Greater Paraburdoo
Detailed Flora and Vegetation Survey
April 2018

Prepared for
Rio Tinto

astron

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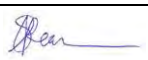
B	21/12/2018	J. McShane	S. Pearse	
0	23/01/2019	J. McShane	B. Lucas	
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Abbreviations

Abbreviation	Definition
Astron	Astron Environmental Services
BAM Act	*Biosecurity and Agriculture Management Act 2007*
BoM	Bureau of Meteorology
DBCA	Department of Biodiversity, Conservation and Attractions
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Area
GDA	Geocentric Datum of Australia
GDE	Groundwater Dependent Ecosystem
GPS	Global Positioning System
ha	Hectare
IBRA	Interim Biogeographic Regionalisation for Australia
indet.	Indeterminate
km	Kilometre
MNES	Matters of National Environmental Significance
MGA	Map Grid of Australia
NVIS	National Vegetation Information System
P	Priority
PEC	Priority Ecological Community
PFC	Percentage Foliar Cover
sp.	Species (singular)
spp.	Species (plural)
subsp.	Subspecies
survey area	Greater Paraburdoo Development Envelope (approximately 11,203 ha)
T	Threatened
TEC	Threatened Ecological Community
TPFL	Threatened and Priority Flora Database
TP List	Threatened and Priority Flora List
WA Herbarium	Western Australian Herbarium
WC Act	*Wildlife Conservation Act 1950*
WoNS	Weeds of National Significance

Executive Summary

Rio Tinto is evaluating the potential development of a number of iron ore deposits within the Greater Paraburdoo area. Astron Environmental Services was commissioned to undertake a Detailed (two phase) flora and vegetation assessment of the Greater Paraburdoo Development Envelope, a survey area of 11,203 hectares. Phase 1 was surveyed in two field visits from 20 to 31 July 2017 and 18 to 25 August 2017 with Phase 2 surveyed from 7 to 15 April 2018.

Twenty-one vegetation units were recorded in the survey area, none of which represent a threatened ecological community or priority ecological community. All vegetation units are considered well represented beyond the survey area and do not support assemblages of species that are unique, located on restricted landforms, or of high conservation significance. One vegetation unit (D7) is considered a potential groundwater dependent ecosystem.

Vegetation condition ranged from Excellent to Completely Degraded. An estimated 41.1% of the survey area was rated between Very Good and Excellent, 17.9% was rated as Good and 10.4% was rated between Poor and Degraded. An estimated 30.6% of the survey area was cleared and rated as Completely Degraded. Disturbances included an extensive network of drill lines, drill pads and tracks as well as mining infrastructure in the central areas. Other disturbances included grazing by cattle in the drainage lines and associated plains and parts of the eastern survey area being burnt within the past two to three years. Weed diversity and abundance was highest in drainage lines and alluvial plains; hilltops and slopes generally had lower weed abundance.

There were 300 confirmed vascular flora taxa from 50 families and 132 genera recorded during the current survey. When combined with the previous site data from within the survey area a total of 470 taxa have been recorded. The most represented families were Fabaceae, Poaceae and Malvaceae.

The survey identified seven confirmed taxa of conservation significance; *Aluta quadrata* T, *Eremophila* sp. Hamersley Range (K. Walker KW 136) P1, *Hibiscus campanulatus* P1, *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727) P3, *Grevillea saxicola* P3, *Nicotiana umbratica* P3, *Sida* sp. Barlee Range (S. van Leeuwen 1642) P3 and one unconfirmed (*Solanum* sp. (indet.)) species of conservation significance. *Solanum octonum* P2 was recorded in previous surveys in and around Doggers Gorge. Botanical collections from this population were not able to be identified as *S. octonum* but matched an undescribed and potentially new taxon given the interim name of *Solanum* sp. (indet.). *Ptilotus trichocephalus* P4 was previously recorded within the survey area but not encountered during the current survey.

Five taxa recorded within the survey area were considered as range extensions of greater than 50 km from their currently known distributions (*Hibiscus sturtii* var. *platychlamys, Plumbago zeylanica, *Ruellia simplex, Sida* sp. Golden calyces glabrous (H.N. Foote 32) and *Sida* sp. L (A.M. Ashby 4202). A further two taxa were not able to be confirmed to species level, but could also be considered range extensions (*Frankenia* aff. *hispidula, F.* aff. *magnifica*).

Twenty-two introduced flora species (weeds) were recorded during the current survey, none of which are listed as Weeds of National Significance or as declared pests. The occurrence of **Ruellia simplex* (Mexican petunia) is the first record within Western Australia and as a result it is listed as "Unlisted – s14" under the *Biosecurity and Agriculture Management Act 2007*.

Table of Contents

List of Figures

List of Plates

List of Tables

List of Appendices

1 Introduction

1.1 Project Background

Rio Tinto, on behalf of the joint venture participants, is evaluating the potential development of a number of iron ore deposits within the Greater Paraburdoo Operations in the Pilbara region of Western Australia. This report presents the outcome of the Detailed flora and vegetation assessment of the Greater Paraburdoo Development Envelope (the survey area). The survey area is 11,203 ha (Figure 1).

1.2 Scope and Objectives

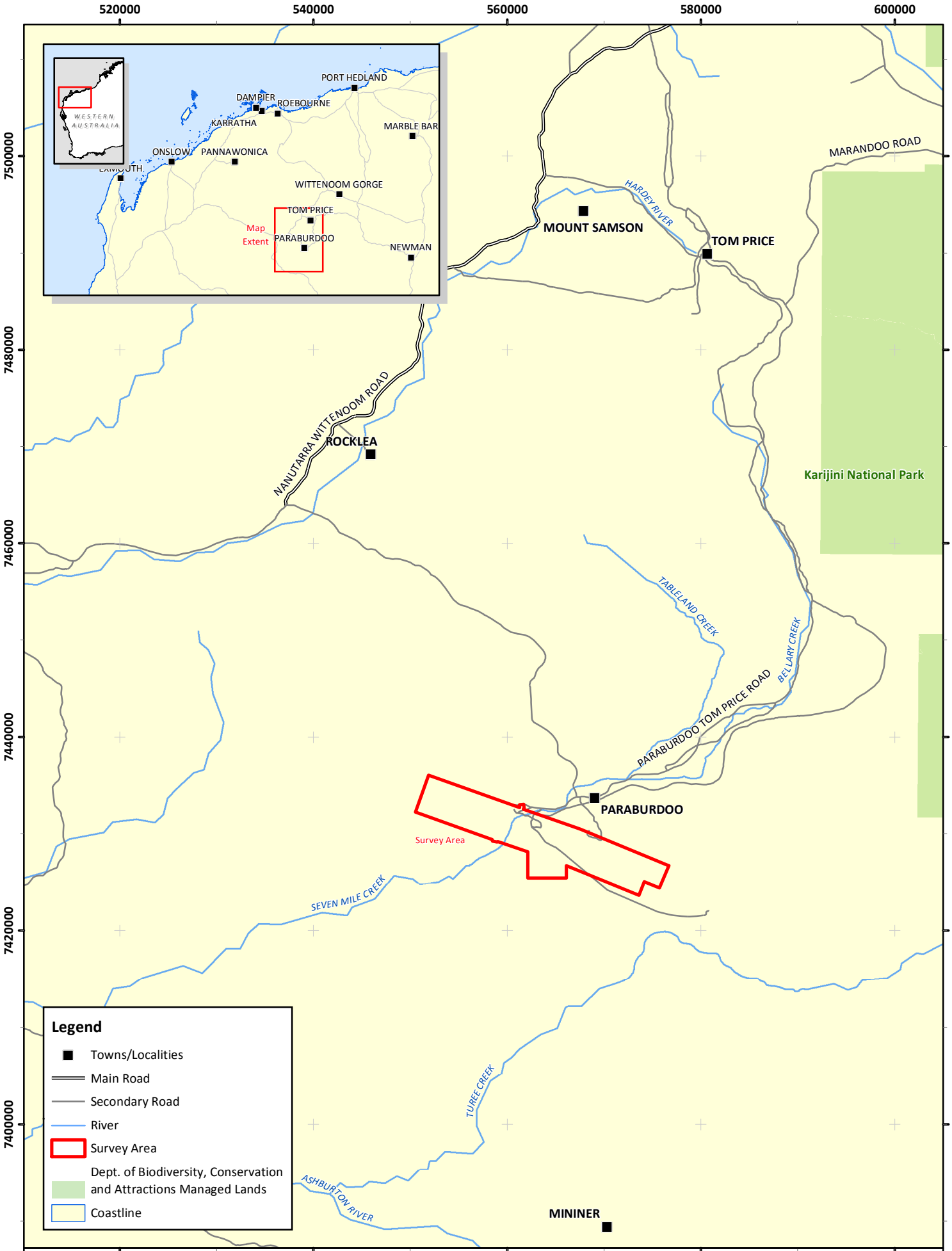
The objective of the assessment was to undertake a Detailed assessment of flora and vegetation values through a desktop assessment and field survey with incorporation of data from previous biological surveys. The resultant data has been utilised to produce this report, which is intended to support and inform the environmental assessment process in accordance with the requirements of the Environmental Protection Authority (EPA). The scope of work was to undertake a:

- desktop assessment, including database searches and literature review of available contextual and project related resources
- dual-phase flora and vegetation assessment, including:
    - establishment of new quadrats to ensure adequate replication within vegetation units (Phase 1) and rescoring these quadrats (Phase 2)
    - ground-truthing, verification and refinement of existing vegetation mapping using quadrats, relevés and mapping notes
    - targeted searches for the presence of threatened (T) and priority (P) flora, and weeds and vegetation of conservation significance
    - mapping of vegetation condition and disturbance within the survey area
    - generation of a vascular flora species list for the survey area.

The scope and key limitations of the survey are outlined in Table 1. Section 3.5 of this report provides more detail on the limitations of the survey.

Table 1: Summary of Astron's vegetation and flora assessment.

Level of survey	Survey area size	Survey timing	Relevant regulatory guidance documents	Key survey limitations
Detailed dual-phase survey	11,203.4 ha	• 20 July to 1 August and 18 to 25 August 2017 (Phase 1) • 7 to 15 April 2018 (Phase 2)	• Position Statement No. 3 (Environmental Protection Authority 2002) • Guidance Statement No. 51 (Environmental Protection Authority 2004b) • Technical Guidance – Flora and Vegetation Surveys for Environmental Impact (Environmental Protection Authority 2016b) • Environmental Factor Guideline - Flora and Vegetation (Environmental Protection Authority 2016a)	• Conditions for ephemeral taxa were average to below average. • Some limitations for access (rail loop, remote areas in the east of the survey area).



Rio Tinto

Greater Paraburdoo - Detailed Flora and Vegetation Survey, April 2018

Figure 1: Survey area location

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Author: B. Eckermann	Date: 13-12-2018
Drawn: C. Dyde	Figure Ref: 14284-18-BIDR-1RevB_181213_Fig01_Locn

Datum: GDA 1994 - Projection: MGA Zone 50

0 5 10 15 20 Km

N

2 Environmental Context

2.1 Physical Environment

2.1.1 Climate

The climate of the Pilbara region of Western Australia is classified as arid tropical with two distinct seasons: a hot, wet summer (October – April) and a mild, dry winter (May – September) (Bureau of Meteorology 2018).

Based on long-term climatic data from the nearest Bureau of Meteorology weather station at Paraburdoo Aero (Station 007185, approximately 10 km north-east of the survey area) the mean annual rainfall since 1974 is 315 mm. The mean maximum daily temperatures range between 24.8°C and 40.6°C, and range above 30°C for much of the year (Bureau of Meteorology 2018) (Figure 2).

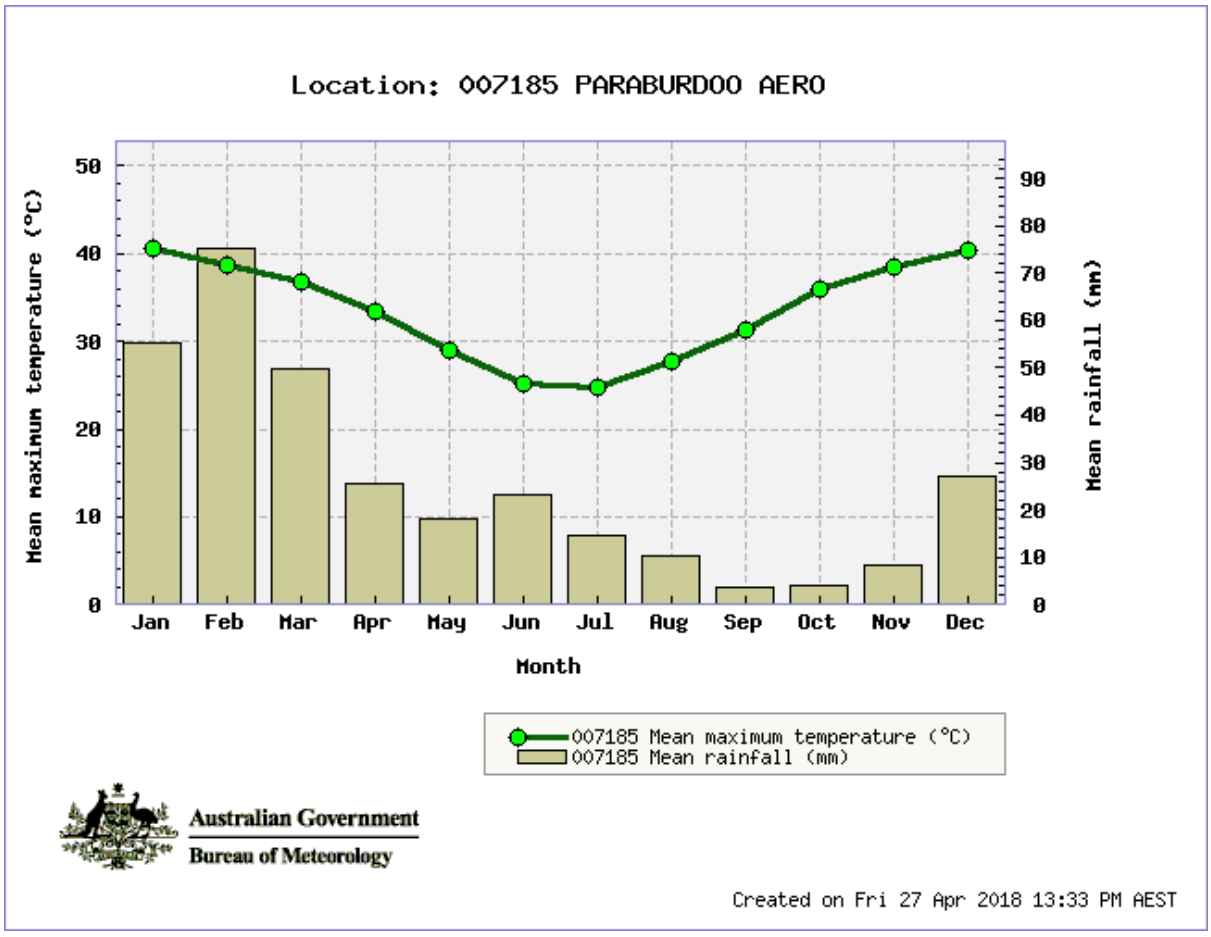


Figure 2: Climate data for Paraburdoo (Station 007185). Mean annual rainfall data has been calculated from 1974 – 2018 and mean maximum temperature has been calculated from 1966 – 2018 (Bureau of Meteorology 2018).

2.1.2 Geology and Soils

The surface geology of the survey area is comprised of 10 units (Stewart et al. 2008), with the Colluvium 3841 being the most dominant (Table 2). Geological mapping of the survey area and surrounds is presented in Figure A.1, Appendix A.

Table 2: Geological units of the survey area (Stewart et al. 2008).

Geological name	Label	Area within survey area (ha)
Colluvium 38491: colluvium, sheetwash, talus; gravel piedmonts and aprons over and around bedrock; clay-silt-sand with sheet and nodular kankar; alluvial and aeolian sand-silt-gravel in depressions and broad valleys in Canning Basin; local calcrete, reworked laterite.	Qrc	2,755.7
Hamersley Group: undivided chert, banded iron-formation, jaspilite, dolomite, mudstone, siltstone.	Lch	2,564.6
Brockman Iron Formation: banded iron-formation, chert, mudstone and siltstone.	Lchk	1,816.2
Fortescue Group: metadolerite, dolerite, gabbro; medium to coarse grained, massive grey-green rock, usually foliated.	Adf	1,058.1
Weeli Wolli Formation: banded iron-formation (commonly jaspilitic), mudstone, siltstone; common interlayered metadoleritic sills.	Lchw	1,016.4
Jeerinah Formation: shale, sandstone, siltstone, mudstone, dolomite, local microbanded chert, jaspilite, conglomerate; fine-grained massive rhyolite; mafic tuff with local accretionary lapilli and agglomerate; thin basalt/dolerite and andesitic basalt flows.	Awfj	893.9
Alluvium 38485: channel and flood plain alluvium; gravel, sand, silt, clay, locally calcreted.	Qa	402.4
Calcrete 38497: pisolitic, nodular or massive calcrete; ferruginous inclusions; calcareous cementing of bedrock and transported materials; locally with intercalated chalcedony; as low mounds, in playa lakes, or as valley calcrete; locally dissected and karstified.	Czk	343.0
Mount McGrath Formation: coarse sandstone, conglomerate, pelite, dolomite.	Lsym	294.4
Bunjinah Formation: metabasaltic pillow lava and breccia; metatuff and minor chert.	Abfb	58.7

2.1.3 Surface Water and Hydrology

No Wetlands of International Importance (i.e. Ramsar wetlands) or Nationally Important Wetlands occur within the survey area (Department of the Environment and Energy 2017c, 2017b). The nearest Nationally Important Wetland is Mt. Bruce coolibah-lignum flats located 85 km north-east of the survey area.

Two major creek lines occur in the west of the survey area, Pirraburdoo Creek (including an area of permanent pooling water known as Ratty Springs) and Seven Mile Creek, both of which run into the Minilya River South Branch south of the survey area. One major creek line named Stoney Creek occurs in the east of the survey area and runs into Turee Creek south of the survey area. A number of other smaller unnamed drainage lines occur in the survey area, some of which contain areas of semi-permanent water, such as Doggers Gorge in the east of the survey area.

2.2 Biological Environment

2.2.1 Interim Biogeographic Regionalisation of Australia

The Interim Biogeographic Regionalisation for Australia (IBRA version 7) divides the Australian continent into 89 bioregions and 419 subregions (Department of the Environment and Energy

2016a). The IBRA regions represent a landscape-based approach to classifying the land surface, including attributes of climate, geomorphology, landform, lithology, and characteristic flora and fauna. The survey area occurs in the Pilbara Bioregion, of which 5% to 10% is represented in the national reserve system (Department of the Environment and Energy 2016b).

The biodiversity of the 53 subregions recognised in Western Australia was documented as part of a national audit to provide priorities for conservation action (Department of Conservation and Land Management 2002). The survey area occurs within the Hamersley subregion (10,168.8 ha) of the Pilbara region and the Ashburton subregion (1,034.6 ha) of the Gascoyne region. These subregions are described in the audit as:

- Hamersley PIL3 – dissected bold plateaux and ranges of flat lying, moderately folded sandstone and quartzite with vegetation described as mulga low woodland over tussock grasses occurring on fine textured soils in valley floors, with scattered snappy gum (*Eucalyptus leucophloia*) over *Triodia brizoides* on skeletal soils of the ranges (Kendrick 2001b).
- Ashburton GAS1 - Mountainous range country divided by broad flat valleys of shales, sandstones and conglomerates with vegetation described a mulga or snakewood low woodlands over hardpans, with low mixed shrublands on hills and areas supporting large areas of *Triodia* (Kendrick 2001a).

2.2.2 Land Systems

Land systems of the Western Australian rangelands have been mapped and described by the Department of Primary Industries and Regional Development (formerly the Department of Agriculture and Food) outlining the distributions and providing comprehensive descriptions of biophysical resources, including soil and vegetation condition. A total of 102 land systems occur in the Pilbara bioregion covering 181,723 km^2 and a total of 172 land systems occur in the Gascoyne bioregion covering 183,784 km^2. Eleven land systems occur in the survey area; four occur within both the Pilbara and Gascoyne bioregions, an additional five occur within the Pilbara bioregion and an additional two occur within the Gascoyne bioregion (Table 3). The layout of these land systems within the survey area is shown in Figure A.2, Appendix A.

Table 3: Distribution of land systems within the survey area.

Land system	Total area within bioregion (ha)	Total area within survey area (ha)	Proportion within survey area (%)
Pilbara bioregion			
Newman - rugged jaspilite plateaux, ridges and mountains with hard spinifex.	1,994,339	6,547.1	0.3
Platform - dissected slopes and raised plains supporting shrubby hard spinifex grasslands.	236,390	880.9	0.4
Boolgeeda - stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands and mulga shrublands.	961,847	720.4	<0.1
Capricorn - rugged sandstone hills, ridges, stony footslopes and interfluves supporting low acacia shrublands or hard spinifex grasslands with scattered shrubs.	698,396	558.5	<0.1
River - active flood plains, major rivers and banks supporting grassy eucalypt woodlands, tussock grasslands and soft spinifex grasslands.	481,994	551.1	0.1
Marandoo - basalt hills and restricted stony plains supporting grassy mulga shrublands.	176,317	523.2	0.3
Rocklea - basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex and occasionally soft spinifex grasslands with scattered shrubs.	2,880,288	185.9	<0.1
Ethel - cobble plains with sparse mulga and other acacia shrublands.	2,886	140.8	4.9
Paraburdoo - basalt derived stony gilgai plains and stony plains supporting snakewood and mulga shrublands with spinifex, chenopods and tussock grasses.	130,774	61.0	<0.1
Gascoyne bioregion			
Boolgeeda - stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands and mulga shrublands.	37,022	412.3	1.1
Ethel -cobble plains with sparse mulga and other acacia shrublands.	113,657	233.3	0.2
Newman - rugged jaspilite plateaux, ridges and mountains with hard spinifex.	6,021	135.6	2.3
Dollar - stony plains supporting mulga and snakewood shrublands with some chenopod low shrubs.	28,827	91.0	0.3
Table - low calcrete plateaux, mesas and lower plains supporting mulga and cassia shrublands and minor spinifex grasslands.	138,971	81.7	<0.1
River - active flood plains, major rivers and banks supporting grassy eucalypt woodlands, tussock grasslands and soft spinifex grasslands.	73,008	80.6	0.1

2.2.3 Pre-European Vegetation

Beard (1975) completed broad-scale (1:1,000,000) pre-European vegetation mapping at an association level.

Four pre-European vegetation units, 82, 181, 567 and 163 (Shepherd, Beeston, and Hopkins 2002), are associated with the survey area (Figure A.3, Appendix A). Table 4 summarises the current and pre-European extent of these four vegetation units in the Pilbara bioregion, Gascoyne bioregion and the survey area.

Table 4: Extent of pre-European vegetation in the survey area (Government of Western Australia 2018).

Vegetation unit	Mapping unit (Beard 1975)	Description	Extent in survey area (ha)	Pre-European extent (ha)	Current extent in bioregion (ha)	Proportion of pre-European extent remaining (%)	Pre-European extent with formal protection (%)
Pilbara bioregion							
82	e16Lr t3Hi	Hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*	6,206	2,177,574	2,1652,35	99.4	13.6
181	a1,11Si	Shrublands; mulga and snakewood scrub	2,726	65,090	63,204	97.1	7.8
567	a1,2Sr t1,2Hi	Hummock grasslands, shrub steppe; mulga and kanji over soft spinifex and *Triodia basedowii*	1,207	776,824	774,213	99.7	25.5
163	ecZi	Shrublands; *Eremophila* and *Cassia* dwarf scrub	30	236	231	98.1	-
Gascoyne bioregion							
181	a1,11Si	Shrublands; mulga and snakewood scrub	978	1,520,571	1,520,558	99.9	15.3
163	ecZi	Shrublands; *Eremophila* and *Cassia* dwarf scrub	57	388,753	388,690	99.9	-

2.3 State and Commonwealth Conservation Categories and Management

Commonwealth and State regulatory authorities maintain databases of the locations and conservation status of significant flora, fauna and ecological communities in Western Australia.

