grassland.		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
5	50	Low Open Forest	*Acacia aptaneura* *Acacia pteraneura* ?
0.5	5	Low Shrubland	*Senna glutinosa* subsp*. x luerssenii* *Eremophila forrestii* subsp*. forrestii* *Rhagodia eremaea*
0.4	40	Tussock Grassland	*Eriachne mucronata* *Themeda* sp. Mt Barricade (M.E. Trudgen 2471)
0.4	3	Very Open Hummock Grassland	*Triodia epactia* *Triodia* sp. Mt Ella (M.E. Trudgen 12739)

Vegetation Association 10:	**Low Open Woodland on Breakaway Slopes and Steep Valleys – Weed Infested**		
Landform Overview:	Hills	**Area (ha):**	0.79
Landform Type:	Breakaway slopes and steep sided valleys		
Vegetation Status:	Native vegetation		
Surface/Rock Type:	Rock outcropping with Ironstones, BIF, cherts, colluvial pebblestones		
Soil Types:	Red sandy silts		
RTIO Landform Type:	Hills		
RTIO Map Symbol Type:	Gorges and Gullies		
Conservation Taxa:	*Triodia* sp. Mt Ella (M.E. Trudgen 12739)(P3) *Spartothamnella puberula* (P2)		
Introduced Species:	*Setaria verticillata* (15% cover) *Bidens bipinnata* (5% cover)		
Condition:	Very Poor		
Typical Vegetation Description:	*Corymbia ferriticola, Brachychiton gregorii, Acacia pruinocarpa and Ficus brachypoda* Low Woodland over *Peripleura obovata, *Bidens bipinnata, Achyranthes aspera and Astrotricha hamptonii Open Heath over Triodia* sp. Mt Ella (M.E. Trudgen 12739) Hummock Grassland with *Themeda triandra, Setaria verticillata and Cymbopogon ambiguus* Open Tussock Grassland.		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
3 - 6	15	Low Woodland	*Corymbia ferriticola* *Brachychiton gregorii* *Acacia pruinocarpa* *Ficus brachypoda*
0.5 – 1.5	50	Open Heath	*Peripleura obovata* *Bidens bipinnata* *Achyranthes aspera* *Astrotricha hamptonii*
0.5	50	Hummock Grassland	*Triodia* sp. Mt Ella (M.E. Trudgen 12739)
0.5	10	Open Tussock Grassland	*Themeda triandra* *Setaria verticillata* *Cymbopogon ambiguus*

Vegetation Association 11:	**Low Open Woodland on Steep Valleys**		
Landform Overview:	Hills	**Area (ha):**	0.22
Landform Type:	Breakaway slopes and steep sided valleys		
Vegetation Status:	Native vegetation		
Surface/Rock Type:	Rock outcropping with Ironstones, BIF, cherts, colluvial pebblestones		
Soil Types:	Red sandy silts		
RTIO Landform Type:	Hills		
RTIO Map Symbol Type:	Gorges and Gullies		
Conservation Taxa:	*Triodia* sp. Mt Ella (M.E. Trudgen 12739) (P3)		
Introduced Species:	None Recorded		
Condition:	Excellent		
Typical Vegetation Description:	*Callitris columellaris, Brachychiton* gregorii. and *Corymbia ferriticola* Low Woodland over *Acacia hamersleyensis, Psydrax latifolia, Santalum lanceolatum and Dodonaea pachyneura* Scattered Shrubs over *Themeda* sp. Mt Barricade (M. E. Trudgen 2471) and *Eriachne mucronata* Open Tussock to Tussock Grassland with *Triodia* sp. Mt Ella (M. E. Trudgen 12739) and *Triodia wiseana* Open Hummock Grassland.		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
6	15	Low Woodland	*Callitris columellaris* *Brachychiton* Schott & Endl. *Corymbia ferriticola*
3	<2	Scattered Shrubs	*Acacia hamersleyensis* *Psydrax latifolia* *Santalum lanceolatum* *Dodonaea pachyneura*
0.4	5 - 30	Open Tussock to Tussock Grassland	*Themeda* sp. Mt Barricade (M. E. Trudgen 2471) *Eriachne mucronata*
0.4	5	Open Hummock	*Triodia* sp. Mt Ella (M. E. Trudgen 12739) *Triodia wiseana*

Plains

Vegetation Association 12:	**Low Open Woodland Mallee and Shrubland on Stony Plains**		
Landform Overview:	Plains	**Area (ha):**	842.98
Landform Type:	Colluvial Plains		
Vegetation Status:	Native Vegetation		
Surface/Rock Type:	Ironstone Colluvial Scree		
Soil Types:	Sandy brown fines		
RTIO Landform Type:	Plains		
RTIO Map Symbol Type:	Spinifex with Eucalypts		
Conservation Taxa:	*Brunonia* sp. long hairs (D. E. Symon 2440) (P1) *Rhagodia* sp. Hamersley (M.E. Trudgen 17794) (P3)		
Introduced Species:	*Malvastrum americanum*		
Condition:	Excellent		
Typical Vegetation Description:	*Corymbia deserticola* subsp. *deserticola* Low open Woodland over *Eucalyptus gamophylla* Very Open to Open Mallee over *Acacia cowleana, Acacia atkinsiana* and *Acacia pruinocarpa* Open Shrubland to Shrubland *over Triodia epactia, Triodia wiseana and Triodia melvillei* Very Open Hummock Grassland to Hummock Grassland		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
7	3%	Low Open woodland	*Corymbia deserticola* subsp. *deserticola*
2 - 3	2 - 10	Very Open Mallee to Open Mallee	*Eucalyptus gamophylla*
1.5 - 2	2 – 20	Open Shrubland to Shrubland	*Acacia cowleana* *Acacia atkinsiana* *Acacia pruinocarpa*
0.5	5 - 40	Very Open Hummock Grassland to Hummock Grassland	*Triodia epactia* *Triodia wiseana* *Triodia melvillei*

Vegetation Association 13:	**Low Mulga Woodland on Alluvial Plains**		
Landform Overview:	Plains	**Area (ha):**	418.86
Landform Type:	Alluvial Plains		
Vegetation Status:	Native Vegetation		
Surface/Rock Type:	Brown sandy silts		
Soil Types:	Red/ brown sandy silt		
RTIO Landform Type:	Plains		
RTIO Map Symbol Type:	*Acacia aneura* Woodlands or Shrublands		
Conservation Taxa:	*Rhagodia* sp. Hamersley (M. E. Trudgen 17794)		
Introduced Species:	*Malvastrum americanum* *Bidens bipinnata*		
Condition:	Good		
Typical Vegetation Description:	*Acacia aptaneura* Low Woodland over *Triodia epactia* Very Open Hummock Grassland to Hummock Grassland with *Aristida contorta, Themeda triandra and Chrysopogon fallax* Very Open Tussock Grassland		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
7	10 - 30	Low Woodland	*Acacia aptaneura*
0.5	5 - 20	Very Open Hummock Grassland to Hummock Grassland	*Triodia epactia*
0.4	2 - 10	Very Open Tussock Grassland	*Aristida contorta* *Themeda triandra* *Chrysopogon fallax*

Vegetation Association 14:	**Low Open Mulga Woodland on Stony Alluvial Plains**		
Landform Overview:	Plains	**Area (ha):**	179.13
Landform Type:	Alluvial Plains		
Vegetation Status:	Native Vegetation		
Surface/Rock Type:	Alluvial sand with ironstone pebbles		
Soil Types:	Brown sandy/ silts		
RTIO Landform Type:	Plains		
RTIO Map Symbol Type:	*Acacia aneura* Woodlands or Shrublands		
Conservation Taxa:	None Recorded		
Introduced Species:	*Vachellia farnesiana*		
Condition:	Excellent		
Typical Vegetation Description:	*Acacia aptaneura* Low Open Woodland over *Acacia pruinocarpa* High Open Shrubland over *Triodia epactia and Triodia melvillei* Open to Very Open Hummock Grassland with *Themeda triandra, Aristida holathera* var. *holathera and Paraneurachne muelleri* Very Open Tussock Grassland		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
6	2 – 10	Low Open Woodland	*Acacia aptaneura*
3	2 - 10	High Open Shrubland	*Acacia pruinocarpa*
0.5	2 - 20	Open to Very Open Hummock Grassland	*Triodia epactia* *Triodia melvillei*
0.4	2	Very Open Tussock Grassland	*Themeda triandra* *Aristida holathera* var. *holathera* *Paraneurachne muelleri*

Vegetation Association 15:	**Low Open Woodland and Triodia on Colluvial Plains**		
Landform Overview:	Plains	**Area (ha):**	114.9
Landform Type:	Colluvial Plains		
Vegetation Status:	Native Vegetation		
Surface/Rock Type:	Ironstone Colluvial Scree		
Soil Types:	Sandy brown fines		
RTIO Landform Type:	Plains		
RTIO Map Symbol Type:	Spinifex with Eucalypts		
Conservation Taxa:	None Recorded		
Introduced Species:	None Recorded		
Condition:	Excellent		
Typical Vegetation Description:	*Corymbia deserticola* subsp*. deserticola, Corymbia hamersleyana and Eucalyptus leucophloia* subsp. *leucophloia* Low Open Woodland over *Eucalyptus gamophylla* Very Open Mallee with *Acacia cowleana* High Open Shrubland over *Triodia wiseana and Triodia epactia* Very Open Hummock Grassland to Hummock Grassland		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
6-8	5	Low Open Woodland	*Corymbia deserticola* subsp*. deserticola* *Corymbia hamersleyana* *Eucalyptus leucophloia* subsp. *leucophloia*
2 - 5	3 - 10	Very Open Mallee	*Eucalyptus gamophylla*
3	3 - 10	High Open Shrubland	*Acacia cowleana*
0.4	5 – 40	Very Open Hummock Grassland to Hummock Grassland	*Triodia wiseana* *Triodia epactia*

Vegetation Association 16:	**Low Open Mulga Woodland on Scalded Plains**		
Landform Overview:	Plains	**Area (ha):**	110.55
Landform Type:	Scalded Plains		
Vegetation Status:	Native Vegetation		
Surface/Rock Type:	Claypan		
Soil Types:	Clay		
RTIO Landform Type:	Plains		
RTIO Map Symbol Type:	*Acacia aneura* Woodlands or Shrublands		
Conservation Taxa:	None Recorded		
Introduced Species:	*Vachellia farnesiana* *Bidens bipinnata*		
Condition:	Very Poor		
Typical Vegetation Description:	*Acacia aptaneura* Low Open Woodland on *Triodia epactia* Scattered Hummock Grass		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
5	2	Low Open Woodland	*Acacia aptaneura*
0.5	1 - 2	Scattered Hummock Grass	*Triodia epactia*

Vegetation Association 17:	**High Shrubland on Colluvial Plains**		
Landform Overview:	Plains	**Area (ha):**	36.57
Landform Type:	Colluvial Scree Plains		
Vegetation Status:	Native Vegetation		
Surface/Rock Type:	Colluvial Scree		
Soil Types:	Brown Sandy fines		
RTIO Landform Type:	Plains		
RTIO Map Symbol Type:	Spinifex with Acacias		
Conservation Taxa:	None Recorded		
Introduced Species:	None Recorded		
Condition:	Excellent		
Typical Vegetation Description:	*Corymbia deserticola subsp. deserticola* Low Open Woodland with *Eucalyptus gamophylla* Very Open Mallee over *Acacia atkinsiana, Acacia pruinocarpa and Acacia ancistrocarpa* High Shrubland over *Triodia epactia, Triodia wiseana and Triodia melvillei* Open Hummock Grassland		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
4	2	Low Open Woodland	*Corymbia deserticola subsp. deserticola*
4	2 – 5	Very Open Mallee	*Eucalyptus gamophylla*
3	10 - 30	High Shrubland	*Acacia atkinsiana* *Acacia pruinocarpa* *Acacia ancistrocarpa*
0.5	15	Open Hummock Grassland	*Triodia epactia* *Triodia wiseana* *Triodia melvillei*

Vegetation Association 18:	**Scattered Low Trees and Mallee on Alluvial Plains**		
Landform Overview:	Plains	**Area (ha):**	22.52
Landform Type:	Alluvial Plains		
Vegetation Status:	Native Vegetation		
Surface/Rock Type:	Alluvial sand with ironstone pebbles		
Soil Types:	Brown sandy silts		
RTIO Landform Type:	Plains		
RTIO Map Symbol Type:	Mixed Woodlands or Shrublands		
Conservation Taxa:	None Recorded		
Introduced Species:	None Recorded		
Condition:	Excellent		
Typical Vegetation Description:	*Acacia aptaneura and Corymbia hamersleyana* Scattered Low Trees over *Eucalyptus gamophylla* Very Open Mallee over *Triodia epactia* Open Hummock Grassland with *Keraudrenia velutina subsp. elliptica* Low Open Shrubland with *Themeda triandra* Very Open Tussock Grassland		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
4	2	Scattered Low Trees	*Acacia aptaneura* *Corymbia hamersleyana*
3	5	Very Open Mallee	*Eucalyptus gamophylla*
1	3	Very Open Tussock Grassland	*Themeda triandra*
0.7	30	Open Hummock Grassland	*Triodia epactia*
0.4	2	Low Open Shrubland	*Keraudrenia velutina subsp. elliptica*

