Rio Tinto

Desktop Flora, Vegetation and Fauna Habitat Assessment at Bungaroo, Robe Valley

Native Vegetation Clearing Permit – Supporting Report

(FDMS RTIO-HSE-0253278)



Robe River Ltd (a member of the Rio Tinto Group)

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EXECUTIVE SUMMARY

Rio Tinto Iron Ore is proposing to undertake mineral, geotechnical and hydrological exploration activities at Bungaroo, Robe Valley (the Proposal). Approval for clearing of native vegetation associated with the proposal is required via a Native Vegetation Clearing Permit (**NVCP**) under Section 51A of the *Environmental Protection Act 1986* (**EP Act**). The study area is approximately 782 ha in size and is located approximately 28 km south of Pannawonica, within the Pilbara region of Western Australia.

Vegetation, flora and fauna assessments at Bungaroo (the study area) were required to address the Ten Clearing Principles as part of the NVCP application process. The study area was surveyed in accordance with Environmental Protection Authority (**EPA**) Position Statement No. 3 (EPA 2002), EPA Guidance Statement No. 51 (EPA 2004a) and Guidance Statement No. 56 (EPA 2004b).

Several previous biological studies have been conducted within the study area and in the locality, including NVCP level assessments and systematic flora surveys. Two conservation listed flora taxa have previously been recorded from the locality. s

The majority of landforms, vegetation, flora and fauna habitats are well represented within the Bungaroo locality and the broader Hamersley subregion. Seventeen vegetation associations were identified across four major landforms over the study area, with an additional 10.0 ha of cleared and disturbed land, associated with historical exploration tracks and clearing.

Four vegetation units were considered significant by Biota (2007a; 2012). Three of these vegetation units were considered to represent Ecosystems at Risk (Major Ephemeral Water Courses) as defined by Kendrick (2001): DC1 ChGpTe, DC2 EvApyAtrTe and DC3 EvCv (Biota 2007a). These vegetation units make up 439.9 ha or 56.2 % of the study area. The other significant vegetation unit, Unit H2 ElAiAbTw (1.8 ha or 0.2 % of the study area), supports large populations of habitat-restricted flora, including the Priority 3 species *Triodia* sp. Robe River (M.E. Trudgen *et al.* 12367), which has been recorded in the study area. This vegetation unit is not restricted to the study area.

Biota (2007a) recorded a total of 351 native flora taxa from 151 genera representing 57 families from the combined Bungaroo project area and broader Bungaroo Valley. This survey area is more than seven times the size of the study area, and it is therefore likely that the Bungaroo study area contains fewer flora taxa than were recorded during the Biota (2007a) survey. Two conservation listed flora taxa were recorded in the study area:

- *Triodia* sp. Robe River (M.E. Trudgen *et al.* MET 12367) – Priority 3; and
- *Rhynchosia bungarensis* – Priority 4.

In addition to the two Priority species known to occur within the study area, one species was considered likely to occur within the study area:

- *Indigofera* sp. Bungaroo Creek (S. van Leeuwen 4301) – Priority 3.

Two Priority flora species were also considered to potentially occur within the study area:

- *Stylidium weeliwolli* – Priority 2; and
- *Eragrostis surreyana* – Priority 3.

Six weed species were previously recorded within the study area. Of these six, **Argemone ochroleuca* subsp*. ochroleuca* is listed as a Declared Pest under the *Biosecurity and Agriculture Management Act 2007*, under category C3 (Management) (DAFWA 2015).

Of the three fauna habitats identified within the study area, the 'Drainage Lines' and 'Rocky Hills and Slopes' habitats have the potential to support fauna of conservation significance, covering 333.9 ha (51.3 %) and 37.2 ha (4.8 %) respectively. Whilst these habitats are considered significant for a range of conservation listed fauna species, no significant microhabitats are considered to be present (Biota 2007b). These fauna habitats are considered well represented in the Bungaroo locality and Hamersley subregion.

The study area occurs within the mapped extent of the Priority 1 'Stygofaunal community of the Bungaroo Aquifer' Priority Ecological Community. Bungaroo Creek bore field overlaps the study area; water extraction as part of the Pilbara Coastal Water Supply project from this bore field utilises approximately 10 GL of water per year from the Bungaroo Aquifer (Biota 2013). This Priority Ecological Community is considered unlikely to be affected by the Proposal as it is understood minimal additional disturbance to groundwater will result from the proposed mineral, geotechnical and hydrological exploration activities.

No conservation listed fauna taxa have been previously recorded from the study area. Five species are considered 'likely' to occur within the study area as it provides them with suitable habitat:

- *Dasyurus hallucatus* (Northern Quoll) – Schedule 1, Endangered;
- *Liasis olivaceus barroni* (Pilbara Olive Python) – Schedule 1, Vulnerable;
- *Rhinonicteris aurantius* (Pilbara Leaf-nosed Bat) – Schedule 1, Vulnerable;
- *Merops ornatus* (Rainbow Bee-eater) – Schedule 3, Migratory; and
- *Notoscincus butleri* (Lined Soil-crevice Skink) – Priority 4.

Given the relatively low level of impact associated with mineral, geotechnical and hydrological exploration activities, the Proposal is not expected to significantly diminish potential habitat of these species at a local or regional scale.

Based on specialist assessment of the study area, it is deemed that the Proposal is not considered to be at variance with any of the Ten Clearing Principles under Schedule 5 of the EP Act.

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1 INTRODUCTION

1.1 PROJECT BACKGROUND AND STUDY AREA LOCATION

Rio Tinto Iron Ore (**Rio Tinto**), on behalf of Robe River Ltd, proposes to undertake mineral, geotechnical and hydrological exploration activities at Bungaroo (the **Proposal**). Approval for clearing of native vegetation associated with the Proposal is required via a Native Vegetation Clearing Permit (**NVCP**) under Section 51A of *the Environmental Protection Act 1986* (**EP Act**).

Vegetation, flora and fauna assessments at Bungaroo (the **study area**) were required to address the Ten Clearing Principles as part of the NVCP application process.

The study area covers approximately 782 ha of predominantly undisturbed ground and intact native vegetation, as well as disturbed areas.

The study area is located approximately 28 km south of Pannawonica, and is approximately 20 km to the south-east of the Mesa J Mine site, within the Pilbara region of Western Australia (**WA**) (Figure 1-1).

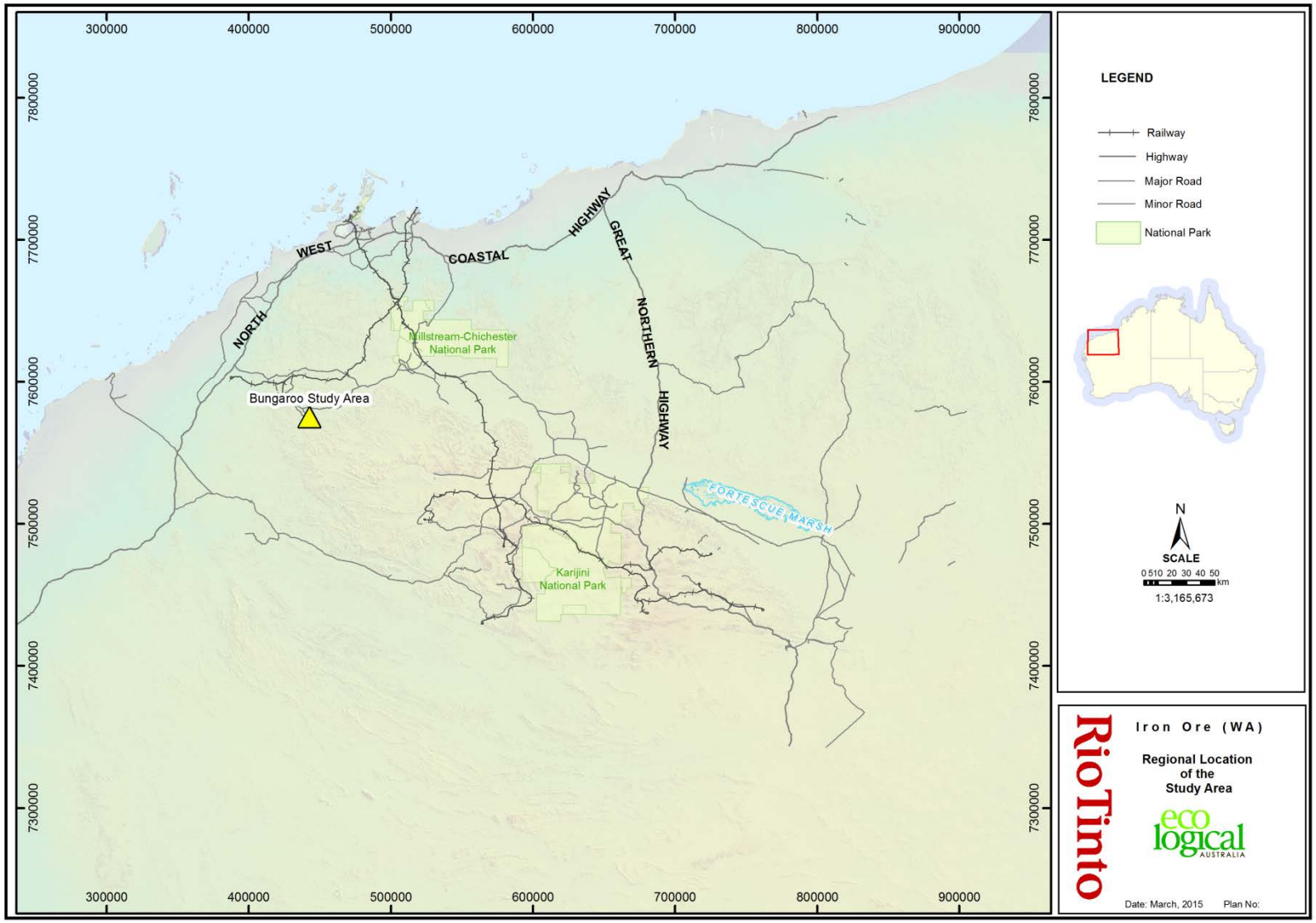


Figure 1-1: Location of the Study Area

1.2 SCOPE OF SURVEY

This report describes the methodologies employed for the flora and vegetation, and fauna habitat assessments of the study area, and documents the results of the surveys. In particular, this report identifies vegetation, flora and fauna habitats of conservation significance relevant to the study area.

This report is intended as a supporting document for an NVCP application by Rio Tinto and has been prepared on the basis of a review of existing information for the study area. A summary of key information pertaining to the study area is provided in Table 1-1.

Table 1-1: Summary of key information

Factor	Consultant	Survey / investigation name	Study area, type and timing	Study standard guidance and limitations
Vegetation and Flora	Biota (2007a)	A Vegetation and Seasonal Flora Survey of the Bungaroo Trial Pit and Transport Corridor to Mesa J, and Sampling of the Broader Bungaroo Valley	Bungaroo (5,677 ha) Level 2 and Rare Flora Survey (two phase) Phase 1: March 2005 Phase 2: July/August 2006	Environmental Protection Authority (**EPA**) Position Statement No. 3 (EPA 2002) EPA Guidance Statement No. 51 (EPA 2004a) Some ephemeral flora (e.g. species that germinate mostly after late winter rains) would not have been present or identifiable at the time of survey. Level of uncertainty regarding the assessment of distribution of vegetation types outside the current study area.
Vegetation and Flora	Biota (2012)	Greater Bungaroo Flora and Vegetation Survey	Greater Bungaroo study area (8,765 ha) Level 2 and Rare Flora Survey (two phase) Phase 1: July 2009 Phase 2: June 2011	EPA Position Statement No. 2 (EPA 2000) EPA Position Statement No. 3 (EPA 2002) EPA Guidance Statement No. 51 (EPA 2004a) Recent fires in the area have altered the vegetation composition, which was dominated with late stage fire ephemerals. Vegetation mapping is therefore not an exact representation of the vegetation units. Access to regions of the study area in 2009 (and to a lesser

				degree in 2011) was limited due to flooding. Not all sections of the study area were ground-truthed or systematically searched for rare flora.
Vegetation and Flora	Rio Tinto (2014)	Flora, Vegetation and Fauna Habitat Assessment at Jimmawurrada NVCP Supporting Report	Jimmawurrada study area (4,323 ha) Rare Flora Survey (two phase) Phase 1: July 2013 Phase 2: October 2013	EPA Position Statement No. 3 (EPA 2002) EPA Guidance Statement No. 51 (EPA 2004a) Survey timing was not optimal. Some annuals and ephemeral flora would not have been present or identifiable at the time of survey Recent fires (early 2013) in the area have altered the vegetation composition, which was dominated with fire ephemerals. Relevés and conservation significant flora surveys were not conducted in these areas.
Vegetation, Flora and Fauna	Eco Logical Australia (**ELA**; 2014)	Statement Addressing the 10 Clearing Principles. Geotech Drilling at Bungaroo, Robe Valley.	Bungaroo study area (223 ha) Desktop assessment	EPA Guidance Statement No. 51 (EPA 2004a) EPA Guidance Statement No. 56 (EPA 2004b) Limitations of the individual reports assessed were not listed. Most surveys were conducted in 2007; therefore the data may not be current.
Vertebrate Fauna and Invertebrate Short-range Endemics (**SRE**s)	Biota (2010a)	Greater Bungaroo Seasonal Fauna Survey	Greater Bungaroo (8,765 ha) Level 2 Fauna Survey (two phase)	EPA Position Statement No. 3 (EPA 2002) EPA Guidance Statement No. 56 (EPA 2004b) EPA Guidance Statement No. 20 (EPA 2009) Not all sections of the study area ground-truthed or sampled for fauna. SRE sampling was targeted at

				specific groups
Vertebrate Fauna and Invertebrate SREs	Biota (2007b)	Bungaroo Trial Pit and Transport corridor to Mesa J, near Pannawonica Fauna Assemblage Seasonal Survey	Bungaroo Trial Pit and Transport Corridor project area (5,677 ha) Level 2 Fauna Survey (two phase) Phase 1: March 2005 Phase 2: June 2006	EPA Position Statement No. 3 (EPA 2002) EPA Guidance Statement No. 56 (EPA 2004b) Absence of seasonal data for some reference and impact sites The presence of asbestos at two sites reduced the targeted trap effort for the Northern Quoll Bats were sampled exclusively using harp traps SRE sampling was targeted at specific groups, and voucher specimens were not provided for all species collected.
Subterranean Fauna	Biota (2010b)	Bungaroo Creek Subterranean Fauna Summary Phases I – VII	Bungaroo Valley project area Subterranean fauna survey (seven phases) Phase I: December 2003 Phase II: October 2005 Phase III: July 2007 Phase IV: June 2008 Phase V: October 2008 Phase VI: July 2009 Phase VII: November 2009	EPA Guidance Statement No. 54 (EPA 2003) EPA Guidance Statement No. 54a (EPA 2007) High frequency of juvenile specimens that could not be adequately identified
Subterranean Fauna	Biota (2013)	Bungaroo Coastal Waters Project Stygofauna Monitoring Baseline Survey	Bungaroo Coastal Waters Project study area Subterranean fauna survey (one phase) Phase 1: July 2013	EPA Guidance Statement No. 54 (EPA 2003) EPA Guidance Statement No. 54a (EPA 2007) Single phase survey Twelve bores could not be accessed; six additional opportunistic bores added as a mitigation measure

This report includes a description of the:

- local environment of the study area including flora, vegetation, fauna habitats, geology, landforms, and hydrology;
- methods employed during the desktop assessment;
- locations and populations of conservation listed flora, including mapping;
- vegetation associations occurring in the study area, an assessment on their condition and conservation significance for the locality and subregion, including mapping;
- terrestrial fauna habitats present, assessment of their significance for the locality and subregion, including mapping; and
- potential impacts of the Proposal on the local environment through application of the Ten Clearing Principles, as outlined in Schedule 5 of the EP Act.

1.3 LIMITATIONS

EPA Guidance Statements No. 51 (EPA 2004a), No. 56 (EPA 2004b) and No. 54a (EPA 2007) recommend including a discussion of the constraints and limitations of the assessment methods used. Limitations of the current assessment of the study area are summarised in Table 1-2.

Table 1-2: Constraints and limitations of the current study

Constraint	Limitations
Sources of Information	The Pilbara bioregion has been relatively well surveyed, with increasing biological survey work occurring due to the resource expansion in the region. Numerous flora and fauna surveys have been undertaken in the wider locality and many within the Bungaroo area; therefore, a suitable number of survey reports are available. Sources of information are not considered a limitation in this assessment.
Scope of works	Results are derived from previous surveys relevant to the study area; the survey requirements of a targeted terrestrial flora, vegetation and fauna survey for a NVCP application were met.
Completeness of survey	The study area and surrounds have been surveyed to equivalent of a Level 1 survey. No additional surveys were deemed necessary for the purpose of this assessment. Fungi and non-vascular flora (algae, mosses and liverworts) were not sampled.
Intensity of survey	No survey was undertaken for the present assessment; rather, results are inferred from previous surveys relevant to the study area.

Constraint	Limitations
Timing, weather, season, cycle	Biota (2007a; 2007b): The baseline survey was conducted during March 2005, which followed a relatively dry wet season for 2004-2005. Follow up surveys were conducted in July and August 2006, following a substantial wet season in 2005-2006 (Biota 2007a and 2007b). Biota (2012): Phase 1 was conducted in July 2009, and phase 2 was conducted in June 2011. Both surveys were conducted following substantial summer rainfall (Biota 2012). Timing is not considered a limitation of these surveys.
Disturbances	The study area is largely undisturbed.
Resources	The biologists undertaking the desktop assessment and subsequent reports were suitably qualified. There were no limitations noted in reports cited in the desktop assessment due to resourcing.
Accessibility / remoteness	All areas of the study area were accessed on foot or by vehicle. Access was not considered a limitation of previous surveys.

1.4 GEOLOGY AND SOILS

The study area comprised of three major geological units based on 1:500,000 scale map sheet (Martin *et al.* 2014; Figure 1-2). These geological units are:

- A-Had-kd: Wittenoom Formation – Thinly bedded dolomite, with minor black chert, shale and sandstone;
- A-HAS-xsl-ci: Mount McRae Shale and Mount Sylvia Formation – Mudstone, siltstone, chert, banded iron-formation, and dolomite; metamorphosed; and
- P_-HAb-cib: Brockman Iron Formation – Banded iron-formation, chert mudstone and siltstone; metamorphosed.

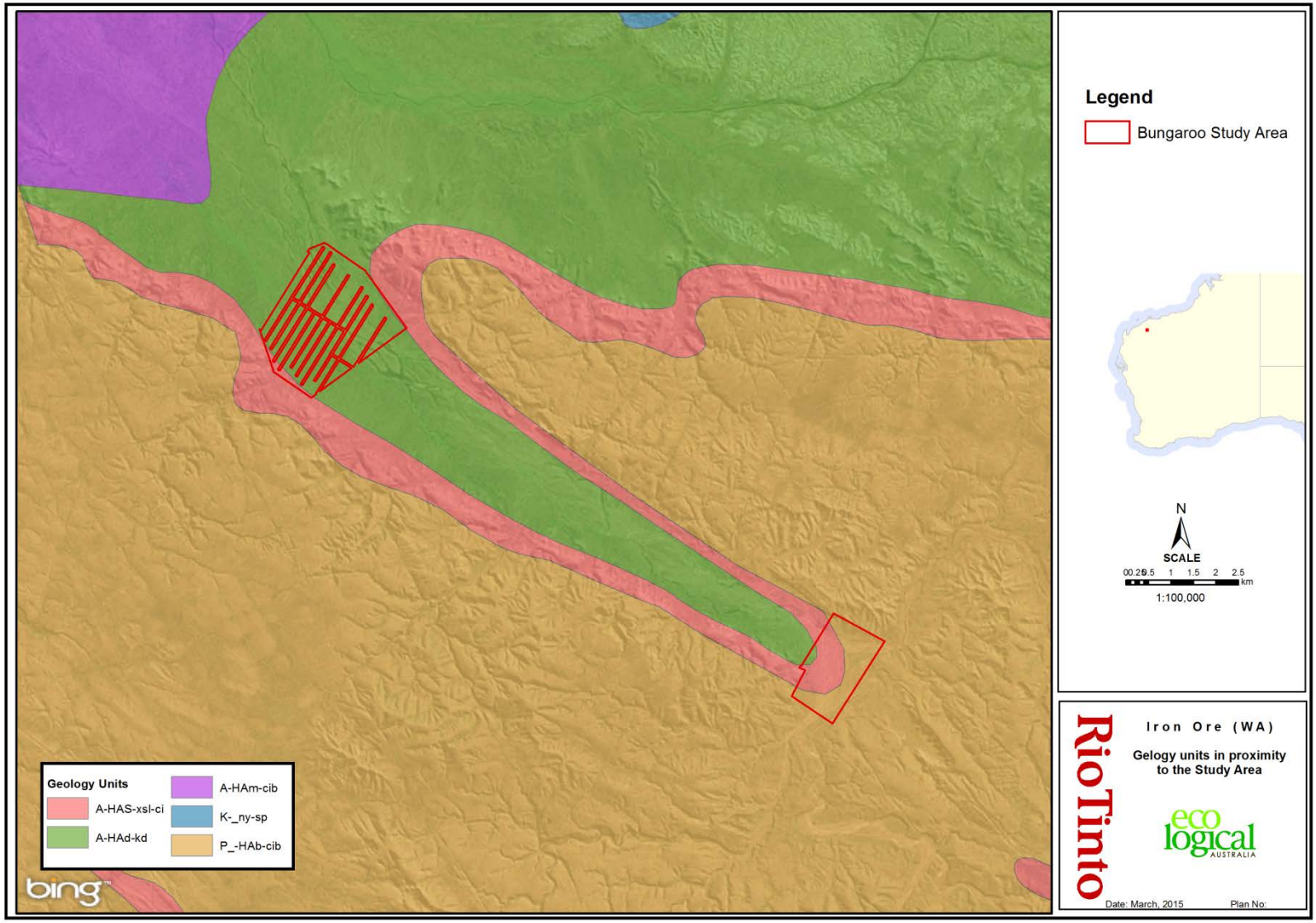


Figure 1-2: Geology units in proximity of the Study Area

1.5 SURFACE HYDROLOGY AND GROUNDWATER

The study area lies within the Robe River catchment basin. The study area intersects the Bungaroo Creek system, which is considered a major ephemeral stream in the Pilbara that would become inundated after significant rainfall events. Additionally, several minor ephemeral drainage lines are located within the study area. The study area lies within the Bungaroo Water Reserve (Department of Water [**DoW**] 2015). Bungaroo Creek bore field overlaps the study area; water extraction as part of the Pilbara Coastal Water Supply project from this bore field utilises approximately 10 GL of water per year from the Bungaroo Aquifer (Biota 2013).

