Vegetation Survey and Desktop Assessment
Caramulla Creek

Prepared for BHP WAIO
8 November 2018

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ONSHORE ENVIRONMENTAL
ACN 095 837 120
PO Box 227
YALLINGUP WA 6282
Telephone / Fax (08) 9756 6206
E-mail: info@onshoreenvironmental.com.au

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EXECUTIVE SUMMARY

BHP Western Australia Iron Ore Pty Ltd (BHP WAIO) commissioned Onshore Environmental Consultants Pty Ltd (Onshore Environmental) to undertake a reconnaissance vegetation survey of Caramulla Creek (hereafter referred to as the study area), and a desktop assessment for an adjacent area identified for Managed Aquifer Recharge (MAR). The focus of the survey was to identify groundwater dependent, riparian and terrestrial vegetation that may potentially by impacted by surplus water discharge into Caramulla Creek, and/or groundwater changes from reinjection of groundwater within the MAR.

The study area was located approximately 55 km east of Newman and 18 km east of BHP WAIO's existing Jimblebar (Wheelarra Hill) mining operations (Figure 1). It incorporated the braided drainage channels of Caramulla Creek, extending approximately 19 km downstream of the proposed surplus water discharge point and covering an area of 6,337 hectares (ha). The 2,500 ha MAR area overlapped the southern end of the study area, extending 4.2 km to the west and 3.2 km to the east (Figure 1). The MAR area was recently surveyed as part of the Caramulla reconnaissance vegetation survey (Onshore Environmental 2018).

A reconnaissance vegetation survey of 6,337 ha encompassing the braided drainage network of Caramulla Creek was conducted under *poor* seasonal conditions between the 18th and 22nd of June 2018. Access was a major limiting factor encountered during the field survey. The main access track aligned north-south through the western fringe of the study area was overgrown from approximately 5 km north of the southern boundary, limiting field assessments to the southern half of the study area.

A total of 21 vegetation associations were mapped from the entire study area, with two associations supporting groundwater dependent vegetation (namely the tree *Eucalyptus camaldulensis* subsp. *obtusa*). There were 16 vegetation associations that supported stands of Mulga and/or *Acacia citrinoviridis,* surface rooting taxa that are known to be at elevated risk from extended periods of inundation. None of the vegetation associations within the study area were aligned with Federal or State listed Threatened Ecological Communities (TECs), or State listed Priority Ecological Communities (PECs).

Vegetation condition ranged from *very good* to *degraded*, with grazing by cattle and resultant introduction of weeds the common disturbances recorded. There were two introduced flora species recorded from the study area; **Cenchrus ciliaris* (Buffel Grass) and **Cenchrus setiger* (Birdwood Grass). Neither taxon is listed as a Declared Pest under the *Biosecurity and Agriculture Management Act 2007* (BAM Act). There were no plant taxa gazetted as Threatened Flora pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act 1950* (WC Act), or listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) recorded from the study area.

Two Priority listed flora were recorded opportunistically from the southern sector of the study area; *Eremophila capricornica* (Priority 1) and *Rhagodia* sp. Hamersley (M. Trudgen 17794) (Priority 3).

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1.0 INTRODUCTION

1.1 Preamble

BHP WAIO commissioned Onshore Environmental to undertake a reconnaissance vegetation survey incorporating the braided network of drainage channels forming Caramulla Creek (hereafter referred to as the study area), and a desktop assessment of an area identified for MAR (Figure 1). The focus of the survey was to identify groundwater dependent, riparian and terrestrial vegetation that may potentially be impacted by surplus water discharge into Caramulla Creek, or from MAR.

1.2 Previous Surveys

There are eight relevant flora and vegetation surveys that have been completed at BHP WAIO tenements within a 7 km radius of the study area and MAR area (Appendix 1), including two surveys that partially overlap the southern sector:

- Onshore Environmental (2018) Caramulla Reconnaissance Flora and Vegetation Survey; and
- GHD (2009) Caramulla Exploration Area Flora and Vegetation Survey.

The remaining survey work has been completed at BHP WAIO tenements situated immediately west of the study area and MAR area, including the Hashimoto project area (Ecologia Environment 2007), Jimblebar project area (Outback Ecology 2010) and Jimblebar East project area (Ecologia Environmental 2005). More recent work has been completed along a 32 km stretch of neighbouring Jimblebar Creek by Onshore Environmental (2015, 2016).

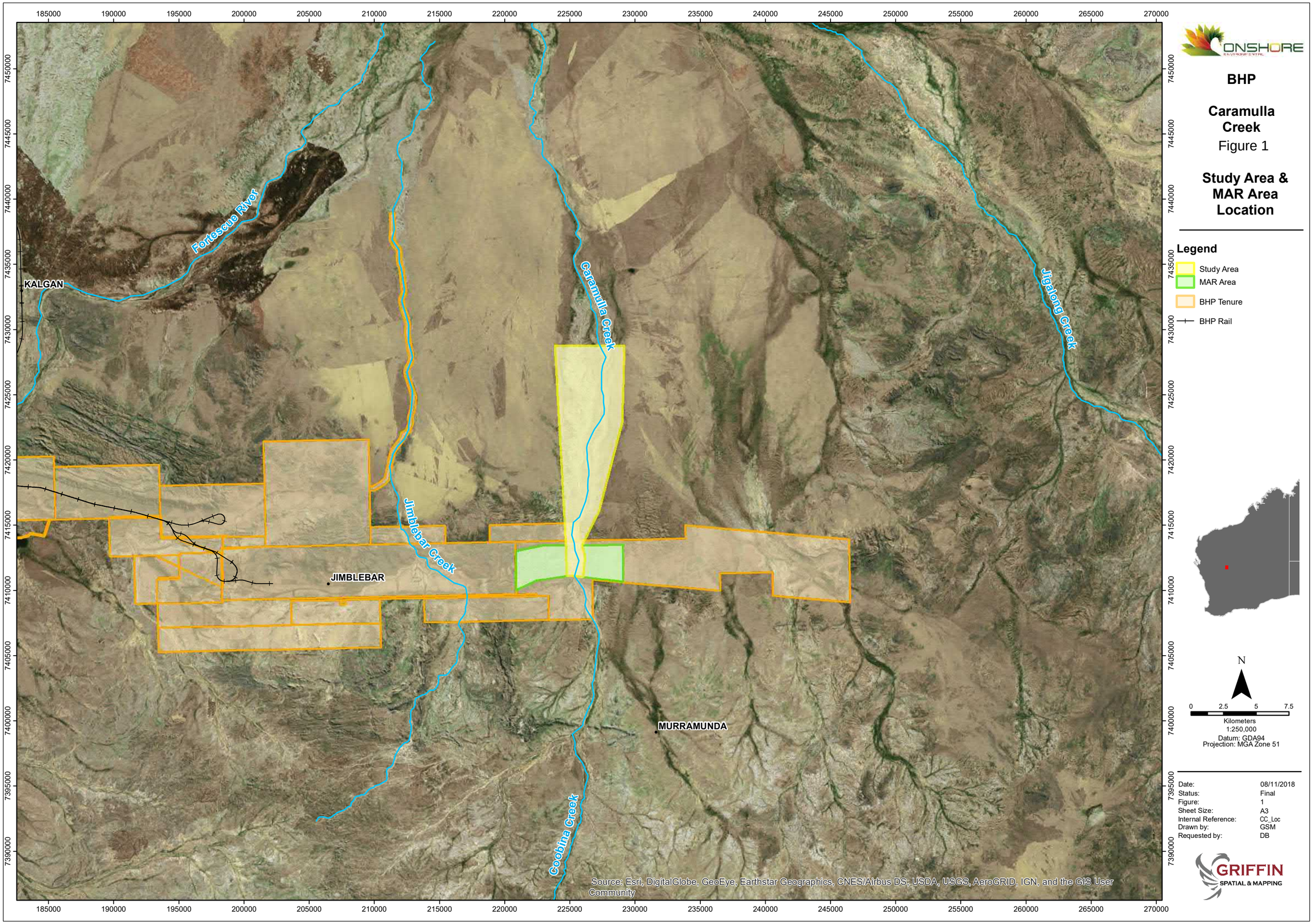
1.3 Climate

The Pilbara region has an arid to tropical climate with two distinct seasons; a hot summer from October to April, and a mild winter from May to September. The majority of annual rainfall is received during the hot summer months, which is typically associated with cyclonic activity and thunderstorms, with falls being of higher intensity and shorter duration contributing to an erratic annual range (Sudmeyer 2016).

Annual rainfall for Newman ranges from 36 mm to over 619 mm, with a long-term average of 332 mm occurring over 30 rain days (BOM 2018). Most of the annual precipitation occurs during the four summer months from December to March. The average maximum summer temperature ranges between 38ºC and 40ºC, while winter maximum temperatures range from 28ºC to 30.5ºC (BOM 2018).

Annual rainfall for Newman in 2017 totalled 519 mm, well above the long term average of 332 mm. However, the majority of this rainfall fell during the first four months of the year, with the remainder of 2017 experiencing very dry conditions. Summer rainfall for 2018 was limited to January and February, with below average monthly totals recorded for the period March to June (Figure 2).

The reconnaissance flora and vegetation survey was undertaken in late June 2018 when seasonal conditions were rated as *poor* due to below average rainfall in the three months leading up to the survey.



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Caramulla Creek

Figure 1

Study Area & MAR Area Location

Legend

- Study Area
- MAR Area
- BHP Tenure
- BHP Rail

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Kilometers

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Datum: GDA94

Projection: MGA Zone 51

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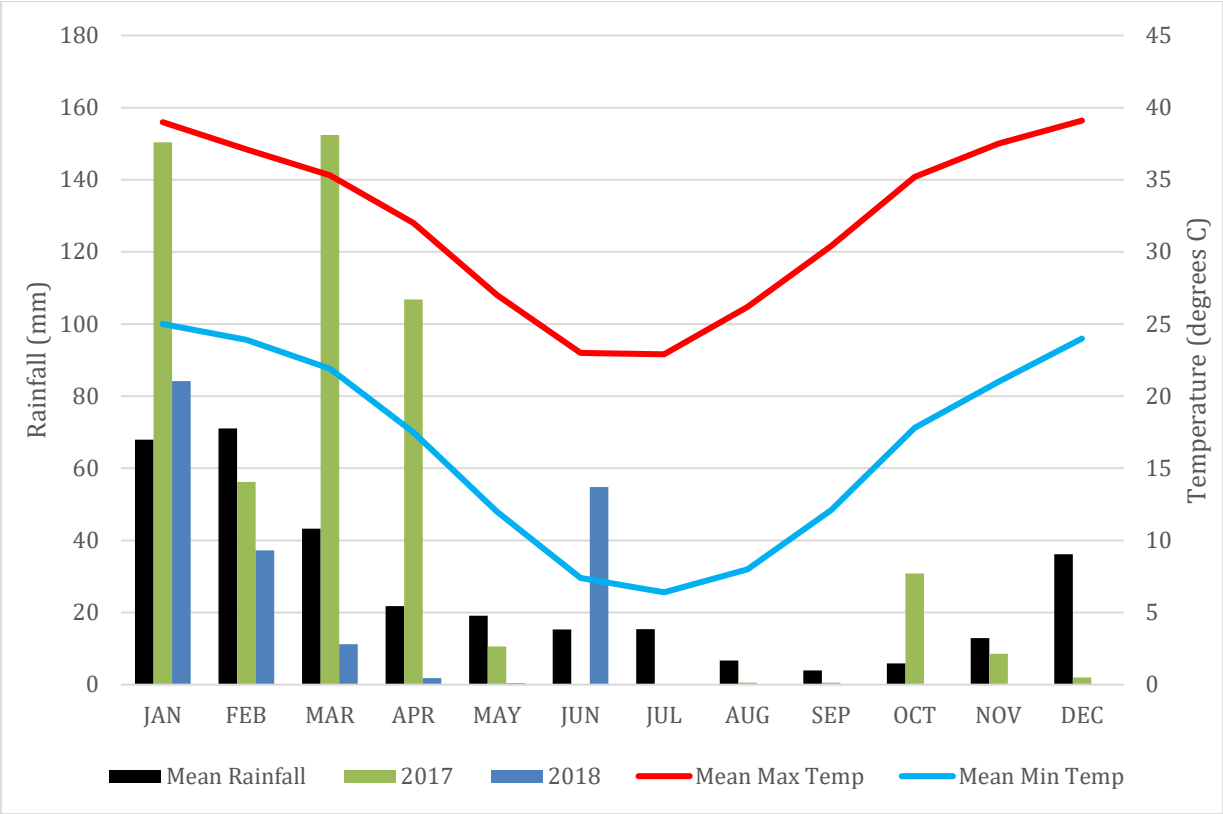


Figure 2 Climatic data recorded from Newman Airport, with long term monthly rainfall compared against monthly rainfall for 2017 and January - June 2018 (BoM 2018).

1.4 Biogeographic Regions

The Interim Biogeographic Regionalisation for Australia (IBRA7) divides Australia into 89 bioregions and 419 sub-regions based on climate, geology, landform, native vegetation and species information (Department of the Environment and Energy [DoEE] 2018a). The study area and MAR area lies on the boundary between the Pilbara and Gascoyne bioregions. The Pilbara bioregion consists of four sub-regions: Chichester, Fortescue, Hamersley and Roebourne. The study area and MAR area are located at the southern edge of the Fortescue sub-region (PIL2), adjacent to the eastern boundary of the Hamersley sub-region (PIL3). The Augustus sub-region (GAS3) of the Gascoyne bioregion lies just to the south of the study area and MAR area.

The Fortescue sub-region is described as alluvial plains and river frontage with extensive salt marsh, mulga-bunch grass, and short grass communities on alluvial plains in the east (Kendrick 2001a). River gum woodlands fringe the drainage lines and it contains the northern limit of Mulga. It also contains a broad calcrete aquifer (originating within a paleo-drainage valley) that feeds many permanent springs in the central Fortescue, supporting large permanent wetlands with extensive stands of River Gum (*Eucalyptus camaldulensis*) and Cadjeput (*Melaleuca argentea*) woodlands (Kendrick 2001a). Caramulla Creek forms part of the Fortescue River catchment area.

The adjacent Hamersley sub-region which incorporates Ophthalmia Range to the west, is described as a mountainous area of Proterozoic sedimentary ranges and plateaux, dissected by gorges (basalt, shale and dolerite) (Kendrick 2001b). It contains Mulga low woodland over bunch grasses on fine textured soils in valley floors, and *Eucalyptus leucophloia* over *Triodia brizoides* on skeletal soils of the ranges.

The nearby Augustus sub-region to the south is described as low rugged ranges of Proterozoic sedimentary and granite ranges interspersed by broad flat valleys. The sub-region includes the Narryera Complex and Bryah Basin of the Proterozoic Capricorn Orogen (on northern margin of

the Yilgarn Craton), as well as the Archaean Marymia and Sylvania Inliers. The main drainage in the sub-region is to the Gascoyne River, however the area also contains the headwaters of the Ashburton River and Fortescue River. Extensive areas of alluvial valley-fill deposits occur within this sub-region. The vegetation on rises consists of Mulga woodland and *Triodia* on shallow stony loams. The hardpan plains of the sub-region are dominated by Mulga parkland with shallow earthy loams (Desmond *et al.* 2001).

1.5 Existing Land Use

Land tenure in the Pilbara consists of Aboriginal and leasehold reserves, national parks and reserves and Crown land which fall under a range of pastoral and mining leases. The current use of lands surrounding the study area and MAR area is predominantly for mineral exploration, iron ore mining and dry land agriculture, specifically pastoralism and cattle grazing. The study area and MAR area are located on Sylvania Station within the Shire of East Pilbara, and approximately 18 km east of the existing Jimblebar mining operations (Figure 1).

Conservation lands amount to less than ten percent of the total area of the Pilbara Bioregion, with the major reserves being Karijini and Millstream-Chichester National Parks. These parks are supplemented by lesser conservation estates such as Cane River and Meentheena Conservation Parks. Wetlands of National Significance include the permanent pools of Millstream and Karijini National Parks and the Fortescue Marsh. The study area and MAR area are not within or adjacent to any gazetted conservation reserves. The Collier Range National Park is the nearest reserve, situated approximately 125 km to the south. Karijini National Park is located approximately 150 km west north-west of the study area.

1.6 Landforms

The study area and MAR area are located at the eastern end of the Ophthalmia Range, which together with the Hamersley Range encompass the Hamersley Plateau. The Hamersley Plateau is characterised by long strike ridges rising 300 m or more above valley floors and flats. Other characteristic landforms of the general area include alluvial plains and sandplains (Tille 2006). The entire region contains mainly rounded ranges and hills in contrast to the characteristic ‘mesa form’ hills that are located further to the northwest. The source of Caramulla Creek lies at the base of these ranges and flows out into the sloping plains to the north which feed in to the Fortescue Marsh. Specific landforms occurring within the study area include hardpan plains, drainage lines, low hills, flood plains and sandplains.

1.7 Soils

Tille (2006) classified the most recent and detailed mapping of Western Australia’s Rangelands and Arid Interior into a hierarchy of soil-landscape mapping units. The study area and MAR area are located within the following soil unit:

- 285: Hamersley Plateaux Zone, located in the Fortescue Province and described as having stony soils with red shallow loams and some red/brown non-cracking clays and red loamy earths.

The Australian Soil Resource Information System (CSIRO 2006) mapped the following three soil types within the study area:

- MM16: Alluvial plains dominated by deep cracking clays (Ug5.38), along with some areas of (Uf6.71) soils and minor areas of (Dr2.33) soils;
- BE6: Extensive flat and gently sloping plains, which sometimes have a surface cover of gravels and on which red-brown hardpan frequently outcrops: chief soils are shallow earthy loams (Um5.3), with associated (Gn) soils of units My5O and Mz23 of Sheet 6. As mapped, there are inclusions of units Oc47 and BB9; and

- Mz25: Plains associated with the Fortescue valley; there is a surface cover of stony gravels close to the ranges and hills: chief soils are acid red earths (Gn2.11) with some neutral red earths (Gn2.12); red-brown hardpan is absent. Associated are areas of calcareous earths (Gc) and loams (Um1) on calcrete (kunkar) and some hard red (Dr) soils around creek lines.

1.8 Geology

The ancient continental Western Shield dominates the geology of Western Australia. The Pilbara region makes up a portion of the Western Shield and consists of pre-Cambrian, Proterozoic and Archaean rocks. Important mineral reserves, including iron ore, are associated with these rock formations.

The study area and MAR area are situated on the southern edge of the Pilbara Craton in close proximity to the sedimentary basins that separate the Yilgarn and Pilbara Cratons. These consist of the sandstone and shales of the Collier and Bresnahan Basins and granites of the Sylvania Inlier (Tille 2006). The Pilbara Craton lies beneath the Proterozoic rocks of the Hamersley and Bangemall Basins. The Hamersley Basin covers the majority of the southern part of the Pilbara Craton and is separated into three stratigraphic groups; the Fortescue, Hamersley and Turee Creek rock groups.

The Fortescue Group consists mainly of basalt with beds of siltstone, mudstone, shale, dolomite and jaspilite. These rocks form the Chichester Plateau, which lies beneath the Hamersley Plateau. The Turee Creek Group consists of interbedded mudstone, siltstone, sandstone, conglomerate and carbonate. These rocks are the youngest of the three groups and are exposed mainly in the Ashburton Valley. The Hamersley Group contains both the Brockman Iron Formation and the Marra Mamba Iron Formation, which together provide most of the major iron ore deposits in the Pilbara (O'Brien and Associates 1992). This group forms the Hamersley Range and Plateau and consists of jaspilite and dolomite. The jaspilite produces deposits of haematite and limonite, which are mined for iron ore.