Vegetation Association 19:	**Barren Cracking Loams**		
Landform Overview:	Plains	**Area (ha):**	16.32
Landform Type:	Barren Loam Plains		
Vegetation Status:	Native Vegetation		
Surface/Rock Type:	Cracking Loam with small ironstone pebbles		
Soil Types:	Loam		
RTIO Landform Type:	Special Cases		
RTIO Map Symbol Type:	Cracking Clays		
Conservation Taxa:	None Recorded		
Introduced Species:	*Vachellia farnesiana*		
Condition:	Very Poor		
Typical Vegetation Description:	*Senna hamersleyensis and Salsola australis* Low Scattered Shrubs over *Panicum decompositum* Scattered Tussock Grass		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
0.2	1	Low Scattered Shrubs	*Senna hamersleyensis* *Salsola australis*
0.2	1	Scattered Tussock Grass	*Panicum decompositum*

Vegetation Association 20	**Low Mulga Woodland on Stony Plains**		
Landform Overview:	Plains	**Area (ha):**	15.28
Landform Type:	Colluvial Plains		
Vegetation Status:	Native Vegetation		
Surface/Rock Type:	Colluvial Scree on Plains		
Soil Types:	Red/ Brown Stones		
RTIO Landform Type:	Plains		
RTIO Map Symbol Type:	*Acacia aneura* Woodlands or Shrublands		
Conservation Taxa:	No Recorded		
Introduced Species:	*Vachellia farnesiana*		
Condition:	Good		
Typical Vegetation Description:	*Acacia aptaneura* and *Acacia pteraneura?* Low Woodland with *Acacia pruinocarpa* High Open Shrubland over *Triodia brizoides* and *Triodia epactia* Open Hummock Grassland to Very Open Grassland		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
4	15	Low Woodland	*Acacia aptaneura* *Acacia pteraneura?*
5	5	High Open Shrubland	*Acacia pruinocarpa*
0.4	2 - 20	Open Hummock Grassland to Very Open Grassland	*Triodia brizoides* *Triodia epactia*

Vegetation Association 21:	**Rehabilitation Shrubland on Colluvial Plains**		
Landform Overview:	Plains	**Area (ha):**	6.46
Landform Type:	Colluvial Scree Plains		
Vegetation Status:	Rehabilitation		
Surface/Rock Type:	Ironstone colluvial scree		
Soil Types:	Red/ brown Sandy fines		
RTIO Landform Type:	Plains		
RTIO Map Symbol Type:	Spinifex with Acacias		
Conservation Taxa:	None Recorded		
Introduced Species:	*Malvastrum americanum*		
Condition:	Good		
Typical Vegetation Description:	*Acacia cowleana* High Shrubland over *Triodia epactia* and *Triodia longiceps* Hummock Grassland over *Themeda triandra* Very Open Tussock Grassland		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
3	20	High Shrubland	*Acacia cowleana*
0.6	40	Hummock Grassland	*Triodia epactia* *Triodia longiceps*
0.7	5	Very Open Tussock Grassland	*Themeda triandra*

Vegetation Association 22:	**Rehabilitation Shrubland on Alluvial Plains**		
Landform Overview:	Plains	**Area (ha):**	2.52
Landform Type:	Alluvial Plains		
Vegetation Status:	Rehabilitation Vegetation		
Surface/Rock Type:	Alluvial soil with ironstone pebbles		
Soil Types:	Brown Sand		
RTIO Landform Type:	Plains		
RTIO Map Symbol Type:	*Acacia aneura* Woodlands or Shrublands		
Conservation Taxa:	None Recorded		
Introduced Species:	*Malvastrum americanum*		
Condition:	Poor		
Typical Vegetation Description:	*Acacia aptaneura* Shrubland to Low Woodland over Themeda triandra and Aristida inaequiglumis Very Open Tussock Grassland with *Triodia epactia* Scattered Hummock Grass		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
1.5 - 6	5	Shrubland to Low Woodland	*Acacia aptaneura*
0.6	5	Very Open Tussock Grassland	*Themeda triandra* *Aristida inaequiglumis*
0.6	1	Scattered Hummock Grass	*Triodia epactia*

Vegetation Association 23:	**Woodland Shrubland on Calcrete**		
Landform Overview:	Plains	**Area (ha):**	1.29
Landform Type:	Colluvial Plains		
Vegetation Status:	Native Vegetation		
Surface/Rock Type:	Ironstone Colluvial Scree with calcrete floaters		
Soil Types:	Sandy brown fines		
RTIO Landform Type:	Plains		
RTIO Map Symbol Type:	Spinifex with Eucalypts		
Conservation Taxa:	None Recorded		
Introduced Species:	None Recorded		
Condition:	Excellent		
Typical Vegetation Description:	*Eucalyptus leucophloia subsp. leucophloia* Scattered Trees over *Acacia aptaneura* Low Open Woodland over *Acacia bivenosa* and *Acacia inaequilatera* High Shrubland over *Triodia wiseana* Hummock Grassland with *Aristida latifolia* and *Eragrostis xerophila*		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
12	1	Scattered Trees	*Eucalyptus leucophloia subsp. leucophloia*
6	3	Low Open Woodland	*Acacia aptaneura*
3	10	High Shrubland	*Acacia bivenosa* *Acacia inaequilatera*
0.5	60	Hummock Grassland	*Triodia wiseana*
0.3	5	Very Open Tussock Grassland	*Aristida latifolia* *Eragrostis xerophila*

Drainage

Vegetation Association 24:	**Mulga Grove on Broad Drainage**		
Landform Overview:	Drainage	**Area (ha):**	59.43
Landform Type:	Broad Drainage Line		
Vegetation Status:	Native Vegetation		
Surface/Rock Type:	No rock present		
Soil Types:	Red alluvial fines		
RTIO Landform Type:	Flowlines		
RTIO Map Symbol Type:	Acacia-Type Creeklines		
Conservation Taxa:	None recorded		
Introduced Species:	*Malvastrum americanum* (<1% cover) *Bidens bipinnata* (2% cover) *Vachellia farnesiana* (<1% cover)		
Condition:	Poor – presence of weed species		
Typical Vegetation Description:	*Acacia aptaneura* and *Eucalyptus xerothermica* Low Closed Forest over *Malvastrum americanum, Bidens bipinnata, Pterocaulon sphaeranthoides* and *Eremophila longifolia* Open Shrubland over *Themeda triandra, Sporobolus australasicus* and *Chrysopogon fallax* Scattered Tussock Grasses with *Triodia epactia* Scattered Hummock Grasses.		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
8 - 10	60	Low Closed Forest	*Acacia aptaneura* *Eucalyptus xerothermica*
0.5 – 1.5	5	Open Shrubland	*Malvastrum americanum* *Bidens bipinnata* *Pterocaulon sphaeranthoides* *Eremophila longifolia*
0.5	1	Scattered Tussock Grasses	*Themeda triandra* *Sporobolus australasicus* *Chrysopogon fallax*
0.4	1	Scattered Hummock Grasses	*Triodia epactia*

Vegetation Association 25:	**Mulga Grove on Broad Drainage – Weed Infestation**		
Landform Overview:	Drainage	**Area (ha):**	43.1
Landform Type:	Broad Drainage Line		
Vegetation Status:	Native Vegetation with weed presence		
Surface/Rock Type:	No rock present		
Soil Types:	Red alluvial fines		
RTIO Landform Type:	Flowlines		
RTIO Map Symbol Type:	Acacia-Type Creeklines		
Conservation Taxa:	None recorded		
Introduced Species:	*Bidens bipinnata* (40 to 70% cover) *Malvastrum americanum* (>1% cover) *Chloris virgata farnesiana* (<1% cover)		
Condition:	Very Poor – massive infestation of *Bidens bipinnata*		
Typical Vegetation Description:	*Acacia aptaneura* and *Eucalyptus xerothermica* Low Closed Forest over *Malvastrum americanum, Bidens bipinnata, Pterocaulon sphaeranthoides* and *Eremophila longifolia* Open Heath over *Themeda triandra, Sporobolus australasicus* and *Chrysopogon fallax* Scattered Tussock Grasses with *Triodia epactia* Scattered Hummock Grasses.		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
8 - 10	60	Low Closed Forest	*Acacia aptaneura* *Eucalyptus xerothermica*
0.5 – 1.5	60	Open Heath	*Malvastrum americanum* *Bidens bipinnata* *Pterocaulon sphaeranthoides* *Eremophila longifolia*
0.5	1	Scattered Tussock Grasses	*Themeda triandra* *Sporobolus australasicus* *Chrysopogon fallax*
0.4	1	Scattered Hummock Grasses	*Triodia epactia*

Vegetation Association 26:	**Low Open Woodland on Minor Drainage Line**		
Landform Overview:	Drainage	**Area (ha):**	20.26
Landform Type:	Minor creekline on lower slopes and plains		
Vegetation Status:	Native vegetation		
Surface/Rock Type:	Creekline pebblestones		
Soil Types:	Alluvial debris and sand		
RTIO Landform Type:	Flowlines		
RTIO Map Symbol Type:	Minor Flowlines		
Conservation Taxa:	*Triodia* sp. Mt Ella (M.E. Trudgen 12739) in Survey Area 4.		
Introduced Species:	None recorded.		
Condition:	Excellent		
Typical Vegetation Description:	*Corymbia hamersleyana* Low Open Woodland over *Eucalyptus gamophylla, Gossypium robinsonii, Acacia cowleana, A. steedmanii* subsp*. borealis, A. bivenosa* and *Jasminum didymum* subsp*. lineare* Open Scrub over *Themeda triandra, Cymbopogon procerus and Eulalia aurea* Tussock Grassland with *Triodia epactia* and *Triodia wiseana* Open Tussock Grassland.		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
8	5	Low Open Woodland	*Corymbia hamersleyana*
4 - 4	40	Open Scrub	*Eucalyptus gamophylla* *Gossypium robinsonii* *Acacia cowleana* *Acacia steedmanii* subsp*. borealis* *Acacia bivenosa* *Jasminum didymum* subsp*. lineare*
0.5	30	Tussock Grassland	*Themeda triandra* *Cymbopogon procerus* *Eulalia aurea*
0.4	10	Open Tussock Grassland	*Triodia epactia* *Triodia wiseana*

Vegetation Association 27:	**Low Open Woodland on Moderate Drainage Line**		
Landform Overview:	Drainage	**Area (ha):**	10.48
Landform Type:	Moderate creekline on lower slopes and plains		
Vegetation Status:	Native vegetation		
Surface/Rock Type:	Creekline pebblestones		
Soil Types:	Alluvial debris and sand		
RTIO Landform Type:	Flowlines		
RTIO Map Symbol Type:	Minor Flowlines		
Conservation Taxa:	None recorded		
Introduced Species:	None recorded		
Condition:	Excellent		
Typical Vegetation Description:	*Corymbia hamersleyana* Low Open Woodland over *Rulingia luteiflora, Acacia pyrifolia* var. *morrisonii, A. monticola* and *Gossypium robinsonii Tephrosia rosea* var. *glabrior* ms *Corchorus lasiocarpus* subsp. *lasiocarpus* ? Low Open Shrubland over *Cymbopogon procerus Themeda* sp. Mt Barricade (M.E. Trudgen 2471) and *Eulalia aurea* Open Tussock Grassland with *Triodia epactia* Very Open Hummock Grassland.		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
6	3	Low Open Woodland	*Corymbia hamersleyana*
2 - 4	15	High Shrubland	*Rulingia luteiflora* *Acacia pyrifolia* var. *morrisonii* *Acacia monticola* *Gossypium robinsonii*
0.5 - 1	4	Low Open Shrubland	*Tephrosia rosea* var. *glabrior* ms *Corchorus lasiocarpus* subsp. *lasiocarpus* ?
0.5 – 0.8	25	Open Tussock Grassland	*Cymbopogon procerus* *Themeda* sp. Mt Barricade (M.E. Trudgen 2471) *Eulalia aurea*
0.4	5	Very Open Hummock Grassland	*Triodia epactia*

Vegetation Association 28:	**Low Open Woodland on Upland Drainage Line**		
Landform Overview:	Drainage	**Area (ha):**	4.65
Landform Type:	Drainage line on breakaway slopes and steep sided valleys		
Vegetation Status:	Native vegetation		
Surface/Rock Type:	Rock outcropping with Ironstones, BIF, cherts, colluvial pebblestones		
Soil Types:	Red sandy silts		
RTIO Landform Type:	Hills		
RTIO Map Symbol Type:	Gorges and Gullies		
Conservation Taxa:	*Triodia* sp. Mt Ella (M.E. Trudgen 12739)(P3) very common in hillside drainage. *Eremophila magnifica* subsp. *magnifica* (P4) recorded in occasional patches.		
Introduced Species:	None recorded		
Condition:	Excellent		
Typical Vegetation Description:	*Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* Low Open Woodland over *Gossypium robinsonii, Acacia hamersleyensis* and *Dodonaea pachyneura* High Shrubland over *Themeda* sp. Mt Barricade (M.E. Trudgen 2471), *Cymbopogon ambiguus* and *Eriachne mucronata* Tussock Grassland with *Triodia* sp. Mt Ella (M.E. Trudgen 12739) and *Triodia wiseana* Open Hummock Grassland.		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
8	5	Low Open Woodland	*Eucalyptus leucophloia* subsp. *leucophloia* *Corymbia hamersleyana*
1.5 - 2	15	High Shrubland	*Gossypium robinsonii* *Acacia hamersleyensis* *Dodonaea pachyneura*
0.5	40	Tussock Grassland	*Themeda* sp. Mt Barricade (M.E. Trudgen 2471) *Cymbopogon ambiguus* *Eriachne mucronata*
0.4	25	Open Hummock Grassland	*Triodia* sp. Mt Ella (M.E. Trudgen 12739) *Triodia wiseana*