1.6 LAND SYSTEMS

Land system (rangeland) mapping is based on regional patterns in topography, soils and vegetation (Christian and Stewart 1953). The most recent land system mapping of the Pilbara bioregion, in which the study area lies, was completed by van Vreeswyk *et al.* (2004). The mapping classifies the Pilbara into 102 land systems.

The study area is located within three of the 102 land systems described for the Pilbara bioregion by van Vreeswyk *et al.* (2004) and Payne *et al.* (1998) (Figure 1-3).

The land systems and their extent within the study area are presented below (Table 1-3).

- Newman land system (RGENEW) consists of rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands (van Vreeswyk *et al.* 2004). This unit is not susceptible to large-scale degradation or erosion;
- Urandy land system (RGEURY) consists of stony plains, alluvial plains and drainage lines supporting shrubby soft spinifex grasslands (van Vreeswyk *et al.* 2004). Most of this unit is not susceptible to degradation or erosion; and
- Boolgeeda land system (RGEBGD) consists of stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands and mulga shrublands (van Vreeswyk *et al.* 2004). This unit is not susceptible to degradation or erosion.

Table 1-3: Land Systems occurring within the Study Area and their representation in the Pilbara bioregion (van Vreeswyk *et al.* 2004)

Land system (Map Code)	Total area (ha) in Pilbara bioregion	Area within study area (ha)	% of study area	Study area % of land system extent
Newman RGENEW	1,458,000	91	11.6%	0.0062%
Urandy RGEURY	131,100	488	62.5%	0.37%
Boolgeeda RGEBGD	774,800	202	25.9%	0.03%

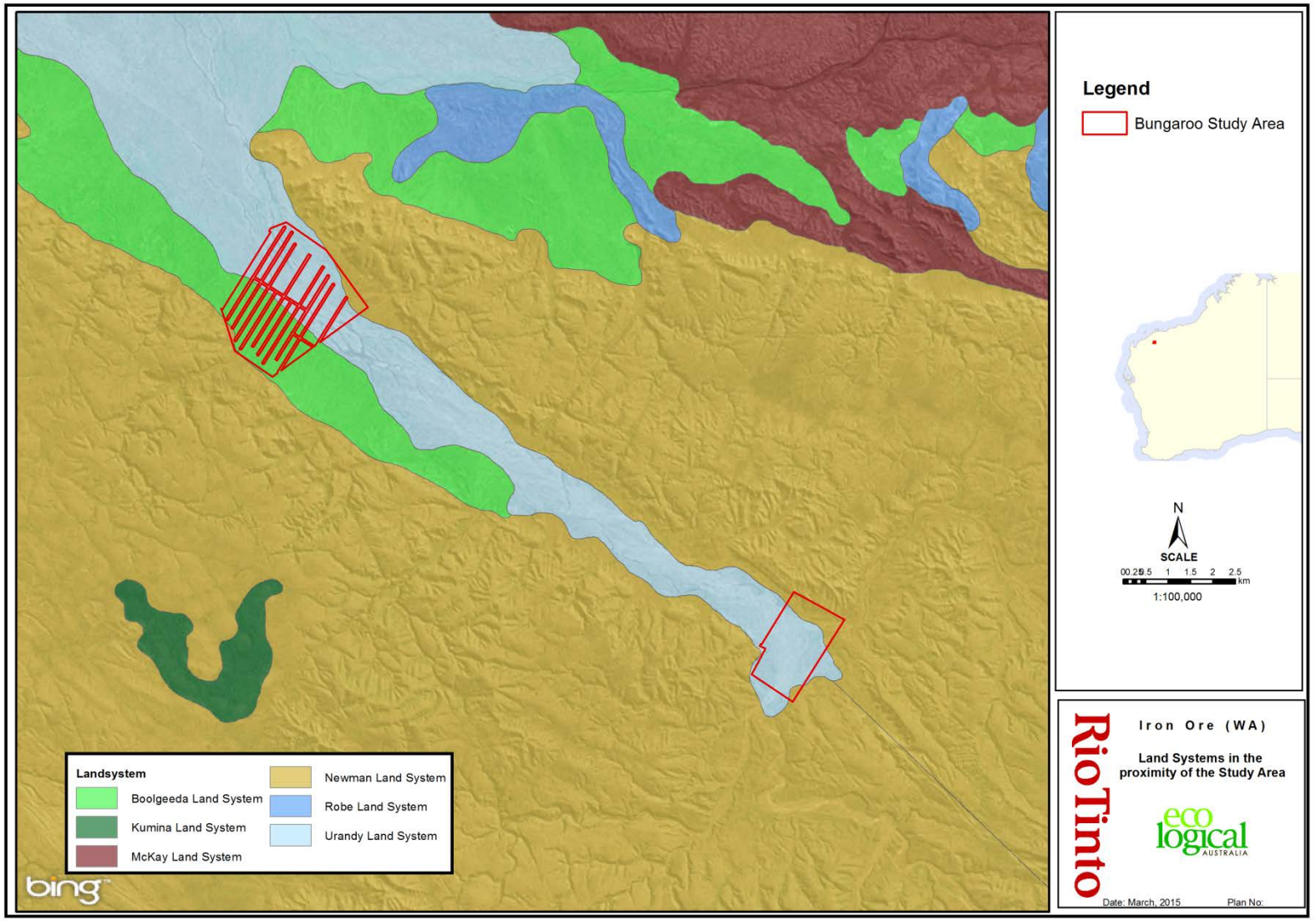


Figure 1-3: Land Systems in the proximity of the Study Area

1.7 VEGETATION

1.7.1 IBRA bioregions and subregions

The Interim Biogeographic Regionalisation of Australia (**IBRA**) recognises 89 bioregions (DoE 2015a). The study area is located in the Pilbara (PIL) bioregion as defined by IBRA. The Pilbara bioregion has been further subdivided into four subregions: Chichester (**PIL1**); Fortescue Plains (**PIL2**); Hamersley (**PIL3**); and Roebourne (**PIL4**). The study area falls within PIL3 subregion and is described by Kendrick (2001) as:

"Mountainous area of Proterozoic ranges and plateaux with low Mulga (*Acacia aneura*) woodland over bunch grasses on fine textured soils and Snappy Gum (*Eucalyptus leucophloia*) over *Triodia brizoides* on the skeletal sandy soil of the ranges."

1.7.2 Beard's regional vegetation mapping

Vegetation type and extent has been mapped at a regional scale by Beard (1975) who categorised vegetation into broad vegetation associations. Based on this mapping at a scale of 1:1,000,000, the Department of Agriculture and Food WA (**DAFWA**) has compiled a list of vegetation extent and types across WA (Shepherd *et al.* 2002). The study area falls within two vegetation associations:

- Hamersley 82: "Hummock grasslands, low tree steppe; Snappy Gum over *Triodia wiseana*" (Shepherd *et al.* 2002). Vegetation association 82 is equivalent to Beard's (1975) mapping unit e16Lr t3Hi which is described as '*Triodia* open Hummock grassland'.
- Hamersley 609: Mosaic: "Hummock grasslands, open low tree steppe; Bloodwood with sparse Kanji shrubs over soft Spinifex/Hummock grasslands, open low tree steppe; Snappy Gum over *Triodia* wiseana on a lateritic crust" (Shepherd *et al.* 2002). Vegetation association 609 is equivalent to Beard's (1975) mapping unit e24Lr a2Sp t1Hi /e16Lr t3Hi which is described as 'Eucalyptus open woodland / *Triodia* open Hummock grassland'.

Given the broad nature of Beard's (1975) mapping; these units are only broadly applicable to the vegetation types occurring in the study area.

1.7.3 Pre-European Vegetation Extent

The pre-European and current extent of native vegetation associations in WA has been interpreted by Shepherd *et al.* (2002) using data from Beard's (1975) regional vegetation mapping and other vegetation mapping, as well as satellite imagery and orthophoto interpretation.

Shepherd *et al.* (2002) identified the Pilbara bioregion as having largely intact native vegetation owing to the lack of intensive agricultural land use practices. Although the native vegetation remains widespread and largely intact, the floristic composition and structural characteristics have almost certainly changed since European settlement due to grazing and altered fire regimes (Shepherd *et al.* 2002). Table 1-4 presents the pre-European and current extent of the two Beard (1975) mapping units across their range, as well as their extent in the study area.

Table 1-4: Beard's mapping unit occurring within the Study Area, its current and Pre-European extent within the Pilbara bioregion and its extent across the Study Area.

Beard's Mapping Unit (Shepherd vegetation association)	Pre-European extent (ha) (Government of WA 2014)	Current extent (ha) (Government of WA 2014)	Extent within the study area (ha) (% of current extent)
e16Lr t3Hi (Hamersley 82)	2,565,901.27	2,553,217.02	20 (0.0007%)
e24Lr a2Sp t1Hi /e16Lr t3Hi (Hamersley 609)	74,186.11	72,765.18	762 (1.05%)

1.8 CONSERVATION AREAS AND ENVIRONMENTALLY SENSITIVE AREAS

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

There are no conservation areas or ESAs within 20 km of the study area.

1.9 PRIORITY ECOLOGICAL COMMUNITIES

Priority Ecological Communities (**PECs**) are possible TECs that do not meet survey criteria or are not adequately defined for the TEC list by the Department of Parks and Wildlife (**Parks and Wildlife** 2014a; 2014b), and are ranked in Priorities 1, 2 and 3 (1 being the highest). Four subterranean invertebrate community PECs are located within 20 km of the study area (Parks and Wildlife 2014c):

The study area intersects the buffer of the Priority 1 PEC 'Stygofaunal Community of the Bungaroo Aquifer' (Figure 1-4). This PEC is discussed further in Section 3.10.

The study area is located 10 km south-west of the buffer of the Priority 4 PEC 'Invertebrate assemblages (Nyeetberry Pool Type)'; the Priority 1 PEC 'Subterranean Invertebrate Community of Pisolitic Hills in the Pilbara' buffer is located 18 km north-west of the study area; and, the Priority 1 PEC 'Subterranean Invertebrate Communities of Mesas in the Robe Valley Region' buffer lies 19 km north-west from the study area (Figure 1-4). Due to the large distances between the study area and these PECs, the Proposal is not expected to impact the conservation values of these subterranean fauna PECs.

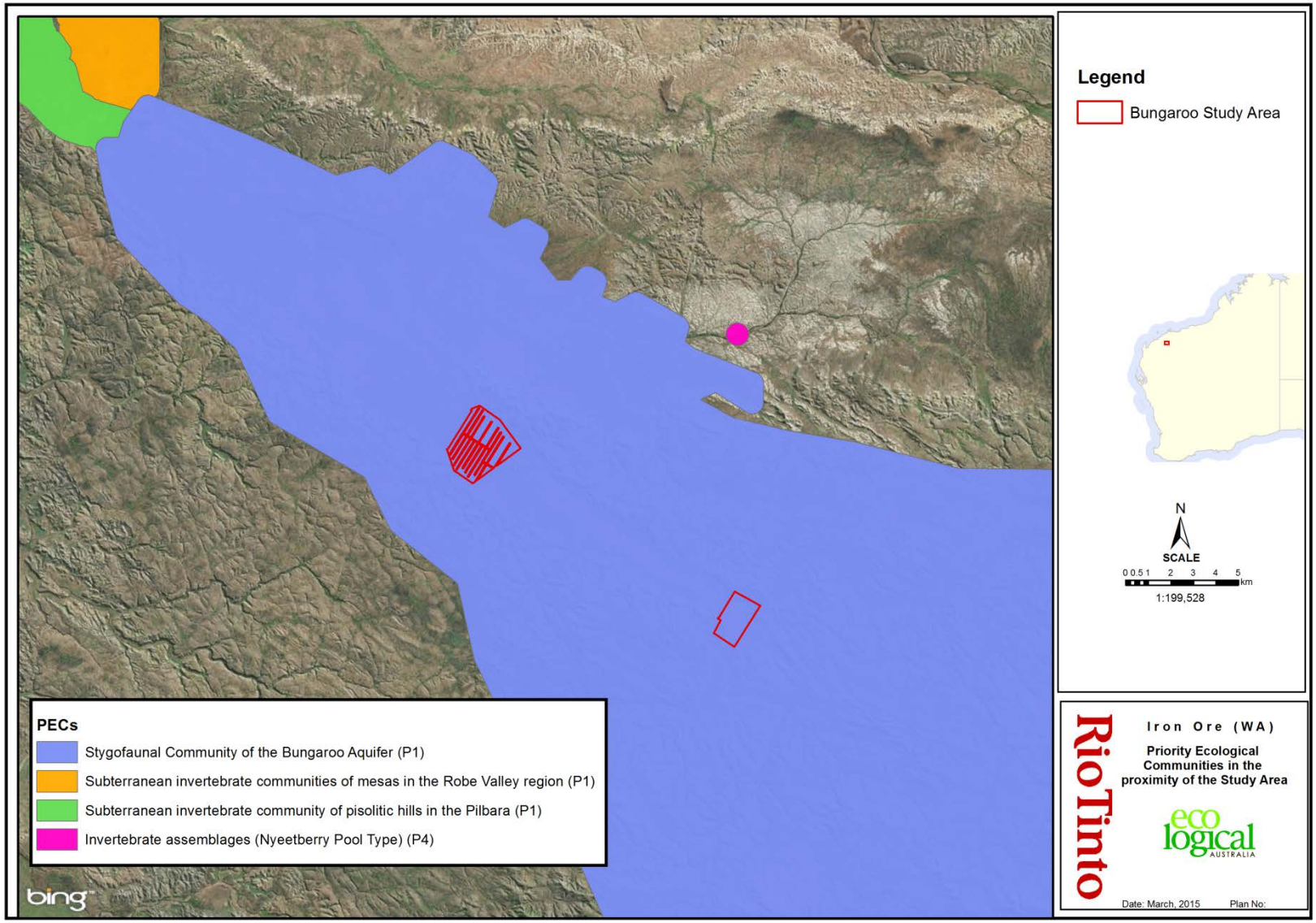


Figure 1-4: Priority Ecological Communities in the proximity of the Study Area

2 METHODOLOGY

2.1 LITERATURE REVIEW

Early systematic flora survey work in the Pilbara bioregion was undertaken by Burbidge (1959) and Beard (1975). These surveys involved the mapping of broad floristic formations and vegetation associations across the bioregion. More recently, DAFWA conducted a regional inventory of flora, vegetation, vegetation condition, and land resources of the bioregion (van Vreeswyk *et al.* 2004). In addition, the Department of Environment and Conservation (**DEC**; now Parks and Wildlife) undertook a comprehensive regional survey of the Pilbara (DEC 2011). In this survey, DEC counted, sampled, documented, and mapped the way plant communities are distributed in relation to soil, climate, landforms and geology within the Pilbara.

Over recent decades there has been an expansion of resource development projects occurring within the Pilbara. As a result, there has been an increase in site-specific ecological surveys to fulfil the statutory requirements of the EP Act, the State *Wildlife Conservation Act 1950* (**WC Act**), and the *Environment Protection and Biodiversity Conservation Act 1999* (**EPBC Act**).

Numerous flora, vegetation and fauna surveys have previously been conducted within and surrounding the study area (Figure 2-1). The findings of these surveys, in addition to the database searches, form the desktop study to determine conservation significant species that are known to, or may occur within the study area, as well as the flora, vegetation associations, ecosystems and fauna habitats.

2.1.1 Flora and Vegetation

Vegetation mapping has been conducted by Biota (2007a; 2012) across the study area. The vegetation associations included in this report are based on the Biota (2007a) report, as this study provided the best overall coverage of the study area (774.9 ha, 99.01 %) and its vegetation and landforms. The unmapped area (7.2 ha, 0.9 %) was extrapolated based on landforms, recent aerial imagery and the surrounding mapped associations by Biota (2007a).

Systematic flora surveys have been conducted for Threatened, Priority and introduced flora by Biota (2007a; 2012). These reports also listed vegetation of conservation significance (excluding TEC/PECs) within the study area.

Vegetation condition in the study area was rated from Excellent to Completely Degraded by Biota (2007a), based on the Trudgen (1988) condition scale (see Appendix 3). The vegetation condition was extrapolated for the study area using recent aerial imagery, based on the vegetation condition extrapolation completed by ELA (2014); the study area covered by the ELA (2014) report lies between the western and eastern portions of the study area.

The Ten Clearing Principles were addressed for an NVCP at Jimmawurrada (Rio Tinto 2014), which lies adjacent to the study area (western portion). This report was included in the desktop review, as it was used as a comparison for flora species diversity with the study area (see Section 3.5).

A summary of the findings of the four most relevant flora and vegetation reports is presented in Table 2-1.

2.1.2 Fauna and fauna habitat

Biota (2007; 2010a) undertook two systematic vertebrate and invertebrate SRE fauna survey assessments to identify conservation significant fauna and fauna habitats in the study area and the vicinity. Numerous subterranean fauna surveys have been undertaken within and in the vicinity of the study area; the two most relevant reports have been summarised (Biota 2010b; 2013).

Fauna habitat was extrapolated for the entire study area based on landforms and vegetation associations identified during the Biota (2007a) survey, and was consistent with the extrapolation completed by ELA (2014).

A summary of the findings from the five most relevant fauna reports is presented in Table 2-2.

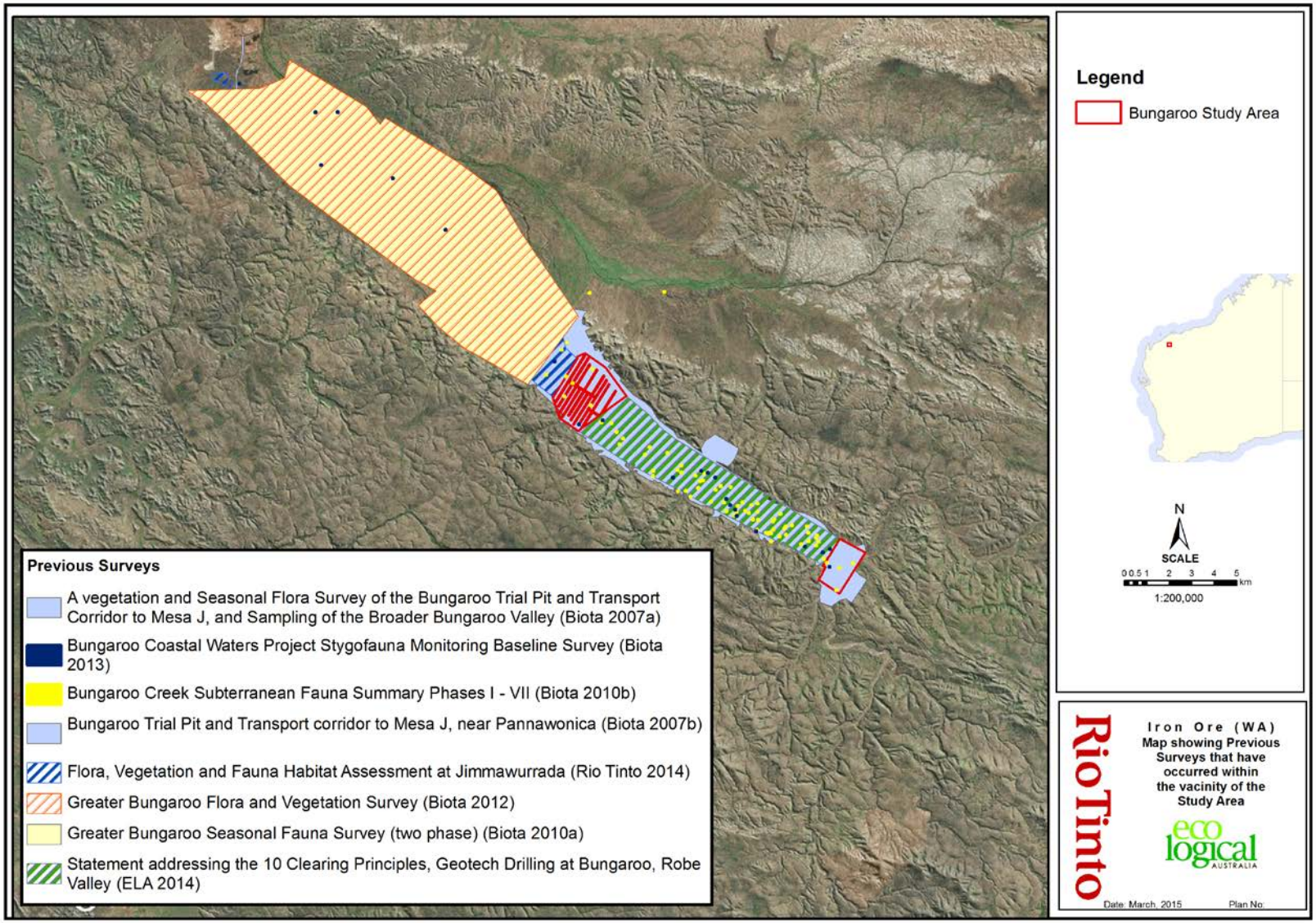


Figure 2-1: Previous biological surveys in the vicinity of the study area

Table 2-1: Summary of previous flora and vegetation reports utilised for the desktop assessment

Report (& Level of Survey)	Size (ha)	Number of Taxa	Conservation Listed Flora	Weeds	Vegetation of Significance
Biota (2007a) A Vegetation and Seasonal Flora Survey of the Bungaroo Trial Pit and Transport Corridor to Mesa J, and Sampling of the Broader Bungaroo Valley Level 2 and Rare Flora Survey (two phase)	5,677	351 Taxa	One Priority 2 species: *Stylidium weeliwolli* One Priority 3 species: *Triodia* sp. Robe River (M.E. Trudgen *et al.* MET 12367) One Priority 4 species: *Rhynchosia bungarensis* *Triodia* sp. Robe River (M.E. Trudgen *et al.* MET 12367) and *Rhynchosia bungarensis* records were within the current study area	13 weed species recorded: **Acetosa vesicaria, *Aerva javanica, *Argemone ochroleuca* subsp. *ochroleuca,*Cenchrus ciliaris, *Cenchrus setiger, *Cucumis melo* subsp. *agrestis, *Echinochloa colona, *Lactuca saligna,*Lactuca serriola, *Malvastrum americanum, *Phoenix dactylifera, *Sonchus oleraceus* and **Setaria verticillata.* Six of these species were recorded in the current study area: **Aerva javanica, *Argemone ochroleuca* subsp. *ochroleuca,*Cenchrus ciliaris, *Echinochloa colona, *Malvastrum americanum* and **Setaria verticillata.*	Ecosystems at Risk (Kendrick 2001): Vegetation associations EcCv, EvCv, ExAscTe, EvApyAtrTe and ChGpTe represent Major Ephemeral Water Courses. Vegetation associations ChGpTe, EvApyAtrTe and EvCv are within the current study area.
Biota (2012) Greater Bungaroo Flora and Vegetation Survey Level 2 and Rare Flora Survey	8,765	284 Taxa	Three Priority 3 species: *Eragrostis surreyana*, *Indigofera* sp. Bungaroo Creek (S. van Leeuwen 4301) and *Triodia* sp. Robe River None of these records occurred within the	15 weed species recorded: **Aerva javanica, *Argemone ochroleuca* subsp. *ochroleuca,*Cenchrus ciliaris, *Cenchrus setiger,*	One vegetation unit, Wetland Mosaic, was considered to be of very high conservation significance (contained unusual vegetation and supported habitat restricted flora).

