



Jimblebar North Reconnaissance Flora and Vegetation Survey

**Prepared for BHP Western Australia Iron Ore
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EXECUTIVE SUMMARY

Onshore Environmental Consultants Pty Ltd (Onshore Environmental) was commissioned by BHP Western Australia Iron Ore Pty Ltd (BHP WAIO) to undertake a single season reconnaissance flora and vegetation survey of the Jimblebar North project area, covering the Crowes Nest and Lasseter deposits, herein referred to as the study area. The study area is located approximately 10 km north-east of BHP WAIO's Jimblebar (Wheellarra Hill) mine and approximately 50 km east of Newman in the Pilbara region of Western Australia. The field survey was conducted between the 12th and 17th of September 2018.

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 scattered throughout the study area; *Eremophila capricornica* (Priority 1) and *Rhagodia* sp. Hamersley (M. Trudgen 17794) (Priority 3).

A total of 34 vegetation associations, classified into 14 broad floristic formations, were described and mapped within the study area. None of the vegetation associations within the study area had any affiliation with Federal or State listed Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs).

Two introduced flora (weed) species were opportunistically recorded from the study area, **Cenchrus ciliaris* and **Cenchrus setiger*, neither are listed as a Declared Pest under the *Biosecurity and Agriculture Management Act 2007* (BAM Act). The condition of vegetation ranged from 'excellent' to 'degraded' with hills generally in better condition than areas of lower relief. The major disturbances throughout the study area were related to grazing by domestic cattle and the introduction of weeds, particularly the establishment of **Cenchrus ciliaris* (Buffel Grass).

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1.0 INTRODUCTION

1.1 Preamble

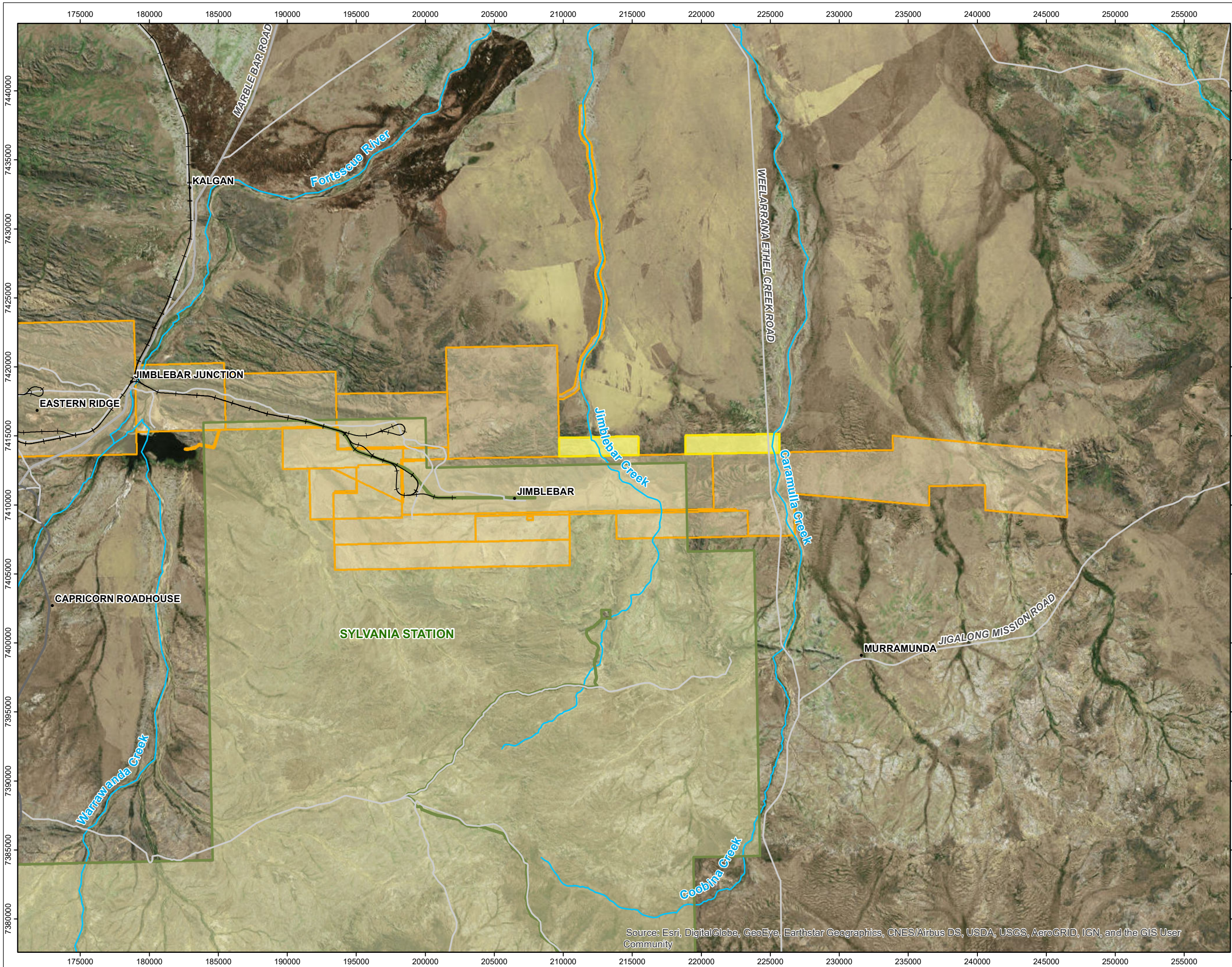
Onshore Environmental was commissioned by BHP WAIO to undertake a single season reconnaissance flora and vegetation survey within the Jimblebar North project area, covering the Crowes Nest and Lasseter deposits, on tenement E52/1776, hereafter referred to as the study area. The study area is located approximately 10 km north-east of BHP WAIO's Jimblebar (Wheelarra Hill) mine and approximately 50 km east of Newman in the Pilbara region of Western Australia (Figure 1). The study area covers an area of approximately 1,680 ha.

1.2 Previous Biological Surveys

There are at least 47 flora and vegetation that have previously been completed in close proximity (within a 25 km radius) to the study area. These surveys comprise 33 detailed survey, four reconnaissance survey, nine targeted survey and one desktop assessments.

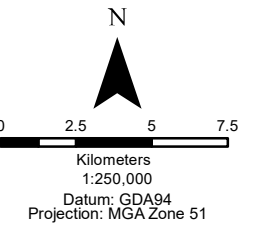
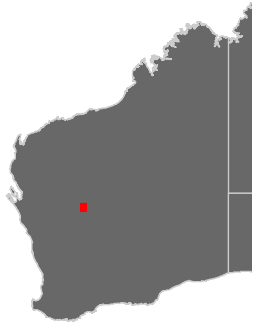
Nine of the previous flora and vegetation surveys have been completed within or partially overlapping the study area:

- Reconnaissance Flora and Vegetation Survey Caramulla (Onshore Environmental 2018);
- Level 2 Riparian and Aquatic Flora and Vegetation Survey Jimblebar Creek and Innawally Pool (Onshore Environmental 2016);
- Targeted Flora Survey *Acacia* sp. East Fortescue (Onshore Environmental 2015a);
- Eastern Mines Weed Survey Jimblebar (Aston 2012);
- Wheelarra Hill North Level 2 Flora and Vegetation Assessment (Syrinx Environmental 2012a);
- Jimblebar Iron Ore Project Flora and Vegetation Assessment (Outback Ecology 2010);
- Caramulla Exploration Area Flora and Vegetation Survey and Fauna Assessment (GHD 2009); and
- Jimblebar Flora and Soil Survey (Ecologia Environmental 1999).



BHP
Jimblebar North
Figure 1
Study Area Location

- Legend**
- Study Area
 - BHP Tenure
 - BHP Rail
 - Sylvania Pastoral Station



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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1.3 Climate

The study area is located in the far south-eastern corner of the Pilbara region in Western Australia. 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, 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 (Bureau of Meteorology [BOM] 2018). Most of the annual precipitation occurs during the four summer months from December to March. The average maximum summer temperature ranges between 38°C and 40°C, while winter maximum temperatures range from 28°C to 30.5°C (BOM 2018).

The field survey was undertaken in September 2018 and seasonal conditions were rated as 'poor' due to no rain falling in July, August and September prior to the survey. Above average rainfall however was received in June, with 54.8 mm recorded compared to the long-term average of 16.2 mm. Total rainfall for the first half of 2018 has been below average, with zero rainfall recorded in July and August (Figure 2, BOM 2018).

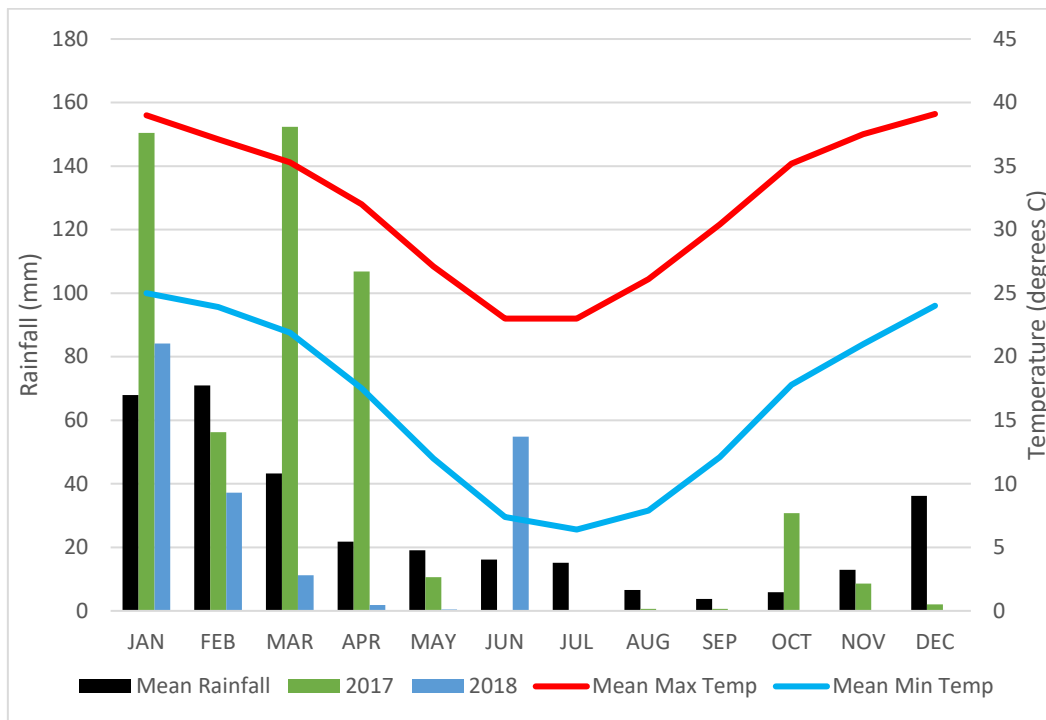


Figure 2 Climatic data recorded from Newman Airport, with long term monthly rainfall compared against monthly rainfall for 2017 and January-September 2018 (BoM 2018).

1.4 Biogeographic Regions

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

The Fortescue subregion is dominated by alluvial plains and river frontage with extensive salt marsh, mulga-bunch grass, and short grass communities on alluvial plains in the east. Deeply incised gorge systems occur in the western (lower) part of the drainage. Drainage lines are fringed by river gum woodlands (Kendrick 2001a).

The Hamersley subregion is characterised by mountain ranges and plateaux of Proterozoic sedimentary rock, dissected by gorges. The vegetation is characterised by Mulga low woodland over bunch grasses on fine textured soils in valley floors, and Snappy Gum (*Eucalyptus leucophloia*) over *Triodia brizoides* on skeletal soils of the ranges (Kendrick 2001b).

1.5 Existing Land Use

Land tenure in the Pilbara consists of Aboriginal lands and leasehold reserves, national parks and reserves, and Crown land which fall under a range of pastoral and mining leases. The dominant land uses in the Fortescue, Hamersley and Augustus subregions are pastoralism (cattle grazing), exploration and mining, conservation (and associated tourism), unallocated Crown land, Crown reserves and urban areas (Kendrick 2001a, Kendrick 2001b, Desmond *et al.* 2001). The study area is located just north of Sylvania Station within the Shire of East Pilbara, and approximately 10 km north-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 is not within or adjacent to any gazetted conservation reserves. The Collier Range National Park is the nearest reserve, situated approximately 130 km to the south. Karijini National Park is located approximately 160 km west north-west of the study area.

1.6 Landforms

The study area is 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 stony plains and some 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 north-east. The source of Jimblebar Creek and 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 with banded mulga, drainage lines, low hills 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 is located within the following soil unit:

- 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) described two soil types as occurring within the study area and surrounds:

- 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 My50 and Mz23 of Sheet 6. As mapped, there are inclusions of units Oc47 and BB9; and
- Fa13: Ranges of banded jaspilite and chert along with shales, dolomites, and iron ore formations; some areas of ferruginous duricrust as well as occasional narrow winding valley plains and steeply dissected pediments. This unit is largely associated with the Hamersley and Ophthalmia Ranges. The soils are frequently stony and shallow and there are extensive areas without soil cover: chief soils are shallow stony earthy loams (Um5.51) along with some (Uc5.11) soils on the steeper slopes. Associated are (Dr2.33, Dr2.32) soils on the limited areas of dissected pediments, while (Um5.52) and (Uf6.71) soils occur on the valley plains.

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, which is prevalent in the Pilbara, are associated with these rock formations.

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 is the most relevant to the study area as it 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 is dominated by the following geological formations (Williams and Tyler 1989) (Figure 3):

- Hb: Brockman Iron Formation: banded iron-formation, chert shale;
- Hj: Weeli Wollu Formations: interlayered banded iron-formation, and metadoleritic sills, minor shale;
- Ho: Boolgeeda Iron Formation: fine grained, finely laminated, dark grey brown to black flaggy iron-formation, minor chert, jaspilite shale;
- Hw: Woongarra Volcanics: rhyolite and rhyodacite as cills or flows; commonly porphyritic;
- Qa: Alluvium: clay, silt, sand, gravel; in drainage channels and adjacent flood plains;
- Cz1: Laterite: massive and pisolitic ferruginous duricrust, in places contains relict structures of parent rock;
- 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;
- Czc: Colluvium: partly consolidated quartz and rock fragments in silt and sand matrix; old valley-fill deposits;
- Qd: Lacustrine: clay and silt, claypan deposits; and
- Qc: Colluvium and Minor Alluvium: quartz, and rock fragments in loam, unconsolidated, grades in to Qz.