Vegetation Association 29:	**High Shrubland on Minor Drainage Line**		
Landform Overview:	Drainage	**Area (ha):**	4.51
Landform Type:	Minor creekline on lower slopes and plains		
Vegetation Status:	Native vegetation		
Surface/Rock Type:	Creekline pebblestones		
Soil Types:	Alluvial debris and sand		
RTIO Landform Type:	Flowlines		
RTIO Map Symbol Type:	Minor Flowlines		
Conservation Taxa:	*Triodia* sp. Mt Ella (M.E. Trudgen 12739) in Survey Area 4.		
Introduced Species:	None recorded.		
Condition:	Excellent		
Typical Vegetation Description:	*Corymbia hamersleyana* and *Eucalyptus leucophloia* subsp. *leucophloia* Scattered Low Trees over *Gossypium robinsonii, Acacia bivenosa, A. atkinsiana, A. cowleana* and *Grevillea wickhamii* subsp. *aprica* ? High Shrubland over *Triodia epactia and T. wiseana* with *Themeda triandra, T.* sp. Mt Barricade (M.E. Trudgen 2471) and *Eriachne mucronata* Very Open Tussock Grassland.		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
6	1	Scattered Low Trees	*Corymbia hamersleyana* *Eucalyptus leucophloia* subsp. *leucophloia*
2 - 4	30	High Shrubland	*Gossypium robinsonii* *Acacia bivenosa* *Acacia atkinsiana* *Acacia cowleana* *Grevillea wickhamii* subsp. *aprica* ?
0.4	15	Open Hummock Grassland	*Triodia epactia* *Triodia wiseana*
0.4	5	Very Open Tussock Grassland	*Themeda triandra* *Themeda* sp. Mt Barricade (M.E. Trudgen 2471) *Eriachne mucronata*

Vegetation Association 30:	**Mimosa Shrubland on Minor Drainage Line**		
Landform Overview:	Drainage	**Area (ha):**	4.37
Landform Type:	Loam area with cracking clay development		
Vegetation Status:	Structurally modified native vegetation.		
Surface/Rock Type:	No rock present		
Soil Types:	Red loam		
RTIO Landform Type:	Special Case		
RTIO Map Symbol Type:	Cracking Clay		
Conservation Taxa:	None recorded		
Introduced Species:	*Vachellia farnesiana* (40 to 60% cover) *Malvastrum americanum* (<1% cover)		
Condition:	Very Poor due to overgrazing, poor species diversity and weed structural dominance (*Vachellia farnesiana*)		
Typical Vegetation Description:	*Vachellia farnesiana* Open Scrub over *Malvastrum americanum, Senna artemisioides* subsp*. oligophylla x helmsii and Solanum lasiophyllum* Low Scattered Shrubs over *Ptilotus gomphrenoides* and *Operculina aequisepala* Scattered Herbs (Creepers).		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
3 - 4	50	Open Scrub	*Vachellia farnesiana*
0.5 - 1	<1	Low Scattered Shrubs	*Malvastrum americanum* *Senna artemisioides* subsp*. oligophylla x helmsii* *Solanum lasiophyllum*
0.2	10	Scattered Herbs	*Ptilotus gomphrenoides* *Operculina aequisepala*

Vegetation Association 31:	**Low Woodland and Dense Shrubland on Minor Drainage Line**		
Landform Overview:	Drainage	**Area (ha):**	1.52
Landform Type:	Moderate creekline on lower slopes and plains		
Vegetation Status:	Native vegetation		
Surface/Rock Type:	Creekline pebblestones		
Soil Types:	Alluvial debris and sand		
RTIO Landform Type:	Flowlines		
RTIO Map Symbol Type:	Minor Flowlines		
Conservation Taxa:	None recorded		
Introduced Species:	*Cenchrus ciliaris* (<1% cover)		
Condition:	Excellent		
Typical Vegetation Description:	*Eucalyptus xerothermica and Acacia aptaneura* Low Woodland over *Petalostylis labicheoides, Acacia pruinocarpa and A. citrinoviridis* Open Scrub *over Rulingia luteiflora, Clerodendrum floribundum* var. *angustifolium, Acacia bivenosa and Gossypium robinsonii* Shrubland over *Triodia epactia and T. wiseana* Open Hummock Grassland.		

Stratum (m)	Total %Cover	Structural Name	Dominant Species
6 - 8	10	Low Woodland	*Eucalyptus xerothermica* *Acacia aptaneura*
3 - 5	30	Open Scrub	*Petalostylis labicheoides* *Acacia pruinocarpa* *Acacia citrinoviridis*
2	20	Shrubland	*Rulingia luteiflora* *Clerodendrum floribundum* var. *angustifolium* *Acacia bivenosa* *Gossypium robinsonii*
0.5	20	Open Hummock Grassland	*Triodia epactia* *Triodia wiseana*

Appendix G

List of botanical taxa recorded by Survey Area

Seq. No.[3]	Family	Taxa	Status	Area 1	Area 2	Area 3	Area 4
16	Marsileaceae	*Marsilea hirsuta*			√		
29	Pteridaceae	*Cheilanthes sieberi* subsp. *sieberi*			√	√	√
52	Cupressaceae	*Callitris columellaris*					√
80	Lauraceae	*Cassytha capillaris*					√
130	Hemerocallidaceae	*Tricoryne* sp. Hamersley Range (S. Van Leeuwen 915)					√
156	Cyperaceae	*Fimbristylis simulans*		√			√
156	Cyperaceae	*Fimbristylis* sp.			√		√
163	Poaceae	*Amphipogon sericeus*		√	√	√	√
163	Poaceae	*Aristida burbidgeae*					√
163	Poaceae	*Aristida contorta*		√	√	√	√

[3] *Seq. No. number refers to the new Western Australia State Herbarium family sequence numbers (FloraBase 2012).*

Seq. No.[3]	Family	Taxa	Status	Area 1	Area 2	Area 3	Area 4
163	Poaceae	*Aristida holathera* var. *holathera*		√	√	√	√
163	Poaceae	*Aristida inaequiglumis*		√	√	√	√
163	Poaceae	*Aristida latifolia*		√			
163	Poaceae	*Aristida obscura*			√	√	√
163	Poaceae	*Bothriochloa ewartiana*			√		√
163	Poaceae	*Brachyachne convergens*		√	√	√	
163	Poaceae	*Cenchrus ciliaris*	*	√			
163	Poaceae	*Chloris virgata*	*		√	√	√
163	Poaceae	*Chrysopogon fallax*		√	√	√	√
163	Poaceae	*Cymbopogon ambiguus*		√	√	√	√
163	Poaceae	*Cymbopogon obtectus*			√	√	√
163	Poaceae	*Cymbopogon procerus*					√
163	Poaceae	*Dichanthium sericeum* subsp. *humilius*			√	√	
163	Poaceae	*Dichanthium* sp.			√	√	√
163	Poaceae	*Digitaria brownii*			√	√	√
163	Poaceae	*Enneapogon lindleyanus*				√	√
163	Poaceae	*Enneapogon polyphyllus*		√	√	√	√
163	Poaceae	*Eragrostis eriopoda*		√	√	√	√
163	Poaceae	*Eragrostis falcata*			√		
163	Poaceae	*Eragrostis xerophila*		√			√
163	Poaceae	*Eriachne aristidea*		√			
163	Poaceae	*Eriachne benthamii*?			√	√	
163	Poaceae	*Eriachne flaccida*		√	√		
163	Poaceae	*Eriachne lanata*					√
163	Poaceae	*Eriachne mucronata*		√	√	√	√
163	Poaceae	*Eriachne pulchella* subsp. *dominii*		√	√	√	√
163	Poaceae	*Eulalia aurea*		√	√	√	√

Seq. No.[3]	Family	Taxa	Status	Area 1	Area 2	Area 3	Area 4
163	Poaceae	*Eulalia aurea*?					√
163	Poaceae	*Iseilema vaginiflorum*				√	
163	Poaceae	*Panicum decompositum*			√	√	
163	Poaceae	*Paraneurachne muelleri*		√	√	√	√
163	Poaceae	*Schizachyrium fragile*		√	√	√	√
163	Poaceae	*Setaria verticillata*	*				√
163	Poaceae	*Sporobolus australasicus*		√	√	√	√
163	Poaceae	*Themeda* sp. Mt Barricade (M.E. Trudgen 2471)					√
163	Poaceae	*Themeda triandra*		√	√	√	√
163	Poaceae	*Triodia brizoides*		√	√		√
163	Poaceae	*Triodia epactia*		√	√	√	√
163	Poaceae	*Triodia epactia*?			√		
163	Poaceae	*Triodia longiceps*				√	
163	Poaceae	*Triodia melvillei*			√		
163	Poaceae	*Triodia* sp. Mt Ella (M.E. Trudgen 12739)	P3		√		√
163	Poaceae	*Triodia wiseana*		√	√	√	√
163	Poaceae	*Urochloa occidentalis*		√	√	√	
169	Menispermaceae	*Tinospora smilacina*					√
175	Proteaceae	*Grevillea berryana*		√	√		√
175	Proteaceae	*Grevillea pyramidalis*					√
175	Proteaceae	*Grevillea pyrifolia*		√			
175	Proteaceae	*Grevillea wickhamii* subsp. *aprica* ?				√	√
175	Proteaceae	*Hakea chordophylla*		√	√	√	√
175	Proteaceae	*Hakea lorea* subsp. *lorea*			√	√	√
196	Haloragaceae	*Haloragis gossei* var. *gossei*		√		√	√
199	Zygophyllaceae	*Tribulus suberosus*		√		√	√
201	Fabaceae	*Acacia adoxa* var. *adoxa*					√

Seq. No.[3]	Family	Taxa	Status	Area 1	Area 2	Area 3	Area 4
201	Fabaceae	*Acacia adsurgens*		√	√	√	√
201	Fabaceae	*Acacia adsurgens* x *rhodophloia*?					√
201	Fabaceae	*Acacia ancistrocarpa*		√	√	√	√
201	Fabaceae	*Acacia aptaneura*		√	√	√	√
201	Fabaceae	*Acacia atkinsiana*		√	√	√	
201	Fabaceae	*Acacia ayersiana*			√	√	√
201	Fabaceae	*Acacia bivenosa*		√	√	√	√
201	Fabaceae	*Acacia citrinoviridis*		√	√		
201	Fabaceae	*Acacia cowleana*			√	√	√
201	Fabaceae	*Acacia dictyophleba*			√	√	√
201	Fabaceae	*Acacia hamersleyensis*			√		√
201	Fabaceae	*Acacia inaequilatera*		√		√	√
201	Fabaceae	*Acacia maitlandii*		√	√		√
201	Fabaceae	*Acacia minyura*			√	√	√
201	Fabaceae	*Acacia monticola*		√			√
201	Fabaceae	*Acacia pachyacra*		√	√	√	√
201	Fabaceae	*Acacia pruinocarpa*		√	√	√	√
201	Fabaceae	*Acacia pteraneura*?		√	√	√	√
201	Fabaceae	*Acacia pyrifolia* var. *morrisonii*		√			√
201	Fabaceae	*Acacia rhodophloia*		√	√		
201	Fabaceae	*Acacia rhodophloia*?				√	
201	Fabaceae	*Acacia sericophylla*					√
201	Fabaceae	*Acacia sibirica*		√	√		
201	Fabaceae	*Acacia steedmanii* subsp. *borealis*				√	√
201	Fabaceae	*Acacia synchronicia*		√			
201	Fabaceae	*Acacia synchronicia*?		√	√		
201	Fabaceae	*Acacia tenuissima*			√	√	√

Seq. No.[3]	Family	Taxa	Status	Area 1	Area 2	Area 3	Area 4
201	Fabaceae	*Acacia tetragonophylla*			√	√	
201	Fabaceae	*Acacia trachycarpa*					√
201	Fabaceae	*Acacia trudgenii*		√	√	√	√
201	Fabaceae	*Gastrolobium grandiflorum*					√
201	Fabaceae	*Gompholobium* sp. Pilbara (N.F. Norris 908)		√		√	√
201	Fabaceae	*Indigofera fractiflexa* ms					√
201	Fabaceae	*Indigofera georgei*				√	√
201	Fabaceae	*Indigofera monophylla*		√		√	√
201	Fabaceae	*Isotropis forrestii*		√	√	√	
201	Fabaceae	*Mirbelia viminalis*					√
201	Fabaceae	*Petalostylis labicheoides*		√			√
201	Fabaceae	*Rhynchosia minima*		√	√		√
201	Fabaceae	*Senna artemisioides* subsp. *helmsii*		√	√	√	√
201	Fabaceae	*Senna artemisioides* subsp. *oligophylla x helmsii*		√	√	√	√
201	Fabaceae	*Senna artemisioides* subsp. *x artemisioides*		√	√	√	√
201	Fabaceae	*Senna ferraria*			√		√
201	Fabaceae	*Senna glaucifolia*			√		
201	Fabaceae	*Senna glutinosa* subsp. *glutinosa*		√	√	√	√
201	Fabaceae	*Senna glutinosa* subsp. *pruinosa*		√	√		√
201	Fabaceae	*Senna glutinosa* subsp. *x luerssenii*		√	√		√
201	Fabaceae	*Senna hamersleyensis*			√		
201	Fabaceae	*Senna notabilis*		√	√	√	
201	Fabaceae	*Senna pleurocarpa* var.?				√	√
201	Fabaceae	*Senna pleurocarpa* var. *angustifolia?*				√	√
201	Fabaceae	*Senna venusta*					√
201	Fabaceae	*Tephrosia rosea* var. *glabrior* ms				√	√
201	Fabaceae	*Tephrosia* sp. Bungaroo Creek (M.E. Trudgen 11601)				√	