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage Matters of National Environmental Significance (MNES) including listed flora, fauna and ecological communities. These listed flora, fauna and ecological communities are allocated a conservation category, which are outlined in Tables B.1 and B.2, Appendix B.

Ecological communities may be subject to processes that threaten to destroy or significantly modify it across much of its range. These communities are identified as threatened ecological communities (TECs) and are listed at both Commonwealth level under the EPBC Act and State level by the Western Australian Minister for Environment (Table B.3, Appendix B). The Department of Biodiversity, Conservation and Attractions (DBCA) maintains a list of priority ecological communities (PECs), which may also be under threat and are assigned one of four priority rankings according to the criteria outlined in Table B.4 (Appendix B).

Under Western Australian legislation, all native flora is protected and it is an offence to 'take' protected flora. The *Wildlife Conservation Act 1950* (WC Act)[1] also provides for native plant species to be specially protected when they are under identifiable threat of extinction, are rare, or otherwise in need of special protection (Department of Biodiversity, Conservation, and Attractions 2017a). Such specially protected flora is considered under the WC Act to be 'declared rare' (threatened). In addition, due to the diversity of Western Australia's flora, many species are known from only a few collections or locations, but have not been adequately surveyed. Such flora may be rare or threatened, but cannot be considered for declaration as threatened flora until adequate surveys have been undertaken. These flora species are included on a supplementary conservation list managed by DBCA called the *Priority Flora List* (Table B.5, Appendix B).

2.4 Introduced Flora (Weeds)

Significant weed species are identified at both the state and national level. The Australian Weeds Strategy (Australian Weeds Committee 2012a) identifies Weeds of National Significance (WoNS) which have the potential to impact primary industry and/or environmental and social values. The management of weeds in Western Australia is primarily regulated through the *Biosecurity and Agriculture Management Act 2007* (BAM Act). Species listed under this act are allocated one of three declared pest categories which define the required level of management (Department of Agriculture and Food Western Australia 2016). Declared pest categories and listed weed species' priority ratings are presented in Table B.6, Appendix B.

2.5 Land Use and Tenure

The survey area is located within the Shire of Ashburton. The majority of the survey area is on the Mininer and Rocklea Station pastoral leases. The local area is used for pastoralism, mineral exploration and mining activity. Karijini National Park is the nearest conservation reserve to the survey area, located approximately 26 km to the north-east (Figure 1).

[1]From 1 January 2019, the *Wildlife Conservation Act 1950* has been replaced by the *Biodiversity Conservation Act 2016* and its regulations. This survey was completed in 2018 under the WC Act.

3 Methods

3.1 Desktop Assessment

3.1.1 Database Searches

Environmentally Sensitive Areas (ESAs) are declared by the Minister for Environment under Section 51B of the *Environmental Protection Act 1986* to prevent incremental degradation of important environmental values such as declared rare (T) flora, TECs or significant wetlands. A search for ESAs in the vicinity of the survey area was conducted using Western Australian government datasets (Department of Water and Environmental Regulation 2017) and the Register of the National Estate dataset (Department of the Environment and Energy 2008).

Database searches were conducted to identify listed conservation significant flora and ecological communities within, or in close proximity to, the survey area. Conservation categories for ecological communities and flora are presented in Appendix B. Search results are presented in Appendix C and details are summarised in Table 5. Introduced flora species were compared to the Department of Primary Industries and Regional Development list, to determine if any have been listed as declared pests (Department of Primary Industries and Regional Development 2018), and the WoNS list (Australian Weeds Committee 2012b). Introduced flora categories are presented in Table B.6, Appendix B.

Table 5: Database searches undertaken.

Database	Date search results received	Search focus	Search area
NatureMap (Department of Biodiversity, Conservation, and Attractions 2017b)	14/07/2017	Flora of conservation significance	Diagonal line with a 20 km buffer running from the north-west to the south-east of the survey area, defined by the coordinates: 23°12’03 S, 117°30’07 E and 23°17’16 S, 117°44’27 E
Threatened and Priority Ecological Communities Database (Department of Biodiversity, Conservation, and Attractions 2017c)	25/08/2017	Listed threatened and priority ecological communities	40 km radius from the survey area boundary
Threatened and Priority Flora Database (TPFL) (Department of Biodiversity, Conservation, and Attractions 2017d)	21/08/2017	Listed threatened and priority flora	50 km radius from the survey area boundary
Threatened and Priority Flora List (TP List) (Department of Biodiversity, Conservation, and Attractions 2017e)	21/08/2017	Listed threatened and priority flora	50 km radius from the survey area boundary
Western Australian Herbarium Flora Database (Department of Biodiversity, Conservation, and Attractions 2017f)			

Database	Date search results received	Search focus	Search area
Protected Matters Search Tool (Department of the Environment and Energy 2017d)	04/07/2017	MNES – flora	20 km radius from a diagonal line running from the north-west to the south-east of the survey area, defined by the coordinates: -23.20083, 117.50056 and -23.28806, 117.74056 (MGA50, GDA94)

3.1.2 Literature Review

Flora and vegetation surveys have previously been commissioned by Rio Tinto within the vicinity of the survey area and supplied to Astron Environmental Services (Astron) for the desktop assessment. The previous survey areas in relation to the current survey area are shown in Figure D.1, Appendix D. The reports reviewed as part of this assessment include:

- Flora, Vegetation and Vertebrate Fauna on 23E/42E Paraburdoo (Mattiske Consulting 1998)
- Eastern Ranges Life of Mine Flora and Vegetation Report NVCP (Rio Tinto 2010a)
- Paraburdoo Mine Area Botanical And Vertebrate Fauna Survey (Ecologia Environment 2011)
- Flora and Vegetation Survey of the Turee Syncline Area (Mattiske Consulting 2011)
- Flora and Vegetation Survey for the Paraburdoo Magazine and the Tom Price Powerline Infrastructure Areas (Pilbara Flora 2011)
- Western Range Phase 2 Vegetation and Flora Report (Biota Environmental Sciences 2012b)
- Western Range Additional Area: Vegetation and Flora Report (Biota Environmental Sciences 2012a)
- Turee Creek Water Pipeline Upgrade and Paraburdoo Town Feeder One Line Replacement (Rio Tinto 2012)
- Flora and Vegetation Assessment of the Eastern Ranges Study Area (Rio Tinto 2014)
- Joe's Crossing Biological Assessment (Astron Environmental Services 2015a)
- Paraburdoo Haul Road Biological Assessment (Astron Environmental Services 2015b)
- Doggers Gorge Flora, Vegetation and Fauna Habitat Assessment (Eco Logical Australia 2016).

Other flora assessments within the survey area that contribute to data including weed and conservation significant flora locations include:

- Eastern Range Rare Flora Surveys (Biota Environmental Sciences 2002)
- Doggers Gorge and Howies Hole Access Rare Flora Survey (Hamersley Iron Pty Ltd 2004)
- Paraburdoo GD_01067a&b (Hamersley Iron Pty Ltd 2005a)
- Paraburdoo Tailings Dam Stage 3 GD_05_01133 (Hamersley Iron Pty Ltd 2005b)
- Paraburdoo 4 East Feasibility and Landfill: Native Vegetation Clearing Permit Report (Biota Environmental Sciences 2008)
- ANFO Shed Relocation and 4 East Structural Drilling NVCP Report (Rio Tinto 2008)
- Flora and Vegetation Survey of the Paraburdoo NLC Mine Pit and North Lobe Creek (Rio Tinto 2009b)

- Botanical Survey for a Drilling Program (AR-08-04080 & AR-08-04081) at Paraburdoo (Rio Tinto 2009a)
- Flora and Vegetation Survey of the Paraburdoo Tailings Dam Southern Cell (PTDSC) Development (Rio Tinto 2009c)
- Paraburdoo 11w Mine Development NVCP (Rio Tinto 2009d)
- Flora and Vegetation of the Paraburdoo Magazine Explosives Compound Construction Area and ANFO Shed Relocation (Rio Tinto 2010b)
- Flora and Vegetation of the Proposed 4 West Waste Dump Extension and Southern Bore Field Collector Upgrade, Paraburdoo (Rio Tinto 2010c)
- Flora and Vegetation of the proposed 4EMP Cutback Waste Dump (AR-09-05178)_NVCP (Rio Tinto 2010d)
- Flora and Vegetation of the proposed 11W & 11W1 Pit Extensions and 11W Waste Dump Extension, Paraburdoo (Rio Tinto 2010e)
- Paraburdoo Weed Inspection and Control Field Visits (Astron Environmental Services 2011)
- Flora and Vegetation Survey of the 4e-Stage 3 Southern Waste Dump NVCP Supporting Report (Rio Tinto 2011a)
- Flora and Vegetation Survey of the 5 West Pit Operations NVCP Supporting Report (Rio Tinto 2011b)
- Assessment to Meet Flora Condition of CPS for AR 8389 and 9607 (Rio Tinto 2013)
- Weed Control Program, Inland Operations, Paraburdoo, 2016 Annual Summary Report (Astron Environmental Services 2016).

3.1.3 Likelihood of Occurrence Assessment

Prior to conducting the Phase 1 field survey in 2017, aerial imagery was interpreted to identify potential habitat types. The conservation significant flora species returned from the database searches were then categorised according to the criteria in Table 6 for potential occurrence within the survey area.

Table 6: Pre-survey criteria used to assess the likely presence of conservation significant flora in the survey area.

Likelihood of occurrence	Pre-survey
Likely	Species previously recorded within the survey area or within 10 km of the survey area and suitable habitat appears to be present in the survey area
Potential	Species previously recorded within 10 km to 20 km of the survey area and/or suitable habitat appears to be present in the survey area
Unlikely	No suitable habitat appears to be present in the survey area

Following the Phase 2 field survey, the likelihood of occurrence of conservation significant flora species not encountered within the survey area was reassessed. Species identified during the desktop assessment as having potential to occur during the desktop exercise were categorised post-field based on the proximity of known populations to the survey area, the presence (and thorough inspection) of suitable habitats within the survey area, the life form, preferred habitat and flowering times for each species.

3.2 Field Survey

3.2.1 Survey Timing and Personnel

The Phase 1 field survey was conducted by Astron Senior Botanist Ben Eckermann (Flora Permit SL011923; DRF Permit 48-1617), and Botanists Lucy Dadour (Flora Permit SL012123) and Linda Vaughan (Flora Permit SL011984), from 20 to 31 July 2017. An additional (Phase 1) field survey was conducted by Ben Eckermann and Linda Vaughan, from 18 to 25 August 2017. The Phase 2 field survey was conducted by Astron Senior Botanist Ben Eckermann (Flora Permit SL012249; DRF Permit 66-1718), and Botanists Dr Kellie McMaster (Flora Permit SL012244), Lucy Dadour (Flora Permit SL012252) and Dr Markus Mikli (Flora Permit SL012330), from 7 to 15 April 2018.

3.2.2 Weather

Daily observations for rainfall and temperature were recorded by Rio Tinto at the Paraburdoo weather station, with long term rainfall and temperature observations being sourced from the Bureau of Meteorology (BoM) at the Paraburdoo Aero station (number 007185), approximately 15 km north-east of the Paraburdoo weather station. Local rainfall and temperatures preceding the survey are presented in Figure 3.

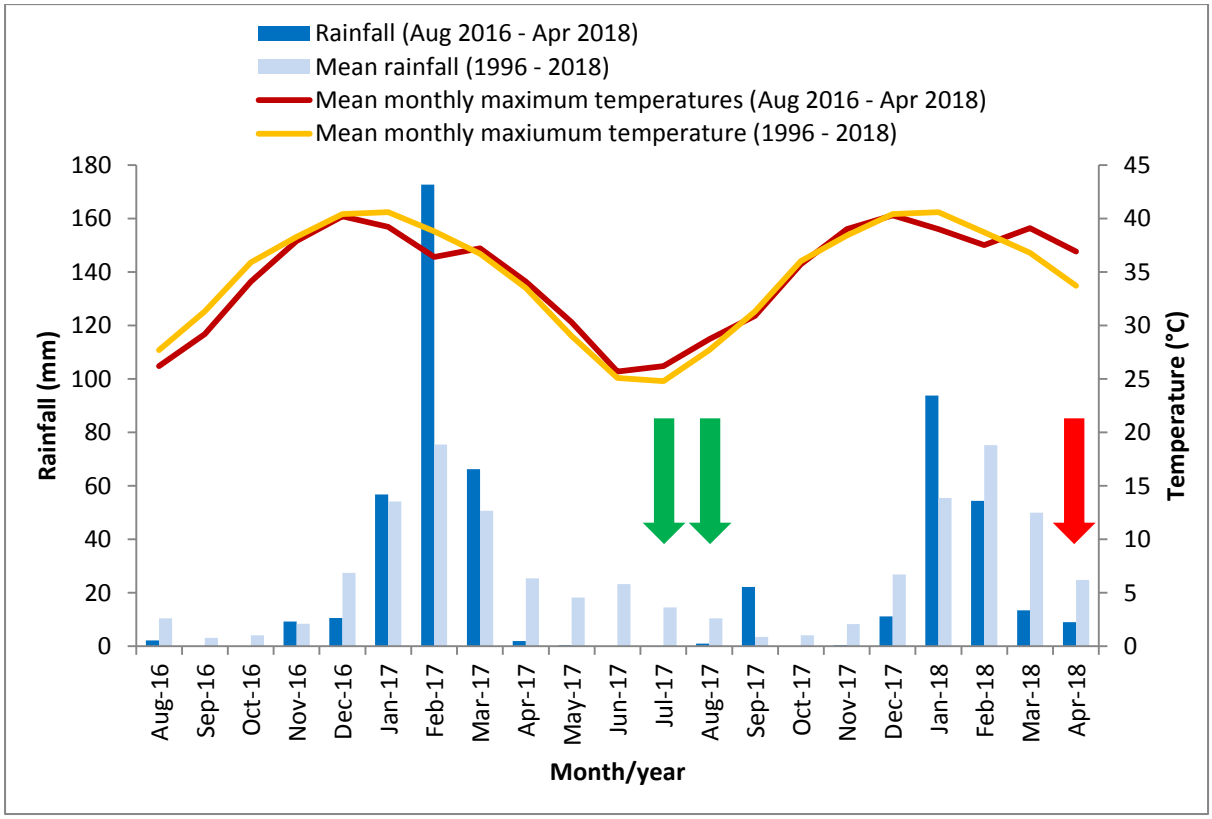


Figure 3: Mean monthly and recorded monthly rainfall (mm) and maximum temperatures (°C). Daily records supplied by Rio Tinto and long term records supplied by BoM from the Paraburdoo Aero station (007185) (Bureau of Meteorology 2018). The green arrows display timing for the Phase 1 surveys, with the red arrow displaying timing for the Phase 2 survey.

Rainfall recorded in the 12 months prior to the second Phase 1 survey in August 2017 was 317.6 mm, 3.2 mm more than the long-term mean of 314.4 mm (Bureau of Meteorology 2018). The majority of this rain fell during the summer cyclone season, with 239.2 mm recorded between February and March 2017. In the three months preceding the first Phase 1 survey in July 2017,

10.4 mm was recorded; the long term mean for the same period is 66.2 mm (Bureau of Meteorology 2018). No rainfall was recorded in the three months preceding the second Phase 1 survey in August 2017. The long term mean rainfall for the same period was 55.9 mm (Bureau of Meteorology 2018).

Rainfall recorded in the 12 months prior to the Phase 2 survey in April 2018 was 230 mm, 84.4 mm less than the long-term mean (Bureau of Meteorology 2018). In the three months preceding the April survey, 191 mm was recorded while the mean average rainfall for the same time period is 180.5 mm (Bureau of Meteorology 2018). The majority of this rain fell during the summer cyclone season, with 171 mm being recorded between January and February 2018. The mean maximum temperature of 37.2°C for April 2018 was above the long term maximum temperature of 33.7°C for April (Bureau of Meteorology 2018) (Figure 3).

3.2.3 Vegetation and Flora Assessment

The survey was undertaken in accordance within the requirements outlined in the Scope of Work provided, dated 25 May 2017, as well as the requirements of the EPA and Rio Tinto policy and guidance documents (Rio Tinto 2017; Environmental Protection Authority 2016b, 2004b, 2002).

Information acquired during the desktop assessment assisted in the design of the field survey prior to Phase 1 in 2017. Pre-survey planning involved the examination of 1:10,000 scale aerial photography to identify potentially different landforms, habitat and vegetation units. It also involved a review of the flora and vegetation assessments previously completed at Greater Paraburdoo (Biota Environmental Sciences 2012b, 2012a; Ecologia Environment 2011; Rio Tinto 2014, 2010a; Eco Logical Australia 2016) to provide context and identify data gaps. Proposed quadrat locations were identified prior to the field survey according to the replicates required to support the previous vegetation mapping and adjusted on site as appropriate (Biota Environmental Sciences 2012b, 2012a; Ecologia Environment 2011; Rio Tinto 2014).

A total of 69 sites, comprising 64 quadrats and five relevés were sampled within the survey area over the Phase 1 and 2 surveys. Forty-one quadrats and three relevés were newly established during the Phase 1 survey. Quadrats that were not permanently marked or did not contribute to the required survey site spatial coverage for each vegetation unit were not considered suitable. Quadrats from previous surveys that had been sampled in a single phase were considered for rescoring during the current survey (Biota Environmental Sciences 2012a; Ecologia Environment 2011). Quadrats that were not permanently marked or did not contribute to the required survey site spatial coverage for each vegetation unit were not considered suitable. Thirteen sites were identified as suitable, with 11 quadrats and two relevés being rescored and incorporated into the survey program. An additional 11 quadrats that had been sampled in two seasons were also incorporated into the survey program (Biota Environmental Sciences 2012b)

A total of 43 sites were revisited during the Phase 2 survey, comprising rescoring all of the 41 quadrats installed in Phase 1 and revisiting two of the three relevés established in Phase 1. One of the relevés (GPR25) was not revisited due to access constraints. In addition to the revisits, one new quadrat (GP45) was established in the H2 vegetation unit during the Phase 2 survey. Survey effort is detailed in Table 7. The data from each surveyed site were used for mapping and floristic analysis purposes.

Mapping notes were also taken to support the vegetation mapping, these recorded location coordinate, photograph, vegetation description, associated species, vegetation condition and fire history (Table 7).

Quadrats were positioned by measuring a square of 50 m by 50 m, in suitable terrain, with the four corners marked with flagging tape and where possible a fence dropper positioned in the north west corner. Dimensions of the quadrat were adjusted according to terrain, drainage and landform features, to represent an estimated 2,500 m^2. Data from relevé locations were sampled from an area of approximately 2,500 m^2. In challenging terrain, visual estimation was used to approximate the area.

The following information was collected for each quadrat and relevé:

- Location – coordinates measured using a handheld global positioning system (GPS) unit (MGA50, GDA94) at each of the four corners of the site.
- Recorder and date –personnel involved in sampling that location and the survey date.
- Habitat and slope – a broad description of the surrounding landscape based on landform, topography and soil.
- Soil – including colour and texture.
- Rock type and abundance – general description of geological units and amount of ground covered by rocks.
- Vegetation description – vegetation was described according to level 5 of the National Vegetation Information System (NVIS) (Department of the Environment and Energy 2017a) and classified according to the Aplin (1979) modification of the vegetation classification system of Specht (1970) (Appendix E).
- Vegetation condition – assessed according to the vegetation condition classification adapted from Trudgen (1988) (Appendix E).
- Fire age – estimate of time since the vegetation was last burnt.
- Taxa and foliar cover – percentage foliar cover (PFC) and maximum height were recorded for all vascular plant taxa present within the site. The inventory of associated species was comprehensive for relevé locations, with each flora species present in an estimated quadrat dimension recorded.
- Disturbances – records of any obvious disturbances such as fire, tracks or grazing.
- Photographs – a digital image was taken at the north-west and south-east corners of each quadrat or from a representative location for each relevé.

Table 7: Survey effort for existing and newly installed quadrats and relevés occurring within the survey area.

Author; phase of survey	Number of sites	Name of sites
One phase of survey: Astron (current survey)	1 quadrat 1 relevé 28 mapping notes	Quadrats: GP45 (Wet season) Relevés : GPR25 (Dry Season) Mapping Notes: MNBE01, MNBE02, MNBE03, MNBE04, MNBE05, MNBE06, MNBE07, MNBE08, MNBE09, MNBE10, MNBE11, MNBE12, MNBE13, MNBE14, MNBE15, MNBE16, MNBE17, MNBE18, MNBE19, MNBE20, MNBE21, MNBE22, MNBE23, MNBE24, MNLD01, MNLD02, MNLV01, MNLV02

Author; phase of survey	Number of sites	Name of sites
Two phases of survey Dry season (Phase 1) and Wet season (Phase 2): Astron (current survey)	41 quadrats 2 relevés	Quadrats: GP01, GP02, GP03, GP04, GP05, GP06, GP07, GP08, GP09, GP10, GP11, GP12, GP13, GP14, GP15, GP16, GP17, GP18, GP21, GP20, GP22, GP23, GP24, GP26, GP27, GP28, GP29, GP30, GP31, GP32, GP33, GP34, GP35, GP36, GP37, GP38, GP39, GP40, GP41, GP42, GP43, Relevés: GPR19, GPR44
Two phases of survey: (Ecologia Environment 2011) initial phase and current survey rescore phase (Astron rescore site codes presented in brackets)	6 quadrats 2 relevés	Quadrats: e029(e029-AR), e030(e030-AR), e038(e038-AR), e043(e043-AR), e073(e073-AR), e122(e122-AR) Relevés: e006(e006-AR), e074(e074-AR)
Two phases of survey: (Biota Environmental Sciences 2012a) initial phase and current survey rescore phase (Astron rescore site codes presented in brackets)	5 quadrats	WRA01(WRA01-AR), WRA21(WRA21-AR), WRA23(WRA23-AR), WRA39(WRA39-AR), WRA44(WRA44-AR)
Two phases of survey (Biota Environmental Sciences 2012b) (rescore phase site codes in brackets)	11 quadrats	WRF01(WRR01), WRF02(WRR02), WRF03(WRR03), WRF32(WRR32), WRF34(WRR34), WRF36(WRR36), WRF38(WRR38), WRF41(WRR41), WRF43(WRR43), WRF44(WRR44), WRF45(WRR45)

3.2.4 Vegetation Description and Mapping

Where appropriate, vegetation was described and mapped to be consistent with the descriptions and mapping previously conducted in and adjacent to the survey area (Biota Environmental Sciences 2012b). Astron adopted these vegetation codes and descriptions, and reconciled vegetation polygon boundaries to maintain consistency with those datasets. The vegetation descriptions for some codes were updated to reflect current nomenclature. Where vegetation was observed to no longer represent previous mapping, vegetation polygon boundaries were adjusted and new vegetation descriptions assigned. Vegetation units were described and mapped using the data collected from quadrats and relevés, and followed the same convention as that previously used; the vegetation unit code is described according to the initials of the dominant flora species defining the community. In past mapping units and newly described areas, all members of the *Acacia aneura* complex are referred to as *Acacia aneura* sens. lat. for consistency. Mapping notes were also used to mark changes in vegetation throughout the survey area.