Report (& Level of Survey)	Size (ha)	Number of Taxa	Conservation Listed Flora	Weeds	Vegetation of Significance
(two phase)			current study area.	**Cucumis melo* subsp. *agrestis, *Chloris barbata, *Cynodon dactylon, *Echinochloa colona, *Euphorbia hirta *Flaveria trinervia, *Lactuca saligna, *Lactuca serriola, *Malvastrum americanum, *Passiflora foetida* subsp. *hispidula, *Portulaca oleracea, *Setaria verticillata,*Sonchus oleraceus* and **Vachellia farnesiana* None of these records occurred within the current study area.	Five vegetation units were considered to be of high conservation status: EcEvMgCYPvCEc, EvTYdCYPv, ExAsclCYPvCEcTe, AiTwTspr and ElAiAbTw (supported Priority flora, habitat restricted flora and/or occurred in significant drainage features). Vegetation association ElAiAbTw is within the current study area.
Rio Tinto (2014) Flora, Vegetation and Fauna Habitat Assessment at Jimmawurrada NVCP Supporting Report Level 1 Flora and Vegetation Survey	4,323	18 additional taxa to Biota (2012)	Priority 3 species: *Eragrostis surreyana* and *Triodia* sp. Robe River (M.E. Trudgen *et al.* MET 12367) None of these records occurred within the current study area.	Eight weed species recorded: **Aerva javanica*, **Argemone ochroleuca* subsp. *ochroleuca*, **Cenchrus ciliaris*, **Cenchrus setiger*, **Malvastrum americanum*, **Passiflora foetida* var. *hispida*, **Setaria verticillata* and **Vachellia farnesiana* None of these records occurred within the current	Four vegetation units were considered to be of significance within the study area: the Mosaic unit, EllGwAptTw, ExAsclCYPvCEcTe and EcEvTYdCYPv supported Priority flora and/or habitat restricted flora). None of these vegetation units are recorded within the current study area.

Report (& Level of Survey)	Size (ha)	Number of Taxa	Conservation Listed Flora	Weeds	Vegetation of Significance
				study area.	
ELA (2014) Statement Addressing the 10 Clearing Principles. Geotech Drilling at Bungaroo, Robe Valley. Desktop assessment	223	129	Priority 3 species: *Indigofera* sp. Bungaroo Creek (S. van Leeuwen 4301) and *Triodia* sp. Robe River One Priority 4 species: *Rhynchosia bungarensis* None of these records occurred within the current study area.	Seven weed species recorded: **Aerva javanica, *Argemone ochroleuca* subsp. *ochroleuca, *Cenchrus ciliaris, *Cucumis melo* subsp. *agrestis, *Echinochloa colona, *Malvastrum americanum* and **Setaria verticillata* None of these records occurred within the current study area.	Two vegetation units were considered to be of high conservation status: ChGpTe and EvApyAtrTe (habitat restricted flora and occurred in significant drainage features). Vegetation associations ChGpTe and EvApyAtrTe are within the current study area

Table 2-2: Summary of previous fauna reports utilised for the desktop assessment

Report (& Level of Survey)	Size (ha)	Number of Taxa	Conservation Listed Fauna	Fauna Habitat of Significance
Biota (2007b) Bungaroo Trial Pit and Transport corridor to Mesa J, near Pannawonica Fauna Assemblage Seasonal Survey Level 2 Fauna Survey (two phase)	5,677	147 vertebrate taxa: 81 Birds 47 Reptiles 11 Native Non-valant Mammals 3 Introduced Mammals 2 Bats 3 Amphibians Three potential invertebrate SRE taxa	One Schedule 1 species: Northern Quoll (*Dasyurus hallucatus*) Three Priority 4 species: Western Pebble-mound Mouse (*Pseudomys chapmani*) , Australian Bustard (*Ardeotis australis*) and *Notoscincus butleri* Potential SRE taxa: *Rhagada* sp. affin. "Mt Brockman", *Lymnea tomentose* and one Mygalomorph taxon. None of these records occurred within the current study area.	Major Creeklines fauna habitat (vegetation units EcCv, ExAscTe, EvApyAtrTe and ChGpTe) is considered to have high conservation value due to its restricted distribution. Gorge habitat is considered to have moderate conservation significance, as it constitutes the primary habitat for the Northern Quoll in the Project Area. Vegetation associations ChGpTe, EvApyAtrTe and EvCv are within the current study area.
Biota (2010a) Greater Bungaroo Seasonal Fauna Survey Level 2 Fauna Survey (two phase)	8,765	147 vertebrate taxa: 73 Birds 48 Reptiles 10 Native non-volant Mammals 3 Introduced mammals 10 Bats 3 Amphibians 10 potential invertebrate SREs	One Schedule 1 species: Orange Leaf-nosed Bat (*Rhinonicteris aurantius*). Three Priority 4 species: *Notoscincus butleri*, Australian Bustard (Ardeotis australis), Star Finch (*Neochima ruficauda subclarescens*) and Ghost Bat (*Macroderma gigas*). One Migratory species: Rainbow Bee-eater (*Merops ornatus*). 10 potential invertebrate SREs: *Aname* sp., *Synothele* sp., Synsphyronus sp., Solanus sp., *Rhagada* sp. Pannawonica, *Lymnaea tomentose*, *Thiara balonnensis* and	No fauna habitat of significance recorded within the study area. In addition to vegetation of significance listed in Table 2-1, vegetation unit ChAiTwTspr was recorded having high conservation significance, as it is associated with Priority 3 species *Triodia* sp. Robe River (M.E. Trudgen *et al.* MET 12367). This vegetation association is not in the current study area.

Report (& Level of Survey)	Size (ha)	Number of Taxa	Conservation Listed Fauna	Fauna Habitat of Significance
			three unidentified species from Selenopidae, Chernetidae and Pupillidae. None of these records occurred within the current study area.	
Biota (2010b) Bungaroo Creek Subterranean Fauna Summary Phases I – VII	Not provided	53 taxa	Hydrobiidae sp. 1 and sp. 2 may also exhibit short-range endemism Bungaroo Blind Cave Eel (Ophisternon sp.) may be a new species Neither of these records occurred within the current study area.	None
Biota (2013) Bungaroo Coastal Waters Project Stygofauna Monitoring Baseline Survey Baseline Survey	Not provided	8 stygofauna taxa	Hydrobiidae sp. nov. aquatic snail is currently only known from the Bungaroo Valley This record did not occur within the current study area.	None
ELA (2014) Statement Addressing the 10 Clearing Principles. Geotech Drilling at Bungaroo, Robe Valley. Desktop assessment	223	Not assessed (desktop study)	Priority 4 species: Western Pebble-mound Mouse (*Pseudomys chapmani*) This record did not occur within the current study area.	PECs: 'Stygofaunal community of the Bungaroo aquifer' (Priority 1). The current study area lies within this PEC All broad fauna habitats have the potential to support fauna of conservation significance.

2.2 DATABASE SEARCHES

A desktop assessment was undertaken during March 2015 to identify known or potential environmental constraints within or pertaining to the study area and surrounds.

The Parks and Wildlife and WA Museum (**WAM**) NatureMap database (Parks and Wildlife 2007 - 2015) was searched for Threatened and Priority flora and fauna that have the potential to utilise the habitats present within the study area.

The Commonwealth Department of the Environment (**DoE**)-administered EPBC Act Protected Matters Search Tool (**PMST**) was also searched for Matters of National Environmental Significance (**MNES**) listed under the EPBC Act including Threatened flora and fauna and TECs.

Spatial data for conservation significant flora and fauna held and maintained by Rio Tinto were also searched as part of the desktop study. Any ESAs and/or conservation areas within or surrounding the study area were identified using relevant Geographic Information System (**GIS**) layers held by Rio Tinto.

The search coordinates used (116˚ 26’ 31” E, 21 ˚ 56’ 05” S) were at a central point within the study area. A buffer of 20 km was used for NatureMap and the PMST, and 10 km for the Rio Tinto database searches. Results of NatureMap and Protected Matters searches undertaken are presented in Appendix 1.

2.2.1 Summary of flora database search

Table 2-3 presents a summary of flora species returned by the database searches.

Table 2-3: Summary of flora species potentially occurring in the study area

Floristic Group	Number
Families	40
Genera	86
Species	159
Taxa	163
Conservation Listed	5
Weed	4

2.2.2 Summary of fauna database search

Table 2-4 presents a summary of fauna species returned by the database searches.

Table 2-4: Summary of terrestrial vertebrate fauna taxa potentially occurring in the study area

Fauna Group	Number of Potential Species
Amphibians	4
Reptiles	56
Avifauna	74
Mammals	22
Conservation Listed	8
Total	156

2.3 LIKELIHOOD OF OCCURRENCE ASSESSMENT

The results of the database searches were used to create a list of flora and fauna of conservation significance recorded, or with the potential to occur, within the study area. The likelihood of a flora or fauna species occurring within the study area was assessed through consideration of available habitats in the study area and each species' ecology. The fauna list will invariably include some species that do not occur in the study area, as some fauna have a limited or patchy distribution, high level of habitat specificity for habitat types not located in the study area, are locally extinct or were erroneously identified in previous surveys. These fauna were excluded from the list where relevant.

The likelihood of a flora species occurring within the study area was determined based on the location of database records, availability of potentially suitable habitat and knowledge of the species' ecology.

2.4 OTHER VEGETATION OF SIGNIFICANCE

Vegetation not legally protected or classified as part of regulatory ratings may still be regarded as being of significance. Vegetation that may fall under this category includes (but is not limited to) vegetation supporting elevated floristic diversity, habitats supporting numerous conservation listed species, Ecosystems at Risk (Kendrick 2001), novel floristic associations, groundwater dependent ecosystems, uncommon vegetation and associations on novel landforms.

Vegetation associations or biological features assigned a significance classification are, for the purpose of this document, considered to be of elevated significance when compared to all other identified associations or features that are common or widespread and therefore well represented.

2.5 ENVIRONMENTALLY SIGNIFICANT AREAS

Rio Tinto manages all work, including clearing, through the Approvals Coordination System which ensures biological and heritage surveys are completed and all government regulatory approvals are in place prior to the commencement of works.

Environmentally significant features are uploaded into Rio Tinto's MapInfo database (a GIS), which includes a description highlighting the significance of these areas. Small populations or individuals are protected as buffered point locations, while larger spatial populations and significant habitat are protected as 'significant areas'. The GIS is used as part of the Approvals Coordination System when reviewing proposed work activities, thereby ensuring appropriate management conditions are in place.

3 RESULTS

3.1 VEGETATION OF THE STUDY AREA

Seventeen vegetation associations were identified across four major landforms over the study area (Biota 2007a; Figure 3-1). The vegetation associations are summarised in Table 3-1 and are described in detail on the following pages, accompanied by mapping of the vegetation (Figure 3-1).

Four vegetation associations were described from Tall Stone Hills and Breakaways (**H**), six units from Plains and Low Rises (**P**), three from Drainage Areas (Major Creeklines; **DC**) and four units from Drainage Areas (Minor Flowlines; **DF**). In addition, one mapping unit represented previously disturbed or cleared areas (**CL**) (Biota 2007a).

The most widespread vegetation associations were DC1 ChGpTe (324.6 ha covering 41.5 % of the study area) and P4 ChAiTw (147.6 ha covering 18.9 % of the study area). The least widespread units were P2 ChAiApyTe and DC3 EvCv (each with an area of 0.1 ha covering 0.01 % of the study area).

Table 3-1: Vegetation associations of the Study Area (Biota 2007a)

Unit	Vegetation Description	Extent within the study area(ha)	Extent within the study area (%)
Vegetation of Plains and Rises			
P1	ChAbTe: *Corymbia hamersleyana* scattered low trees over *Acacia bivenosa* open shrubland over *Triodia epactia* hummock grassland	8.8	1.1
P2	ChAiApyTe: *Corymbia hamersleyana* open woodland over *Acacia inaequilatera*, *A. pyrifolia* tall open shrubland over *Triodia epactia* hummock grassland	0.1	0.0
P3	ChAiTe: *Corymbia hamersleyana* low open woodland over *Acacia inaequilatera* tall open shrubland over mixed scattered shrubs over *Triodia epactia* hummock grassland	26.5	3.4
P4	ChAiTw: *Corymbia hamersleyana* scattered low trees over *Acacia inaequilatera* scattered tall shrubs over mixed scattered shrubs over *Triodia wiseana* open hummock grassland	147.6	18.9
P5	ChAiTw/ChAiApyT: *Corymbia hamersleyana* scattered low trees over *Acacia inaequilatera* scattered tall shrubs over mixed scattered shrubs over *Triodia wiseana* open hummock grassland / *Corymbia hamersleyana* open woodland	22.4	2.9
P6	ChAiTw/ChAiTe: *Corymbia hamersleyana* scattered low trees over *Acacia inaequilatera* scattered tall shrubs over mixed scattered shrubs over *Triodia wiseana* open hummock grassland / *Corymbia hamersleyana* low open woodland	64.8	8.3
	Total	**270.2**	**34.5**
Vegetation of Tall Stony Hills and Breakaways			
H1	AiTw: *Acacia inaequilatera* tall open shrubland over *Triodia wiseana* hummock grassland	28.3	3.6
H2	ElAiAbTw: *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia inaequilatera*, *A. bivenosa* scattered tall shrubs over *Triodia wiseana* hummock grassland	4.2	0.5

Unit	Vegetation Description	Extent within the study area(ha)	Extent within the study area (%)
H3	ElAiAprTw: *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia inaequilatera*, A. pruinocarpa scattered tall shrubs over *Triodia wiseana* (*Triodia* sp. Robe River (M.E. Trudgen et al. MET 12367)) open hummock grassland	1.8	0.2
H4	ElAmaTw: *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia maitlandii* open heath over *Triodia wiseana* open hummock grassland	0.6	0.1
	Total	**34.8**	**4.4**
Vegetation of Drainage Areas (Major Creeklines)			
DC1	ChGpTe: *Corymbia hamersleyana* scattered low trees over *Grevillea pyramidalis* scattered tall shrubs over *Tephrosia rosea* var. *glabrior* scattered low shrubs over *Triodia epactia* hummock grassland	324.6	41.5
DC2	EvApyAtrTe: *Eucalyptus victrix* scattered low trees over *Acacia pyrifolia*, *A. trachycarpa* open shrubland over *Tephrosia rosea* var. *glabrior* low shrubland over *Triodia epactia* very open hummock grassland	115.2	14.7
DC3	EvCv: *Eucalyptus victrix* open forest over *Cyperus vaginatus* sedgeland	0.1	0.0
	Total	**439.9**	**56.2**
Vegetation of Drainage Areas (Minor Flowlines)			
DF1	AcTe: *Acacia colei* var. *ileocarpa* tall open shrubland over *Triodia epactia* hummock grassland	6.4	0.8
DF2	ApyGOaGpyTeTw: *Acacia pyrifolia*, *Gossypium australe*, *Grevillea pyramidalis* shrubland to tall shrubland over *Tephrosia rosea* var. *glabrior* low open shrubland over *Triodia epactia*, *T. wiseana* open hummock grassland	10.4	1.3
DF3	ChAeGwTe: *Corymbia hamersleyana* low open woodland over *Acacia elachantha*, *Grevillea wickhamii* tall open scrub over *Triodia epactia* hummock grassland	0.4	0.1

Unit	Vegetation Description	Extent within the study area(ha)	Extent within the study area (%)
DF4	ChAtuTwTe: *Corymbia hamersleyana*, *Eucalyptus leucophloia* scattered low trees over *Acacia tumida* var. *pilbarensis*, *Petalostylis labicheoides* tall open scrub over *Triodia wiseana* open hummock grassland	10.0	1.3
	Total	**27.3**	**3.5**
Other mapping units			
CL	Previously cleared or disturbed areas, such as tracks	9.2	1.2
	Total	**9.2**	**1.2**
GRAND TOTAL		**782.1**	**100.0**

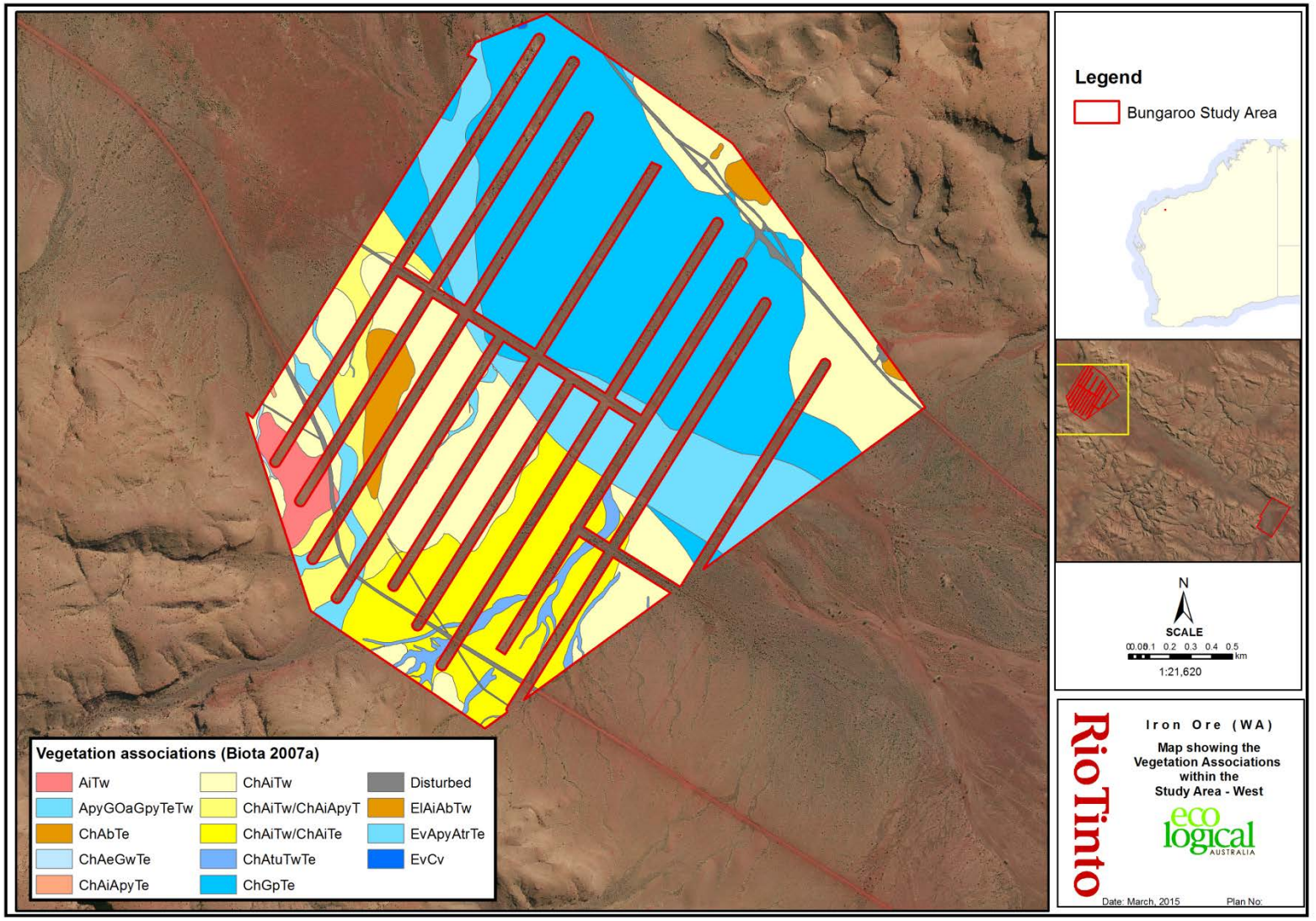
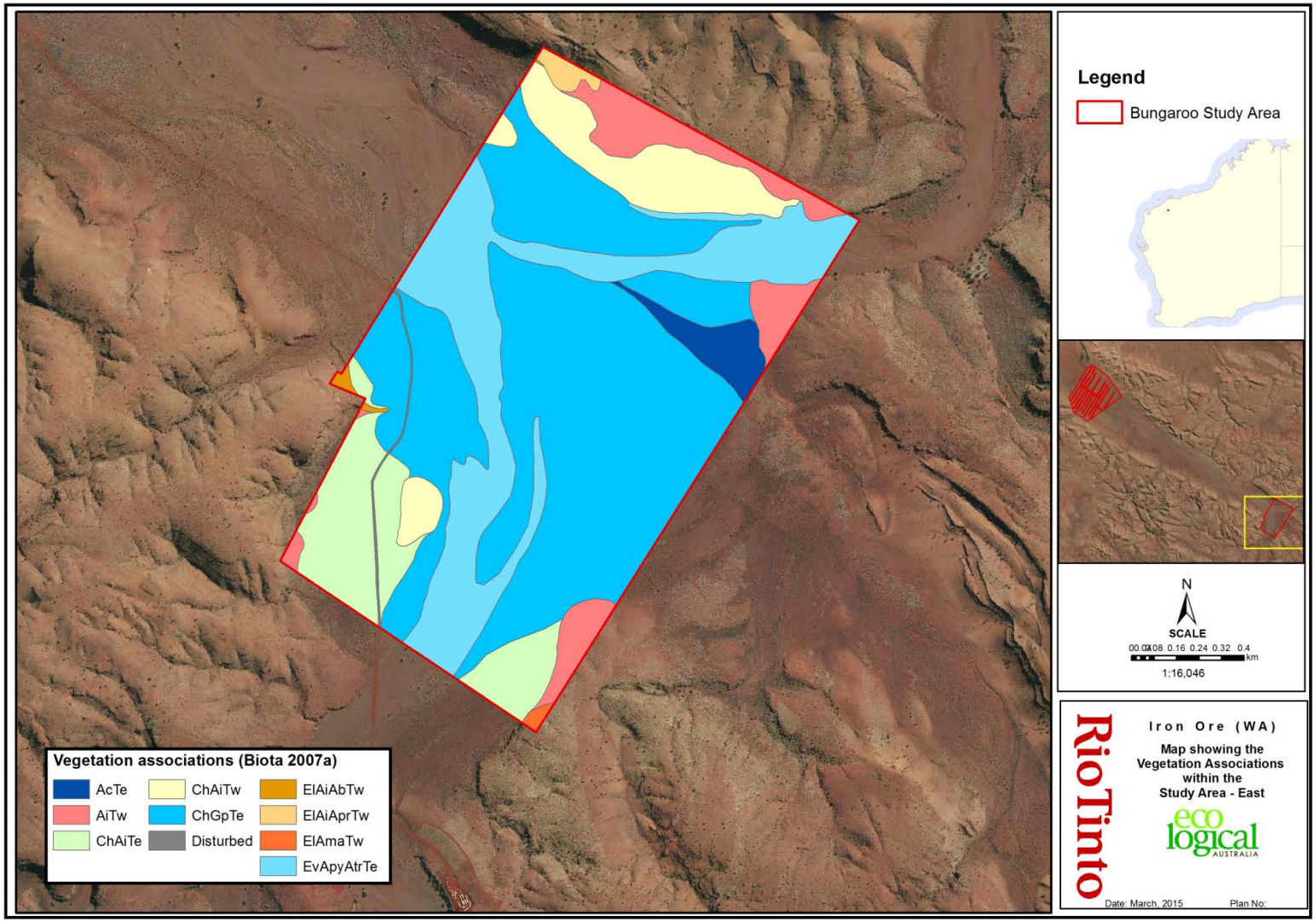


Figure 3-1: Vegetation Mapping of the Study Area


Vegetation associations (Biota 2007a)
AcTe
AiTw
ChAiTe
ChAiTw
ChGpTe
Disturbed
ElAiAbTw
ElAiAprTw
ElAmaTw
EvApyAtrTe
Legend
Bungaroo Study Area
N
SCALE
0.08 0.16 0.24 0.32 0.4
km
1:16,046
RioTinto
Iron Ore (WA)
Map showing the Vegetation Associations within the Study Area - East
ecological AUSTRALIA
Date: March, 2015
Plan No:

3.2 VEGETATION CONDITION

The condition of vegetation within the study area varied from Excellent to Completely Degraded (Biota 2007a). The majority of the study area was deemed to be in Good condition (464.2 ha or 59.3 %), with 276.9 ha (35.4 %) in Very Good condition and 31.1 ha (4.0 %) in Excellent condition. A total of 1.2 % of the study area was ranked as being in Completely Degraded condition, associated with historical exploration tracks.