Seq. No.[3]	Family	Taxa	Status	Area 1	Area 2	Area 3	Area 4
201	Fabaceae	*Vachellia farnesiana*	*		√		
208	Rhamnacea	*Ventilago viminalis*					√
211	Moraceae	*Ficus brachypoda*					√
224	Cucurbitaceae	*Cucumis maderaspatanus*		√	√	√	√
224	Cucurbitaceae	*Cucurbitaceae* sp.				√	
229	Celastraceae	*Maytenus cunninghamii*			√	√	√
229	Celastraceae	*Stackhousia* sp. Swollen gynophore (W Barker 2041)			√	√	
242	Euphorbiaceae	*Euphorbia australis*			√	√	√
242	Euphorbiaceae	*Euphorbia boophthona*		√	√	√	
242	Euphorbiaceae	*Euphorbia drummondii*				√	√
242	Euphorbiaceae	*Euphorbia schultzii*		√	√		√
247	Phyllanthaceae	*Notoleptopus decaisnei*		√			
261	Violaceae	*Hybanthus aurantiacus*				√	√
263	Thymelaeaceae	*Pimelea forrestiana*?					√
263	Thymelaeaceae	*Pimelea holroydii*			√		
281	Myrtaceae	*Calytrix carinata*				√	√
281	Myrtaceae	*Corymbia deserticola* subsp. *deserticola*		√	√	√	√
281	Myrtaceae	*Corymbia ferriticola*					√
281	Myrtaceae	*Corymbia hamersleyana*		√	√	√	√
281	Myrtaceae	*Eucalyptus gamophylla*		√	√	√	√
281	Myrtaceae	*Eucalyptus kingsmillii* subsp. *kingsmillii*					√
281	Myrtaceae	*Eucalyptus leucophloia* subsp. *leucophloia*		√	√	√	√
281	Myrtaceae	*Eucalyptus trivalva*				√	√
281	Myrtaceae	*Eucalyptus xerothermica*		√	√	√	√
299	Sapindaceae	*Diplopeltis stuartii* var. *stuartii*				√	
299	Sapindaceae	*Dodonaea lanceolata*				√	√
299	Sapindaceae	*Dodonaea pachyneura*			√		√

Seq. No.[3]	Family	Taxa	Status	Area 1	Area 2	Area 3	Area 4
299	Sapindaceae	*Dodonaea petiolaris*			√	√	√
299	Sapindaceae	*Dodonaea viscosa* subsp. *mucronata*?					√
301	Oleaceae	*Jasminum didymum* subsp. *lineare*		√	√	√	√
309	Malvaceae	*Abutilon cunninghamii*		√	√		√
309	Malvaceae	*Abutilon dioicum* ms				√	√
309	Malvaceae	*Abutilon fraseri*					√
309	Malvaceae	*Abutilon malvifolium*					√
309	Malvaceae	*Abutilon otocarpum*				√	
309	Malvaceae	*Brachychiton gregorii*			√		√
309	Malvaceae	*Corchorus lasiocarpus* subsp. *lasiocarpus*?				√	√
309	Malvaceae	*Corchorus lasiocarpus* subsp. *parvus*					√
309	Malvaceae	*Corchorus lasiocarpus* subsp. *parvus*?		√			√
309	Malvaceae	*Corchorus sidoides* subsp. *sidoides*			√	√	
309	Malvaceae	*Gossypium australe*		√		√	√
309	Malvaceae	*Gossypium robinsonii*		√	√	√	√
309	Malvaceae	*Hibiscus burtonii*					√
309	Malvaceae	*Hibiscus coatesii*			√	√	√
309	Malvaceae	*Hibiscus robinsonii*					√
309	Malvaceae	*Hibiscus sturtii var. platychlamys*		√			√
309	Malvaceae	*Hibiscus sturtii var. truncatus*					√
309	Malvaceae	*Keraudrenia velutina* subsp. *elliptica*		√	√	√	√
309	Malvaceae	*Malvastrum americanum*	*		√	√	
309	Malvaceae	*Rulingia luteiflora*		√	√	√	√
309	Malvaceae	*Sida arenicola*			√		
309	Malvaceae	*Sida echinocarpa*		√	√	√	
309	Malvaceae	*Sida ectogama*			√	√	√
309	Malvaceae	*Sida fibulifera*		√			

Seq. No.[3]	Family	Taxa	Status	Area 1	Area 2	Area 3	Area 4
309	Malvaceae	*Sida platycalyx*				√	
309	Malvaceae	*Sida* sp. 1				√	√
309	Malvaceae	*Sida* sp. 2				√	√
309	Malvaceae	*Sida* sp. 3		√	√	√	√
309	Malvaceae	*Sida* sp. Dark green fruits (S.Van Leeuwin 2260)					√
309	Malvaceae	*Sida* sp. Excedentifolia (J.L.Egan 1925)		√	√		√
309	Malvaceae	*Sida* sp. Pilbara (A. A. Mitchell PRP 1543)		√	√	√	√
309	Malvaceae	*Sida* sp. Shovelanna Hill (svl 3842)					√
309	Malvaceae	*Sida* sp. Spiciform panicles (E. Leyland S.N. 14/8/90)			√	√	√
309	Malvaceae	*Sida* sp. Verrucose Glands (F.H. Mollemans 2423)		√	√		
309	Malvaceae	*Triumfetta maconochieana*					√
309	Malvaceae	*Wahlenbergia tumidifructa*			√		
309	Malvaceae	*Waltheria virgata*					√
328	Gyrostemonaceae	*Codonocarpus cotinifolius*		√	√	√	√
330	Capparaceae	*Capparis lasiantha*		√	√	√	√
330	Capparaceae	*Capparis mitchellii*					√
330	Capparaceae	*Capparis spinosa*			√		
330	Capparaceae	*Capparis umbonata*		√		√	√
331	Cleomaceae	*Cleome viscosa*			√	√	√
332	Brassicaceae	*Lepidium echinatum*			√	√	√
332	Brassicaceae	*Lepidium pedicellosum*				√	
338	Santalaceae	*Anthobolus leptomerioides*		√	√		√
338	Santalaceae	*Exocarpos sparteus*					√
338	Santalaceae	*Santalum lanceolatum*		√	√	√	√
339	Loranthaceae	*Amyema fitzgeraldii*			√		
339	Loranthaceae	*Amyema miquelii*					√
339	Loranthaceae	*Amyema sanguinea* var. *pulchra*				√	√

Seq. No.[3]	Family	Taxa	Status	Area 1	Area 2	Area 3	Area 4
355	Caryophyllaceae	*Polycarpaea holtzei*		√			
355	Caryophyllaceae	*Polycarpaea longiflora*			√	√	√
357	Amaranthaceae	*Achyranthes aspera*					√
357	Amaranthaceae	*Alternanthera nana*				√	
357	Amaranthaceae	*Gomphrena canescens*		√			
357	Amaranthaceae	*Ptilotus astrolasius* var. *astrolasius*		√		√	√
357	Amaranthaceae	*Ptilotus calostachyus*		√	√	√	√
357	Amaranthaceae	*Ptilotus carinatus*		√		√	
357	Amaranthaceae	*Ptilotus clementii*		√			
357	Amaranthaceae	*Ptilotus exaltatus* var. *exaltatus*		√	√	√	√
357	Amaranthaceae	*Ptilotus gaudichaudii* var. *gaudichaudii*				√	
357	Amaranthaceae	*Ptilotus gomphrenoides*			√		
357	Amaranthaceae	*Ptilotus helipteroides*		√			
357	Amaranthaceae	*Ptilotus incanus*		√	√	√	√
357	Amaranthaceae	*Ptilotus roei*			√	√	
357	Amaranthaceae	*Ptilotus rotundifolius*		√	√	√	√
358	Chenopodiaceae	*Dysphania kalpari*			√	√	
358	Chenopodiaceae	*Dysphania rhadinostachya* subsp. *inflata* ?		√	√	√	√
358	Chenopodiaceae	*Maireana villosa*			√	√	
358	Chenopodiaceae	*Maireana villosa* ?			√	√	
358	Chenopodiaceae	*Rhagodia eremaea*			√	√	√
358	Chenopodiaceae	*Rhagodia* sp. Hamersley (M.E.Trudgen 17794)	**P3**		√	√	
358	Chenopodiaceae	*Salsola australis*		√	√	√	√
358	Chenopodiaceae	*Salsola tragus*			√		
358	Chenopodiaceae	*Sclerolaena cornishiana*			√	√	
367	Nyctaginaceae	*Boerhavia coccinea*					√
409	Rubiaceae	*Oldenlandia crouchiana*		√			

Seq. No.[3]	Family	Taxa	Status	Area 1	Area 2	Area 3	Area 4
409	Rubiaceae	*Psydrax latifolia*			√	√	√
409	Rubiaceae	*Psydrax rigidula* ?		√	√	√	√
409	Rubiaceae	*Spermacoce brachystema*				√	
413	Apocynaceae	*Marsdenia australis*					√
413	Apocynaceae	*Sarcostemma viminale* subsp. *australe*		√			√
415	Boraginaceae	*Halgania erecta*					√
415	Boraginaceae	*Halgania gustafsenii* var. *gustafsenii* ms				√	√
415	Boraginaceae	*Heliotropium chrysocarpum*		√			
415	Boraginaceae	*Trichodesma zeylanicum* var. *zeylanicum*		√			√
416	Convolvulaceae	*Bonamia rosea*			√	√	√
416	Convolvulaceae	*Convolvulus clementii*			√		
416	Convolvulaceae	*Duperreya commixta*		√	√	√	√
416	Convolvulaceae	*Evolvulus alsinoides* var. *villosicalyx*		√	√	√	√
416	Convolvulaceae	*Operculina aequisepala*			√		
416	Convolvulaceae	*Polymeria ambigua*				√	
417	Solanaceae	*Nicotiana occidentalis* subsp. *obliqua*			√	√	√
417	Solanaceae	*Solanum ellipticum* ?			√		
417	Solanaceae	*Solanum horridum*					√
417	Solanaceae	*Solanum lasiophyllum*		√	√	√	√
417	Solanaceae	*Solanum phlomoides*		√			
417	Solanaceae	*Solanum sturtianum*			√	√	√
427	Plantaginacea	*Stemodia grossa*		√		√	√
428	Scrophulariaceae	*Eremophila cuneifolia*			√		
428	Scrophulariaceae	*Eremophila forrestii* subsp. *forrestii*		√	√	√	√
428	Scrophulariaceae	*Eremophila fraseri*		√	√	√	√
428	Scrophulariaceae	*Eremophila jucunda* subsp. *pulcherrima*		√	√		√
428	Scrophulariaceae	*Eremophila lanceolata*			√	√	

Seq. No.[3]	Family	Taxa	Status	Area 1	Area 2	Area 3	Area 4
428	Scrophulariaceae	*Eremophila latrobei* subsp. *filiformis*			√		√
428	Scrophulariaceae	*Eremophila latrobei* subsp. *latrobei* ?					√
428	Scrophulariaceae	*Eremophila longifolia*		√	√	√	√
428	Scrophulariaceae	*Eremophila magnifica* subsp. *magnifica*	**P4**				√
428	Scrophulariaceae	*Eremophila phyllopoda* subsp. *obliqua*		√	√		
432	Lamiaceae	*Clerodendrum floribundum* var. *angustifolium*		√	√		√
432	Lamiaceae	*Clerodendrum* sp.?					√
432	Lamiaceae	*Dicrastylis doranii ?*					√
432	Lamiaceae	*Prostanthera albiflora*			√		√
432	Lamiaceae	*Spartothamnella puberula*	**P2**				√
432	Lamiaceae	*Spartothamnella teucriiflora*		√			
433	Phrymaceae	*Mimulus gracilis*			√		
433	Phrymaceae	*Peplidium* sp. C (N.T. Burbidge & A. Kanis 8158)				√	
437	Acanthaceae	*Dicladanthera forrestii*				√	
437	Acanthaceae	*Dipteracanthus australasicus* subsp. *australasicus*			√		√
438	Bignoniaceae	*Pandorea pandorana*					√
450	Campanulaceae	*Lobelia heterophylla*			√		√
458	Goodeniaceae	*Brunonia australis*				√	
458	Goodeniaceae	*Brunonia* sp. long hairs (D.E. Symon 2440)	**P1**	√	√		
458	Goodeniaceae	*Dampiera candicans*					√
458	Goodeniaceae	*Scaevola amblyanthera* var. *centralis*					√
458	Goodeniaceae	*Scaevola browniana*					√
458	Goodeniaceae	*Scaevola browniana* subsp. *browniana*					√
458	Goodeniaceae	*Scaevola parvifolia* subsp. ?			√	√	√
458	Goodeniaceae	*Scaevola spinescens*		√			
458	Goodeniaceae	*Velleia panduriformis*			√	√	
458	Goodeniaceae	*Goodenia cusackiana*					√