3.2.4.1 Vegetation Condition Mapping

Vegetation condition was mapped according to vegetation unit boundaries throughout the survey area, using a combination of quadrat and relevé data, opportunistic observations and the mean condition rating for each vegetation unit. Vegetation condition was rated at each survey site using the five point Trudgen (1988) scale, and then applied to the whole vegetation unit polygon in which it was mapped. A mean condition rating was calculated for each vegetation unit using the data collected from survey sites and this was applied to any polygons not already attributed with a rating.

3.2.5 Targeted Flora Survey

Previously recorded conservation significant flora records and associated habitat preference information assisted in identifying vegetation units and habitat within the survey area that have potential to support conservation significant flora (Department of Biodiversity, Conservation, and Attractions 2017c, 2017d, 2017e, 2017f; Rio Tinto 2014; Biota Environmental Sciences 2012b, 2012a; Ecologia Environment 2011). Habitats and vegetation units in the survey area considered to have the potential to support conservation significant flora were strategically targeted in the field to record the presence or absence of conservation significant flora, with preference given to searching areas that had little or no previous survey history. Traverses were spaced according to the accessibility of habitats, but generally observers were 30 m to 50 m apart. Where conservation significant flora was encountered, a waypoint was established to represent one or a number of individuals.

3.3 Taxonomy and Nomenclature

Plant specimens that were not identified in the field were identified in Perth by Johan Hurter and Astron Senior Botanist Ben Eckermann who have worked extensively in the Pilbara region and are highly familiar with the flora of the region. The assigned nomenclature is consistent with the current listing of scientific names recognised by the Western Australian Herbarium (WA Herbarium) and was used for the species list and associated species information collected. Where specimens had inadequate descriptive material to allow confident identification, they were assigned a 'sp.' (species) epithet, indicating that identification could not be confirmed beyond genus level. Range extensions and conservation significant taxa were submitted to the Rio Tinto sponsored taxonomist Steve Dillon at the WA Herbarium for confirmation.

3.4 Floristic Analysis

A species accumulation curve was created in order to examine the adequacy of survey effort, while cluster analyses were completed to examine the relationship between:

- floristic groups and structural vegetation units within the survey area
- survey area quadrats and relevés and their association with quadrats and relevés surveyed at a broader scale.

For the analysis of data collected by Astron only, 58 samples (quadrats and relevés) were classified, with repeat samples from Phase 1 and Phase 2 combined. For the broader regional contextual analysis, quadrats and relevés from Astron Phase 1 and Phase 2 surveys were included in a dataset along with a further 369 sites from a selection of surveys in the locality (Ecologia Environment 2011; Biota Environmental Sciences 2012b, 2012a; Rio Tinto 2014; GHD Pty Ltd 2009; Mattiske Consulting 2011).

The species lists from all projects used in the analyses were reconciled to provide consistency in nomenclature. Any taxa not confirmed to species level were removed from the analyses. All weed and annual species were also removed prior to analysis. Singletons (species recorded from only one site) were retained.

The species accumulation curve and cluster analyses were completed by Astron Senior Scientist Dr Aaron Gove using R 3.2.1 (R Development Core Team 2015) and PRIMER v6 software (Clarke and Gorley 2006), respectively. The compositional differences amongst samples were quantified using the Bray-Curtis index of similarity based on presence- absence data, while the dendrograms were created using the Average Linkage method. Following normal convention, statistically significant clusters were those distinguished by a P-value <0.05.

3.5 Limitations

Following completion of the desktop assessment and field surveys, a review of any limitations that may have affected a complete assessment of the data collected was conducted. The limitations listed in Table 8 are based on those suggested as considerations in Guidance Statements 51 and 56 (Environmental Protection Authority 2004a, 2004b).

Table 8: Statement of limitations.

Potential limitation	Statement regarding potential limitation
(i) Sources of information and availability of contextual information Is the region well documented?	Previous biological surveys have been conducted in the broader locality, and broad-scale information is available from Beard (1975) and Payne et al. (1980). Thirty-one previous biological reports within the survey area were available for review (refer to Section 3.1.2), contextual information is therefore not a limiting factor for this survey.
(ii) Scope The level of survey and detail required to undertake the survey. Was there adequate time to complete the survey to the desired standard?	There was adequate time to complete the flora and vegetation surveys, complete vegetation mapping, and conduct targeted searches for threatened and priority flora within the survey area as outlined in the scope of works.
(iii) Proportion of flora and fauna identified, recorded and/or collected Was the survey sampling, timing and intensity considered adequate? Was the survey conducted at what was considered an appropriate time of the year for plant identification? Were any taxonomic groups considered to be under-represented?	The field survey was conducted during seasonally below average conditions for the southern Pilbara region in July and August 2017 (Phase 1) and during seasonally average conditions in April 2018 (Phase 2). Sampling intensity was considered adequate without being comprehensive; the flora taxonomic groups recorded within the survey area were considered well represented. Most taxonomic groups expected within the survey area were well represented, and the total floristic richness was considered comparable to other surveys in the area. Five of the priority flora species assessed as having the potential to occur, likely to occur, or were previously recorded in the survey area (Appendix F) are annual or short-lived perennial species, and as such the dry seasonal conditions are likely to have been a limiting factor to the flora survey.
(iv) Completeness Is there further work which may be required i.e. was the relevant area fully surveyed?	The survey area was considered adequately surveyed to compile a representative list of species, (including priority and introduced flora species), as well as describe and map vegetation at a level appropriate for possible future management decisions.
(v) Mapping reliability Were the aerial photographs, satellite images and site maps available considered adequate to fully understand the area surveyed? Was the mapping generated considered to have a high degree of reliability?	Colour aerial photography at a scale of 1: 10,000 was used to locate the survey area and to assist in navigation and delineation of vegetation boundaries. The aerial photography was of good resolution and, in general, accurately represented ground conditions.

Potential limitation	Statement regarding potential limitation
(vi) Timing When was the survey conducted in terms of season, rainfall, severe weather events etc.? Was the survey conducted at an appropriate time for access, observation of the optimal suite of species and for identification of flowering and fruiting species?	Seasonal conditions were below average for surveying the southern Pilbara region during Phase 1 in July/August 2017 and average during Phase 2 in April 2018. No rainfall was recorded in the three months preceding the Phase 1 field surveys and as a result, many annual and short-lived perennial species were absent. Rainfall was 5.8% above average in the three months preceding the Phase 2 survey, and 1% above average in the 12 months preceding the Phase 2 survey. Dry conditions were recorded during the on-ground survey with many annual or short-lived perennial species already desiccated. The survey timing was not ideal and is considered a limiting factor.
(vii) Disturbance Had the survey area been impacted by any disturbance which may have limited the survey, i.e. fire, flood, accidental human intervention etc.?	The survey area has been significantly affected by mining and exploration operations in the past. A history of pastoral activity and cattle grazing was evident on the plains, floodplains and drainage lines. There was evidence of a fire in the south-eastern section of the survey area over the past two to three years. None of these disturbances limited the outcomes of this survey.
(viii) Intensity In retrospect, was the intensity considered to be adequate?	The intensity of the survey was considered adequate to compile a representative species list, map the vegetation of the survey area to association level with adequate quadrat replication and conduct targeted surveys for priority flora in potential habitat.
(ix) Resources Were the appropriate tools and materials available to complete the task effectively?	Resources were adequate to complete the survey and all appropriate tools and materials required to complete the task were available.
(x) Access Were there any factors limiting access to the survey area?	Much of the survey area was able to be accessed by vehicle; areas that were unable to be reached by vehicle were accessed and traversed by foot. All areas within the rail loop and some isolated vegetation within the mining infrastructure area were not able to be accessed. Areas in the eastern portion of the survey area were remote from track access or the tracks were not accessible by vehicle and poorly searched.
(xi) Experience Were personnel undertaking the field survey and plant identification trained and/or experienced in undertaking the required tasks?	The botanists responsible for undertaking the field survey have considerable experience in conducting vegetation and flora surveys in the Pilbara. The identification of specimens brought back from the field was conducted by Johan Hurter and Ben Eckermann who both have extensive Pilbara botanical experience. Range extensions and conservation significant taxa were submitted to the Rio Tinto sponsored taxonomist Steve Dillon at the WA Herbarium for confirmation.

4 Results

4.1 Desktop Assessment

4.1.1 Environmentally Sensitive Areas

The only ESA intersecting the survey area was the 50 m of vegetation surrounding the locations of *Aluta quadrata* T. The Hamersley Range National Park (1977 boundary, now named Karijini National Park) is also considered an ESA and occurs approximately 26 km north-east of the survey area (Department of the Environment and Energy 2008).

4.1.2 Vegetation and Flora

No EPBC Act listed MNES TECs and no State-listed TECs or PECs have been previously recorded within 40 km of the survey area.

The DBCA TPFL (Department of Biodiversity, Conservation, and Attractions 2017d), TP List (Department of Biodiversity, Conservation, and Attractions 2017e) and WA Herbarium database (Department of Biodiversity, Conservation, and Attractions 2017f) searches indicated a total of 56 conservation significant flora taxa have been previously recorded within 50 km of the survey area (Table F.1, Appendix F) (Department of Biodiversity, Conservation, and Attractions 2017f, 2017e, 2017b, 2017d). This includes one State-listed threatened species, nine P1 taxa, 13 P2 taxa, 26 P3 taxa and seven P4 taxa. The pre-survey desktop assessment indicated nine of the listed conservation significant flora species had been previously recorded, four were considered likely to occur within the survey area and a further eight were considered to have the potential to occur (Table F.1, Appendix F).

4.1.3 Literature Review

Results of the literature review indicate that no TECs or PECs have been previously recorded within, or in the vicinity of the survey area.

Nine currently listed flora taxa of conservation significance have been previously recorded within, or in close proximity to, the survey area: *Aluta quadrata* T, *Eremophila* sp. Hamersley Range (K. Walker KW 136) P1, *Hibiscus campanulatus* P1, *Solanum octonum* P2, *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727) P3, *Grevillea saxicola* P3, *Nicotiana umbratica* P3, *Sida* sp. Barlee Range (S. van Leeuwen 1642) P3 and *Ptilotus trichocephalus* P4 (Table 9) (Biota Environmental Sciences 2012b, 2012a; Ecologia Environment 2011; Rio Tinto 2010a, 2014, 2012; Eco Logical Australia 2016; Mattiske Consulting 1998, 2011; Pilbara Flora 2011).

Table 9: Summary of relevant vegetation and flora surveys in the vicinity of the current survey area.

Survey parameter	Mattiske Consulting (1998)	Rio Tinto Iron Ore (2010a)	ecologia Environment (2011)	Mattiske Consulting (2011)	Pilbara flora (2011)	Biota Environmental Sciences (2012b)	Biota Environmental Sciences (2012a)	Rio Tinto Iron Ore (2012)	Rio Tinto Iron Ore (2014)	Astron Environmental Services (2015a)	Astron Environmental Services (2015b)	Eco Logical (2016)
Survey area size (ha)	3,691	1,740	5,655	9,197	697	10,500	4,423	203	2,132	80	142	272
Survey focus	Consolidation of biological values	Native Vegetation Clearing Permit (NVCP)	Single phase Level 2	Baseline survey	NVCP	Two phase Level 2	Single phase Level 2	NVCP	NVCP	Biological Assessment	Biological Assessment	NVCP
Survey timing	N/A	Jul 2010	Jul-Aug 2011	Jun 2011	Nov 2010	May 2011	Sep 2011	Mar 2012	May-Jun and Jul 2014	Nov 2014	Feb 2015	May and Aug 2015
Seasonal conditions	N/A	Average	Average	Optimal	Poor	Optimal	Not optimal	Optimal	Average	Below average	Below average	Optimal
Survey effort (quadrats/relevés)	206 sites	102 quadrats 135 relevés	77 quadrats	122 sampling sites	73 relevés 92 mapping points	38 quadrats	49 quadrats	38 relevés 110 mapping notes	55 quadrats 140 relevés	4 quadrats 7 relevés	19 relevés	33 relevés
Total vegetation units mapped	17	50	22	30	19	22	22	14	62	5	11	11
Conservation significant ecological communities recorded	0	0	0	0	0	0	0	0	0	0	0	0
Total species recorded	195	191	294	230	174	311	326	252	214	62	141	263
Conservation significant flora species recorded (currently listed - as at July 2017)	0	1	2	0	0	6	2	2	5	0	1	7
Aluta quadrata T			✓			✓						
Eremophila sp. Hamersley Range (K. Walker KW 136) P1									✓			
Hibiscus campanulatus P1						✓		✓	✓			✓
Solanum octonum P2									✓			✓
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727) P3						✓	✓	✓				
Grevillea saxicola P3									✓		✓	✓
Nicotiana umbratica P3						✓						✓
Sida sp. Barlee Range (S. van Leeuwen 1642) P3		✓				✓			✓			✓
Ptilotus trichocephalus P4			✓			✓	✓					✓

4.2 Field Survey

4.2.1 Vegetation

There were 21 vegetation units recorded within the survey area. Part of the survey area has been mapped previously and presented in the following reports:

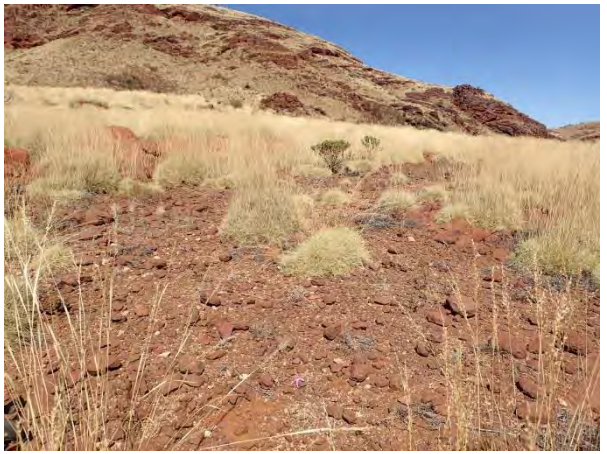
- Eastern Ranges Life of Mine Flora and Vegetation Report NVCP (Rio Tinto 2010a)
- Paraburdoo Mine Area Botanical And Vertebrate Fauna Survey (Ecologia Environment 2011)
- Western Range Phase 2 Vegetation and Flora Report (Biota Environmental Sciences 2012b)
- Western Range Additional Area: Vegetation and Flora Report (Biota Environmental Sciences 2012a)
- Flora and Vegetation Assessment of the Eastern Ranges Study Area (Rio Tinto 2014)
- Doggers Gorge Flora, Vegetation and Fauna Habitat Assessment: Native Vegetation Clearing Permit – Supporting Report (Eco Logical Australia 2016).

Areas where vegetation had been removed for roads, tracks and mining activities were mapped as 'cleared'. Vegetation mapping, quadrat, relevé and mapping note locations are presented in Figure G.1 Appendix G, site data is provided in Appendix H, and vegetation unit descriptions and representative photos are presented in Table 10. All previous vegetation sampling site locations are presented in Appendix I.

Table 10: Vegetation units described for the survey area.

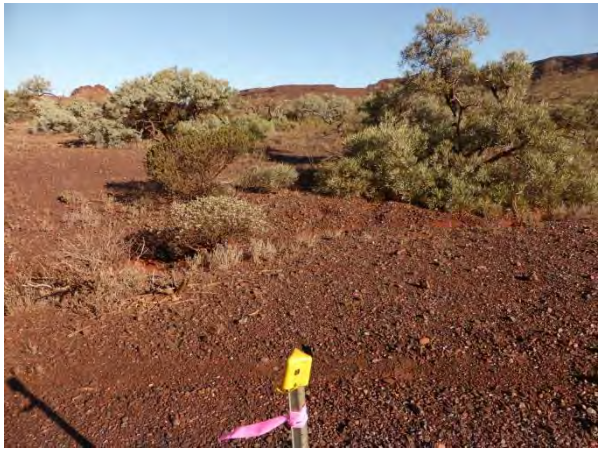
Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
Vegetation of Hills and Ridges				
H1 – AanAprAteTe *Acacia aneura* sens. lat.*, A. pruinocarpa* tall open shrubland over *A. tetragonophylla* scattered shrubs over *Triodia epactia* hummock grassland **Associated species:** *Acacia aptaneura, Aristida contorta, Bulbostylis barbata, Eremophila cuneifolia, E. jucunda* subsp. *pulcherrima, E. latrobei, E. phyllopoda* subsp. *obliqua, Eriachne mucronata, E. pulchella, Gomphrena cunninghamii, Grevillea berryana, Maireana georgei, Polycarpaea longiflora, Psydrax suaveolens, Ptilotus obovatus, P. schwartzii* var. *schwartzii, Senna glutinosa* subsp. *glutinosa, Solanum lasiophyllum, Tribulus suberosus*	GP04, GP20, WRF38, WRF41, WRF45, MNBE01, MNBE02, MNBE06, MNBE17	Degraded – Excellent	1,871.2 (16.7 %)	 **Plate 1: Vegetation unit H1 – AanAprAteTe.**

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
H2 – AprGbERsppTe *Acacia pruinocarpa, Grevillea berryana* tall open shrubland over *Eremophila fraseri* subsp. *fraseri, E. canaliculata, E. cuneifolia* scattered low shrubs over *Triodia epactia* hummock grassland **Associated species:** *Acacia aneura sens. lat., A. tetragonophylla, Bulbostylis barbata, Eremophila cryptothrix, E. jucunda* subsp. *pulcherrima, E. latrobei, Eriachne pulchella, Euphorbia boophthona, Maireana georgei, Paspalidium clementii, Ptilotus obovatus, P. schwartzii* var. *schwartzii, Senna glutinosa* subsp. *glutinosa, S. stricta, Solanum lasiophyllum, Tribulus suberosus*	GP42, GP45, WRF36, MNBE23	Degraded – Excellent	273.3 (2.4%)	 Plate 2: Vegetation unit H2 – AprGbERsppTe.
H3 – DpERcrTe *Dodonaea pachyneura, Eremophila cryptothrix* tall shrubland over *Triodia epactia* hummock grassland **Associated species:** *Acacia aptaneura, A. pruinocarpa, A. tetragonophylla, Bulbostylis barbata, Cheilanthes brownii, Dodonaea petiolaris, Eremophila latrobei* (various subspecies), *Eriachne mucronata, E. pulchella* subsp. *pulchella, Grevillea berryana, Marsdenia australis, Paspalidium clementii, Ptilotus schwartzii* var. *schwartzii, P. obovatus, Sida fibulifera, S.* sp. Excedentifolia (J.L. Egan 1925), *Solanum lasiophyllum, Tribulus suberosus*	GP01, GP02	Very Good – Excellent	13.3 (0.1%)	 Plate 3: Vegetation unit H3 – DpERcrTe.

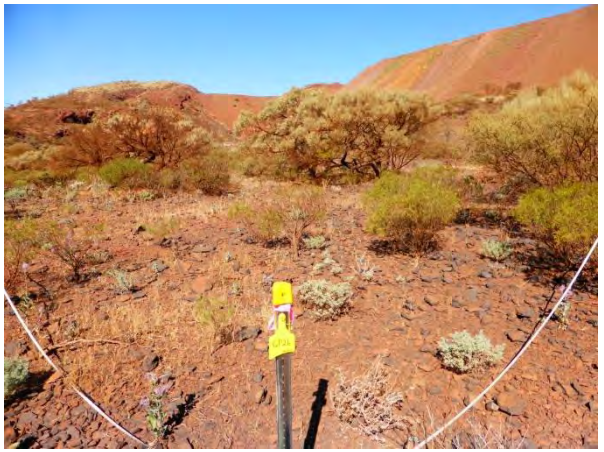
Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
H4 – AteAsyERcTe *Acacia tetragonophylla, A. synchronicia* scattered tall shrubs over *Eremophila cuneifolia* scattered shrubs over *Triodia epactia* hummock grassland **Associated species:** *Acacia pruinocarpa, Bulbostylis barbata, Cleome viscosa, Corchorus crozophorifolius, Cucumis variabilis, Enneapogon caerulescens, Eremophila fraseri* subsp. *fraseri, E. phyllopoda* subsp. *obliqua, Eriachne mucronata, Indigofera monophylla, Polycarpaea longiflora, Ptilotus obovatus, Senna artemisioides* subsp. *oligophylla, S. glutinosa* subsp. *glutinosa, S. stricta, Sida echinocarpa, Solanum cleistogamum, S. lasiophyllum, Sporobolus australasicus, Tribulus suberosus, Trichodesma zeylanicum* var. *zeylanicum*	e029-AR, e030-AR, GP12, GP16, WRF43, MNBE08, MNBE09, MNBE20	Degraded – Excellent	1,349.7 (12.0%)	 Plate 4: Vegetation unit H4 – AteAsyERcTe.
H5 – AteERfTw *Acacia tetragonophylla* scattered tall shrubs over *Eremophila fraseri* subsp. *fraseri* scattered shrubs over *Triodia wiseana* hummock grassland **Associated species:** *Acacia pyrifolia, *Aerva javanica, Cymbopogon ambiguus, Eremophila cuneifolia, Gomphrena cunninghamii, Ptilotus obovatus, Solanum lasiophyllum*	GP28, GP30, MNBE12, MNBE14	Good – Excellent	30.9 (0.3%)	 Plate 5: Vegetation unit H5 – AteERfTw.

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
H8 – AanSaoERsppARc *Acacia aneura* sens. lat. tall open scrub over *Senna artemisioides* subsp. *oligophylla*, *Eremophila* spp. open heath over *Aristida contorta* open bunch grassland **Associated species:** *Acacia tetragonophylla, *Aerva javanica, *Cenchrus ciliaris, Corchorus crozophorifolius, Enneapogon caerulescens, Eremophila cuneifolia, E. forrestii* subsp. *forrestii, Gomphrena cunninghamii, Polycarpaea longiflora, Ptilotus obovatus, Senna glutinosa* subsp. x *luerssenii, S. stricta, Sporobolus australasicus, Tribulus suberosus*	e122-AR, GP31, WRF03, MNBE11	Good – Excellent	45.3 (0.4%)	 Plate 6: Vegetation unit H8 – AanSaoERsppARc.
H11 – ArAanERpoERIp *Acacia rhodophloia, A. aneura* sens. lat. tall open shrubland over *Eremophila phyllopoda* subsp. *obliqua* scattered shrubs over *Eriachne pulchella* open bunch grassland **Associated species:** *Acacia aptaneura, A. macraneura, A. pruinocarpa, A. tetragonophylla, Aristida contorta, Bulbostylis barbata, Eremophila fraseri* subsp. *fraseri, E. jucunda* subsp. *pulcherrima, Gomphrena canescens* subsp. *canescens, Goodenia microptera, Grevillea berryana, Heliotropium heteranthum, Portulaca oleracea, Psydrax latifolia, Ptilotus exaltatus, P. schwartzii* var. *schwartzii, Solanum cleistogamum, S. lasiophyllum, Trianthema glossostigmum, Tribulus suberosus, Trigastrotheca molluginea, Triodia epactia*	GP07, GP09, GP10, GP17, MNBE05, MNBE10, MNBE21, MNBE24, MNLD02	Good – Excellent	155.6 (1.4%)	 Plate 7: Vegetation unit H11 – ArAanERpoERIp.

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
H12 – EllAprGbTe *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia pruinocarpa, Grevillea berryana* scattered tall shrubs over *Triodia epactia* hummock grassland **Associated species:** *Acacia aptaneura, A. sibirica, A. tetragonophylla, Bulbostylis barbata, Dysphania rhadinostachya* subsp. *rhadinostachya, Eremophila jucunda* subsp. *pulcherrima, E. phyllopoda* subsp. *obliqua, Eriachne mucronata, E. pulchella, Ptilotus schwartzii* var. *schwartzii, Senna glutinosa* subsp. *glutinosa, Trachymene oleracea* subsp. *oleracea*	GP06, GP14, GP40, MNBE03, MNBE04, MNBE13, MNBE22, MNLD01	Good – Excellent	848.2 (7.6%)	 Plate 8: Vegetation unit H12 – EllAprGbTe.