The surface geology of the study area and MAR area are dominated by the following geological formations (Williams and Tyler 1991) (Figure 3):

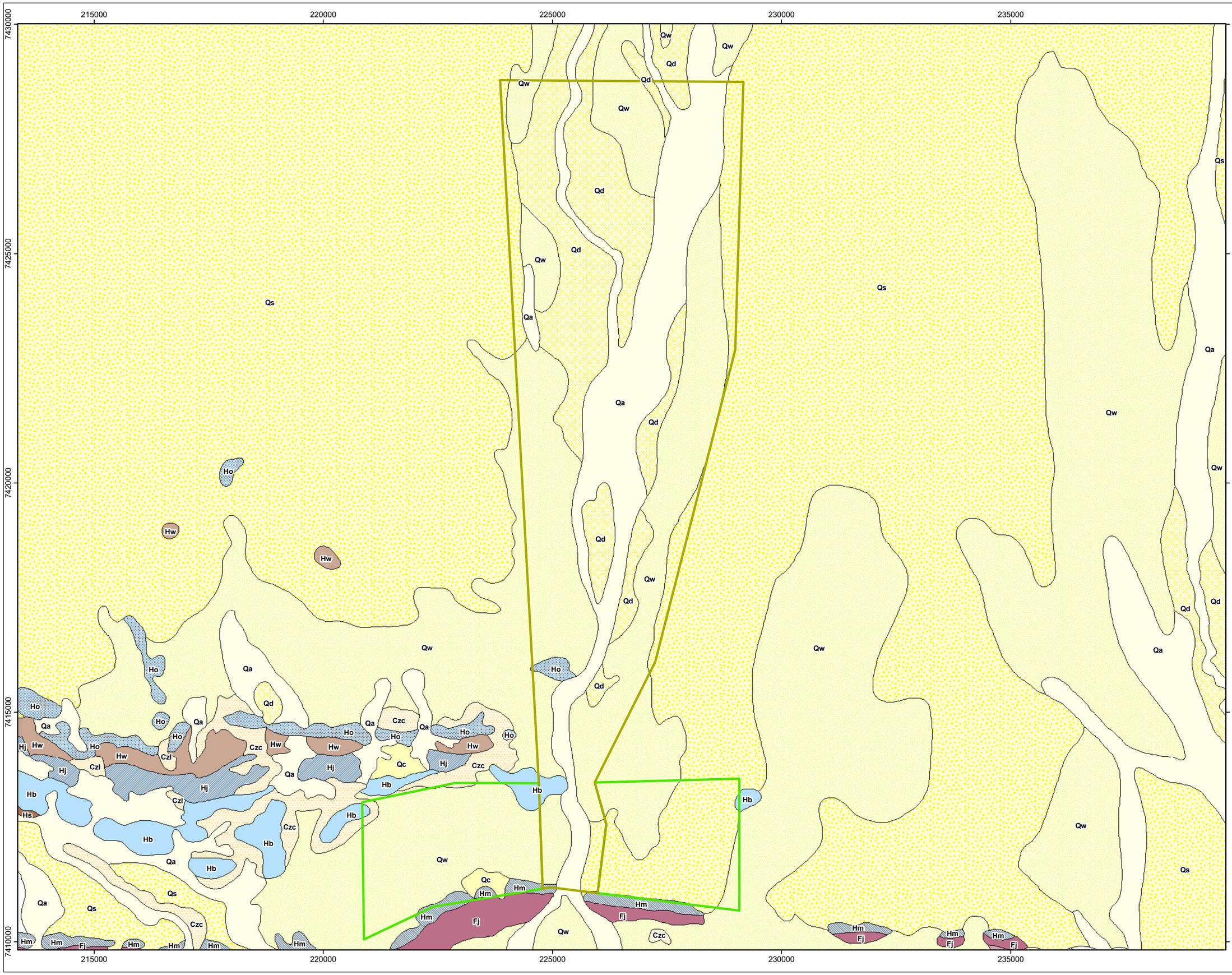
- Qw: Colluvium and alluvium: clay, silt, sand, gravel in broad sheet wash areas; distinctive vegetation striped photo- pattern;
- Qs: Eolian sand: in sheets and longitudinal (seif), chain and net dunes;
- Qc: Colluvium and Minor Alluvium: quartz, and rock fragments in loam, unconsolidated, grades in to Qz;
- Qd: Lacustrine: clay and silt, claypan deposits;
- Qa: Alluvium: clay, silt, sand, gravel; in drainage channels and adjacent flood plains;
- Hb: Brockman Iron Formation: banded iron-formation, chert shale;
- Hm: Marra Mamba Iron Formation: chert, ferruginous chert, minor shale;
- Ho: Boolgeeda Iron Formation: fine grained, finely laminated, dark grey brown to black flaggy iron-formation, minor chert, jaspilite shale; and
- Czc: Colluvium: partly consolidated quartz and rock fragments in silt and sand matrix; old valley-fill deposits.

1.9 Hydrology

The study area and MAR area are located within the Fortescue River Catchment. The hydrology of the area is dominated by ephemeral creeks and drainage lines flowing in a general northerly direction. Jimblebar Creek, Caramulla Creek and Fortescue River are the major drainage lines of the local area and all three flow north into the Fortescue River catchment area. Caramulla Creek drains into a broader braided channel to the north.

All rivers in the Pilbara region are seasonal and require heavy rains to flow (Johnson 2004). Due to the hot dry climate and high evaporation rates groundwater is the most available source of water

(Johnson 2004). The ground water table generally follows the surface topography. It is recharged via infiltration from rainfall, and stored in large groundwater reserves in the valley fill alluvium of the Fortescue River and Hamersley Range (Johnson 2004).



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Caramulla Creek

Figure 3

Surface Geology within the Study Area & MAR Area

Legend

- Study Area
- MAR Area

Surface Geology

- Qa
- Qd
- Qs
- Qw
- Qc
- Czc
- Czl
- Ho
- Hw
- Hj
- Hb
- Hs
- Hm
- Fj
- Fb

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1.10 Flora and Vegetation

The study area and MAR area are located within the Hamersley Botanical District, which is part of the Eremaean Province (Beard 1990). It is dominated by tree and shrub steppe communities consisting mainly of *Eucalyptus* and *Acacia* species; *Triodia pungens* and *Triodia wiseana* and some Mulga (*Acacia aptaneura*) occur within valley areas and short grass plains occur on alluvia.

Vegetation within the study area and MAR area (Figure 4) are classified as the following three vegetation associations, as mapped by Beard (1975) and later refined by Shepherd *et al.* (2002):

- 29: Sparse low woodland; mulga, discontinuous in scattered groups;
- 82: Hummock grasslands, low tree steppe; Snappy gum over *Triodia wiseana*; and
- 111: Hummock grasslands, shrub steppe; *Eucalyptus gamophylla* over hard spinifex.

While the Pre-European extent for each vegetation association is close to 100 percent, less than 13 percent of each association occurs within formal or informal reserves (Table 1).

Table 1 Pre-European extent of vegetation associations occurring within the study area and MAR area (Shepherd *et al.* 2002).

Vegetation Association	Description	Pre-Euro. Extent Remaining (ha)	Pre-European Extent in IUCN I-IV Reserves (ha)
29	Sparse low woodland; mulga, discontinuous in scattered groups	877,888 (99.98%)	2,328 (0.27%)
82	Hummock grasslands, low tree steppe; Snappy gum over *Triodia wiseana*	2,157,852 (99.4%)	262,983 (12.1%)
111	Hummock grasslands, shrub steppe; *Eucalyptus gamophylla* over hard spinifex	430,925 (99.99%)	7,007 (1.63%)

Riparian zones of the Pilbara are generally ephemeral and comprise incised drainage channels surrounded by levee banks and floodplains. Surface water is rare but does occur at localised points including natural springs and deep rocky pools. Dominant tree species of the riparian zone are *Eucalyptus camaldulensis*, *Eucalyptus victrix* and *Melaleuca argentea. Eucalyptus camaldulensis* and *Eucalyptus victrix* are facultative phreatophytes that draw on groundwater in times of drought but also possess the ability to utilise surface water. *Melaleuca argentea* is an obligate phreatophyte associated with shallow groundwater (less than 3 metres below natural ground level) and/or permanent pools of surface water along the major creeklines.

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Figure 4

Beard (1975) vegetation complexes within the Study Area & MAR Area

Legend

- Study Area
- MAR Area

Pre-European Vegetation (Beard 1975)

- FORTESCUE VALLEY, 111
- FORTESCUE VALLEY, 157
- FORTESCUE VALLEY, 199
- FORTESCUE VALLEY, 216
- FORTESCUE VALLEY, 29
- FORTESCUE VALLEY, 82
- KUMARINA HILLS, 111
- KUMARINA HILLS, 157
- KUMARINA HILLS, 18
- KUMARINA HILLS, 216
- KUMARINA HILLS, 28
- KUMARINA HILLS, 29

N

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1.11 Land Systems

The Department of Agriculture and Food (now the Department of Primary Industries and Regional Development) conducted inventory and condition surveys of the Pilbara (Van Vreeswyk *et al.* 2004) using an integrated survey method involving the land system approach to rangeland description evaluation. The primary objective of the surveys was to provide comprehensive descriptions and mapping of the biophysical resources of the region, as well as an evaluation on the condition of soils and vegetation.

A total of 102 land systems were defined in the Pilbara at a scale of 1:250,000 (Van Vreeswyk *et al.* 2004), eight of which occur within the study area and MAR area (Table 2, Figure 5). The southern sector of the study area and the MAR area supports the River, Washplain, Cadgie, Zebra and Jamindie land systems. The central and northern part of the study area is dominated by the Fortescue land system, with the Washplain and Divide land systems fringing the study area (Figure 5).

Table 2 Land systems occurring within the study area and MAR area (descriptions from Van Vreeswyk *et al.* 2004).

Land System	Representation in the Pilbara	Description
Cadgie	495 km^2 or 0.3%	Hardpan plains with thin sand cover and sandy banks supporting mulga shrublands with soft and hard spinifex.
Divide	5,293 km^2 or 2.9%	Sandplains and occasional dunes supporting shrubby hard spinifex grasslands.
Fortescue	504 km^2 or 0.3%	Alluvial plains and flood plains supporting patchy grassy woodlands and shrublands and tussock grasslands.
Jamindie	2,074 km^2 or 1.1%	Stony hardpan plains and rises supporting groved mulga shrublands, occasionally with spinifex understorey.
McKay	4,202 km^2 or 2.3%	Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands.
River	4,088 km^2 or 2.3%	Active flood plains and major rivers supporting grassy eucalypt woodlands, tussock grasslands and soft spinifex grasslands.
Washplain	917 km^2 or 0.5%	Hardpan plains supporting groved mulga shrublands.
Zebra	374 km^2 or 0.2%	Hardpan plains with large linear gravelly sand banks supporting acacia shrublands with soft and hard spinifex.

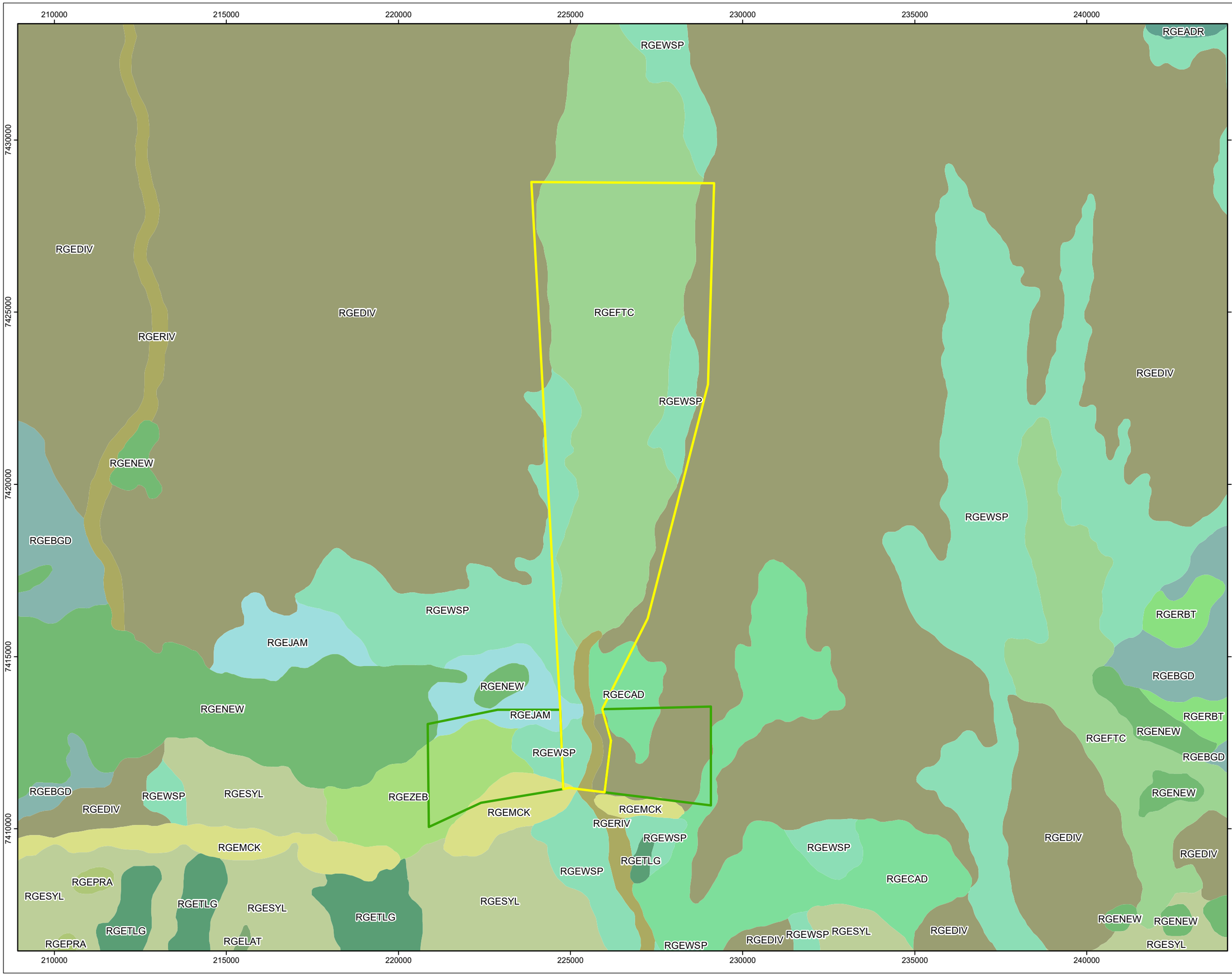

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Figure 5

Land systems occurring within the Study Area & MAR Area (descriptions from van Vreeswyk et al. 2004)

Legend

- Study Area
- MAR Area

Land Systems (within 5km)

- RGEADR, Adrian Land
- RGEBGD, Boolgeeda Land System
- RGECAD, Cadgie Land System
- RGEDIV, Divide Land System
- RGEFTC, Fortescue Land System
- RGEJAM, Jamindie Land System
- RGELAT, Laterite Land System
- RGEMCK, McKay Land System
- RGENEW, Newman Land System
- RGEPRA, Prairie Land System
- RGERBT, Robertson Land System
- RGERIV, River Land System
- RGESYL, Sylvania Land System
- RGETLG, Talga Land System
- RGEWSP, Washplain Land System
- RGEZEB, Zebra Land System

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2.0 METHODOLOGY

2.1 Legislation and Guidance Statements

The reconnaissance vegetation survey was carried out in a manner that was compliant with Environmental Protection Authority (EPA) requirements for the environmental surveying and reporting of flora and vegetation in Western Australia:

- Statement of Environmental Principles, Factors and Objectives (EPA 2016a);
- Environmental Factor Guideline Flora and Vegetation (EPA 2016b); and
- Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016c).

The survey was also conducted in accordance with BHP WAIO's Vegetation and Flora Survey Procedure (BHP 2018).

2.2 Desktop Assessment

The desktop assessment was undertaken to identify flora and vegetation values of significance known from the study area, MAR area and surrounds. This review considered regional information, previous biological surveys in the locality, and the results of various database searches, as discussed in the following sections.

2.2.1 Literature Review

Several regional-scale reports were reviewed, along with bioregional data (Kendrick 2003), land systems mapping (Van Vreeswyk et al. 2004), and vegetation descriptions and mapping by Beard (1975a, 1975b).

A comprehensive literature review of published and unpublished reports relevant to the study area and MAR area was completed. At least eight relevant flora and vegetation surveys have been completed at BHP WAIO tenements within a 7 km radius of the study area and MAR area (as detailed in Appendix 1), including two surveys that partially overlap the southern sector of the study area and MAR area:

- Onshore Environmental (2018) Caramulla Reconnaissance Flora and Vegetation Survey; and
- GHD (2009) Caramulla Exploration Area Flora and Vegetation Survey.

2.2.2 Database Searches

Database searches included databases relating to significant flora, TECs and PECs previously collected or described within, or in close proximity to, the study area and MAR area. For this report the search was extended beyond the study area and MAR area to place flora values into a local and regional context. The following databases were searched:

- NatureMap1: This database is the most comprehensive source of information on the distribution of Western Australia's flora and fauna, comprising records from the Fauna Survey Returns Database, the WA Threatened and Priority Flora Database, and the WA Herbarium Specimen Database. These databases are maintained by the Department of Biodiversity, Conservation and Attractions (DBCA), the WA Museum Specimen Database, and BirdLife Australia's Atlas of Australian Birds (40 km radial search, accessed 17th January 2018) (DBCA 2018c);
- DBCA's Threatened and Priority flora database was searched to confirm the NatureMap results (50 km radial search, accessed 22nd January 2018) (DBCA 2018a);
- DBCA's TEC, PEC and Environmentally Sensitive Areas (ESAs) database was searched to identify significant communities (50 km radial search, accessed 13th December 2017) (DBCA 2018b);

- BHP Billiton Iron Ore's Threatened and Priority flora database was searched to identify records of significant flora known to be in close proximity of the study area and MAR area (50 km radial search, accessed 22nd January 2018);
- The Commonwealth EPBC Act Protected Matters Search Tool was used to identify flora species listed as Threatened at Commonwealth level and other relevant Matters of National Environmental Significance that may occur in the locality (50 km radial search, accessed 17th January 2018) (DoEE 2018b);
- International Union for Conservation of Nature (IUCN) database (accessed 17th January 2018) (IUCN 2018); and
- The Western Australian Organisms List (WAOL) was searched to provide the status of introduced species, either known to occur in, or are in close proximity to, the study area and MAR area, which have been categorised under the BAM Act.

The database search results were reviewed prior to the commencement of the field survey, with a particular focus on species and communities with the potential to be impacted from surplus water discharge and/or groundwater injection.

2.2.3 Assessment of Likelihood of Occurrence

In order to determine conservation significant flora with the potential to occur in the study area and MAR area, results from the literature review and database searches were tabulated and reviewed on the basis of known habitat preferences for each taxon identified. Habitats were defined according to surface geology and landform mapping, land unit interpretation (using land systems), combined with interpretation of high resolution aerial imagery.

The likelihood of each taxon occurring within the study area and MAR area was assessed using a set of rankings and criteria (as described in Table 3). The criteria are based on presence of suitable habitat and distance to known records.

Table 3 Ranking system used to assign the likelihood that a species would occur.

Rank	Criteria
Recorded	The species has previously been recorded in the study area.
Likely to occur	There are previous records within a 20 km radius of the study area, and habitat that it is known to occur or has been identified in the study area.
Possible to occur	There are previous records within a 40 km radius of the study area, and habitat that it is known to occur or has been identified in the study area; or Suitable habitat is present, however there are no existing records of the species from the locality, likely due to low sampling intensity in the locality.
Unlikely to occur	The species is linked to a specific habitat, which is absent from the study area; or Suitable habitat is present, however there are no existing records of the species from the locality despite reasonable previous sampling intensity in the locality.
Would not occur	The species is strongly linked to a specific habitat, which is absent from the study area; and/or The species' range is very restricted and would not include the study area.

2.3 Reconnaissance Survey Methodology

2.3.1 Timing and Personnel

The reconnaissance vegetation survey of the study area was completed by Principal Botanist Dr Jerome Bull and Senior Botanist Ms Jessica Waters working over a five-day period between the 18th and 22nd of June 2018.

Seasonal conditions at the time of the June 2018 field surveys were rated as *poor*, resulting from relatively low rainfall during the three months preceding field work, with below average monthly totals recorded for the period March to June (Figure 2).

The Principal Botanist working on the survey has over 15 years Pilbara experience, and the accompanying Senior Botanist has in excess of seven years Pilbara experience. Together the survey team has completed numerous surveys in close proximity to the study area over recent years.