Weeds were recorded as being widespread throughout the Bungaroo Valley, usually occurring as only scattered individuals, but occasionally as dense infestations (Biota 2007a). Weeds were the predominant disturbance factor recorded within the study area, which led to the determination of the majority of the study area as Good condition. In particular, lower lying areas associated with the Drainage Areas landforms were observed to contain extensive infestations of **Argemone ochroleuca* subsp*. ochroleuca* (Mexican Poppy) and **Cenchrus ciliaris* (Buffel Grass; Figure 3-6). These areas were mapped as Good condition (ELA 2014). There were no known rehabilitated areas within the study area.

Figure 3-2 presents the condition mapping for the study area, whilst Table 3-2 presents the extent of condition of vegetation associations mapped within the study area.

Table 3-2: Extent of condition of vegetation within study area

Condition	Area (ha.)	% of study area
Excellent	31.1	4.0
Very Good	276.9	35.4
Good	464.2	59.3
Completely Degraded	9.2	1.2

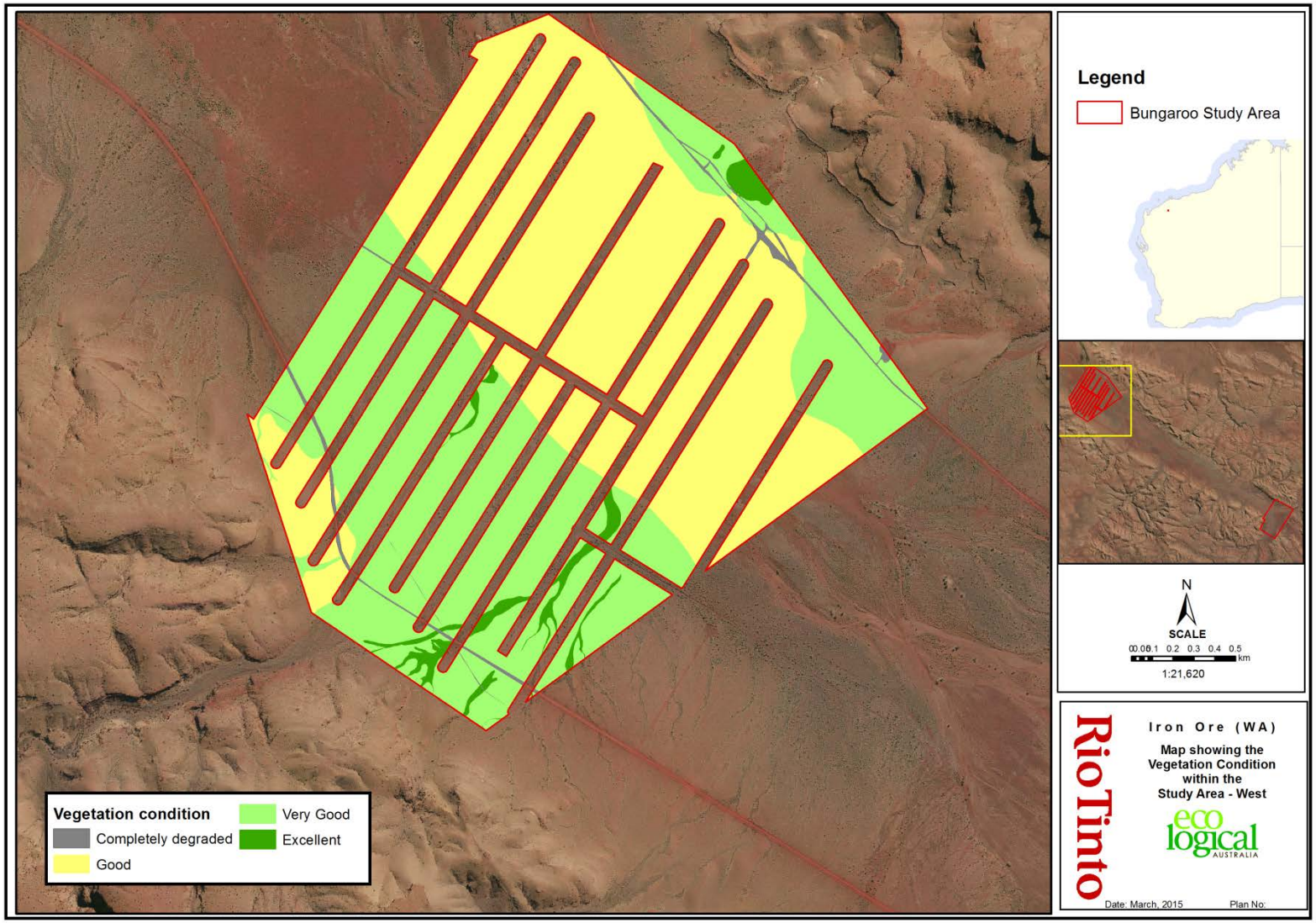
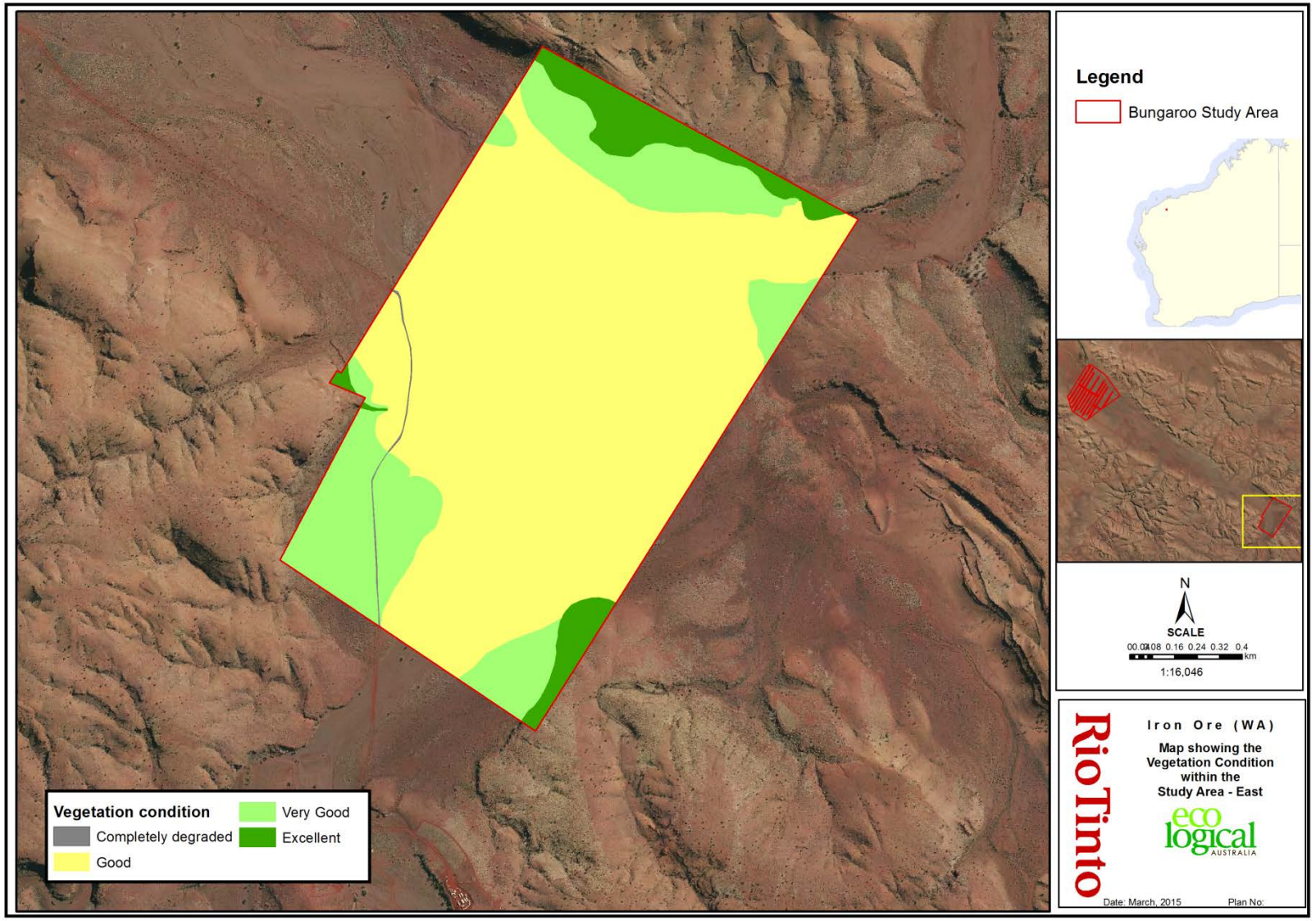


Figure 3-2: Vegetation Condition Mapping of the Study Area


Legend
Bungaroo Study Area
N
SCALE
0 0.04 0.08 0.16 0.24 0.32 0.4
km
1:16,046
Vegetation condition
Completely degraded
Good
Very Good
Excellent
RioTinto
Iron Ore (WA)
Map showing the Vegetation Condition within the Study Area - East
ecological AUSTRALIA
Date: March, 2015
Plan No:

3.3 VEGETATION OF CONSERVATION SIGNIFICANCE

None of the vegetation associations occurring within the study area correspond to any ecosystems listed as Threatened under the EPBC Act and none are consistent with ecosystems listed as TECs by Parks and Wildlife (2014).

None of the vegetation associations occurring within the study area are representative of listed PECs by Parks and Wildlife (2014). The Priority 1 PEC 'Stygofaunal Community of the Bungaroo Aquifer' is discussed in Section 3.10 below.

3.4 OTHER VEGETATION OF SIGNIFICANCE

Three vegetation units were considered to represent Ecosystems at Risk from various threatening processes as defined by Kendrick (2001): vegetation units DC1 ChGpTe, DC2 EvApyAtrTe and DC3 EvCv represent Major Ephemeral Water Courses (Biota 2007a).

These three vegetation units occur in the Drainage Areas (Major Creeklines) landform and make up 439.9 ha or 56.2 % of the study area. Biota (2007a) describes vegetation units DC1 and DC2 as "vegetation of the Bungaroo Creek drainage system" (the major drainage for the area) and DC3 as ''restricted to permanently wet areas of Bungaroo and Jimmawurrada Creeks and fringing habitat''. These vegetation types are considered likely to have a restricted distribution within the Hamersley subregion and were considered to be of high conservation value by Biota (2007a). This is also reflected in Beard's (1975) vegetation mapping units and Shepherd *et al.* (2002) vegetation associations, which place the majority of the study area in vegetation association 609. Vegetation association 609 is restricted to the north-west portion of the Hamersley subregion and covers an area of 72,765 ha (Government of WA 2014), or 1.3 % of the Hamersley subregion. The extent of this vegetation association within the study area amounts to approximately 1.1 % of the total remaining extent of vegetation association 609.

One vegetation unit was also considered to be of significance by Biota (2012). Unit H2 ElAiAbTw supports large populations of habitat restricted flora, the Priority 3 species *Triodia* sp. Robe River (M.E. Trudgen *et al.* 12367). Within the study area, 1.8 ha or 0.2 % is mapped as this vegetation unit; however, this vegetation unit is not restricted to the study area, with a total of 216 ha mapped within the Bungaroo Valley (Biota 2007a, Biota 2012).

The remainder of the vegetation units are not considered to be of significance, and are comparatively widespread across the Robe Valley locality of the Hamersley subregion and are considered to be well represented (Biota 2007a; Biota 2012).

3.5 NATIVE FLORA

A native flora species list for the study area was generated from the survey conducted by Biota (2007a) and from the NatureMap database search (Parks and Wildlife 2007 - 2015). This list is presented in Appendix 4. The flora taxa identified from the literature review and database searches represent a larger area; and therefore represent a wider range of habitats than is actually present in the study area. Therefore, some of these species may not occur within the study area due to lack of suitable habitat.

A total of 163 native flora taxa representing 86 genera and 40 families were returned through the NatureMap database search (Parks and Wildlife 2007 - 2015). Biota (2007a) recorded a total of 351

native flora taxa from 151 genera representing 57 families from the combined Bungaroo project area and broader Bungaroo Valley. The most taxon-rich families recorded during the Biota (2007a) survey were Poaceae (42 taxa), Malvaceae (37 taxa) and Fabaceae (36 taxa). The most species-rich genera were *Acacia* (21 taxa), *Sida* (14 taxa) and *Cassia/Ptilotus*/*Tephrosia* (13 taxa each). The Biota (2007a) survey area is more than seven times the size of the current study area (5,677 ha compared to just 782.1 ha) and also contained a wider variety of landforms and vegetation units. It is therefore likely that the study area contains fewer flora taxa than were recorded during the Biota (2007a) survey.

By comparison, an assessment of the Jimmawurrada survey area, which lies immediately north of the western portion of the study area, recorded a total of 284 native flora taxa from 135 genera and 51 families (Rio Tinto 2014). The Jimmawurrada survey area covered an area approximately five times the size of the study area but represents similar landforms and vegetation.

The Bungaroo Valley appears to be relatively more diverse when compared to other areas within the Robe Valley locality (Biota 2007a). Other surveys by Biota in the locality have reported relatively poor species diversity when compared to other surveys further east in the Hamersley Range. The high species diversity recorded from the study area and surrounds is likely to be a reflection of the drainage channels and floodplains that dominate the Bungaroo Creek system (Biota 2007a).

3.6 CONSERVATION LISTED FLORA OCCURRING IN THE STUDY AREA

Searches of Parks and Wildlife's FloraBase website (WAH 2015), confirm three Threatened flora species; *Lepidium catapycnon*, *Thryptomene wittweri* and *Aluta quadrata,* occur in the Pilbara. None of these species were recorded in previous surveys of the study area and locality (Biota 2007a; Biota 2012; Rio Tinto 2014), nor were they returned by any of the database searches (Appendix 1). None of these species are considered likely or potentially to occur within the study area.

Six Priority listed flora species were returned by Rio Tinto and NatureMap database searches (Appendix 1). No conservation significant flora species were listed in the PMST database search. This included one Priority 2 species, four Priority 3 species and one Priority 4 species (Table 3-3).

Of these six flora species, two were recorded within the study area, one species is considered 'likely' to occur, two species have the 'potential' to occur, and the remaining species was considered 'unlikely' to occur based on the criteria used to assess the likelihood of occurrence (Appendix 2).

The two conservation listed flora species previously recorded within the study area are discussed below and their locations are presented in Figure 3-3.

Triodia sp. Robe River (M.E. Trudgen *et al.* MET 12367) – Priority 3

Triodia sp. Robe River (M.E. Trudgen *et al.* MET 12367) is a perennial hummock grass that grows to 0.4 m high and is found across a variety of soils: red skeletal stony soils, orange-brown pebbles, gravel loam, laterite, banded ironstone and basalt (WAH 2015). It is known to occur in a range of habitats, including rocky hillsides and crests, breakaways, scree slopes, gorges and creek beds.

NatureMap (Parks and Wildlife 2007 - 2015) lists this species as having a distribution of approximately 170 km across the Pilbara region. Within the Rio Tinto database, this species has a distribution of approximately 150 km (Figure 3-4 and Figure 3-5). This species has a total population count of 211,191 plants from 2,761 records, within the Rio Tinto database. This species has previously been recorded from Fortescue, Cane, Hamersley Range and Nanutarra within the

NatureMap database (Parks and Wildlife 2007 - 2015); and from Mesa A, J and K, Pannawonica and the western Hamersley Range in the Rio Tinto database.

Triodia sp. Robe River (M.E. Trudgen *et al.* MET 12367) was recorded from two locations within the study area and eight locations within 100 m of the study area boundary (Figure 3-3). This species was recorded from the western and eastern portions of the study area in association with stony hills (Biota 2007a).

Due to the relatively small scale of the Proposal and the large number of known individuals in the region, the Proposal is unlikely to impact on the conservation status of this species.

Rhynchosia bungarensis **– Priority 4**

Rhynchosia bungarensis is a compact prostrate shrub to 0.5 m high, occurring on sandy substrates amongst boulders, rockpiles, valleys, drainage lines and gully floors (WAH 2015).

NatureMap (Parks and Wildlife 2007 - 2015) lists this species as having a widespread distribution of approximately 350 km across the Pilbara region. Within the Rio Tinto database, this species also has a distribution of approximately 350 km (Figure 3-4 and Figure 3-5). This species has a total population count of 8,383 plants from 990 records, within the Rio Tinto database. This species has previously been recorded from the Dampier Archipelago, Fortescue, Hamersley Range, Nanutarra, Wittenoom and Juna Downs within the NatureMap database (Parks and Wildlife 2007 - 2015); and from Dampier, Millstream-Chichester National Park, Pannawonica, Mt Brockman, Yandicoogina and Koodaideri in the Rio Tinto database.

Rhynchosia bungarensis was recorded from seven locations within the study area boundary; three of which fall within a series of drill lines that have been excised from the study area (Figure 3-3). Each location within the study area represents one individual of the species (Rio Tinto database). This species was recorded from the western and eastern portions of the study area in association with Bungaroo Creek (Biota 2007a).

Due to the large area of occupancy across the Pilbara and the relatively small scale of the Proposal, the conservation status of this species is unlikely to be impacted by the Proposal.

3.7 LIKELY AND POTENTIALLY OCCURRING CONSERVATION LISTED FLORA

One species was considered likely to occur within the study area; *Indigofera* sp. Bungaroo Creek (S. van Leeuwen 4301) (Priority 3). This species is a tall perennial shrub with deep pink-red flowers, and occurs on stony red loamy soils on low rocky rises and along drainage lines (WAH 2015).

Indigofera sp. Bungaroo Creek (S. van Leeuwen 4301) has a range of approximately 215 km on NatureMap within the Pilbara region (Parks and Wildlife 2007 - 2015) and 210 km from the Rio Tinto database. *Indigofera* sp. Bungaroo Creek (S. van Leeuwen 4301) has a total population count of 11,792 plants, from 1,408 records, within the Rio Tinto database. It has previously been recorded from Tom Price, Rocklea, Nanutarra and Newman within the Rio Tinto database (see Figure 3-4 and Figure 3-5) and from north of Pannawonica and across the Hamersley Range to Tom Price on NatureMap (Parks and Wildlife 2007 - 2015).

Due to the relatively small scale of the Proposal and the large number of known individuals in the region, the Proposal is unlikely to impact on the conservation status of this species.

The two species considered to have the potential to occur within the study area are:

- *Stylidium weeliwolli* (Priority 2); and
- *Eragrostis surreyana* (Priority 3).

These species are discussed further in Table 3-3 and their regional extents as identified from the Rio Tinto database are presented in Figure 3-4 and Figure 3-5.

Table 3-3: Conservation listed flora species returned by database searches, including Likelihood of Occurrence assessment of potential presence via habitat preference and proximity of previous recordings.