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Jimblebar North
Figure 3

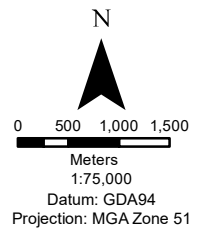
Surface Geology within the Study Area

Legend

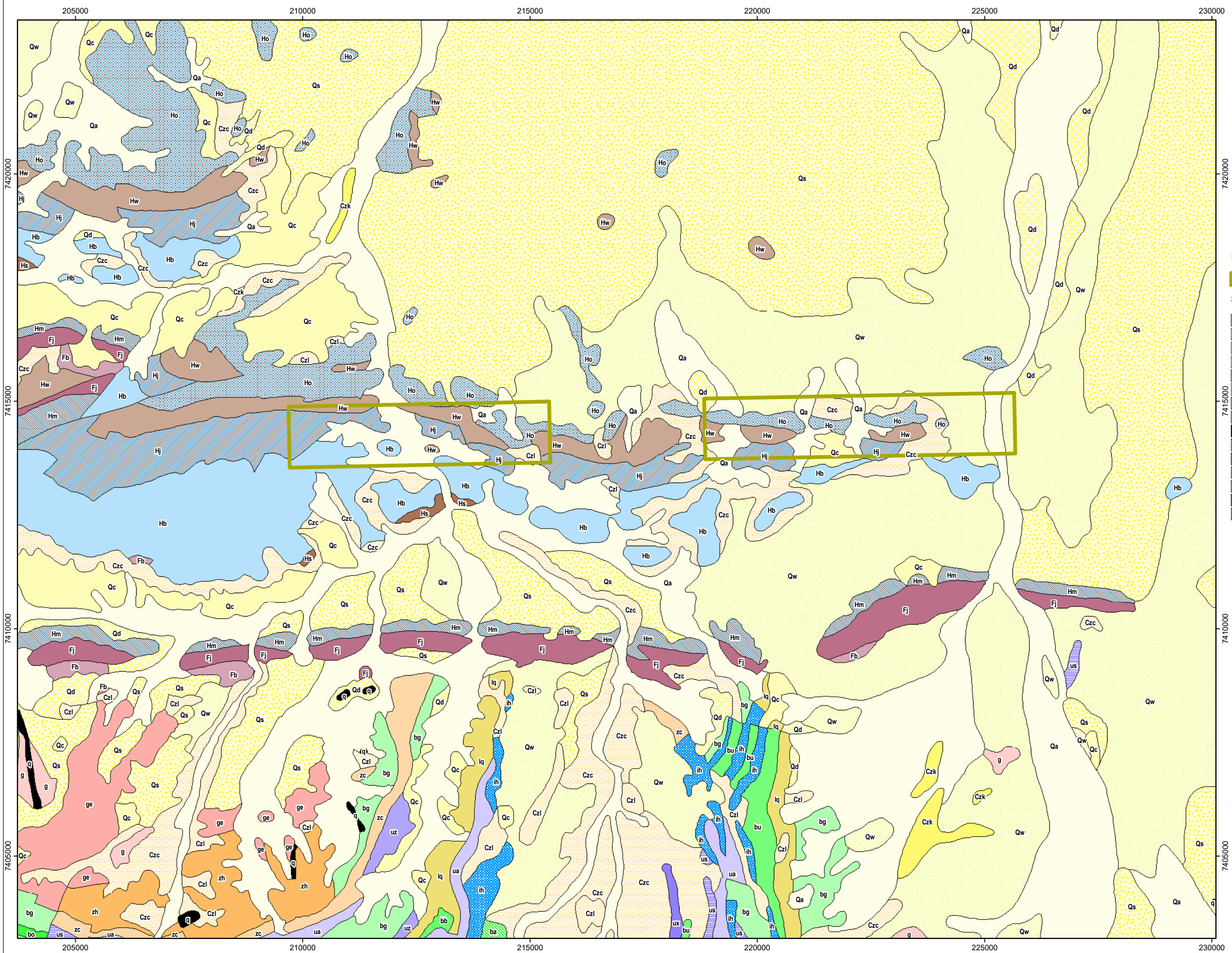
Study Area

Surface Geology

	Qa		Fj
	Qd		Fb
	Qs		g
	Qw		ge
	Qc		lq
	Czc		ih
	Czl		zc
	Czk		zh
	q		bb
	Ho		bg
	Hw		bo
	Hj		bu
	Hb		ba
	Hs		ua
	Hm		us
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1.9 Hydrology

The study area is located within the Fortescue River Catchment. The hydrology of the area is dominated by ephemeral creeks and drainage lines flowing into major drainage lines to the north and east of the study area. 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 dissects the eastern end of the Lasseter deposit of the study area and drains into a broader braided channel to the north; and Jimblebar Creek runs through the centre of the Crowes Nest deposit of the study area (Figure 1).

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).

1.10 Regional Vegetation

The study area is located within the Fortescue Botanical Districts, which is part of the Eremaean Province (Beard 1990). Vegetation within the study area (Figure 4) is classified as the following vegetation associations, as mapped by Beard (1975) and later refined by Shepherd *et al.* (2002):

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

While the Pre-European extent for each vegetation association is close to 100 percent, less than nine 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 (Shepherd *et al.* 2002).

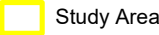










Vegetation Association	Description	Pre-Euro. Extent Remaining (ha)	Remaining area (ha) in IUCN Class I-IV Reserves	% remaining Other Reserves	% remaining DBCA Managed PL
29	Sparse low woodland; Mulga, discontinuous in scattered groups	7,782,264 (100%)	0.3	0.0	2.4
82	Hummock grasslands, low tree steppe; Snappy gum over <i>Triodia wiseana</i>	2,290,910 (100%)	8.9	0.2	1.0

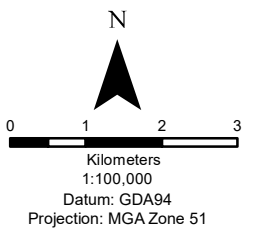


BHP
Jimblebar North
Figure 4

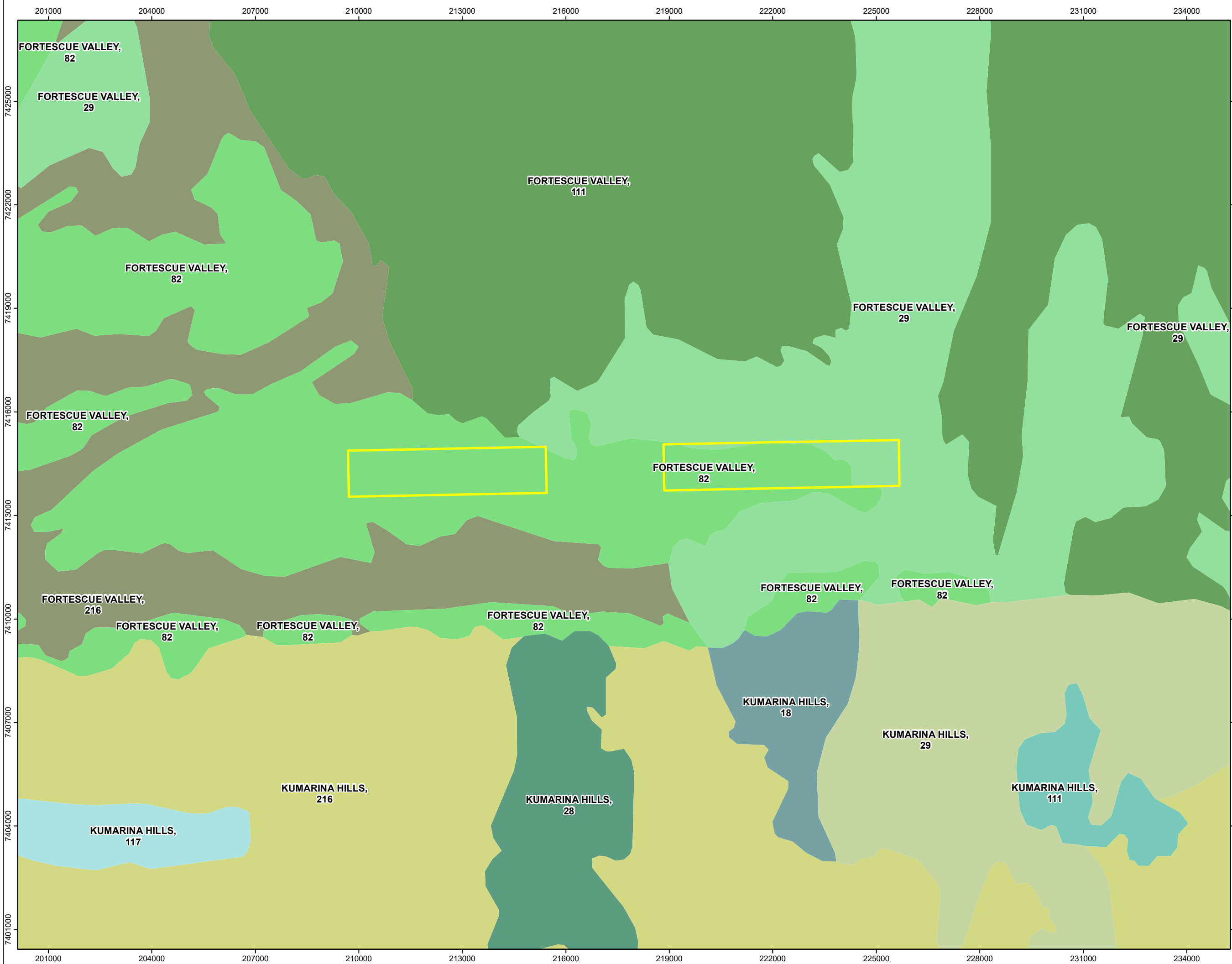
Beard (1975) vegetation complexes within the study area

Legend

-  Study Area
- Pre-European Vegetation (Beard 1975)**
-  FORTESCUE VALLEY, 111
-  FORTESCUE VALLEY, 216
-  FORTESCUE VALLEY, 29
-  FORTESCUE VALLEY, 82
-  KUMARINA HILLS, 111
-  KUMARINA HILLS, 117
-  KUMARINA HILLS, 18
-  KUMARINA HILLS, 216
-  KUMARINA HILLS, 28
-  KUMARINA HILLS, 29



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1.11 Land Systems

The Department of Agriculture (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), six of which occur within the study area (Table 2, Figure 5). The study area is dominated by the ridges of the Newman Land System and stony hardpan plains and rises of the Jamindie Land System (Figure 5).

Table 2 Land systems occurring within the study 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.
Jamindie	2,074 km ² or 1.1%	Stony hardpan plains and rises supporting groved mulga shrublands, occasionally with spinifex understorey.
Newman	14,580 km ² or 8.0%	Rugged jaspilite plateaux, ridges and mountains 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.

2.0 METHODOLOGY

2.1 Guidance and Legalisation

2.1.1 Guidance Documents

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

- Statement of Environmental Principles, Factors and Objectives (EPA 2018);
- Environmental Factor Guideline Flora and Vegetation (EPA 2016a); and
- Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016b).

The survey was also conducted in accordance with the following BHP WAIO procedure:

- Vegetation and Flora Survey Procedure (BHP WAIO 2018).

2.1.2 Legalisation and Assessment of Conservation Significance

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

International Level:

- IUCN: The IUCN 'Red List' lists species at risk under nine categories (status codes) (Appendix 1).

Commonwealth Level:

- *Environment Protection and Biodiversity Conservation Act 1999* (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 2).

State Level:

- *Wildlife Conservation Act 1950* (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 (Appendix 3). It should be noted that the WC Act will be superseded by the new *Biodiversity Conservation Act 2016*.
- 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 4). 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.

2.2 Desktop Assessment

2.2.1 Literature Review

A literature review of relevant surveys previously completed within or in close proximity to the study area was completed, comprising nine flora and vegetation survey, as identified by BHP WAIO, which occur within or partially overlap the study area.

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. For this report the search was extended beyond the study area to place species and community values into a local and regional context.

The following databases were searched:

- NatureMap: This database represents the most comprehensive source of information on the distribution of Western Australia's flora, comprising records from the Department of Biodiversity, Conservation and Attractions (DBCA) database, and the Western Australian Herbarium (WAH) Specimen Database (40 km radial search, accessed 20 August 2018) (Department of Parks and Wildlife [DPaW] 2018);
- DBCA's Threatened Flora Database was searched to confirm the NatureMap results (50 km radial search, accessed 5 September 2018) (DBCA 2018a);
- DBCA's TEC, PEC and Environmentally Sensitive Areas (ESAs) database was searched to identify significant communities (50 km radial search, accessed 3 September 2018) (DBCA 2018b);
- EPBC Act Protected Matters database (50 km radial search, accessed 20 August 2018) (DoEE 2018b);
- International Union for Conservation of Nature (IUCN) database (accessed 20 August 2018) (IUCN 2018); and
- BHP Billiton Iron Ore's database was searched to identify records of significant flora species known to be in close proximity of the study area (30 km radial search, accessed 24 August 2018).

2.2.3 Assessment of Likelihood of Occurrence in the Study Area

A list of conservation significant flora species occurring within a 50 km radius of the study area was compiled during the literature review and database searches. The likelihood of each taxon occurring within the study area was assessed using a set of rankings and criteria (as described in Table 3). The criteria are based on presence of suitable landform (inferred from aerial imagery with contours overlaid, and from knowledge of the adjacent areas) and distance to known records.

Table 3 Ranking system used to assign the likelihood that a flora species would occur in the study area.

Rank	Criteria
Recorded	The species has been recorded in the study area.
Likely to occur	The species has previously been recorded from a landform/habitat which is present within the study area, and there are previous records within a 20 km radius of the study area.
Possible to occur	The species has previously been recorded from a landform/habitat which is present within the study area, and there are previous records within a 50 km radius of the study area.
Unlikely to occur	The landform/habitat from which the species has previously been recorded is absent within the study area, and/or there are no previous records within a 50 km radius of the study area.

2.3 Reconnaissance Survey Methodology

2.3.1 Timing and Personnel

The flora and vegetation survey was completed by Principal Botanist Dr Jerome Bull, working over a six-day period between the 12th and 17th September 2018 (in conjunction with the Level 1 vertebrate fauna survey).

Seasonal conditions at the time of the September 2018 field surveys were rated as *poor*, with no rainfall received in July, August or September 2018 (prior to the survey).

The Principal Botanist working on the survey has over 15 years Pilbara experience, and has completed numerous surveys in close proximity to the study area over recent years.

2.3.2 Flora Species

A total of 174 relevé sites were established throughout the study area, to gather information for the identification of flora species.

Targeted Flora Searches

Targeted searches were conducted for flora of conservation significance and introduced flora species across the study area. Ground-truthing provided an opportunity to record opportunistic locations for Threatened and Priority listed flora and undertake closer examination of specific landforms where conservation significant flora may be expected to occur. Opportunistic collections were also made while moving around the study area, with targeted weed searches completed in high moisture habitats along the main drainage channels.

The locations of flora of conservation significance and introduced flora 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.

Species Identification and Nomenclature

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 WAH. 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 WAH, as listed on FloraBase.

Voucher specimens are lodged with the WAH 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 WAH's specimen acquisition policy. Threatened and Priority Flora Report Forms will be submitted to DBCA for the Priority flora species recorded from the study area.

2.3.3 Vegetation Association and Condition Mapping

Relevé sites were established throughout the study area, to gather information for the identification and mapping of vegetation association and condition.

The vegetation mapping utilised high-resolution aerial photography of the entire study area at a scale of 1:20,000, with definition of vegetation polygons based on contrasting shading patterns. Ground-truthing of the study area was completed during the survey with vegetation descriptions made within selected vegetation polygons to confirm dominant structural layers and associated plant taxa.

The location of the relevé site were overlaid on the aerial photography, and associated flora and vegetation data was used to provide vegetation association descriptions for individual polygons defined. 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 5). This is largely a structural classification suitable for broader scale mapping, but taking all ecologically significant strata into account.

A vegetation association code was applied to each vegetation association. This code is comprised of the dominate landform on which the vegetation association occurs and the dominant plant taxa in each vegetation stratum.

Vegetation condition at each relevé site was determined using a recognised rating scale (based on Keighery 1994) (see Appendix 6).

2.3.4 Field Survey Constraints

The Environmental Protection Authority (EPA) Technical Guidance (EPA 2016b) list potential limitations that field surveys may encounter. Limitations associated with the flora and vegetation reconnaissance survey are addressed in Table 4. There were no survey-specific limitations for this survey.

Table 4 **Relevance of constraints, as identified by EPA to the flora and vegetation (EPA 2016b).**

Constraint	Relevance
Availability of contextual information at a regional and local scale	There are nine flora and vegetation survey that have been previously completed within or partially overlapping the study area. In addition, there has been high intensity sampling from neighbouring tenements, with at least an additional 38 previous flora and vegetation surveys having been undertaken within a 25 km radius of the study area, providing an extensive local database. This is confirmed by the intensity of records for the local area on FloraBase.
Proportion of flora recorded and/or collected, any identification issues	The reconnaissance flora and vegetation survey was aimed at describing and mapping vegetation associations, and recording flora of conservation significance and introduced flora. Hence, a large proportion of the more common taxa occurring within the study area were not collected. Seasonal conditions at the time of the field survey were 'poor', resulting in an under-estimation of the ephemeral flora component, with limited annual species present at the time of the survey.
Survey timing, rainfall, season of survey	The survey was completed in September 2018 under 'poor' seasonal conditions resulting from no rainfall during in the months preceding field work (July – September).
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 to the creeklines 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)	A Principal Botanist working over a six-day period assessed a total of 174 relevé plots during the field survey, representing an adequate survey intensity for a reconnaissance survey. All allocated tasks detailed in the scope of works were achieved during the reconnaissance survey.
Access restrictions within the survey area	There were no access restrictions experienced during the survey with the study area accessible by vehicle and on foot; noting that vegetation mapping was facilitated by high-resolution aerial photography.
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 experience in the Pilbara region, and has completed numerous surveys in close proximity to the study area over recent years.

3.0 RESULTS

3.1 Literature Review

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 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. This dataset has recently been published (Western Australian Museum 2018) and will provide added 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 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 at least 47 flora and vegetation that have previously been completed in close proximity (within a 25 km radius) to the study area. The flora and vegetation surveys comprise 33 detailed survey, four reconnaissance survey, nine targeted survey and one desktop assessments.

Nine of the previous flora and vegetation surveys have been completed within or partially overlapping the study area. These surveys are described in Appendix 7.

3.2 Database Searches

3.2.1 Flora Species

Threatened Flora listed under the EPBC Act

A search of the EPBC Act Protected Matters Database (DoEE 2018b) identified one Threatened Flora or their habitat as occurring within a 50 km radius of the study area; *Pityrodia augustensis*, currently listed as Vulnerable under the EPBC Act (Appendix 2).