2.3.2 Vegetation Association Mapping

Desktop vegetation mapping was completed for the study area prior to field work commencing, to ensure representative sampling was completed across all vegetation types during the field survey. Desktop vegetation mapping utilised high-resolution aerial photography at a scale of 1:7,500, with definition of vegetation polygons based on contrasting shading patterns. Like polygons were labelled with the same preliminary vegetation code; there were 15 vegetation associations differentiated.

The Weelarrana-Ethel Creek Road was the sole access track present in the study area, aligned north-south inside the western boundary. It was proposed to survey vegetation types intersecting this track first, and then utilise the track as a baseline from which five additional transects extending to the east would then be ground-truthed. Transects were strategically positioned to ensure that all vegetation types identified during the desktop mapping exercise were intersected, allowing them to be described accurately during the field survey.

On day one of the field survey it became evident that the Weelarrana-Ethel Creek Road was only accessible for approximately 5 km north from the southern boundary of the study area; the remaining 13 km extending north was overgrown and inaccessible. The restricted vehicular access resulted in the field survey being restricted to the southern half of the study area with only three of the five planned polygons able to be accessed (Figure 6); all vegetation polygons in the northern half have been interpreted by desktop mapping, and inferences made from mapping confirmed in the southern sector.

For the southern half of the study area, predetermined transects were surveyed by the two botanists working as a pair along the braided drainage channels of Caramulla Creek. The vegetation association boundaries mapped utilising high-resolution aerial photography were confirmed during the field survey, and flora and vegetation data were recorded to provide vegetation association descriptions for the polygons defined. Releve sites were assessed within target polygons to ensure the maximum number of vegetation associations were adequately surveyed.

Description of vegetation structure follows the height, life form and density classes of Specht (1970) as modified by Aplin (1979) and Trudgen (2002) (see Appendix 2). This is largely a structural classification suitable for broader scale mapping, but taking all ecologically significant strata into account. Vegetation condition was determined using a recognised rating scale (adapted from Keighery 1994 and Trudgen 2002, see Appendix 3).

2.3.3 Targeted Surveys for Conservation Significant Flora and Introduced Species

Targeted searches for conservation significant flora and introduced species were conducted during the extensive foot traverses completed in the southern half of the study area, to validate vegetation mapping. Ground-truthing provided an opportunity to record opportunistic locations for Threatened and Priority listed flora, and undertake closer examination of specific habitats where significant flora may be expected to occur. Opportunistic weed collections were also made while moving around the study area, with targeted searches completed in high moisture habitats of the main drainage channels and adjacent floodplains.

The locations of significance flora and introduced species were recorded using a hand-held GPS. For each record, the numbers of individuals, ground cover, plant height and photograph were recorded, along with a description of the habitat and associated vegetation.

2.3.4 Vegetation Association Coding

Each vegetation association was given a unique code, comprising a:

- two letter capital prefix to indicate the landform (BA = Breakaways, HS = hill slopes and low undulating hills, FS = Footslopes, SA = sandplains, HP = hardpan plains, FP = flood plains, MA = major drainage lines); followed by a
- sequence of two or three letter codes to reflect the dominant plant taxa. The code comprised a capital letter representing the genus, and one or two lower case letters representing the species, e.g. He = *Heliotropium,* followed by one and up to a maximum of three letters representing the species (lowercase), e.g. te = *tenuifolium.*

A space was inserted after the landform code and followed by the dominant vegetation stratum as determined by the highest ground cover class. Where two vegetation strata provided the same cover class, the taller height class was referred to first. A maximum of three taxa were represented within each stratum. A space between plant taxa reflected a different vegetation stratum, with a maximum of three strata represented in any single code. For example, the code 'FS Tw Ell' represents the vegetation association 'Hummock Grassland of *Triodia wiseana* with Scattered Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* on footslopes'.

2.3.5 Species Identification, Nomenclature and Data Entry

Flora specimen identification was completed in the field by the Principal Botanist where the species was common and well known. Where the collection was unknown or difficult to determine without microscopic examination, belonged to a recognised species complex, was poorly collected or otherwise unusual, a voucher specimen was collected. Each voucher specimen was assigned a unique job code to facilitate tracking of data. Specimens were pressed and dried in the field, then freighted to Perth for further investigation.

Specimens were identified using flora keys, consulting appropriate publications, checking voucher reference collections, and comparing the specimens to the collections held at the WA Herbarium. Taxonomy was completed by Principal Botanist Dr Jerome Bull. Nomenclature and conservation significance rankings used in this report are in accordance with the current listing of WA flora recognised by the WA Herbarium, as listed on FloraBase.

All raw survey data collected during the field survey was entered in Microsoft Excel format to comply with BHP WAIO's Biological Survey Spatial Data Requirements (SPR-IEN-EMS-015) (BHP Billiton Iron Ore 2016). This database was updated following completion of taxonomy.

All GIS data is associated with metadata in ESRI ISO format (*.xml format) recorded in the Geocentric Datum of Australia 1994 (GDA94) in decimal degrees (Longitude, Latitude) with an accuracy to five decimal points. The following tags have information entered into them where available:

- date the data was created;
- capture scale (GPS accuracy, or digitised scale, i.e. GPS5m or 25k, 250k, etc.);
- method of capture (e.g. GPS track, digitised mapping, digital field mapping);
- abstract;
- metadata author - data creator;
- point of contact 1 - Person and his/her details who is supplying the data;
- point of contact 2 - delivery contact name and department at BHP WAIO;
- dataset history - how the data has been created or captured (i.e. manually digitised, imported .xls file, uploaded GPS waypoints, etc.;
- data themes or categories – select relevant themes or categories;
- key words - enter key words associated with the dataset, e.g. flora; and
- title - clear title describing the dataset.

Raw data has been entered into six feature classes:

- study area;
- vegetation (sample) sites;
- flora observations;
- vegetation mapping;
- vegetation condition; and
- flora area.

Voucher specimens are lodged with the WA Herbarium for selected taxa representing flora of conservation significance, range extensions, undescribed or poorly collected taxa, provided these were not already vouchered from the locality and collection material is of adequate condition. This is in keeping with the WA Herbarium's specimen acquisition policy. No specimens were required to be vouchered from this survey. Threatened and Priority Flora Report Forms will be submitted to DBCA for the Priority flora species recorded from the study area.

2.3.6 Field Survey Constraints

The EPA Technical Guidance (EPA 2016c) list seven potential limitations that field surveys may encounter. These limitations are addressed in Table 4. There were no survey-specific limitations for this survey.

Table 4 Relevance of limitations, as identified by EPA (2016c), to the flora and vegetation survey.

Constraint	Relevance
Availability of contextual information at a regional and local scale	The Caramulla Creek locality has been relatively well surveyed historically. A total of eight relevant flora and vegetation surveys have been completed within a 7 km radius of the study area, including two surveys which partially overlap the southern sector. This provides an extensive local database which is confirmed by the intensity of records for the local area on FloraBase. Publicly available databases for rare flora and significant vegetation communities were also available for review. Regional and local level information was therefore not considered to be a limiting factor for this study.
Proportion of flora recorded and/or collected, any identification issues	The objective of the survey was to identify groundwater dependent, riparian and terrestrial vegetation that may potentially by impacted by surplus water discharge into Caramulla Creek from adjacent mining operations, or from the MAR. The majority of plant specimens collected during the reconnaissance field survey were of sufficient quality to be fully determined. However, seasonal conditions at the time of the June 2018 field survey were rated as *poor*, resulting in a likely under-estimation of the ephemeral flora component.

Constraint	Relevance
	The main access track was inaccessible approximately 5 km north from the southern boundary of the study area. This resulted in the northern half of the study area not being surveyed; vegetation mapping within this sector was inferred. Fungi and non-vascular flora (algae, mosses and liverworts) were not sampled, which is consistent with the accepted level of effort for a survey of this type and scale.
Survey timing, rainfall, season of survey	Seasonal conditions at the time of the June 2018 field survey was rated as *poor*, resulting from relatively low rainfall during the three months preceding field work. The objective of the reconnaissance survey was to identify groundwater dependent, riparian and terrestrial vegetation with the potential to be impacted by surplus water discharge or MAR, all target species were able to be identified during the survey despite the poor seasonal conditions.
Disturbance that may have affected the results of survey such as fire, flood or clearing	Disturbances within the study area included grazing of vegetation and damage by domestic stock (cattle), and the presence of introduced weed species. None of the disturbances were a constraint to completing the survey.
Was the appropriate area fully surveyed (effort and extent)	Two botanists working over a five-day period walked three out of the five predetermined transects across Caramulla Creek, and assessed approximately 60 relevé plots. An additional six transects were completed in the southern sector to further investigate vegetation associations present. However, the northern half of the study area could not be surveyed due to limited access, and hence vegetation mapping was inferred for this area.
Access restrictions within the survey area	The study area was accessed by vehicle and on foot. However the main access track was overgrown from 5 km north of the southern boundary, restricting access and limiting the field survey to the southern half of the study area. Access was considered to be a limiting factor for the survey.
Competency/experience of the team carrying out the survey, including experience in the bioregion surveyed	The Principal Botanist working on the survey has over 15 years Pilbara experience, and the accompanying Senior Botanist has in excess of seven years Pilbara experience. Together the survey team has completed numerous surveys in close proximity to the study area over recent years. The vast local and regional experience of both botanists working on the survey is considered a significant asset to the survey.

2.3.7 Assessment of Conservation Significance

The conservation significance of flora and ecological communities are classified at a Commonwealth, State and Local level on the basis of various Acts and Agreements, including:

Commonwealth Level:

- EPBC Act: The DoEE lists Threatened flora and ecological communities, which are determined by the Threatened Species Scientific Committee according to criteria set out in the Act. The Act lists flora that are considered to be of conservation significance under one of six categories (Appendix 4).

State Level:

- WC Act: At a State level, native flora species are protected under the *WC Act – Wildlife Conservation Notice*. A number of species are assigned an additional level of conservation significance based on a limited number of known populations and the perceived threats to these locations.
- DBCA Priority list: DBCA produces a list of Priority species and ecological communities that have not been assigned statutory protection under the WC Act. Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are

added under Priorities 1, 2 or 3. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been removed from the threatened species list for other taxonomic reasons, are placed in Priority 4. These species require regular monitoring (see Appendix 5). The list of PECs identifies those that need further investigation before nomination for TEC status at a State level.

Local Level:

- Species may be considered of local conservation significance because of their patterns of distribution and abundance. Although not formally protected by legislation, such species are acknowledged to be in decline as a result of threatening processes, primarily habitat loss through land clearing.

3.0 SURVEY RESULTS

3.1 Desktop Assessment

3.1.1 Previous Flora and Vegetation Surveys

The flora and vegetation of the Pilbara has been assessed at a broad scale by Burbidge (1959) and Beard (1975). More recently, the Department of Agriculture and Food completed an inventory and condition survey of the Pilbara based on land system mapping (Van Vreeswyk *et al.* 2004). More specific data has been collected as part of DBCA's Pilbara Region Biological Survey 2002-2013 (DBCA 2013). This dataset has recently been published and will provide a regional context that will benefit impact assessment for future development proposals within the Pilbara.

In addition to the larger broad scale surveys, an increasing number of smaller intensive flora and vegetation surveys have been completed in recent years associated with resource development projects. These surveys have resulted in the collection of a significant amount of site-specific biological survey data, most of which has been undertaken for formal environmental impact assessment. There are eight relevant flora and vegetation surveys that have been completed within a 7 km radius of the study area and MAR area, with two of the surveys partially overlapping the southern sector of the study area and the MAR area (Appendix 1).

3.1.2 Threatened Flora listed under the EPBC Act

A search of the EPBC Act Protected Matters database was undertaken for a 50 km buffer around the study area and MAR area (DoEE 2018b). The database search listed two Threatened Flora or their habitat as likely to occur within the search radius; *Lepidium catapycnon* (Hamersley Lepidium) and *Pityrodia augustensis* (Mt Augustus Foxglove). DBCA has recently downgraded *Lepidium catapycnon* from Threatened Flora to Priority 4 status.

The nearest known records for *Pityrodia augustensis* are over 300 km south of the study area and MAR area (DoEE 2018b). This species has been recorded from rocky hillsides near Mt Augustus and the Mt Fraser Range north of Meekatharra. It is considered unlikely to occur within the study area or MAR area due to absence of suitable habitat and long distance to previous records.

3.1.3 Threatened Flora listed under the IUCN Red List

A search of the International Union for Conservation of Nature (IUCN) database (IUCN 2018) determined that no Threatened Flora taxon was likely to occur within the study area or MAR area.

3.1.4 Threatened Flora listed under the WA Wildlife Conservation (Rare Flora) Notice

The DBCA rare flora database search (DBCA 2018a) did not identify any plant taxon gazetted as Threatened Flora (T) pursuant to subsection (2) of Section 23F of the WC Act from a 50 km radius around the study area and MAR area.

3.1.5 Priority Flora recognised by the DBCA

The DBCA rare flora database search (DBCA 2018a) and NatureMap search (DBCA 2018c) identified 14 Priority flora taxa as potentially occurring within a 25 km radius of the study area and MAR area. One of these Priority flora species has previously been recorded within the both the study area and MAR area, *Rhagodia* sp. Hamersley (M. Trudgen 17794); and one additional species from within the MAR area, *Eremophila capricornica*. Based on the known distributions and habitat preferences of Priority flora species identified during the literature review and database searches, and comparison with the habitats that appeared to be present in the study area and MAR area, three Priority flora taxa were determined as being "likely to occur", and

six Priority flora taxa were determined to "possibly" occur (Table 5). These eleven species were considered the key target species during the field survey.

Table 5 Significant flora previously recorded from a 25 km search radius of the study area and MAR area (DBCA 2018a, DBCA 2018c). SCC - State Conservation Code (WC Act) and DBCA, FCC - Federal Conservation Code (EPBC Act).

Taxon	Cons. Code	Life Form	Habitat Preference	Likelihood
Acacia sp. East Fortescue (J. Bull & D. Roberts ONS A 27.01)	1	Perennial	Eroded BIF ironstone present on low undulating hills	Would not occur
Amaranthus centralis	3	Annual	River banks	Possible
Aristida jerichoensis var. *subspinulifera*	3	Perennial	Hard pan plains	Possible
Crotalaria smithiana	3	Annual	Floodplain	Possible
Eremophila capricornica	1	Perennial	Hardpan plains	Recorded
Eremophila pilosa	1	Perennial	Red brown clay loam, sandplains	Possible
Eremophila youngii subsp. *lepidota*	4	Perennial	Stony red sandy loam; flats plains, floodplains, sometimes semi-saline, clay flats	Possible
Goodenia berringbinensis	4	Annual	Gilgai soaks with light yellow-brown clay soil	Likely
Goodenia hartiana	2	Perennial	Sand dune swales, sand hills	Possible
Goodenia nuda	4	Perennial	Plains and floodplains	Likely
Ipomoea racemigera	2	Annual	Flats and stream channels	Likely
Isotropis parviflora	2	Annual	Valley slope of ironstone plateau	Would not occur
Rhagodia sp. Hamersley (M. Trudgen 17794)	3	Perennial	Plains	Recorded
Triodia sp. Mt Ella (M.E. Trudgen 12739)	3	Perennial	Amongst rocks and outcrops, gully slopes	Would not occur

3.1.6 TECs listed under State and Federal Legislation

TECs listed by the DBCA are significant at State level and are protected as Environmentally Sensitive Areas (ESAs) under the Environmental Protection Act 1986. Two TECs are listed for the Pilbara bioregion: 'Themeda grasslands on cracking clays (Hamersley Station, Pilbara)' and 'Ethel Gorge aquifer stygobiont community' (DBCA 2018b). The Ethel Gorge stygobiont TEC is located approximately 50 km west of the study area and MAR area, while the nearest known occurrence for the Themeda grasslands TEC is approximately 270 km to the northwest. Neither TEC is therefore relevant to the study area or MAR area, with no suitable habitat expected to occur. Furthermore, a search of the DBCA ecological community database (2017b) confirmed there were no current listed TEC records for the immediate study area and MAR area.

Twenty-three of the 69 TECs listed for Western Australia are also federally recognised and listed under the Commonwealth EPBC Act. These do not include either of the two State level TECs listed for the Pilbara bioregion. A search of the EPBC Act Protected Matters database (DoEE 2018b) confirmed there were no Federal listed TECs previously recorded within, or adjacent to, the study area or MAR area.

A search of the EPBC Act Protected Matters database (DoEE 2018b) confirmed there were no Federal listed TECs previously recorded within, or adjacent to, the study area and MAR area. The nearest known TEC is the Endangered 'Ethel Gorge aquifer stygobiont community' located

approximately 50 km west of the study area and MAR area. This TEC is a subterranean community and has no relationship with flora and vegetation and therefore will not be discussed further.

Similarly, a search of the DBCA ecological community database (DBCA 2018b) confirmed there were no current listed TEC records for the study area or MAR area.

3.1.7 PECs recognised by DBCA

PECs include potential TECs that do not meet survey criteria or are not adequately defined. A total of 42 PECs were listed for the Pilbara bioregion at 30 June 2017. A search of the State database (DBCA 2018b) confirmed there were no PECs within a 50 km radius of the study area or MAR area.

3.1.8 ESAs known from the Locality

Environmentally Sensitive Areas (ESAs) are defined in the Environmental Protection (Environmentally Sensitive Areas) Notice 2005 under section 51B of the WA *Environmental Protection Act 1986*. ESAs include World Heritage sites; areas included on the Register of the National Estate; defined wetlands; vegetation containing Threatened flora; Threatened Ecological Communities; and Bush Forever sites.

There are no ESAs known to occur within a 50 km radius of the study area or MAR area.

3.2 Vegetation Associations

A total of 21 vegetation associations classified into 14 broad floristic formations were described and mapped from the study area during the reconnaissance survey (Table 6, Figure 6). None of the vegetation associations were aligned with Federal or State listed TECs, or State listed PECs, and all were well represented regionally.

Two vegetation associations occurring along the main drainage channels of Caramulla Creek have elevated local significance, as they support the groundwater dependent tree species *Eucalyptus camaldulensis* subsp. *obtusa:*

- 1 MA Eco EcoAciAcp MgApy - Open Woodland of *Eucalyptus camaldulensis* subsp. *obtusa* over Low Open Woodland of *Eucalyptus camaldulensis* subsp. *obtusa, Acacia coriacea* subsp. *pendens* and *Acacia citrinoviridis* over High Open Shrubland of *Melaleuca glomerata* and *Acacia pyrifolia* on brown sand on major drainage lines; and
- 7 MA ApyPlMg EcoAciAcp CyaEuaCc - High Open Shrubland of *Acacia pyrifolia, Petalostylis labicheoides* and *Melaleuca glomerata* with Scattered Low Trees of *Eucalyptus camaldulensis* subsp. *obtusa, Acacia citrinoviridis* and *Acacia coriacea* subsp. *pendens* and Scattered Tussock Grasses of *Cymbopogon ambiguus, Eulalia aurea* and **Cenchrus ciliaris* on brown sand on major drainage lines.

Together they were mapped over 246 ha or 3.9 percent of the study area.

Vegetation associations supporting species with the potential to be impacted by surface water discharge (i.e. Mulga species and/or *Acacia citrinoviridis*) were recorded from 16 vegetation associations (including the two associations occurring along major drainage lines supporting *Eucalyptus camaldulensis* subsp. *obtusa*). Together they were mapped over 5,800 ha or 91.5 percent of the study area (Table 6, Figure 6).

The remaining five vegetation associations did not support groundwater dependent species, or species with the potential to be impacted by surface water discharge (i.e. Mulga or *Acacia citrinoviridis*). Together they were mapped over 537.9 ha or 8.4 percent of the study area (Table 6, Figure 6).

Vegetation condition within the study area was predominantly rated as *very good* (2,589 ha or 41 percent of the study area) or *good* (3,446 ha or 54 percent of the study area), with the remainder rated as *poor* (255 ha or 4 percent of the study area) or *degraded* (47 ha or 0.7 percent of the study

area) (Figure 7). Disturbances recorded during the field survey were primarily related to grazing by cattle, introduction of weeds and old access tracks.

Table 6 Vegetation descriptions for vegetation associations mapped within the study area.