NM = Returned from NatureMap database search, RT= Returned from Rio Tinto database search

Species	Status	Database		Nearest Known Locality	Habitat and Discussion	Likelihood of Occurrence
		NM	RT			
Stylidium weeliwolli	P2		x	4 km north-west	Annual herb, 0.1-0.25 m high that occurs on gritty sand and sandy clay soils at edge of watercourses. The study area represents potentially suitable habitat for the species.	Potential
Eragrostis surreyana	P3	x	x	8 km north-west	Tufted annual grass, prostrate to 0.05 m high that occurs in wetlands, seepage areas, seasonally wet areas or the edge of rockpools above waterfalls in wet, deep brown, gravelly, clayey sand, often between rocks. This species was recorded in Bungaroo Creek by Rio Tinto (2014). This species is considered to have the potential to occur in the study area due to the presence of suitable seasonally wet habitat and the nearby records in Bungaroo Creek.	Potential
Indigofera sp. Bungaroo Creek (S. van Leeuwen 4301)	P3	x	x	1.2 km north-west	Perennial shrub that occurs on stony red loamy soils on low rocky rises and along drainage lines. This species has been recorded from alluvial habitat that continues into the study area and has been recorded in close proximity. Therefore it is considered likely to occur in the study area.	Likely
Terminalia supranitifolia	P3	x		3 km north-west	Spreading, tangled shrub or tree, 1.5-3 m high that occurs on sand, among rockpiles of basalt rocks, at the base of plateau and in rock outcrops. While suitable habitat could occur in parts of the study area, there are only two records in the vicinity in NatureMap (Parks and Wildlife 2007 – 2015), despite numerous surveys in the Robe Valley locality; therefore this species is considered unlikely to occur.	Unlikely

Species	Status	Database		Nearest Known Locality	Habitat and Discussion	Likelihood of Occurrence
		NM	RT			
Triodia sp. Robe River (M.E. Trudgen *et al.* MET 12367)	P3	x	x	Within study area	Perennial hummock grass that grows to 0.4 m high found across a variety of soils: red skeletal stony soils, orange-brown pebbles, gravel loam, laterite, banded ironstone and basalt. Habitats include rocky hillsides and crests, breakaways, scree slopes, gorges and creek beds. The species has previously been recorded in the study area.	Recorded
Rhynchosia bungarensis	P4	x	x	Within study area	Compact prostrate shrub, to 0.5 m high occurring on pebbly, shingly coarse sand amongst boulders, often in rockpiles, but also found in valleys, drainage gullies, small creeks and gully floors. The species has previously been recorded in the study area.	Recorded

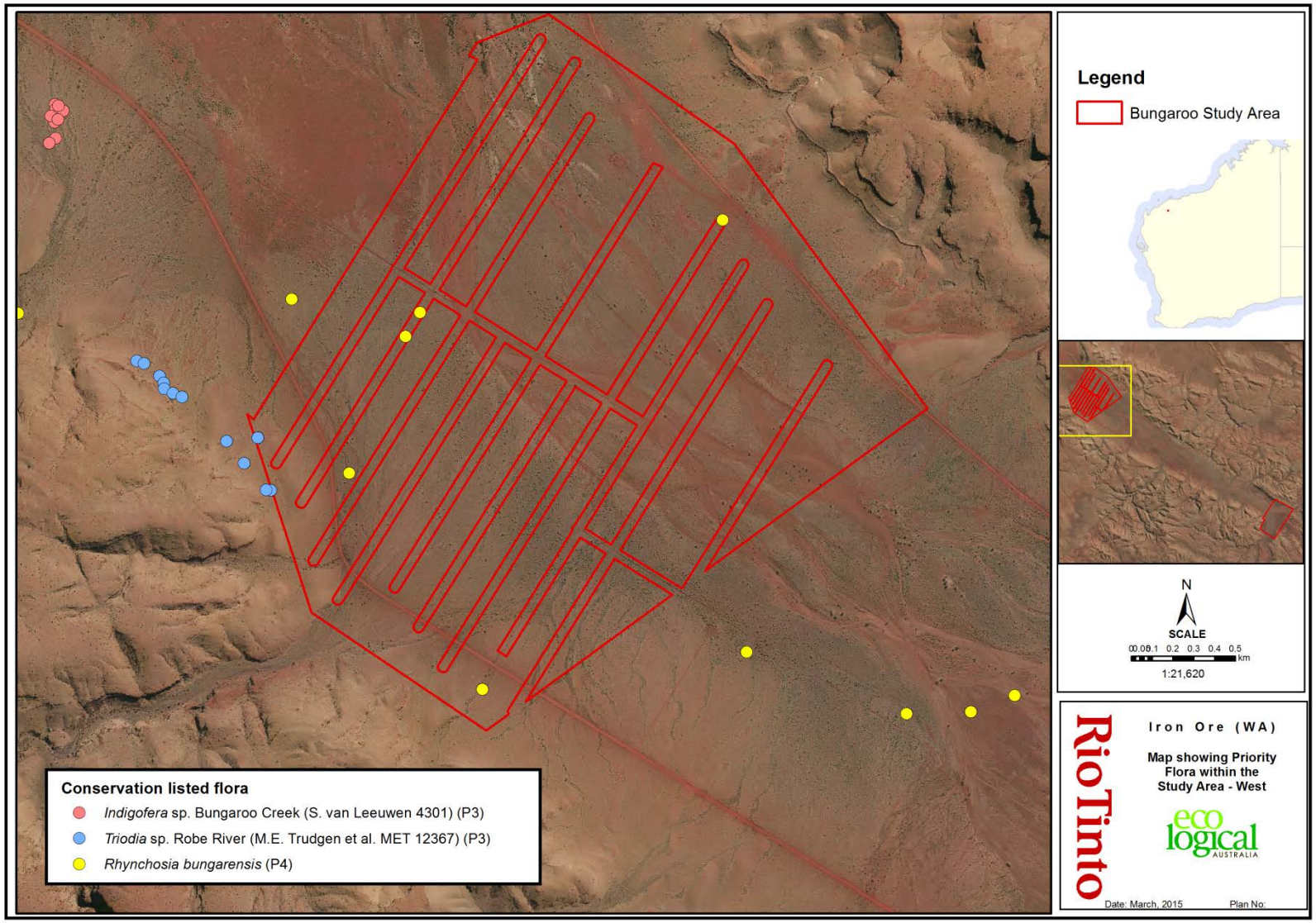
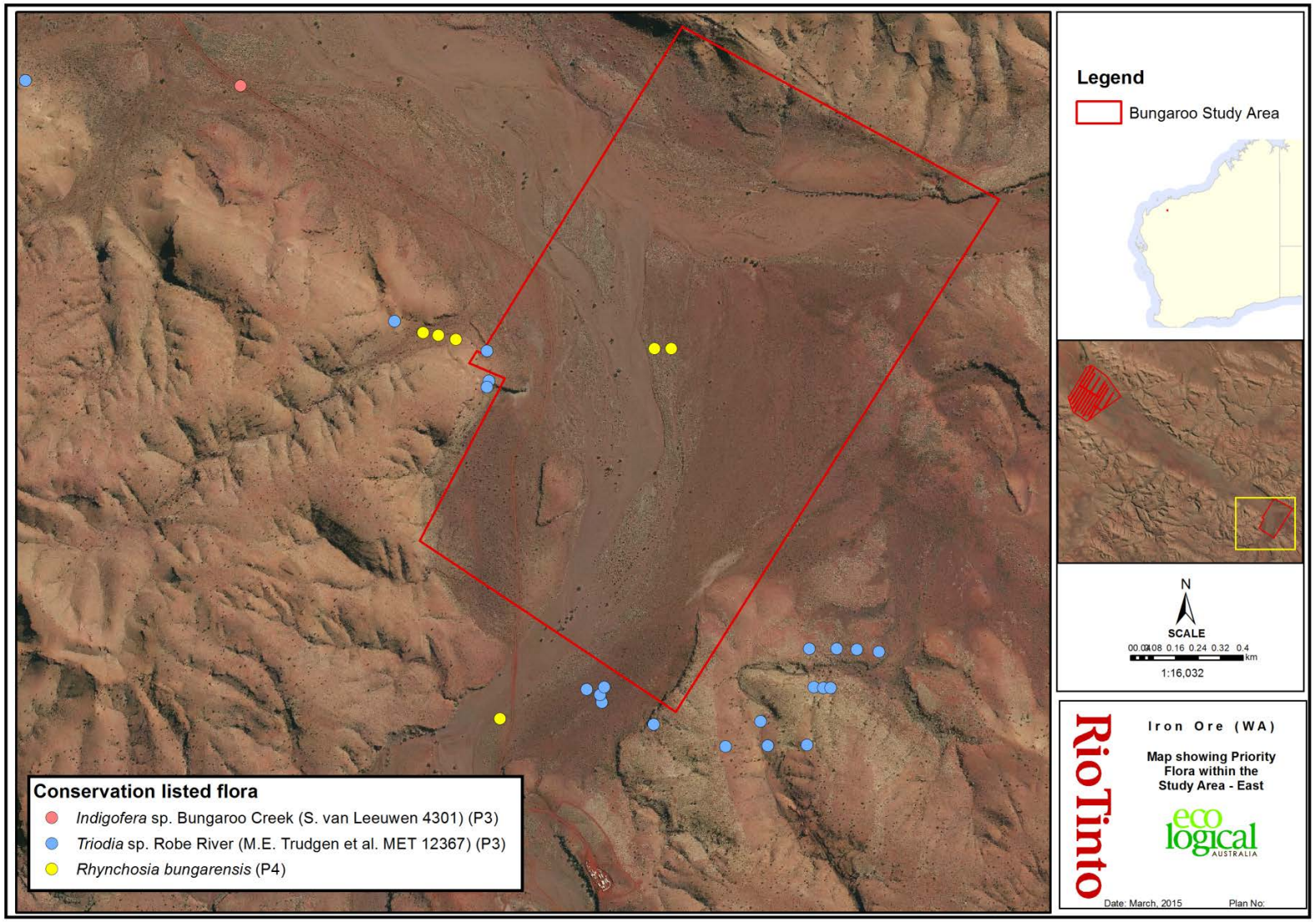


Figure 3-3: Conservation listed flora previously recorded in the vicinity and within the Study Area


Legend
Bungaroo Study Area
N
SCALE
0.08 0.16 0.24 0.32 0.4
km
1:16,032
Conservation listed flora
Indigofera sp. Bungaroo Creek (S. van Leeuwen 4301) (P3)
Triodia sp. Robe River (M.E. Trudgen et al. MET 12367) (P3)
Rhynchosia bungarensis (P4)
RioTinto
Iron Ore (WA)
Map showing Priority Flora within the Study Area - East
ecological AUSTRALIA
Date: March, 2015
Plan No:

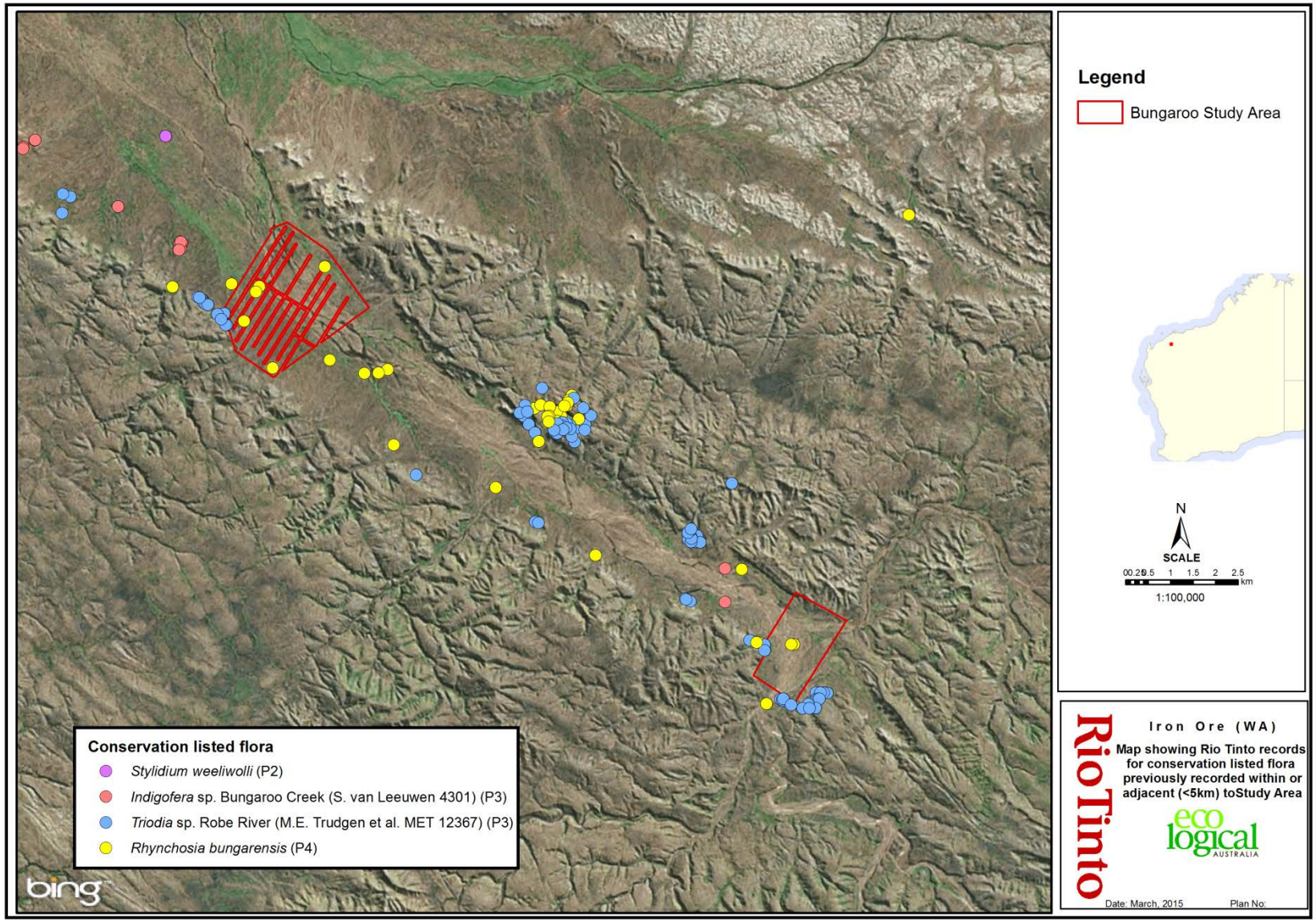


Figure 3-4: Map showing Rio Tinto records for conservation listed flora previously recorded within or adjacent (<5 km) to the Study Area

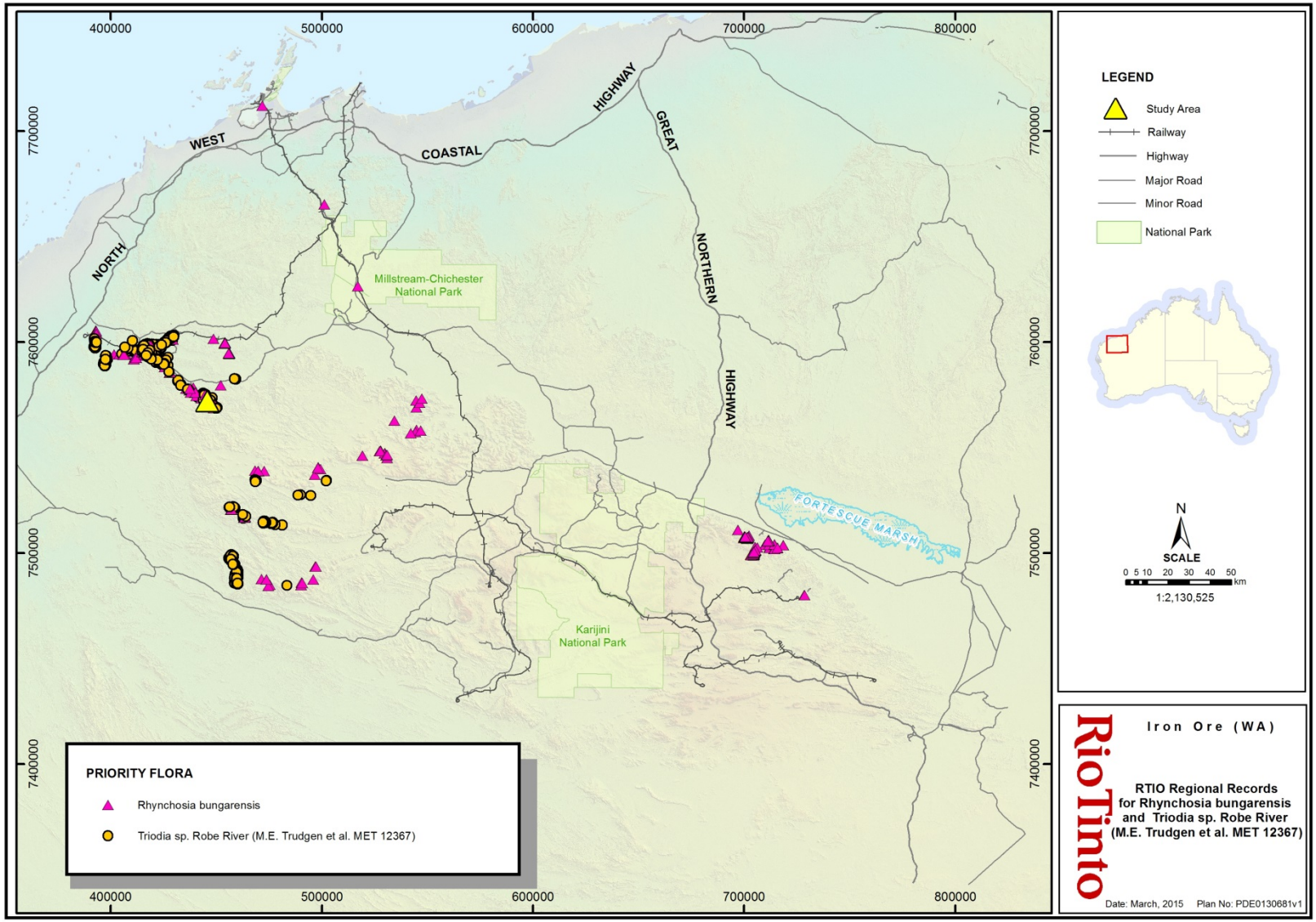
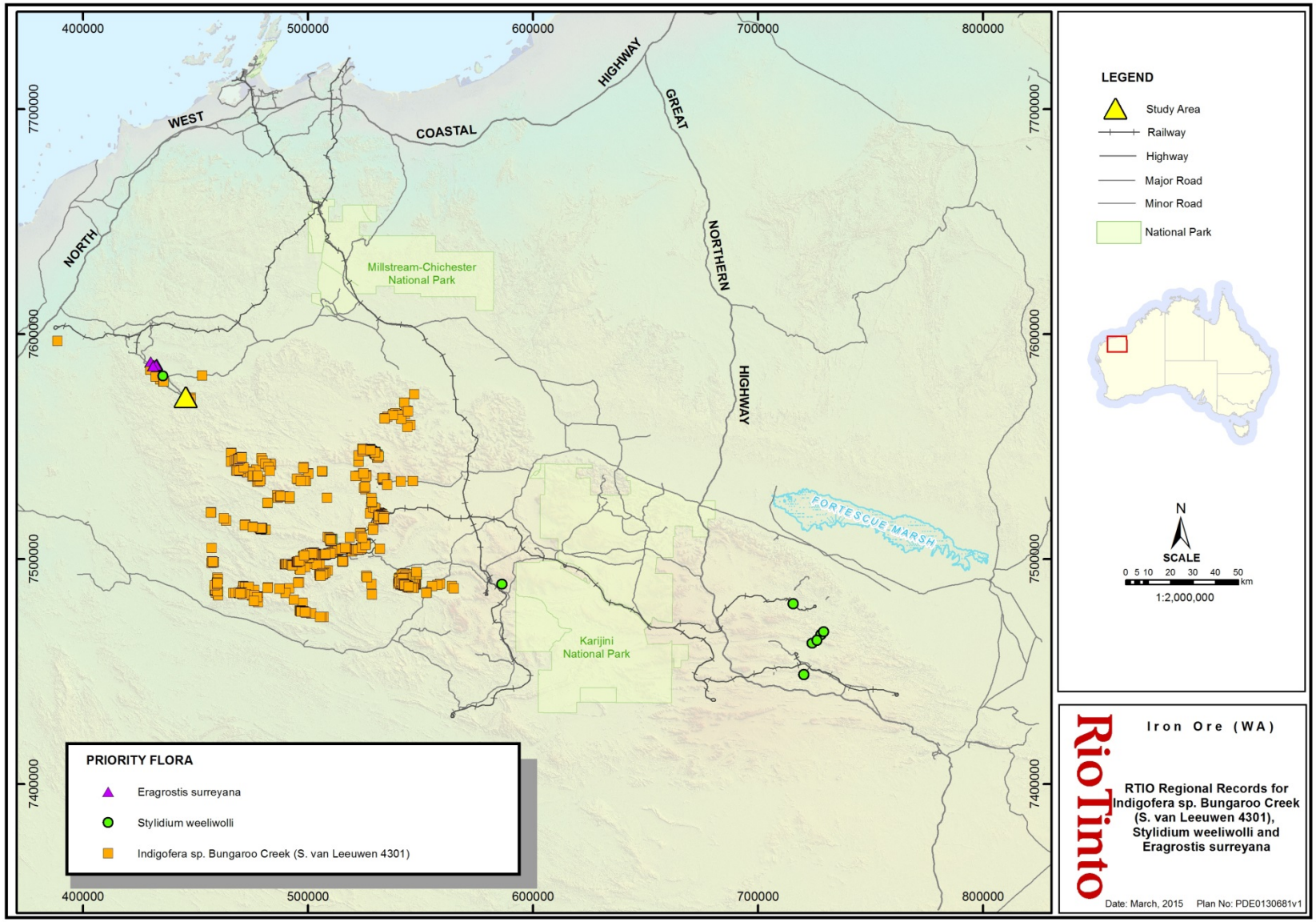


Figure 3-5: Regional records for highlighted recorded and potential occurring conservation listed flora


400000
500000
600000
700000
800000
7700000
7600000
7500000
7400000
WEST
COASTAL
HIGHWAY
GREAT
NORTH
NORTHERN
HIGHWAY
Millstream-Chichester National Park
Karijini National Park
FORTESCUE MARSH
PRIORITY FLORA
Eragrostis surreyana
Stylidium weeliwolli
Indigofera sp. Bungaroo Creek (S. van Leeuwen 4301)
LEGEND
Study Area
Railway
Highway
Major Road
Minor Road
National Park
N
SCALE
0 5 10 20 30 40 50
km
1:2,000,000
RioTinto
Iron Ore (WA)
RTIO Regional Records for Indigofera sp. Bungaroo Creek (S. van Leeuwen 4301), Stylidium weeliwolli and Eragrostis surreyana
Date: March, 2015
Plan No: PDE0130681v1

3.8 INTRODUCED FLORA OCCURRING WITHIN THE STUDY AREA

Six introduced species have been previously recorded from the study area (Table 3-4 and Figure 3-6). The majority of the introduced species were recorded from areas which have been heavily grazed by cattle and are near water points or drainage features.

The ranking of all six species as per the Parks and Wildlife Weed Prioritisation process (Parks and Wildlife 2013) is shown in Table 3-4. Of these six, **Argemone ochroleuca* subsp. *ochroleuca* is listed as a Declared Pest under the *Biosecurity and Agriculture Management Act 2007* (**BAM Act**), under category C3 (Management) (DAFWA 2015).

Strict weed hygiene protocols should be implemented during clearing of vegetation and subsequent earthworks to minimise the introduction and spread of weeds to or from the study area.

Table 3-4: Introduced species recorded in the study area and Parks and Wildlife weed prioritisation ranking.