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
Vegetation of Stony Plains				
P1 – AanAxAteERcSspp *Acacia aneura* sens. lat., *A. xiphophylla* tall open shrubland over *A. tetragonophylla* open shrubland over *Eremophila cuneifolia, Senna* spp. scattered low shrubs **Associated species:** *Acacia synchronicia, Aristida contorta, Bulbostylis barbata, *Cenchrus ciliaris, Corchorus crozophorifolius, Enchylaena tomentosa* var. *tomentosa, Enneapogon caerulescens, E. polyphyllus, Eriachne pulchella, Gomphrena kanisii, Goodenia tenuiloba, Hybanthus aurantiacus, Jasminum didymum* subsp. *lineare, Paraneurachne muelleri, Polycarpaea longiflora, Ptilotus aervoides, Ptilotus exaltatus, P. obovatus, Senna artemisioides* subsp. *oligophylla, S. glutinosa* subsp. x *luerssenii, S. stricta, Sporobolus australasicus, Trianthema glossostigmum, Tribulus suberosus, Triodia epactia*	WRA39-AR, WRF02, WRF32, WRF34	Degraded – Excellent	1,875.7 (16.7%)	 Plate 9: Vegetation unit P1 – AanAxAteERcSspp.

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
P2 – AanAteSspp *Acacia aneura* sens. lat., *A. tetragonophylla* tall open shrubland over *Senna* spp. scattered low shrubs **Associated species:** *Acacia aptaneura, Aristida contorta, Enneapogon caerulescens, Eremophila phyllopoda* subsp. *obliqua, Eriachne pulchella, Gomphrena canescens* subsp. *canescens, Grevillea berryana, Heliotropium heteranthum, Maireana melanocoma, Portulaca oleracea, Ptilotus exaltatus, P. schwartzii* var. *schwartzii, Senna artemisioides* subsp. *helmsii, S. stricta, Solanum cleistogamum, S. lasiophyllum, Tribulus suberosus, Trigastrotheca molluginea, Triodia epactia*	GP22, GP34, GP36, MNBE18	Good – Excellent	68.7 (0.6%)	 Plate 10: Vegetation unit P2 – AanAteSspp.
P4 – AanAxAteERcTa *Acacia aneura* sens. lat., *A. xiphophylla* tall open shrubland over *A. tetragonophylla, Eremophila cuneifolia* shrubland over *Triodia angusta* hummock grassland **Associated species:** *Acacia aptaneura, A. synchronicia, Enchylaena tomentosa* var. *tomentosa, Enneapogon caerulescens, Eremophila jucunda* subsp. *pulcherrima, E. latrobei, E. phyllopoda* subsp. *obliqua, Goodenia forrestii, Lawrencia densiflora, Lepidium pedicellosum, Maireana georgei, Paspalidium clementii, Ptilotus clementii, P. obovatus, P. schwartzii* var. *schwartzii, Senna artemisioides* subsp. *oligophylla, S. glutinosa* subsp. x *luerssenii, Sida echinocarpa, Solanum horridum, S. lasiophyllum, Sporobolus australasicus, Tribulus suberosus, Trigastrotheca molluginea*	GP24, GP32, GP37, MNBE16	Good – Excellent	27.7 (0.2%)	 Plate 11: Vegetation unit P4 – AanAxAteERcTa.

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
P8 – AxSsTdFhMg *Acacia xiphophylla* tall open shrubland over *Senna stricta* open shrubland over *Tecticornia disarticulata, Frankenia aff. hispidula, Maireana georgei* low open shrubland **Associated species:** *Acacia synchronicia, A. tetragonophylla, Cynodon prostratus, Enchylaena tomentosa* var. *tomentosa, Enneapogon caerulescens, Eremophila cuneifolia, Eriachne pulchella, Grevillea berryana, Maireana eriosphaera, M. melanocoma, Paspalidium clementii, Polycarpaea longiflora, Portulaca oleracea, Ptilotus exaltatus, P. obovatus, P. schwartzii* var. *schwartzii, Salsola australis, Scaevola acacioides, S. spinescens, Sclerolaena eriacantha, Senna artemisioides* subsp. *oligophylla, S. glutinosa* subsp. x *luerssenii, Trianthema glossostigmum, Tribulus suberosus*	GP21, GP26, GP39	Good – Excellent	48.1 (0.4%)	 Plate 12: Vegetation unit P8 – AxSsTdFmMg.

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
Vegetation of Drainage Lines				
D1 – AanAwTe *Acacia aneura* sens. lat., *A. wanyu* tall shrubland over *Triodia epactia* open hummock grassland **Associated species:** *Abutilon* sp. Dioicum (A.A. Mitchell PRP 1618) , *Acacia aptaneura, A. tetragonophylla, Aristida contorta, Bulbostylis barbata, *Cenchrus ciliaris, Enchylaena tomentosa* var. *tomentosa, Eremophila cuneifolia, E. jucunda* subsp. *pulcherrima, E. latrobei, E. phyllopoda* subsp. *obliqua, Eriachne mucronata, Hibiscus campanulatus* P1, *Jasminum didymum* subsp. *lineare, Maireana georgei, Paspalidium clementii, Ptilotus obovatus, Santalum lanceolatum, Senna artemisioides* subsp. *oligophylla, Solanum lasiophyllum, Tribulus suberosus*	GP15, GP33, GPR44	Degraded – Excellent	63.3 (0.6%)	 Plate 13: Vegetation unit D1 – AanAwTe.

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
D3 – AciAanAwTe *Acacia citrinoviridis, A. aneura* sens. lat., *A. wanyu* tall shrubland over *Triodia epactia* open hummock grassland **Associated species:** *Abutilon* sp. Dioicum (A.A. Mitchell PRP 1618), *Acacia pyrifolia, A. tetragonophylla, *Aerva javanica, Corchorus crozophorifolius, Cucumis variabilis, Dipteracanthus australasicus* subsp. *australasicus, Duperreya commixta, Enchylaena tomentosa* var. *tomentosa, Hybanthus aurantiacus, Indigofera monophylla, Jasminum didymum* subsp. *lineare, Polycarpaea longiflora, Ptilotus obovatus, Rhynchosia minima, Senna artemisioides* subsp. *oligophylla, Sida* sp. spiciform panicles (E. Leyland s.n. 14/8/90), *Sporobolus australasicus, Tephrosia* sp. Fortescue (A.A. Mitchell 606), *Trichodesma zeylanicum* var. *zeylanicum*	GP03, GP38, GP41	Degraded – Excellent	432.9 (3.9%)	 Plate 14: Vegetation unit D3 – AciAanAwTe.
D6 – CfAciAanTe *Corymbia ferriticola* scattered low trees over *Acacia citrinoviridis, A. aneura* sens. lat. tall shrubland over *Triodia epactia* open hummock grassland **Associated species:** *Abutilon* sp. Dioicum (A.A. Mitchell PRP 1618), *Acacia pruinocarpa, A. pyrifolia, A. tetragonophylla, *Cenchrus ciliaris, Cleome viscosa, Corchorus crozophorifolius, Cymbopogon ambiguus, Dodonaea pachyneura, Duperreya commixta, Eremophila fraseri* subsp. *fraseri, E. latrobei* subsp. *glabra, Eriachne mucronata, Gomphrena cunninghamii, Hibiscus campanulatus* P1, *Indigofera monophylla, Pluchea dentex, Ptilotus obovatus, *Rumex vesicarius*	GP05, GP29, GPR19, GPR25, MNBE15, MNLV02	Poor – Excellent	28.4 (0.3%)	 Plate 15: Vegetation unit D6 – CfAciAanTe.

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
D7 – EcEvAamMgCYPv *Eucalyptus camaldulensis, E. victrix* open forest over *Acacia ampliceps, Melaleuca glomerata* tall shrubland over *Cyperus vaginatus open sedgeland* **Associated species:** *Acacia citrinoviridis, A. coriacea* subsp. *pendens, Ammannia baccifera, *Cenchrus ciliaris, *C. setiger, Cucumis variabilis, Eragrostis tenellula, Euphorbia biconvexa, Jasminum didymum* subsp. *lineare, *Malvastrum americanum, Melaleuca linophylla, Petalostylis labicheoides, Phyllanthus maderaspatensis, Pluchea rubelliflora, Rhynchosia minima, *Sonchus oleraceus, Stemodia grossa, Typha domingensis*	e038-AR, e074-AR, GP27, WRF01	Degraded – Good	78.2 (0.7%)	 Plate 16: Vegetation unit D7 – EcEvAamMgCYPv.
D8 – EvAcMgCEspp *Eucalyptus victrix* woodland over *Acacia coriacea* subsp. *pendens, Melaleuca glomerata* tall shrubland over *Cenchrus* spp. open tussock grassland **Associated species:** *Acacia citrinoviridis, A. pyrifolia, *Aerva javanica, *Cenchrus ciliaris, *C. setiger, Cleome viscosa, Corchorus crozophorifolius, Cucumis variabilis, Cyperus vaginatus, Jasminum didymum* subsp. *lineare, Petalostylis labicheoides, Pluchea rubelliflora, Stemodia grossa, Tephrosia rosea* var. Fortescue creeks (M.I.H. Brooker 2186)	GP13, WRA01-AR, WRA21-AR, WRF44	Degraded – Poor	215.1 (1.9%)	 Plate 17: Vegetation unit D8 – EvAcMgCEspp.

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
D9 – AciAanCEspp *Acacia citrinoviridis, A. aneura* sens. lat. tall shrubland over **Cenchrus* species tussock grassland **Associated species:** *Acacia synchronicia, A. tetragonophylla, *Aerva javanica, *Cenchrus ciliaris, Corchorus crozophorifolius, Cucumis variabilis, Duperreya commixta, Enchylaena tomentosa* var. *tomentosa, Eremophila cuneifolia, Senna artemisioides* subsp. *oligophylla, Sporobolus australasicus*	e006-AR, e043-AR, GP23, WRA44-AR, MNBE19, MNLV01	Degraded – Poor	157.3 (1.4%)	 Plate 18: Vegetation unit D9 – AciAanCEspp.
D10 – AanAxTe *Acacia aneura* sens. lat., *A xiphophylla* tall shrubland over mixed open shrubland over *Triodia epactia* open hummock grassland **Associated species:** *Acacia synchronicia, A. tetragonophylla, A. wanyu, *Cenchrus ciliaris, *C. setiger, Cynodon prostratus, Dipteracanthus australasicus* subsp. *australasicus, Duperreya commixta, Enchylaena tomentosa* var. *tomentosa, Enneapogon caerulescens, Eremophila cuneifolia, E. forrestii* subsp. *forrestii, Frankenia aff. hispidula, Lepidium pedicellosum, L. platypetalum, Maireana georgei, M. thesioides, M. tomentosa* subsp. *tomentosa, Pterocaulon sphacelatum, Ptilotus obovatus, Scaevola spinescens, Sclerolaena eriacantha, Senna artemisioides* subsp. *oligophylla, S. glutinosa* subsp. x *luerssenii, S. stricta, Sporobolus australasicus, Tribulus suberosus*	e073-AR, GP43, WRA23-AR	Degraded – Excellent	136.1 (1.2%)	 Plate 19: Vegetation unit D10 – AanAxTe.

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
D13 – AciTErTe *Acacia citrinoviridis* tall shrubland over *Tephrosia rosea* var. Fortescue creeks (M.I.H. Brooker 2186) low open shrubland over *Triodia epactia* open hummock grassland **Associated species:** *Acacia pyrifolia, A. tetragonophylla, Corchorus crozophorifolius, Cucumis variabilis, Dodonaea pachyneura, Duperreya commixta, Enchylaena tomentosa* var. *tomentosa, Enneapogon caerulescens, Glycine canescens, Gomphrena cunninghamii, Goodenia microptera, Hibiscus campanulatus* P1, *Hybanthus aurantiacus, Indigofera monophylla, Jasminum didymum* subsp. *lineare, Petalostylis labicheoides, Polycarpaea longiflora, Ptilotus obovatus, Rhagodia eremaea, Solanum lasiophyllum, Sporobolus australasicus, Tribulus suberosus, Trigastrotheca molluginea*	GP08, GP11, GP18, MNBE07	Good – Very Good	24.6 (0.2%)	 Plate 20: Vegetation unit D13 – AciTErTe.
D14 – AciAscCEspp *Acacia citrinoviridis, A. sclerosperma* subsp. *sclerosperma* tall open shrubland over **Cenchrus* spp. open tussock grassland **Associated species:** **Cenchrus ciliaris*, **C. setiger*, *Ptilotus obovatus*	GP35	Degraded	30.2 (0.3%)	 Plate 21: Vegetation unit D14 – AciAscCEspp.

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
Cleared	N/A	Completely degraded	3,429.5 (30.6%)	N/A

4.2.1.1 Vegetation of Local Significance

Five vegetation units described and mapped within the survey area are considered to be of local conservation significance: H3, P8, D6, D7 and D8.

The H3 vegetation unit occurred on the steep south-facing slopes in the west of the survey area. Biota (2012a) noted that *Aluta quadrata* T was generally found in association with this vegetation unit, however the single population of *A. quadrata* T within the survey area was found in different vegetation. Despite this, the H3 vegetation unit has conservation significance at a local scale due to its association with threatened flora.

The P8 vegetation unit occurred in the valleys and lower slopes north of the Eastern Range operations in the survey area. While this vegetation unit did not support conservation significant flora or have affinity with any described TECs or PECs, the presence of *Acacia xiphophylla* (snakewood) on slopes and the understorey assemblage of low shrubs dominated by *Frankenia* spp. and chenopods, in particular *Tecticornia disarticulata*, was considered unusual. The P8 vegetation unit occurs across a relatively small range within the survey area and upon review of previous work was not observed outside of this range. As such the P8 vegetation unit is considered to have some conservation significance at a local scale.

The D6 vegetation unit occurred on the deeper incised gorges in the Eastern Range and Doggers Gorge sections of the survey area. This habitat supports a number of conservation significant flora taxa including *Eremophila* sp. Hamersley Range (K. Walker KW 136) P1, *Hibiscus campanulatus* P1, *Grevillea saxicola* P3, *Sida* sp. Barlee Range (S. van Leeuwen 1642) P3 and *Solanum* sp. (indet.). Due to the restricted nature of the habitat and the association with conservation significant flora the D6 vegetation unit has conservation significance at a local scale. The D3 vegetation unit supports a similar suite of conservation significant flora in some instances, but is more widely distributed and generally characterised by minor drainage lines, as such the D3 vegetation unit is not considered to have conservation significance at a local scale.

The D7 vegetation unit occurred on major drainage lines that supported the potential GDE species *Eucalyptus camaldulensis, E. victrix* and *Sesbania formosa* and is therefore considered to have some conservation significance at a local scale. To a lesser extent the D8 vegetation unit also supported the potential GDE species *E. victrix* and may have some conservation significance at a local scale.

The remaining vegetation associations recorded in the survey area represent what may be expected on similar landforms in the broader Hamersley and Gascoyne subregions and are not considered locally restricted (Kendrick 2001b, 2001a; Beard 1975). No vegetation assemblages were considered analogous with a listed TEC or PEC.

4.2.1.2 Ecosystems at Risk

As part of the biodiversity audit of each IBRA bioregion carried out by the then Department of Conservation and Land Management, a number of ecological communities were identified as 'ecosystems at risk' (McKenzie, May, and McKenna 2002). This audit was conducted prior to the formal PEC listing process and many of the ecological communities highlighted were subsequently raised to PEC status. There were a number of ecological communities not raised to PEC status that were identified through this audit, two of which have relevance to the survey area (Kendrick 2001b):

- Lower-slope mulga – this community was represented by the vegetation unit H1 within the survey area. A total of 1,871.2 ha of H1 were mapped and the vegetation condition ranged from 'Degraded to 'Excellent' and was often affected by the presence of weeds.

- Major ephemeral watercourses – this community was represented by the vegetation unit D7 and to a lesser extent D8 within the survey area. A combined total of 293.3 ha of D7 and D8 were mapped and the vegetation condition ranged from 'Degraded' to 'Good' and was affected by the presence of weeds and grazing.

4.2.1.3 Groundwater Dependent Ecosystems

Of the 21 vegetation units present within the survey area, one (D7) is considered as a potential groundwater dependent ecosystem (GDE) due to the presence of an assemblage of vegetation that is likely to be dependent on groundwater. Each of the three major creek systems, Pirraburdoo Creek, Seven Mile Creek and Stoney Creek, as well as Doggers Gorge support areas of pools of an unknown permanency and riparian vegetation that relies on this water source for ecological processes. At the time of survey each of the three creek systems and Doggers Gorge had some areas of pooling.

4.2.1.4 Vegetation Condition

Vegetation in the survey area ranged from 'Excellent' to 'Completely Degraded' (Trudgen 1988) condition (Table 11) (Figure J.1, Appendix J). Vegetation of the drainage lines and associated plains was generally of low quality due to the presence of introduced flora (in particular **Cenchrus* spp.) and grazing pressure from cattle. Vegetation of the hills and slopes were of better quality but still showed the influence of historic clearance and introduced flora species. Generally the areas nearer to the operating mining areas were also affected by dust.

An extensive network of drill lines, drill pads and tracks exists throughout the survey area. Mining infrastructure occurs in the central parts of the survey area. Together this cleared vegetation accounts for 3,429.5 ha (30.6%) in the survey area. A number of colonising species were observed regenerating on some of these tracks, but most remained cleared of vegetation.

Table 11: Vegetation condition recorded for the survey area.

Vegetation condition	Total mapped area within the survey area (ha)	Proportion of survey area (%)
Excellent	1,843.0	16.5
Very Good	2,761.0	24.6
Good	2,008.1	17.9
Poor	706.9	6.3
Degraded	454.9	4.1
Completely Degraded	3,429.5	30.6

4.2.1.5 Floristic Groups – Current Survey

Based on classification analysis, there were 23 significant floristic groups identified within the survey area. Of the 58 sites assessed from the survey area, six were represented by a single survey site Table 12.

Table 12: Floristic groups identified by one site in the survey area and corresponding vegetation unit.

Quadrat/ relevé	Quadrat/relevé description	Structural vegetation association
GP11	*Acacia citrinoviridis,* (*Grevillea berryana*) tall open scrub over *Tephrosia rosea* var. Fortescue creeks (M.I.H. Brooker 2186) open shrubland over *Corchorus crozophorifolius, Ptilotus obovatus* low open shrubland	D13
GP23	*Acacia citrinoviridis* tall shrubland over *Corchorus crozophorifolius* scattered low shrubs over **Cenchrus ciliaris,* (**Cenchrus setiger*) tussock grassland	D9
GPR25	*Corymbia ferriticola* scattered low trees over *Acacia citrinoviridis* tall shrubland over *Eriachne mucronata, *Cenchrus ciliaris, Cymbopogon ambiguus* very open tussock grassland	D6
GP34	*Acacia tetragonophylla* tall shrubland over *Eremophila phyllopoda* subsp. *obliqua* scattered shrubs over *Aristida contorta*, *Eriachne pulchella* subsp. *dominii* very open tussock grassland with *Trigastrotheca molluginea*, *Goodenia microptera* scattered herbs	P2
GP45	*Acacia pruinocarpa* tall open shrubland over *Triodia epactia* hummock grassland	H2
WRA21-AR	*Eucalyptus victrix* open woodland over *Acacia citrinoviridis*, (*Melaleuca glomerata. A. coriacea* subsp. *pendens*) tall open scrub over **Cenchrus ciliaris*, (**C. setiger*) open tussock grassland	D8

Site GP11 occurred in vegetation unit D13 associated with drainage lines south of the Eastern Range area. Drainage units may not cluster together when assessed using multivariate analysis; this can be partially attributed to flora species from the surrounding vegetation being present that may not be representative of the drainage vegetation, as such the species composition at this site is not considered unique. This site presented next to other D13 sites in the dendrogram shown in Figure K.2 (Appendix K).

Site GP23 occurred in the drainage lines vegetation unit D9, which is a highly disturbed unit dominated by **Cenchrus* spp. The vegetation structure and species diversity of this unit was modified by the presence of **Cenchrus* spp. at high densities which is likely to have affected the diversity of other species that occurred. This site presented next to other D9 sites in the dendrogram shown in Figure K.2 (Appendix K).

Site GPR25 occurred in vegetation unit D6 associated with drainage lines in a gorge in the Eastern Range area. This site occurred in a deep gorge adjacent to cleared areas for mining and was affected by the presence of dust and weeds. Drainage units may not cluster together using multivariate analysis; this can be partially attributed to flora species from the surrounding vegetation being present that may not be representative of the drainage vegetation, as such the species composition at this site is not considered unique. This site presented next to other D6 sites in the dendrogram shown in Figure K.2 (Appendix K).

Site GP34 occurred in the stony plains vegetation unit P2 south of the tailings storage facility. The occurrence of vegetation unit P2 in this area was influenced by the nearby drainage line and this may explain why species composition was considered unique. This site does present near other P2 sites in the dendrogram shown in Figure K.2 (Appendix K).

Site GP45 occurred in the hills and ridges vegetation unit H2 in the west of the survey area. The occurrence of vegetation unit H2 in this area was previously mapped by Biota (2012a) and is a narrow polygon. It is possible that the species assemblage at this site was influenced by the

surrounding vegetation, however this site does present near another H2 site in the dendrogram shown in Figure K.2 (Appendix K).

Site WRA21-AR occurred in the drainage lines vegetation unit D8 in the west of the survey area. As with site GP11, drainage units may not cluster together using multivariate analysis, although this site does fall next to other D8 sites in the dendrogram shown in Figure K.2 (Appendix K).

4.2.1.6 Floristic Groups – Broader Regional Context

Multivariate floristic analysis of 469 regional sites using presence/absence of perennial native taxa identified 109 significant clusters (Figure K.3 to Figure K.9, Appendix K). Sites from the current survey were present in 44 of these significant clusters, with 26 consisting exclusively of sites from the current survey. The inclusion of both Phase 1 and Phase 2 as separate sites contributed to the formation of these significant clusters. Sites from the same projects tended to cluster together, in particular GHD (2009), Mattiske (2011) and Rio Tinto (2014). Sites from similar habitats and vegetation within the survey area also tended to cluster together.

4.2.2 Flora

There were 300 confirmed vascular flora taxa, from 50 families and 132 genera, recorded during the current survey. The dominant native plant families were Fabaceae, Poaceae and Malvaceae, with 50, 33 and 32 confirmed taxa represented respectively. *Acacia* and *Eremophila* were the most frequently recorded genera (Table 13). Nineteen taxa; *Abutilon* sp., *Boerhavia* sp., *Cheilanthes* sp., *Clerodendrum* sp., *Dysphania* sp., *Eremophila* sp., *Eucalyptus* sp., *Euphorbia biconvexa*?, *Euphorbia* sp., *Euphorbia boophthona*?, *Goodenia* sp., *Maireana* sp., *Pterocaulon* sp., *Sclerolaena* sp., *Sida* ?sp. L (A.M. Ashby 4202), *Sida* sp., *Solanum* sp. (indet), *Streptoglossa* sp. and *Tephrosia* sp., were unable to be identified to species level due to insufficient diagnostic material and may represent additional taxa for the survey area. Based on the diagnostic material available, one species was considered likely to be conservation significant taxa; *Solanum* sp. (indet) and is discussed in section 4.2.2.1. None of the other 18 species were considered likely to be conservation significant taxa. A species list from the current survey and a matrix indicating species recorded within each quadrat or relevé is presented in Appendix L.

The species accumulation curve indicates that 72% and 91% of the potential total species pool available at the time of the surveys was recorded, including opportunistic observations. The species accumulation curve indicates that the total number of species has reached an asymptote, and that sampling has been near-exhaustive (Appendix K).