Pityrodia augustensis (Mt Augustus Foxglove) is restricted to the northern slopes of Mt Augustus with the nearest known records for *Pityrodia augustensis* are over 300 km south of the study area. It occurs as a bushy shrub up to 1 m in height and is found on rocky slopes or drainage lines. It is considered unlikely that *Pityrodia augustensis* occurs within the study area due to the distance from the nearest record.

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.

Threatened Flora listed under the WC Act

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.

Priority Flora recognised by the DBCA

The DBCA rare flora database search (DBCA 2018a) identified 14 Priority flora taxa as potentially occurring within a 50 km radius of the study area. The NatureMap search (DPaW 2018) identified 18 Priority flora as potentially occurring within a 25 km radius.

A total of 20 Priority flora taxa were identified during the desktop assessment; 19 from database searches, and one additional species from the literature review. These taxa are detailed in Table 5.

Based on the known distributions and habitat preferences of Priority flora taxa, and comparison with the habitats identified and mapped for the study area, three Priority flora taxa were determined as being “likely” to occur within the study area and 13 as “possible” to occur, with the remaining taxa identified as “unlikely” to occur (Table 5).

Table 5 Conservation significant flora taxa identified during the desktop assessment.

Taxon	Cons. Code	Life Form	Habitat Preference	Suitable Habitat Present	Likelihood in the Study Area
<i>Acacia</i> sp. East Fortescue (J. Bull & D. Roberts ONS A 27.01)	P1	Perennial	Eroded BIF ironstone present on low undulating hills	Yes	Possible
<i>Amaranthus centralis</i>	P3	Annual	River banks	Yes	Possible
<i>Aristida jerichoensis</i> var. <i>subspinulifera</i>	P3	Perennial	Hardpan plains	Yes	Possible
<i>Crotalaria smithiana</i>	P3	Annual	Floodplain	Yes	Possible
<i>Eremophila capricornica</i>	P1	Perennial	Hardpan plains	Yes	Likely
<i>Eremophila pilosa</i>	P1	Perennial	Red brown clay loam, sandplains	Yes	Possible
<i>Eremophila youngii</i> subsp. <i>lepidota</i>	P4	Perennial	Stony red sandy loam; flats plains, floodplains, sometimes semi-saline, clay flats	Yes	Possible
<i>Euphorbia inappendiculata</i> var. <i>inappendiculata</i>	P2	Annual	Unknown	Yes	Possible
<i>Goodenia berringbinensis</i>	P4	Annual	Gilgai soaks with light yellow-brown clay soil	No	Unlikely
<i>Goodenia hartiana</i>	P2	Perennial	Sand dune swales, sand hills	No	Unlikely
<i>Goodenia nuda</i>	P4	Perennial	Plains and floodplains	Yes	Likely
<i>Gymnanthera cunninghamii</i>	P3	Perennial	Sandy soils, creek beds.	Yes	Possible

Taxon	Cons. Code	Life Form	Habitat Preference	Suitable Habitat Present	Likelihood in the Study Area
<i>Hibiscus campanulatus</i>	P1	Perennial	Incised ironstone gullies, protected areas below cliffs, rocky creeklines and below breakaways.	No	Unlikely
<i>Ipomoea racemigera</i>	P2	Annual	Flats and stream channels	Yes	Possible
<i>Isotropis parviflora</i>	P2	Annual	Valley slope of ironstone plateau	Yes	Possible
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)	P3	Perennial	Plains	Yes	Likely
<i>Rostellularia adscendens</i> var. <i>latifolia</i>	P3	Annual	Ironstone soils, near creeks, rocky hills	Yes	Possible
<i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431)	P3	Perennial	Clay pan, grass plain.	No	Unlikely
<i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739)	P3	Perennial	Amongst rocks and outcrops, gully slopes	Yes	Possible
<i>Vittadinia</i> sp. Coondewanna Flats (S. van Leeuwen 4684)	P1	Perennial	Plains.	Yes	Possible

3.2.2 Ecological Communities

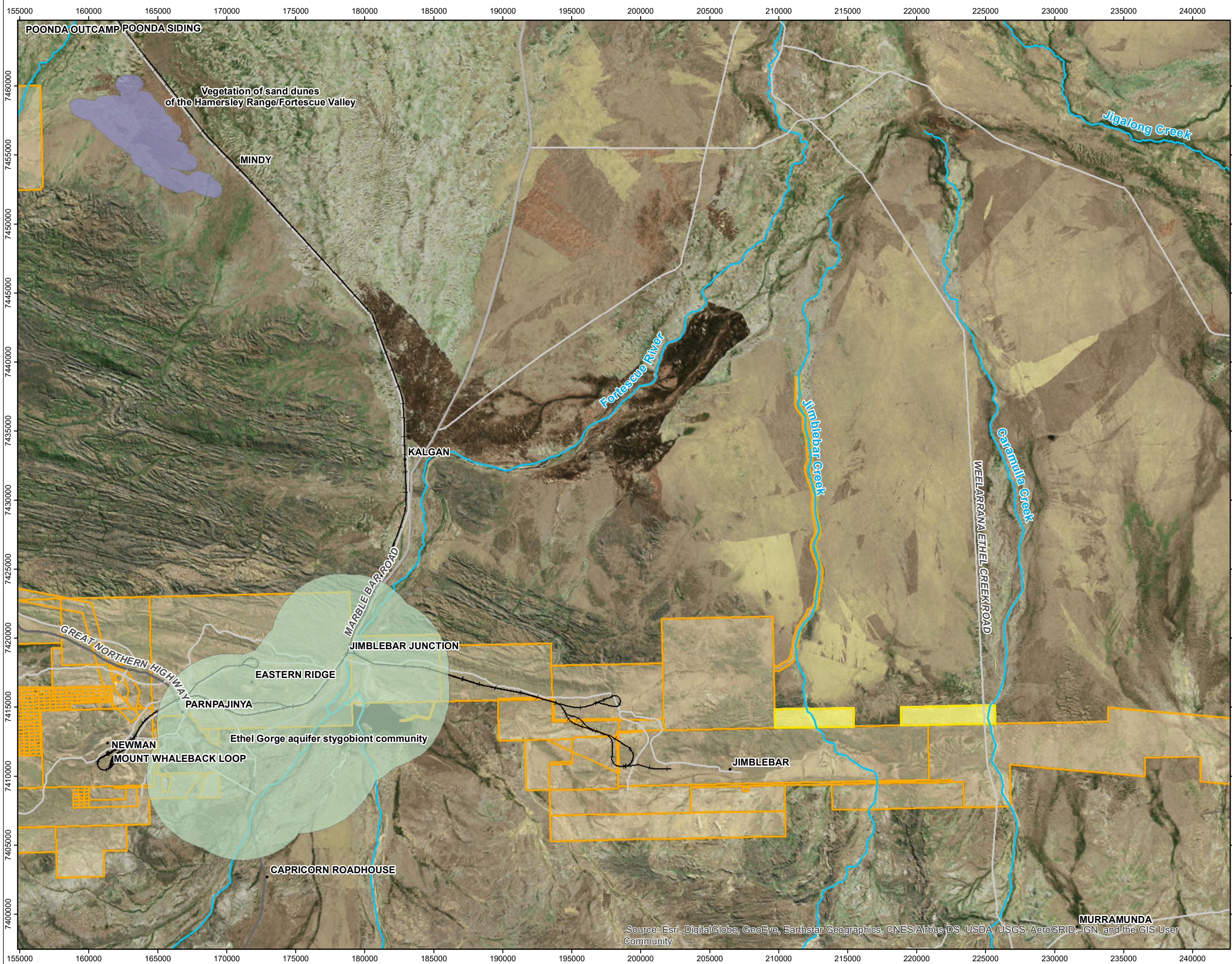
TECs listed under State and Federal Legislation

A search of the EPBC Act Protected Matters database (DoEE 2018b) identified no Federal listed TECs previously recorded within, or adjacent to, the study area.

Search results from the DBCA ecological community database (DBCA 2018b) confirmed there was one State listed TEC known from within 50 km of the study area; the Endangered 'Ethel Gorge aquifer stygobiont community'. The buffer of this TEC is located approximately 25 km west of the study area (Figure 6). This community is subterranean and has no features related to flora or vegetation, and therefore will not be discussed further.

PECs recognised by DBCA

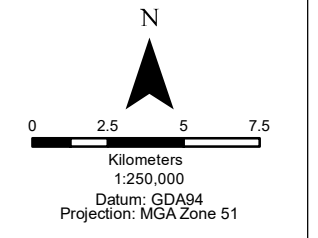
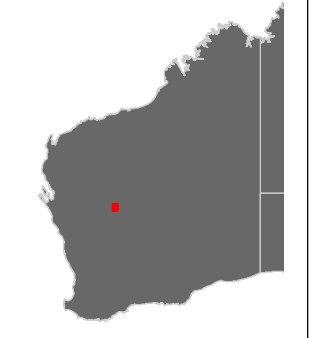
A search of the State database (DBCA 2018b) identified one PEC, the Priority 3 'Vegetation of sand dunes of the Hamersley Range/Fortescue Valley'. The buffer to this community is located over 50 km north-west of the study area (Figure 6), and it is not expected to occur within the study area.



BHP
Jimblebar North
Figure 6
PEC/TEC
Locations
Surrounding Study Area

Legend

- Study Area
- BHP Tenure
- BHP Rail
- Ethel Gorge aquifer stygobiont community
- Vegetation of sand dunes of the Hamersley Range/Fortescue Valley



Date: 03/01/2019
 Status: Final
 Figure: 6
 Sheet Size: A3
 Internal Reference: JN_pec/tec_Loc
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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

3.3 Reconnaissance Field Survey

3.3.1 Flora Species

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 were recorded from the study area.

Priority Flora recognised by the DBCA

Two Priority flora species, 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 7, Appendix 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) and during a survey of Caramulla Creek (Onshore Environmental *in prep*). One of the WAH specimens was a collection made by Onshore Environmental from BHP WAIO's Orebody 31 project area (Onshore Environmental 2014b). 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 (Wheellarra Hill) mine, 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*.

Eremophila capricornica was recorded from 70 point locations scattered throughout the study area from sandy/stony plains and hill slopes (Figure 7). Records ranged from a few scattered individuals through to approximately 150 individuals, from were from the following broad vegetation types of the study area:

- *Acacia* High Shrubland;
- *Triodia* Hummock Grassland; and
- *Acacia* Low Open Woodland.



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 Creek and Caramulla project areas (Onshore Environmental 2018 and *in prep*).

Rhagodia sp. Hamersley (M. Trudgen 17794) was recorded as scattered individuals offering less than 1 percent ground cover at 13 locations within the study area, occurring in the following broad vegetation types:

- *Triodia* Hummock Grassland;
- *Acacia* High Shrubland;
- *Acacia* Low Open Forest/ Woodland;
- *Acacia* Low Scattered Trees; and
- *Aristida* Tussock Grassland.



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

Introduced Flora

Two introduced flora species were opportunistically recorded from the study area **Cenchrus ciliaris* (Buffel Grass) and **Cenchrus setiger* (Birdwood Grass) (Figure 8, Appendix 9).

**Cenchrus ciliaris* is a tufted perennial grass originating from the Middle East and used as a fodder species by pastoralists. 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).

Recorded from 22 locations on sandy plains, floodplains and throughout the major drainage line within the study area (Figure 8). Ground cover ranges from less than 1% to 40% in some floodplain areas, with the number of individuals at each location ranging from five to estimated at more than 500 at one location.



Plate 3 **Cenchrus ciliaris* (Buffel Grass)

**Cenchrus setiger* is an erect tussocky stoloniferous perennial grass up to 0.5 m in height. 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.

From within the study area, **Cenchrus setiger* was recorded at 12 locations on sandy plains, floodplains and throughout the major drainage line within the study area (Figure 8). The number of individuals at each location ranged from three to estimated at more than 400 at one location, with ground cover recorded as less than 1% through to 30% at one floodplain site.

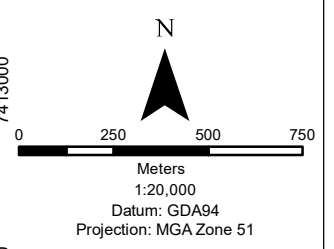
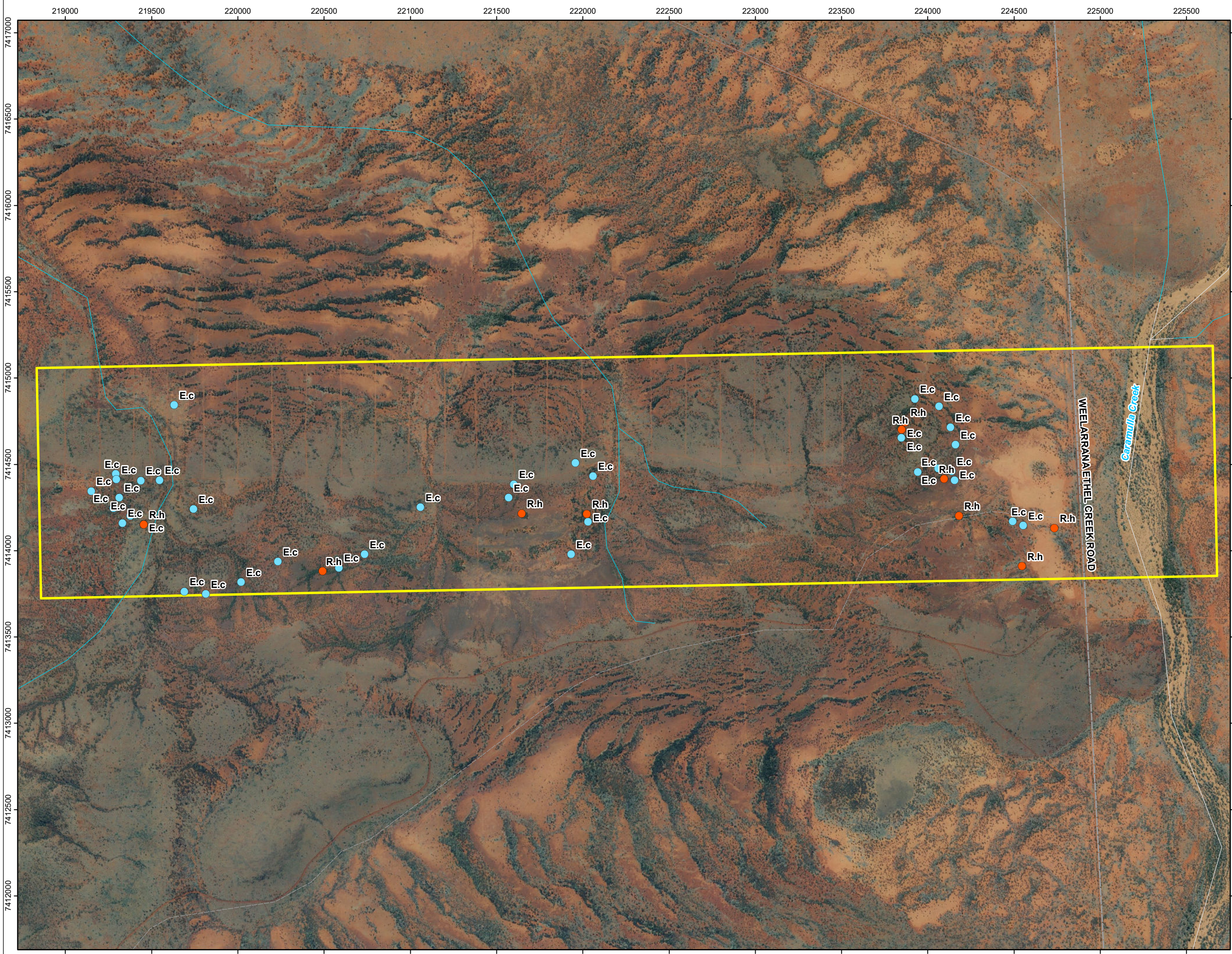


Plate 4 **Cenchrus setiger* (Birdwood Grass)

Jimblebar Nth
Figure 7
Significant Flora
Lasseter

Legend

- Study Area
- Significant Flora**
- Eremophila capricornica (E.c)
- Rhagodia sp. Hamersley (M. Trudgen 17794) (R.h)