Broad Floristic Formation	Vegetation Code	Mapping Code	Vegetation Association	Condition	Area (ha)	% of Study Area
Vegetation associations supporting groundwater dependent vegetation AND supporting *Acacia citrinoviridis*[1]					**245.7**	**3.9**
Eucalyptus Open Woodland	MA Eco EcoAciAcp MgApy	1	Open Woodland of ***Eucalyptus camaldulensis* subsp. *obtusa*** over Low Open Woodland of *Eucalyptus camaldulensis* subsp. *obtusa*, *Acacia coriacea* subsp. *pendens* and ***Acacia citrinoviridis*** over High Open Shrubland of *Melaleuca glomerata* and *Acacia pyrifolia* on brown sand on major drainage lines	Good	203.6	3.2
Acacia High Open Shrubland	MA ApyPlMg EcoAciAcp CyaEuaCc	7	High Open Shrubland of *Acacia pyrifolia*, *Petalostylis labicheoides* and *Melaleuca glomerata* with Scattered Low Trees of ***Eucalyptus camaldulensis* subsp. *obtusa***, ***Acacia citrinoviridis*** and *Acacia coriacea* subsp. *pendens* and Scattered Tussock Grasses of *Cymbopogon ambiguus*, *Eulalia aurea* and **Cenchrus ciliaris* on brown sand on major drainage lines	Good	42.1	0.7
Vegetation supporting Mulga and/or *Acacia citrinoviridis*[2]					**5,554.3**	**87.6**
Acacia Low Open Forest	HP AptAa ChfEuaAri ErffSeaoErfr	2a	Low Open Forest of ***Acacia pteraneura*** and ***Acacia aptaneura*** over Open Tussock Grassland of *Chrysopogon fallax*, *Eulalia aurea* and *Aristida inaequiglumis* with Open Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Senna artemisioides* subsp. *oligophylla* and *Eremophila fraseri* on brown clay loam on hardpan plains	Good	774.4	12.2
	MA AciAcp CcCs MgAmac	2b	Low Open Forest of ***Acacia citrinoviridis*** and *Acacia coriacea* subsp. *pendens* with Tussock Grassland of **Cenchrus ciliaris* and **Cenchrus setiger* and High Open Shrubland of *Melaleuca glomerata* and *Acacia macraneura* on brown sand on major drainage lines	Poor	56.6	0.9
Acacia Low Woodland	HP ApHallCh ChfAriEua ErffSeahSeao	3	Low Woodland of ***Acacia aptaneura***, *Hakea lorea* subsp. *lorea* and *Corymbia hamersleyana* with Open Tussock Grassland of *Chrysopogon fallax*, *Aristida inaequiglumis* and *Eulalia aurea* and Open Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Senna artemisioides* subsp. *helmsii* and *Senna artemisioides* subsp. *oligophylla* on brown clay loam on hardpan plains	Good	678.5	10.7
Acacia Low Open Woodland	HP Apt PtoSolSccn AriEnpoTrl	4	Low Open Woodland of ***Acacia pteraneura*** over Low Open Shrubland of *Ptilotus obovatus*, *Solanum lasiophyllum* and *Sclerolaena cornishiana* over Very Open Tussock Grassland of *Aristida inaequiglumis*, *Enneapogon polyphyllus* and *Tripogonella loliiformis* on brown sandy loam on hardpan plains	Very Good	148.2	2.3

[1] Potential groundwater dependent species and *Acacia citrinoviridis* are shown in **BOLD**.

[2] Mulga species and *Acacia citrinoviridis* are shown in **BOLD**.

Broad Floristic Formation	Vegetation Code	Mapping Code	Vegetation Association	Condition	Area (ha)	% of Study Area
Acacia High Shrubland	SA AsAteAw Apt SegfSeaoSeah	5a	High Shrubland of *Acacia sclerosperma*, *Acacia tetragonophylla* and *Acacia wanyu* with Low Open Woodland of ***Acacia pteraneura*** and Low Open Shrubland of *Senna glaucifolia*, *Senna artemisioides* subsp. *oligophylla* and *Senna artemisioides* subsp. *helmsii* on brown loamy sand on sandplains	Very Good	158.5	2.5
Melaleuca High Shrubland	MA Mg AcpAci ThaEuaCc	6	High Shrubland of *Melaleuca glomerata* with Low Open Woodland of *Acacia coriacea* subsp. *pendens* and ***Acacia citrinoviridis*** and Very Open Tussock Grassland of *Themeda avenacea*, *Eulalia aurea* and **Cenchrus ciliaris* on brown sand in major drainage lines	Good	92.9	1.5
Acacia Shrubland	BA AwEreAsi AciAaApr AwAsiAcit	8	Shrubland of *Acacia wanyu*, *Eremophila exilifolia* and *Acacia sibirica* with Low Open Woodland of ***Acacia citrinoviridis***, ***Acacia aptaneura*** and *Acacia pruinocarpa* and High Open Shrubland of *Acacia wanyu*, *Acacia sibirica* and ***Acacia citrinoviridis*** on brown loamy sand on breakaway slopes	Very Good	17.0	0.3
Senna Low Open Shrubland	HP SeahSccnSol AriArcEua ApAaApt	9	Low Open Shrubland of *Senna artemisioides* subsp. *helmsii*, *Sclerolaena cornishiana* and *Solanum lasiophyllum* over Very Open Tussock Grassland of *Aristida inaequiglumis*, *Aristida contorta* and *Eulalia aurea* with Scattered Low Trees of ***Acacia paraneura***, ***Acacia aptaneura*** and ***Acacia pteraneura*** on brown clay loam on hardpan plains	Good	518.8	8.2
Triodia Hummock Grassland	SA Tb Apt AriArhhTrl	10a	Hummock Grassland of *Triodia basedowii* with Low Open Woodland of ***Acacia pteraneura*** and Very Open Tussock Grassland of *Aristida inaequiglumis*, *Aristida holathera* var. *holathera* and *Tripogonella loliiformis* on brown loamy sand on sandplains	Very Good	603.8	9.5
Triodia Open Hummock Grassland	FS Tv Apt Aw	11	Open Hummock Grassland of *Triodia vanleeuwenii* with Low Open Woodland of ***Acacia pteraneura*** and High Open Shrubland of *Acacia wanyu* on brown sandy loam on footslopes	Good	14.4	0.2
**Cenchrus* Tussock Grassland	FP CcCsEua AciAmacAw	12b	Tussock Grassland of **Cenchrus ciliaris*, **Cenchrus setiger* and *Eulalia aurea* with High Shrubland of ***Acacia citrinoviridis***, *Acacia macraneura* and *Acacia wanyu* and Low Open Woodland of ***Acacia citrinoviridis***, *Corymbia hamersleyana* and ***Acacia aptaneura*** on orange sand on floodplains	Poor	156.2	2.5
	FP CcCsTha AciAaCh As	12c	Tussock Grassland of **Cenchrus ciliaris*, **Cenchrus setiger* and *Themeda avenacea* with Low Woodland of ***Acacia citrinoviridis***, ***Acacia aptaneura*** and *Corymbia hamersleyana* with High Open Shrubland of *Acacia sclerosperma* on brown sand on floodplains	Poor	42.7	0.7

Broad Floristic Formation	Vegetation Code	Mapping Code	Vegetation Association	Condition	Area (ha)	% of Study Area
Eragrostis Tussock Grassland	SA ErerAriEua AaChHall ErffSeahSeao	13a	Tussock Grassland of *Eragrostis eriopoda*, *Aristida inaequiglumis* and *Eulalia aurea* with Low Open Woodland of ***Acacia aptaneura***, *Corymbia hamersleyana* and *Hakea lorea* subsp. *lorea* and Open Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Senna artemisioides* subsp. *helmsii* and *Senna artemisioides* subsp. *oligophylla* on orange sand on sand plains	Very Good	1,630.8	25.7
	SA ErerChf ApAptCh SeahErff	13b	Tussock Grassland of *Eragrostis eriopoda* and *Chrysopogon fallax* with Low Woodland of ***Acacia paraneura***, ***Acacia pteraneura*** and *Corymbia hamersleyana* and Open Shrubland of *Senna artemisioides* subsp. *helmsii* and *Eremophila forrestii* subsp. *forrestii* on orange sand on sand plains	Good	661.5	10.4
Other vegetation associations					**537.9**	**8.4**
Acacia High Shrubland	FP AsAwAte Aw CcCsErer	5b	High Shrubland of *Acacia sclerosperma*, *Acacia wanyu* and *Acacia tetragonophylla* over Open Shrubland of *Acacia wanyu* with Very Open Tussock Grassland of **Cenchrus ciliaris*, **Cenchrus setiger* and *Eragrostis eriopoda* on brown loamy sand on floodplains	Very Good	20.6	0.3
Triodia Hummock Grassland	HS Tv ChHallApr Atru	10b	Hummock Grassland of *Triodia vanleeuwenii* with Low Open Woodland of *Corymbia hamersleyana*, *Hakea lorea* subsp. *lorea* and *Acacia pruinocarpa* and High Open Shrubland of *Acacia trudgeniana* on brown sandy loam on hillslopes	Very Good	60.6	1.0
Triodia Hummock Grassland	SA Tb ChHall AancAsAd	10c	Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Corymbia hamersleyana* and *Hakea lorea* subsp. *lorea* and High Open Shrubland of *Acacia ancistrocarpa*, *Acacia sclerosperma* and *Acacia dictyophleba* on orange sand on sandplains	Good	331.7	5.2
**Cenchrus* Tussock Grassland	FP CcCsChf ChCoasHall AdAs	12a	Tussock Grassland of **Cenchrus ciliaris* and **Cenchrus setiger* and *Chrysopogon fallax* with Low Open Woodland of *Corymbia hamersleyana*, *Corymbia aspera* and *Hakea lorea* subsp. *lorea* and High Open Shrubland of *Acacia dictyophleba* and *Acacia sclerosperma* on brown sand on floodplains	Degraded	47.1	0.7
Themeda Tussock Grassland	FP ThaTtEua Ch AancAd	14	Tussock Grassland of *Themeda avenacea*, *Themeda triandra* and *Eulalia aurea* with Low Open Woodland of *Corymbia hamersleyana* and High Open Shrubland of *Acacia ancistrocarpa* and *Acacia dictyophleba* on brown loamy sand in drainage areas	Good	77.9	1.2

ONSHORE ENVIRONMENTAL

BHP

Caramulla Creek

Figure 6

Vegetation Types

Legend

Study Area

Caramulla Creek

Mosaic of 2a and 13a

Mosaic of 2a and 13a

N

0 500 1,000 1,500

Meters

1:50,000

Datum: GDA94

Projection: MGA Zone 51

Date:	08/11/2018
Status:	Final
Figure:	6
Sheet Size:	A3
Internal Reference:	CC_Vegtypes
Drawn by:	GSM
Requested by:	DB

GRIFFIN SPATIAL & MAPPING

222000 223500 225000 226500 228000 229500 231000

7429500 7428000 7426500 7425000 7423500 7422000 7420500 7419000 7417500 7416000 7414500 7413000 7411500

Legend

Study Area

Transect Locations

- Transect 1
- Transect 2
- Transect 3

Vegetation Types

Hillslopes

HS Tv ChHallApr Atru - 10b	Hummock Grassland of Triodia vanleeuwenii with Low Open Woodland of Corymbia hamersleyana, Hakea lorea subsp. lorea and Acacia pruinocarpa and High Open Shrubland of Acacia trudgeniana on brown sandy loam on hillslopes

Footslopes

FS Tv Apt Aw - 11	Open Hummock Grassland of Triodia vanleeuwenii with Low Open Woodland of Acacia pteraneura and High Open Shrubland of Acacia wanyu on brown sandy loam on footslopes

Breakaway Slopes

BA AwEreAsi AciAaApr AwAsiAcit - 8	Shrubland of Acacia wanyu, Eremophila exilifolia and Acacia sibirica with Low Open Woodland of Acacia citrinoviridis, Acacia aptaneura and Acacia pruinocarpa and High Open Shrubland of Acacia wanyu, Acacia sibirica and Acacia citrinoviridis on brown loamy sand on breakaway slopes

Sandy Plain

SA AsAteAw Apt SegfSeaoSeah - 5a	High Shrubland of Acacia sclerosperma, Acacia tetragonophylla and Acacia wanyu with Low Open Woodland of Acacia pteraneura and Low Open Shrubland of Senna glaucifolia, Senna artemisioides subsp. oligophylla and Senna artemisioides subsp. helmsii on brown loamy sand on sandplains
SA ErerAriEua AaChHall ErffSeahSeao - 13a	Tussock Grassland of Eragrostis eriopoda, Aristida inaequiglumis and Eulalia aurea with Low Open Woodland of Acacia aptaneura, Corymbia hamersleyana and Hakea lorea subsp. lorea and Open Shrubland of Eremophila forrestii subsp. forrestii, Senna artemisioides subsp. helmsii and Senna artemisioides subsp. oligophylla on orange sand on sand plains
SA ErerChf ApAptCh SeahErff - 13b	Tussock Grassland of Eragrostis eriopoda and Chrysopogon fallax with Low Woodland of Acacia paraneura, Acacia pteraneura and Corymbia hamersleyana and Open Shrubland of Senna artemisioides subsp. helmsii and Eremophila forrestii subsp. forrestii on orange sand on sand plains
SA Tb Apt AriArhhTrl - 10a	Hummock Grassland of Triodia basedowii with Low Open Woodland of Acacia pteraneura and Very Open Tussock Grassland of Aristida inaequiglumis, Aristida holathera var. holathera and Tripogonella loliiformis on brown loamy sand on sandplains
SA Tb ChHall AancAsAd - 10c	Hummock Grassland of Triodia basedowii with Low Open Woodland of Corymbia hamersleyana and Hakea lorea subsp. lorea and High Open Shrubland of Acacia ancistrocarpa, Acacia sclerosperma and Acacia dictyophleba on orange sand on sandplains

Flood Plain

FP AsAwAte Aw CcCsErer - 5b	High Shrubland of Acacia sclerosperma, Acacia wanyu and Acacia tetragonophylla over Open Shrubland of Acacia wanyu with Very Open Tussock Grassland of *Cenchrus ciliaris, *Cenchrus setiger and Eragrostis eriopoda on brown loamy sand on floodplains
FP CcCsChf ChCoasHall AdAs - 12a	Tussock Grassland of *Cenchrus ciliaris and *Cenchrus setiger and Chrysopogon fallax with Low Open Woodland of Corymbia hamersleyana, Corymbia aspera and Hakea lorea subsp. lorea and High Open Shrubland of Acacia dictyophleba and Acacia sclerosperma on brown sand on floodplains
FP CcCsEua AciAmacAw - 12b	Tussock Grassland of *Cenchrus ciliaris, *Cenchrus setiger and Eulalia aurea with High Shrubland of Acacia citrinoviridis, Acacia macraneura and Acacia wanyu and Low Open Woodland of Acacia citrinoviridis, Corymbia hamersleyana and Acacia aptaneura on orange sand on floodplains
FP CcCsTha AciAaCh As - 12c	Tussock Grassland of *Cenchrus ciliaris, *Cenchrus setiger and Themeda avenacea with Low Woodland of Acacia citrinoviridis, Acacia aptaneura and Corymbia hamersleyana with High Open Shrubland of Acacia sclerosperma on brown sand on floodplains
FP ThaTtEua Ch AancAd - 14	Tussock Grassland of Themeda avenacea, Themeda triandra and Eulalia aurea with Low Open Woodland of Corymbia hamersleyana and High Open Shrubland of Acacia ancistrocarpa and Acacia dictyophleba on brown loamy sand in drainage areas

Hardpan Plains

HP ApHallCh ChfAriEua ErffSeahSeao - 3	Low Woodland of Acacia aptaneura, Hakea lorea subsp. lorea and Corymbia hamersleyana with Open Tussock Grassland of Chrysopogon fallax, Aristida inaequiglumis and Eulalia aurea and Open Shrubland of Eremophila forrestii subsp. forrestii, Senna artemisioides subsp. helmsii and Senna artemisioides subsp. oligophylla on brown clay loam on hardpan plains
HP Apt PtoSolSccn AriEnpoTrl - 4	Low Open Woodland of Acacia pteraneura over Low Open Shrubland of Ptilotus obovatus, Solanum lasiophyllum and Sclerolaena cornishiana over Very Open Tussock Grassland of Aristida inaequiglumis, Enneapogon polyphyllus and Tripogonella loliiformis on brown sandy loam on hardpan plains
HP AptAa ChfEuaAri ErffSeaoErfr - 2a	Low Open Forest of Acacia pteraneura and Acacia aptaneura over Open Tussock Grassland of Chrysopogon fallax, Eulalia aurea and Aristida inaequiglumis with Open Shrubland of Eremophila forrestii subsp. forrestii, Senna artemisioides subsp. oligophylla and Eremophila fraseri on brown clay loam on hardpan plains
HP SeahSccnSol AriArcEua ApAaApt - 9	Low Open Shrubland of Senna artemisioides subsp. helmsii, Sclerolaena cornishiana and Solanum lasiophyllum over Very Open Tussock Grassland of Aristida inaequiglumis, Aristida contorta and Eulalia aurea with Scattered Low Trees of Acacia paraneura, Acacia aptaneura and Acacia pteraneura on brown clay loam on hardpan plains

Major Drainage Line

MA AciAcp CcCs MgAmac - 2b	Low Open Forest of Acacia citrinoviridis and Acacia coriacea subsp. pendens with Tussock Grassland of *Cenchrus ciliaris and *Cenchrus setiger and High Open Shrubland of Melaleuca glomerata and Acacia macraneura on brown sand on major drainage lines
MA ApyPlMg EcoAciAcp CyaEuaCc - 7	High Open Shrubland of Acacia pyrifolia, Petalostylis labicheoides and Melaleuca glomerata with Scattered Low Trees of Eucalyptus camaldulensis subsp. obtusa, Acacia citrinoviridis and Acacia coriacea subsp. pendens and Scattered Tussock Grasses of Cymbopogon ambiguus, Eulalia aurea and *Cenchrus ciliaris on brown sand on major drainage lines
MA Eco EcoAciAcp MgApy - 1	Open Woodland of Eucalyptus camaldulensis subsp. obtusa over Low Open Woodland of Eucalyptus camaldulensis subsp. obtusa, Acacia coriacea subsp. pendens and Acacia citrinoviridis over High Open Shrubland of Melaleuca glomerata and Acacia pyrifolia on brown sand on major drainage lines
MA Mg AcpAci ThaEuaCc - 6	High Shrubland of Melaleuca glomerata with Low Open Woodland of Acacia coriacea subsp. pendens and Acacia citrinoviridis and Very Open Tussock Grassland of Themeda avenacea, Eulalia aurea and *Cenchrus ciliaris on brown sand in major drainage lines

Others

Mosaic of HP AptAa ChfEuaAri ErffSeaoErfr and SA ErerAriEua AaChHall ErffSeahSeao - Mosaic of 2a and 13a	Mosaic of Low Open Forest of Acacia pteraneura and Acacia aptaneura over Open Tussock Grassland of Chrysopogon fallax, Eulalia aurea and Aristida inaequiglumis with Open Shrubland of Eremophila forrestii subsp. forrestii, Senna artemisioides subsp. oligophylla and Eremophila fraseri on brown clay loam on hardpan plains & Tussock Grassland of Eragrostis eriopoda, Aristida inaequiglumis and Eulalia aurea with Low Open Woodland of Acacia aptaneura, Corymbia hamersleyana and Hakea lorea subsp. lorea and Open Shrubland of Eremophila forrestii subsp. forrestii, Senna artemisioides subsp. helmsii and Senna artemisioides subsp. oligophylla on orange sand on sand plains

ONSHORE ENVIRONMENTAL

BHP

Caramulla Creek

Figure 6

Vegetation Types Legend

Date:	08/11/2018
Status:	Final
Figure:	6
Sheet Size:	A3
Internal Reference:	CC_Vegtypes_leg
Drawn by:	GSM
Requested by:	DB

GRIFFIN SPATIAL & MAPPING

222000 223500 225000 226500 228000 229500 231000

7429500 7428000 7426500 7425000 7423500 7422000 7420500 7419000 7417500 7416000 7414500 7413000 7411500

Caramulla Creek

ONSHORE ENVIRONMENTAL

BHP WAIO

Caramulla Creek

Figure 7

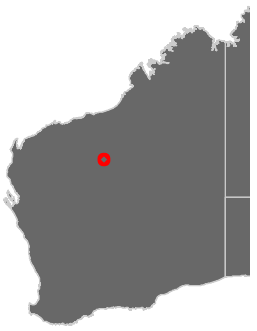
Vegetation Condition within the Study Area