Species	Ranking (Parks and Wildlife 2013)
**Aerva javanica*	Low
**Argemone ochroleuca* subsp. *ochroleuca*	Low
**Cenchrus ciliaris*	Low
**Echinochloa colona*	Low
**Malvastrum americanum*	Negligible
**Setaria verticillata*	Low

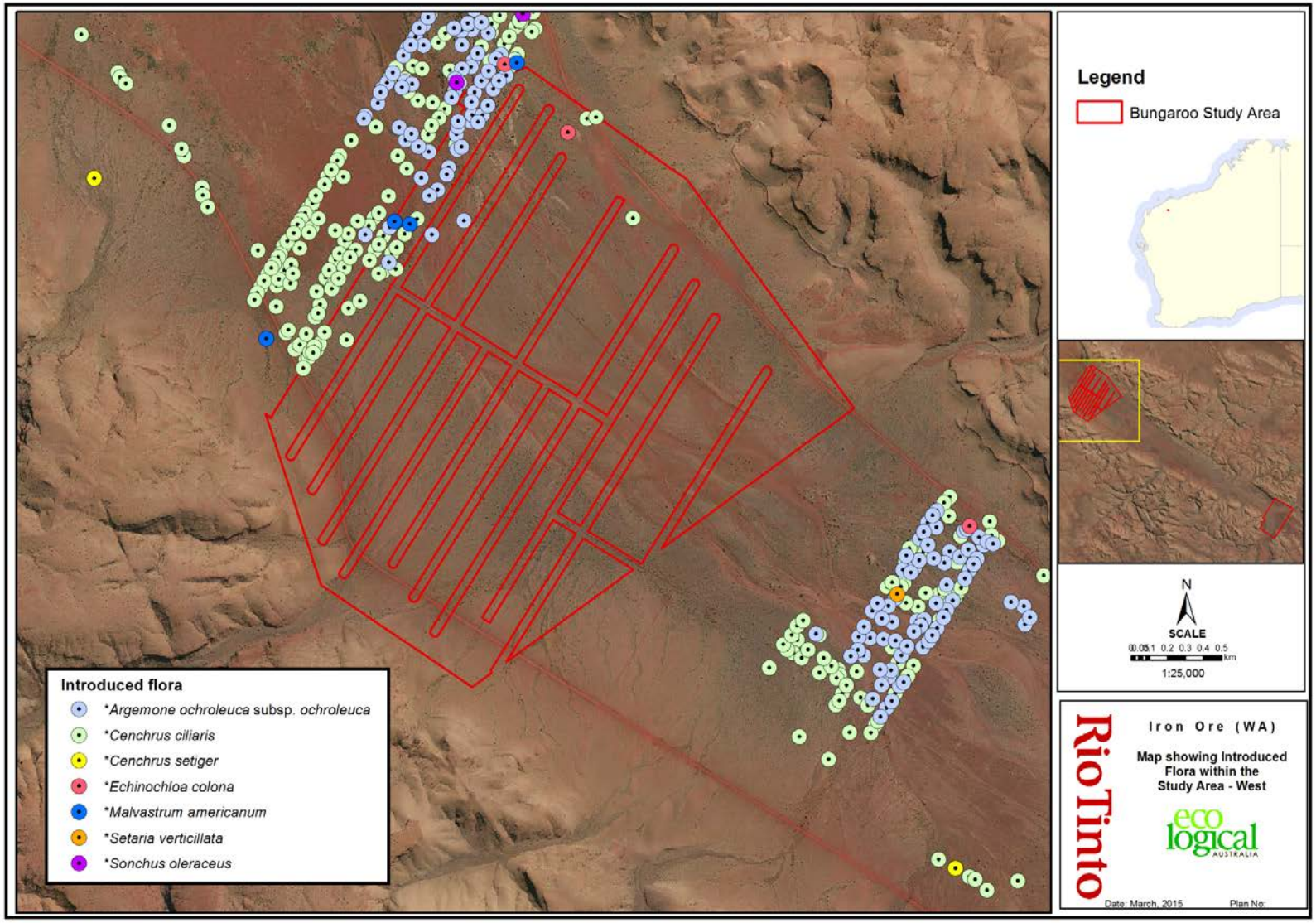
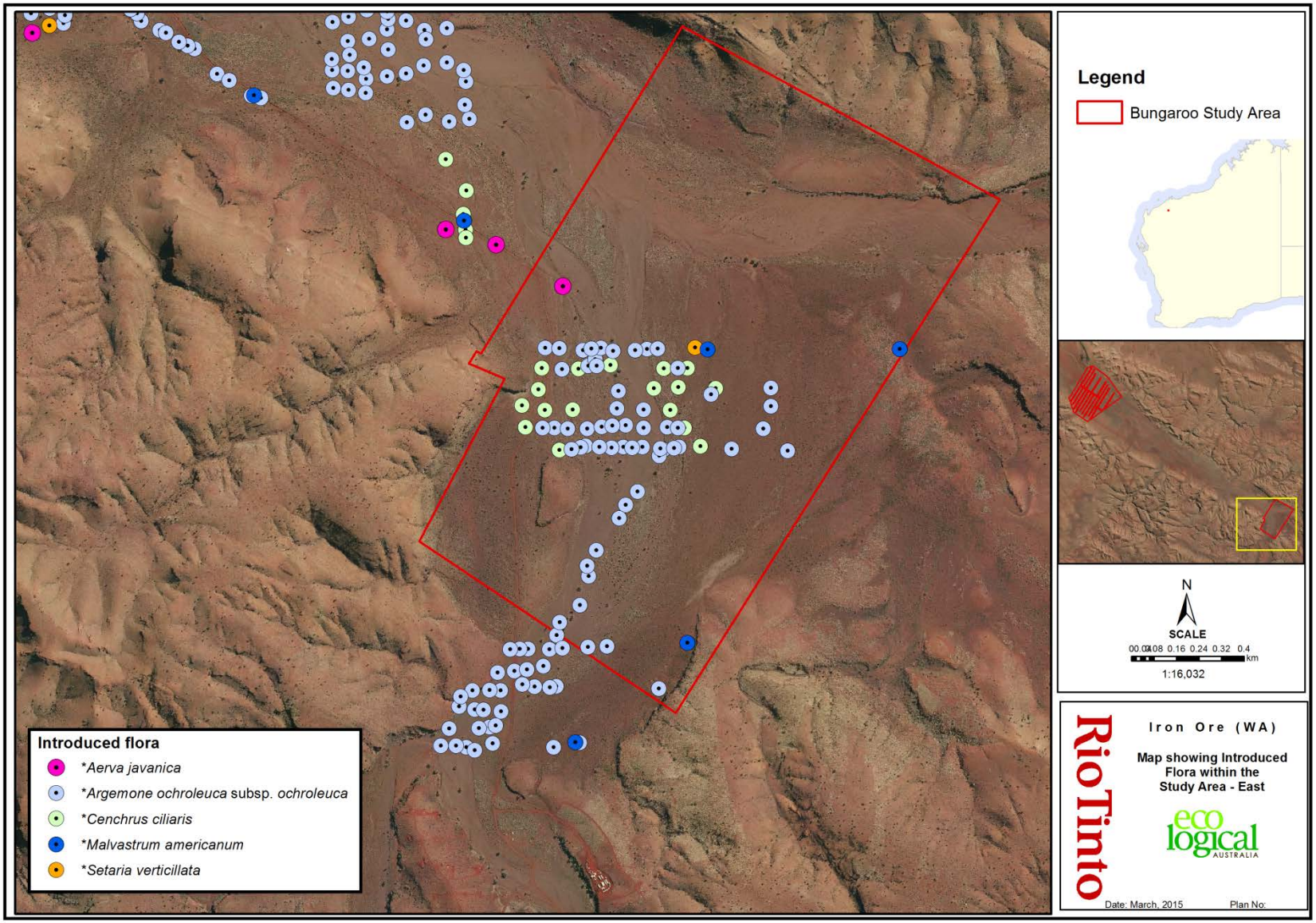


Figure 3-6: Map showing locations of Introduced Flora (weeds) recorded in the vicinity and within the Study Area


Introduced flora
*Aerva javanica
*Argemone ochroleuca subsp. ochroleuca
*Cenchrus ciliaris
*Malvastrum americanum
*Setaria verticillata
Legend
Bungaroo Study Area
N
SCALE
0.08 0.16 0.24 0.32 0.4
km
1:16,032
Rio Tinto
Iron Ore (WA)
Map showing Introduced Flora within the Study Area - East
ecological AUSTRALIA
Date: March, 2015
Plan No:

3.9 FAUNA HABITATS OF THE STUDY AREA

The study area consisted of three broad habitat types: Drainage Lines (D), Undulating Plains (P), and Rocky Hills and Slopes (H). In addition, one mapping unit represented previously cleared and disturbed areas (CL).

The most widespread fauna habitat was the Drainage Lines habitat, covering an area of 401.1 ha (51.3 %) of the study area. The least widespread fauna habitat was the Rocky Hills and Slopes habitat, covering an area of 37.2 ha (4.8 %) of the study area. The Undulating Plains fauna habitat covered an area of 333.9 ha (42.7 %) of the study area.

The habitat types recorded are described below, accompanied by mapping of the habitat types (Table 3-5; Figure 3-7).

Table 3-5: List of habitat types within the study area including microhabitats and extent (ELA 2014)

Unit	Fauna Habitat Description	Significant Microhabitat	Extent within study area (ha)	Extent within study area (%)
P	**Undulating Plains:** this habitat is vegetated with scattered to open *Corymbia hamersleyana* woodland with understories comprising scattered to open shrubland *Acacia* spp. over *Triodia epactia* hummock grasslands (Biota 2007a, 2007b).	No significant microhabitats identified within the study area	401.1	42.7
H	**Rocky Hills and Slopes:** this habitat is dominated by scattered *Eucalyptus leucophloia* subsp. *leucophloia* trees over open *Acacia* spp. shrubland over open *Triodia* hummock grasslands (Biota 2007a, 2007b).	No significant microhabitats identified within the study area	37.2	4.8
D	**Drainage Lines:** this habitat comprised broad major drainage lines primarily vegetated with open *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* woodland over tall *Acacia* shrubland over *Triodia* hummock grasslands and occasionally *Eucalyptus victrix* (Biota 2007a, 2007b). It also includes broad alluvial plains that are comprised of many small drainage lines that become seasonally inundated.	No significant microhabitats identified within the study area	333.9	51.3
CL	**Cleared and disturbed areas**	None	9.2	1.2
TOTAL			**782.1**	**100**

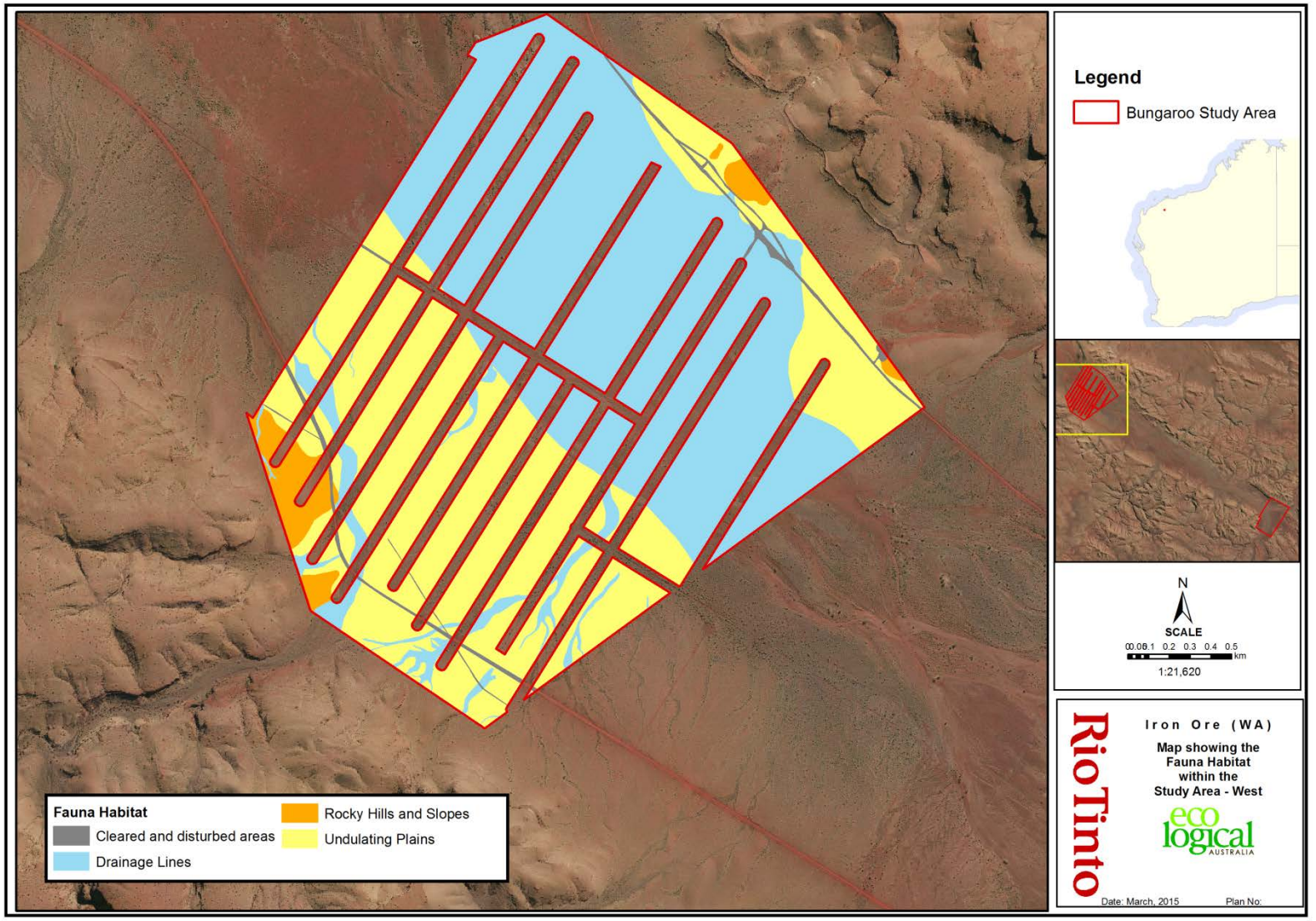
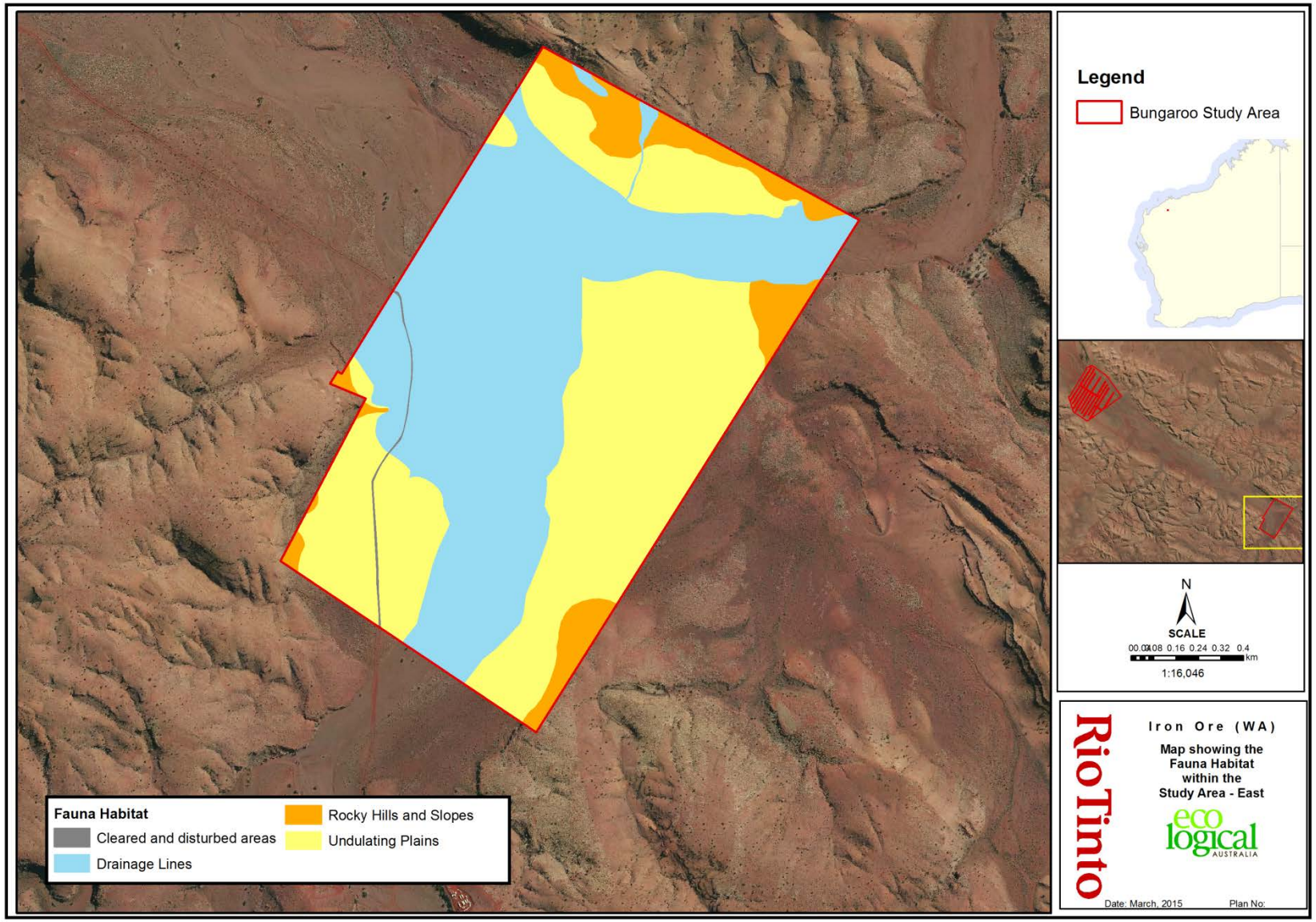


Figure 3-7: Fauna habitat mapping of the Study Area


Legend
Bungaroo Study Area
N
SCALE
0.04 0.08 0.16 0.24 0.32 0.4
km
1:16,046
Fauna Habitat
Cleared and disturbed areas
Drainage Lines
Rocky Hills and Slopes
Undulating Plains
RioTinto
Iron Ore (WA)
Map showing the Fauna Habitat within the Study Area - East
ecological AUSTRALIA
Date: March, 2015
Plan No:

3.10 FAUNA HABITATS OF SIGNIFICANCE

The study area occurs within the mapped extent of the Priority 1 'Stygofaunal community of the Bungaroo Aquifer' PEC; this PEC is described by Parks and Wildlife (2014b) as a 'unique assemblage of aquatic subterranean fauna including eels, snails and other stygofauna'.

Seven previous phases of stygofauna sampling have been completed by Biota (2010b), as part of the Bungaroo Iron Ore Trial Pit project and the Pilbara Coastal Water Supply project. The latter includes the construction and commissioning of a bore field in the Bungaroo Creek area, which will extract up to 10 GL of water per year from the Bungaroo Creek aquifer. Dewatering and alteration to the groundwater system have the potential to impact stygofauna by reducing available habitat and altering the hydrological regime. A Water Resource Management Operating Strategy developed for the project states the need for a detailed stygofauna monitoring programme to be developed (Biota 2013).

Given the current water extraction from the Bungaroo Creek bore field, any additional hydrological sampling on behalf of the Proposal (expected to result in minimal disturbance to the groundwater) is unlikely to impact the conservation status of the Priority 1 'Stygofaunal community of the Bungaroo Aquifer' PEC.

3.11 OTHER HABITATS OF SIGNIFICANCE

The 'Drainage Lines' and 'Rocky Hills and Slopes' habitats have the potential to support fauna of conservation significance and cover 333.9 ha (51.3 %) and 37.2 ha (4.8 %) respectively. The remaining habitat (Undulating Plains), covering 401.1 ha (42.7 %), is considered to have low potential to support conservation significant fauna species (Figure 3-7).

The Undulating Plains habitat type provides a diverse range of microhabitats for a range of birds, reptiles and ground-dwelling mammals, including tree hollows, long unburnt spinifex clumps, fallen logs and woody debris. No significant microhabitats are considered to be present within this habitat type in the study area (Biota 2007b).

The Rocky Hills and Slopes habitat contains microhabitats such as rocky cracks and crevices for small ground dwelling mammals and reptiles, and overhangs suitable to provide shelter for larger mammals and reptiles. No suitable caves have been observed within this habitat type that would provide long-term roosting potential for conservation listed species such as the Ghost Bat or Pilbara Leaf-nosed Bat (Biota 2007b; Biota 2010a). Although this type of habitat is widespread across the Pilbara bioregion, it often creates geographically isolated microhabitats for a range of species. No significant microhabitats are considered to be present within this habitat type in the study area (Biota 2007b).

The Drainage Lines habitat includes riparian vegetation, semi-permanent and ephemeral waterways. These microhabitats are not available in other habitat types and are likely to support a diverse fauna assemblage. The tree-lined creeks and rivers provide good cover and microhabitats such as tree hollows and sandy soils for burrowing. Drainage Lines also represent a refuge and semi-permanent water source for a wide range of species during the drier months. Whilst this habitat type is considered significant for a range of conservation listed fauna species, no significant microhabitats are considered to be present in the study area (Biota 2007b).

3.12 CONSERVATION LISTED FAUNA POTENTIALLY OCCURRING IN THE STUDY AREA

No conservation listed fauna species have been previously recorded in the study area (Figure 3-8).

The desktop study, utilising previous survey results and various database searches identified nineteen conservation listed fauna species that may occur within the vicinity of the study area (Table 3-6).

Five species were considered 'likely' and eight have the 'potential' to occur, whilst the remaining six were considered 'unlikely' to occur based on the criteria used to assess the likelihood of occurrence (Appendix 2, Table 3-6).

The Priority 4 species *Ardeotis australis* (Australian Bustard) has recently been removed from the Parks and Wildlife Priority fauna list (Parks and Wildlife 2014d). Therefore, although this species was considered likely to occur, it has been removed from the list of potentially occurring conservation listed fauna. The five species considered likely to occur within the study area are discussed in detail below.

***Dasyurus hallucatus* (Northern Quoll) – Schedule 1, Endangered**

The Northern Quoll typically inhabits dissected rocky escarpments; however, it will utilise a range of habitats and den sites from rock crevices, tree hollows and goanna burrows, to the roofs of buildings (Van Dyck and Strahan 2008). The Northern Quoll has a relatively large home-range size of up to 150 ha for males (35 ha for females).