A total of 352 confirmed vascular flora taxa were recorded from sites within the survey area in the three previous major surveys (Biota Environmental Sciences 2012b, 2012a; Ecologia Environment 2011). When combined with the confirmed taxa from the current survey (Phase 1 and Phase 2), a total of 470 vascular flora taxa have been recorded within the survey area. A list of taxa recorded during the current survey is presented in Table L.1, Appendix L. A compiled list of taxa recorded during the three previous major surveys (Biota Environmental Sciences 2012b, 2012a; Ecologia Environment 2011) and each phase of the current survey is presented in Table L.2, Appendix L. A species by site matrix for taxa recorded in sites established during the current survey is presented in Table L.3, Appendix L. A species by site matrix for taxa recorded within the survey during the three previous major surveys (Biota Environmental Sciences 2012b, 2012a; Ecologia Environment 2011) and the rescores performed during the current survey is presented in Table L.4, Appendix L.

Table 13: Taxa most frequently recorded in the survey area.

Family	Number of taxa
Fabaceae	50
Poaceae	33
Malvaceae	32
Chenopodiaceae	21
Scrophulariaceae	18
Amaranthaceae	16
Genus	**Number of taxa**
Acacia	23
Eremophila	18
Maireana	9
Ptilotus	9
Sida	9
Hibiscus	9

4.2.2.1 *Conservation Significant Flora*

Systematic searches were conducted in 18 targeted search polygons for the State listed threatened flora species, *Aluta quadrata* T, with no new occurrences being located in the survey area. Additional systematic searches were focused on visiting areas known or considered likely to support conservation significant flora, with preference given to searching areas supporting P1 or P2 taxa. The combined (Phase 1 and 2) field program identified seven confirmed taxa of conservation significance and one unconfirmed (*Solanum* sp. (indet.)) taxon of conservation significance (Table 14). Conservation significant flora locations from this survey are mapped in Figure N.1 to Figure N.6, Appendix N and regional distributions of all records sourced from the Rio Tinto database are shown in Figure O.1 to Figure O.8, Appendix O. Habitat and abundance details for these taxa are summarised below and in Table 15. Survey effort, as shown by track log traverses within the survey area, is presented in Figure M.1 to Figure M.2, Appendix M.

Table 14: Conservation significant flora recorded in the survey area during the current survey.

Conservation significant taxa	Phase 1	Phase 2
Aluta quadrata T	✓	
Eremophila sp. Hamersley Range (K. Walker KW 136) P1	✓	✓
Hibiscus campanulatus P1	✓	✓
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727) P3	✓	✓
Grevillea saxicola P3	✓	✓
Nicotiana umbratica P3	✓	
Sida sp. Barlee Range (S. van Leeuwen 1642) P3	✓	✓
Solanum sp. (indet.)		✓

Aluta quadrata T was recorded from one previously known population on canga outcropping on the northern margin of Pirraburdoo Creek; individuals within this population were counted and their

locations recorded using a handheld GPS. No further populations of *A. quadrata* were encountered during the current survey.

Eremophila sp. Hamersley Range (K. Walker KW 136) P1 was recorded from two populations and known from a further three single points from a previous survey (Rio Tinto 2014). Two of these previous survey points were visited and no individuals were found, these have been removed from Figure N.1 and Table N.2 (Appendix N). One of the populations was systematically searched with a total of 2,568 individuals recorded. The second population was not re-visited due to time and access constraints.

Hibiscus campanulatus P1 occurs throughout the survey area, in particular around the Eastern Range area and was generally associated with the drainage features, gorges and south facing slopes. Systematic searches were not conducted for this species and the population numbers presented in Table 15 are not a comprehensive assessment of the numbers occurring in the survey area, which would likely support many thousands more individuals than recorded to date. Individuals were marked opportunistically during the current survey.

Goodenia sp. East Pilbara (A.A. Mitchell PRP 727) P3 was recorded from three populations during the current survey and known from a further five populations from previous surveys. It appeared to be highly habitat restricted and occurred in association with calcrete soils and low calcrete hills within the survey area. None of the known populations have been systematically searched due to seasonal conditions and time constraints (all individuals encountered were senescing at the time of survey) and as such the abundance presented in Table 15 is an underestimation. A number of potential habitat targets around the northern floodplains of the Pirraburdoo Creek and the plains north of the Western Range area were searched. It may occur elsewhere within the survey area on calcrete soils not targeted during the current survey.

Grevillea saxicola P3 was recorded from four populations from the current survey and known from a further 11 populations from previous surveys. It was generally associated with the lower slopes and associated drainage features of ironstone hills, particularly in the valleys to the north of Eastern Range around Mount Misery. None of the known populations have been systematically searched and as such the abundance presented in Table 15 is an underestimation. It may occur elsewhere within the survey area in suitable habitat not targeted during the current survey.

Nicotiana umbratica P3 was recorded from one opportunistic collection during the Phase 1 survey within the eastern survey area and three occurrences from previous surveys. It was located at the base of a rocky slope in a shady ironstone gorge near Doggers Gorge. It was not systematically searched for during the Phase 1 survey or revisited during Phase 2, due to timing constraints, and as such the abundance presented in Table 15 is an underestimation. It may occur elsewhere within the survey area in suitable habitat not targeted during the survey.

Sida sp. Barlee Range (S. van Leeuwen 1642) P3 was recorded from four populations during the current survey and known from a further 19 populations from previous surveys. It was generally associated with the steep slopes and rocky outcrops of gorges and drainage features of ironstone hills. None of the known populations have been systematically searched and as such the abundance presented in Table 15 is an underestimation. It may occur elsewhere within the survey area in suitable habitat not targeted during the current survey.

Solanum octonum P2 was recorded previously in and around Doggers Gorge (Eco Logical Australia 2016; Rio Tinto 2014), but had not been encountered during the Phase 1 survey. The Doggers Gorge population was revisited during Phase 2 and four sterile specimens were collected for confirmation. These were submitted to Steve Dillon, Rio Tinto sponsored taxonomist at the WA Herbarium. It was found that the material collected in the field could not be matched to *S. octonum* and did not match

any described *Solanum*. The submitted specimens did match a single sheet from a collection made approximately 2 km north and named *Solanum* sp. (indet.). This single sheet was accompanied by a note stating 'belongs to *S. sturtianum* subgroup, but does not match any species named'. The note was written by Tony Bean, the *Solanum* taxonomist who had separated the *S. sturtianum* group (to which *S. octonum* belongs) and published the work in 2013 (Bean 2013).

It is considered likely that any previously recorded locations of *S. octonum* within the survey area will match the undescribed *Solanum* sp. (indet.), but collections with flowering and fruiting material are required to be certain. It is also likely that if it is a new taxon, it will be of conservation significance, given the lack of vouchered material and the fact that five of the eight new species described in 2013 (Bean 2013) have priority status (Steve Dillon, 5th June 2018, pers. comm.). In the interim, all previous records of *S. octonum* from the survey area have been presented as *Solanum* sp. (indet.) (Table 15).

Ptilotus trichocephalus P4 was previously recorded from a number of locations on the stony plains in the south of the survey area (Biota Environmental Sciences 2012a; Ecologia Environment 2011; Hamersley Iron Pty Ltd 2005b). Previously recorded locations were visited during both phases of survey to determine whether this ephemeral taxon could be observed during the seasonal conditions, however no individuals were found. It is possible that additional populations occur within the survey area and would be more likely to be encountered during favourable seasonal conditions.

Table 15: Conservation significant flora recorded in the survey area.

Species	Current survey recorded abundance	Total abundance in survey area[1]	Regional abundance[2]	Habitat	Vegetation unit/s
Aluta quadrata T	1,017	1,017	42,612	Edge of creek beds, base of cliffs, rocky crevices, near crest of ridge.	D9,H1
Eremophila sp. Hamersley Range (K. Walker KW 136) P1	2,656	2,658	6,961	High in the landscape, cliff tops, gorge tops, steep rocky slopes, skeletal red-brown soils.	D3, D6, H1, H12
Hibiscus campanulatus P1	4,638	8,957	13,952	Hill slopes, base of slopes, rocky gully areas, often on Canga detritals.	D1, D3, D6, D7, D8, D9, D10, D13, H1 H2, H4, H12, P1, P8
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727) P3	2,422	2,433	73,395	Red-brown clay soil, calcrete pebbles. Low undulating plain, swampy plains, stony plains, hill slopes.	D1, D3, D9, H4, P1, P8
Grevillea saxicola P3	226	548	2,089	Low rocky hill, red-brown sandy loam with ironstone pebble cover, steep scree slopes.	D3, D6, D10, D11, D12, D13, H1, H2, H4, H5, P2, P8
Nicotiana umbratica P3	5	9	145	Shallow soils. Rocky outcrops.	D8, H12
Sida sp. Barlee Range (S. van Leeuwen 1642) P3	122	534	11,865	Skeletal red soils pockets. Steep slope.	D3, D6, D8, H1, H12
Ptilotus trichocephalus P4[3]	0	671	4,535	Sandy soils, colluvial plains.	P1
Solanum sp. (indet.)[4]	72	123	123	Rocky gullies, gorges.	D6, D8, H12

[1] – Includes all previous points that occur within the survey area (Table N.2, Appendix N).

[2] – Includes all records from Rio Tinto database.

[3] – Species not observed in current survey (Phase 1 or 2), but previously recorded within survey area (Table N.2, Appendix N).

[4] – Includes previous records of *Solanum octonum* P2 that are now considered as *Solanum* sp. (indet.).

4.2.2.2 *Post-survey Likelihood of Occurrence of Conservation Significant Flora*

With a greater understanding of the landforms, soils and habitats of the survey area, the list of conservation significant flora identified during the desktop exercise as having the potential to occur was reviewed for likelihood of occurrence (Table F.1, Appendix F). This review identified six priority flora taxa that have been recorded within 20 km of the survey area and are still considered to have potential to occur within the survey area; *Sida* sp. Hamersley Range (K. Newbey 10692) P1, *Hibiscus*

sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2, *Eremophila coacta* P3, *Pilbara trudgenii* P3, *Eremophila magnifica* subsp. *magnifica* P4 and *Ptilotus mollis* P4 (Appendix F).

There were three taxa recorded from previous projects that were reported at the time as being potentially new taxon; *Eriachne* sp. Western Range (2012b), *Corchorus* sp. aff. *sidoides (2014)* and *Abutilon* sp. which was considered to possibly be a new subspecies of *Abutilon* sp. Pritzelianum (S. van Leeuwen 5095) P1 (2016). No taxa matching the descriptions for either of these three were encountered as part of the current survey.

4.2.2.3 Range Extensions

Four native taxa recorded within the survey area were considered as range extensions of greater than 50 km from their currently known distributions (*Hibiscus sturtii* var. *platychlamys, Plumbago zeylanica, Sida* sp. Golden calyces glabrous (H.N. Foote 32) and *Sida* sp. L (A.M. Ashby 4202). A further two taxa were not able to be confirmed to species level, but would also be considered range extensions; *Frankenia* aff. *hispidula* and *F.* aff. *magnifica* (Table 16). Specimens of each of these taxa have been confirmed by the Rio Tinto sponsored taxonomist (Steve Dillon) at the WA Herbarium. The *Frankenia* genus has been undergoing taxonomic revision at the WA Herbarium and it is possible that *F.* aff. *magnifica* will be raised to a phrase name as part of this work. It is unknown whether the leaf characters which led to the name of *F.* aff. *hispidula* being applied will be sufficient to warrant a phrase name. At this stage it is unknown whether any conservation significance will be applied to either of these two taxa (S. Dillon, pers. comm., 18th December 2018). Four of these range extension taxa were also recorded in previous surveys and are presented in Table 16. One introduced (weed) species; **Ruellia simplex* is considered a range extension (Section 4.2.2.4). During the process of consolidating species data from previous work within the survey area, it was noted that numerous other species would also have been significant range extensions but were not presented in the previous reporting. As these records cannot be confirmed they are not presented within this report.

Table 16: Range extension taxa recorded during the survey.

Taxa	Surveys species previously recorded			
	Current survey	ecologia Environment (2011)	Biota Environmental Sciences (2012b)	Rio Tinto Iron Ore (2014)
Frankenia aff. *hispidula*	✓			
Frankenia aff. *magnifica*	✓	✓		
Hibiscus sturtii var. *platychlamys*	✓	✓		
Plumbago zeylanica	✓		✓	
Sida sp. Golden calyces glabrous (H.N. Foote 32)	✓			
Sida sp. L (A.M. Ashby 4202)	✓			✓
**Ruellia simplex*	✓			

4.2.2.4 Introduced Flora (Weeds)

Weed diversity in the survey area is considered high with 22 weed taxa recorded in the current survey. A total of 28 weed taxa have been recorded from all current and previous surveys within the survey area. None of the weed species recorded are listed as a WoNS (Australian Weeds Committee 2012b), or listed as declared pest plants in Western Australian under the BAM Act (Department of Primary Industries and Regional Development 2018). Habitat and abundance details for each weed taxa are summarised in Table 17.

The occurrence of **Ruellia simplex* (Mexican petunia) is the first record within Western Australia and as a result it is listed as "Unlisted – s14" under the BAM Act (Department of Primary Industries and Regional Development 2018). It is a weed of waterways and riparian vegetation and is becoming widely naturalised in the warmer parts of eastern Australia (Weeds of Australia Biosecurity Queensland Edition 2016). It was recorded from a sterile collection in Seven Mile Creek during the Phase 1 survey and was revisited during the Phase 2 survey to collect diagnostic material. Waypoints were collected for 38 individuals; however, this was not an exhaustive count of the population which may extend further along this creek in either direction.

Photographs and descriptions of weeds within the survey area are presented in Table P.1 (Appendix P). Indicative weed locations are mapped in Figure P.1, Appendix P and presented in Table P.2, Appendix P. However, locations are indicative only and weed distribution is much higher than presented, especially in the disturbed and cleared areas. An increase in weed species distribution would also be likely in a survey following summer rainfall.

Table 17: Introduced flora species (weeds) recorded in the survey area.

Species	Family	Current survey recorded abundance	Total abundance in surveys area[1]	Habitat
**Aerva javanica* (kapok bush)	Amaranthaceae	749	9,429	Disturbed, major and minor drainage, plains and hills
**Argemone ochroleuca* subsp. *ochroleuca* (Mexican poppy)	Papaveraceae	19	20,495	Disturbed major drainage
**Bidens bipinnata* (bipinnate beggartick)	Asteraceae	182	188	Major and minor drainage
**Cenchrus ciliaris* (buffel grass)	Poaceae	7,309	36,360	Disturbed, plains, major and minor drainage, base of low hills
**Cenchrus setiger* (birdwood grass)	Poaceae	5,155	7,576	Disturbed, major and minor drainage, plains
**Chloris barbata* (purpletop chloris)	Poaceae	6	364	Major drainage
**Citrullus colocynthis*[2]	Cucurbitaceae	0	22	Major drainage
**Citrullus amarus*	Cucurbitaceae	1	4	Major drainage
**Cynodon dactylon* (couch grass)	Poaceae	20	159	Major drainage
**Echinochloa colona* (awnless barnyard grass)	Poaceae	5	7	Major drainage
**Euphorbia hirta* (asthma plant)	Euphorbiaceae	102	102	Major drainage
**Flaveria trinervia* (speedy weed)	Asteraceae	19	38	Disturbed, major and minor drainage
**Lactuca serriola* (prickly lettuce)[2]	Asteraceae	0	27	Disturbed, major and minor drainage

Species	Family	Current survey recorded abundance	Total abundance in surveys area[1]	Habitat
**Malvastrum americanum* (spiked malvastrum)	Malvaceae	77	266	Disturbed, major and minor drainage
**Melochia pyramidata*[2]	Malvaceae	0	1	Major and minor drainage
**Passiflora foetida* subsp. *hispida* (stinking passion flower)	Passifloraceae	300	310	Major and minor drainage
**Phoenix dactylifera* (date palm)	Arecaceae	3	3	Major drainage
**Ricinus communis* (castor oil plant)[2]	Euphorbiaceae	0	3	Disturbed areas
**Ruellia simplex* (Mexican petunia)	Acanthaceae	39	39	Major drainage
**Rumex vesicarius* (ruby dock)	Apocynaceae	27	3,442	Disturbed, major and minor drainage, hilltops and slopes.
**Setaria verticillata* (whorled pigeon grass)	Poaceae	124	128	Major and minor drainage
**Sisymbrium orientale* (Indian hedge mustard)	Brassicaceae	1	4	Major and minor drainage
**Solanum nigrum* (black berry nightshade)	Solanaceae	8	52	Major drainage
**Sonchus oleraceus* (common sowthistle)	Asteraceae	27	389	Major and minor drainage
**Trianthema portulacastrum* (giant pigweed)[2]	Aizoaceae	0	10	Major and minor drainage, roadsides and disturbed areas
**Tribulus terrestris* (caltrop)[2]	Zygophyllaceae	0	13	Disturbed areas
**Vachellia farnesiana* (mimosa bush)	Fabaceae	5	104	Major drainage
**Washingtonia filifera*	Arecaceae	2	3	Major drainage

[1] - Includes all previous points that occur within the survey area (Table P.2, Appendix P), an assumption of one individual was made where no abundance data was collected.
[2] - Species not observed in current survey (Phase 1 or 2), but within survey area (Table P.2, Appendix P).

5 Discussion

5.1 Overview of the Survey Area

The survey area is characterised by the major ironstone ranges of the Western Range, Paraburdoo and Eastern Range with hills and slopes dominated by *Acacia, Eremophila* and *Triodia* species. These are incised by two major creek lines in the west of the survey area, Pirraburdoo Creek (including an area of permanent pooling water known as Ratty Springs) and Seven Mile Creek, as well as a major creek line named Stoney Creek in the east of the survey area and a series of gorges and minor ephemeral drainage lines which are generally highly impacted by weeds, in particular **Cenchrus ciliaris* (buffel grass) and **C. setiger* (birdwood grass). The adjacent detrital plains generally support snakewood (*Acacia xiphophylla*) and mulga (*A. aneura* sens. lat.) communities, with isolated calcrete low hills.

5.2 Vegetation

The vegetation recorded generally represents what would be expected from similar landforms in the broader Hamersley and Gascoyne subregion. Twenty-one vegetation units were mapped within the survey area and 23 statistically significant groups were identified from the floristic analysis. This indicates that the scale of mapping based on visual interpretation was conservative and appropriate for the floristic diversity of the survey area.

Of the 23 groups identified from the floristic analysis, six were formed by individual survey sites: GP11, GP23, GPR25, GP34, GP45 and WRA21. None of these sites is likely to represent unique or conservation significant vegetation in the survey area. The 23 groups identified showed some pattern of grouping according to the structural vegetation associations, including landforms.

One of the vegetation units (D7) was considered as a potential GDE due to the presence of pooled water and associated riparian vegetation. The obligate phreatophyte species *Melaleuca argentea* was not recorded within the D7 vegetation unit or within the survey area more broadly, however the facultative phreatophyte taxa *Eucalyptus camaldulensis* subsp. *refulgens, E. victrix* and *Sesbania formosa* were recorded consistently within the D7 vegetation unit.

The vegetation condition within the survey area has been influenced by a long history of disturbance from mining and pastoral land uses. Weed species diversity and densities are high in areas associated with drainage features, tracks and historically disturbed sites. Areas within the survey area are currently being used for running cattle, with evidence of grazing pressure being observed in vegetation associated with drainages and water sources. There was also evidence of recent fire (in the last two years) throughout large areas in the south-east of the survey area.

There were three vegetation units that did not achieve the minimum of three permanent sites established; H3, H5 and D14. Each of these vegetation units occurred in small areas which restricted the available habitat to establish the desired quadrat repetition.

The survey area lies within the Pre-European vegetation 82, 181, 567 and 163; all have an above 97% pre-European extent remaining, well above The Australian and New Zealand Environment and Conservation Council 30% retention target (Commonwealth of Australia 2001) and the criteria for 10% level of pre-clearing extent as representing ‘endangered’ adopted by the EPA (Environmental Protection Authority 2000).

5.3 Flora

The suite of flora species recorded was considered typical of what may be expected in the area (Beard 1975; Kendrick 2001b; Desmond, Kendrick, and Chant 2001) and aligns with what has been previously recorded in surrounding areas (Biota Environmental Sciences 2012b, 2012a; Ecologia Environment 2011; Rio Tinto 2010a, 2014, 2012; Eco Logical Australia 2016; Mattiske Consulting 1998, 2011; Pilbara Flora 2011). The high number of *Eremophila* taxa recorded highlights the proximity to the Ashburton IBRA region and the Gascoyne flora.

Despite rainfall conditions being below average preceding the Phase 1 and Phase 2 surveys, the floristic diversity was considered reasonably high, with an estimated 72% to 91% (difference is based on four models of comparison) of flora sampled, based on comparison of the total species pool. It is likely however, that many of the annuals and herbaceous species that were noted would have been more widespread throughout suitable habitats in better seasonal conditions. Specimens generally had adequate material to allow confident identification.

Aluta quadrata T was recorded from a previously known population on the northern margin of Pirraburdoo Creek on hill slopes of outcropping canga. This population represents the smallest of the three known populations of *A. quadrata* T and is approximately 8 km from the nearest locations to the west. There are 18 records of *A. quadrata* T listed with the WA Herbarium, with a range of approximately 43 km (Department of Biodiversity, Conservation, and Attractions 2018). No new populations of *A. quadrata* T were found during the current survey and given the survey effort expended during previous and current surveys, it is considered unlikely that any undiscovered populations occur within the survey area.

Eremophila sp. Hamersley Range (K. Walker KW 136) P1 was recorded from two populations during Phase 1 in association with rugged upper slopes and gorges in the Eastern Range area. During the Phase 2 survey, the western most of these two populations was systematically searched, however the eastern most population was not revisited due to time and access constraints. As such the numbers presented in Table 15 in Section 4.2.2.1 are likely to be an underrepresentation of the population extent within the survey area. There were three previous locations of single individuals recorded within the survey area (Rio Tinto 2014). Two of these locations were visited and no individuals were found, and the third occurred in an inaccessible area and was not visited. There are 15 records of *Eremophila* sp. Hamersley Range (K. Walker KW 136) P1 listed with the WA Herbarium, with a range of approximately 385 km (Department of Biodiversity, Conservation, and Attractions 2018).

Hibiscus campanulatus P1 was recorded from a number of populations throughout the survey area but in greatest density around the Eastern Range area. It is likely be more widespread and in greater numbers than recorded as it was encountered in the majority of drainage lines surveyed. A conservative estimate would double the number of individuals recorded during previous and current surveys. There are 22 records of *H. campanulatus* P1 listed with the WA Herbarium, with a range of approximately 180 km (Department of Biodiversity, Conservation, and Attractions 2018). Despite this broad range of distribution, *H. campanulatus* P1 is known to be highly localised around the Paraburdoo and Channar areas.

Goodenia sp. East Pilbara (A.A. Mitchell PRP 727) P3 was recorded from a number of populations throughout the survey area in association with calcrete habitats. None were systematically searched due to seasonal conditions and time constraints and it may occur elsewhere within the survey area on calcrete soils. There are 41 records of *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727) P3 listed with the WA Herbarium, with a range of over 500 km (Department of Biodiversity, Conservation, and Attractions 2018).

Grevillea saxicola P3 was recorded from a number of populations throughout the survey area in association with the lower slopes and associated drainage features of ironstone hills, particularly in the valleys to the north of Eastern Range around Mount Misery. None of the known populations have been systematically searched and it may occur elsewhere within the survey area in suitable habitat. There are 37 records of *G. saxicola* P3 listed with the WA Herbarium, with a range of over 300 km (Department of Biodiversity, Conservation, and Attractions 2018).