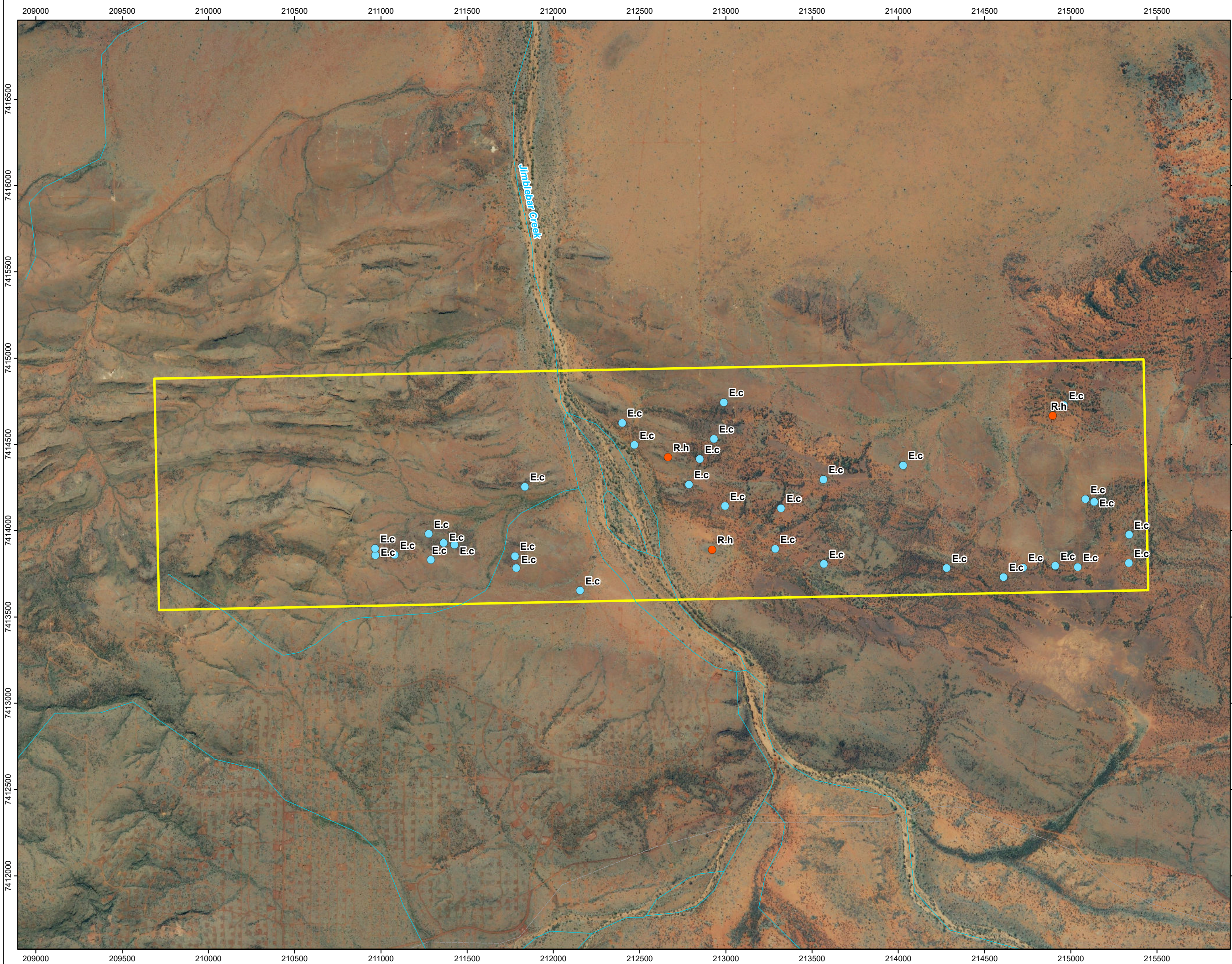


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Jimblebar Nth
Figure 7
Significant Flora
Crowes Nest

Legend

- Study Area
- Significant Flora**
- Eremophila capricornica (E.c)
- Rhagodia sp. Hamersley (M. Trudgen 17794) (R.h)



N

0 250 500 750

Meters
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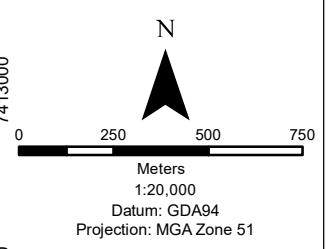
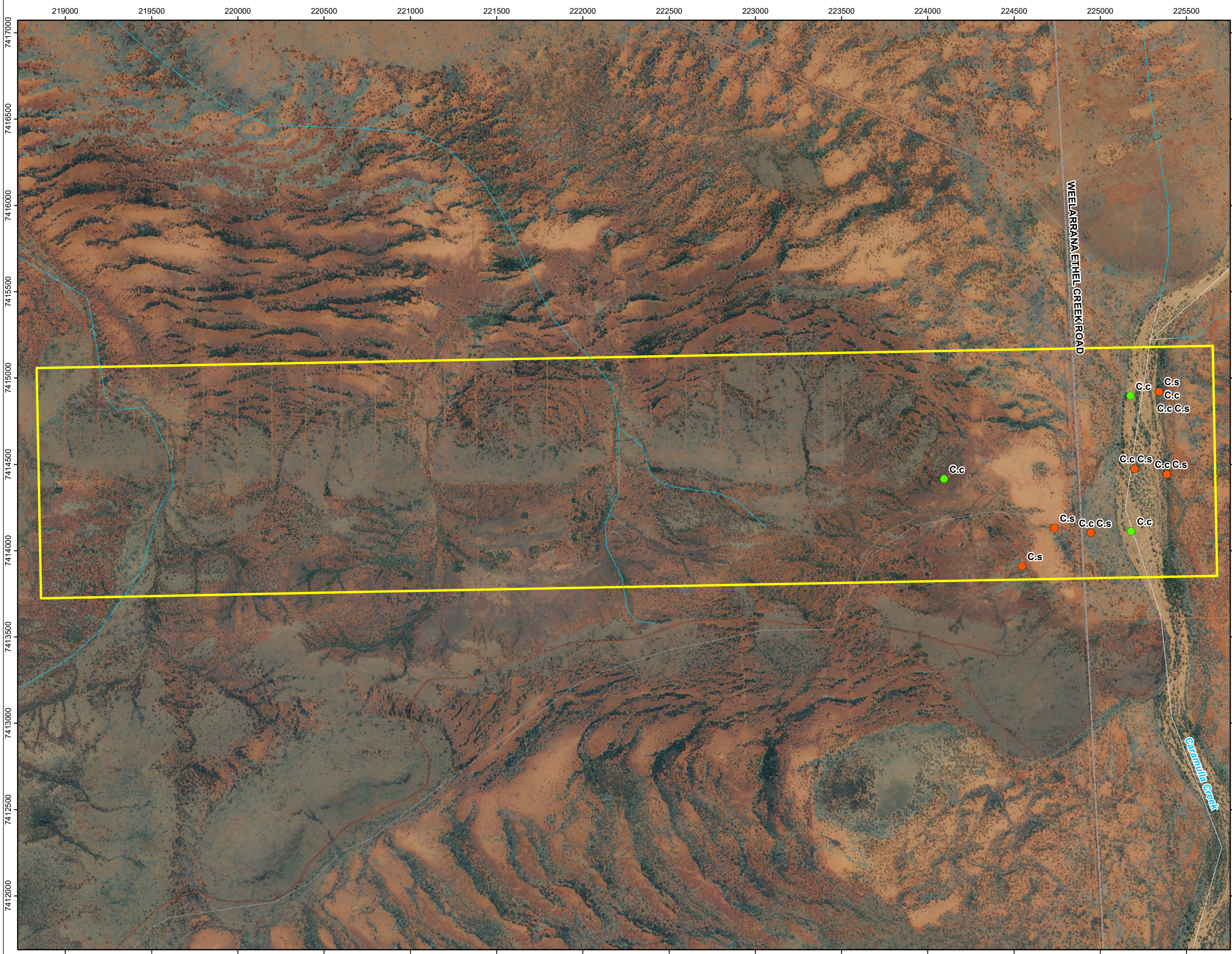
Figure 8

Introduced Flora

Lasseter

Legend

- Study Area
- Introduced Flora**
 - Cenchrus ciliaris (C.c)
 - Cenchrus setiger (C.s)

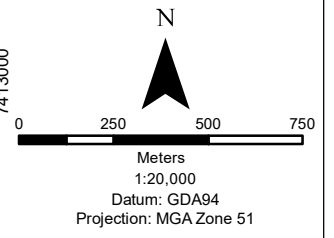
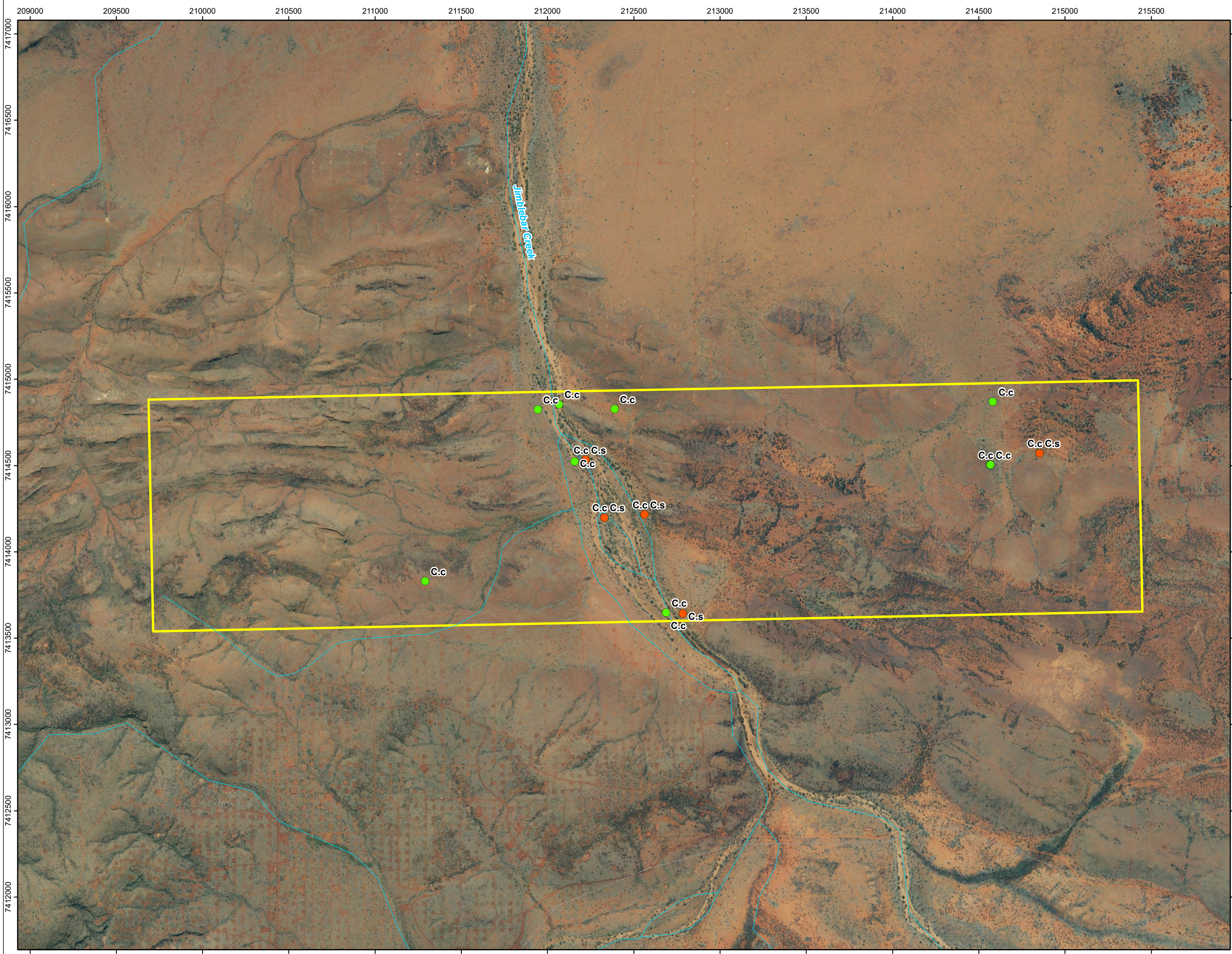


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Jimblebar Nth
Figure 8
Introduced Flora
Crowes Nest

Legend

- Study Area
- Introduced Flora**
 - Cenchrus ciliaris (C.c)
 - Cenchrus setiger (C.s)



Date: 03/01/2019
Status: Final
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3.3.2 Vegetation

Vegetation Associations

A total of 34 vegetation associations were described and mapped within the study area (Figure 9). The vegetation associations have been classified into 14 broad floristic formations on the basis of the dominant vegetation stratum (Table 6).

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

Broad Floristic Formation	Code	Vegetation Code	Vegetation Description
<i>Eucalyptus</i> Woodland	1	MA Eco AcpAci MgApy	Woodland of <i>Eucalyptus camaldulensis</i> var. <i>obtusa</i> over Low Open Woodland of <i>Acacia coriacea</i> subsp. <i>pendens</i> and <i>Acacia citrinoviridis</i> over High Open Shrubland of <i>Melaleuca glomerata</i> and <i>Acacia pyrifolia</i> in brown sandy clay loams on major drainage lines
<i>Acacia</i> Low Open Forest	2a	FP AciAcpHall CcCsTha EcoEv	Low Open Forest of <i>Acacia citrinoviridis</i> , <i>Acacia coriacea</i> subsp. <i>pendens</i> and <i>Hakea lorea</i> subsp. <i>lorea</i> over Tussock Grassland of * <i>Cenchrus ciliaris</i> , * <i>Cenchrus setiger</i> and <i>Themeda avenacea</i> and Open Woodland of <i>Eucalyptus camaldulensis</i> subsp. <i>obtusa</i> and <i>Eucalyptus victrix</i> in brown silty loams on floodplains
	2b	GR AaGrbAan SesDopeSca TpTv	Low Open Forest of <i>Acacia aptaneura</i> , <i>Grevillea berryana</i> and <i>Acacia aneura</i> over Shrubland of <i>Senna stricta</i> , <i>Dodonaea petiolaris</i> and <i>Scaevola acacioides</i> over Open Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia vanleeuwenii</i> in brown silty loams on ironstone outcrops
	2c	SP AcaoAptApr DopeSieErlI PslAtet	Low Open Forest of <i>Acacia catenulata</i> subsp. <i>occidentalis</i> , <i>Acacia pteraneura</i> and <i>Acacia pruinocarpa</i> over Shrubland of <i>Dodonaea petiolaris</i> , <i>Sida ectogama</i> and <i>Eremophila latrobei</i> subsp. <i>latrobei</i> with High Open Shrubland of <i>Psyrax latifolia</i> and <i>Acacia tetragonophylla</i> in brown silty clay loams on stony plains
<i>Acacia</i> Low Woodland	3a	HS Apt Ecap Tv	Low Woodland of <i>Acacia pteraneura</i> over Low Shrubland of <i>Eremophila capricornica</i> over Open Hummock Grassland of <i>Triodia vanleeuwenii</i> in brown sandy loams on undulating low hills
	3b	MA AcpAci Mg CcCsArhh	Low Woodland of <i>Acacia coriacea</i> subsp. <i>pendens</i> and <i>Acacia citrinoviridis</i> over High Shrubland of <i>Melaleuca glomerata</i> over Open Tussock Grassland of * <i>Cenchrus ciliaris</i> , * <i>Cenchrus setiger</i> and <i>Aristida holathera</i> var. <i>holathera</i> in brown sands on major drainage lines
<i>Acacia</i> Scattered Low Trees	4a	HP AptAp ErlnSeaoPto AriArcErh	Scattered Low Trees of <i>Acacia pteraneura</i> and <i>Acacia paraneura</i> over Scattered Low Shrubs of <i>Eremophila lanceolata</i> , <i>Senna artemisioides</i> subsp. <i>oligophylla</i> and <i>Ptilotus obovatus</i> over Scattered Tussock Grasses of <i>Aristida inaequiglumis</i> , <i>Aristida contorta</i> and <i>Eriachne helmsii</i> in brown sandy clay loams on hardpan plains
	4b	SP AptAcaoAa ErlApt PtscPtrPto (occurs as a mosaic)	Scattered Low Trees of <i>Acacia pteraneura</i> , <i>Acacia catenulata</i> subsp. <i>occidentalis</i> and <i>Acacia aptaneura</i> over Scattered High Shrubs of <i>Eremophila latrobei</i> subsp. <i>latrobei</i> and <i>Acacia pteraneura</i> over Scattered Low Shrubs of <i>Ptilotus schwartzii</i> , <i>Ptilotus roei</i> and <i>Ptilotus obovatus</i> in brown silty clay loams on stony plains