This species was recorded through presence of scats in the Biota (2007b) survey, within the deep gorge/gully habitat (trap site BUNVE02) located approximately 5 km south-east of the western portion of the study area (Biota 2007b). The location of this record was not in the Rio Tinto database; for the purposes of Figure 3-8, it was inferred based on the location of the trap site (Biota 2007b).

Drainage Lines habitat could be used for foraging and dispersal by this species within the study area (Van Dyck and Strahan 2008). If the species was present within the study area, the potential for the Proposal to impact on the conservation status of the species is considered low given the relatively low impacts associated with Proposal and the absence of core habitat within the study area.

***Liasis olivaceus barroni* (Pilbara Olive Python) – Schedule 1, Vulnerable**

The Pilbara Olive Python inhabits rocky escarpments, deep gullies and gorges within the Pilbara region and is often recorded near water holes and riverine habitats (Wilson and Swan 2010). Observations from the Robe River locality (Pearson and Sutherland, unpublished, as cited in Swan 2007) indicated the Pilbara Olive Python spends the cooler winter months hiding in caves and rock crevices away from water sources. In the hotter months, they may move widely and shelter in a range of sites associated with riparian areas (Doughty *et al.* 2011).

The closest record occurs approximately 1 km north-west of the western portion of the study area, which represents an opportunistic observation of the species (Rio Tinto database). Suitable foraging and dispersal habitat occurs for this species represented by Drainage Lines within the study area. The species could also occur in the Rocky Hills and Slopes habitat during the winter months.

If the species was present within the study area, the potential for the Proposal to impact on the conservation status of the species is considered low given the relatively low impacts associated with the proposed activities, the variety of habitats utilised and the mobility of this species.

***Rhinonicteris aurantius* (Pilbara Leaf-nosed Bat) – Schedule 1, Vulnerable**

The Pilbara leaf-nosed Bat is the Pilbara form of the Orange Leaf-nosed Bat and occurs only in the Pilbara region of Western Australia; the Orange Leaf-nosed Bat occurs more widely through the Kimberley and across northern Australia into north-western Queensland (Churchill 2008). Populations occurring in the Pilbara bioregion of WA are considered to be isolated from more northern populations (Armstrong 2001). While the Pilbara leaf-nosed Bat is relatively widespread throughout the Pilbara region, it is restricted to certain landform units and the number of suitable roosts within these landform units is limited (Armstrong 2001). The Pilbara Leaf-nosed Bat roosts within deep caves and mine adits with suitable microclimates (warm and humid). In the Pilbara, this species has been observed foraging in numerous habitats including *Triodia* hummock grasslands, small watercourses and around pools in riverine or gorge habitats (Armstrong 2001).

Five individuals of this species have been recorded within drainage habitats approximately 1.5 km north of the western portion of the study area (Biota 2010a). While the study area represents suitable foraging habitat, it lacks deep caves that are suitable as roosting habitat for the species (Biota 2007b). It is considered likely that the species would utilise the Drainage Lines habitat of the study area as foraging and dispersal habitat.

If the species was present within the study area, the potential for the Proposal to impact on the conservation status of the species is considered low given the relatively low impacts associated with the proposed activities.

***Merops ornatus* (Rainbow Bee-eater) – Schedule 3, Migratory**

The Rainbow Bee-eater occupies a wide range of habitats including open woodlands, riverbanks, road cuttings, beaches, cliffs, mangroves and rain forests (Pizzey and Knight 2007). The Rainbow Bee-eater can occur as a resident, breeding visitor, passage migrant or winter visitor (Pizzey and Knight 2007). This species nests in burrows dug at a slight angle in the flat ground, sandy banks and margins of roads and tracks (Johnstone and Storr 1998).

All habitats within the study area represent potential foraging habitat for the Rainbow Bee-eater. Sandy banks within Drainage Lines habitat may represent potential breeding habitat, although this is considered marginal at best and is well represented outside the study area in the locality.

If the species was present within the study area, the potential for the Proposal to impact on the conservation status of the species is considered low given the migratory nature and low habitat-specificity of this species, and the relatively low impacts associated with the proposed activities.

***Notoscincus butleri* (Lined Soil-crevice Skink) – Priority 4**

The Lined Soil-crevice Skink is endemic to WA and is restricted to the arid north-west of the Pilbara bioregion (Storr *et al.* 1999). This species is associated with spinifex-dominated areas near creek and river margins (Wilson and Swan 2008).

This species has been recorded numerous times within 10 km of the study area; the closest record occurs approximately 4 km west of the eastern portion of the study area (Parks and Wildlife 2007 – 2015). This species was recorded 23 times by Biota (2010a) and 14 times by Biota (2007b). Given the

high number of records in the locality, it is considered likely to occur within the study area. The Drainage Lines habitat of the study area represents suitable habitat for this species.

If the species was present within the study area, the potential for the Proposal to impact on the conservation status of the species is considered low given the relatively low impacts associated with the proposed activities.

3.13 ENVIRONMENTALLY SIGNIFICANT AREAS

No internal Rio Tinto significant areas (restriction areas) will be established within the study area as no Threatened flora, fauna or ecosystems were recorded in the study area.

Table 3-6: Conservation listed fauna species returned by database searches, including Likelihood of Occurrence assessment of potential presence via habitat preference and proximity of previous recordings.

NM = Returned from NatureMap database search, RT= Returned from Rio Tinto database search, PMST= Returned from EPBC Act Protected Matters Search Tool. Status: EN = Endangered (EPBC Act), VU = Vulnerable (EPBC Act), M = Migratory (EPBC Act), S1 = Schedule 1 (WC Act), S3 = Schedule 3 (WC Act), P1-P4 = Priority ranking (Parks and Wildlife 2007-2015).

Species	Common Name	Status		Database			Distance to nearest record	Habitat and Discussion	Likelihood of occurrence
		WC Act	EPBC Act	NM	RT	PMST			
Dasyurus hallucatus	Northern Quoll	S1	EN			x	23 km north-west	This species has a large home range size; it favours rocky areas for denning habitat and utilises riparian habitats and gullies, ridges and canyons for foraging (Van Dyck and Strahan 2008). This species was recorded through presence of scats in the Biota (2007b) survey, within the deep gorge/gully habitat located approximately 5 km south-east of the western portion of the study area (Biota 2007b). Within NatureMap, the closest known record occurs 23 km north-west of the study area (Parks and Wildlife 2007 – 2015). The study area does contain potentially suitable foraging habitat for the species, and therefore it is considered likely to occur.	Likely
Liasis olivaceus barroni	Pilbara Olive Python	S1	VU		x	x	1.1 km north-west	The Pilbara subspecies is usually associated with rocky gullies and watercourses usually where areas of permanent or persistent water are present, which provide highly suitable habitat for hunting prey. In the hotter months, they may move widely and shelter in riparian areas (Doughty *et al.* 2011). Suitable habitat occurs for this species within the study area, and Biota (2007b) considered it likely that the species occurs within the locality. Due to the close proximity of a record of this species, the Pilbara Olive Python is	Likely

Species	Common Name	Status		Database			Distance to nearest record	Habitat and Discussion	Likelihood of occurrence
		WC Act	EPBC Act	NM	RT	PMST			
								considered likely to occur in the study area.	
Rhinonicteris aurantius	Pilbara Leaf-nosed Bat	S1	VU		x	x	1.5 km north	While the species is relatively widespread throughout the Pilbara region, it roosts only within deep caves and mine adits with very specific temperature and humidity characteristics that suit the species' requirements (Armstrong 2001). This species has been observed foraging in numerous habitats including *Triodia* hummock grasslands, small watercourses and around pools in riverine or gorge habitats (Armstrong 2001). Individuals of this species have been recorded within drainage habitats approximately 1.5 km north of the western portion of the study area (Biota 2010a). While the study area represents suitable foraging habitat, it lacks deep caves that are suitable as roosting habitat for the species (Biota 2007b). It is considered likely that the species would utilise the study area as foraging and dispersal habitat.	Likely
Rostratula benghalensis subsp. *australis*	Australian Painted Snipe	S1; S3	EN; M			x	100 km north	Generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and clay pans (Morcombe 2007). Although this species is wide-ranging, the study area is unlikely to represent suitable habitat for this species.	Unlikely
Actitis hypoleucos	Common Sandpiper	S3	M			x	28 km north-west	Found in a range of coastal and wetland systems in association with muddy banks rivers and estuaries. It also occurs inland within temporary shallow wetlands such as floodplains (Morcombe 2007). There is potential for this species to utilise the study area for foraging on at least an occasional basis when the Bungaroo Creek system is	Potential

Species	Common Name	Status		Database			Distance to nearest record	Habitat and Discussion	Likelihood of occurrence
		WC Act	EPBC Act	NM	RT	PMST			
								seasonally inundated.	
Apus pacificus	Fork-tailed Swift	S3	M			x	102 km north	This species utilises a wide range of habitats for aerial foraging and is a common non-breeding migrant throughout the Pilbara between October and April (Morcombe 2007). The study area could potentially represent foraging habitat for the species during the migratory period.	Potential
Ardea ibis	Cattle Egret	S3	M			x	60 km north-east	This species occurs commonly along river systems throughout the Pilbara, however prefers large water bodies or wetlands (Morecombe 2007). While the closest known record for this species is a long way from the study area (Atlas of Living Australia 2015), this species is highly mobile and a common, opportunistic forager in a wide range of temporary wetlands, including floodplains. The study area represents potential seasonal habitat for the species when the Bungaroo Creek system is seasonally inundated, and therefore it is considered to have the potential to occur.	Potential
Ardea modesta	Great Egret	S3	M			x	27 km north-east	Utilises a range of wetland and riparian habitats (Morcombe 2007). This species is highly mobile and a common, opportunistic forager in a wide range of temporary wetlands, including floodplains. The study area represents potential seasonal habitat for the species when the Bungaroo Creek system is seasonally inundated, and therefore it is considered to have the potential to occur.	Potential
Charadrius veredus	Oriental Plover	S3	M			x	85 km east	Associated with inland plains, clay pans and tidal flats (Morcombe 2007). The Bungaroo Creek system could represent potentially suitable habitat for this species.	Unlikely

Species	Common Name	Status		Database			Distance to nearest record	Habitat and Discussion	Likelihood of occurrence
		WC Act	EPBC Act	NM	RT	PMST			
								However, in consideration of the distance of nearest records, it is unlikely to occur.	
Glareola maldivarum	Oriental Pratincole	S3	M			x	74 km north-west	This species inhabits open plains, floodplains or short grassland, often with extensive bare areas (DoE 2015b). The study area represents potentially suitable foraging habitat for this species, particularly when the Bungaroo Creek system is seasonally inundated. This species is highly mobile and a common, opportunistic forager in a wide range of habitats. Therefore, despite the distance of the nearest known record, this species is considered to have the potential to occur in the study area.	Potential
Haliaeetus leucogaster	White-bellied Sea-Eagle	S3	M			x	35 km north-east	Usually found in costal habitats, although has been known to come inland in search for prey over rivers (Morcombe 2007). The study area represents marginal foraging habitat for this species given it contains part of a river system (Bungaroo Creek). The Robe River, approximately 20 km to the north-west of the study area, is likely to represent more suitable habitat for this species in the locality.	Unlikely
Hirundo rustica	Barn Swallow	S3	M			x	280 km north-east	This species is migratory and does not breed in Australia (Morcombe 2007). Foraging is usually within coastal lowlands and open country. It is considered unlikely that the species would occur in the study area as the habitat is not considered suitable.	Unlikely
Merops ornatus	Rainbow Bee-eater	S3	M		x	x	1.7 km north-west	This species is widespread throughout the Pilbara and occurs in almost every habitat type, preferring areas near water and sandy substrates for breeding. This species was recorded	Likely

Species	Common Name	Status		Database			Distance to nearest record	Habitat and Discussion	Likelihood of occurrence
		WC Act	EPBC Act	NM	RT	PMST			
								1.7 km north-west of the western portion of the study area (Biota 2010a), and numerous additional records occur in the locality (Biota 2010a; Parks and Wildlife 2007 – 2015). It is likely that the species utilises the study area for foraging.	
Pandion haliaetus	Osprey	-	M	x			64 km south-east	Occurs in coastal and terrestrial wetland habitats. This species tends to stay in coastal environments; however, there are records of this species occurring over 250 km inland (Parks and Wildlife 2007 – 2015). The study area could represent potential foraging habitat for the species when the Bungaroo Creek system is seasonally inundated; however, it is considered marginal habitat and this species is considered unlikely to occur.	Unlikely
Leggadina lakedownensis	Lakeland Downs Mouse	P4					65 km west	Inhabits seasonally inundated areas including cracking clays covered by tussock grasslands (Menkhorst and Knight 2011). This species has not been recorded in previous surveys of the locality (Biota 2007b; Biota 2010a). The study area does not support suitable habitat for this species and the species is therefore considered unlikely to occur.	Unlikely
Macroderma gigas	Ghost Bat	P4			x		5.3 km north-west	This species is known to occur in the Hamersley Range and wider Pilbara in natural caves, adits and mines (Armstrong and Anstee 2000). This species was recorded from three locations approximately 5 km north-west of the western portion of the study area at the mouth of a shallow cave (Biota 2010a). No caves are known to occur in the study area that could provide roosting habitat for the species; however, the Bungaroo Creek system and associated riverine habitats	Potential

Species	Common Name	Status		Database			Distance to nearest record	Habitat and Discussion	Likelihood of occurrence
		WC Act	EPBC Act	NM	RT	PMST			
								represent suitable foraging habitat for this species. It is considered that this species would potentially utilise the study area for foraging habitat.	
Notoscincus butleri	Lined Soil-crevice Skink	P4		x	x		4 km west	This species is known from the west Pilbara region and is often recorded in spinifex-dominated areas near creeks and river margins (Wilson and Swan 2008). This species has been recorded from nine known locations within 10 km of the study area; the closest of which occurs approximately 4 km west of the eastern portion of the study area (Parks and Wildlife 2007 – 2015). Biota (2010a) recorded this species from three locations and the remaining six locations were returned from the NatureMap database search (Parks and Wildlife 2007 – 2015). Given the numerous records in close proximity and the suitability of habitat in the study area, this species is considered likely to occur.	Likely
Pseudomys chapmani	Western Pebble-mound Mouse	P4			x	x	4.6 km north-west	The Western Pebble-mound Mouse is confined to the central and eastern Pilbara; however, it is widely distributed throughout this region (Menkhorst and Knight 2001). It is typically found in stony habitats on lower slopes and hillsides and is easily observed via extensive pebble mounds it constructs. This species has been recorded between the two portions of the study area on lower stony slopes (ELA 2014). This is the only record of the species for the locality (Biota 2007b; Biota 2010a); however, there is suitable habitat within the study area for this species and it is therefore considered to potentially occur.	Potential

Species	Common Name	Status		Database			Distance to nearest record	Habitat and Discussion	Likelihood of occurrence
		WC Act	EPBC Act	NM	RT	PMST			
Sminthopsis longicaudata	Long-tailed Dunnart	P4		x			3 km south	Occurs on rocky landscapes and breakaways supporting mixed *Acacia* shrubland and *Triodia* grasslands. Known to occur throughout the Eremanean Province of WA, as well as from the Northern Territory (Menkhorst and Knight 2011). This species was recorded approximately 3 km south of the eastern portion of the study area (Parks and Wildlife 2007 – 2015). There is potentially suitable habitat for the species within the study area in the Rocky Hills and Slopes habitat; however, this habitat type is not well represented within the study area. It is therefore considered to potentially occur.	Potential

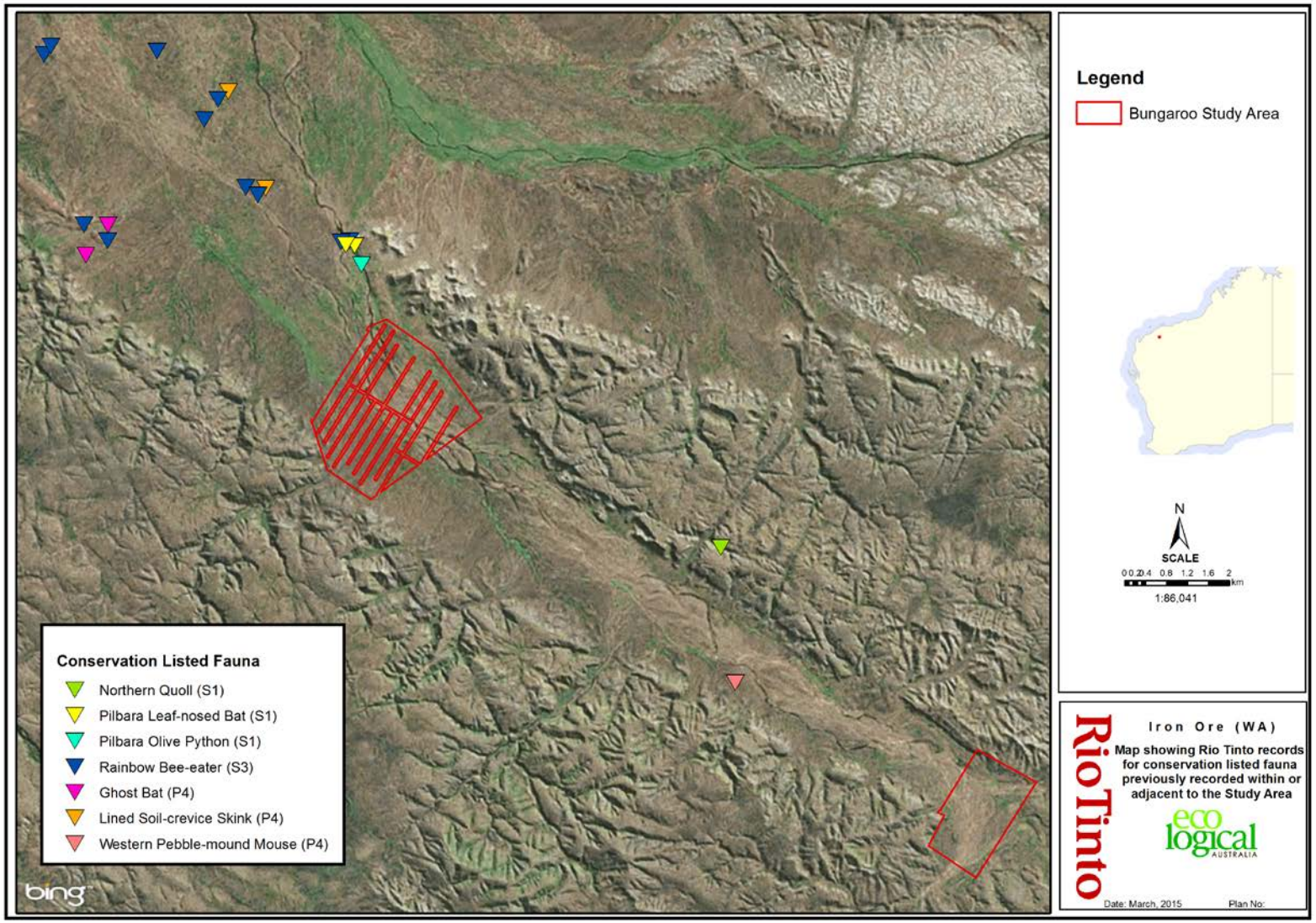


Figure 3-8: Map showing Rio Tinto records for conservation listed fauna previously recorded within or adjacent (<5 km) to study area

4 STATEMENT ADDRESSING THE TEN CLEARING PRINCIPLES

Rio Tinto proposes to undertake mineral, geotechnical and hydrological exploration activities within the Bungaroo study area of the Robe Valley in the Pilbara. The study area comprises approximately 773 ha of native vegetation and an additional 9 ha of cleared areas and disturbed areas.

Based on specialist assessment of the study area and discussion below, it is deemed that the Proposal is unlikely to be at variance with the Ten Clearing Principles under Schedule 5 of the EP Act.

4.1 COMPRISES HIGH LEVEL OF BIOLOGICAL DIVERSITY

Native vegetation should not be cleared if it comprises a high level of biological diversity.

The Pilbara is one of Australia's 15 National Biodiversity Hotspots (DoE 2015c) and is a secondary centre of endemism and species richness for *Acacia*, *Triodia*, *Corymbia* and *Sida* in WA (Kendrick 2001). The Hamersley subregion of the Pilbara has been identified by the Threatened Species Scientific Committee for the Australian Government as a Biodiversity Hotspot as it provides habitat for a number of threatened, endemic and fire-sensitive species and communities (DoE 2015c).

Seventeen vegetation associations were identified across four major landforms over the study area. Four were described from Tall Stone Hills and Breakaways, six from Plains and Low Rises, three from Drainage Areas (Major Creeklines) and four from Drainage Areas (Minor Flowlines). The majority of vegetation was in Good condition (464.2 ha or 59.3 %). Four vegetation units were considered significant by Biota (2007a; 2012). Three of these vegetation units were considered to represent Ecosystems at Risk from various threatening processes as defined by Kendrick (2001) and represent Major Ephemeral Water Courses (Biota 2007a): DC1 ChGpTe, DC2 EvApyAtrTe and DC3 EvCv. These vegetation units make up 439.9 ha or 56.2 % of the study area. Unit H2 ElAiAbTw (1.8 ha or 0.2 % of the study area) supports large populations of habitat-restricted flora, the Priority 3 species *Triodia* sp. Robe River (M.E. Trudgen *et al.* 12367), which has been recorded in the study area, and was considered to be significant by Biota (2012). This vegetation unit is not restricted to the study area.

Biota (2007a) recorded a total of 351 native flora taxa from 151 genera representing 57 families from the combined Bungaroo project area and broader Bungaroo Valley. The most taxon-rich families recorded during the Biota (2007a) survey were Poaceae (42 taxa), Malvaceae (37 taxa) and Fabaceae (36 taxa). The most species-rich genera were *Acacia* (21 taxa), *Sida* (14 taxa) and *Senna/Ptilotus*/*Tephrosia* (13 taxa each). The Biota (2007a) survey area is more than seven times the size of the study area (5,677 ha compared to just 782 ha) and also contained a wider variety of landforms and vegetation units. It is therefore likely that the study area contains fewer flora taxa than were recorded during the Biota (2007a) survey.

The dominant plant groups are consistent with other surveys of the Bungaroo locality. The Bungaroo Valley appears to be relatively more diverse than other areas within the Robe Valley locality (Biota 2007a). Other surveys by Biota in the locality have reported relatively poor species diversity when compared to other surveys further east in the Hamersley Range. The high species diversity recorded from the study area and surrounds is likely to be a reflection of the drainage channels and floodplains that dominate the Bungaroo Creek system (Biota 2007a). Within the study area, 59.7 % (467.2 ha) of the vegetation associations occur within the Drainage Areas (Major Creeks and Minor Flowlines) landforms.