Seq. No.[3]	Family	Taxa	Status	Area 1	Area 2	Area 3	Area 4
458	Goodeniaceae	*Goodenia microptera*		√	√	√	√
458	Goodeniaceae	*Goodenia prostrata*			√	√	
458	Goodeniaceae	*Goodenia stellata*		√	√		
458	Goodeniaceae	*Goodenia stobbsiana*		√		√	√
460	Asteraceae	*Asteraceae* sp. 1					√
460	Asteraceae	*Asteraceae* sp. 2			√		
460	Asteraceae	*Bidens bipinnata*	*		√	√	√
460	Asteraceae	*Blumea tenella*				√	
460	Asteraceae	*Brachyscome ciliocarpa*				√	
460	Asteraceae	*Calocephalus* sp. Wittenoom (A.S. George 1082)		√			
460	Asteraceae	*Centipeda minima* subsp. *macrocephala*			√	√	
460	Asteraceae	*Chrysocephalum apiculatum*			√		√
460	Asteraceae	*Chrysocephalum pterochaetum*					√
460	Asteraceae	*Olearia xerophila*					√
460	Asteraceae	*Peripleura arida*		√	√	√	
460	Asteraceae	*Peripleura obovata*					√
460	Asteraceae	*Pluchea dentex*					√
460	Asteraceae	*Pterocaulon sphaeranthoides*		√	√	√	√
460	Asteraceae	*Rhodanthe margarethae*					√
460	Asteraceae	*Streptoglossa bubakii*		√			
460	Asteraceae	*Streptoglossa decurrens*		√		√	
460	Asteraceae	*Vittadinia* sp. ?					√
472	Araliaceae	*Astrotricha hamptonii*					√
472	Araliaceae	*Trachymene oleracea* subsp. *oleracea*		√		√	√
Total		**304**		**130**	**167**	**163**	**213**

Appendix H

List of all of botanical taxa recorded by vegetation type

List of botanical taxa recorded by area and by vegetation association

Taxon	DEC Status	Vegetation Association																													
		Hills											Plains												Drainage							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Abutilon cunninghamii			√	√			√													√											√
Abutilon dioicum ms				√							√			√																	
Abutilon fraseri											√																				
Abutilon malvifolium				√																											
Abutilon otocarpum																	√														
Acacia adoxa var. *adoxa*			√	√	√	√	√		√			√														√		√			
Acacia adsurgens			√															√					√						√		
Acacia adsurgens x *rhodophloia* ?						√																										
Acacia ancistrocarpa		√	√	√	√								√	√	√	√		√	√			√		√			√			√	
Acacia aptaneura		√	√	√		√	√			√			√	√	√	√	√	√	√		√	√	√	√	√	√				√		√
Acacia atkinsiana		√		√	√								√					√									√			√		
Acacia ayersiana										√				√	√																	
Acacia bivenosa		√	√	√	√	√	√		√	√			√	√		√		√			√	√		√		√	√		√	√		√
Acacia citrinoviridis																									√							√
Acacia cowleana			√	√	√	√			√				√	√		√		√	√			√	√				√			√		
Acacia dictyophleba			√	√		√		√					√	√		√			√		√	√	√				√		√			
Acacia hamersleyensis				√	√	√	√					√			√			√										√			
Acacia inaequilatera		√	√			√										√								√			√			√		
Acacia maitlandii		√	√	√	√	√	√																				√		√	√		√
Acacia minyura		√			√								√	√					√													
Acacia monticola		√		√	√		√			√																	√	√	√	√		
Acacia pachyacra		√	√	√		√			√				√	√					√		√	√										
Acacia pruinocarpa		√		√	√	√				√	√		√	√	√	√	√	√	√		√	√		√	√		√		√	√		√
Acacia pteraneura ?										√		√	√	√	√						√											
Acacia pyrifolia var. *morrisonii*		√		√		√		√			√																√	√		√		
Acacia rhodophloia		√													√						√											
Acacia rhodophloia ?																			√													
Acacia sericophylla																											√					
Acacia sibirica															√									√								
Acacia steedmanii subsp. *borealis*			√		√	√		√					√			√			√								√	√	√			
Acacia synchronicia		√																			√											
Acacia synchronicia ?		√																									√					√
Acacia tenuissima		√	√	√	√	√	√		√				√			√			√								√			√		
Acacia tetragonophylla				√										√	√		√		√							√	√					
Acacia trachycarpa			√																													
Acacia trudgenii		√	√	√	√	√		√	√				√			√											√		√			
Achyranthes aspera											√																					
Alternanthera nana														√								√										
Amphipogon sericeus		√	√	√	√	√	√		√	√			√			√			√			√										
Amyema fitzgeraldii																										√						
Amyema miquelii						√																						√				
Amyema sanguinea var. *pulchra*									√										√													
Anthobolus leptomerioides		√	√	√						√								√						√			√					

Taxon	DEC Status	Vegetation Association																													
		Hills											Plains												Drainage							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Aristida burbidgeae				√		√			√		√																				
Aristida contorta		√	√			√	√		√	√			√	√	√	√	√	√	√		√	√		√	√		√				
Aristida holathera var. *holathera*		√	√		√	√			√				√	√	√	√			√		√	√			√		√				
Aristida inaequiglumis		√				√	√						√	√	√		√	√		√	√	√	√		√	√	√				
Aristida latifolia																								√							
Aristida obscura					√					√				√	√		√														
Asteraceae sp. 1																											√				
Asteraceae sp. 2																										√					
Astrotricha hamptonii				√							√																				
Bidens bipinnata	*									√	√			√			√								√	√					
Blumea tenella																										√					
Boerhavia coccinea				√																											
Bonamia rosea													√		√						√	√					√				
Bothriochloa ewartiana			√																						√						
Brachyachne convergens														√										√		√					
Brachychiton gregorii				√							√	√																		√	
Brachyscome ciliocarpa																	√														
Brunonia australis													√																		
Brunonia sp. long hairs (D.E. Symon 2440)	P1									√			√																		
Callitris columellaris												√																			
Calocephalus sp. Wittenoom (A.S. George 1082)																								√							
Calytrix carinata				√												√															
Capparis lasiantha		√	√	√	√	√	√	√			√			√										√	√		√	√	√		
Capparis mitchellii				√							√																				
Capparis spinosa																														√	
Capparis umbonata		√	√	√	√			√					√											√			√				
Cassytha capillaris				√							√																				
Cenchrus ciliaris	*																														√
Centipeda minima subsp. *macrocephala*																							√		√	√					
Cheilanthes sieberi subsp. *sieberi*				√						√		√		√											√	√					
Chloris virgata	*		√																							√					
Chrysocephalum apiculatum																				√					√			√			
Chrysocephalum pterochaetum									√																						
Chrysopogon fallax			√							√				√	√		√				√				√					√	
Cleome viscosa				√	√	√			√				√	√			√					√			√						
Clerodendrum floribundum var. *angustifolium*				√	√		√																					√			√
Clerodendrum sp.?				√							√																				
Codonocarpus cotinifolius		√	√	√			√					√	√			√			√		√						√				√
Convolvulus clementii																									√						
Corchorus lasiocarpus subsp. *lasiocarpus* ?							√																				√	√			
Corchorus lasiocarpus subsp. *parvus*				√	√																										

Taxon	DEC Status	Vegetation Association																												
		Hills											Plains												Drainage						
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Corchorus lasiocarpus subsp. *parvus* ?		√				√																		√			√					
Corchorus sidoides subsp. *sidoides*													√						√													
Corymbia deserticola subsp. *deserticola*		√	√	√	√				√				√	√	√	√		√									√			√		
Corymbia ferriticola				√						√	√	√																	√			
Corymbia hamersleyana		√	√	√	√	√	√	√	√				√	√		√					√			√			√	√	√	√		
Cucumis maderaspatanus										√				√											√				√			
Cucurbitaceae sp.														√																		
Cymbopogon ambiguus		√		√	√		√		√		√	√				√							√		√		√		√			
Cymbopogon obtectus			√	√	√	√	√		√				√	√	√				√						√							
Cymbopogon procerus						√	√	√				√															√	√	√	√		
Dampiera candicans						√	√		√			√															√					
Dichanthium sericeum subsp. *humilius*														√																		
Dichanthium sp.						√								√						√										√		
Dicladanthera forrestii														√																		
Dicrastylis doranii ?				√								√																				
Digitaria brownii													√	√	√		√					√	√		√		√					
Diplopeltis stuartii var. *stuartii*																											√					
Dipteracanthus australasicus subsp. *australasicus*				√		√	√							√											√		√					
Dodonaea lanceolata				√			√		√																		√	√	√			
Dodonaea pachyneura				√	√							√																	√			
Dodonaea petiolaris				√			√			√			√																			
Dodonaea viscosa subsp. *mucronata* ?				√	√						√																√					
Duperreya commixta		√		√	√	√	√			√	√	√	√	√	√			√	√		√				√	√	√		√	√		√
Dysphania kalpari													√		√								√									
Dysphania rhadinostachya subsp. *inflata* ?		√		√		√						√		√	√		√				√				√		√					
Enneapogon lindleyanus				√	√	√					√			√														√				
Enneapogon polyphyllus		√	√		√	√			√	√				√	√		√	√	√		√	√		√	√		√					
Eragrostis eriopoda			√			√	√						√	√		√			√		√				√		√					
Eragrostis falcata															√																	
Eragrostis xerophila				√								√												√								
Eremophila cuneifolia		√																														
Eremophila forrestii subsp. *forrestii*						√				√		√	√	√	√						√			√	√						√
Eremophila fraseri		√	√							√			√	√	√																	
Eremophila jucunda subsp. *pulcherrima*		√		√	√																											
Eremophila lanceolata														√			√								√							
Eremophila latrobei subsp. *filiformis*				√											√																	
Eremophila latrobei subsp. *latrobei* ?				√	√					√																			√			

Taxon	DEC Status	Vegetation Association																												
		Hills											Plains												Drainage						
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Eremophila longifolia			√			√							√	√	√	√	√		√		√			√	√		√	√			√	
Eremophila magnifica subsp. *magnifica*	P4			√	√		√																						√			
Eremophila phyllopoda subsp. *obliqua*										√					√																	
Eriachne aristidea		√																														
Eriachne benthamii ?														√	√																	
Eriachne flaccida													√																			
Eriachne lanata					√																											
Eriachne mucronata		√	√	√	√		√			√	√	√		√														√	√	√	√	
Eriachne pulchella subsp. *dominii*		√		√	√				√	√				√	√				√									√				
Eucalyptus gamophylla		√	√			√		√	√				√	√	√	√		√	√		√							√	√	√	√	
Eucalyptus kingsmillii subsp. *kingsmillii*				√																												
Eucalyptus leucophloia subsp. *leucophloia*		√	√	√	√	√	√		√	√		√	√		√	√					√			√				√		√	√	
Eucalyptus trivalva																√													√			
Eucalyptus xerothermica						√		√					√	√	√		√	√			√				√	√	√	√				√
Eulalia aurea			√	√	√	√		√	√				√	√	√				√		√	√	√				√	√				√
Eulalia aurea ?								√																								
Euphorbia australis																	√						√					√				
Euphorbia boophthona																	√										√		√			
Euphorbia drummondii				√													√										√					
Euphorbia schultzii						√															√				√							
Evolvulus alsinoides var. *villosicalyx*		√		√			√							√			√								√		√					
Exocarpos sparteus				√			√		√																							
Ficus brachypoda				√	√	√	√				√	√																	√			
Fimbristylis simulans		√		√																										√		
Fimbristylis sp.				√																					√							
Gastrolobium grandiflorum																												√				
Gompholobium sp. Pilbara (N.F. Norris 908)			√	√	√	√	√		√				√			√						√				√		√	√		
Gomphrena canescens		√																														
Goodenia cusackiana				√	√																											
Goodenia microptera						√			√				√									√					√					√
Goodenia prostrata																	√								√							
Goodenia stellata																									√							√
Goodenia stobbsiana		√					√		√													√					√					
Gossypium australe									√												√		√							√		
Gossypium robinsonii			√	√	√	√					√		√	√	√							√		√			√	√	√	√		√
Grevillea berryana		√		√																	√											
Grevillea pyramidalis					√																											
Grevillea pyrifolia																														√		
Grevillea wickhamii subsp. *aprica* ?			√	√	√											√											√	√	√	√		
Hakea chordophylla		√	√	√	√	√	√		√				√	√	√				√		√					√	√	√				

Taxon	DEC Status	Vegetation Association																													
		Hills											Plains												Drainage							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Hakea lorea subsp. *lorea*													√	√		√									√	√					
Halgania erecta			√																												
Halgania gustafsenii var. *gustafsenii* ms			√		√	√	√		√				√			√										√					
Haloragis gossei var. *gossei*									√													√									√
Heliotropium chrysocarpum		√																						√							
Hibiscus burtonii				√	√	√	√																								
Hibiscus coatesii				√	√						√		√													√					
Hibiscus robinsonii																										√					
Hibiscus sturtii var. platychlamys						√															√										
Hibiscus sturtii var. truncatus					√																										
Hybanthus aurantiacus				√																						√	√	√			
Indigofera fractiflexa ms				√																											
Indigofera georgei									√					√																	
Indigofera monophylla		√				√			√				√			√					√					√					
Iseilema vaginiflorum													√	√																	
Isotropis forrestii																			√					√							√
Jasminum didymum subsp. *lineare*			√	√	√	√		√	√			√	√					√			√			√		√	√	√			
Keraudrenia velutina subsp. *elliptica*		√	√	√	√	√		√	√				√		√	√			√			√				√			√		
Lepidium echinatum				√										√			√														
Lepidium pedicellosum																														√		
Leptopus decaisnei																							√								
Lobelia heterophylla				√	√						√																				
Maireana villosa														√	√																
Maireana villosa ?														√	√																
Malvastrum americanum	*												√	√								√	√		√	√				√	
Marsdenia australis			√	√																											
Marsilea hirsuta																														√	
Maytenus cunninghamii							√						√																√		
Mimulus gracilis																										√					
Mirbelia viminalis				√			√																								
Nicotiana occidentalis subsp. *obliqua*				√						√							√							√							
Oldenlandia crouchiana		√																													
Olearia xerophila				√	√	√	√			√	√	√														√	√	√			
Operculina aequisepala																														√	
Pandorea pandorana												√																			
Panicum decompositum													√	√					√	√		√	√				√				
Paraneurachne muelleri		√	√	√	√	√	√		√				√	√	√	√		√	√		√	√				√		√	√		
Peplidium sp. C (N.T. Burbidge & A. Kanis 8158)																	√														
Peripleura arida													√		√										√		√				√
Peripleura obovata											√																				
Petalostylis labicheoides				√								√									√						√	√	√		√