Broad Floristic Formation	Code	Vegetation Code	Vegetation Description
Acacia Open Scrub	5a	MI AmAancGrwh AnlAma Tp	Open Scrub of <i>Acacia monticola</i> , <i>Acacia ancistrocarpa</i> and <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> over Shrubland of <i>Androcalva luteiflora</i> and <i>Acacia maitlandii</i> over Open Hummock Grassland of <i>Triodia pungens</i> in brown loamy sands on minor drainage lines
	5b	MI AwAnlAma AwSeglAma Tp	Open Scrub of <i>Acacia wanyu</i> , <i>Androcalva luteiflora</i> and <i>Acacia maitlandii</i> over Shrubland of <i>Acacia wanyu</i> , <i>Senna glutinosa</i> subsp. <i>luerssenii</i> and <i>Acacia maitlandii</i> over Open Hummock Grassland of <i>Triodia pungens</i> in brown loamy sands on minor drainage lines
	5c	SA AancAb Tb ChHall	Open Scrub of <i>Acacia ancistrocarpa</i> and <i>Acacia bivenosa</i> over Open Hummock Grassland of <i>Triodia basedowii</i> with Low Open Woodland of <i>Corymbia hamersleyana</i> and <i>Hakea lorea</i> subsp. <i>lorea</i> in red sands on sandplains
Acacia High Shrubland	6a	FP Aw ErcuSesmFrs EnraErmuErx	High Shrubland of <i>Acacia wanyu</i> over Low Shrubland of <i>Eremophila cuneifolia</i> , <i>Senna</i> sp. Meekatharra (E. Bailey 1-26) and <i>Frankenia setosa</i> over Open Tussock Grassland of <i>Enteropogon ramosus</i> , <i>Eriachne mucronata</i> and <i>Eragrostis xerophila</i> in brown loamy sands on drainage areas
	6b	FP AsAmacAsi ChApt StspSeaoErf	High Shrubland of <i>Acacia sclerosperma</i> , <i>Acacia macraneura</i> and <i>Acacia sibirica</i> with Low Open Woodland of <i>Corymbia hamersleyana</i> and <i>Acacia pteraneura</i> and Open Shrubland of <i>Stylobasium spathulatum</i> , <i>Senna artemisioides</i> subsp. <i>oligophylla</i> and <i>Eremophila forrestii</i> subsp. <i>forrestii</i> in brown loamy sands on floodplains
	6c	HS ArAsiAte ArEreAsi TvTp	High Shrubland of <i>Acacia rhodophloia</i> , <i>Acacia sibirica</i> and <i>Acacia tetragonophylla</i> over Shrubland of <i>Acacia rhodophloia</i> , <i>Eremophila exilifolia</i> and <i>Acacia sibirica</i> over Open Hummock Grassland of <i>Triodia vanleeuwenii</i> and <i>Triodia pungens</i> in brown silty loams on hill slopes
	6d	FP AdAsAanc Tb CcCs	High Shrubland of <i>Acacia dictyophleba</i> , <i>Acacia sclerosperma</i> and <i>Acacia ancistrocarpa</i> over Open Hummock Grassland of <i>Triodia basedowii</i> over Open Tussock Grassland of <i>*Cenchrus ciliaris</i> and <i>*Cenchrus setiger</i> in brown sands on floodplains
	6e	HS AbaAwErfr Tv AaGrbAcao	High Shrubland of <i>Acacia balsamea</i> , <i>Acacia wanyu</i> and <i>Eremophila fraseri</i> over Open Hummock Grassland of <i>Triodia vanleeuwenii</i> with Low Open Woodland of <i>Acacia aptaneura</i> , <i>Grevillea berryana</i> and <i>Acacia catenulata</i> subsp. <i>occidentalis</i> in red sandy loams on undulating low hills
Acacia High Open Shrubland	7a	SP Aw ErcuScctMati EnraArcErx	High Open Shrubland of <i>Acacia wanyu</i> over Low Open Shrubland of <i>Eremophila cuneata</i> , <i>Sclerolaena cuneata</i> and <i>Maireana triptera</i> over Very Open Tussock Grassland of <i>Enteropogon ramosus</i> , <i>Aristida contorta</i> and <i>Eragrostis xerophila</i> in brown sandy loams on stony plains

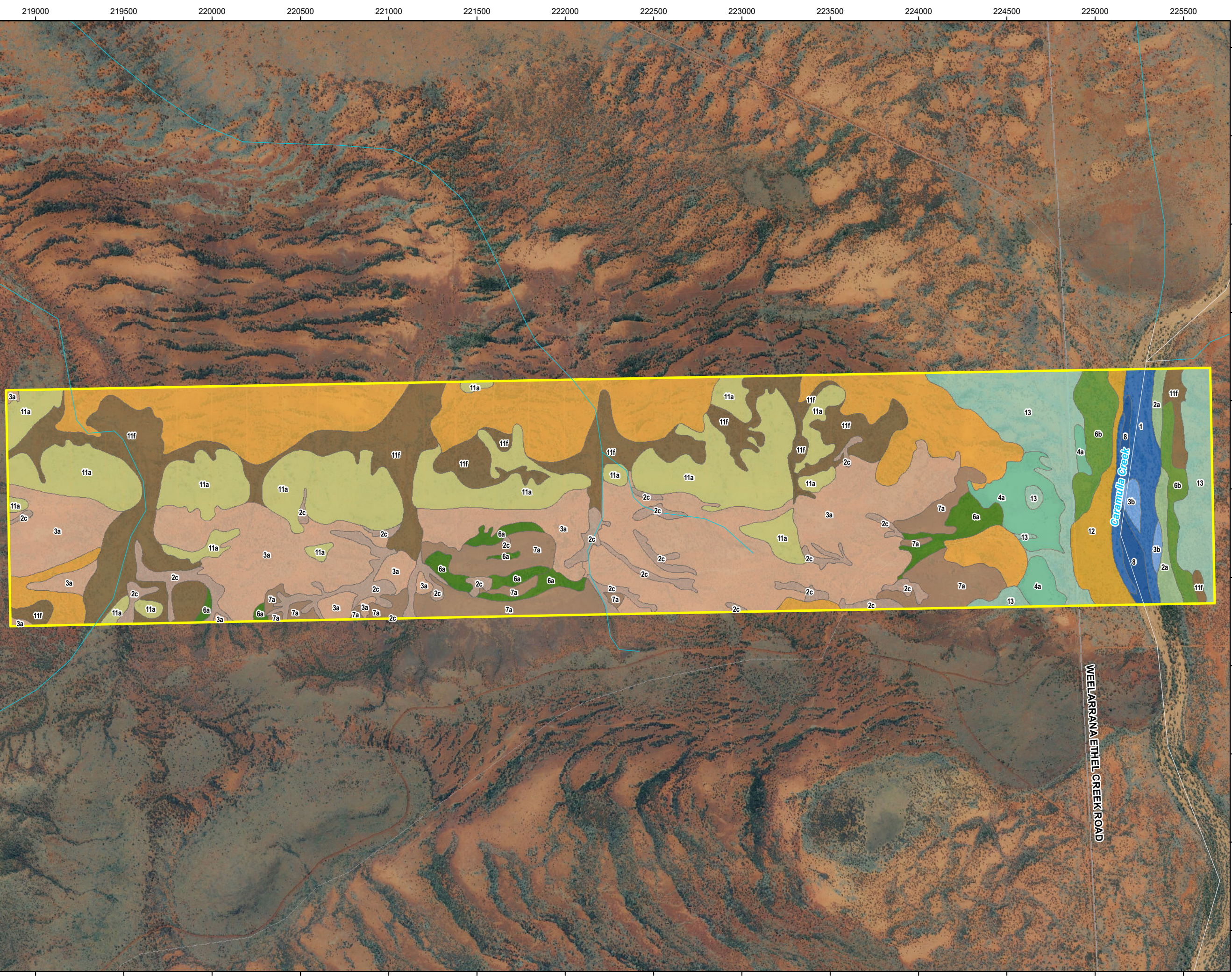
Broad Floristic Formation	Code	Vegetation Code	Vegetation Description
	7b	FS Aw SeglSes ErcuMatiMag	High Open Shrubland of <i>Acacia wanyu</i> over Open Shrubland of <i>Senna glutinosa</i> subsp. <i>luerssenii</i> and <i>Senna stricta</i> over Low Open Shrubland of <i>Eremophila cuneata</i> , <i>Maireana triptera</i> and <i>Maireana georgei</i> in brown silty loams on footslopes
<i>Petalostylis</i> High Open Shrubland	8	MA PIAPy TefcCocrCyf CyaAhh	High Open Shrubland of <i>Petalostylis labicheoides</i> and <i>Acacia pyrifolia</i> over Low Open Shrubland of <i>Tephrosia rosea</i> var. Fortescue Creeks (M.I.H. Brooker 2186), <i>Corchorus crozophorifolius</i> and <i>Cynanchum floribundum</i> over Very Open Tussock Grassland of <i>Cymbopogon ambiguus</i> , <i>Aristida holathera</i> var. <i>holathera</i> and * <i>Cenchrus ciliaris</i> in brown sands on major drainage lines
<i>Acacia</i> Shrubland	9	HS AmaDopSegl TpTv AmaAaa	Shrubland of <i>Acacia maitlandii</i> , <i>Dodonaea pachyneura</i> and <i>Senna glutinosa</i> subsp. <i>luerssenii</i> over Open Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia vanleeuwenii</i> with Low Open Shrubland of <i>Acacia maitlandii</i> and <i>Acacia adoxa</i> var. <i>adoxo</i> in brown silty loams on hill slopes
<i>Corchorus</i> Low Shrubland	10	MA CocrTefcApy AcpCh CcCyaArhh	Low Shrubland of <i>Corchorus crozophorifolius</i> , <i>Tephrosia rosea</i> var. Fortescue Creeks (M.I.H. Brooker 2186) and <i>Acacia pyrifolia</i> with Scattered Low Trees of <i>Acacia coriacea</i> subsp. <i>pendens</i> and <i>Corymbia hamersleyana</i> and Very Open Tussock Grassland of * <i>Cenchrus ciliaris</i> , <i>Cymbopogon ambiguus</i> and <i>Aristida holathera</i> var. <i>holathera</i> in brown loamy sands on major drainage lines
<i>Triodia</i> Hummock Grassland	11a	FS Tv GrwhAancAb SeglSegpAma	Hummock Grassland of <i>Triodia vanleeuwenii</i> with High Open Shrubland of <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> , <i>Acacia ancistrocarpa</i> and <i>Acacia bivenosa</i> over Open Shrubland of <i>Senna glutinosa</i> subsp. <i>luerssenii</i> , <i>Senna glutinosa</i> subsp. <i>pruinosa</i> and <i>Acacia maitlandii</i> in brown sandy loams on footslopes
	11b	HS TpTv EllAaHc Grwh	Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia vanleeuwenii</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> , <i>Acacia aptaneura</i> and <i>Hakea chordophylla</i> over High Open Shrubland of <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> in brown sandy loams on hill slopes
	11c	HS Tp SeggAmaSegp PtoSesErcu	Hummock Grassland of <i>Triodia pungens</i> with Open Shrubland of <i>Senna glutinosa</i> subsp. <i>glutinosa</i> , <i>Acacia maitlandii</i> and <i>Senna glutinosa</i> subsp. <i>pruinosa</i> and Low Open Shrubland of <i>Ptilotus obovatus</i> , <i>Senna stricta</i> and <i>Eremophila cuneifolia</i> in brown sandy loams on hill slopes
	11d	FS TvTb GrwhAancAads AtenAbAanc	Hummock Grassland of <i>Triodia vanleeuwenii</i> and <i>Triodia basedowii</i> with High Open Shrubland of <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> , <i>Acacia ancistrocarpa</i> and <i>Acacia adsurgens</i> and Open Shrubland of <i>Acacia tenuissima</i> , <i>Acacia bivenosa</i> and <i>Acacia ancistrocarpa</i> in brown loamy sands on footslopes
	11e	HC Tv AprHc SeglSegpAb	Hummock Grassland of <i>Triodia vanleeuwenii</i> with Low Open Woodland of <i>Acacia pruinocarpa</i> and <i>Hakea chordophylla</i> and Open Shrubland of <i>Senna glutinosa</i> subsp. <i>luerssenii</i> , <i>Senna glutinosa</i> subsp. <i>pruinosa</i> and <i>Acacia bivenosa</i> in brown sandy loams on hill crests

Broad Floristic Formation	Code	Vegetation Code	Vegetation Description
	11f	SP Tb AptApr ErffSeahAanc	Hummock Grassland of <i>Triodia basedowii</i> with Low Open Woodland of <i>Acacia pteraneura</i> and <i>Acacia pruinocarpa</i> and Open Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> and <i>Acacia ancistrocarpa</i> in brown loamy sands on sandy/stony plains
	11g	SA Tb ChHall AancAdAb	Hummock Grassland of <i>Triodia basedowii</i> with Low Open Woodland of <i>Corymbia hamersleyana</i> and <i>Hakea lorea</i> subsp. <i>lorea</i> and High Open Shrubland of <i>Acacia ancistrocarpa</i> , <i>Acacia dictyophleba</i> and <i>Acacia bivenosa</i> in red loamy sands on sandplains
	11h	SA Tb AscAsy AptHallApr	Hummock Grassland of <i>Triodia basedowii</i> with High Shrubland of <i>Acacia sclerosperma</i> and <i>Acacia synchronicia</i> and Low Open Woodland of <i>Acacia pteraneura</i> , <i>Hakea lorea</i> subsp. <i>lorea</i> and <i>Acacia pruinocarpa</i> in orange sands on sandplains
	11i	SA Tb AwSegl ChApr	Hummock Grassland of <i>Triodia basedowii</i> with Open Shrubland of <i>Acacia wanyu</i> and <i>Senna glutinosa</i> subsp. <i>luerssenii</i> and Scattered Low Trees of <i>Corymbia hamersleyana</i> and <i>Acacia pruinocarpa</i> in red loamy sands on sandplains
	11j	FS Tv AbaApa AbaSeglAw	Hummock Grassland of <i>Triodia vanleeuwenii</i> with High Open Shrubland of <i>Acacia balsamea</i> and <i>Acacia pachyacra</i> and Open Shrubland of <i>Acacia balsamea</i> , <i>Senna glutinosa</i> subsp. <i>luerssenii</i> and <i>Acacia wanyu</i> in brown sandy loams on footslopes
<i>Triodia</i> Open Hummock Grassland	12	SA Tb CcErerCs ChAaHall	Open Hummock Grassland of <i>Triodia basedowii</i> with Open Tussock Grassland of <i>*Cenchrus ciliaris</i> , <i>Eragrostis eriopoda</i> and <i>*Cenchrus setiger</i> and Low Open Woodland of <i>Corymbia hamersleyana</i> , <i>Acacia aptaneura</i> and <i>Hakea lorea</i> subsp. <i>lorea</i> in brown loamy sands on sandplains
<i>Aristida</i> Tussock Grassland	13	HP AriEuaChf AptAp PslAw	Tussock Grassland of <i>Aristida inaequiglumis</i> , <i>Eulalia aurea</i> and <i>Chrysopogon fallax</i> with Low Woodland of <i>Acacia pteraneura</i> and <i>Acacia paraneura</i> and High Open Shrubland of <i>Psydrax latifolia</i> and <i>Acacia wanyu</i> in brown sandy loams on hardpan plains
<i>Cenchrus</i> Tussock Grassland	14	FP CcCs AcpAciCh AdAsAmac	Tussock Grassland of <i>*Cenchrus ciliaris</i> and <i>*Cenchrus setiger</i> with Low Woodland of <i>Acacia coriacea</i> subsp. <i>pendens</i> , <i>Acacia citrinoviridis</i> and <i>Corymbia hamersleyana</i> and High Open Shrubland of <i>Acacia dictyophleba</i> , <i>Acacia sclerosperma</i> and <i>Acacia macraneura</i> in brown sands on floodplains

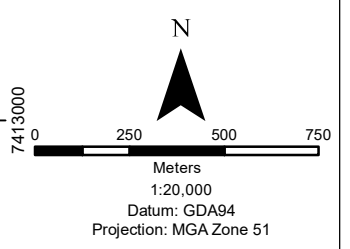
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Figure 9
Vegetation Types
Lasseter

Legend

Study Area



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Date: 03/01/2019
 Status: Final
 Figure: 9
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 Drawn by: GSM
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Figure 9 Vegetation Types Legend

Legend

 Study Area


Vegetation Types

Hill Crest

 HC Tv AprHc SeglSegpAb-11e

Hummock Grassland of *Triodia vanleeuwenii* with Low Open Woodland of *Acacia pruinocarpa* and *Hakea chordophylla* and Open Shrubland of *Senna glutinosa* subsp. *luerssenii*, *Senna glutinosa* subsp. *pruinosa* and *Acacia bivenosa* in brown sandy loams on hill crests