Nicotiana umbratica P3 was recorded from one population during Phase 1 at the base of a rocky slope in a shady ironstone gorge near Doggers Gorge. There were three previous locations of single individuals recorded from previous surveys. None of these populations were systematically searched due to time constraints and as such, *N. umbratica* P3 is likely to be more widespread than recorded within the survey area. There are 27 records of *N. umbratica* P3 listed with the WA Herbarium, with a range of over 450 km (Department of Biodiversity, Conservation, and Attractions 2018).

Sida sp. Barlee Range (S. van Leeuwen 1642) P3 was recorded from a number of populations throughout the survey area in association with steep slopes, rocky outcrops, gorges and drainage features of ironstone hills. None of the known populations have been systematically searched and it may occur elsewhere within the survey area in suitable habitat. There are 47 records of *Sida* sp. Barlee Range (S. van Leeuwen 1642) P3 listed with the WA Herbarium, with a range of approximately 400 km (Department of Biodiversity, Conservation, and Attractions 2018).

The previous records of *Solanum octonum* P2 within the survey area are considered likely to match the undescribed *Solanum* sp. (indet.), as presented in Section 4.2.2.1. This new taxon is considered likely to be of conservation significance and requires further collections of reproductive material to confirm and describe. From limited survey effort it appears likely to be restricted to the eastern section of the survey area, however more widespread systematic searches have not been conducted. The range and extent of this species outside of the survey area is not currently known.

Ptilotus trichocephalus P4 was previously recorded from a number of populations on the stony plains in the south of the survey area. No individuals were encountered during either phase of the current survey despite visits to known populations to assess the likelihood of encountering this ephemeral taxon in season. It may occur elsewhere within the survey area in suitable habitat and would be more likely to be encountered during favourable seasonal conditions. There are 18 records of *P. trichocephalus* P4 listed with the WA Herbarium, with a range of approximately 260 km (Department of Biodiversity, Conservation, and Attractions 2018).

There were six conservation significant taxa still considered to have the potential to occur within the survey area following the post-field review of likelihood of occurrence (Table F.1, Appendix F). The preferred habitat for each of the following six taxa was present within the survey area.

Sida sp. Hamersley Range (K. Newbey 10692) P1 is known from 2 km east south-east of the survey area. Recent fires had affected sections of the eastern part of the survey area and these areas were not thoroughly searched. There is greatest potential for this taxon to occur in this part of the survey area and due to the proximity of the known population it is considered to have the potential to still occur. There are 15 records of *Sida* sp. Hamersley Range (K. Newbey 10692) P1 listed with the WA Herbarium, with a range of approximately 220 km (Department of Biodiversity, Conservation, and Attractions 2018).

Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2 is known from 19 km north-east of the survey area. It is morphologically similar to *H. campanulatus* P1 and occurs in similar rocky drainage line and rocky slope habitat. It is considered to have some potential to occur in suitable habitat in the survey area. There are 18 records of *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2

listed with the WA Herbarium, with a range of approximately 200 km (Department of Biodiversity, Conservation, and Attractions 2018).

Eremophila coacta P3 is known from 0.4 km east of the survey area. Recent fires had affected sections of the eastern part of the survey area and these areas were not thoroughly searched. There is greatest potential for this taxon to occur in this part of the survey area and due to the proximity of the known population it is considered to have the potential to still occur. There are 12 records of *E. coacta* P3 listed with the WA Herbarium, with a range of approximately 110 km (Department of Biodiversity, Conservation, and Attractions 2018).

Pilbara trudgenii P3 is known from 0.1 km north of the survey area. Due to the proximity of the known population and the limited survey effort in this rugged part of the survey area it is considered to have the potential to still occur. It was noted that areas of suitable breakaway habitat adjacent to the known population were searched and reported in Rio Tinto (2014). Despite these searches not recording any *P. trudgenii* P3 individuals it was noted that "it is still possible that there are very small isolated populations occurring high on cliff faces" Rio Tinto (2014). There are 11 records of *P. trudgenii* P3 listed with the WA Herbarium, with a range of approximately 130 km (Department of Biodiversity, Conservation, and Attractions 2018).

Eremophila magnifica subsp. *magnifica* P4 is known from 5 km north-east of the survey area. Due to the proximity of the known population and the limited survey effort in the north-eastern part of the survey area it is considered to have the potential to still occur in suitable rocky slope habitat. There are 41 records of *E. magnifica* subsp. *magnifica* P4 listed with the WA Herbarium, with a range of over 300 km (Department of Biodiversity, Conservation, and Attractions 2018).

Ptilotus mollis P4 is known from 3 km south-east of the survey area. Due to the proximity of the known population, the limited survey effort in this south-eastern part of the survey area and the fact that recent fire had affected areas in the east of the survey area it is considered to have the potential to still occur. There are 34 records of *P. mollis* P4 listed with the WA Herbarium, with a range of approximately 700 km (Department of Biodiversity, Conservation, and Attractions 2018).

The **Ruellia simplex* (Mexican petunia) collected from Seven Mile Creek is the first record for Western Australia. As this hasn't been previously recorded in Western Australia it is listed as "Unlisted – s14" under the BAM Act (Department of Primary Industries and Regional Development 2018). It has become naturalised in warmer parts of eastern Australia and is widespread in coastal districts of Queensland and is becoming naturalised in coastal districts of northern New South Wales. **Ruellia simplex* inhabits waterways, riparian vegetation, dams, ponds, wetlands and drainage ditches in sub-tropical and tropical regions and is regarded as an environmental weed with the potential to form dense monocultures in riparian vegetation (Weeds of Australia Biosecurity Queensland Edition 2016). The presence of flowering material indicated the potential for seed production and movement of plants within the creek. The population of **Ruellia simplex* was not systematically surveyed and it is possible that more individuals extend further along the creek than currently recorded.

5.4 Contextual Analysis

Five vegetation units recorded within the survey area are considered to be of local significance because of uniqueness, restricted occurrence and association with conservation significant flora.

The H3 vegetation unit occurred on the steep south facing slopes in the west of the survey area. It was described in Biota (2012a) as occurring in gullies and on the slopes of steep-sided valleys on the south of the Western Range and was noted as the main unit from which *Aluta quadrata* T was

recorded. It was also reported in ecologia (2011) from an area previously mapped and reported in Biota (2012a) which occurs within the current survey area. The single population of *A. quadrata* T within the survey area was not recorded from vegetation unit H3 but in similar habitat on the rocky hill slope vegetation unit H1 and adjacent drainage. No vegetation units comparable with H3 were described in projects assessed within 50 km of the survey area. Due to the relationship with *A. quadrata* T the H3 vegetation unit was considered to have conservation significance at a local scale.

The P8 vegetation unit occurred in the valleys and lower slopes north of the Eastern Range operations in the survey area. It was first described within the current survey area as vegetation unit 'P-XIP' in Rio Tinto (2010a). This same occurrence was further defined as vegetation unit 'P-XIP-Td' in Rio Tinto (2014) and noted as being 'vegetation of significance'. It was described as 'a novel association within mountain valley systems of the study area, due to the presence of low shrubland of *Tecticornia disarticulata* by which it is characterised' (Rio Tinto 2014). It was hypothesised that the presence of *T. disarticulata* may suggest the occurrence of brackish water as a result of gypsum sediments or marine siltstones in the surrounding area however this was unable to be confirmed (Rio Tinto 2014). It was noted that the P-XIP-Td vegetation unit appeared relatively restricted as it was known from only one other location approximately 15 km to the west at Western Range (Rio Tinto 2014), however no similar vegetation was described from the Western Range in Biota (2012a). Upon review of site data from Biota (2012a) the only occurrences of *T. disarticulata* and *Frankenia magnifica* were in quadrats described from the stony plains vegetation unit P1. It is possible that vegetation present at Western Range and mapped as P1 may have been analogous to P8 but was not identified by Biota (2012a). No other vegetation comparable with P8 was described from projects within 50 km of the survey area and as such the P8 vegetation unit is considered to have some conservation significance at a local scale.

The D6 vegetation unit occurred on the deeper incised gorges in the Eastern Range and Doggers Gorge sections of the survey area. Similar vegetation units were described from these areas as 'CfAciDpERcrTe' in Ecologia (2011), 'UR-DG-o1 and UR-DG-o2' in Rio Tinto (2014) (2010,) and as '11' in Eco Logical (2016). Rio Tinto (2014) discussed UR-DG as vegetation of low to moderate significance as it provides riparian habitat for priority flora, riparian flora and fauna. This habitat supports a number of conservation significant flora taxa including *Eremophila* sp. Hamersley Range (K. Walker KW 136) P1, *Hibiscus campanulatus* P1, *Grevillea saxicola* P3, *Sida* sp. Barlee Range (S. van Leeuwen 1642) P3 and *Solanum* sp. (indet.). Similar vegetation was also described from Turee Creek as 'W' in GHD (2009) and as '12b'in Mattiske (2011). Although the D6 vegetation unit appears to occur across a wide range, the flora species which inhabit these gorge habitats can be localised and may have conservation significance (as for *H. campanulatus* P1). As such the D6 vegetation unit is considered to have some conservation significance at a local scale.

The D7 vegetation unit occurred on major drainage lines that supported the potential GDE species *Eucalyptus camaldulensis, E. victrix* and *Sesbania formosa* and was originally described as D7 in Biota (2012b, 2012a) and Ecologia (2011). Similar vegetation units were described from the survey area as '9' in EcoLogical (2016) and from Turee Creek as '1a' in Mattiske (2011). Despite the D7 vegetation unit appearing to occur across a wide range, it is analogous to the Ecosystem at Risk 'major ephemeral watercourses' as described in Kendrick (2001b) and has some conservation significance at a local scale. To a lesser extent the D8 vegetation unit also supported *E. victrix* and may have some conservation significance at a local scale.

The remaining vegetation associations recorded in the survey area represent what may be expected on similar landforms in the broader Hamersley and Gascoyne subregions and are not considered locally restricted (Kendrick 2001b, 2001a; Beard 1975). No vegetation assemblages were considered analogous with a listed TEC or PEC.

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Appendix A: Geology, Land Systems, Pre-European Vegetation, Land Use and Tenure Mapping of the Survey Area

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550000 555000 560000 565000 570000 575000

7440000 7435000 7430000 7425000 7420000

Survey Area

Surface Geological Unit (Stewart et al. 2008)

QUATERNARY

Qa
Qrc

CENOZOIC

Czk

PALEOPROTEROZOIC

Lsya
Lsym
Lsyd
Lch
Lchk
Lchw
Lchb

ARCHEAN

Abfb
Abfo
Asfb
Abfr
Awfj
Awfh
Achm
Alhw
Adf

Rio Tinto

Greater Paraburdoo - Detailed Flora and Vegetation Survey, April 2018

Figure A.1: Geological units of the Paraburdoo survey area

Coordinate System: GDA 1994 MGA Zone 50

0 1 2 3 4 5 Km

N

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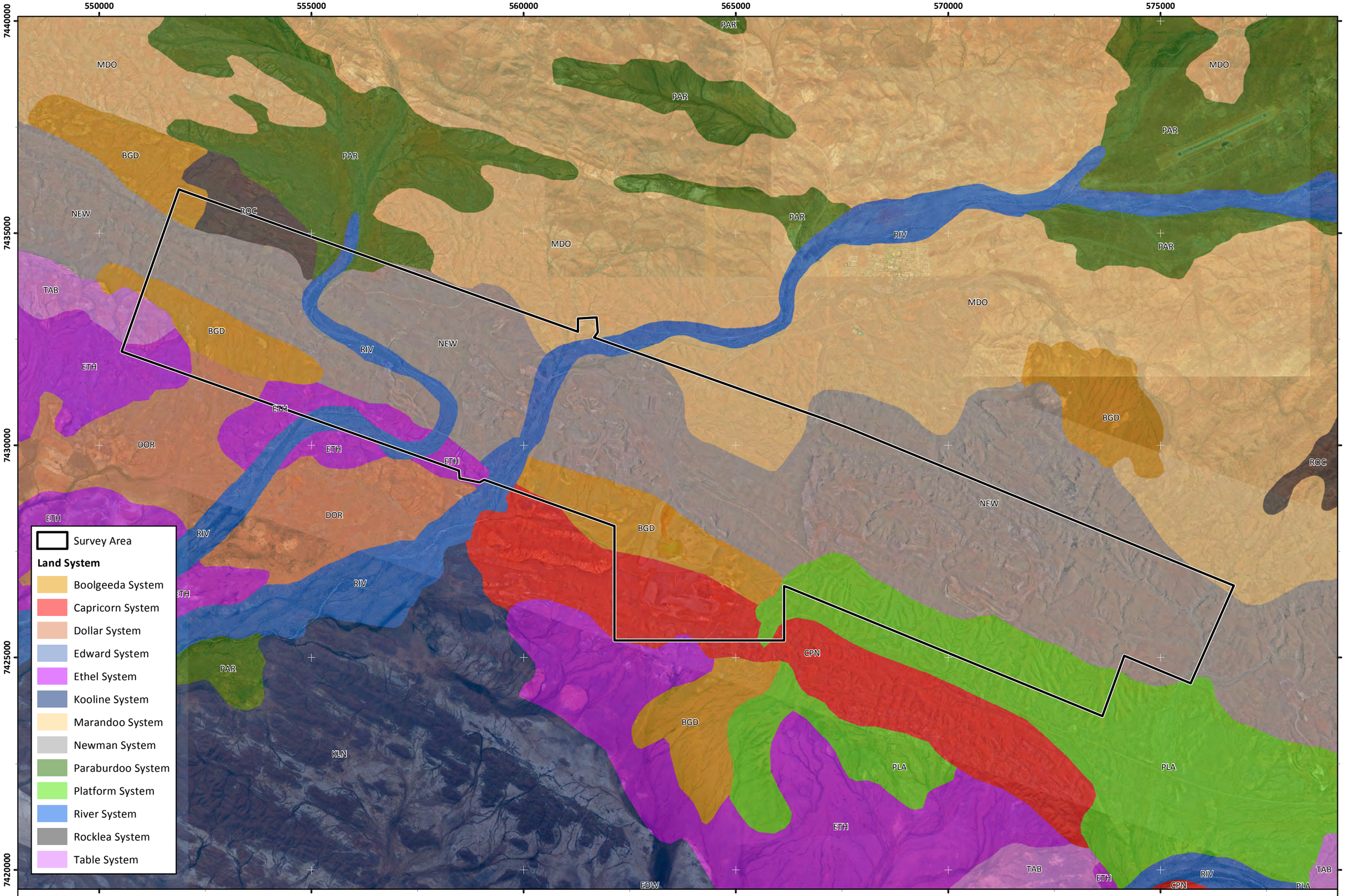
Author: L. Dadour | Drawn: C. Dyde | Date: 13-12-2018 | Figure Ref: 14284-18-BIDR-1RevB_181213_FigA01_Geo



Rio Tinto

Greater Paraburdoo - Detailed Flora and Vegetation Survey, April 2018

Figure A.2: Land systems of the Paraburdoo survey area

Coordinate System: GDA 1994 MGA Zone 50

0 1 2 3 4 5 Km

N

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550000 555000 560000 565000 570000 575000

7440000 7435000 7430000 7425000 7420000

Survey Area

Vegetation Association (Shepherd et al. 2002)

- ASHBUIRTON VALLEY_162
- ASHBUIRTON VALLEY_163
- ASHBUIRTON VALLEY_181
- HAMMERSLEY_181
- HAMMERSLEY_567
- HAMMERSLEY_82

Rio Tinto

Greater Paraburdoo - Detailed Flora and Vegetation Survey, April 2018

Figure A.3: Pre-European vegetation of the Paraburdoo survey area

Coordinate System: GDA 1994 MGA Zone 50

0 1 2 3 4 5 Km

N

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Appendix B: Conservation Categories for Flora and Ecological Communities and Categories for Introduced Flora

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Table B.1: Categories and definitions for threatened flora and fauna species listed under the *Environment Protection and Biodiversity Conservation Act 1999.*

Conservation category	Definition
Extinct	Taxa with no reasonable doubt that the last member of the species has died.
Extinct in the wild	Taxa known to survive only in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriated seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically endangered (CR)	Taxa facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered (E)	Taxa are not critically endangered; and are facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (V)	Taxa are not critically endangered or endangered; and are facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
Conservation dependent (CD)	Taxa are the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or the following subparagraphs are satisfied: • the taxa is a species of fish; • the taxa is the focus of a management plan that provides management actions necessary to stop the decline of, and support the recovery of, the taxa so that its chances of long term survival in nature are maximized; • the management plan is in force under a law of the Commonwealth or of a State or Territory; • cessation of the management plan would adversely affect the conservation status of the taxa • fish includes all taxa of bony fish, sharks, rays, crustaceans, molluscs and other marine organisms, but does not include marine mammals/reptiles.

Table B.2: Definitions and criteria for threatened ecological communities under the *Environment Protection and Biodiversity Conservation Act 1999* (Department of Environment and Conservation 2013).

Categories of ecological communities	
Critically endangered	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	If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable	If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

Table B.3: Categories of Threatened Ecological Communities (Department of Environment and Conservation 2013).

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

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

Possible Threatened Ecological Communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community Lists under Priorities 1, 2 and 3. Ecological communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5 (Table B.4).

Table B.4: Definitions and criteria for Priority Ecological Communities (Department of Environment and Conservation 2013).

P1: Priority One – Poorly-known ecological communities
Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
P2: Priority Two – Poorly-known ecological communities
Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
P3: Priority Three – Poorly-known ecological communities
(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
P4: Priority Four
Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. (i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. (ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.
P5: Priority Five – Conservation dependent ecological communities
Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Taxa that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are added to the Priority Flora and Priority Fauna Lists 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. Taxa 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 taxa require regular monitoring. Conservation dependent species are placed in Priority 5.

Table B.5: Priority species under Western Australian *Wildlife Conservation Act 1950* (Department of Parks and Wildlife 2015)

P1: Priority One – Poorly known taxa
Taxa 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. Taxa 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 taxa
Taxa 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. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
P3: Priority Three – Poorly known taxa
Taxa 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. Taxa 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 taxa in need of monitoring
(a) Rare. Taxa 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 taxa are usually represented on conservation lands. (b) Near Threatened. Taxa 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) Taxa 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 taxa
Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxa becoming threatened within five years.

Note: From 1 January 2019, the *Wildlife Conservation Act 1950* (WC Act) has been replaced by the *Biodiversity Conservation Act 2016* and its regulations. This survey was completed in 2018 under the WC Act.

The management of introduced flora species in Western Australia is now regulated through the *Biosecurity and Agriculture Management Act 2007* (BAM Act). A list of declared pests, including 'pest' plants is provided under the BAM Act, which has been updated to incorporate a number of other Acts that are administered by the Department of Agriculture and Food Western Australia. Declared pests can fall into two categories: one that relates to the prevention of introducing the species or eradicating it; and the other relates to managing the species and whether it can be kept (i.e. for scientific purposes, education or other purpose).

The threat and risk posed to site-specific biodiversity values, influences to rehabilitation success, primary production, infrastructure assets or human health will differ depending on the unique characteristics of each site and the associated land management practice or operation. Therefore site or project specific weed assessments and priorities should be reviewed for each project.

As per introduced flora species, the BAM Act seeks to establish a modern biosecurity regulatory scheme to prevent serious animal pests from entering the State and becoming established, and to minimise the spread and impact of any that are already present within the State. Declared animal pests fall into three categories as Gazetted under the *Biosecurity and Agriculture Management Regulations 2013*. These categories are outlined in Table B.6.

Table B.6: Declared pests control categories as gazetted under the *Biosecurity and Agriculture Management Regulations 2013*.

Category	Description
C1 (Exclusion)	Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2 (Eradication)	Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3 (Management)	Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

Appendix C: Database Searches

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Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Your Ref: **14284-17**
Our Ref: **19-0817FL**
Enquiries: Steve Martin
Phone: (08) 9219 9522
Email: flora.data@dbca.wa.gov.au

Astron Environmental Services
129 Royal Street
East Perth WA 6004

Attention: Daniel Roocke

Dear Daniel Roocke,

REQUEST FOR THREATENED AND PRIORITY FLORA INFORMATION

I refer to your request of 09 August 2017 for Threatened (Declared Rare) and Priority Flora information in the Paraburdoo area. The search was conducted within the area of the shapefile you submitted with an additional 50km buffer.

A search was undertaken for this area of **(1)** the Department's *Threatened (Declared Rare) and Priority Flora* database (for results, see "TPFL" – coordinates are GDA94), **(2)** the *Western Australian Herbarium Specimen* database for Threatened and Priority flora species opportunistically collected in the area of interest (for results, see "WAHERB"- coordinates are GDA94 – see condition number 4 in the attached 'Conditions in Respect of Supply') and **(3)**, the Department's *Threatened and Priority Flora List* [this list is searched using 'place names'. This list, which may also be used as a species target list, contains species that are declared rare (Conservation Code R or X for those presumed to be extinct), poorly known (Conservation Codes 1, 2 or 3), or require monitoring (Conservation Code 4) – for results, *if any*, see "TP List"]. The results are attached electronically to this email.

Attached also are the conditions under which this information has been supplied. Your attention is specifically drawn to the ninth point, which refers to the requirement to undertake field investigations for the accurate determination of Threatened and Priority flora occurrence at a site. *The information supplied should be regarded as an indication only of the Threatened and Priority flora that may be present and may be used as a target list in any surveys undertaken.*

The information provided does not preclude you from obtaining and complying with, where necessary, land clearing approvals from other agencies.

An invoice for $ 300 (plus GST) to supply this information will be forwarded.

It would be appreciated if any populations of Threatened and Priority flora you encounter in the area could be reported to this Department to ensure their ongoing management.

If you require any further details, or wish to discuss Threatened and Priority flora management, please contact Dr Ken Atkins, Manager, Species and Communities Branch, on (08) 9219 9511.

Yours faithfully

Steve Martin
.....
THREATENED FLORA DATABASE OFFICER
for the Director General

21 August 2017

Species and Communities Branch
17 Dick Perry Avenue, Technology Park, Kensington
Phone: (08) 9219 9511
Postal Address: Locked Bag 104, Bentley Delivery Centre, Western Australia 6983
www.dbca.wa.gov.au

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

THREATENED AND PRIORITY FLORA INFORMATION

Conditions with Respect to the Supply of Information

- The data supplied may not be provided to any other organisations, nor be used for any purpose other than for the project for which it has been originally provided for; without the prior consent of the Executive Director, Department of Biodiversity, Conservation and Attractions.
- Specific locality information for threatened flora is regarded as confidential, and should be treated as such by receiving organisations. Specific locality information for threatened flora may not be used in reports without the written permission of the Executive Director, Department of Biodiversity, Conservation and Attractions. Reports may only show generalised locations at a low resolution or, where necessary, show specific locations without identifying species. Species and Communities Branch is to be contacted for guidance on the presentation of threatened flora information.
- The Department of Biodiversity, Conservation and Attractions respects the privacy of private landowners who may have threatened and priority flora on their property. Threatened and priority flora locations identified in the data as being on private property should be treated in confidence, and contact with property owners must only be made through the Department of Biodiversity, Conservation and Attractions.
- The development of the Perth Herbarium database was not originally intended for electronic mapping (eg. GIS ArcView). The latitude and longitude coordinates for each entry are not verified prior to being data based. It is only in recent times that collections have been submitted with GPS coordinates. Therefore, be aware when using this data in ArcView that some records may not plot to the locality description given with each collection.
- Acknowledgment of the Department Biodiversity, Conservation and Attractions as the source of data is to be made in any published material and cited as Biodiversity, Conservation and Attractions (2017) Threatened and Priority Flora Database Search for [search area] accessed on the [date of search]. Prepared by the Species and Communities Branch for [Requesters name and company] for [purpose of search].
- Copies of all such publications are to be forwarded to the Department of Biodiversity, Conservation and Attractions, Attention; the Manager, Species and Communities Branch.