Taxon	DEC Status	Vegetation Association																												
		Hills											Plains												Drainage						
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Pimelea forrestiana ?											√																				
Pimelea holroydii																														√	
Pluchea dentex									√																						
Polycarpaea holtzei		√																													
Polycarpaea longiflora				√			√		√					√									√		√		√	√			
Polymeria ambigua																							√				√				
Prostanthera albiflora															√												√				
Psydrax latifolia				√								√	√		√												√		√		
Psydrax rigidula ?		√		√			√			√				√	√						√							√		
Pterocaulon sphaeranthoides		√		√										√	√							√	√	√	√				√	√
Ptilotus astrolasius var. *astrolasius*		√		√	√	√	√			√			√	√												√	√	√		√
Ptilotus calostachyus		√	√	√	√	√	√		√	√			√		√	√					√							√		
Ptilotus carinatus													√											√							
Ptilotus clementii		√																													
Ptilotus exaltatus var. *exaltatus*		√	√	√	√	√				√			√	√							√	√		√			√			√
Ptilotus gaudichaudii var. *gaudichaudii*														√																	
Ptilotus gomphrenoides																				√										√	
Ptilotus helipteroides		√																												√	
Ptilotus incanus				√	√	√				√	√		√	√	√			√	√		√			√	√		√				√
Ptilotus roei														√			√														
Ptilotus rotundifolius		√	√	√	√	√							√								√									
Rhagodia eremaea				√	√	√				√	√			√											√						
Rhagodia sp. Hamersley (M.E.Trudgen 17794)	**P3**												√	√																	
Rhodanthe margarethae				√							√	√																			
Rhynchosia minima				√	√	√																		√			√			√	
Rulingia luteiflora													√								√	√					√	√			√
Salsola australis						√								√	√		√			√				√							
Salsola tragus															√																
Santalum lanceolatum				√	√	√						√	√								√				√		√	√	√	√		√
Sarcostemma viminale subsp. *australe*							√														√										
Scaevola amblyanthera var. *centralis*									√																						
Scaevola browniana				√	√		√																								
Scaevola browniana subsp. *browniana*				√								√																			
Scaevola parvifolia subsp. ?			√			√							√	√		√			√		√						√				
Scaevola spinescens		√																													
Schizachyrium fragile		√		√		√			√	√			√													√		√			
Sclerolaena cornishiana														√	√		√			√										√	
Senna artemisioides subsp. *helmsii*			√			√			√				√	√	√						√			√			√				
Senna artemisioides subsp. *oligophylla x helmsii*			√	√	√	√	√		√	√			√					√			√					√	√	√		√	√
Senna artemisioides subsp. *x*								√											√		√	√		√	√	√					√

Taxon	DEC Status	Vegetation Association																													
		Hills											Plains												Drainage							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
artemisioides																															
Senna ferraria			√	√	√		√		√			√																			
Senna glaucifolia															√																
Senna glutinosa subsp. *glutinosa*		√	√	√	√	√	√		√				√		√	√					√	√		√			√		√		√
Senna glutinosa subsp. *pruinosa*		√	√	√	√		√		√																						
Senna glutinosa subsp. *x luerssenii*		√	√	√						√			√					√			√			√			√				√
Senna hamersleyensis																				√											
Senna notabilis													√	√	√		√			√		√			√							√
Senna pleurocarpa var. ?						√							√																		
Senna pleurocarpa var. *angustifolia ?*				√		√		√	√				√																√	√		
Senna venusta												√																			
Setaria verticillata	*										√																				
Sida arenicola													√																		
Sida echinocarpa		√											√		√						√	√			√		√				
Sida ectogama										√				√				√								√					
Sida fibulifera																								√							
Sida platycalyx														√																	
Sida sp. 1			√				√		√					√																	
Sida sp. 2				√					√										√												
Sida sp. 3		√				√	√						√								√								√		
Sida sp. Dark green fruits (S.Van leeuwin 2260)				√																											
Sida sp. Excedentifolia (J.L.Egan 1925)				√	√					√					√																
Sida sp. Pilbara (A. A. Mitchell PRP 1543)		√			√	√			√			√	√		√				√												
Sida sp. Shovelanna Hill (svl 3842)				√			√					√																	√		
Sida sp. Spiciform panicles (E. Leyland S.N. 14/8/90)													√	√											√		√				
Sida sp. Verrucose Glands (F.H. Mollemans 2423)													√								√										
Solanum ellipticum ?				√																											
Solanum horridum				√																											
Solanum lasiophyllum				√		√			√				√	√	√					√	√	√	√	√			√			√	
Solanum phlomoides																											√				
Solanum sturtianum			√	√	√								√	√	√	√					√	√									
Spartothamnella puberula	P2										√																				
Spartothamnella teucriiflora																															√
Spermacoce brachystema														√																	
Sporobolus australasicus		√			√					√			√	√	√		√		√			√	√	√	√	√					√
Stackhousia sp. Swollen gynophore (W Barker 2041)													√																		

Taxon	DEC Status	Vegetation Association																													
		Hills											Plains												Drainage							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Stemodia grossa		√											√														√					
Streptoglossa bubakii																							√								
Streptoglossa decurrens		√																				√									√
Tephrosia rosea var. *glabrior* ms				√																							√	√				
Tephrosia sp. Bungaroo Creek (M.E. Trudgen 11601)																											√					
Themeda sp. Mt Barricade (M.E. Trudgen 2471)			√	√	√	√			√	√	√	√															√	√	√	√		
Themeda triandra		√	√	√		√	√	√	√		√		√	√	√	√	√	√	√		√	√	√		√	√	√	√		√	√	√
Tinospora smilacina				√																												
Trachymene oleracea subsp. *oleracea*		√					√				√																√					
Tribulus suberosus		√			√					√						√											√					
Trichodesma zeylanicum var. *zeylanicum*				√		√					√										√											√
Tricoryne sp. Hamersley Range (S. Van Leeuwen 915)				√																												
Triodia brizoides		√	√	√	√	√							√		√						√				√							
Triodia epactia			√	√	√	√	√	√	√	√			√	√	√	√	√	√	√		√	√	√		√		√	√	√	√		√
Triodia epactia ?		√		√	√										√																	
Triodia longiceps														√								√										
Triodia melvillei													√	√	√			√														
Triodia sp. Mt Ella (M.E. Trudgen 12739)	**P3**			√	√		√			√	√	√													√		√		√	√		
Triodia wiseana		√	√	√	√	√	√		√			√	√			√		√						√			√	√	√	√		√
Triumfetta maconochieana				√								√																				
Urochloa occidentalis														√										√	√	√						
Vachellia farnesiana	*														√		√			√					√						√	
Velleia panduriformis													√																			
Ventilago viminalis					√																											
Vittadinia sp. ?																											√					
Wahlenbergia tumidifructa																									√	√						
Waltheria virgata					√							√																				
Total (304)		**77**	**64**	**129**	**81**	**81**	**59**	**18**	**57**	**44**	**36**	**37**	**93**	**88**	**66**	**38**	**33**	**26**	**37**	**12**	**57**	**40**	**20**	**41**	**56**	**25**	**99**	**37**	**47**	**39**	**17**	**39**

Appendix I

Locations of conservation flora recorded at the Survey Areas

Taxa	Status	Waypoint	Survey Area	Easting	Northing	Height (m)	Cover (%)	Numbers
Brunonia sp. long hairs (D.E. Symon 2440)	P1	S1-WP10	1	627833	7488185	0.4	+	1
Brunonia sp. long hairs (D.E. Symon 2440)	P1	S1-WP209	2	659191	7464891	0.4	+	2
Spartothamnella puberula	P2	S1-WP138	4	663583	7475135	0.4	+	1
Eremophila magnifica subsp. *magnifica*	P4	S2-WP31	4	658996	7471897	1	5	100
Eremophila magnifica subsp. *magnifica*	P4	S2-WP180	4	663904	7474287	0.7	+	10
Eremophila magnifica subsp. *magnifica*	P4	S2-WP181	4	663898	7474226	0.5	+	8
Eremophila magnifica subsp. *magnifica*	P4	S2-WP182	4	663771	7474200	1	+	20
Eremophila magnifica subsp. *magnifica*	P4	S2-WP183	4	663717	7474150	1	2	30
Eremophila magnifica subsp. *magnifica*	P4	S2-WP184	4	663716	7474150	1	+	6
Eremophila magnifica subsp. *magnifica*	P4	S2-WP190	4	663273	7474087	1	2	>50
Eremophila magnifica subsp. *magnifica*	P4	S2-WP222	4	663486	7474328	1.5	+	10
Eremophila magnifica subsp. *magnifica*	P4	S2-WP223	4	663568	7474336	1	1	50
Rhagodia sp. Hamersley (M.E.Trudgen 17794)	P3	S1-WP56	3	655162	7471027	1.5	+	3

Taxa	Status	Waypoint	Survey Area	Easting	Northing	Height (m)	Cover (%)	Numbers
Rhagodia sp. Hamersley (M.E.Trudgen 17794)	P3	S1-WP62	3	655791	7470768	1.5	+	1
Rhagodia sp. Hamersley (M.E.Trudgen 17794)	P3	S1-WP103	3	660976	7469953	1.2	+	7
Rhagodia sp. Hamersley (M.E.Trudgen 17794)	P3	S1-WP107	3	661359	7469951	1	+	2
Rhagodia sp. Hamersley (M.E.Trudgen 17794)	P3	S1-WP108	3	661762	7470290	1.5	+	4
Rhagodia sp. Hamersley (M.E.Trudgen 17794)	P3	S1-WP122	3	663828	7470827	1.2	+	1
Rhagodia sp. Hamersley (M.E.Trudgen 17794)	P3	S1-WP125	3	663475	7470757	1.2	+	8
Rhagodia sp. Hamersley (M.E.Trudgen 17794)	P3	S1-WP126	3	663472	7470597	1	+	3
Rhagodia sp. Hamersley (M.E.Trudgen 17794)	P3	S1-WP233	2	663849	7464268	1.2	+	6
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S1-WP128	4	663935	7474933	0.5	10	>100
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S1-WP129	4	663880	7474871	0.6	20	>200
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S1-WP131	4	663761	7475079	0.5	10	>100
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S1-WP137	4	663540	7475031	0.5	35	>200
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S1-WP138	4	663583	7475135	0.5	50	>300
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S1-WP141	4	663302	7475074	0.5	20	>200
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S1-WP170	4	653192	7464971	0.4	5	60
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S1-WP171	4	653182	7464954	0.4	5	70
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S1-WP198	4	656368	7464434	0.3	+	10
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S1-WP253	4	663863	7472512	0.5	20	>200
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S1-WP255	4	663918	7472520	0.5	15	>150
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP2	4	658325	7472131	0.4	30	>200
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP4	4	658256	7472162	0.4	30	>200
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP6	4	657982	7472181	0.5	5	50
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP10	4	658105	7472078	0.6	10	>100

Taxa	Status	Waypoint	Survey Area	Easting	Northing	Height (m)	Cover (%)	Numbers
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP12	4	658194	7471938	0.4	2	30
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP13	4	658333	7471903	0.4	1	10
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP19	4	658776	7471935	0.5	1	15
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP21	4	658780	7472065	0.5	1	20
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP27	4	659146	7471804	0.4	5	50
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP29	4	659047	7471884	0.4	1	10
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP32	4	658965	7471984	0.5	15	>150
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP34	4	658946	7471803	0.5	5	50
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP53	4	660096	7471842	0.5	2	30
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP63	4	660591	7471725	0.5	+	10
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP84	4	661341	7471637	0.5	1	15
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP85	4	661348	7471706	0.5	+	5
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP86	4	661356	7471653	0.5	5	30
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP89	4	661506	7471694	0.4	5	40
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP99	4	661939	7471932	0.5	10	>100
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP100	4	661958	7471944	0.5	15	>150
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP102	4	662138	7471993	0.5	10	>100
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP103	4	662137	7471896	0.3	+	2
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP114	4	662316	7472203	0.4	40	>300
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP115	4	662326	7472237	0.3	+	2
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP117	4	662368	7472282	0.4	+	20
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP119	4	662321	7472396	0.4	2	70
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP127	4	663147	7472192	0.5	2	100