Legend

- Study Area

Vegetation Condition

- Degraded
- Poor
- Good
- Very Good



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Meters

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Datum: GDA94

Projection: MGA Zone 51

Date:	08/11/2018
Status:	Final
Figure:	7
Sheet Size:	A3
Internal Reference:	CC_VegCond
Drawn by:	GSM
Requested by:	DB

GRIFFIN SPATIAL & MAPPING

Broad Floristic Formation	*Eucalyptus* Open Woodland
Vegetation Association	1. MA Eco EcoAciAcp MgApy Open Woodland of *Eucalyptus camaldulensis* subsp. *obtusa* over Low Open Woodland of *Eucalyptus camaldulensis* subsp. *obtusa, Acacia coriacea* subsp. *pendens* and *Acacia citrinoviridis* over High Open Shrubland of *Melaleuca glomerata* and *Acacia pyrifolia* on brown sand on major drainage lines

Area within Study Area (ha)	203.6
Releves Sampled	CC01, CC27, 1E, 2F, CC37, CC52, 3F
Soils and Geology	Brown sand
Land Form	Major drainage line (main channel)
TEC or PEC	No
Conservation Significant Flora	*Rhagodia* sp. Hamersley (M. Trudgen 17794) (Priority 3)
Introduced (Weed) Species	**Cenchrus ciliaris, *Cenchrus setiger*
Vegetation Condition	Good
Disturbances	Weeds, cattle grazing
Average Fire Age	Old (6+ years)
Vegetation Structure & Floristics	
Trees 10-30 m	*Eucalyptus camaldulensis* var. *obtusa, Eucalyptus victrix*
Trees <10 m	*Eucalyptus camaldulensis* var. *obtusa, Eucalyptus victrix, Acacia coriacea* subsp. *pendens, Acacia citrinoviridis*
Shrubs >2 m	*Melaleuca glomerata, Acacia pyrifolia, Petalostylis labicheoides, Acacia citrinoviridis*
Shrubs <1 m	*Acacia pyrifolia, Corchorus crozophorifolius, Isotropis forrestii, Trichodesma zeylanicum*
Tussock Grasses	*Cymbopogon ambiguus* (riverine form), *Eulalia aurea, *Cenchrus ciliaris, Eragrostis speciosa, Themeda avenacea, *Cenchrus setiger, Themeda triandra*
Sedges	*Cyperus ixiocarpus*
Herbs	*Goodenia lamprosperma, Pluchea rubelliflora, Wahlenbergia tumidifructa, Cynanchum floribundum, Cleome viscosa*

Broad Floristic Formation	*Acacia* Low Open Forest 2a. HP AptAa ChfEuaAri ErffSeaoErfr
Vegetation Association	Low Open Forest of *Acacia pteraneura* and *Acacia aptaneura* over Open Tussock Grassland of *Chrysopogon fallax, Eulalia aurea* and *Aristida inaequiglumis* with Open Shrubland of *Eremophila forrestii* subsp. *forrestii, Senna artemisioides* subsp. *oligophylla* and *Eremophila fraseri* on brown clay loam on hardpan plains

Area within Study Area (ha)	774.4
Releves Sampled	CC56, CC57, 1A, 2A, 2K
Soils and Geology	Brown clay loam
Land Form	Hardpan plains
TEC or PEC	No
Conservation Significant Flora	*Rhagodia* sp. Hamersley (M. Trudgen 17794) (Priority 3)
Introduced (Weed) Species	**Cenchrus setiger, *Cenchrus ciliaris*
Vegetation Condition	Good
Disturbances	Cattle grazing, road/access track, weeds
Average Fire Age	Old (6+ years)
Vegetation Structure & Floristics	
Trees <10 m	*Acacia aptaneura, Acacia pteraneura, Acacia macraneura, Hakea lorea* subsp. *lorea, Corymbia hamersleyana*
Shrubs >2 m	*Psydrax latifolia, Psydrax suaveolens, Acacia sclerosperma*
Shrubs 1-2 m	*Eremophila forrestii* subsp. *forrestii, Senna artemisioides* subsp. *oligophylla, Eremophila fraseri, Senna artemisioides* subsp. *helmsii, Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3)
Shrubs <1 m	*Ptilotus obovatus, Eremophila forrestii* subsp. *forrestii, Sclerolaena cornishiana, Isotropis forrestii, Sida* sp. verrucose glands (F.H. Mollemans 2423), *Hibiscus sturtii* var. *platychlamys, Eremophila lanceolata, Sida platycalyx*
Hummock Grassland	*Triodia basedowii*
Tussock Grasses	*Chrysopogon fallax, Eulalia aurea, Aristida inaequiglumis, *Cenchrus setiger, Digitaria brownii*
Sedges	*Fimbristylis dichotoma*
Herbs	*Cleome viscosa, Cheilanthes brownii*

Broad Floristic Formation	*Acacia* Low Open Forest
Vegetation Association	2b. MA AciAcp CcCs MgAmac Low Open Forest of *Acacia citrinoviridis* and *Acacia coriacea* subsp. *pendens* with Tussock Grassland of **Cenchrus ciliaris* and **Cenchrus setiger* and High Open Shrubland of *Melaleuca glomerata* and *Acacia macraneura* on brown sand on major drainage lines

Area within Study Area (ha)	56.6
Releves Sampled	CC41, CC48, 3H
Soils and Geology	Brown sand
Land Form	Major drainage lines - channels and islands
TEC or PEC	No
Conservation Significant Flora	*Rhagodia* sp. Hamersley (M. Trudgen 17794) (Priority 3)
Introduced (Weed) Species	**Cenchrus ciliaris, *Cenchrus setiger*
Vegetation Condition	Poor
Disturbances	Cattle grazing, weeds
Average Fire Age	Old (6+ years)
Vegetation Structure & Floristics	
Trees <10 m	*Acacia citrinoviridis, Acacia coriacea* subsp. *pendens, Acacia macraneura, Corymbia hamersleyana*
Shrubs >2 m	*Melaleuca glomerata, Eremophila fraseri, Acacia macraneura, Acacia sibirica, Acacia rhodophloia, Acacia citrinoviridis*
Shrubs <1 m	*Corchorus crozophorifolius, Senna artemisioides* subsp. *helmsii*
Tussock Grasses	**Cenchrus ciliaris, *Cenchrus setiger, Themeda avenacea, Eulalia aurea*
Herbs	*Cheilanthes brownii*

Broad Floristic Formation	*Acacia* Low Woodland
Vegetation Association	3. HP ApHallCh ChfAriEua ErffSeahSeao Low Woodland of *Acacia aptaneura, Hakea lorea* subsp. *lorea* and *Corymbia hamersleyana* with Open Tussock Grassland of *Chrysopogon fallax, Aristida inaequiglumis* and *Eulalia aurea* and Open Shrubland of *Eremophila forrestii* subsp. *forrestii, Senna artemisioides* subsp. *helmsii* and *Senna artemisioides* subsp. *oligophylla* on brown clay loam on hardpan plains

Area within Study Area (ha)	678.5
Releves Sampled	CC25, CC16, CC44, 3I, CC33, CC54
Soils and Geology	Brown clay loam
Land Form	Hardpan plains
TEC or PEC	No
Conservation Significant Flora	None
Introduced (Weed) Species	**Cenchrus ciliaris, *Cenchrus setiger*
Vegetation Condition	Good
Disturbances	Cattle grazing, road/access tracks
Average Fire Age	Old (6+ years)
Vegetation Structure & Floristics	
Trees <10 m	*Acacia aptaneura, Hakea lorea* subsp. *lorea, Acacia pteraneura, Corymbia aspera, Acacia citrinoviridis, Acacia paraneura*
Shrubs >2 m	*Psydrax latifolia, Acacia aptaneura, Acacia ancistrocarpa, Acacia wanyu*
Shrubs 1-2 m	*Eremophila forrestii* subsp. *forrestii, Senna artemisioides* subsp. *helmsii, Senna artemisioides* subsp. *oligophylla*
Shrubs <1 m	*Solanum lasiophyllum, Eremophila lanceolata, Sida platycalyx, Senna artemisioides* subsp. *oligophylla, Sclerolaena cornishiana, Maireana villosa, Sida* sp. verrucose glands (F.H. Mollemans 2423)
Hummock Grasses	*Triodia basedowii*
Tussock Grasses	*Chrysopogon fallax, Eulalia aurea, Aristida inaequiglumis, Eragrostis xerophila, *Cenchrus ciliaris, *Cenchrus setiger, Eragrostis eriopoda*
Sedges	*Fimbristylis dichotoma*

Broad Floristic Formation	*Acacia* Low Open Woodland
Vegetation Association	4. HP Apt PtoSolSccn AriEnpoTrl Low Open Woodland of *Acacia pteraneura* over Low Open Shrubland of *Ptilotus obovatus, Solanum lasiophyllum* and *Sclerolaena cornishiana* over Very Open Tussock Grassland of *Aristida inaequiglumis, Enneapogon polyphyllus* and *Tripogonella loliiformis* on brown sandy loam on hardpan plains

Area within Study Area (ha)	148.2
Releves Sampled	1B, 2C, 2J
Soils and Geology	Brown sandy loam
Land Form	Hardpan plains
TEC or PEC	No
Conservation Significant Flora	None
Introduced (Weed) Species	**Cenchrus ciliaris*
Vegetation Condition	Very Good
Disturbances	Weeds, cattle grazing
Average Fire Age	Old (6+ years)
Vegetation Structure & Floristics	
Trees <10 m	*Acacia pteraneura*
Shrubs >2 m	*Acacia sclerosperma, Acacia pteraneura*
Shrubs 1-2 m	*Senna* sp. Meekatharra (E. Bailey 1-26), *Senna artemisioides* subsp. *helmsii, Rhagodia eremaea*
Shrubs <1 m	*Ptilotus obovatus, Solanum lasiophyllum, Sclerolaena cornishiana, Senna glaucifolia*
Tussock Grasses	*Aristida inaequiglumis, Enneapogon polyphyllus, Tripogonella loliiformis, Eragrostis eriopoda, Chrysopogon fallax*

Broad Floristic Formation	5a. SA AsAteAw Apt SegfSeaoSeah *Acacia* High Shrubland
Vegetation Association	High Shrubland of *Acacia sclerosperma*, *Acacia tetragonophylla* and *Acacia wanyu* with Low Open Woodland of *Acacia pteraneura* and Low Open Shrubland of *Senna glaucifolia, Senna artemisioides* subsp. *oligophylla* and *Senna artemisioides* subsp. *helmsii* on brown loamy sand on sandplains

Area within Study Area (ha)	158.5
Releves Sampled	1C, 2D, CC09
Soils and Geology	Brown loamy sand
Land Form	Sand plain with hardpan crust
TEC or PEC	No
Conservation Significant Flora	None
Introduced (Weed) Species	**Cenchrus ciliaris, *Cenchrus setiger*
Vegetation Condition	Very Good
Disturbances	Cattle grazing, weeds
Average Fire Age	Old (6+ years)
Vegetation Structure & Floristics	
Trees <10 m	*Acacia pteraneura, Acacia citrinoviridis*
Shrubs >2 m	*Acacia sclerosperma, Acacia pteraneura, Acacia tetragonophylla, Acacia wanyu, Acacia citrinoviridis*
Shrubs 1-2 m	*Senna glaucifolia, Solanum lasiophyllum, Ptilotus obovatus, Eremophila margarethae, Acacia wanyu*
Shrubs <1 m	*Senna glaucifolia, Senna artemisioides* subsp. *oligophylla, Corchorus crozophorifolius, Senna artemisioides* subsp. *helmsii*
Hummock Grasses	*Triodia basedowii*
Tussock Grasses	*Tripogonella loliiformis, Aristida contorta, *Cenchrus ciliaris, *Cenchrus setiger, Eragrostis eriopoda, Aristida inaequiglumis, Enneapogon polyphyllus*

Broad Floristic Formation	*Acacia* High Shrubland 5b. FP AsAwAte Aw CcCsErer
Vegetation Association	High Shrubland of *Acacia sclerosperma, Acacia wanyu* and *Acacia tetragonophylla* over Open Shrubland of *Acacia wanyu* with Very Open Tussock Grassland of **Cenchrus ciliaris, *Cenchrus setiger* and *Eragrostis eriopoda* on brown loamy sand on floodplains

Area within Study Area (ha)	20.6
Releves Sampled	CC04, 2D, CC09
Soils and Geology	Brown loamy sand with limited CID outcropping
Land Form	Floodplains - eroded slopes next to drainage line
TEC or PEC	No
Conservation Significant Flora	None
Introduced (Weed) Species	*Cenchrus ciliaris, *Cenchrus setiger*
Vegetation Condition	Very Good
Disturbances	Cattle grazing, weeds
Average Fire Age	Old (6+years)
Vegetation Structure & Floristics	
Trees <10 m	*Corymbia hamersleyana, Acacia pteraneura, Acacia citrinoviridis, Acacia aptaneura*
Shrubs >2 m	*Acacia sclerosperma, Acacia wanyu, Acacia tetragonophylla, Acacia macraneura, Acacia citrinoviridis*
Shrubs 1-2 m	*Acacia wanyu*
Shrubs <1 m	*Senna artemisioides* subsp. *oligophylla, Corchorus crozophorifolius, Senna glaucifolia, Senna artemisioides* subsp. *helmsii, Eremophila forrestii* subsp. *forrestii, Ptilotus obovatus, Ptilotus astrolasius*
Hummock Grasses	*Triodia basedowii, Triodia epactia*
Tussock Grasses	**Cenchrus ciliaris, *Cenchrus setiger, Eragrostis eriopoda, Enneapogon polyphyllus, Aristida inaequiglumis*

Broad Floristic Formation	*Melaleuca* High Shrubland
Vegetation Association	6. MA Mg AcpAci ThaEuaCc High Shrubland of *Melaleuca glomerata* with Low Open Woodland of *Acacia coriacea* subsp. *pendens* and *Acacia citrinoviridis* and Very Open Tussock Grassland of *Themeda avenacea, Eulalia aurea* and **Cenchrus ciliaris* on brown sand in major drainage lines

Area within Study Area (ha)	92.9
Releves Sampled	CC60, 3J
Soils and Geology	Brown sand
Land Form	Major drainage lines
TEC or PEC	No
Conservation Significant Flora	None
Introduced (Weed) Species	**Cenchrus ciliaris, *Cenchrus setiger*
Vegetation Condition	Good
Disturbances	Cattle grazing, weeds
Average Fire Age	Old (6+ years)
Vegetation Structure & Floristics	
Trees <10 m	*Acacia coriacea* subsp. *pendens, Acacia citrinoviridis, Eucalyptus victrix, Eucalyptus camaldulensis* subsp. *obtusa*
Shrubs >2 m	*Melaleuca glomerata, Acacia sibirica*
Tussock Grasses	*Themeda avenacea, Eulalia aurea, *Cenchrus ciliaris, *Cenchrus setiger, Chrysopogon fallax*

Broad Floristic Formation	*Acacia* High Open Shrubland
Vegetation Association	7. MA ApyPlMg EcoAciAcp CyaEuaCc High Open Shrubland of *Acacia pyrifolia, Petalostylis labicheoides* and *Melaleuca glomerata* with Scattered Low Trees of *Eucalyptus camaldulensis* subsp. *obtusa*, *Acacia citrinoviridis* and *Acacia coriacea* subsp. *pendens* and Scattered Tussock Grasses of *Cymbopogon ambiguus, Eulalia aurea* and **Cenchrus ciliaris* on brown sand on major drainage lines

Area within Study Area (ha)	42.1
Releves Sampled	CC10, CC20, CC28
Soils and Geology	Brown sand
Land Form	Major drainage lines
TEC or PEC	No
Conservation Significant Flora	None
Introduced (Weed) Species	**Cenchrus ciliaris*
Vegetation Condition	Good
Disturbances	Cattle grazing, weeds
Average Fire Age	Old (6+ years)
Vegetation Structure & Floristics	
Trees <10m	*Eucalyptus camaldulensis* subsp. *obtusa, Acacia citrinoviridis, Acacia coriacea* subsp. *pendens, Corymbia hamersleyana*
Shrubs >2m	*Acacia pyrifolia, Petalostylis labicheoides, Melaleuca glomerata, Acacia citrinoviridis*
Shrubs 1-2m	*Acacia pyrifolia, Petalostylis labicheoides*
Shrubs <1m	*Trichodesma zeylanicum, Tephrosia rosea* var. Fortescue Creeks (M.I.H. Brooker 2186), *Acacia pyrifolia, Isotropis forrestii*
Tussock Grasses	*Aristida holathera* var. *holathera, Cymbopogon ambiguus, Eulalia aurea, *Cenchrus ciliaris, Eragrostis speciosa*
Sedges	*Cyperus ixiocarpus*
Herbs	*Cleome viscosa*

Broad Floristic Formation	*Acacia* Shrubland
Vegetation Association	8. BA AwEreAsi AciAaApr AwAsiAcit Shrubland of *Acacia wanyu, Eremophila exilifolia* and *Acacia sibirica* with Low Open Woodland of *Acacia citrinoviridis, Acacia aptaneura* and *Acacia pruinocarpa* and High Open Shrubland of *Acacia wanyu, Acacia sibirica* and *Acacia citrinoviridis* on brown loamy sand on breakaway slopes

Area within Study Area (ha)	17.0
Releves Sampled	CC19, CC21
Soils and Geology	Brown loamy sand
Land Form	Breakaways and edge of drainage line
TEC or PEC	No
Conservation Significant Flora	None
Introduced (Weed) Species	**Cenchrus ciliaris, *Cenchrus setiger*
Vegetation Condition	Very Good
Disturbances	Cattle grazing, weeds
Average Fire Age	Old (6+ years)
Vegetation Structure & Floristics	
Trees <10 m	*Acacia citrinoviridis, Acacia aptaneura, Acacia pruinocarpa, Acacia macraneura*
Shrubs >2 m	*Acacia wanyu, Acacia sibirica, Acacia citrinoviridis*
Shrubs 1-2 m	*Acacia wanyu, Eremophila exilifolia, Acacia sibirica, Eremophila fraseri*
Shrubs <1 m	*Corchorus crozophorifolius, Ptilotus obovatus, Senna artemisioides* subsp. *helmsii*
Tussock Grasses	*Eriachne mucronata, Tripogonella loliiformis, *Cenchrus ciliaris, *Cenchrus setiger, Chrysopogon fallax, Aristida holathera* var. *holathera, Aristida contorta*

Broad Floristic Formation	*Senna* Low Open Shrubland
Vegetation Association	9. HP SeahSccnSol AriArcEua ApAaApt Low Open Shrubland of *Senna artemisioides* subsp. *helmsii, Sclerolaena cornishiana* and *Solanum lasiophyllum* over Very Open Tussock Grassland of *Aristida inaequiglumis, Aristida contorta* and *Eulalia aurea* with Scattered Low Trees of *Acacia paraneura, Acacia aptaneura* and *Acacia pteraneura* on brown clay loam on hardpan plains

Area within Study Area (ha)	518.8
Releves Sampled	CC55, 2B, CC13, CC22, 3B, 3D, 3K
Soils and Geology	Brown clay loam
Land Form	Hardpan plains
TEC or PEC	No
Conservation Significant Flora	None
Introduced (Weed) Species	**Cenchrus ciliaris*
Vegetation Condition	Good
Disturbances	Cattle grazing, road/access track, weeds
Average Fire Age	Old (6+ years)
Vegetation Structure & Floristics	
Trees <10 m	*Acacia paraneura, Acacia aptaneura, Acacia pteraneura, Hakea lorea* subsp*. lorea, Acacia macraneura*
Shrubs 1-2 m	*Senna artemisioides* subsp. *helmsii, Senna artemisioides* subsp. *oligophylla, Eremophila forrestii* subsp. *forrestii*
Shrubs <1 m	*Senna artemisioides* subsp. *helmsii, Senna artemisioides* subsp. *oligophylla, Sclerolaena cornishiana, Solanum lasiophyllum, Ptilotus obovatus, Senna* sp. Meekatharra (E. Bailey 1-26), *Eremophila lanceolata, Sida platycalyx, Eremophila cuneifolia*
Tussock Grasses	*Aristida inaequiglumis, Aristida contorta, Eulalia aurea, Eragrostis eriopoda, Tripogonella loliiformis, Chrysopogon fallax*
Sedges	*Fimbristylis dichotoma*