Hillslopes

 HS AbaAwErfr Tv AaGrbAcao-6e

High Shrubland of *Acacia balsamea*, *Acacia wanyu* and *Eremophila fraseri* over Open Hummock Grassland of *Triodia vanleeuwenii* with Low Open Woodland of *Acacia aptaneura*, *Grevillea berryana* and *Acacia catenulata* subsp. *occidentalis* in red sandy loams on undulating low hills

 HS AmaDopSegl TpTv AmaAaa-9

Shrubland of *Acacia maitlandii*, *Dodonaea pachyneura* and *Senna glutinosa* subsp. *luerssenii* over Open Hummock Grassland of *Triodia pungens* and *Triodia vanleeuwenii* with Low Open Shrubland of *Acacia maitlandii* and *Acacia adoxa* var. *adoxia* in brown silty loams on hill slopes

 HS Apt Ecap Tv-3a

Low Woodland of *Acacia pteraneura* over Low Shrubland of *Eremophila capricornica* over Open Hummock Grassland of *Triodia vanleeuwenii* in brown sandy loams on undulating low hills

 HS ArAsiAte ArEreAsi TvTp-6c

High Shrubland of *Acacia rhodophloia*, *Acacia sibirica* and *Acacia tetragonophylla* over Shrubland of *Acacia rhodophloia*, *Eremophila exiliifolia* and *Acacia sibirica* over Open Hummock Grassland of *Triodia vanleeuwenii* and *Triodia pungens* in brown silty loams on hill slopes

 HS Tp SeggAmaSegp PtoSesErcu-11c

Hummock Grassland of *Triodia pungens* with Open Shrubland of *Senna glutinosa* subsp. *glutinosa*, *Acacia maitlandii* and *Senna glutinosa* subsp. *pruinosa* and Low Open Shrubland of *Ptilotus obovatus*, *Senna stricta* and *Eremophila cuneifolia* in brown sandy loams on hill slopes

 HS TpTv EIIAaHc Grwh-11b

Hummock Grassland of *Triodia pungens* and *Triodia vanleeuwenii* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia*, *Acacia aptaneura* and *Hakea chordophylla* over High Open Shrubland of *Grevillea wickhamii* subsp. *hispidula* in brown sandy loams on hill slopes

Foot Slopes

 FS Aw SeglSes ErcuMatiMag-


High Open Shrubland of *Acacia wanyu* over Open Shrubland of *Senna glutinosa* subsp. *luerssenii* and *Senna stricta* over Low Open Shrubland of *Eremophila cuneata*, *Maireana triptera* and *Maireana georgei* in brown silty loams on footslopes

 FS Tv AbaApa AbaSeglAw-11j

Hummock Grassland of *Triodia vanleeuwenii* with High Open Shrubland of *Grevillea wickhamii* subsp. *hispidula*, *Acacia ancistrocarpa* and *Acacia bivenosa* over Open Shrubland of *Senna glutinosa* subsp. *luerssenii*, *Senna glutinosa* subsp. *pruinosa* and *Acacia maitlandii* in brown sandy loams on footslopes

 FS Tv GrwhAancAb SeglSegpAma-11a

Hummock Grassland of *Triodia vanleeuwenii* and *Triodia basedowii* with High Open Shrubland of *Grevillea wickhamii* subsp. *hispidula*, *Acacia ancistrocarpa* and *Acacia adsurgens* and Open Shrubland of *Acacia tenuissima*, *Acacia bivenosa* and *Acacia ancistrocarpa* in brown loamy sands on footslopes


 FS TvTb GrwhAancAads AtenAbAanc-11d

Low Open Forest of *Acacia citrinoviridis*, *Acacia coriacea* subsp. *pendens* and *Hakea lorea* subsp. *lorea* over Tussock Grassland of *Cenchrus ciliaris*, *Cenchrus setiger* and *Themeda avenacea* and Open Woodland of *Eucalyptus camaldulensis* subsp. *obtusata* and *Eucalyptus victrix* in brown silty loams on floodplains


Flood Plain

 FP AciAcpHall CcCsTha EcoEv-


High Shrubland of *Acacia dictyophleba*, *Acacia sclerosperma* and *Acacia ancistrocarpa* over Open Hummock Grassland of *Triodia basedowii* over Open Tussock Grassland of *Cenchrus ciliaris* and *Cenchrus setiger* in brown sands on floodplains

 FP AdAsAanc Tb CcCs-6d

High Shrubland of *Acacia sclerosperma*, *Acacia macraneura* and *Acacia sibirica* with Low Open Woodland of *Corymbia hamersleyana* and *Acacia pteraneura* and Open Shrubland of *Stylobasium spathulatum*, *Senna artemisioides* subsp. *oligophylla* and *Eremophila forrestii* subsp. *forrestii* in brown loamy sands on floodplains

 FP AsAmacAsi ChApt StspSeaoErff-

High Shrubland of *Acacia wanyu* over Low Shrubland of *Eremophila cuneifolia*, *Senna* sp. *Meekatharra* and *Frankenia setosa* over Open Tussock Grassland of *Enteropogon ramosus*, *Eriachne mucronata* and *Eragrostis xerophila* in brown loamy sands on drainage areas

 FP Aw ErcuSesmFrs EnraErmuErx-

Tussock Grassland of *Cenchrus ciliaris* and *Cenchrus setiger* with Low Woodland of *Acacia coriacea* subsp. *pendens*, *Acacia citrinoviridis* and *Corymbia hamersleyana* and High Open Shrubland of *Acacia dictyophleba*, *Acacia sclerosperma* and *Acacia macraneura* in brown sands on floodplains

 FP CcCs AcpAciCh AdAsAmac-14

Tussock Grassland of *Aristida inaequiglumis*, *Eulalia aurea* and *Chrysopogon fallax* with Low Woodland of *Acacia pteraneura* and *Acacia paraneura* and High Open Shrubland of *Psychdrax latifolia* and *Acacia wanyu* in brown sandy loams on hardpan plains


 HP AriEuaChf AptAp PslAw-13

Scattered Low Trees of *Acacia pteraneura* and *Acacia paraneura* over Scattered Low Shrubs of *Eremophila lanceolata*, *Senna artemisioides* subsp. *oligophylla* and *Ptilotus obovatus* over Scattered Tussock Grasses of *Aristida inaequiglumis*, *Aristida contorta* and *Eriachne helmsii* in brown sandy clay loams on hardpan plains

 HP AptAp ErlnSeaoPto AriArcErh-4a

Low Open Forest of *Acacia aptaneura*, *Grevillea berryana* and *Acacia aneura* over Shrubland of *Senna stricta*, *Dodonaea petiolaris* and *Scaevola acacioides* over Open Hummock Grassland of *Triodia pungens* and *Triodia vanleeuwenii* in brown silty loams on ironstone outcrops

Hardpan Plains

 HP AriEuaChf AptAp PslAw-13

Open Scrub of *Acacia ancistrocarpa* and *Acacia bivenosa* over Open Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Corymbia hamersleyana* and *Hakea lorea* subsp. *lorea* in red sands on sandplains

 HP AptAp ErlnSeaoPto AriArcErh-4a

Hummock Grassland of *Triodia basedowii* with High Shrubland of *Acacia sclerosperma* and *Acacia synchronicia* and Low Open Woodland of *Acacia pteraneura*, *Hakea lorea* subsp. *lorea* and *Acacia pruinocarpa* in orange sands on sandplains

Ironstone Outcrops

 GR AaGrbAan SesDopeSca TpTv-2b

Hummock Grassland of *Triodia basedowii* with Open Shrubland of *Acacia wanyu* and *Senna glutinosa* subsp. *luerssenii* and Scattered Low Trees of *Corymbia hamersleyana* and *Acacia pruinocarpa* in red loamy sands on sandplains


Sandy Plain

 SA AancAb Tb ChHall-5c

Open Hummock Grassland of *Triodia basedowii* with Open Tussock Grassland of *Cenchrus ciliaris*, *Eragrostis eriopoda* and *Cenchrus setiger* and Low Open Woodland of *Corymbia hamersleyana*, *Acacia aptaneura* and *Hakea lorea* subsp. *lorea* in brown loamy sands on sandplains

 SA Tb AscAsy AptHallApr-11h

Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Acacia pteraneura*, *Acacia paraneura* and *Acacia pruinocarpa* in red loamy sands on sandplains

 SA Tb AwSegl ChApr-

Hummock Grassland of *Triodia basedowii* with Open Shrubland of *Acacia wanyu* and *Senna glutinosa* subsp. *luerssenii* and Scattered Low Trees of *Corymbia hamersleyana* and *Acacia pruinocarpa* in red loamy sands on sandplains


 SA Tb CcEreCs ChAaHall-12

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 dictyophleba* and *Acacia bivenosa* in red loamy sands on sandplains


 SA Tb ChHall AancAdAb-11g

Low Open Forest of *Acacia catenulata* subsp. *occidentalis*, *Acacia pteraneura* and *Acacia pruinocarpa* over Shrubland of *Dodonaea petiolaris*, *Sida ectogama* and *Eremophila latrobei* subsp. *latrobei* with High Open Shrubland of *Psychdrax latifolia* and *Acacia tetragonophylla* in brown silty clay loams on stony plains

Stony Plain

 SP AcaoAptApr DopeSieErl PslAtet-

High Open Shrubland of *Acacia wanyu* over Low Open Shrubland of *Eremophila cuneata*, *Sclerolaena cuneata* and *Maireana triptera* over Very Open Tussock Grassland of *Enteropogon ramosus*, *Aristida contorta* and *Eragrostis xerophila* in brown sandy loams on stony plains


 SP Aw ErcuScctMati EnraArcErx-

Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Acacia pteraneura* and *Acacia pruinocarpa* and Open Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Senna artemisioides* subsp. *helmsii* and *Acacia ancistrocarpa* in brown loamy sands on sandy/stony plains

 SP Tb AptApr ErffSeahAanc-11f

Low Woodland of *Acacia coriacea* subsp. *pendens* and *Acacia citrinoviridis* over High Shrubland of *Melaleuca glomerata* over Open Tussock Grassland of *Cenchrus ciliaris*, *Cenchrus setiger* and *Aristida holathera* var. *holathera* in brown sands on major drainage lines

Major Drainage Line

 MA AcpAci Mg CcCsArhh-

Low Shrubland of *Corchorus crozophorifolius*, *Tephrosia rosea* var. *Fortescue* Creeks and *Acacia pyrifolia* with Scattered Low Trees of *Acacia coriacea* subsp. *pendens* and *Corymbia hamersleyana* and Very Open Tussock Grassland of *Cenchrus ciliaris*, *Cymbopogon ambiguus* and *Aristida holathera* var. *holathera* in brown loamy sands on major drainage lines

 MA CocrTefcApy AcpCh CcCyaArhh-

Woodland of *Eucalyptus camaldulensis* var. *obtusata* over Low Open Woodland of *Acacia coriacea* subsp. *pendens* and *Acacia citrinoviridis* over High Open Shrubland of *Melaleuca glomerata* and *Acacia pyrifolia* in brown sandy clay loams on major drainage lines

 MA Eco AcpAci MgApy-1

High Open Shrubland of *Petalostylis labicheoides* and *Acacia pyrifolia* over Low Open Shrubland of *Tephrosia rosea* var. *Fortescue* Creeks, *Corchorus crozophorifolius* and *Cynanchum floribundum* over Very Open Tussock Grassland of *Cymbopogon ambiguus*, *Aristida holathera* var. *holathera* and *Cenchrus ciliaris* in brown sands on major drainage lines


 MA PIApy TefcCocrCyf CyaAhh-8

Open Scrub of *Acacia monticola*, *Acacia ancistrocarpa* and *Grevillea wickhamii* subsp. *hispidula* over Shrubland of *Androcalva luteiflora* and *Acacia maitlandii* over Open Hummock Grassland of *Triodia pungens* in brown loamy sands on minor drainage lines

Minor Drainage Line

 MI AmAancGrwh AnlAma Tp-5a

Open Scrub of *Acacia wanyu*, *Androcalva luteiflora* and *Acacia maitlandii* over Shrubland of *Acacia wanyu*, *Senna glutinosa* subsp. *luerssenii* and *Acacia maitlandii* over Open Hummock Grassland of *Triodia pungens* in brown loamy sands on minor drainage lines

 MI AwAnlAma AwSeglAma Tp-5b

Mosaic of Low Open Forest of *Acacia catenulata* subsp. *occidentalis*, *Acacia pteraneura* and *Acacia pruinocarpa* over Shrubland of *Dodonaea petiolaris*, *Sida ectogama* and *Eremophila latrobei* subsp. *latrobei* with High Open Shrubland of *Psychdrax latifolia* and *Acacia tetragonophylla* in brown silty clay loams on stony plains and Scattered Low Trees of *Acacia pteraneura*, *Acacia catenulata* subsp. *occidentalis* and *Acacia aptaneura* over Scattered High Shrubs of *Eremophila latrobei* subsp. *latrobei* and *Acacia pteraneura* over Scattered Low Shrubs of *Ptilotus schwartzii*, *Ptilotus roei* and *Ptilotus obovatus* in brown silty clay loams on stony plains

Mosaic

 Mosaic of SP AcaoAptApr DopeSieErl PslAtet & SP AptAcaoAa ErlApt PtsctrPto-2c/4b

Open Scrub of *Acacia wanyu*, *Androcalva luteiflora* and *Acacia maitlandii* over Shrubland of *Acacia wanyu*, *Senna glutinosa* subsp. *luerssenii* and *Acacia maitlandii* over Open Hummock Grassland of *Triodia pungens* in brown loamy sands on minor drainage lines

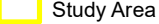





Date: 03/01/2019
Status: Final
Figure: 9
Sheet Size: A3
Internal Reference: JN_VT_West
Drawn by: GSM
Requested by: DB

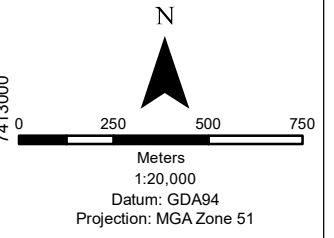
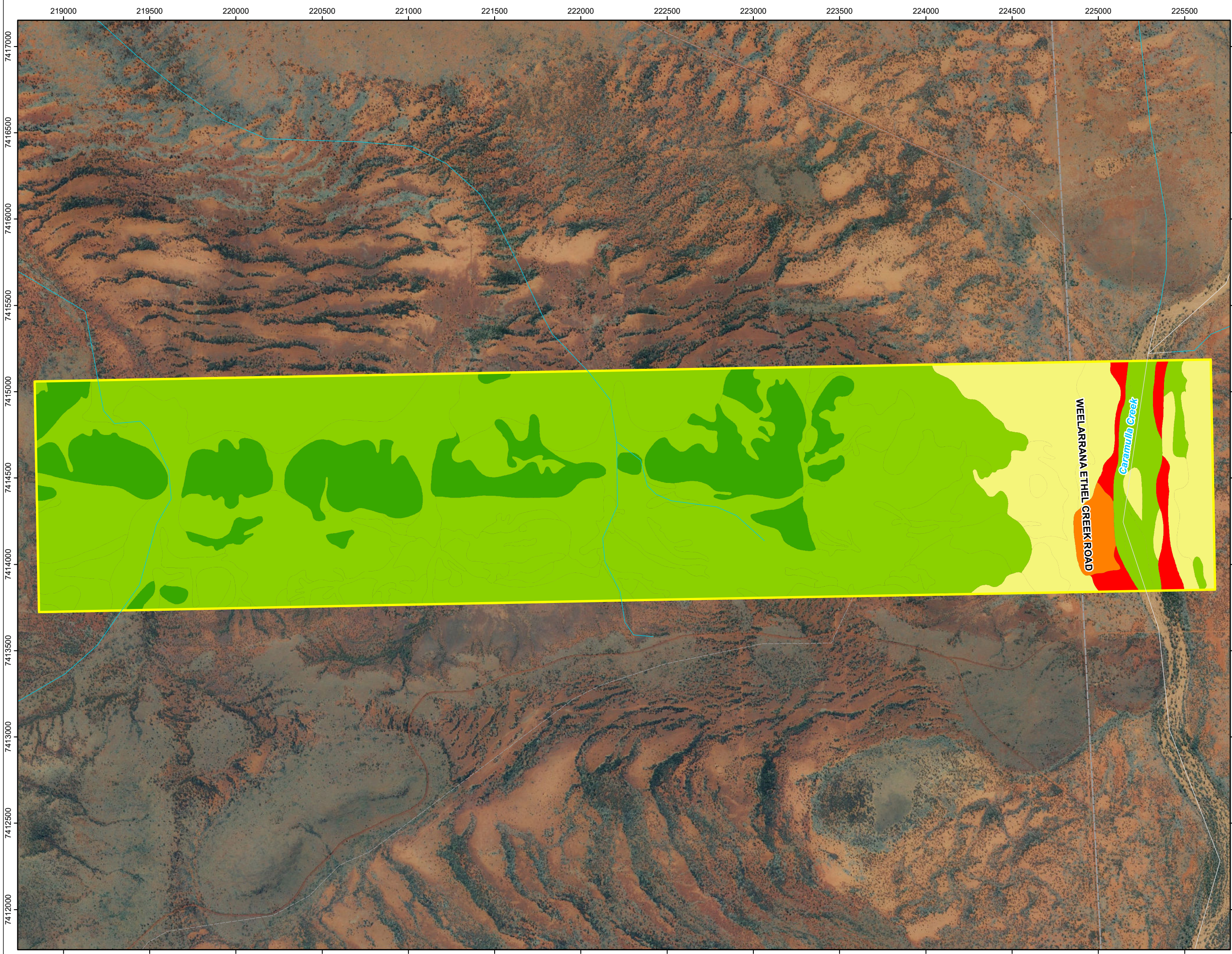
Vegetation Condition

Vegetation condition within the study area ranged from 'excellent' to 'degraded' (Figure 10). The condition of vegetation across the hillslopes, hillcrests and footslopes of the study area were generally rated as excellent to very good. Condition was generally reduced to good, poor or degraded in areas of lower relief including drainage lines and floodplains. The vegetation of the study area showed obvious signs of degradation by cattle grazing. **Cenchrus ciliaris* and/or **Cenchrus setiger* was a dominant component of seven vegetation associations along the major drainage line, occurring on the banks of the drainage line and extending across the floodplains.