Taxa	Status	Waypoint	Survey Area	Easting	Northing	Height (m)	Cover (%)	Numbers
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP128	4	663314	7472175	0.5	+	10
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP138	4	662626	7472177	0.5	10	>100
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP139	4	662523	7472172	0.4	5	100
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP141	4	662569	7472400	0.6	+	10
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP144	4	662850	7472702	0.4	10	>100
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP146	4	662879	7473028	0.5	5	50
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP147	4	662795	7473055	0.4	2	20
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP148	4	662755	7473159	0.3	1	10
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP149	4	662661	7473162	4	5	100
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP150	4	662616	7473253	0.3	2	30
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP166	4	663125	7473948	0.5	2	50
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP167	4	662972	7473843	0.4	+	10
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP171	4	662764	7473778	0.4	5	100
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP172	4	662571	7473604	0.5	5	100
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP179	4	663956	7474291	0.4	2	20
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP181	4	663898	7474226	0.5	1	10
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP184	4	663716	7474150	0.5	+	5
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP185	4	663555	7474005	0.4	+	10
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP190	4	663273	7474087	0.3	2	100
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP191	4	663240	7474100	4	2	30
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP199	4	662994	7474971	0.5	10	>100
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP206	4	662694	7474963	0.4	5	100
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP207	4	662786	7474937	0.4	10	>100

Taxa	Status	Waypoint	Survey Area	Easting	Northing	Height (m)	Cover (%)	Numbers
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP208	4	662903	7474941	0.4	5	50
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP213	4	663102	7475016	0.4	15	>150
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP214	4	663105	7475144	0.4	1	10
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP215	4	663163	7475136	0.4	15	>150
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP216	4	663183	7475016	0.4	2	20
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	S2-WP222	4	663486	7474328	0.4	1	10

Appendix J

Locations of introduced species recorded at the survey areas

Taxa	EWS	Waypoint	Easting	Northing	Height (m)	Cover (%)	Numbers
Cenchrus ciliaris	High	S1-WP11	627571	7488256	0.4	+	2
Chloris virgata	Low	S1-WP66	656116	7469919	0.4	+	1
Chloris virgata	Low	S1-WP157	651578	7464392	0.5	+	4
Chloris virgata	Low	S2-WP77	661130	7471396	1	1	>20
Setaria verticillata	Low	S1-WP138	663583	7475135	0.7	5	>200
Bidens bipinnata	Unrated	S1-WP56	655162	7471027	0.7	1	>1000
Bidens bipinnata	Unrated	S1-WP59	655541	7470939	0.5	+	10
Bidens bipinnata	Unrated	S1-WP64	655823	7469985	0.5	15	>2000
Bidens bipinnata	Unrated	S1-WP66	656116	7469919	0.4	30	>1000
Bidens bipinnata	Unrated	S1-WP75	657178	7469934	0.4	+	50
Bidens bipinnata	Unrated	S1-WP108	661762	7470290	1	+	200
Bidens bipinnata	Unrated	S1-WP110	661791	7470082	0.5	+	10
Bidens bipinnata	Unrated	S1-WP112	662108	7470690	0.5	+	1

Taxa	EWS	Waypoint	Easting	Northing	Height (m)	Cover (%)	Numbers
Bidens bipinnata	Unrated	S1-WP138	663583	7475135	0.7	15	>2000
Bidens bipinnata	Unrated	S1-WP153	651080	7464694	0.6	70	>2000
Bidens bipinnata	Unrated	S1-WP154	651303	7464474	0.4	+	100
Bidens bipinnata	Unrated	S1-WP155	651343	7464390	0.6	70	>2000
Bidens bipinnata	Unrated	S1-WP157	651578	7464392	0.6	70	>2000
Bidens bipinnata	Unrated	S1-WP161	651582	7464266	0.7	70	>2000
Bidens bipinnata	Unrated	S1-WP162	651982	7464278	0.7	60	>2000
Bidens bipinnata	Unrated	S1-WP164	652318	7464332	0.5	40	>2000
Bidens bipinnata	Unrated	S1-WP178	654935	7464451	0.3	<1	100
Bidens bipinnata	Unrated	S1-WP198	656368	7464434	0.4	1	200
Bidens bipinnata	Unrated	S1-WP237	650572	7463834	0.5	2	200
Bidens bipinnata	Unrated	S1-WP241	650914	7464643	0.6	40	>2000
Bidens bipinnata	Unrated	S2-WP18	658776	7471808	0.4	+	10
Malvastrum americanum	Moderate	S1-WP56	655162	7471027	1	+	10
Malvastrum americanum	Moderate	S1-WP58	654780	7470040	0.3	+	1
Malvastrum americanum	Moderate	S1-WP59	655541	7470939	0.5	+	2
Malvastrum americanum	Moderate	S1-WP64	655823	7469985	0.5	+	100
Malvastrum americanum	Moderate	S1-WP66	656116	7469919	0.4	30	>1000
Malvastrum americanum	Moderate	S1-WP75	657178	7469934	0.4	+	10
Malvastrum americanum	Moderate	S1-WP81	658941	7469980	0.5	+	>100
Malvastrum americanum	Moderate	S1-WP100	660553	7469788	0.4	+	20
Malvastrum americanum	Moderate	S1-WP108	661762	7470290	1	+	1
Malvastrum americanum	Moderate	S1-WP110	661791	7470082	0.5	+	100

Taxa	EWS	Waypoint	Easting	Northing	Height (m)	Cover (%)	Numbers
Malvastrum americanum	Moderate	S1-WP113	662395	7470793	0.3	+	10
Malvastrum americanum	Moderate	S1-WP155	651343	7464390	0.4	1	100
Malvastrum americanum	Moderate	S1-WP161	651582	7464266	0.6	+	20
Malvastrum americanum	Moderate	S1-WP162	651982	7464278	0.7	+	20
Malvastrum americanum	Moderate	S1-WP164	652318	7464332	0.4	+	105
Malvastrum americanum	Moderate	S1-WP178	654935	7464451	0.4	+	5
Malvastrum americanum	Moderate	S1-WP185	655150	7464485	0.5	+	10
Malvastrum americanum	Moderate	S1-WP187	655950	7464544	0.5	+	20
Malvastrum americanum	Moderate	S1-WP191	655390	7464780	0.4	+	50
Malvastrum americanum	Moderate	S1-WP197	656683	7465066	0.2	+	50
Malvastrum americanum	Moderate	S1-WP198	656368	7464434	0.4	1	5
Malvastrum americanum	Moderate	S1-WP237	650572	7463834	0.5	1	100
Malvastrum americanum	Moderate	S1-WP242	650592	7464439	0.4	1	100
Malvastrum americanum	Moderate	S1-WP244	650611	7464735	0.5	+	20
Vachellia farnesiana	High	S1-WP152	651094	7464796	3	+	6
Vachellia farnesiana	High	S1-WP154	651303	7464474	2	+	4
Vachellia farnesiana	High	S1-WP185	655150	7464485	3	5	40
Vachellia farnesiana	High	S1-WP187	655950	7464544	4	5	100
Vachellia farnesiana	High	S1-WP193	656078	7464557	2.5	4	75
Vachellia farnesiana	High	S1-WP197	656683	7465066	2.5	40	>1000
Vachellia farnesiana	High	S1-WP244	650611	7464735	3	60	>1000
Vachellia farnesiana	High	S1-WP245	650595	7464842	1.5	+	2

Appendix K

Vertebrate fauna listed for the Survey Areas

Combined vertebrate fauna listings from the *EPBC Act*, NatureMap and Birds Australia Data Base Search.

Naming Conventions

All avifauna classifications and naming conventions are based on Christidis and Boles (2008) as modified by Birds Australia (2012).

All other fauna utilise the classifications and naming conventions provided by NatureMap (2012).

Species Exclusions

As the NVCP Areas is an inland terrestrial site with no major watercourses. Oceanic, marine and freshwater aquatic species have been excluded from the combined fauna list.

Group	Order	Family	Species	Common Name	Status
Mammal	Dasyuromorphia	Dasyuridae	*Dasyurus hallucatus*	Nothern Quoll	WCA Schedule 1 and EPBCA Endangered
Mammal	Dasyuromorphia	Dasyuridae	*Dasykaluta rosamondae*	Little Red Kaluta	
Mammal	Dasyuromorphia	Dasyuridae	*Ningaui timealeyi*	Pilbara Ningaui	
Mammal	Dasyuromorphia	Dasyuridae	*Sminthopsis macroura*	Stripe-faced Dunnart	
Mammal	Dasyuromorphia	Dasyuridae	*Sminthopsis ooldea*	Ooldea Dunnart	
Mammal	Chiroptera	Emballonuridae	*Taphozous georgianus*	Common Sheathtail-bat	
Mammal	Chiroptera	Emballonuridae	*Taphozous hilli*	Hill's Sheathtail-bat	
Mammal	Chiroptera	Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	
Mammal	Diprotodontia	Macropodidae	*Macropus robustus subsp. erubescens*	Euro	
Mammal	Chiroptera	Molossidae	*Mormopterus beccarii*	Beccari's Freetail-bat	
Mammal	Chiroptera	Molossidae	*Chaerephon jobensis*	Northern Freetail-bat	
Mammal	Chiroptera	Molossidae	*Tadarida australis*	White-striped Freetail-bat	
Mammal	Rodentia	Muridae	*Mus musculus*	House Mouse	Introduced
Mammal	Rodentia	Muridae	*Leggadina lakedownensis*	Short-tailed Mouse	DEC Priority 4
Mammal	Rodentia	Muridae	*Pseudomys chapmani*	Western Pebble-mound Mouse	DEC Priority 4
Mammal	Rodentia	Muridae	*Pseudomys hermannsburgensis*	Sandy Inland Mouse	
Mammal	Rodentia	Muridae	*Zyzomys argurus*	Common Rock-rat	
Mammal	Chiroptera	Pteropodidae	*Pteropus scapulatus*	Little Red Flying-fox	
Mammals	Chiroptera	Hipposideridae	*Rhinonicteris aurantia*	Pilbara Leaf-nosed Bat	WCA Schedule 1 and EPBCA Vulnerable
Mammal	Chiroptera	Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat	
Mammal	Chiroptera	Vespertilionidae	*Scotorepens greyii*	Little Broad-nosed Bat	
Mammal	Chiroptera	Vespertilionidae	*Vespadelus finlaysoni*	Finlayson's Cave Bat	
Mammal	Chiroptera	Vespertilionidae	*Nyctophilus geoffroyi*	Lesser Long-eared Bat	
Bird	Passeriformes	Acanthizidae	*Acanthiza apicalis*	Broad-tailed Thornbill	
Bird	Passeriformes	Acanthizidae	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill	
Bird	Passeriformes	Acanthizidae	*Acanthiza robustirostris*	Slaty-backed Thornbill	
Bird	Passeriformes	Acanthizidae	*Acanthiza uropygialis*	Chestnut-rumped Thornbill	

Group	Order	Family	Species	Common Name	Status
Bird	Passeriformes	Acanthizidae	*Aphelocephala leucopsis*	Southern Whiteface	
Bird	Passeriformes	Acanthizidae	*Gerygone fusca*	Western Gerygone	
Bird	Passeriformes	Acanthizidae	*Gerygone fusca subsp. fusca*		
Bird	Passeriformes	Acanthizidae	*Pyrrholaemus brunneus*	Redthroat	
Bird	Passeriformes	Acanthizidae	*Smicrornis brevirostris*	Weebill	
Bird	Accipitriformes	Accipitridae	*Accipiter fasciatus*	Brown Goshawk	EPBCA Marine
Bird	Accipitriformes	Accipitridae	*Haliastur sphenurus*	Whistling Kite	EPBCA Marine
Bird	Accipitriformes	Accipitridae	*Accipiter cirrocephalus*	Collared Sparrowhawk	
Bird	Accipitriformes	Accipitridae	*Aquila audax*	Wedge-tailed Eagle	
Bird	Accipitriformes	Accipitridae	*Circus assimilis*	Spotted Harrier	
Bird	Accipitriformes	Accipitridae	*Milvus migrans*	Black Kite	
Bird	Accipitriformes	Accipitridae	*Hamirostra melanosternon*	Black-breasted Buzzard	
Bird	Apodiformes	Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar	
Bird	Apodiformes	Aegothelidae	*Aegotheles cristatus subsp. cristatus*		
Bird	Passeriformes	Artamidae	*Artamus cinereus*	Black-faced Woodswallow	
Bird	Passeriformes	Artamidae	*Artamus minor*	Little Woodswallow	
Bird	Passeriformes	Artamidae	*Artamus personatus*	Masked Woodswallow	
Bird	Passeriformes	Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	EPBCA Marine
Bird	Passeriformes	Campephagidae	*Coracina maxima*	Ground Cuckoo-shrike	
Bird	Passeriformes	Campephagidae	*Coracina novaehollandiae subsp. subpallida*		
Bird	Caprimulgiformes	Caprimulgidae	*Eurostopodus argus*	Spotted Nightjar	EPBCA Marine
Bird	Casuariiformes	Casuariidae	*Dromaius novaehollandiae*	Emu	
Bird	Passeriformes	Climacteridae	*Climacteris melanura*	Black-tailed Treecreeper	
Bird	Passeriformes	Climacteridae	*Climacteris melanura subsp. wellsi*		
Bird	Columbiformes	Columbidae	*Geopelia cuneata*	Diamond Dove	
Bird	Columbiformes	Columbidae	*Geopelia striata*	Peaceful Dove	
Bird	Columbiformes	Columbidae	*Geophaps plumifera*	Spinifex Pigeon	