Disclaimers with Respect to the Supply of Information

- Receiving organisations should note that while every effort has been made to prevent errors and omissions in the data, they may be present. The Department of Biodiversity, Conservation and Attractions accepts no responsibility for this.
- Receiving organisations must also recognise that the database is subject to continual updating and amendment, and such considerations should be taken into account by the user.
- It should be noted that the supplied data does not necessarily represent a comprehensive listing of the threatened flora of the area in question. Its comprehensiveness is dependent on the amount of surveys carried out within a specified area. The receiving organisation should consider engaging a botanist, if required, to undertake a survey of the area under consideration.

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

ABBREVIATIONS USED IN THREATENED AND PRIORITY FLORA DATABASE

VESTING

AAP	Aboriginal Planning Authority
AGR	Chief Executive, Dep. of Agriculture
ALT	Aboriginal Land Trust
APB	Agricultural Protection Board of WA
BGP	Botanical Gardens & Parks Authority
BSA	Boy Scouts Association
CC	Conservation Commission – NPNCA - LFC
CGT	Crown Grant in Trust
COM	Commonwealth of Australia
CRO	Crown Freehold-Govt Ownership
CRW	Crown
DAG	Dep. of Agriculture
DOW	Dep. of Water
DPI	Dep. of Planning
EXD	Exec Direc CALM
FES	Fire and Emergency Services Aust.
HOW	Dep. of Housing/State Housing Commission
ILD	Industrial Lands Develop. Auth
LAC	LandCorp
LGA	Shire/LGA
MAG	Minister for Agriculture
MCB	Metropolitan Cemeteries Board
MED	Ministry of Education
MHE	Minister for Health
MIN	Minister for Mines
MPL	Ministry for Planning
MPR	Minister for Prisons
MRD	Main Roads WA
MTR	Minister for Transport
MWA	Minister for Water Resources
MWO	Minister for Works
NAT	Natural Trust of Australia WA
NON	Not Vested
PLB	Pastoral Lands Board
PRI	Private/Freehold
RAI	Public Transport Authority
REL	Religious Organisation
SPC	State Planning Commission
SYN	Synergy (ex Western Power)
SWA	State of Western Australia
TEL	Telstra
UNK	Unknown
WAT	Water Corporation
WEL	Minister Community Welfare
WRC	Water & Rivers Commission
XPL	Ex-Pastoral Lease

PURPOSES

ABR	Aboriginal Reserve
ACC	Access Track
AER	Aerodrome
AIR	Airport
ARS	Agricultural Research Station
BAP	Baptist Union of WA
CAM	Camping
CAR	Caravan park
CEM	Cemetery
CFA	Conservation of Fauna
CFF	Conservation Of Flora & Fauna
CFL	Conservation of Flora
CHU	Church
CMN	Communications
COM	Common
CON	Conservation Park
CPK	Car Park
CRM	Conservation & Resource Management
DEF	Defence
DRA	Drain
EDE	Educational Endowment
EDU	Educational purposes
UWA	
ENE	Enjoyment of Natural Environ.
EPL	Ex-pastoral Lease (Sect 33(2) CALM Act)
EPS	Explosives
EXC	Excepted from sale
EXL	Exploration Lease
EXP	Experimental Farm
FIR	Firing Range
FOR	State Forest
FP	Foreshore Purposes
GE	General Lease
GHA	Grain Handling
GOL	Golf
GRA	Gravel Pit
GVT	Government Requirements
HAR	Harbour Purposes
HEP	Heritage Purposes
HER	Heritage trail
HOS	Hospital
KEN	Kennels
LGA	LGA/Shire Requirements
LPR	Landscape Protection
MIN	Mining lease
MUN	Municipal Purposes
NPK	National Park
NRE	Nature Reserve
OTH	Other
PAR	Parkland (& Recreation)
PAS	Pastoral lease
PCR	Proposed for Conservation
PFF	Protection of Flora & Fauna
PFL	Protection of Flora
PIC	Picnic ground
PLA	Plantation
PMC	Protection of Meteorite Crater
POS	Public Open Space
PPA	Public parkland
PRS	Prison site
PUR	Purchase Lease
PUT	Public Utility
QUA	Quarry
RAC	Racecourse
RAD	Radio Station
REC	Recreation
REH	Rehabilitation/Re-establish Native Plants
RRE	Railway Reserve
RUB	Rubbish
SAL	Saleyards
SAN	Sand
SCH	School-site
SET	Settlers requirements
SHO	Showgrounds
SNN	Sanitary
SOI	Soil Conservation
STO	Stopping place
STK	Stock Route
TIM	Timber
TOU	Tourism
TOW	Town-site
TRA	Training Ground
TRI	Trig station
UCL	Unallocated Crown Land
UNK	Unknown
VER	Road Verge
VPF	Vermin Proof Fence
WAT	Water
WLS	Wildlife Sanctuary
WOO	Firewood

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

ABBREVIATIONS USED IN THE WESTERN AUSTRALIAN HERBARIUM DATABASE

Geocode Method - The method that was used to record the latitude and longitude.

Auto - Indicates that the coordinate data in the record was created automatically (i.e. by software), usually by creating a coordinate from information provided in the Nearest Named Place or Locality textual description fields.

GAP - Acronym for "Generalised Arbitrary Point" as used in HISPID. GAP indicates that the coordinate data was obtained manually from the Nearest Named Place or Locality textual description fields.

GPS - Acronym for "Global Positioning System". GPS indicates that the coordinate data in the record was obtained from a GPS unit by the collector of the specimen.

MAN - Shorthand for manual. MAN indicates that the coordinate data was created by hand using some method not allowed for by one of the other manual Geocode Method values, in particular, TOPO, GAP, or GPS.

TOPO - Shorthand for topographic map. TOPO indicates that the coordinate data was obtained by plotting textual locality details against a topographic map.

None - Indicates that no coordinate data has been supplied by the collector.

Unknown - Indicates that there is no known method for determining the coordinate data. Should be used if the collector provided no indication of how they sampled the specimen's coordinate data.

PREC (Precision) - precision ratings for coordinates.

Precision 1: Absolutely precise (to nearest 100m or nearest second) and must be GPS determined. For example 35°26'42"S 123°40'26"E

Precision 2: Falling within a diameter of 3km (ca 2 minutes) or if no GPS mentioned in collecting notes. (The location must be able to be pinpointed on a 1:250 000 map, a spot locality. For example 35°26'42"S 123°40'26"E

Precision 3: Falling within a diameter of 10km (ca 7 minutes) or for degrees and minutes, where seconds have not been given. For example 35°26'_"S 123°40'_"E

Precision 4: Falling within a diameter of ca 50km (30 minutes). For example 35°26'_"S 123°40'_"E

Precision 5: Where a location is a prescribed large geographical area within a state or only the state is given. Diameter is greater than 50km. For example 35°_'_"S 123°_'_"E

Precision 6: used when localities are New Holland, Eastern Australia or Not given. Fields will be left blank.

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

CONSERVATION CODES

For Western Australian Flora and Fauna

T Threatened species

Listed as Specially Protected under the *Wildlife Conservation Act 1950,* published under Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora).

- Fauna that is rare or likely to become extinct are declared to be fauna that is in need of special protection
- Flora that are extant and considered likely to become extinct, or rare and therefore in need of special protection, are declared to be rare flora

Species* which have been adequately searched for and are deemed to be, in the wild, either rare, at risk of extinction, or otherwise in need of special protection, and have been gazetted as such.
The assessment of the conservation status of these species is based on their national extent.

X Presumed extinct species

Listed as Specially Protected under the *Wildlife Conservation Act 1950,* published under Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora (which may also be referred to as Declared Rare Flora).

Species which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such.

IA Migratory birds protected under an international agreement

Listed as Specially Protected under the *Wildlife Conservation Act 1950,* listed under Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice.

Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), relating to the protection of migratory birds.

S Other specially protected fauna

Listed as Specially Protected under the *Wildlife Conservation Act 1950.* Fauna declared to be in need of special protection, otherwise than for the reasons mentioned for Schedules 1, 2 or 3, are published under Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice.

Threatened Fauna and Flora are ranked according to their level of threat using IUCN Red List categories and criteria. *For example:* Carnaby's Cockatoo (*Calyptorynchus latirostris*) is listed as 'Specially Protected' under the *Wildlife Conservation Act 1950,* published under Schedule 1, and referred to as a 'Threatened' species with a ranking of 'Endangered'.

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.

A list of the current rankings can be downloaded from the Parks and Wildlife Threatened Species and Communities webpage at http://dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

P Priority species

Species that maybe threatened or near threatened but are data deficient, have not yet been adequately surveyed to be listed under the Schedules of the Wildlife Conservation (Specially Protected Fauna) Notice or the Wildlife Conservation (Rare Flora) Notice, are added to the Priority Fauna or Priority Flora Lists 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 that are subject to a specific conservation program are placed in Priority 5.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

1: Priority One: Poorly-known species

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

2: Priority Two: Poorly-known species

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

3: Priority Three: Poorly-known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations 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 locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

4: Priority Four: Rare, Near Threatened and other species in need of monitoring

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.
(b) Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

5: Priority Five: Conservation Dependent species

Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

*Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies, variety or forma).

Threatened and Priority Ecological Community buffers in WA

UNDER NO CIRCUMSTANCES IS THIS DATA TO BE PROVIDED TO ANY THIRD PARTIES, for more details see conditions for the supply of this information.

Citation

Title: Threatened and Priority Ecological Community buffers in WA

Custodian: Department of Parks and Wildlife

Description

Abstract: Ecological communities throughout WA that are "Presumed Totally Destroyed", "Critically Endangered", "Endangered", "Vulnerable", "Priority 1-5", "Lower Risk" and "Not evaluated". Communities are based on various life-forms including plants, invertebrates and micro-organisms.

Geographical Bounding Box

North: -14.788854

South: -35.005719

East: 128.870214

West: 113.765525

Data Currency and Status

Beginning Date: 1/1/94

Ending Date: current

Maintenance/Update: As requested

Access

Stored Data Format: ESRI shapefile

Coordinate System: GCS_GDA_1994

Access Constraints: Digital data is only available with written permission of the custodian. In addition, some occurrence data eg. location of sites on private land, is password restricted.

Data Quality

Positional Accuracy: Point location data within occurrences usually from GPS fix, usually within 100 metres. Some digitized from hard copy.

Attribute Accuracy: Not documented.

Logical Consistency: Not documented.

Completeness: Information on specific communities was obtained from regional, subregional or specific habitat surveys of floristic communities, invertebrate communities, wetland assemblages and communities of micro-organisms.

Attributes List:

Name	Description
BDY_ID	Associated boundary polygon unique identifier
OCC_UNIQUE	Unique occurrence identifier
COM_ID	Shortened community name identifier
COM_NAME	Community name
CT_DESC	State listed Category of Threat
S_ID_COUNT	Number of Site IDs within a buffer
FIRST_S_ID	First site identifier
LAST_S_ID	Last site identifier
BUFFER	Buffer radius from site ID or boundary in metres

General Information:

buffers

- The buffer radius around each occurrence of a TEC or PEC is included to help ensure that developments with potential to impact groundwater or surface water are picked up.
- For wetland TEC or PECs we seek to include an area within the buffer zone that is intended to help protect groundwater and surface water. The area required to protect different types of wetlands from a variety of hydrological impacts will, of course, differ.
- For upland TEC or PECs that are believed not to be groundwater dependent, the buffer area radius encompasses the TEC or PEC site location recorded in the TEC database, and extends at least to the furthest point in the occurrence. This is to ensure that the 'buffer' area encompasses at least the entire TEC or PEC. This means that some linear occurrences may need a larger buffer radius to encompass the entire occurrence.
- Occurrences with a buffer distance of 0 are no longer extant.

Contact Information

Contact Organisation:	**Department of Parks and Wildlife**
Contact Position:	**TEC Ecologist, Species and Communities Branch**
Mail Address:	**Locked Bag 104, Bentley Delivery Centre**
Suburb/Locality:	**Kensington**
Country/State:	**WA**
Postcode:	**6983**
Telephone:	**(08) 9219 9157**
Email:	**communities.data@dpaw.wa.gov.au**

Metadata Information

Metadata Date: **current**

DEPARTMENT OF PARKS AND WILDLIFE

THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES INFORMATION

CONDITIONS IN RESPECT OF SUPPLY OF INFORMATION

1. All requests for data are to be made in writing to the Director General, Department of Parks and Wildlife Attention: Species and Communities Branch

2. The data supplied may not be supplied to other organisations, nor be used for any purpose other than for the project for which they have been provided, without the prior written consent of the data custodian (Val English), Species and Communities Branch.

3. Specific locality information for threatened and priority ecological communities (TECs/PECs) is regarded as confidential, and should be treated as such by receiving organisations. Specific locality information for TECs/PECs may not be used in public reports without the written permission of the Director General, Department of Parks and Wildlife. Publicly available reports may only show generalised locations (ie buffer locations). The TEC database manager is to be contacted for guidance on the presentation of TEC/PEC information.

4. Note that the Department of Parks and Wildlife respects the privacy of private landowners who may have threatened and priority ecological communities on their property. Locations of TECs/PECs identified in the data as being on private property should be treated in confidence, and contact with property owners made through the Department of Environment and Conservation.

5. Receiving organisations should note that while every effort has been made to prevent errors and omissions in the data provided, they may be present. The Department of Parks and Wildlife accepts no responsibility for this.

6. Receiving organisations must also recognise that the Threatened Ecological Communities database is subject to continual updating and amendment, and such considerations should be taken into account by the user.

7. It should be noted that the supplied data do not necessarily represent a comprehensive listing of the threatened and priority ecological communities of the area in question. Its comprehensiveness is dependant on the amount of survey carried out within the specified area. Private property has been relatively little surveyed. The receiving organisation should employ a consultant, if there is any likelihood of the presence of any threatened or priority ecological community, to undertake a survey of the area under consideration.

8. Acknowledgment of the Department of Parks and Wildlife as source of the data is to be made in any published material. Copies of all such publications are to be forwarded to the Department of Parks and Wildlife, Attention: Manager, Species and Communities Branch.

NatureMap
Mapping Western Australia's biodiversity

Greater Paraburdoo Flora Search

Created By Guest user on 14/07/2017

Kingdom Plantae
Current Names Only Yes
Core Datasets Only Yes
Method 'By Line'
Vertices 23° 12' 03" S,117° 30' 07" E 23° 17' 16" S,117° 44' 27" E
Group By Family

Family	Species	Records
Acanthaceae	3	5
Aizoaceae	4	8
Amaranthaceae	21	37
Apocynaceae	3	3
Araliaceae	2	3
Asphodelaceae	1	2
Asteraceae	26	42
Boraginaceae	9	14
Brassicaceae	7	11
Campanulaceae	3	4
Capparaceae	1	2
Caryophyllaceae	1	1
Chenopodiaceae	29	39
Cleomaceae	2	3
Convolvulaceae	9	18
Cucurbitaceae	1	1
Cyperaceae	5	9
Euphorbiaceae	10	13
Fabaceae	69	172
Frankeniaceae	2	5
Gentianaceae	1	1
Geraniaceae	1	1
Goodeniaceae	12	24
Lamiaceae	2	4
Loranthaceae	5	7
Lythraceae	1	1
Malvaceae	45	102
Marsileaceae	1	1
Molluginaceae	1	2
Moraceae	1	1
Myrtaceae	14	43
Nyctaginaceae	3	3
Oleaceae	2	4
Papaveraceae	1	1
Phyllanthaceae	3	6
Poaceae	37	52
Polygalaceae	1	1
Polygonaceae	1	1
Portulacaceae	5	11
Potamogetonaceae	1	1
Primulaceae	1	1
Proteaceae	4	13
Pteridaceae	3	6
Rhamnaceae	2	2
Rubiaceae	4	8
Santalaceae	1	5
Sapindaceae	5	9
Scrophulariaceae	24	84
Solanaceae	12	20
Surianaceae	1	4
Thymelaeaceae	1	2
Typhaceae	1	1
Violaceae	1	5
Zygophyllaceae	6	8
TOTAL	**412**	**827**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Acanthaceae					
1.	7164	*Dicladanthera forrestii*			
2.	11320	*Dipteracanthus australasicus subsp. australasicus*			
3.	17326	*Harnieria kempeana*			
Aizoaceae					
4.	44241	*Trianthema glossostigmum*			
5.	44305	*Trianthema pilosum*			
6.	44362	*Trianthema triquetrum*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
7.	29095	*Zaleya galericulata subsp. galericulata*			
Amaranthaceae					
8.	2646	*Aerva javanica (Kapok Bush)*	Y		
9.	2660	*Amaranthus cuspidifolius*			
10.	20018	*Amaranthus undulatus*			
11.	18361	*Gomphrena affinis subsp. pilbarensis*			
12.	2676	*Gomphrena canescens (Batchelors Buttons)*			
13.	2680	*Gomphrena cunninghamii*			
14.	2690	*Ptilotus aervoides*			
15.	2696	*Ptilotus astrolasius*			
16.	2698	*Ptilotus auriculifolius*			
17.	2704	*Ptilotus calostachyus (Weeping Mulla Mulla)*			
18.	2706	*Ptilotus carinatus*			
19.	2711	*Ptilotus clementii (Tassel Top)*			
20.	2718	*Ptilotus drummondii (Narrowleaf Mulla Mulla)*			
21.	2728	*Ptilotus gomphrenoides*			
22.	2731	*Ptilotus helipteroides (Hairy Mulla Mulla)*			
23.	2741	*Ptilotus macrocephalus (Featherheads)*			
24.	41001	*Ptilotus nobilis subsp. nobilis (Yellow Tails)*			
25.	2747	*Ptilotus obovatus (Cotton Bush)*			
26.	2751	*Ptilotus polystachyus (Prince of Wales Feather)*			
27.	2757	*Ptilotus schwartzii*			
28.	12239	*Ptilotus trichocephalus*		P4	
Apocynaceae					
29.	6567	*Carissa lanceolata (Conkerberry, Marnuwiji)*			
30.	6599	*Rhyncharrhena linearis (Bush Bean, Wintjulanypa)*			
31.	13100	*Tylophora cinerascens*			
Araliaceae					
32.	6202	*Astrotricha hamptonii (Ironplant)*			
33.	19053	*Trachymene pilbarensis*			
Asphodelaceae					
34.	1364	*Asphodelus fistulosus (Onion Weed)*	Y		
Asteraceae					
35.	7836	*Angianthus tomentosus (Camel-grass)*			
36.	43104	*Apowollastonia hamersleyensis*			
37.	7878	*Brachyscome iberidifolia*			
38.	7893	*Calocephalus knappii*			
39.	7895	*Calocephalus multiflorus (Yellow-top)*			
40.	7905	*Calotis multicaulis (Many-stemmed Burr-daisy)*			
41.	33516	*Chrysocephalum gilesii*			
42.	35558	*Flaveria trinervia (Speedy Weed)*	Y		
43.	8088	*Ixiochlamys cuneifolia*			
44.	12638	*Olearia mucronata*		P3	
45.	8153	*Olearia xerophila*			
46.	20311	*Pilbara trudgenii*		P3	
47.	8168	*Pluchea rubelliflora*			
48.	8189	*Pseudognaphalium luteoalbum (Jersey Cudweed)*			
49.	8192	*Pterocaulon sphacelatum (Apple Bush, Fruit Salad Plant)*			
50.	13301	*Rhodanthe floribunda*			
51.	13310	*Rhodanthe margarethae*			
52.	13238	*Rhodanthe maryonii*			
53.	13285	*Schoenia ayersii*			
54.	8213	*Senecio magnificus (Showy Groundsel)*			
55.	8231	*Sonchus oleraceus (Common Sowthistle)*	Y		
56.	8234	*Streptoglossa adscendens*			
57.	8237	*Streptoglossa decurrens*			
58.	8238	*Streptoglossa liatroides*			
59.	12729	*Taplinia saxatilis*			
60.	45613	*Taraxacum khatoonae*	Y		
Boraginaceae					
61.	17301	*Heliotropium chrysocarpum*			
62.	6704	*Heliotropium conocarpum*			
63.	6705	*Heliotropium crispatum*			
64.	6712	*Heliotropium heteranthum*			
65.	17307	*Heliotropium inexplicitum*			
66.	6713	*Heliotropium ovalifolium*			
67.	17309	*Heliotropium pachyphyllum*			

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68.	6718	*Heliotropium tenuifolium (Mamukata)*			
69.	6727	*Trichodesma zeylanicum (Camel Bush, Kumbalin)*			
Brassicaceae					
70.	3032	*Lepidium muelleri-ferdinandii*			
71.	3033	*Lepidium oxytrichum*			
72.	3035	*Lepidium pedicellosum*			
73.	3037	*Lepidium phlebopetalum (Veined Peppercress)*			
74.	3039	*Lepidium platypetalum (Slender Peppercress)*			
75.	3072	*Sisymbrium orientale (Indian Hedge Mustard)*	Y		
76.	3074	*Stenopetalum anfractum*			
Campanulaceae					
77.	37480	*Lobelia arnhemiaca*			
78.	36880	*Lobelia heterophylla subsp. pilbarensis*			
79.	7393	*Wahlenbergia tumidifructa*			
Capparaceae					
80.	48291	*Capparis spinosa subsp. nummularia*			
Caryophyllaceae					
81.	2903	*Polycarpaea longiflora*			
Chenopodiaceae					
82.	2453	*Atriplex codonocarpa (Flat-topped Saltbush)*			
83.	2473	*Atriplex quadrivalvata*			Y
84.	2499	*Dissocarpus paradoxus (Curious Saltbush)*			
85.	2502	*Dysphania kalpari (Rat's Tail, Kalpari)*			
86.	2504	*Dysphania plantaginella*			
87.	2506	*Dysphania rhadinostachya*			
88.	11890	*Dysphania rhadinostachya subsp. rhadinostachya*			
89.	2511	*Enchylaena tomentosa (Barrier Saltbush)*			
90.	2513	*Eremophea spinosa*			
91.	2538	*Maireana carnosa (Cottony Bluebush)*			
92.	2543	*Maireana eriosphaera*			
93.	2544	*Maireana georgei (Satiny Bluebush)*			
94.	2547	*Maireana lanosa (Woolly Bluebush)*			
95.	2551	*Maireana melanocoma (Pussy Bluebush)*			
96.	2556	*Maireana planifolia (Low Bluebush)*			
97.	2565	*Maireana suaedifolia*			
98.	2566	*Maireana thesioides (Lax Bluebush)*			
99.	2567	*Maireana tomentosa (Felty Bluebush)*			
100.	11662	*Maireana tomentosa subsp. tomentosa*			
101.	2571	*Maireana villosa*			
102.	2582	*Rhagodia eremaea (Thorny Saltbush)*			
103.	30434	*Salsola australis*			
104.	2597	*Sclerolaena bicornis (Goathead Burr)*			
105.	2603	*Sclerolaena cornishiana (Cartwheel Burr)*			
106.	2606	*Sclerolaena cuneata (Yellow Bindii)*			
107.	2611	*Sclerolaena eriacantha (Tall Bindii)*			
108.	8877	*Sclerolaena gardneri*			
109.	2619	*Sclerolaena lanicuspis (Spinach Burr)*			
110.	31492	*Tecticornia disarticulata*			
Cleomaceae					
111.	2985	*Cleome oxalidea*			
112.	2988	*Cleome viscosa (Tickweed, Tjinduwadhu)*			
Convolvulaceae					
113.	6606	*Bonamia media*			
114.	44782	*Bonamia pilbarensis*			
115.	6612	*Convolvulus clementii*			
116.	31274	*Duperreya commixta*			
117.	6617	*Evolvulus alsinoides (Tropical Speedwell)*			
118.	11200	*Evolvulus alsinoides var. villosicalyx*			
119.	6633	*Ipomoea muelleri (Poison Morning Glory, Yumbu)*			
120.	6651	*Operculina aequisepala*			
121.	6653	*Polymeria ambigua (Morning Glory)*			
Cucurbitaceae					
122.	41721	*Cucumis variabilis*			
Cyperaceae					
123.	774	*Cyperus bifax (Downs Nutgrass)*			
124.	786	*Cyperus cunninghamii*			