Jimblebar Nth
Figure 10
Vegetation Condition
Lasseter

Legend

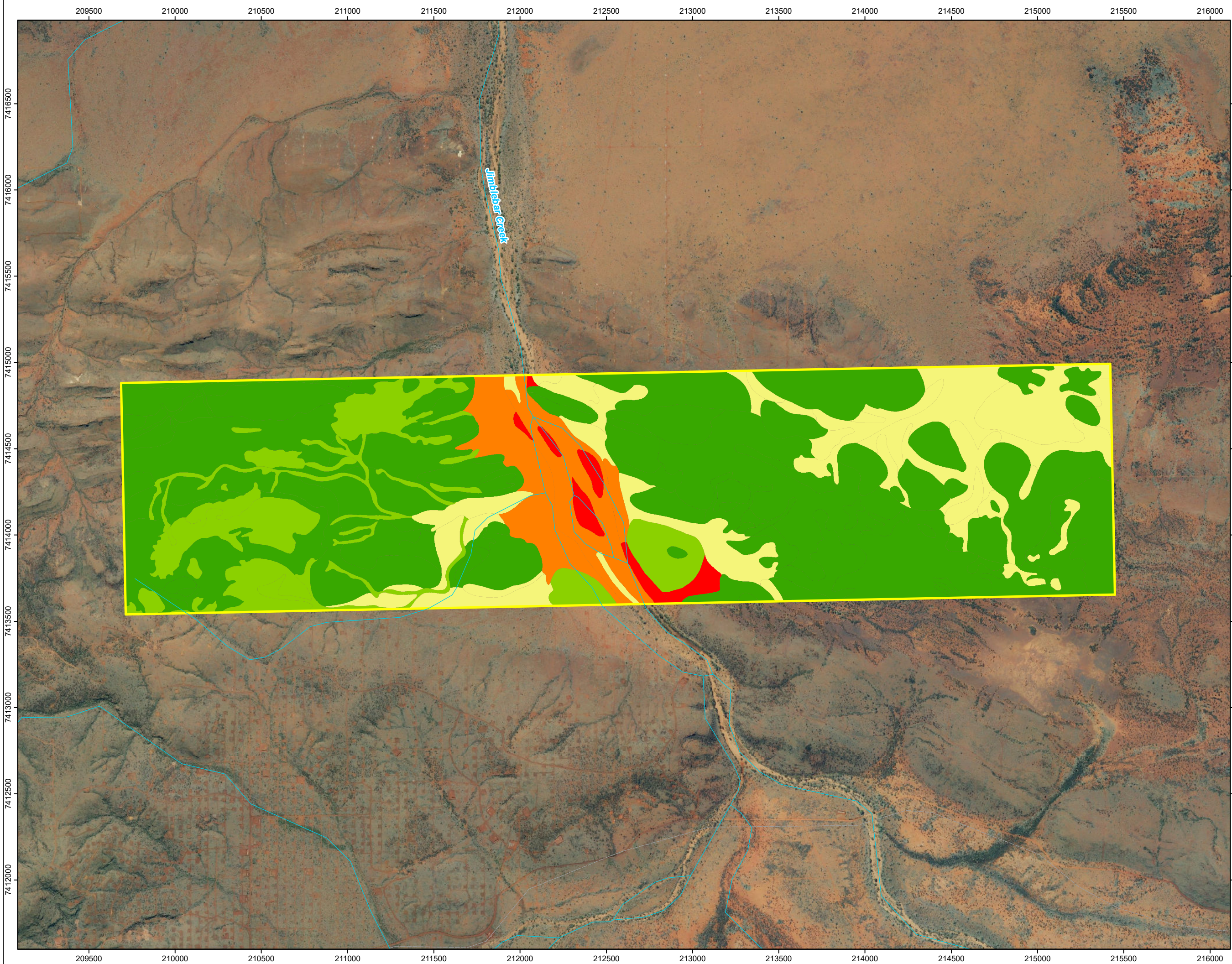
-  Study Area
- Vegetation Condition**
-  Degraded
-  Poor
-  Good
-  Very Good
-  Excellent



Date: 03/01/2019
Status: Final
Figure: 10
Sheet Size: A3
Internal Reference: JN_VC_East
Drawn by: GSM
Requested by: DB

Jimblebar Nth

Figure 10 Vegetation Condition Crowes Nest



Legend

Study Area

Vegetation Condition

- Degraded
- Poor
- Good
- Very Good
- Excellent

N

0 250 500 750

Meters
1:20,000
Datum: GDA94
Projection: MGA Zone 51

Date:	03/01/2019
Status:	Final
Figure:	10
Sheet Size:	A3
Internal Reference:	JN_VC_West
Drawn by:	GSM
Requested by:	DB

3.3.3 Ecological Communities

TECs listed under State and Federal Legislation

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

PECs recognised by DBCA

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

4.0 SUMMARY

The single season reconnaissance flora and vegetation survey of the Jimblebar North project area, covering the Crowes Nest and Lasseter deposits, was completed between the 12th and 17th of September 2018.

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 from the study area; *Eremophila capricornica* (Priority 1) and *Rhagodia* sp. Hamersley (M. Trudgen 17794) (Priority 3).

A total of 34 vegetation associations, classified into 14 broad floristic formations, were described and mapped within the study area. None of the vegetation associations within the study area had any affiliation with Federal or State listed TECs or PECs.

Two introduced flora (weed) species were opportunistically recorded from the study area, **Cenchrus ciliaris* and **Cenchrus setiger*, neither are listed as a Declared Pest under the BAM Act. Vegetation condition within the study area ranged from 'excellent' to 'degraded'.

5.0 STUDY TEAM

The reconnaissance flora and vegetation survey for the Jimblebar North study area was planned, coordinated and executed by the following personnel:

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Project Staff

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

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APPENDIX 1

Status codes for species listed on the IUCN 'Red List'

Category	Description
Extinct (EX)	A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Extinct in the Wild (EW)	A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Critically Endangered (CR)	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.
Near Threatened (NT)	A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
Least Concern (LC)	A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
Data Deficient (DD)	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.
Not Evaluated (NE)	A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

APPENDIX 2

Conservation categories for species listed 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 3

Conservation categories for species listed under the WC Act

Flora Species - Wildlife Conservation (Rare Flora) Notice 2017

Category	Description
Schedule 1	Flora that are considered likely to become extinct or rare, as critically endangered flora.
Schedule 2	Flora that are considered likely to become extinct or rare, as endangered flora.
Schedule 3	Flora that are considered likely to become extinct or rare, as vulnerable flora.
Schedule 4	Flora presumed to be extinct.

APPENDIX 4

Conservation codes for Western Australian flora

Threatened Species

Published as Specially Protected under the *Wildlife Conservation Act 1950*, and listed under Schedules 1 to 4 of the *Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora* (which may also be referred to as Declared Rare Flora).

Threatened fauna is that subset of 'Specially Protected Fauna' declared to be 'likely to become extinct' pursuant to section 14(4) of the *Wildlife Conservation Act*.

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*.

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.

Priority One: Poorly-known species

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

Priority Two: Poorly-known species

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

Priority Three: Poorly-known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

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

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.

(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent.

(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

APPENDIX 5

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

APPENDIX 6

Vegetation condition scale (as developed by Keighery 1994)

Condition	Description
Excellent	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Very Good	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
Good	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
Poor	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	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	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 7

Summary of background and results for previous flora and
vegetation surveys

Flora and Vegetation Surveys

Project	Survey Timing	Season	Survey Type	No. Taxa	Significant Flora	Introduced Flora
Surveys completed within or partly overlapping the study area						
Reconnaissance Flora and Vegetation Survey Caramulla (Onshore Environmental 2018)	17-21 Feb 2017	Poor	Reconnaissance	N/A	<i>Eremophila capricornica</i> (P1), <i>Ipomoea racemigera</i> (P2), <i>Crotalaria smithiana</i> (P3), <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3), <i>Goodenia nuda</i> (P4), <i>Indigofera</i> sp. indet (species of interest), <i>Tephrosia</i> sp. Willowra (G.M. Chippendale 4809) (species of interest)	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Citrullus</i> sp. indet, * <i>Malvastrum americanum</i> , * <i>Vachellia farnesiana</i>
Level 2 Riparian and Aquatic Flora and Vegetation Survey Jimblebar Creek and Innawally Pool (Onshore Environmental 2016)	25-29 May 2016	Poor	Detailed	242	<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3), <i>Goodenia nuda</i> (P4)	* <i>Cenchrus ciliaris</i> , * <i>Cynodon dactylon</i> , * <i>Echinochloa colona</i> , * <i>Malvastrum americanum</i> , * <i>Tribulus terrestris</i>
Targeted Flora Survey <i>Acacia</i> sp. East Fortescue (Onshore Environmental 2015a)	25-31 Mar 2015 2-6 Aug 2015	Excellent	Targeted	N/A	<i>Acacia</i> sp. East Fortescue (J. Bull & D. Roberts ONS A 27.01) (P1)	N/A
Consolidation of Regional Vegetation Mapping BHP Billiton Iron Ore Pilbara Tenure (Onshore Environmental 2014a)	24-30 Jul 2013 20-30 Aug 2013	Good	Vegetation Mapping	N/A	<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3), <i>Goodenia nuda</i> (P4)	N/A
Eastern Mines Weed Survey Jimblebar (Aston 2012)	22-30 May 2012	Good	Targeted	N/A	N/A	* <i>Aerva javanica</i> , * <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Chloris barbata</i> , * <i>Chloris virgata</i> , * <i>Citrullus colocynthis</i> , * <i>Cynodon dactylon</i> , * <i>Malvastrum americanum</i> , * <i>Rumex vesicarius</i> , * <i>Solanum nigrum</i> , * <i>Sonchus asper</i> , * <i>Vachellia farnesiana</i>

Project	Survey Timing	Season	Survey Type	No. Taxa	Significant Flora	Introduced Flora
Wheellarra Hill North Level 2 Flora and Vegetation Assessment (Syrinx Environmental 2012a)	17-29 May 2011 4-12 Oct 2011	Good	Detailed	321	<i>Aristida ?jerichoensis</i> var. <i>subspinulifera</i> (P3) ¹	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Malvastrum americanum</i>
Jimblebar Iron Ore Project Flora and Vegetation Assessment (Outback Ecology 2010)	12-18 Jul 2008 24-29 Sep 2008 24-26 Jan 2009 17-25 Mar 2009 27-29 Jul 2009	Poor	Detailed	326	<i>Goodenia nuda</i> (P4)	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Cucumis myriocarpus</i> , * <i>Malvastrum americanum</i> , * <i>Rumex vesicarius</i>
Caramulla Exploration Area Flora and Vegetation Survey and Fauna Assessment (GHD 2009)	1-8 Dec 2008	Poor	Detailed	225	<i>Crotalaria smithiana</i> (P3)	* <i>Cenchrus ciliaris</i> , * <i>Malvastrum americanum</i>
Jimblebar Flora and Soil Survey (Ecologia Environmental 1999)	11-16 Jun 1998	Good	Detailed	179	None	* <i>Cenchrus ciliaris</i> , * <i>Lactuca serriola</i> , * <i>Malvastrum americanum</i> , * <i>Sonchus oleraceus</i>
Surveys completed within the surrounding area						
Dynasty and West Jimblebar Flora and Vegetation Survey (Onshore Environmental 2015b)	Feb-Mar 2015	Good	Detailed	263	<i>Ipomoea racemigera</i> (P2), <i>Goodenia berringbinensis</i> (P4, RE ²), <i>Goodenia nuda</i> (P4), <i>Eragrostis speciosa</i> (RE), <i>Hibiscus verdcourtii</i> (RE), <i>Eleocharis pallens</i> (RE), <i>Tribulus</i> cf. <i>eichlerianus</i> (RE)	* <i>Aerva javanica</i> , * <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Malvastrum americanum</i>

¹ Targeted searches by Onshore Environmental (2014e) confirmed this taxon to be *Aristida inaequiglumis* (not Threatened or Priority flora)

² RE stands for range extension

Project	Survey Timing	Season	Survey Type	No. Taxa	Significant Flora	Introduced Flora
OB31 Jimblebar Access Track VCP Level 1 Flora and Vegetation Survey and Vertebrate Fauna Assessment (Onshore Environmental 2015c)	Jul 2015	Excellent	Reconnaissance	N/A	<i>Acacia clelandii</i> (RE)	* <i>Cenchrus ciliaris</i>
Jimblebar Creek Riparian Flora and Vegetation Baseline Survey (Onshore Environmental 2015d)	Sep 2014	Poor	Detailed	167	<i>Chamaecrista symonii</i> (RE), <i>Eragrostis speciosa</i> (RE), <i>Halgania erecta</i> (RE)	* <i>Cenchrus ciliaris</i> , * <i>Cenchrus setiger</i> , * <i>Bidens bipinnata</i>
Orebody 31 Level 2 Flora and Vegetation Assessment (Onshore Environmental 2014b)	Oct 2013	Good	Detailed	280	<i>Acacia</i> sp. East Fortescue (J. Bull & D. Roberts ONS A 27.01) (P1), <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) (P3), <i>Rhagodia</i> sp. Hamersley (M. Trudgen 12739) (P3)	* <i>Cenchrus ciliaris</i> , * <i>Malvastrum americanum</i>
OB19 Level 2 Flora and Vegetation Assessment (Onshore Environmental 2014c)	Mar 2013 Sep 2013	Good	Detailed	276	<i>Isotropis parviflora</i> (P2), <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) (P3)	* <i>Cenchrus ciliaris</i> , * <i>Bidens bipinnata</i>
South West Jimblebar Level 2 Flora and Vegetation Survey (Syrinx Environmental 2014)	Mar 2011 Aug-Sep 2013	Good	Detailed	330	<i>Vittadinia</i> sp. Coondewanna Flats (S. van Leeuwen 4684) (P1), <i>Euphorbia inappendiculata</i> var. <i>inappendiculata</i> (P2), <i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3), <i>Abutilon malvifolium</i> (RE), <i>Brachyscome ciliaris</i> (RE), <i>Euphorbia porcata</i> (RE), <i>Diplachne fusca</i> subsp. <i>muelleri</i> (RE), <i>Tephrosia sphaerospora</i> (RE)	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Cenchrus setiger</i> , * <i>Malvastrum americanum</i> , * <i>Taraxacum khatoonae</i> , * <i>Vachellia farnesiana</i>
OB31 Targeted Significant Flora Survey (Onshore Environmental 2014d)	Apr 2014	Excellent	Targeted	N/A	<i>Acacia</i> sp. East Fortescue (J. Bull & D. Roberts ONS A 27.01) (P1), <i>Rhagodia</i> sp. Hamersley (M. Trudgen 12739) (P3), <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) (P3), <i>Goodenia nuda</i> (P4), <i>Acacia clelandii</i> (RE)	N/A