Group	Order	Family	Species	Common Name	Status
Bird	Columbiformes	Columbidae	*Ocyphaps lophotes*	Crested Pigeon	
Bird	Columbiformes	Columbidae	*Phaps chalcoptera*	Common Bronzewing	
Bird	Columbiformes	Columbidae	*Geopelia striata subsp. placida*		
Bird	Passeriformes	Corvidae	*Corvus bennetti*	Little Crow	
Bird	Passeriformes	Corvidae	*Corvus orru*	Torresian Crow	
Bird	Passeriformes	Cracticidae	*Cracticus nigrogularis*	Pied ButcherBird	
Bird	Passeriformes	Cracticidae	*Cracticus tibicen*	Australian Magpie	
Bird	Passeriformes	Cracticidae	*Cracticus torquatus*	Grey ButcherBird	
Bird	Cuculiformes	Cuculidae	*Chrysococcyx osculans*	Black-eared Cuckoo	EPBC Marine
Bird	Passeriformes	Dicaeidae	*Dicaeum hirundinaceum*	MistletoeBird	
Bird	Passeriformes	Dicruridae	*Grallina cyanoleuca*	Magpie-lark	
Bird	Passeriformes	Dicruridae	*Rhipidura leucophrys*	Willie Wagtail	
Bird	Passeriformes	Dicruridae	*Rhipidura fuliginosa subsp. alisteri*		
Bird	Passeriformes	Estrilidae	*Emblema pictum*	Painted Finch	
Bird	Passeriformes	Estrilidae	*Taeniopygia guttata*	Zebra Finch	
Bird	Falconiformes	Falconidae	*Falco cenchroides*	Australian Kestrel	EPBCA Marine
Bird	Falconiformes	Falconidae	*Falco berigora*	Brown Falcon	
Bird	Falconiformes	Falconidae	*Falco longipennis subsp. longipennis*		
Bird	Coraciiformes	Halcyonidae	*Dacelo leachii*	Blue-winged Kookaburra	
Bird	Coraciiformes	Halcyonidae	*Dacelo leachii subsp. leachii*		
Bird	Passeriformes	Hirundinidae	*Hirundo neoxena*	Welcome Swallow	
Bird	Passeriformes	Maluridae	*Amytornis striatus*	Striated Grasswren	
Bird	Passeriformes	Maluridae	*Amytornis striatus subsp. whitei*		
Bird	Passeriformes	Maluridae	*Malurus lamberti*	Variegated Fairy-wren	
Bird	Passeriformes	Maluridae	*Malurus leucopterus*	White-winged Fairy-wren	
Bird	Passeriformes	Maluridae	*Malurus splendens*	Splendid Fairy-wren	
Bird	Passeriformes	Maluridae	*Stipiturus ruficeps*	Rufous-crowned Emu-wren	

Group	Order	Family	Species	Common Name	Status
Bird	Passeriformes	Maluridae	*Stipiturus ruficeps subsp. ruficeps*		
Bird	Passeriformes	Meliphagidae	*Acanthagenys rufogularis*	Spiny-cheeked Honeyeater	
Bird	Passeriformes	Meliphagidae	*Epthianura tricolor*	Crimson Chat	
Bird	Passeriformes	Meliphagidae	*Lacustroica whitei*	Grey Honeyeater	
Bird	Passeriformes	Meliphagidae	*Lichenostomus keartlandi*	Grey-headed Honeyeater	
Bird	Passeriformes	Meliphagidae	*Lichenostomus penicillatus*	White-plumed Honeyeater	
Bird	Passeriformes	Meliphagidae	*Lichenostomus virescens*	Singing Honeyeater	
Bird	Passeriformes	Meliphagidae	*Lichmera indistincta*	Brown Honeyeater	
Bird	Passeriformes	Meliphagidae	*Lichmera indistincta subsp. indistincta*		
Bird	Passeriformes	Meliphagidae	*Manorina flavigula*	Yellow-throated Miner	
Bird	Passeriformes	Meliphagidae	*Melithreptus gularis*	Black-chinned Honeyeater	
Bird	Passeriformes	Meliphagidae	*Certhionyx variegatus*	Pied Honeyeater	
Bird	Coraciiformes	Meropidae	*Merops ornatus*	Rainbow Bee-eater	EPBCA Migratory and Marine, JAMBA
Bird	Passeriformes	Motacillidae	*Anthus australis subsp. australis*		
Bird	Passeriformes	Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	
Bird	Passeriformes	Neosittidae	*Daphoenositta chrysoptera subsp. pileata*	Varied Sittella	
Bird	Passeriformes	Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush	
Bird	Passeriformes	Pachycephalidae	*Colluricincla harmonica subsp. rufiventris*		
Bird	Passeriformes	Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler	
Bird	Passeriformes	Pardalotidae	*Pardalotus rubricatus*	Red-browed Pardalote	
Bird	Passeriformes	Pardalotidae	*Pardalotus striatus*	Striated Pardalote	
Bird	Passeriformes	Pardalotidae	*Pardalotus striatus subsp. murchisoni*		
Bird	Passeriformes	Petroicidae	*Petroica goodenovii*	Red-capped Robin	
Bird	Galliformes	Phasianidae	*Coturnix ypsilophora*	Brown Quail	

Group	Order	Family	Species	Common Name	Status
Bird	Galliformes	Phasianidae	*Coturnix pectoralis*	Stubble Quail	EPBC Marine
Bird	Caprimulgiformes	Podargidae	*Podargus strigoides*	Tawny Frogmouth	
Bird	Passeriformes	Pomatostomidae	*Pomatostomus superciliosus*	White-browed Babbler	
Bird	Passeriformes	Pomatostomidae	*Pomatostomus temporalis*	Grey-crowned Babbler	
Bird	Passeriformes	Pomatostomidae	*Pomatostomus temporalis subsp. rubeculus*		
Bird	Psittaciformes	Psittacidae	*Cacatua roseicapilla subsp. assimilis*		
Bird	Psittaciformes	Psittacidae	*Cacatua sanguinea*	Little Corella	
Bird	Psittaciformes	Psittacidae	*Cacatua sanguinea subsp. westralensis*	Little Corella	
Bird	Psittaciformes	Psittacidae	*Melopsittacus undulatus*	Budgerigar	
Bird	Psittaciformes	Psittacidae	*Neophema bourkii*	Bourke's Parrot	
Bird	Psittaciformes	Psittacidae	*Platycercus zonarius subsp. zonarius*		
Bird	Passeriformes	Ptilonorhynchidae	*Ptilonorhynchus maculatus subsp. guttatus*	Western BowerBird	
Bird	Strigiformes	Strigidae	*Ninox novaeseelandiae*	Boobook Owl	EPBCA Marine
Bird	Passeriformes	Sylviidae	*Cincloramphus cruralis*	Brown Songlark	
Bird	Passeriformes	Sylviidae	*Cincloramphus mathewsi*	Rufous Songlark	
Bird	Passeriformes	Sylviidae	*Eremiornis carteri*	Spinifex-Bird	
Bird	Charadriiformes	Turnicidae	*Turnix velox*	Little Button-quail	
Bird	Gruiformes	Otididae	*Ardeotis australis*	Australian Bustard	DEC Priority 4
Reptile	Squamata	Agamidae	*Ctenophorus caudicinctus subsp. caudicinctus*		
Reptile	Squamata	Agamidae	*Ctenophorus isolepis subsp. isolepis*		
Reptile	Squamata	Agamidae	*Ctenophorus reticulatus*	Western Netted Dragon	
Reptile	Squamata	Agamidae	*Diporiphora valens*		
Reptile	Squamata	Agamidae	*Pogona minor subsp. minor*		

Group	Order	Family	Species	Common Name	Status
Reptile	Squamata	Boidae	*Liasis olivaceus subsp. barroni*	Pilbara Olive Python	WCA Schedule 1 and EPBCA Vulnerable
Reptile	Squamata	Boidae	*Antaresia perthensis*	Pygmy Python	
Reptile	Squamata	Boidae	*Antaresia stimsoni subsp. stimsoni*		
Reptile	Squamata	Carphodactylidae	*Nephrurus wheeleri subsp. cinctus*		
Reptile	Squamata	Diplodactylidae	*Diplodactylus conspicillatus*	Fat-tailed Gecko	
Reptile	Squamata	Diplodactylidae	*Diplodactylus pulcher*		
Reptile	Squamata	Diplodactylidae	*Lucasium stenodactylum*		
Reptile	Squamata	Diplodactylidae	*Lucasium wombeyi*		
Reptile	Squamata	Diplodactylidae	*Rhynchoedura ornata*	Beaked Gecko	
Reptile	Squamata	Diplodactylidae	*Strophurus elderi*		
Reptile	Squamata	Diplodactylidae	*Strophurus wellingtonae*		
Reptile	Squamata	Diplodactylidae	*Oedura marmorata*	Marbled Velvet Gecko	
Reptile	Squamata	Elapidae	*Acanthophis wellsi*	Pilbara Death Adder	
Reptile	Squamata	Elapidae	*Brachyurophis approximans*		
Reptile	Squamata	Elapidae	*Demansia psammophis subsp. cupreiceps*		
Reptile	Squamata	Elapidae	*Demansia rufescens*	Rufous Whipsnake	
Reptile	Squamata	Elapidae	*Furina ornata*	Moon Snake	
Reptile	Squamata	Elapidae	*Parasuta monachus*		
Reptile	Squamata	Elapidae	*Pseudechis australis*	Mulga Snake	
Reptile	Squamata	Elapidae	*Pseudonaja modesta*	Ringed Brown Snake	
Reptile	Squamata	Elapidae	*Pseudonaja nuchalis*	Gwardar	
Reptile	Squamata	Elapidae	*Vermicella snelli*		
Reptile	Squamata	Elapidae	*Suta fasciata*	Rosen's Snake	
Reptile	Squamata	Gekkonidae	*Gehyra punctata*		
Reptile	Squamata	Gekkonidae	*Gehyra variegata*		
Reptile	Squamata	Gekkonidae	*Heteronotia binoei*	Bynoe's Gecko	
Reptile	Squamata	Gekkonidae	*Heteronotia spelea*	Desert Cave Gecko	

Group	Order	Family	Species	Common Name	Status
Reptile	Squamata	Gekkonidae	*Gehyra pilbara*		
Reptile	Squamata	Pygopodidae	*Delma elegans*		
Reptile	Squamata	Pygopodidae	*Delma haroldi*		
Reptile	Squamata	Pygopodidae	*Delma nasuta*		
Reptile	Squamata	Pygopodidae	*Delma pax*		
Reptile	Squamata	Pygopodidae	*Delma tincta*		
Reptile	Squamata	Pygopodidae	*Lialis burtonis*		
Reptile	Squamata	Pygopodidae	*Pygopus nigriceps*		
Reptile	Squamata	Pygopodidae	*Delma butleri*		
Reptile	Squamata	Scincidae	*Carlia munda*		
Reptile	Squamata	Scincidae	*Cryptoblepharus buchananii*		
Reptile	Squamata	Scincidae	*Cryptoblepharus ustulatus*		
Reptile	Squamata	Scincidae	*Ctenotus duricola*		
Reptile	Squamata	Scincidae	*Ctenotus grandis subsp. titan*		
Reptile	Squamata	Scincidae	*Ctenotus helenae*		
Reptile	Squamata	Scincidae	*Ctenotus pantherinus subsp. ocellifer*		
Reptile	Squamata	Scincidae	*Ctenotus rubicundus*		
Reptile	Squamata	Scincidae	*Ctenotus rutilans*		
Reptile	Squamata	Scincidae	*Ctenotus saxatilis*	Rock Ctenotus	
Reptile	Squamata	Scincidae	*Ctenotus schomburgkii*		
Reptile	Squamata	Scincidae	*Cyclodomorphus melanops subsp. melanops*		
Reptile	Squamata	Scincidae	*Egernia formosa*		
Reptile	Squamata	Scincidae	*Lerista flammicauda*		
Reptile	Squamata	Scincidae	*Lerista muelleri*		
Reptile	Squamata	Scincidae	*Lerista zietzi*		
Reptile	Squamata	Scincidae	*Menetia surda subsp. surda*		
Reptile	Squamata	Scincidae	*Morethia ruficauda subsp. exquisita*		

Group	Order	Family	Species	Common Name	Status
Reptile	Squamata	Scincidae	*Proablepharus reginae*		
Reptile	Squamata	Scincidae	*Tiliqua multifasciata*	Central Blue-tongue	
Reptile	Squamata	Scincidae	*Eremiascincus richardsonii*	Broad-banded Sand Swimmer	
Reptile	Squamata	Scincidae	*Lerista jacksoni*		
Reptile	Squamata	Typhlopidae	*Ramphotyphlops grypus*		
Reptile	Squamata	Typhlopidae	*Ramphotyphlops hamatus*		
Reptile	Squamata	Typhlopidae	*Ramphotyphlops waitii*		
Reptile	Squamata	Varanidae	*Varanus acanthurus*	Spiny-tailed Monitor	
Reptile	Squamata	Varanidae	*Varanus brevicauda*	Short-tailed Pygmy Monitor	
Reptile	Squamata	Varanidae	*Varanus bushi*	Pilbara Mulga Monitor	
Reptile	Squamata	Varanidae	*Varanus tristis subsp. tristis*	Racehorse Monitor	
Reptile	Squamata	Varanidae	*Varanus panoptes subsp. rubidus*		
Reptile	Squamata	Varanidae	*Varanus pilbarensis*	Pilbara Rock Monitor	
Amphibian	Anura	Hylidae	*Cyclorana maini*	Sheep Frog	
Amphibian	Anura	Hylidae	*Litoria rubella*	Little Red Tree Frog	
Amphibian	Anura	Limnodynastidae	*Neobatrachus aquilonius*	Northern Burrowing Frog	
Amphibian	Anura	Limnodynastidae	*Opisthodon spenceri*	Centralian Burrowing Frog	
Amphibian	Anura	Myobatrachidae	*Uperoleia russelli*	Northwest Toadlet	