Broad Floristic Formation	*Triodia* Hummock Grassland
Vegetation Association	10a. SA Tb Apt AriArhhTrI Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Acacia pteraneura* and Very Open Tussock Grassland of *Aristida inaequiglumis, Aristida holathera* var. *holathera* and *Tripogonella loliiformis* on brown loamy sand on sand plains

Area within Study Area (ha)	603.8
Releves Sampled	CC02, 2I, CC12, CC14, CC17, CC32
Soils and Geology	Brown loamy sand
Land Form	Sand plain
TEC or PEC	No
Conservation Significant Flora	*Eremophila capricornica* (Priority 1)
Introduced (Weed) Species	None recorded
Vegetation Condition	Very Good
Disturbances	Cattle grazing
Average Fire Age	Old (6+ years)
Vegetation Structure & Floristics	
Trees <10 m	*Acacia pteraneura, Hakea lorea* subsp. *lorea, Corymbia hamersleyana, Acacia pruinocarpa, Acacia aptaneura*
Shrubs >2 m	*Acacia ancistrocarpa, Acacia pachyacra, Acacia sclerosperma, Acacia pteraneura*
Shrubs 1-2 m	*Stylobasium spathulatum, Senna glutinosa* subsp. x *luerssenii, Senna artemisioides* subsp. *oligophylla, Eremophila forrestii* subsp. *forrestii, Senna artemisioides* subsp. *helmsii*
Shrubs <1 m	*Ptilotus obovatus, Eremophila forrestii* subsp. *forrestii*
Hummock Grasses	*Triodia basedowii*
Tussock Grasses	*Aristida inaequiglumis, Aristida holathera* var. *holathera, Tripogonella loliiformis, Eulalia aurea, Eragrostis eriopoda*

Broad Floristic Formation	*Triodia* Hummock Grassland
Vegetation Association	10b. HS Tv ChHallApr Atru Hummock Grassland of *Triodia vanleeuwenii* with Low Open Woodland of *Corymbia hamersleyana, Hakea lorea* subsp. *lorea* and *Acacia pruinocarpa* and High Open Shrubland of *Acacia trudgeniana* on brown sandy loam on hillslopes

Area within Study Area (ha)	60.6
Releves Sampled	CC06, CC15, CC18
Soils and Geology	Brown sandy loam
Land Form	Hillslopes
Priority Ecological Community	No
Conservation Significant Flora	*Rhagodia* sp. Hamersley (M. Trudgen 17794) (Priority 3)
Introduced (Weed) Species	None
Vegetation Condition	Very Good
Disturbances	Road/access track
Average Fire Age	Old (6+ years)
Vegetation Structure & Floristics	
Trees <10 m	*Corymbia hamersleyana, Hakea lorea* subsp. *lorea, Acacia pruinocarpa, Acacia pteraneura, Acacia aptaneura, Corymbia deserticola*
Shrubs >2 m	*Acacia trudgeniana, Acacia ancistrocarpa*
Shrubs 1-2 m	*Eremophila exilifolia, Eremophila latrobei* subsp. *latrobei, Senna glutinosa* subsp. *glutinosa, Eremophila forrestii* subsp. *forrestii, Senna glutinosa* subsp. x *luerssenii*
Shrubs <1 m	*Ptilotus obovatus, Eremophila exilifolia, Acacia hilliana, Halgania solanacea* var. Mt Doreen (G.M. Chippendale 4206), *Ptilotus rotundifolius*
Hummock Grasses	*Triodia vanleeuwenii*

Broad Floristic Formation	*Triodia* Hummock Grassland
Vegetation Association	10c. SA Tb ChHall AancAsAd Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Corymbia hamersleyana* and *Hakea lorea* subsp. *lorea* and High Open Shrubland of *Acacia ancistrocarpa, Acacia sclerosperma* and *Acacia dictyophleba* on orange sand on sandplains

Area within Study Area (ha)	331.7
Releves Sampled	CC11, CC23
Soils and Geology	Orange sand
Land Form	Sand plains
TEC or PEC	No
Conservation Significant Flora	None
Introduced (Weed) Species	**Cenchrus ciliaris*
Vegetation Condition	Good
Disturbances	Cattle grazing, road/access track
Average Fire Age	Old (6+ years)
Vegetation Structure & Floristics	
Trees <10 m	*Corymbia hamersleyana, Hakea lorea* subsp. *lorea, Acacia pruinocarpa*
Shrubs >2 m	*Acacia sclerosperma, Acacia pachyacra, Acacia ancistrocarpa, Acacia pyrifolia*
Shrubs <1 m	*Chrysocephalum apiculatum, Scaevola parvifolia* subsp. *pilbarae, Kennedia prorepens*
Hummock Grasses	*Triodia basedowii*
Tussock Grasses	**Cenchrus ciliaris, Aristida holathera* var. *holathera, Eragrostis eriopoda*

Broad Floristic Formation	*Triodia* Open Hummock Grassland
Vegetation Association	11. FS Tv Apt Aw Open Hummock Grassland of *Triodia vanleeuwenii* with Low Open Woodland of *Acacia pteraneura* and High Open Shrubland of *Acacia wanyu* on brown sandy loam on footslopes

Area within Study Area (ha)	14.4
Releves Sampled	CC07
Soils and Geology	Brown sandy loam
Land Form	Footslopes
TEC or PEC	No
Conservation Significant Flora	*Eremophila capricornica* (Priority 1), *Rhagodia* sp. Hamersley (M. Trudgen 17794) (Priority 3)
Introduced (Weed) Species	**Cenchrus ciliaris*
Vegetation Condition	Good
Disturbances	Cattle grazing, road/access track, weeds
Average Fire Age	Old (6+ years)
Vegetation Structure & Floristics	
Trees <10 m	*Acacia pteraneura*
Shrubs >2 m	*Acacia wanyu*
Shrubs 1-2 m	*Senna glutinosa* subsp. x *luerssenii*
Shrubs <1 m	*Eremophila capricornica, Ptilotus obovatus, Eremophila cuneifolia*
Hummock Grasses	*Triodia vanleeuwenii*

Broad Floristic Formation	**Cenchrus* Tussock Grassland
Vegetation Association	12a. FP CcCsChf ChCoasHall AdAs Tussock Grassland of **Cenchrus ciliaris* and **Cenchrus setiger* and *Chrysopogon fallax* with Low Open Woodland of *Corymbia hamersleyana, Corymbia aspera* and *Hakea lorea* subsp. *lorea* and High Open Shrubland of *Acacia dictyophleba* and *Acacia sclerosperma* on brown sand on floodplains

Area within Study Area (ha)	47.1
Releves Sampled	CC34, CC30, CC38, CC51
Soils and Geology	Brown sand
Land Form	Floodplains - raised sandy
TEC or PEC	No
Conservation Significant Flora	None
Introduced (Weed) Species	**Cenchrus ciliaris, *Cenchrus setiger*
Vegetation Condition	Degraded
Disturbances	Cattle grazing, weeds
Average Fire Age	Old (6+ years)
Vegetation Structure & Floristics	
Trees <10 m	*Corymbia hamersleyana, Corymbia aspera, Hakea lorea* subsp. *lorea, Eucalyptus victrix, Acacia coriacea* subsp. *pendens, Acacia citrinoviridis*
Shrubs >2 m	*Acacia dictyophleba, Acacia sclerosperma, Acacia ancistrocarpa, Acacia pachyacra*
Shrubs 1-2 m	*Senna artemisioides* subsp. *oligophylla, Senna artemisioides* subsp. *helmsii, Eremophila forrestii* subsp. *forrestii*
Tussock Grasses	**Cenchrus ciliaris, *Cenchrus setiger, Chrysopogon fallax, Themeda triandra, Eragrostis eriopoda*
Hummock Grasses	*Triodia basedowii*

Broad Floristic Formation	12b. FP CcCsEua AciAmacAw **Cenchrus* Tussock Grassland
Vegetation Association	Tussock Grassland of **Cenchrus ciliaris, *Cenchrus setiger* and *Eulalia aurea* with High Shrubland of *Acacia citrinoviridis, Acacia macraneura* and *Acacia wanyu* and Low Open Woodland of *Acacia citrinoviridis, Corymbia hamersleyana* and *Acacia aptaneura* on orange sand on floodplains

Area within Study Area (ha)	156.2
Releves Sampled	CC29, CC36, CC46, CC49
Soils and Geology	Orange sand
Land Form	Floodplains - raised drainage margins/levee banks
TEC or PEC	No
Conservation Significant Flora	None
Introduced (Weed) Species	**Cenchrus ciliaris, *Cenchrus setiger*
Vegetation Condition	Poor
Disturbances	Cattle grazing, weeds
Average Fire Age	Old (6+ years)
Vegetation Structure & Floristics	
Trees <10 m	*Corymbia hamersleyana, Acacia citrinoviridis, Acacia aptaneura, Acacia pteraneura, Hakea lorea* subsp. *lorea, Acacia coriacea* subsp. *pendens, Corymbia aspera*
Shrubs >2 m	*Acacia citrinoviridis, Acacia wanyu, Acacia macraneura*
Shrubs 1-2 m	*Acacia wanyu, Eremophila fraseri, Senna artemisioides* subsp. *helmsii*
Shrubs <1 m	*Tephrosia rosea* var. Fortescue Creeks (M.I.H. Brooker 2186), *Corchorus crozophorifolius, Isotropis forrestii*
Tussock Grasses	**Cenchrus ciliaris, *Cenchrus setiger, Chrysopogon fallax, Eulalia aurea, Themeda triandra, Themeda avenacea*

Broad Floristic Formation	**Cenchrus* Tussock Grassland
Vegetation Association	12c. FP CcCsTha AciAaCh As Tussock Grassland of **Cenchrus ciliaris, *Cenchrus setiger* and *Themeda avenacea* with Low Woodland of *Acacia citrinoviridis*, *Acacia aptaneura* and *Corymbia hamersleyana* with High Open Shrubland of *Acacia sclerosperma* on brown sand on floodplains

Area within Study Area (ha)	42.7
Releves Sampled	CC03, 1D, 2G, 2H
Soils and Geology	Brown sand
Land Form	Floodplain
TEC or PEC	No
Conservation Significant Flora	None
Introduced (Weed) Species	**Cenchrus ciliaris*
Vegetation Condition	Poor
Disturbances	Cattle grazing, weeds
Average Fire Age	Old (6+ years)
Vegetation Structure & Floristics	
Trees 10-30 m	*Eucalyptus camaldulensis*
Trees <10 m	*Acacia citrinoviridis, Acacia aptaneura, Corymbia hamersleyana, Eucalyptus victrix, Acacia coriacea* subsp. *pendens, Acacia paraneura, Acacia aptaneura, Corymbia aspera*
Shrubs >2 m	*Acacia sclerosperma*
Tussock Grasses	**Cenchrus ciliaris, *Cenchrus setiger, Themeda avenacea, Aristida holathera* var. *holathera, Bothriochloa ewartiana*

Broad Floristic Formation	*Eragrostis* Tussock Grassland
Vegetation Association	13a. SA ErerAriEua AaChHall ErffSeahSeao Tussock Grassland of *Eragrostis eriopoda, Aristida inaequiglumis* and *Eulalia aurea* with Low Open Woodland of *Acacia aptaneura, Corymbia hamersleyana* and *Hakea lorea* subsp. *lorea* and Open Shrubland of *Eremophila forrestii* subsp. *forrestii, Senna artemisioides* subsp. *helmsii* and *Senna artemisioides* subsp. *oligophylla* on orange sand on sand plains

Area within Study Area (ha)	1,630.8
Releves Sampled	CC26, CC45, CC43, CC47, CC50, CC53, CC58
Soils and Geology	Orange sand to brown loamy sand
Land Form	Sand plains
TEC or PEC	No
Conservation Significant Flora	None
Introduced (Weed) Species	**Cenchrus ciliaris, *Cenchrus setiger*
Vegetation Condition	Very Good
Disturbances	Cattle grazing, weeds
Average Fire Age	Old (6+ years)
Vegetation Structure & Floristics	
Trees <10 m	*Acacia aptaneura, Corymbia hamersleyana, Hakea lorea* subsp. *lorea, Acacia pruinocarpa, Acacia citrinoviridis, Acacia paraneura*
Shrubs >2 m	*Acacia sclerosperma, Acacia pachyacra, Acacia dictyophleba, Acacia ancistrocarpa, Acacia aptaneura*
Shrubs 1-2 m	*Eremophila forrestii* subsp. *forrestii, Senna artemisioides* subsp. *helmsii, Senna artemisioides* subsp. *oligophylla, Acacia ancistrocarpa, Acacia wanyu*
Shrubs <1 m	*Solanum lasiophyllum, Sida platycalyx, Maireana villosa, Sclerolaena cornishiana, Eremophila lanceolata*
Tussock Grasses	*Eragrostis eriopoda, Aristida inaequiglumis, Eulalia aurea, Chrysopogon fallax, Paraneurachne muelleri, *Cenchrus ciliaris, Themeda triandra, *Cenchrus setiger*
Hummock Grasses	*Triodia basedowii*

Broad Floristic Formation	13b. SA ErerChf ApAptCh SeahErff *Eragrostis* Tussock Grassland
Vegetation Association	Tussock Grassland of *Eragrostis eriopoda* and *Chrysopogon fallax* with Low Woodland of *Acacia paraneura, Acacia pteraneura* and *Corymbia hamersleyana* and Open Shrubland of *Senna artemisioides* subsp. *helmsii* and *Eremophila forrestii* subsp. *forrestii* on orange sand on sand plains

Area within Study Area (ha)	661.5
Releves Sampled	3C, 3E
Soils and Geology	Orange sand
Land Form	Sand plain
TEC or PEC	No
Conservation Significant Flora	None
Introduced (Weed) Species	**Cenchrus ciliaris*
Vegetation Condition	Good
Disturbances	Cattle grazing, weeds
Average Fire Age	Old (6+ years)
Vegetation Structure & Floristics	
Trees <10 m	*Acacia paraneura, Acacia pteraneura, Corymbia hamersleyana, Acacia aptaneura*
Shrubs >2 m	*Acacia paraneura*
Shrubs 1-2 m	*Senna artemisioides* subsp. *helmsii, Eremophila forrestii* subsp. *forrestii*
Shrubs <1 m	*Sclerolaena cornishiana, Solanum lasiophyllum, Sida platycalyx, Eremophila lanceolata*
Tussock Grasses	*Eragrostis eriopoda, Chrysopogon fallax, Tripogonella loliiformis, Aristida contorta, *Cenchrus ciliaris*
Sedges	*Fimbristylis dichotoma*

Broad Floristic Formation	*Themeda* Tussock Grassland
Vegetation Association	14. FP ThaTtEua Ch AancAd Tussock Grassland of *Themeda avenacea, Themeda triandra* and *Eulalia aurea* with Low Open Woodland of *Corymbia hamersleyana* and High Open Shrubland of *Acacia ancistrocarpa* and *Acacia dictyophleba* on brown loamy sand in drainage areas

Area within Study Area (ha)	77.9
Releves Sampled	3G
Soils and Geology	Brown loamy sand
Land Form	Drainage areas on sand plains
TEC or PEC	No
Conservation Significant Flora	None
Introduced (Weed) Species	**Cenchrus ciliaris*
Vegetation Condition	Good
Disturbances	Cattle grazing, weeds
Average Fire Age	Old (6+ years)
Vegetation Structure & Floristics	
Trees <10 m	*Corymbia hamersleyana*
Shrubs >2 m	*Acacia ancistrocarpa, Acacia dictyophleba*
Shrubs <1 m	*Pterocaulon sphacelatum, Kennedia prorepens, Hibiscus sturtii* var. *platychlamys, Isotropis forrestii, Sida* sp. verrucose glands (F.H. Mollemans 2423)
Tussock Grasses	*Themeda avenacea, Themeda triandra, Eulalia aurea, Chrysopogon fallax*

3.3 Threatened Ecological Communities

The field survey confirmed that no TECs occur within the study area.

3.4 Priority Ecological Communities

None of the vegetation associations described and mapped from the study area were found to be aligned with any of the PECs documented from the Pilbara.

3.5 Significant Flora

3.5.1 Threatened Flora listed under the WC Act and EPBC Act

No plant taxon gazetted as Threatened Flora (T) pursuant to subsection (2) of Section 23F of the WC Act or listed under the EPBC Act was recorded from the study area.

3.5.2 Priority Flora

Two Priority listed flora, as defined by DBCA, were recorded during the reconnaissance vegetation survey, *Eremophila capricornica* (Priority 1) and *Rhagodia* sp. Hamersley (M. Trudgen 17794) (Priority 3) (Figure 8).

Eremophila capricornica is a newly described species growing to 0.75 m tall and producing mauve to lilac flowers between June and August (Plate 1). There are two specimens of *Eremophila capricornica* in the WAH and both of these match the collection from the study area. This taxon was also recently collected at the Caramulla project area (Onshore Environmental 2018), which partially overlaps the study area. One of the WAH specimens was a collection made by Onshore Environmental from BHP WAIO's Orebody 31 project area (Onshore Environmental 2014). This specimen was identified as *Eremophila demissa* by Mr Steven Dillon, who was the BHP sponsored botanist at the WAH at the time of the project, and noted as being worthy of lodgement due to it being a significant range extension. Buirchell and Brown (2016) have recently conducted an analysis of new and geographically restricted *Eremophila* taxa from Western Australia. This resulted in 13 new *Eremophila* taxa being described, including *Eremophila capricornica* (Buirchell and Brown 2016). The lodged specimen of *Eremophila demissa* originating from the Orebody 31 survey was analysed by Buirchell and Brown on the 15th August 2017 and was subsequently determined to be *Eremophila capricornica*. *Eremophila capricornica* can be separated from *Eremophila demissa* by its thinner and shorter sepals, lanceolate shaped sepals, less dense covering of glandular hairs on the inner sepal surface (versus densely glandular), shorter pedicel length (2-3 mm versus 3-7 mm), and its oblanceolate leaves (versus obovate to elliptic).

Currently *Eremophila capricornica* is poorly collected with only three specimens lodged at the WAH. Hence, it is determined to have a restricted geographical range and has been assigned a conservation status of Priority 1. It is likely that this taxon is present across BHP WAIO tenements in the vicinity of the Jimblebar mining operations, including, but not necessarily restricted to, the tenements of Orebody 31, Hashimoto and Caramulla. '*Eremophila demissa'* was also recorded from four study sites within the Jimblebar Creek and Innawally Pool survey (Onshore Environmental 2016), and these records are also likely to be *Eremophila capricornica*[3].

Eremophila capricornica was recorded from two locations within the following vegetation associations in the southern sector of the study area:

- SA Tb Apt AriArhhTrl: Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Acacia pteraneura* and Very Open Tussock Grassland of *Aristida inaequiglumis*, *Aristida holathera* var. *holathera* and *Tripogonella loliiformis* on brown loamy sand on sand plains;

[3] These collections were not vouchered as the revision by Buirchell and Brown (2016) had not been completed at that time.

and

- FS Tv Apt Aw: Open Hummock Grassland of *Triodia vanleeuwenii* with Low Open Woodland of *Acacia pteraneura* and High Open Shrubland of *Acacia wanyu* on brown sandy loam on footslopes.

Plate 1 *Eremophila capricornica*

Rhagodia sp. Hamersley (M. Trudgen 17794) is a perennial chenopod growing to a height of 2 m and occurring in orange to red loam soils on flood plains (Plate 2). The current known distribution is restricted to the Pilbara bioregion with increasing numbers of populations recorded in recent years between Tom Price and Newman. *Rhagodia* sp. Hamersley (M. Trudgen 17794) has previously been recorded from numerous BHP WAIO tenements in the south-east Pilbara, including the adjacent Caramulla project area (Onshore Environmental 2018).