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125.	18318	*Cyperus involucratus*	Y		
126.	818	*Cyperus vaginatus (Stiffleaf Sedge)*			
127.	16257	*Schoenoplectus subulatus*			
Euphorbiaceae					
128.	17422	*Adriana tomentosa var. tomentosa*			
129.	42844	*Euphorbia australis var. hispidula*			
130.	35303	*Euphorbia australis var. subtomentosa*			
131.	4620	*Euphorbia boophthona (Gascoyne Spurge)*			
132.	9048	*Euphorbia careyi*			
133.	4623	*Euphorbia coghlanii (Namana)*			
134.		*Euphorbia sp.*			
135.	4647	*Euphorbia tannensis*			
136.	12097	*Euphorbia tannensis subsp. eremophila (Desert Spurge)*			
137.	42879	*Euphorbia trigonosperma*			
Fabaceae					
138.	3209	*Acacia ampliceps*			
139.	44586	*Acacia ampliceps x sclerosperma subsp. sclerosperma*			
140.	3217	*Acacia aneura (Mulga, Wanari)*			
141.	37260	*Acacia aptaneura*			
142.	3228	*Acacia atkinsiana*			
143.	3232	*Acacia ayersiana*			
144.	3241	*Acacia bivenosa*			
145.	44588	*Acacia bivenosa x sclerosperma subsp. sclerosperma*			
146.	3260	*Acacia citrinoviridis*			
147.	13502	*Acacia coriacea subsp. pendens*			
148.	3280	*Acacia cuspidifolia (Bohemia)*			
149.	3360	*Acacia hamersleyensis*			
150.	36418	*Acacia incurvaneura*			
151.	3434	*Acacia maitlandii (Maitland's Wattle)*			
152.	3435	*Acacia marramamba*			
153.	3500	*Acacia pruinocarpa (Gidgee)*			
154.	29016	*Acacia pyrifolia var. morrisonii*			
155.	29015	*Acacia pyrifolia var. pyrifolia*			
156.	3519	*Acacia rhodophloia*			
157.	44584	*Acacia rhodophloia x sibirica*			
158.	13078	*Acacia sclerosperma subsp. sclerosperma*			
159.	8949	*Acacia sibirica (Bastard Mulga)*			
160.	3553	*Acacia spondylophylla*			
161.	13070	*Acacia synchronicia*			
162.	3577	*Acacia tetragonophylla (Kurara, Wakalpuka)*			
163.	29531	*Acacia thoma*			
164.	3598	*Acacia wanyu*			
165.	3606	*Acacia xiphophylla*			
166.	3774	*Crotalaria cunninghamii (Green Birdflower, Bilbun)*			
167.	20175	*Crotalaria cunninghamii subsp. sturtii*			
168.	3783	*Crotalaria medicaginea*			
169.	20179	*Crotalaria medicaginea var. neglecta*			
170.	17118	*Cullen leucanthum*			
171.	17119	*Cullen leucochaites*			
172.	3941	*Glycine tabacina (Glycine Pea)*			
173.	3973	*Indigofera colutea (Sticky Indigo)*			
174.	16644	*Indigofera decipiens*			
175.	17961	*Indigofera fractiflexa*			
176.	3982	*Indigofera monophylla*			
177.	3985	*Indigofera rugosa*			
178.	4061	*Lotus cruentus (Redflower Lotus)*			
179.	3614	*Neptunia dimorphantha (Sensitive Plant)*			
180.	3675	*Petalostylis labicheoides (Slender Petalostylis)*			
181.	4190	*Rhynchosia australis (Rhynchosia)*			
182.	4191	*Rhynchosia minima (Rhynchosia)*			
183.	17645	*Senna artemisioides*			
184.	12279	*Senna artemisioides subsp. helmsii*			
185.	12280	*Senna artemisioides subsp. oligophylla*			
186.	12307	*Senna glutinosa subsp. glutinosa*			
187.	12309	*Senna glutinosa subsp. pruinosa*			
188.	12308	*Senna glutinosa subsp. x luerssenii*			
189.	18451	*Senna hamersleyensis*			
190.	12312	*Senna notabilis*			
191.	18595	*Senna sp. Karijini (M.E. Trudgen 10392)*			

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192.	14577	*Senna sp. Meekatharra (E. Bailey 1-26)*			
193.	18445	*Senna stricta*			
194.	4196	*Sesbania cannabina (Sesbania Pea)*			
195.	4198	*Sesbania formosa (White Dragon Tree)*			
196.	4228	*Swainsona forrestii*			
197.	4230	*Swainsona incei*			
198.	4233	*Swainsona leeana*			
199.	4234	*Swainsona maccullochiana (Ashburton Pea)*			
200.	42142	*Swainsona thompsoniana*		P3	
201.	41825	*Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)*			
202.	41811	*Tephrosia sp. Fortescue (A.A. Mitchell 606)*			
203.	42442	*Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)*			
204.	40060	*Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)*			
205.	30716	*Vachellia farnesiana (Mimosa Bush)*	Y		
206.	4323	*Vigna lanceolata (Maloga Vigna, Wega)*			
Frankeniaceae					
207.	5207	*Frankenia magnifica*			
208.	5212	*Frankenia setosa (Bristly Frankenia)*			
Gentianaceae					
209.	41646	*Schenkia clementii*			
Geraniaceae					
210.	4335	*Erodium cygnorum (Blue Heronsbill)*			
Goodeniaceae					
211.	12517	*Goodenia cusackiana*			
212.	7509	*Goodenia forrestii*			
213.	7526	*Goodenia microptera*			
214.	12552	*Goodenia muelleriana*			
215.	12571	*Goodenia pascua*			
216.	12574	*Goodenia prostrata*			
217.	7545	*Goodenia scaevolina (Ngurubi)*			
218.	29381	*Goodenia sp. East Pilbara (A.A. Mitchell PRP 727) (O'Meara's Goodenia)*		P3	
219.	10982	*Goodenia stobbsiana*			
220.	7556	*Goodenia tenuiloba*			
221.	12578	*Scaevola acacioides*			
222.	7644	*Scaevola spinescens (Currant Bush, Maroon)*			
Lamiaceae					
223.	13689	*Clerodendrum tomentosum var. lanceolatum*			
224.	12707	*Prostanthera albiflora*			
Loranthaceae					
225.	2372	*Amyema fitzgeraldii (Pincushion Mistletoe)*			
226.	11614	*Amyema gibberula var. gibberula*			
227.	11874	*Amyema sanguinea var. sanguinea*			
228.	14307	*Amyema sp. Fortescue (M.E. Trudgen 5358)*			
229.	2396	*Lysiana casuarinae*			
Lythraceae					
230.	5278	*Ammannia multiflora*			
Malvaceae					
231.	4886	*Abutilon amplum*			
232.	4889	*Abutilon cryptopetalum*			
233.	4891	*Abutilon fraseri (Lantern Bush)*			
234.	18120	*Abutilon fraseri subsp. fraseri*			
235.	4895	*Abutilon lepidum*			
236.	4901	*Abutilon otocarpum (Desert Chinese Lantern)*			
237.	42920	*Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)*			
238.	40910	*Androcalva luteiflora (Yellow-flowered Rulingia)*			
239.	13560	*Corchorus crozophorifolius*			
240.	18409	*Corchorus lasiocarpus subsp. lasiocarpus*			
241.	18408	*Corchorus lasiocarpus subsp. parvus*			
242.	4865	*Corchorus tridens*			
243.	4918	*Gossypium robinsonii (Wild Cotton)*			
244.	4924	*Hibiscus burtonii*			
245.	48312	*Hibiscus campanulatus*		P1	
246.	4925	*Hibiscus coatesii*			
247.	4930	*Hibiscus goldsworthii*			
248.	43022	*Hibiscus sp. Gardneri (A.L. Payne PRP 1435)*			
249.	4942	*Hibiscus sturtii (Sturt's Hibiscus)*			

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250.	11651	*Hibiscus sturtii var. campylochlamys*			
251.	11477	*Hibiscus sturtii var. platychlamys*			
252.	4953	*Lawrencia densiflora*			
253.	4955	*Lawrencia glomerata*			
254.	4962	*Malvastrum americanum (Spiked Malvastrum)*	Y		
255.	46816	*Seringia elliptica (Showy fire-bush)*			
256.	46821	*Seringia nephrosperma (Free carpel fire-bush)*			
257.	4969	*Sida brownii*			
258.	4970	*Sida calyxhymenia (Tall Sida)*			
259.	4971	*Sida cardiophylla*			
260.	4976	*Sida echinocarpa*			
261.	4977	*Sida fibulifera (Silver Sida)*			
262.	15110	*Sida laevis*			
263.	16616	*Sida sp. Barlee Range (S. van Leeuwen 1642)*		P3	
264.	31854	*Sida sp. Excedentifolia (J.L. Egan 1925)*			
265.	33697	*Sida sp. Hamersley Range (K. Newbey 10692)*		P1	
266.	33698	*Sida sp. Pilbara (A.A. Mitchell PRP 1543)*			
267.	20253	*Sida sp. Shovelanna Hill (S. van Leeuwen 3842)*			
268.	19712	*Sida sp. dark green fruits (S. van Leeuwen 2260)*			
269.	16617	*Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)*			
270.	4989	*Sida spinosa (Spiny Sida)*			
271.	4875	*Triumfetta chaetocarpa (Urchins)*			
272.	14694	*Triumfetta clementii*			
273.	4879	*Triumfetta leptacantha*			
274.	5106	*Waltheria indica*			
275.	5107	*Waltheria virgata*			
Marsileaceae					
276.	76	*Marsilea hirsuta (Nardoo)*			
Molluginaceae					
277.	48201	*Trigastrotheca molluginea*			
Moraceae					
278.	19648	*Ficus brachypoda*			
Myrtaceae					
279.	19448	*Aluta quadrata*		T	
280.	16783	*Corymbia candida*			
281.	17077	*Corymbia ferriticola*			
282.	17093	*Corymbia hamersleyana*			
283.	17092	*Corymbia opaca*			
284.	35345	*Eucalyptus camaldulensis subsp. obtusa (Blunt-budded River Red Gum)*			
285.	5655	*Eucalyptus gamophylla (Twin-leaf Mallee, Warilu)*			
286.	13528	*Eucalyptus kingsmillii subsp. kingsmillii*			
287.	18088	*Eucalyptus leucophloia subsp. leucophloia*			
288.	18058	*Eucalyptus repullulans*			
289.	5875	*Melaleuca argentea (Silver Cadjeput, Bandaran)*			
290.	5879	*Melaleuca bracteata (River Teatree)*			
291.	5915	*Melaleuca glomerata*			
292.	5933	*Melaleuca linophylla*			
Nyctaginaceae					
293.	2770	*Boerhavia coccinea (Tar Vine, Wituka)*			
294.		*Boerhavia sp.*			
295.	2776	*Commicarpus australis (Perennial Tar Vine)*			
Oleaceae					
296.	6501	*Jasminum didymum*			
297.	12059	*Jasminum didymum subsp. lineare (Desert Jasmine)*			
Papaveraceae					
298.	17797	*Argemone ochroleuca subsp. ochroleuca*	Y		
Phyllanthaceae					
299.	38421	*Notoleptopus decaisnei*			
300.	4680	*Phyllanthus maderaspatensis*			
301.	4706	*Sauropus crassifolius*			
Poaceae					
302.	19835	*Amphipogon sericeus*			
303.	203	*Aristida anthoxanthoides (Yellow Threeawn)*			
304.	207	*Aristida contorta (Bunched Kerosene Grass)*			
305.	217	*Aristida nitidula (Flat-awned Threeawn)*			
306.	229	*Astrebla pectinata (Barley Mitchell Grass)*			

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307.	258	*Cenchrus ciliaris (Buffel Grass)*	Y		
308.	272	*Chloris virgata (Feathertop Rhodes Grass)*	Y		
309.	279	*Cymbopogon ambiguus (Scentgrass)*			
310.	46555	*Cynodon prostratus*			
311.	311	*Digitaria ciliaris (Summer Grass)*	Y		
312.	357	*Enneapogon caerulescens (Limestone Grass)*			
313.	360	*Enneapogon lindleyanus (Wiry Nineawn, Purple-head Nineawn)*			
314.	363	*Enneapogon pallidus (Conetop Nineawn)*			
315.	365	*Enneapogon polyphyllus (Leafy Nineawn)*			
316.	378	*Eragrostis dielsii (Mallee Lovegrass)*			
317.	380	*Eragrostis eriopoda (Woollybutt Grass, Wangurnu)*			
318.	393	*Eragrostis setifolia (Neverfail Grass)*			
319.		*Eragrostis sp.*			
320.	400	*Eriachne aristidea*			
321.	403	*Eriachne benthamii (Swamp Wanderrie)*			
322.	413	*Eriachne mucronata (Mountain Wanderrie Grass)*			
323.	421	*Eriachne tenuiculmis*			
324.	458	*Iseilema dolichotrichum*			
325.	465	*Iseilema vaginiflorum (Red Flinders Grass)*			
326.	19124	*Leptochloa fusca subsp. fusca*			
327.	503	*Panicum decompositum (Native Millet, Kaltu-kaltu)*			
328.	515	*Paraneurachne muelleri (Northern Mulga Grass)*			
329.	10975	*Paspalidium basicladum*			
330.	518	*Paspalidium clementii (Clements Paspalidium)*			
331.	519	*Paspalidium constrictum (Knottybutt Grass)*			
332.	629	*Sporobolus australasicus (Fairy Grass)*			
333.	17820	*Themeda sp. Hamersley Station (M.E. Trudgen 11431)*		P3	
334.	673	*Themeda triandra*			
335.	681	*Triodia brizoides*			
336.	13131	*Triodia epactia*			
337.	704	*Triodia wiseana (Limestone Spinifex)*			
338.	706	*Triraphis mollis (Needle Grass)*			
Polygalaceae					
339.	41365	*Polygala glaucifolia*			
Polygonaceae					
340.	2443	*Rumex vesicarius (Ruby Dock)*	Y		
Portulacaceae					
341.	2869	*Calandrinia schistorhiza*			
342.	31131	*Calandrinia sp. Black angular seeds (A.A. Mitchell PRP 1661)*			
343.	31073	*Calandrinia sp. The Pink Hills (F. Obbens FO 19/06)*			
344.	2882	*Portulaca intraterranea*			
345.	2884	*Portulaca oleracea (Purslane, Wakati)*			
Potamogetonaceae					
346.	20426	*Potamogeton tepperi*			
Primulaceae					
347.	6483	*Samolus junceus*			
Proteaceae					
348.	1963	*Grevillea berryana*			
349.	44441	*Grevillea saxicola*		P3	
350.	2099	*Grevillea striata (Beefwood)*			
351.	19137	*Hakea lorea subsp. lorea*			
Pteridaceae					
352.	32	*Cheilanthes brownii*			
353.	37	*Cheilanthes lasiophylla (Woolly Cloak Fern)*			
354.	8462	*Cheilanthes tenuifolia (Rock Fern)*			
Rhamnaceae					
355.	16189	*Cryptandra monticola*			
356.	4846	*Ventilago viminalis (Supplejack, Barndaragu)*			
Rubiaceae					
357.	7338	*Oldenlandia crouchiana*			
358.	18154	*Psydrax latifolia*			
359.	18155	*Psydrax suaveolens*			
360.	13339	*Synaptantha tillaeacea var. tillaeacea*			
Santalaceae					
361.	2357	*Santalum lanceolatum (Northern Sandalwood, Yarnguli)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Sapindaceae					
362.	12023	*Diplopeltis stuartii var. stuartii (Desert Pepperflower)*			
363.	11406	*Dodonaea lanceolata var. lanceolata*			
364.	4772	*Dodonaea pachyneura*			
365.	4773	*Dodonaea petiolaris*			
366.	4782	*Dodonaea viscosa (Sticky Hopbush)*			
Scrophulariaceae					
367.	31471	*Eremophila accrescens*			
368.	15167	*Eremophila canaliculata*			
369.	15030	*Eremophila coacta*		P3	
370.	18053	*Eremophila cryptothrix*			
371.	7192	*Eremophila cuneifolia (Pinyuru, T'iranju)*			
372.	7205	*Eremophila exilifolia*			
373.	15052	*Eremophila forrestii subsp. forrestii*			
374.	17152	*Eremophila forrestii subsp. hastieana (Grey Poverty Bush)*			
375.	16696	*Eremophila fraseri subsp. fraseri*			
376.	17519	*Eremophila jucunda subsp. pulcherrima*			
377.	7228	*Eremophila lachnocalyx (Woolly-calyxed Eremophila)*			
378.	7230	*Eremophila latrobei (Warty Fuchsia Bush, Mintjingka)*			
379.	17597	*Eremophila latrobei subsp. filiformis*			
380.	17576	*Eremophila latrobei subsp. latrobei*			
381.	7234	*Eremophila longifolia (Berrigan, Tulypurpa)*			
382.	14893	*Eremophila magnifica subsp. magnifica*		P4	
383.	18570	*Eremophila oppositifolia subsp. angustifolia*			
384.	15164	*Eremophila petrophila subsp. petrophila*			
385.	17283	*Eremophila phyllopoda subsp. obliqua*			
386.	15160	*Eremophila platycalyx subsp. pardalota*			
387.	15057	*Eremophila reticulata*			
388.	40643	*Eremophila sp. Hamersley Range (K. Walker KW 136)*		P1	
389.	23997	*Eremophila tietkensii*			
390.	16040	*Eremophila youngii subsp. lepidota*		P4	
Solanaceae					
391.	47241	*Datura leichhardtii subsp. leichhardtii*	Y		
392.	6971	*Nicotiana benthamiana (Tjuntiwari)*			
393.	11856	*Nicotiana occidentalis subsp. occidentalis*			
394.	6980	*Nicotiana umbratica*		P3	
395.	7009	*Solanum gabrielae*			
396.	7014	*Solanum horridum*			
397.	7018	*Solanum lasiophyllum (Flannel Bush, Mindjulu)*			
398.	7022	*Solanum nigrum (Black Berry Nightshade)*	Y		
399.	42541	*Solanum octonum*		P2	
400.	7029	*Solanum phlomoides*			
401.	42546	*Solanum piceum*			
402.	7036	*Solanum sturtianum (Thargomindah Nightshade)*			
Surianaceae					
403.	3182	*Stylobasium spathulatum (Pebble Bush)*			
Thymelaeaceae					
404.	11185	*Pimelea microcephala subsp. microcephala*			
Typhaceae					
405.	98	*Typha domingensis (Bulrush, Djandjid)*			
Violaceae					
406.	5215	*Hybanthus aurantiacus*			
Zygophyllaceae					
407.	4374	*Tribulus astrocarpus*			
408.	4377	*Tribulus hirsutus*			
409.	4380	*Tribulus occidentalis (Perennial Caltrop)*			
410.	18072	*Tribulus suberosus*			
411.	4392	*Zygophyllum iodocarpum*			
412.	4393	*Zygophyllum kochii*			

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
5 - Priority 5

Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Australian Government
Department of the Environment and Energy

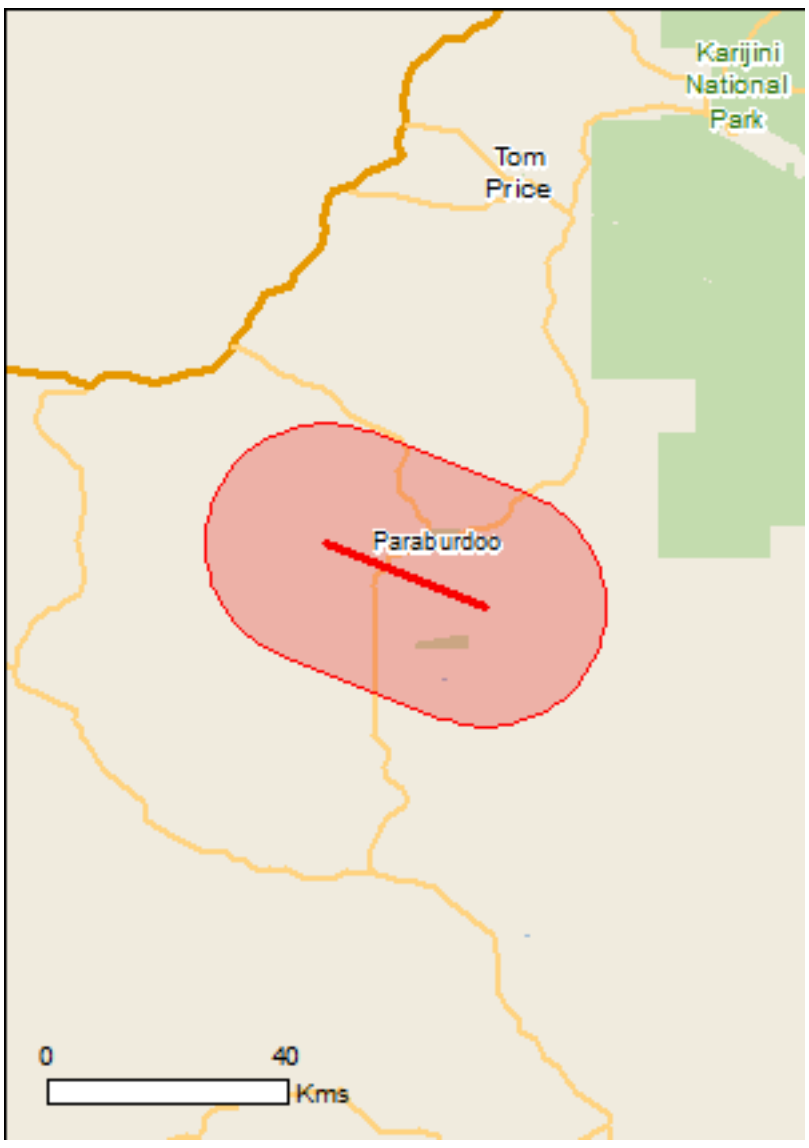
EPBC Act Protected Matters Report

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.

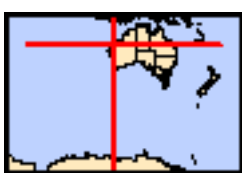
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 04/07/17 13:11:57



Coordinates
Buffer: 20.0Km



Summary

Matters of National Environmental 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.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	9
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	13
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	9
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Pezoporus occidentalis		
Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Rostratula australis		
Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus hallucatus		
Northern Quoll, Digul [331]	Endangered	Species or species habitat likely to occur within area
Macroderma gigas		
Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Macrotis lagotis		
Greater Bilby [282]	Vulnerable	Species or species habitat likely to occur within area
Rhinonicteris aurantia (Pilbara form)		
Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat known to occur within area
Plants		
Lepidium catapycnon		
Hamersley Lepidium, Hamersley Catapycnon [9397]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Liasis olivaceus barroni		
Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		

Name	Threatened	Type of Presence
Hirundo rustica		
Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus		
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

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, 2001.

Name	Status	Type of Presence
Mammals		
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		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

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 and National Heritage properties, Wetlands of International and National 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 resolutions.

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 information sources.

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.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

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.

Coordinates

-23.20083 117.50056,-23.28806 117.74056

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:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian 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, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-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.

Department of the Environment
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

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Appendix D: Previous Survey Area Locations

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