Project	Survey Timing	Season	Survey Type	No. Taxa	Significant Flora	Introduced Flora
Tenement E52/2238 Level 1 Flora and Vegetation Level 1 Vertebrate Fauna Survey (Onshore Environmental 2014e)	Jul 2014	Good	Reconnaissance	N/A	None	* <i>Cenchrus ciliaris</i> , * <i>Vachellia farnesiana</i>
OB18 to OB31 Infrastructure Corridor Targeted Flora Survey (Onshore Environmental 2014f)	Sep 2014	Good	Targeted	N/A	<i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) (P3), <i>Goodenia nuda</i> (P4)	* <i>Cenchrus ciliaris</i>
Orebody 17/18 Derived Vegetation Association Mapping Report (Onshore Environmental 2013)	N/A	N/A	Desktop	N/A	N/A	N/A
South West Jimblebar Flora and Vegetation Survey (Syrinx Environmental 2012b)	Mar 2011	Good	Detailed	202	<i>Aristida ?jerichoensis</i> var. <i>subspinulifera</i> (P3), <i>Goodenia ?nuda</i> (P4), <i>Alloteropsis cimicina</i> (RE), <i>Brachyscome ciliaris</i> (RE), <i>Evolvulus alsinoides</i> var. <i>decumbens</i> (RE), <i>Tephrosia sphaerospora</i> (RE), <i>Tribulopsis angustifolia</i> (RE)	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i>
Level 1 Flora and Fauna Surveys along the Great Northern Highway for Jimblebar Mine Module Transport (Eco Logical Australia 2012)	Aug 2011	Good	Reconnaissance	52	None	* <i>Cenchrus ciliaris</i>
Orebody 31 Flora and Vegetation Assessment (Syrinx Environmental 2011)	Feb 2011 Mar 2011	Good	Detailed	206	None	* <i>Cenchrus ciliaris</i> , * <i>Malvastrum americanum</i>

Project	Survey Timing	Season	Survey Type	No. Taxa	Significant Flora	Introduced Flora
RGP6 Jimblebar Hub (Water Pipeline) Flora and Vegetation Assessment (ENV Australia 2010a)	Nov 2009	Poor	Detailed	166	None	* <i>Cenchrus ciliaris</i> , * <i>Malvastrum americanum</i>
Jimblebar Wye Targeted Declared Rare Flora and Priority Listed Flora Assessment (ENV Australia 2010b)	Mar 2010 Jun 2010	Good	Targeted	N/A	<i>Gymnanthera cunninghamii</i> (P3)	N/A
Ammonium Nitrate Storage Facility Flora and Vegetation Assessment (ENV Australia 2009a)	Sep 2009	Poor	Detailed	123	None	* <i>Cenchrus ciliaris</i>
Construction Water Supply Pipeline and Ammonium Nitrate Storage Facility Flora and Vegetation Assessment (ENV Australia 2009b)	Sep-Nov 2009	Poor	Detailed	213	<i>Goodenia nuda</i> (P4)	* <i>Cenchrus ciliaris</i> , * <i>Malvastrum americanum</i>
Eastern Pilbara Accommodation Camp Flora and Fauna Assessment (Outback Ecology 2009a)	Oct-Nov 2008	Poor	Detailed	115	None	None
Wheelarra Hill Iron Ore Mine Modification Flora and Fauna Assessment (Outback Ecology 2009b)	Oct-Nov 2008 Jan 2009	Poor Good	Detailed	146	<i>Goodenia nuda</i> (P4)	* <i>Cenchrus ciliaris</i>
Draft Report for Wheelarra Hill (Jimblebar Mine Site) Priority Species Verification – <i>Goodenia hartiana</i> (GHD 2008a)	Sep 2007	Poor	Targeted	N/A	None	N/A

Project	Survey Timing	Season	Survey Type	No. Taxa	Significant Flora	Introduced Flora
Mesa Gap Biological Survey (GHD 2008b)	Oct 2007	Poor	Detailed	133	None	None
Rapid Growth Project 5: Repeater 9 Access Road Flora and Vegetation Assessment (ENV Australia 2008a)	Jun 2008	Poor	Detailed	163	<i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3)	* <i>Aerva javanica</i> , * <i>Brassica tournefortii</i> , * <i>Cenchrus ciliaris</i> , * <i>Citrullus lanatus</i> , * <i>Cynodon dactylon</i> , * <i>Datura leichhardtii</i> , * <i>Malvastrum americanum</i> , * <i>Rumex vesicarius</i> , * <i>Setaria verticillata</i> , * <i>Sonchus asper</i> , * <i>Sonchus oleraceus</i> , * <i>Vachellia farnesiana</i>
Jimblebar Access Road Flora and Vegetation Assessment (ENV Australia 2008b)	May 2007	Poor	Detailed	112	None	* <i>Aerva javanica</i> , * <i>Cenchrus ciliaris</i> , * <i>Citrullus lanatus</i>
OB17 Flora and Vegetation Survey (Pilbara Flora 2008)	Oct 2008	Poor	Detailed	61	None	None
West Jimblebar Exploration Lease Flora and Vegetation Assessment - Management Recommendations (ENV Australia 2007a)	May 2007	Average	Detailed	318	<i>Goodenia nuda</i> (P4), <i>Thyridolepis xerophila</i> (RE)	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Malvastrum americanum</i>
OB18 Flora and Vegetation Assessment Phase II (ENV Australia 2007b)	Jul-Aug 2006	Good	Detailed	276	None	* <i>Cenchrus ciliaris</i> , * <i>Rumex vesicarius</i>
Jimblebar Stage 2, Levee Banks and Communications Tower Redevelopment Flora and Vegetation Assessments (ENV Australia 2007c)	Apr 2007 Jun 2007	Average	Detailed	103	None	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Cenchrus setiger</i> , * <i>Citrullus lanatus</i> , * <i>Cynodon dactylon</i>

Project	Survey Timing	Season	Survey Type	No. Taxa	Significant Flora	Introduced Flora
RGP4 Jimblebar Rail Loop Flora and Vegetation Assessment (ENV Australia 2007d)	Nov-Dec 2006	Good	Detailed	65	None	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i>
Jimblebar Marra Mamba Exploration Biological Survey (Ecologia Environmental 2006)	May 2006	Good	Detailed	267	<i>Goodenia nuda</i> (P4)	* <i>Cenchrus ciliaris</i> , * <i>Rumex vesicarius</i>
East Jimblebar Exploration Project Biological Survey (Ecologia Environmental 2005)	Feb 2005	Good	Detailed	155	None	* <i>Cenchrus ciliaris</i>
OB18 Flora and Fauna Review (Ecologia Environmental 2004a)	Jul 2004	Good	Targeted	155	<i>Rhodanthe frenchii</i> (P2) ³	* <i>Cenchrus ciliaris</i>
Jimblebar-Wheelarra Hill Expansion Biological Study (Ecologia Environmental 2004b)	Feb 2004	Good	Detailed	181	None	* <i>Cenchrus ciliaris</i>
Eastern Ophthalmia Range Expansion Biological Survey (Ecologia Environmental 2004c)	Mar 2004	Good	Detailed	248	<i>Isotropis winneckeii</i> (P1) ⁴	
Jimblebar - Wheelarra Hill 3 Flora and Fauna Assessment (Biota Environmental Sciences 2004)	Aug 2003	Poor	Detailed	227	None	* <i>Rumex vesicarius</i>

³ It is noted that the original identification was not confirmed through the WAH and the collection represents a 300 km range extension to the east. It has not been recorded locally during numerous surveys over a 17 year period since the original record

⁴ Early identifications of *Isotropis winneckeii* have since been confirmed by the WAH to be *Isotropis parviflora*, as *Isotropis winneckeii* does not occur in the Pilbara

Project	Survey Timing	Season	Survey Type	No. Taxa	Significant Flora	Introduced Flora
Jimblebar Rail Spur Biological Assessment Survey (Ecologia Environmental 1996)	Jun 1995	Good	Detailed	106	None	* <i>Cenchrus ciliaris</i> , * <i>Malvastrum americanum</i> , * <i>Rumex vesicarius</i> , * <i>Sonchus oleraceus</i>
Orebody 18 Biological Assessment Survey (Ecologia Environmental 1995)	Aug 1995	Good	Detailed	250	None	* <i>Bidens bipinnata</i> , * <i>Rumex vesicarius</i> , * <i>Sonchus oleraceus</i>
Jimblebar Mine Site Biological Survey (BHP IO 1994)	Jun 1994	Good	Detailed	132	None	* <i>Rumex vesicarius</i>
Ecological Observations Jimblebar Railway Line (Dames and Moore 1993)	Nov 1992	Poor	Targeted	N/A	None	N/A

APPENDIX 8

Records for conservation significant flora species recorded from
the study area

SPECIES	# INDIVIDUALS	COUNT OR ESTIMATE	COVERAGE	PLANT HEIGHT
<i>Eremophila capricornica</i>	60	Count	4	0.4
<i>Eremophila capricornica</i>	8	Count	<1	0.35
<i>Eremophila capricornica</i>	2	Count	<1	0.3
<i>Eremophila capricornica</i>	2	Count	<1	0.35
<i>Eremophila capricornica</i>	55	Count	3	0.4
<i>Eremophila capricornica</i>	120	Count	6	0.4
<i>Eremophila capricornica</i>	80	Count	5	0.45
<i>Eremophila capricornica</i>	5	Count	<1	0.35
<i>Eremophila capricornica</i>	1	Count	<1	0.4
<i>Eremophila capricornica</i>	3	Count	<1	0.3
<i>Eremophila capricornica</i>	40	Count	3	0.4
<i>Eremophila capricornica</i>	100	Count	7	0.4
<i>Eremophila capricornica</i>	15	Count	1	0.4
<i>Eremophila capricornica</i>	45	Count	3	0.4
<i>Eremophila capricornica</i>	90	Count	6	0.4
<i>Eremophila capricornica</i>	130	Count	11	0.4
<i>Eremophila capricornica</i>	140	Count	11	0.4
<i>Eremophila capricornica</i>	160	Count	10	0.4
<i>Eremophila capricornica</i>	75	Count	6	0.4
<i>Eremophila capricornica</i>	56	Count	3.5	0.4
<i>Eremophila capricornica</i>	15	Count	1	0.4
<i>Eremophila capricornica</i>	27	Count	3	0.3
<i>Eremophila capricornica</i>	67	Count	5	0.4
<i>Eremophila capricornica</i>	20	Count	1.5	0.3
<i>Eremophila capricornica</i>	10	Count	0.5	0.4
<i>Eremophila capricornica</i>	8	Count	0.5	0.45
<i>Eremophila capricornica</i>	>150	Estimate	18	0.4
<i>Eremophila capricornica</i>	37	Count	3	0.4
<i>Eremophila capricornica</i>	20	Count	1	0.4

SPECIES	# INDIVIDUALS	COUNT OR ESTIMATE	COVERAGE	PLANT HEIGHT
<i>Eremophila capricornica</i>	40	Count	2.5	0.4
<i>Eremophila capricornica</i>	40	Count	2.5	0.4
<i>Eremophila capricornica</i>	2	Count	<1	0.4
<i>Eremophila capricornica</i>	50	Count	3	0.4
<i>Eremophila capricornica</i>	15	Count	1	0.4
<i>Eremophila capricornica</i>	25	Count	1.5	0.4
<i>Eremophila capricornica</i>	80	Count	6	0.4
<i>Eremophila capricornica</i>	100	Count	7	0.45
<i>Eremophila capricornica</i>	8	Count	0.5	0.4
<i>Eremophila capricornica</i>	100	Count	7	0.4
<i>Eremophila capricornica</i>	55	Count	3.5	0.4
<i>Eremophila capricornica</i>	40	Count	2.5	0.4
<i>Eremophila capricornica</i>	62	Count	5	0.4
<i>Eremophila capricornica</i>	85	Count	6	0.4
<i>Eremophila capricornica</i>	95	Count	6.5	0.5
<i>Eremophila capricornica</i>	21	Count	1.5	0.4
<i>Eremophila capricornica</i>	40	Count	2	0.35
<i>Eremophila capricornica</i>	130	Count	7	0.4
<i>Eremophila capricornica</i>	48	Count	4	0.35
<i>Eremophila capricornica</i>	30	Count	1.5	0.4
<i>Eremophila capricornica</i>	90	Count	5.5	0.4
<i>Eremophila capricornica</i>	2	Count	<1	0.5
<i>Eremophila capricornica</i>	70	Count	5	0.4
<i>Eremophila capricornica</i>	80	Count	8	0.4
<i>Eremophila capricornica</i>	100	Count	5	0.4
<i>Eremophila capricornica</i>	95	Count	5	0.4
<i>Eremophila capricornica</i>	30	Count	2	0.4
<i>Eremophila capricornica</i>	20	Count	1	0.4
<i>Eremophila capricornica</i>	75	Count	6	0.4

SPECIES	# INDIVIDUALS	COUNT OR ESTIMATE	COVERAGE	PLANT HEIGHT
<i>Eremophila capricornica</i>	80	Count	7	0.4
<i>Eremophila capricornica</i>	8	Count	<1	0.3
<i>Eremophila capricornica</i>	15	Count	3	2-4
<i>Eremophila capricornica</i>	5	Count	<1	0.3
<i>Eremophila capricornica</i>	55	Count	4	0.4
<i>Eremophila capricornica</i>	85	Count	6	0.4
<i>Eremophila capricornica</i>	40	Count	3	0.4
<i>Eremophila capricornica</i>	20	Count	0.5	0.3
<i>Eremophila capricornica</i>	120	Count	12	0.4
<i>Eremophila capricornica</i>	50	Count	2.5	0.4
<i>Eremophila capricornica</i>	90	Count	8	0.4
<i>Eremophila capricornica</i>	65	Count	4	0.4
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)	3	Count	<1	1.2
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)	3	Count	<1	1
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)	3	Count	<1	1-2
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)	3	Count	<1	1-2
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)	1	Count	<1	1.5
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)	3	Count	<1	1.5
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)	1	Count	<1	1
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)	4	Count	<1	1
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)	1	Count	<1	1
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)	2	Count	<1	1.2
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)	4	Count	<1	1.2
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)	1	Count	<1	1.5
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)	6	Count	0.5	1-2

APPENDIX 9

Records for introduced flora species recorded from the study area

SPECIES	# INDIVIDUALS	COUNT OR ESTIMATE	COVERAGE	PLANT HEIGHT
<i>*Cenchrus ciliaris</i>	50	Count	2	0.3
<i>*Cenchrus ciliaris</i>	>300	Estimate	15	0.4
<i>*Cenchrus ciliaris</i>	50	Count	3	0.4
<i>*Cenchrus ciliaris</i>	5	Count	<1	0.2
<i>*Cenchrus ciliaris</i>	25	Count	0.5	0.3
<i>*Cenchrus ciliaris</i>	130	Count	1.5	0.2
<i>*Cenchrus ciliaris</i>	5	Count	<1	0.4
<i>*Cenchrus ciliaris</i>	25	Count	1	0.3
<i>*Cenchrus ciliaris</i>	100	Count	7	0.5
<i>*Cenchrus ciliaris</i>	20	Count	0.5	0.3
<i>*Cenchrus ciliaris</i>	>100	Estimate	5	0.5
<i>*Cenchrus ciliaris</i>	>100	Estimate	5	0.1
<i>*Cenchrus ciliaris</i>	>300	Estimate	35	0.3
<i>*Cenchrus ciliaris</i>	>300	Estimate	20	0.1
<i>*Cenchrus ciliaris</i>	>150	Count	10	0.3
<i>*Cenchrus ciliaris</i>	>300	Count	40	0.2
<i>*Cenchrus ciliaris</i>	>100	Estimate	7	0.1
<i>*Cenchrus ciliaris</i>	>200	Estimate	10	0.3
<i>*Cenchrus ciliaris</i>	30	Count	1	0.3
<i>*Cenchrus ciliaris</i>	50	Count	1	0.3
<i>*Cenchrus ciliaris</i>	>200	Estimate	>25	0.5
<i>*Cenchrus ciliaris</i>	>500	Estimate	40	0.5
<i>*Cenchrus setiger</i>	50	Count	2	0.4
<i>*Cenchrus setiger</i>	50	Count	3	0.4
<i>*Cenchrus setiger</i>	5	Count	<1	0.2
<i>*Cenchrus setiger</i>	100	Count	5	0.5
<i>*Cenchrus setiger</i>	>100	Estimate	5	0.1
<i>*Cenchrus setiger</i>	>100	Estimate	20	0.3
<i>*Cenchrus setiger</i>	>300	Estimate	20	0.1

SPECIES	# INDIVIDUALS	COUNT OR ESTIMATE	COVERAGE	PLANT HEIGHT
<i>*Cenchrus setiger</i>	>150	Count	10	0.3
<i>*Cenchrus setiger</i>	50	Count	2	0.4
<i>*Cenchrus setiger</i>	3	Count	<1	1.5
<i>*Cenchrus setiger</i>	>200	Estimate	>25	0.5
<i>*Cenchrus setiger</i>	>400	Estimate	30	0.5