Rhagodia sp. Hamersley (M. Trudgen 17794) was recorded from 13 locations within the following five vegetation associations in the southern sector of the study area:

- MA Eco EcoAciAcp MgApy: Open Woodland of *Eucalyptus camaldulensis* subsp. *obtusa* over Low Open Woodland of *Eucalyptus camaldulensis* subsp. *obtusa*, *Acacia coriacea* subsp. *pendens* and *Acacia citrinoviridis* over High Open Shrubland of *Melaleuca glomerata* and *Acacia pyrifolia* on brown sand on major drainage lines;
- HP AptAa ChfEuaAri ErffSeaoErfr: Low Open Forest of *Acacia pteraneura* and *Acacia aptaneura* over Open Tussock Grassland of *Chrysopogon fallax*, *Eulalia aurea* and *Aristida inaequiglumis* with Open Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Senna artemisioides* subsp. *oligophylla* and *Eremophila fraseri* on brown clay loam on hardpan plains;
- MA AciAcp CcCs MgAmac: Low Open Forest of *Acacia citrinoviridis* and *Acacia coriacea* subsp. *pendens* with Tussock Grassland of **Cenchrus ciliaris* and **Cenchrus setiger* and High Open Shrubland of *Melaleuca glomerata* and *Acacia macraneura* on brown sand on major drainage lines;
- HS Tv ChHallApr Atru: Hummock Grassland of *Triodia vanleeuwenii* with Low Open Woodland of *Corymbia hamersleyana*, *Hakea lorea* subsp. *lorea* and *Acacia pruinocarpa* and High Open Shrubland of *Acacia trudgeniana* on brown sandy loam on hillslopes; and

- FS Tv Apt Aw: Open Hummock Grassland of *Triodia vanleeuwenii* with Low Open Woodland of *Acacia pteraneura* and High Open Shrubland of *Acacia wanyu* on brown sandy loam on footslopes.

Plate 2 *Rhagodia* sp. Hamersley (M. Trudgen 17794)

222000 223500 225000 226500 228000 229500 231000

7429500 7428000 7426500 7425000 7423500 7422000 7420500 7419000 7417500 7416000 7414500 7413000 7411500

Caramulla Creek

R.h
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E.c

ONSHORE ENVIRONMENTAL

BHP WAIO

Caramulla Creek

Figure 8

Significant Flora

Legend

- Study Area

Significant Flora

- Eremophila capricornica (E.c)
- Rhagodia sp.Hamersley (M. Trudgen 17794) (R.h)

N

0 500 1,000 1,500

Meters

1:50,000

Datum: GDA94

Projection: MGA Zone 51

Date:	08/11/2018
Status:	Final
Figure:	8
Sheet Size:	A3
Internal Reference:	CC_Sig_Flora
Drawn by:	GSM
Requested by:	DB

GRIFFIN SPATIAL & MAPPING

3.6 Introduced Flora

Two introduced flora species were recorded from the study area, **Cenchrus ciliaris* (Buffel Grass) and **Cenchrus setiger* (Birdwood Grass) (Figure 9). Neither taxon is listed as a Declared Pest under the BAM Act.

**Cenchrus ciliaris* (Buffel Grass) is a tufted perennial grass originating from the Middle East and used as a fodder species by pastoralists (Plate 3). It grows in dense tussocks up to 1 m tall and typically occurs in monospecific stands on loamy plains and creekline levee banks. It is an aggressive colonising species that has become well established throughout the Pilbara, Gascoyne and Murchison regions of Western Australia, and is continuing to spread in the south west (Hussey *et al*. 1997). It was common throughout the southern half of the study area, recorded from 36 spot locations and occurring within 19 of the 21 vegetation associations mapped. Ground coverage ranged from less than one percent for a few scattered plants, up to 40 percent for dense monospecific grasslands.

**Cenchrus setiger* (Birdwood Grass) is an erect tussocky stoloniferous perennial grass up to 0.5 m in height (Plate 4). Flowers are cream or purple and flowering occurs between April and May. It occurs on brown sands, red loams and pindan soils on sand dunes, plains, rangelands, stony hillsides and floodplains. It has been recorded across the north of Western Australia from Geraldton to the Northern Territory border. It was common throughout the southern half of the study area, recorded from 18 spot locations and occurring within 11 of the 21 vegetation associations mapped. Ground coverage ranged from less than one percent for a few scattered plants, up to 30 percent for dense grasslands.

Plates 3 and 4 *Cenchrus ciliaris* and *Cenchrus setiger*

ONSHORE ENVIRONMENTAL

BHP WAIO

Caramulla Creek

Figure 9

Introduced Flora

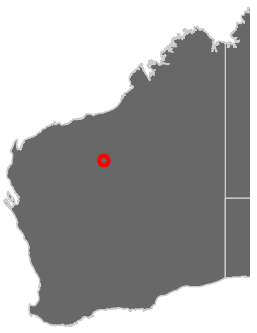
Legend

- Study Area

Introduced Flora

- Cenchrus ciliaris (C.c)
- Cenchrus setiger (C.s)

Caramulla Creek



N

0 500 1,000 1,500

Meters

1:50,000

Datum: GDA94

Projection: MGA Zone 51

Date:	08/11/2018
Status:	Final
Figure:	9
Sheet Size:	A3
Internal Reference:	CC_Intro_Flora
Drawn by:	GSM
Requested by:	DB

GRIFFIN SPATIAL & MAPPING

4.0 SUMMARY

A reconnaissance vegetation survey of 6,337 ha encompassing the braided drainage network of Caramulla Creek was conducted under *poor* seasonal conditions between the 18th and 22nd of June 2018. Access was a major limiting factor encountered during the field survey. The main access track aligned north-south through the western fringe of the study area was overgrown from approximately 5 km north of the southern boundary, limiting field assessments to the southern half of the study area.

A total of 21 vegetation associations were mapped from the entire study area, with two associations supporting groundwater dependent vegetation (namely the tree *Eucalyptus camaldulensis* subsp. *obtusa*). There were 16 vegetation associations that supported species with the potential to be impacted by surface water discharge (i.e. stands of Mulga and/or *Acacia citrinoviridis*), as they are surface rooting taxa that are known to be at elevated risk from extended periods of inundation. None of the vegetation associations within the study area were aligned with Federal or State listed TECs or State listed PECs.

Vegetation condition ranged from *very good* to *degraded*, with grazing by cattle and resultant introduction of weeds the common disturbances recorded. There were two introduced flora species recorded from the study area; **Cenchrus ciliaris* (Buffel Grass) and **Cenchrus setiger* (Birdwood Grass). Neither taxon is listed as a Declared Pest under the BAM Act. There were no plant taxa gazetted as Threatened Flora pursuant to subsection (2) of section 23F of the WC Act, or listed under the EPBC Act recorded from the study area.

Two Priority listed flora were recorded opportunistically from the southern sector of the study area; *Eremophila capricornica* (Priority 1) and *Rhagodia* sp. Hamersley (M. Trudgen 17794) (Priority 3).

5.0 STUDY TEAM

The desktop assessment and reconnaissance vegetation survey was planned, co-ordinated and executed by the following personnel:

Onshore Environmental Consultants P/L
ABN 41 095 837 120
PO Box 227
YALLINGUP WA 6282
pf 08 9756 6206 m 0427 339 842
Email info@onshoreenvironmental.com.au

Project Staff

Dr Darren Brearley	PhD	Project Manager and Principal Botanist
Dr Jerome Bull	PhD	Principal Botanist
Ms Jessica Waters	BSc	Senior Botanist
Mrs Breanne Menezies	BSc	Senior Environmental Advisor
Mrs Kerry Keenan		Data Analyst
Mr Todd Griffin		GIS Specialist

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APPENDIX 1

Results from previous flora and vegetation surveys completed in the vicinity of the study area

Project	Survey Timing	Season	Survey Type	Vegetation with potential GDV[4]	Vegetation with Mulga or *Acacia citrinoviridis*[5]
Onshore Environmental (2018) Caramulla Reconnaissance Flora and Vegetation Survey	17-21 Feb 2018	Poor	Single season reconnaissance	• Woodland of ***Eucalyptus camaldulensis*** over Low Woodland of *Acacia citrinoviridis* and *Acacia coriacea* subsp. *pendens* over Open Tussock Grassland of *Cymbopogon ambiguus, Eulalia aurea* and **Cenchrus ciliaris* on brown sand on major drainage lines. • Low Woodland of ***Eucalyptus camaldulensis***, *Acacia pteraneura* and ***Eucalyptus victrix*** over Open Tussock Grassland of *Themeda triandra*, *Themeda avenacea* and *Eulalia aurea* over Very Open Herbs of **Bidens bipinnata* and *Cheilanthes sieberi* on orange clayey sand on medium drainage lines.	• Woodland of *Eucalyptus camaldulensis* over Low Woodland of ***Acacia citrinoviridis*** and *Acacia coriacea* subsp. *pendens* over Open Tussock Grassland of *Cymbopogon ambiguus*, *Eulalia aurea* and **Cenchrus ciliaris* on brown sand on major drainage lines. • Low Open Forest of ***Acacia aptaneura*** over Open Tussock Grassland of *Eulalia aurea*, *Themeda triandra* and *Chrysopogon fallax* with Low Open Shrubland of *Ptilotus obovatus*, *Eremophila forrestii* subsp. *forrestii* and *Maireana villosa* on brown sandy clay loam on drainage areas/floodplains. • Low Open Forest of *Acacia catenulata* subsp. *occidentalis* and ***Acacia pteraneura*** over Shrubland of *Eremophila latrobei* subsp. *latrobei*, *Dodonaea viscosa* and *Senna glutinosa* subsp. x *luerssenii* with High Open Shrubland of *Acacia rhodophloia* on orange sandy loam on breakaways. • Low Woodland of ***Acacia aptaneura***, *Acacia catenulata* subsp. *occidentalis* and *Acacia pruinocarpa* over Open Hummock Grassland of *Triodia basedowii* with Open Shrubland of *Eremophila forrestii* subsp. *forrestii* and *Sida ectogama* on brown clay loam on hardpan plains. • Low Woodland of ***Acacia pteraneura*** over High Open Shrubland of ***Acacia pteraneura*** and Very Open Hummock Grassland of *Triodia basedowii* on brown silty loam on hardpan plains. • Low Woodland of ***Acacia aptaneura*** over Open Tussock Grassland of *Aristida contorta*, *Aristida inaequiglumis* and *Eulalia aurea* with Open Shrubland of *Senna glaucifolia*, *Eremophila fraseri* and *Eremophila forrestii* subsp. *forrestii* on brown sandy clay loam on hardpan plains. • Low Woodland of *Acacia catenulata* subsp. *occidentalis*, *Grevillea berryana* and ***Acacia pteraneura*** over Shrubland of *Sida ectogama* and *Eremophila forrestii* subsp. *forrestii* over Very Open Hummock Grassland of *Triodia pungens* and *Triodia basedowii* on brown silty loam on stony plains. • Low Woodland of ***Acacia pteraneura*** over High Shrubland of *Acacia wanyu* over Open Hummock Grassland of *Triodia vanleeuwenii* on brown loamy sand on hillslopes. • Low Woodland of *Corymbia aspera* and ***Acacia aptaneura*** over Tussock Grassland of *Themeda triandra*, *Aristida inaequiglumis* and *Eulalia aurea* on brown light clay on floodplains. • Low Woodland of *Eucalyptus camaldulensis*, ***Acacia pteraneura*** and *Eucalyptus victrix* over Open Tussock Grassland of *Themeda triandra*, *Themeda avenacea* and *Eulalia aurea* over Very Open Herbs of **Bidens bipinnata* and *Cheilanthes sieberi* on orange clayey sand on medium drainage lines. • High Shrubland of *Acacia eriopoda*, *Acacia ancistrocarpa* and *Androcalva luteiflora* with Open Tussock Grassland of *Themeda triandra*, *Eulalia aurea* and *Eriachne*

[4] Potential groundwater dependent species shown in **BOLD**.

[5] Mulga species and *Acacia citrinoviridis* are shown in **BOLD.**

Project	Survey Timing	Season	Survey Type	Vegetation with potential GDV[4]	Vegetation with Mulga or *Acacia citrinoviridis*[5]
					mucronata with Low Open Woodland of ***Acacia aptaneura*** on brown sand on minor drainage lines. • High Shrubland of ***Acacia pteraneura***, *Acacia wanyu* and *Acacia sclerosperma* subsp. *sclerosperma* over Open Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Acacia pteraneura* on brown sandy clay loam on footslopes. • Shrubland of *Acacia wanyu, Psydrax latifolia* and *Eremophila forrestii* subsp. *forrestii* with Low Open Woodland of ***Acacia aptaneura*** and ***Acacia pteraneura*** and High Open Shrubland of ***Acacia aptaneura***, ***Acacia pteraneura*** and *Acacia wanyu* on brown sandy clay loam on hardpan plains. • Low Shrubland of *Eremophila cuneifolia*, *Senna* sp. Meekatharra (E. Bailey 1-26) x ?*artemisioides* subsp. *oligophylla* and *Sclerolaena cuneata* with Low Open Woodland of ***Acacia aptaneura*** and ***Acacia pteraneura*** and High Open Shrubland of *Acacia wanyu* on brown sandy loam on footslopes. • Low Shrubland of *Eremophila margarethae*, *Senna* sp. Meekatharra x ?*artemisioides* subsp. *oligophylla* and *Sclerolaena cornishiana* with Low Open Woodland of ***Acacia pteraneura*** and High Open Shrubland of ***Acacia pteraneura***, *Acacia sclerosperma* subsp. *sclerosperma* and *Acacia tetragonophylla* on brown sandy loam on hardpan plains. • Hummock Grassland of *Triodia vanleeuwenii* with Low Woodland of ***Acacia aptaneura*** and ***Acacia pteraneura*** and Shrubland of *Eremophila exilifolia*, *Acacia maitlandii* and *Senna stricta* on brown sandy loam on hillslopes/breakaways. • Hummock Grassland of *Triodia vanleeuwenii* with Low Open Woodland of ***Acacia pteraneura***, *Acacia pruinocarpa* and *Grevillea berryana* and Open Shrubland of *Senna glutinosa* subsp. x *luerssenii*, *Eremophila latrobei* subsp. *latrobei* and *Eremophila forrestii* subsp. *forrestii* on brown sandy loam on hillslopes. • Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Corymbia hamersleyana*, *Hakea lorea* subsp. *lorea* and ***Acacia aptaneura*** and High Open Shrubland of *Acacia pachyacra*, *Acacia ancistrocarpa* and *Acacia tenuissima* on red sand on stony sand plains. • Hummock Grassland of *Triodia basedowii* with High Shrubland of ***Acacia aptaneura***, *Acacia ancistrocarpa* and *Acacia pachyacra* with Low Open Woodland of ***Acacia aptaneura***, *Corymbia hamersleyana* and *Hakea lorea* subsp. *lorea* on orange loamy sand on sand plains. • Hummock Grassland of *Triodia vanleeuwenii* with Low Open Shrubland of *Eremophila exilifolia* and Scattered Low Trees of *Acacia pruinocarpa*, *Hakea lorea* subsp. *lorea* and ***Acacia aptaneura*** on orange/brown sandy loam on footslopes. • Open Hummock Grassland of *Triodia basedowii* with Low Open Woodland of ***Acacia aptaneura***, ***Acacia paraneura*** and ***Acacia pteraneura*** and High Open Shrubland of *Eremophila fraseri*, *Acacia subcontorta* and ***Acacia aptaneura*** on brown sandy loam on sand plains. • Open Hummock Grassland of *Triodia schinzii* with Low Open Woodland of ***Acacia pteraneura*** and High Open Shrubland of *Eremophila fraseri* and ***Acacia pteraneura*** on orange sandy loam on sandy/stony plains.

Project	Survey Timing	Season	Survey Type	Vegetation with potential GDV[4]	Vegetation with Mulga or *Acacia citrinoviridis*[5]
					• Tussock Grassland of *Eriachne flaccida*, *Eulalia aurea* and *Chrysopogon fallax* with Scattered Low Trees of ***Acacia aptaneura***, *Hakea lorea* subsp. *lorea* and *Acacia macraneura* and Scattered Tall Shrubs of *Acacia tetragonophylla* on brown light medium clay on gilgai plains. • Open Tussock Grassland of *Aristida contorta*, *Eulalia aurea* and *Aristida inaequiglumis* with Low Open Woodland of *Acacia aptaneura* and ***Acacia paraneura*** and Low Open Shrubland of *Senna artemisioides* subsp. *helmsii*, *Sclerolaena cornishiana* and *Sida platycalyx* on orange clay loam on hardpan plains.
Onshore Environmental (2016) Level 2 Riparian & Aquatic Flora & Vegetation Survey Jimblebar Creek and Innawally Pool	25-29 May 2016	Poor	Single season detailed and riparian vegetation monitoring	• Tussock Grassland of **Cenchrus ciliaris*, *Themeda triandra* and *Cymbopogon ambiguus* (riverine form) with Open Woodland of ***Eucalyptus camaldulensis* var. *obtusa*** and ***Eucalyptus victrix*** and High Open Shrubland of *Acacia pyrifolia* and *Melaleuca glomerata* on brown sand in major drainage channel.	• Low Woodland of ***Acacia aptaneura***, ***Acacia pteraneura*** over Open Shrubland of *Eremophila forrestii* subsp. *forrestii* and *Eremophila fraseri* over Very Open Tussock Grassland of *Aristida contorta*, *Eragrostis eriopoda* and **Cenchrus ciliaris* on red brown loam in minor drainage lines/zones. • Hummock Grassland of *Triodia basedowii* with Low Woodland of ***Acacia pteraneura*** and High Open Shrubland of *Acacia dictyophleba* and *Acacia pachyacra* on red sand on stony sandplains. • Hummock Grassland of *Triodia basedowii* with Open Shrubland of *Acacia wanyu*, *Acacia pachyacra* and *Senna glutinosa* subsp. x *luerssenii* and Scattered Low Trees of ***Acacia aptaneura*** and *Corymbia hamersleyana* on red loamy sand on stony sand plains. • Open Hummock Grassland of *Triodia basedowii*, *Triodia schinzii* and *Triodia pungens* with Low Open Woodland of *Corymbia hamersleyana*, *Hakea lorea* subsp. *lorea* and ***Acacia aptaneura*** over High Open Shrubland of *Acacia dictyophleba*, *Acacia sclerosperma* and *Acacia pachyacra* on red sand on sand plains and islands between river channels. • Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835)[6] with Low Woodland of ***Acacia pteraneura***, *Acacia pruinocarpa* and *Acacia fuscaneura* over Open Shrubland of *Senna glutinosa* subsp. x *luerssenii*, *Dodonaea petiolaris* and *Eremophila latrobei* subsp. *latrobei* on red sandy loam on hillslopes. • Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of ***Acacia pteraneura***, *Acacia pruinocarpa* and *Corymbia hamersleyana* over Open Shrubland of *Acacia wanyu*, *Acacia pachyacra* and *Senna stricta* on brown sandy loam on ironstone footslopes, ridges and breakaways. • Open Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) and *Triodia basedowii* with Low Open Woodland of ***Acacia pteraneura*** and *Corymbia hamersleyana* over Open Shrubland of *Acacia sibirica* and *Acacia wanyu* on red loamy sand on eroded slopes.
Onshore Environmental (2015) Jimblebar Creek Riparian Flora	8-12 Sep 2014	Poor	Single season detailed	• Woodland (to Open Woodland) of ***Eucalyptus camaldulensis* subsp. *refulgens*** and ***Eucalyptus victrix*** over High Open Shrubland of *Melaleuca*	• Low Open Forest of ***Acacia aneura*** over High Open Shrubland of *Eremophila fraseri* over Very Open Hummock Grassland of *Triodia basedowii* on bare plains. • Low Open Forest of ***Acacia aptaneura*** and ***Acacia paraneura*** over Open Shrubland of *Acacia wanyu*, *Eremophila fraseri* and *Senna glutinosa* subsp. *luerssenii* over Very

[6] Species now known as *Triodia vanleeuwenii*

Project	Survey Timing	Season	Survey Type	Vegetation with potential GDV[4]	Vegetation with Mulga or *Acacia citrinoviridis*[5]
and Vegetation Baseline Survey				*glomerata*, *Acacia citrinoviridis* and *Acacia pyrifolia* var. *pyrifolia* along major drainage lines. • Low Open Forest of *Acacia citrinoviridis*, *Acacia coriacea* subsp. *pendens* and *Melaleuca glomerata* with Scattered Trees of ***Eucalyptus camaldulensis* subsp. *refulgens*** and ***Eucalyptus victrix*** on major drainage lines. • Low Open Woodland of ***Eucalyptus victrix*** and *Acacia citrinoviridis* over High Open Shrubland of *Acacia monticola* and *Acacia pyrifolia* var. *pyrifolia* in medium drainage lines. • Tussock Grassland of **Cenchrus ciliaris* and *Cymbopogon procerus* with Woodland of ***Eucalyptus camaldulensis* subsp. *refulgens*** and ***Eucalyptus victrix*** and Low Open Woodland of *Acacia citrinoviridis* and *Acacia coriacea* subsp. *pendens* on levee banks of major drainage lines.	Open Hummock Grassland of *Triodia pungens* and *Triodia* sp. Shovelanna Hill (S. Van Leeuwen 3835) on floodplains. • Low Open Forest of ***Acacia citrinoviridis***, *Acacia coriacea* subsp. *pendens* and *Melaleuca glomerata* with Scattered Trees of *Eucalyptus camaldulensis* subsp. *refulgens* and *Eucalyptus victrix* on major drainage lines. • Low Open Woodland of ***Acacia aptaneura***, *Acacia pruinocarpa* and ***Acacia paraneura*** over Open Shrubland of *Eremophila fraseri, Acacia tetragonophylla* and *Acacia wanyu* over Low Open Shrubland of *Ptilotus obovatus* and *Solanum lasiophyllum* on raised stony plains. • Low Open Woodland of *Eucalyptus victrix* and ***Acacia citrinoviridis*** over High Open Shrubland of *Acacia monticola* and *Acacia pyrifolia* var. *pyrifolia* in medium drainage lines. • High Shrubland of ***Acacia citrinoviridis***, *Acacia pyrifolia* var. *pyrifolia* and *Gossypium robinsonii* over Low Shrubland of *Corchorus crozophorifolius* and *Tephrosia rosea* var. Fortescue Creeks (M.I.H. Brooker 2186) over Open Tussock Grassland of **Cenchrus ciliaris*, *Cymbopogon procerus* and *Eriachne pulchella* subsp. *dominii* on flood banks within major drainage channels. • Hummock Grassland of *Triodia pungens* with High Shrubland of *Acacia pyrifolia* var. *pyrifolia*, *Gossypium robinsonii* and ***Acacia citrinoviridis*** and Low Open Woodland of *Corymbia hamersleyana* on floodplains. • Hummock Grassland of *Triodia pungens* and *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of ***Acacia aptaneura***, *Acacia pruinocarpa* and *Corymbia hamersleyana* and High Open Shrubland of *Acacia ancistrocarpa*, *Acacia wanyu* and *Acacia synchronicia* on eroded plains and slopes. • Open Hummock Grassland of *Triodia pungens* (and Open Tussock Grassland of **Cenchrus ciliaris*) with Low Open Woodland of *Corymbia hamersleyana* and ***Acacia citrinoviridis*** and High Open Shrubland of *Acacia sclerosperma* subsp. *sclerosperma*, *Acacia pyrifolia* var. *pyrifolia* and *Acacia ancistrocarpa* on levee banks of major drainage lines. • Tussock Grassland of **Cenchrus ciliaris* and *Cymbopogon procerus* with Woodland of *Eucalyptus camaldulensis* subsp. *refulgens* and *Eucalyptus victrix* and Low Open Woodland of ***Acacia citrinoviridis*** and *Acacia coriacea* subsp. *pendens* on levee banks of major drainage lines. • Tussock Grassland of **Cenchrus ciliaris* with Low Woodland of ***Acacia citrinoviridis*** and Very Open Hummock Grassland of *Triodia pungens* on levee banks of major drainage lines.
Astron Environmental Services (2010) Jimblebar Iron Ore Project	NA	NA	Desktop assessment of phreatophytic vegetation	• Woodland of ***Eucalyptus camaldulensis* var. *refulgens*** over Low Woodland of *Acacia citrinoviridis*, *Acacia coriacea* subsp. *pendens* and	• Woodland of *Eucalyptus camaldulensis* subsp. *refulgens* over Low Woodland of ***Acacia citrinoviridis***, *Acacia coriacea* subsp. *pendens* and *Melaleuca glomerata* over Open Shrubland of *Acacia pyrifoli*a, *Petalostylis labicheoides* and *Senna artemisioides* subsp. *artemisioides*. • Low Woodland of ***Acacia aneura* var. *pilbarana***[7], *Acacia pruinoc*arpa and ***Acacia paraneura*** over Shrubland of *Acacia sclerosperma* subsp. *sclerosperma*, *Eremophila*

[7] Species now known as *Acacia aptaneura*

Project	Survey Timing	Season	Survey Type	Vegetation with potential GDV[4]	Vegetation with Mulga or *Acacia citrinoviridis*[5]
Ophthalmia Dam (and downstream) Phreatophytic Vegetation Assessment				*Melaleuca glomerata* over Open Shrubland of *Acacia pyrifolia*, *Petalostylis labicheoides* and *Senna artemisioides* subsp. *artemisioides*.	*longifolia* and *Rhagodia eremaea* over Open Hummock Grassland of Triodia pungens. • Hummock Grassland of *Triodia pungens* with Low Woodland of *Eucalyptus leucophloia* and ***Acacia citrinoviridis*** and Open Shrubland of ***Acacia aneura* var. *aneura***, *Senna glutinosa* subsp. *luerssenii* and *Eremophila latrobei* subsp. *latrobei*.
Outback Ecology (2010) Jimblebar Iron Ore Project Flora and Vegetation Assessment	July and Sept 2008, Jan and Mar 2009	Poor	Two season detailed	• Woodland of ***Eucalyptus camaldulensis*** and ***Eucalyptus victrix*** over Low Open Woodland of *Acacia aneura* var. *aneura* and *Acacia coriacea* subsp. *pendens* with Open Tussock Grassland of **Cenchrus ciliaris*, *Chrysopogon fallax* and *Eulalia aurea*.	• Low Open Forest of ***Acacia aneura* var. *tenuis***, *Eucalyptus leucophloia* and *Corymbia ferriticola* over Hummock Grassland of *Triodia pungens* with Open Shrubland of *Senna glutinosa* subsp. *luerssenii* and *Dodonaea petiolaris*. • Low Open Forest of *Acacia catenulata* subsp. *occidentalis*, ***Acacia aneura* var. *aneura*** and *Acacia pruinocarpa* over Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Dodonaea petiolaris* and *Sida ectogama* and Open Tussock Grassland of *Paspalidium clementii*, *Paspalidium rarum* and *Digitaria brownie*. • Woodland of *Eucalyptus camaldulensis* and *Eucalyptus victrix* over Low Open Woodland of ***Acacia aneura* var. *aneura*** and *Acacia coriacea* subsp. *pendens* with Open Tussock Grassland of **Cenchrus ciliaris*, *Chrysopogon fallax* and *Eulalia aurea*. • Low Woodland of *Corymbia hamersleyana*, *Corymbia aspera* and ***Acacia paraneura*** over Shrubland of *Petalostylis cassioides*, *Dodonaea petiolaris* and *Acacia ancistrocarpa* and Open Hummock Grassland of *Triodia basedowii* and *Triodia pungens*. • Low Woodland of ***Acacia aneura* var. *aneura***, ***Acacia aneura* var. *tenuis*** and *Acacia catenulata* subsp. *occidentalis* over Shrubland of *Senna glutinosa* subsp. *luerssenii*, *Eremophila latrobei* subsp. *filiformis* and *Eremophila fraseri* subsp. *fraseri* with Open Tussock Grassland of *Paspalidium clementii*, *Chrysopogon fallax* and *Perotis rara*. • Low Woodland of ***Acacia aneura* var. *tenuis*** and ***Acacia paraneura*** over Open Hummock Grassland of *Triodia basedowii* with Open Shrubland of *Eremophila forrestii* subsp. *forrestii* and *Senna glutinosa* subsp. *luerssenii*. • High Shrubland *of* ***Acacia paraneura***, *Acacia wanyu* and *Senna glutinosa* subsp. *luerssenii* over Low Shrubland of *Eremophila cuneifolia*, *Eremophila jucunda* subsp. *pulcherrima*, *Maireana* subsp. and Open Hummock Grassland of *Triodia pungens* and *Triodia* sp. Shovelanna Hill. • High Open Shrubland of ***Acacia paraneura*** and *Acacia pruinocarpa* over Very Open Tussock Grassland of *Aristida contorta*, *Digitaria brownii* and *Eriachne mucronata* and Very Open Herbs of *Ptilotus aervoides*. • High Open Shrubland of ***Acacia paraneura*** and *Acacia tetragonophylla* over Low Open Shrubland of *Senna artemisioides* subsp. *oligophylla*, *Eremophila cuneifolia*, *Ptilotus obovatus* and Open Tussock Grassland of *Aristida contorta*, *Chrysopogon fallax* and *Eriachne flaccida*. • Hummock Grassland of *Triodia basedowii* with High Open Shrubland of ***Acacia aneura* var. *tenuis*** and *Acacia pruinocarpa*.

Project	Survey Timing	Season	Survey Type	Vegetation with potential GDV[4]	Vegetation with Mulga or *Acacia citrinoviridis*[5]
					• Open Hummock Grassland of *Triodia* sp. Shovelanna Hill with High Open Shrubland of ***Acacia paraneura*** and *Acacia pruinocarpa* and Open Shrubland of *Eremophila exilifolia* and *Eremophila latrobei* subsp. *latrobei*. • Open Hummock Grassland of *Triodia* sp. Shovelanna Hill and *Triodia basedowii* with High Open Shrubland of ***Acacia paraneura*** over Low Open Shrubland of *Eremophila jucunda* subsp. *pulcherrima*.
GHD (2009) Caramulla Exploration Area Flora and Vegetation Survey	Dec 2008	Poor	Single season detailed	• Mid Woodland of ***Eucalyptus camaldulensis*** and ***E. victrix*** over Open High Shrubland of *Melaleuca glomerata*, *Acacia citrinoviridis* and *A. pyrifolia* over Sparse Tussock Grasslands of **Cenchrus ciliaris*, *Eragrostis elongate* and *Eulalia aurea* on Sand on Broad Drainage Lines. • Mid Open Woodland of *Acacia aneura*, ***Eucalyptus victrix*** and *Corymbia candida* over Scattered Mixed Shrubs over Tussock Grasses on Broad Floodplain.	• Low Woodland of ***Acacia aneura*** and *A. sibirica* over Tall Sparse Shrubland of *A. wanyu, A. sclerosperma* and *Ptilotus obovatus* over Sparse Hummock and Tussock Grasslands of *Triodia pungens*, *Eriachne* and *Aristida* spp. on Rocks and Sandy Loam on Minor Creeklines. • Mid Woodland of *Eucalyptus camaldulensis* and *E. victrix* over Open High Shrubland of *Melaleuca glomerata*, ***Acacia citrinoviridis*** and *A. pyrifolia* over Sparse Tussock Grasslands of **Cenchrus ciliaris*, *Eragrostis elongate* and *Eulalia aurea* on Sand on Broad Drainage Lines. • Low Woodland to High Open Shrubland of ***Acacia aneura***, *A. ancistrocarpa* and *A. sclerosperma* over Low Shrubland of *Sida* spp., *Senna* spp. and *Scaevola spinescens* over Mixed Tussock and Hummock Grassland of *Cymbopogon* sp., *Themeda* sp., and *Triodia* spp. on Minor Drainage Lines. • High Sparse Shrubland of ***Acacia aneura***, *A. pruinocarpa* and *A. pachyacra* over Low Sparse Shrubland of *Senna* spp., *Solanum lasiophyllum* and *Eremophila* spp. over Sparse Tussock grassland of *Eriachne* spp., *Aristida* spp., *Amphipogon caricinus* on rocks on Low Rises, Rocky Footslopes. • High Sparse Shrubland of ***Acacia aneura****, A. pruinocarpa* and *A. pachyacra* over Low Sparse Shrubland of *Senna* spp., *Solanum lasiophyllum* and *Eremophila* spp. over Sparse Tussock grassland of *Eriachne* spp., *Aristida* spp., *Amphipogon caricinus* on rocks on Low Rises, Rocky Footslopes. • Mid Open Woodland of ***Acacia aneura****, Eucalyptus victrix* and *Corymbia candida* over Scattered Mixed Shrubs over Tussock Grasses on Broad Floodplain. • Low Woodland of ***Acacia aneura****, A. pruinocarpa*, ***A. citrinoviridis*** over Mid Sparse Shrubland of *Keraudrenia velutina* subsp. *elliptica*, *Eremophila latrobei* and *E. forrestii* over Sparse Tussock Grassland of *Eragrostis* spp., *Eulalia aurea* and *Themeda* sp. Includes Intergroves. • Low Open Woodland of ***Acacia aneura*** and *Acacia* spp. with Isolated Emergent *Eucalyptus gamophylla* and *Corymbia* spp. over Sparse Low Shrubland of *Kennedia prorepens*, *Scaevola parvifolia* and *Eremophila forrestii* over Open Mid Hummock Grassland of *Triodia basedowii* and *Triodia schinzii* on Sandplain.
Ecologia Environment (2007) Hashimoto Exploration Project Biological	24 Aug-1 Sep 2005, 15-21 Feb 2006	Good	Two season detailed	• Mixed *Eucalyptus/Corymbia* (including ***E. victrix***) open low woodland B over *Mirbelia viminalis* open dwarf scrub C over *Triodia pungens* mid-dense hummock grass and *Eriachne mucronata* very open low grass.	• ***Acacia aneura****/Acacia rhodophloia* open low woodland B over *Triodia basedowii* mid-dense hummock grass. • ***Acacia aneura*** open low woodland B over *Lamarchea sulcata / Eremophila exilifolia* open dwarf scrub C over *Triodia basedowii* mid-dense hummock grass. • ***Acacia aneura*** low woodland A over open low scrub B over very open low grass. • *Eucalyptus leucophloia/Corymbia ferriticola/****Acacia aneura*** open low woodland B over *Senna luerssenii/Dodonaea petiolaris* open low scrub A over *Triodia pungens* hummock grass and *Eriachne mucronata* very open low grass.

Project	Survey Timing	Season	Survey Type	Vegetation with potential GDV[4]	Vegetation with Mulga or *Acacia citrinoviridis*[5]
Survey: Flora and Vegetation				• ***Eucalyptus victrix***/*Corymbia hamersleyana*/*Acacia aneura*/*Acacia coriacea* open low woodland A over *Melaleuca glomerata* scrub over *Cymbopogon ambiguous/Eulalia aurea* open tall grass. • ***Eucalyptus victrix***/*Acacia aneura/Acacia coriacea* open low woodland A over *Acacia adsurgens*/*Melaleuca glomerata* open scrub over *Cymbopogon ambiguous/Cenchrus ciliaris* open tall grass.	• *Eucalyptus leucophloia* open low woodland B over ***Acacia aneura***/*Acacia monticola* open scrub over *Triodia pungens/Triodia basedowii* mid-dense hummock grass. • *Eucalyptus victrix/Corymbia hamersleyana*/***Acacia aneura***/*Acacia coriacea* open low woodland A over *Melaleuca glomerata* scrub over *Cymbopogon ambiguous/Eulalia aurea* open tall grass. • *Eucalyptus victrix*/***Acacia aneura***/*Acacia coriacea* open low woodland A over *Acacia adsurgens/Melaleuca glomerata* open scrub over *Cymbopogon ambiguous/Cenchrus ciliaris* open tall grass.
Ecologia Environmental (2005) Jimblebar East Exploration Project Biological Survey	Feb 2005	Good	Single season detailed	None recorded	• *Acacia* aff. *catenulata* / ***Acacia paraneura*** / *Acacia pruinocarpa* / *Acacia ayersiana* sparse medium to low woodland or tall shrubland, over *Acacia inaequilatera* / *Dodonaea petiolaris* / *Rhagodia* sp. Hamersley (M. Trudgen 17794) / *Eremophila latrobei* subsp. *filiformis* tall to medium shrubs, over *Ptilotus obovatus* var. *obovatus* sparse low shrubs, over herbland and grassland, sometimes with *Triodia lanigera* hummock grass. • Mixed dominant *Acacia pruinocarpa* / *Corymbia hamersleyana* / ***Acacia paraneura*** sparse to scattered low woodland or trees, over *Grevillea wickhamii* subsp. *hispidula* / *Acacia ancistrocarpa* tall to low shrubland with other shrubs, over mixed tussock grasses, over *Triodia lanigera* / *Triodia schinzii* open to sparse hummock grassland. • Mixed dominants of *Acacia pruinocarpa* / ***Acacia paraneura*** / *Corymbia hamersleyana* or *Corymbia deserticola* sparse to scattered low woodland or trees, over mixed medium to low shrubs such as *Acacia pachyacra* / *Acacia ancistrocarpa* / *Grevillea wickhamii*, over *Keraudrenia velutina* subsp. *elliptica* / *Bonamia rosea* open to sparse dwarf shrubland, over soft tussock grasses and *Triodia lanigera* moderately dense to open hummock grassland. • ***Acacia paraneura*** / *Corymbia hamersleyana* open to scattered low woodland or trees sometimes with *Corymbia ferriticola* subsp. *ferriticola*, over *Hakea chordophylla* / *Acacia ancistrocarpa* / *Acacia pachyacra* open to scattered medium to low shrubland, over dwarf shrubs such as *Kennedia prorepens* and *Bonamia rosea*, over soft tussock grasses such as *Eriachne helmsii*, over *Triodia lanigera* open to scattered hummock grassland. • ***Acacia paraneura*** / *Acacia pruinocarpa* open scattered low woodland to tall shrubland, over *Acacia pachyacra* sometimes with *Acacia ancistrocarpa* sparse to scattered medium to low shrubs, over dwarf shrubs and tussock grasses, over *Triodia lanigera* moderately dense to sparse hummock grassland. • ***Acacia paraneura*** open to scattered medium to low woodland or trees, over mixed medium to low shrubs such as *Acacia ancistrocarpa* and *Eremophila fraseri*, over

Project	Survey Timing	Season	Survey Type	Vegetation with potential GDV[4]	Vegetation with Mulga or *Acacia citrinoviridis*[5]
					Eriachne helmsii and *Aristida inaequiglumis* and other mixed species as moderately dense to open soft tussock grassland, sometimes over *Triodia lanigera* scattered hummock grass.

APPENDIX 2

Vegetation Classifications for the Pilbara based on Specht (1970), as modified by Aplin (1979) and Trudgen (2002)

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

Source: S. Van Leeuwen (DBCA)

APPENDIX 3

Vegetation condition scale
(adapted from Keighery 1994 and Trudgen 2002)

Condition	Code	Description
Excellent	1	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Very Good	2	Some relatively slight signs of damage caused by human activities since European settlement. For example, some sings of damage to tree trunks cause by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
Good	3	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
Poor	4	Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
Degraded	5	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
Completely Degraded	6	Areas that are completely or almost completely without native species in the structure of their vegetation; i.e. areas that are cleared or ‘parkland cleared’ with their flora comprising weed or crop species with isolated native trees or shrubs.

APPENDIX 4

Conservation categories for flora described under the EPBC Act

Category	Description
Extinct	A species is extinct if there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild	A species is categorised as extinct in the wild if it is only known to survive in cultivations, in captivity, or as a naturalised population well outside its past range; or if it has not been recorded in its known/expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered	The species is facing an extremely high risk of extinction in the wild and in the immediate future.
Endangered	The species is likely to become extinct unless the circumstances and factors threatening its abundance, survival, or evolutionary development cease to operate; or its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction.
Vulnerable	Within the next 25 years, the species is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate.
Conservation Dependent	The species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

APPENDIX 5

Conservation Codes for Western Australian Flora

Specially protected fauna or flora are 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. Categories of specially protected fauna and flora are:
T Threatened Species
Published as Specially Protected under the *Wildlife Conservation Act 1950* and listed under the *Wildlife Conservation (Rare Flora) Notice* for Threatened Flora (which may also be referred to as Declared Rare Flora). Threatened flora is flora that has been declared to be 'likely to become extinct or is rare, or otherwise in need of special protection', pursuant to section 23F(2) of the *Wildlife Conservation Act 1950*. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

Priority Species Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, 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 species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. 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 Taxa
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 localities 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 Taxa
Species that are known from one or a few collections (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 localities 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 Taxa
Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
4: Priority Four - Rare, Near Threatened and other taxa 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 taxa 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.