Two conservation listed flora taxa were recorded in the study area:

- *Triodia* sp. Robe River (M.E. Trudgen *et al.* MET 12367) – Priority 3; and
- *Rhynchosia bungarensis* – Priority 4.

No conservation listed fauna taxa were recorded in the study area.

The study area occurs within the mapped extent of the Priority 1 'Stygofaunal community of the Bungaroo Aquifer' PEC. This PEC contains a unique assemblage of aquatic subterranean fauna including eels, snails and other stygofauna (Parks and Wildlife 2014b). Bungaroo Creek bore field overlaps the study area; water extraction as part of the Pilbara Coastal Water Supply project from this bore field utilises approximately 10 GL of water per year from the Bungaroo Aquifer (Biota 2013). The predicted hydrological sampling to be conducted as part of the Proposal is expected to be minimal and it is unlikely that the Proposal will therefore impact the conservation status of the Priority 1 'Stygofaunal community of the Bungaroo Aquifer' PEC.

Given the nature of the Proposal, only a small portion of vegetation is expected to be cleared and disturbance to groundwater is expected to be minimal; therefore the Proposal is not considered to be at variance with this Principle.

4.2 POTENTIAL IMPACT TO ANY SIGNIFICANT HABITAT FOR FAUNA INDIGENOUS TO WESTERN AUSTRALIA

Native vegetation should not be cleared if it comprises the whole, or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.

Three broad fauna habitat types were recorded in the study area. None of these are considered to be habitats of elevated conservation significance; all are considered typical and well represented throughout the Hamersley subregion. No caves, semi-permanent water holes or other microhabitats of significance were recorded in the study area.

The study area occurs within the mapped extent of the Priority 1 'Stygofaunal community of the Bungaroo Aquifer' PEC. Bungaroo Creek bore field overlaps the study area; water extraction as part of the Pilbara Coastal Water Supply project from this bore field utilises approximately 10 GL of water per year from the Bungaroo Aquifer (Biota 2013). This PEC is considered unlikely to be affected by the Proposal as it is understood minimal additional disturbance to groundwater will result from the proposed mineral, geotechnical and hydrological exploration activities.

No conservation listed fauna taxa were recorded in the study area. Five species are considered 'likely' to occur within the study area as it provides them with suitable habitat: Northern Quoll, Pilbara Olive Python, Pilbara Leaf-nosed Bat, Rainbow Bee-eater, and Lined Soil-crevice Skink. However, similar habitat occurs extensively near, but outside, the study area. Furthermore, these habitats occur widely in the Pilbara region. The Proposal is not expected to impact the conservation status of these species.

The Proposal is not considered to be at variance with this Principle as the proposed activities are unlikely to represent a significant impact on habitat for native fauna.

4.3 POTENTIAL IMPACT TO ANY RARE FLORA

Native vegetation should not be cleared if it includes, or is necessary for the continued existence of rare flora.

Three Threatened flora species are known to occur in the Pilbara; *Lepidium catapycnon*, *Thryptomene wittweri* and *Aluta quadrata*. None of these species were recorded in the study area and none are considered likely or to have the potential to occur. The Proposal is therefore not at variance with this Principle.

4.4 PRESENCE OF ANY THREATENED ECOLOGICAL COMMUNITIES

Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of a threatened ecological community (TEC).

None of the vegetation associations occurring within the study area correspond to any ecosystems listed as Threatened under the EPBC Act and none are consistent with ecosystems listed as TECs by Parks and Wildlife (2014a). The Proposal is therefore not at variance with this Principle.

4.5 SIGNIFICANCE AS A REMNANT OF NATIVE VEGETATION IN THE AREA THAT HAS BEEN EXTENSIVELY CLEARED

Native vegetation should not be cleared if it is significant as remnant vegetation in an area that has been extensively cleared.

The study area intersects two pre-European vegetation associations defined by Shepherd *et al.* (2002):

- Hamersley 82 (e16Lr t3Hi): Hummock grasslands, low tree steppe; Snappy Gum over *Triodia wiseana*.
- Hamersley 609 (e24Lr a2Sp t1Hi/e16Lr t3Hi): Mosaic: Hummock grasslands, open low tree steppe; Bloodwood with sparse Kanji shrubs over soft Spinifex/Hummock grasslands, open low tree steppe; Snappy Gum over *Triodia wiseana* on a lateritic crust.

Shepherd *et al.* (2002) identified the Pilbara bioregion as having largely intact native vegetation owing to the lack of intensive agricultural land use practices. Although the native vegetation remains widespread and largely intact, the floristic composition and structural characteristics are almost certainly changed since European settlement by grazing and altered fire regimes (Shepherd *et al.* 2002).

Locally, the area has been subject to a minor degree of clearing for mining exploration activities and bore fields associated with the Pilbara Coastal Water Supply project; however, it is considered that there is adequate representation of all local vegetation types within and surrounding the study area and that mineral, geotechnical and hydrological exploration activities will not significantly affect this. Vegetation associations 82 and 609 have over 99.5% and 98.1% of their pre-European extent remaining, respectively (Government of WA 2014).

The Proposal is not at variance with this Principle as the study area is not representative of an area of significant remnant vegetation within an extensively cleared landscape.

4.6 IMPACT ON ANY WATERCOURSES AND/OR WETLANDS

Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

There are no wetlands of regional or national significance that occur within or in close proximity to the study area.

One major drainage line (Bungaroo Creek) and multiple minor drainage lines run through the study area. The Drainage Areas (Major Creeklines) vegetation association units DC1 ChGpTe, DC2 EvApyAtrTe and DC3 EvCv are inferred to be representative of a major ephemeral water course (Biota 2007a), which is identified by Kendrick (2001) as an Ecosystem at Risk within the Hamersley subregion. These vegetation units make up 439.9 ha or 56.2 % of the study area.

The Proposal is not at variance with this Principle assuming only a small portion of the Drainage Areas (Major Creeklines) vegetation associations within the study area will be cleared.

4.7 POTENTIAL TO CAUSE APPRECIABLE LAND DEGREDATION

Native vegetation should not be cleared if the clearing of vegetation is likely to cause appreciable land degradation.

The study area intersects the Newman, Urandy and Boolgeeda land systems. These land systems are not susceptible to large-scale degradation or erosion (van Vreeswyk *et al.* 2004). It is not expected that the Proposal will result in substantial nutrient export, water-logging/flooding, acidification, salinisation or deep subsoil compaction.

Six weed species have been recorded within the study area; strict weed hygiene protocols will be implemented during the implementation of the Proposal to minimise the introduction and spread of weeds to or from the study area, and reduce any potential land degradation.

The amount of clearing required to support the Proposal represents only a small portion of the study area. The Proposal is therefore not considered to be at variance with this Principle.

4.8 POTENTIAL TO IMPACT ON THE ENVIRONMENTAL VALUES OF ADJACENT OR NEARBY CONSERVATION AREAS.

Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

There are no conservation areas within the study area. The closest conservation area is the Millstream-Chichester National Park, located approximately 67 km to the north-east of the study area.

The Proposal is not at variance with this Principle.

4.9 POTENTIAL DETERIORATION IN THE QUALITY OF SURFACE OR UNDERGROUND WATER

Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

No permanent water features occur in or adjacent to the study area. The study area is located within the Bungaroo Water Reserve which is classed as a Public Drinking Water Source Area (DoW 2015). Bungaroo Creek also runs through the study area and is considered a major drainage line.

Some groundwater will be extracted as part of the Proposal. Bungaroo Creek bore field overlaps the study area; water extraction as part of the Pilbara Coastal Water Supply project from this bore field utilises approximately 10 GL of water per year from the Bungaroo Aquifer (Biota 2013). Given the temporary nature of mineral, geotechnical and hydrological exploration activities and small amount of vegetation clearing and water extraction proposed, the Proposal is not expected to affect surface water or groundwater quality in the region.

The Proposal is not considered to be at variance with this Principle.

4.10 POTENTIAL OF CLEARING TO CAUSE, OR EXACERBATE, THE INCIDENCE OR INTENSITY OF FLOODING

The Pilbara bioregion often experiences large rainfall events and cyclones. Significant changes to the landform, such as extensive clearing of native vegetation, can lead to localised and/or wide-scale flooding. The Proposal is not considered significant enough to cause or exacerbate the incidence or intensity of flooding in, or in the vicinity of, the study area as it is assumed only a small portion of the study area will be cleared.

The Proposal is not considered to be at variance with this Principle.

5 CONCLUSIONS

Rio Tinto proposes to clear native vegetation (and disturbed ground) to support mineral, geotechnical and hydrological exploration activities at Bungaroo. The study area covers approximately 782 ha of predominantly undisturbed ground and intact native vegetation, as well as cleared and disturbed areas.

The majority of landforms, vegetation, flora and fauna habitats are well represented within the Bungaroo locality and the broader Hamersley subregion. Seventeen vegetation associations were identified across four major landforms over the study area, with an additional 10.0 ha of cleared and disturbed land, associated with historical exploration tracks.

Four vegetation units were considered significant by Biota (2007a; 2012). Three of these vegetation units were considered to represent Ecosystems at Risk (Major Ephemeral Water Courses) as defined by Kendrick (2001): vegetation units DC1 ChGpTe, DC2 EvApyAtrTe and DC3 EvCv (Biota 2007a). These vegetation units make up 439.9 ha or 56.2 % of the study area. Unit H2 ElAiAbTw (1.8 ha or 0.2 % of the study area) supports large populations of habitat-restricted flora, the Priority 3 species *Triodia* sp. Robe River (M.E. Trudgen *et al.* 12367), which has been recorded in the study area. This vegetation unit is not restricted to the study area.

Biota (2007a) recorded a total of 351 native flora taxa from 151 genera representing 57 families from the combined Bungaroo project area and broader Bungaroo Valley. The Biota (2007a) survey area is more than seven times the size of the study area, and it is therefore likely that the study area contains fewer flora taxa than were recorded during the Biota (2007a) survey. Two conservation listed flora taxa were recorded in the study area:

- *Triodia* sp. Robe River (M.E. Trudgen *et al.* MET 12367) – Priority 3; and
- *Rhynchosia bungarensis* – Priority 4.

In addition to the two Priority species known to occur within the study area, one species was considered likely to occur within the study area:

- *Indigofera* sp. Bungaroo Creek (S. van Leeuwen 4301) – Priority 3.

Two Priority flora species were considered to potentially occur within the study area:

- *Stylidium weeliwolli* – Priority 2; and
- *Eragrostis surreyana* – Priority 3.

Six weed species were previously recorded within the study area.

Of the three fauna habitats identified within the study area, The 'Drainage Lines' and 'Rocky Hills and Slopes' habitats have the potential to support fauna of conservation significance, covering 333.9 ha (51.3 %) and 37.2 ha (4.8 %) respectively. The remaining habitat (Undulating Plains), covering 401.1 ha (42.7 %), is considered to have low potential to support conservation significance fauna species. Whilst these habitats are likely to be utilised by a range of conservation listed fauna species, no significant microhabitats are considered to be present and therefore species of conservation significance would not be dependent on the habitats in the study area (Biota 2007b).

The study area occurs within the mapped extent of the Priority 1 'Stygofaunal community of the Bungaroo Aquifer' PEC. Bungaroo Creek bore field overlaps the study area; water extraction as part

of the Pilbara Coastal Water Supply project from this bore field utilises approximately 10 GL of water per year from the Bungaroo Aquifer (Biota 2013). This PEC is considered unlikely to be affected by the Proposal as it is understood minimal additional disturbance to groundwater will result from the proposed mineral, geotechnical and hydrological exploration activities.

No conservation listed fauna taxa have been previously recorded from the study area. Five species are considered 'likely' to occur within the study area as it provides them with suitable habitat:

- *Dasyurus hallucatus* (Northern Quoll) – Schedule 1, Endangered;
- *Liasis olivaceus barroni* (Pilbara Olive Python) – Schedule 1, Vulnerable;
- *Rhinonicteris aurantius* (Pilbara Leaf-nosed Bat) – Schedule 1, Vulnerable;
- *Merops ornatus* (Rainbow Bee-eater) – Schedule 3, Migratory; and
- *Notoscincus butleri* (Lined Soil-crevice Skink) – Priority 4.

The manner in which the clearing of native vegetation is regulated, undertaken and rehabilitated is under various Government and internal Rio Tinto operational controls. These operational controls are presented in Appendix 6, and will be followed during the course of the proposed development.

6 REFERENCES

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7 APPENDICES

Appendix 1: Results of NatureMap and EPBC Protected Matters Search Tool

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 19/03/2015

Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 116°26' 30" E,21°56' 03" S
Buffer 20km
Group By Kingdom

Kingdom	Species	Records
Animalia	173	1503
Plantae	163	232
TOTAL	**336**	**1735**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Animalia					
1.	24283	*Accipiter fasciatus subsp. didimus (Brown Goshawk)*			
2.	30833	*Amphibolurus longirostris (Long-nosed Dragon)*			
3.	-12179	*Aname mellosa*			
4.	-13575	*Anapistula sp.*			Y
5.	25318	*Antaresia perthensis (Pygmy Python)*			
6.	24285	*Aquila audax (Wedge-tailed Eagle)*			
7.	24340	*Ardea novaehollandiae (White-faced Heron)*			
8.	24610	*Ardeotis australis (Australian Bustard)*			
9.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
10.	24352	*Artamus cinereus subsp. melanops (Black-faced Woodswallow)*			
11.	24355	*Artamus minor (Little Woodswallow)*			
12.	-1922	*Arthrorhabdus paucispinus*			
13.	24251	*Bos taurus (European Cattle)*	Y		
14.	25331	*Brachyurophis approximans (North-western Shovel-nosed Snake)*			
15.	25715	*Cacatua roseicapilla (Galah)*			
16.	24726	*Cacatua roseicapilla subsp. roseicapilla (Galah)*			
17.	25716	*Cacatua sanguinea (Little Corella)*			
18.	25454	*Canis lupus (Dog, Dingo)*	Y		
19.	25015	*Carlia munda (Shaded-litter Rainbow Skink)*			
20.	25600	*Centropus phasianinus (Pheasant Coucal)*			
21.	24186	*Chalinolobus gouldii (Gould's Wattled Bat)*			
22.	24431	*Chrysococcyx basalis (Horsfield's Bronze Cuckoo)*			
23.	24833	*Cincloramphus cruralis (Brown Songlark)*			
24.	24289	*Circus assimilis (Spotted Harrier)*			
25.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
26.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
27.	24363	*Coracina novaehollandiae subsp. subpallida (Black-faced Cuckoo-shrike)*			
28.	24416	*Corvus bennetti (Little Crow)*			
29.	24418	*Corvus orru subsp. cecilae (Western Crow)*			
30.	24420	*Cracticus nigrogularis (Pied Butcherbird)*			
31.	25595	*Cracticus tibicen (Australian Magpie)*			
32.	24422	*Cracticus tibicen subsp. dorsalis (White-backed Magpie)*			
33.	24424	*Cracticus torquatus subsp. torquatus (Grey Butcherbird)*			
34.	30892	*Cryptoblepharus ustulatus*			
35.	24865	*Ctenophorus caudicinctus subsp. caudicinctus (Ring-tailed Dragon)*			
36.	24876	*Ctenophorus isolepis subsp. isolepis (Crested Dragon, Military Dragon)*			
37.	24882	*Ctenophorus nuchalis (Central Netted Dragon)*			
38.	25036	*Ctenotus duricola*			
39.	25041	*Ctenotus grandis subsp. grandis*			
40.	25043	*Ctenotus grandis subsp. titan*			
41.	25044	*Ctenotus hanloni*			
42.	25045	*Ctenotus helenae*			
43.	25064	*Ctenotus pantherinus subsp. ocellifer (Leopard Ctenotus)*			
44.	25065	*Ctenotus pantherinus subsp. pantherinus (Leopard Ctenotus)*			

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NatureMap
Mapping Western Australia's biodiversity

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
45.	25072	*Ctenotus rubicundus*			
46.	25073	*Ctenotus saxatilis (Rock Ctenotus)*			
47.	25090	*Cyclodomorphus melanops subsp. melanops (Slender Blue-tongue)*			
48.	25375	*Cyclorana maini (Sheep Frog)*			
49.	25547	*Dacelo leachii (Blue-winged Kookaburra)*			
50.	24304	*Dacelo leachii subsp. leachii (Blue-winged Kookaburra)*			
51.	24091	*Dasykaluta rosamondae (Little Red Kaluta)*			
52.	24093	*Dasyurus hallucatus (Northern Quoll)*		T	
53.	25001	*Delma nasuta*			
54.	25002	*Delma pax*			
55.	25247	*Demansia psammophis subsp. psammophis (Yellow-faced Whipsnake)*			
56.	24926	*Diplodactylus conspicillatus (Fat-tailed Gecko)*			
57.	24944	*Diplodactylus savagei (Southern Pilbara Beak-faced Gecko)*			
58.	24470	*Dromaius novaehollandiae (Emu)*			
59.	41406	*Egernia cygnitos (Western Pilbara Spiny-tailed Skink)*			
60.	25094	*Egernia formosa*			
61.	25540	*Elanus caeruleus (Black-shouldered Kite)*			
62.	24631	*Emblema pictum (Painted Finch)*			
63.	24570	*Epthianura tricolor (Crimson Chat)*			
64.	42404	*Eremiascincus isolepis*			
65.	43381	*Eremiascincus pallidus (Western Narrow-banded Skink, Narrow-banded Sand Swimmer)*			
66.	24837	*Eremiornis carteri (Spinifex-bird)*			
67.	-1924	*Ethmostigmus curtipes*			
68.	24368	*Eurostopodus argus (Spotted Nightjar)*			
69.	25621	*Falco berigora (Brown Falcon)*			
70.	24471	*Falco berigora subsp. berigora (Brown Falcon)*			
71.	25622	*Falco cenchroides (Australian Kestrel)*			
72.	24472	*Falco cenchroides subsp. cenchroides (Australian Kestrel)*			
73.	25623	*Falco longipennis (Australian Hobby)*			
74.	24041	*Felis catus (Cat)*	Y		
75.	25301	*Furina ornata (Moon Snake)*			
76.	24956	*Gehyra pilbara*			
77.	24958	*Gehyra punctata*			
78.	24959	*Gehyra variegata*			
79.	24401	*Geopelia cuneata (Diamond Dove)*			
80.	25585	*Geopelia striata (Zebra Dove)*			
81.	24403	*Geopelia striata subsp. placida (Peaceful Dove)*			
82.	24404	*Geophaps plumifera (Spinifex Pigeon)*			
83.	24443	*Grallina cyanoleuca (Magpie-lark)*			
84.	24295	*Haliastur sphenurus (Whistling Kite)*			
85.	-12381	*Hanseniella sp. B18*			Y
86.	24961	*Heteronotia binoei (Bynoe's Gecko)*			
87.	24367	*Lalage tricolor (White-winged Triller)*			
88.	25135	*Lerista flammicauda*			
89.	25155	*Lerista muelleri*			
90.	25005	*Lialis burtonis*			
91.	25238	*Liasis olivaceus subsp. barroni (Pilbara Olive Python)*		T	
92.	25661	*Lichmera indistincta (Brown Honeyeater)*			
93.	-13550	*Limnesia sp. B04*			Y
94.	25392	*Litoria rubella (Little Red Tree Frog)*			
95.	30933	*Lucasium stenodactylum*			
96.	24180	*Macroderma gigas (Ghost Bat)*		P4	
97.	25489	*Macropus robustus (Euro)*			
98.	24136	*Macropus rufus (Red Kangaroo, Marlu)*			
99.	25651	*Malurus lamberti (Variegated Fairy-wren)*			
100.	25652	*Malurus leucopterus (White-winged Fairy-wren)*			
101.	24583	*Manorina flavigula (Yellow-throated Miner)*			
102.	24736	*Melopsittacus undulatus (Budgerigar)*			
103.	25184	*Menetia greyii*			
104.	25187	*Menetia surda subsp. surda*			
105.	24598	*Merops ornatus (Rainbow Bee-eater)*		IA	
106.	25542	*Milvus migrans (Black Kite)*			
107.	-13642	*Missulena rutraspina*			
108.	25193	*Morethia ruficauda subsp. exquisita*			
109.	24223	*Mus musculus (House Mouse)*	Y		
110.	33954	*Nedsia hurlberti (amphipod)*		T	
111.	33957	*Nedsia sculptilis (amphipod)*		T	
112.	24972	*Nephrurus wheeleri subsp. cinctus*			
113.	24973	*Nephrurus wheeleri subsp. wheeleri*			

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NatureMap
Mapping Western Australia's biodiversity

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
114.	24095	*Ningaui timealeyi (Pilbara Ningaui)*			
115.	25747	*Ninox connivens (Barking Owl)*			
116.	24820	*Ninox novaeseelandiae subsp. boobook (Boobook Owl)*			
117.	-13025	*Nomindar jarrnarm*			Y
118.	25196	*Notoscincus butleri (Lined Soil-crevice Skink)*		P4	
119.	25197	*Notoscincus ornatus subsp. ornatus*			
120.	24194	*Nyctophilus geoffroyi (Lesser Long-eared Bat)*			
121.	24742	*Nymphicus hollandicus (Cockatiel)*			
122.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
123.	24976	*Oedura marmorata (Marbled Velvet Gecko)*			
124.	-12621	*Omoedus orbiculatus*			
125.	24618	*Oreoica gutturalis (Crested Bellbird)*			
126.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
127.	25254	*Parasuta monachus*			
128.	24627	*Pardalotus rubricatus (Red-browed Pardalote)*			
129.	25682	*Pardalotus striatus (Striated Pardalote)*			
130.	24144	*Petrogale rothschildi (Rothschild's Rock-wallaby)*			
131.	24659	*Petroica goodenovii (Red-capped Robin)*			
132.	25698	*Phalacrocorax melanoleucos (Little Pied Cormorant)*			
133.	24666	*Phalacrocorax melanoleucos subsp. melanoleucos (Little Pied Cormorant)*			
134.	24409	*Phaps chalcoptera (Common Bronzewing)*			
135.	-13060	*Pilbarascutigera incola*			
136.	24101	*Planigale ingrami (Long-tailed Planigale)*			
137.	25721	*Platycercus zonarius (Australian Ringneck, Ring-necked Parrot)*			
138.	25703	*Podargus strigoides (Tawny Frogmouth)*			
139.	-12132	*Prethopalpus sp.*			Y
140.	24106	*Pseudantechinus woolleyae (Woolley's Pseudantechinus)*			
141.	25261	*Pseudechis australis (Mulga Snake)*			
142.	24235	*Pseudomys desertor (Desert Mouse)*			
143.	24237	*Pseudomys hermannsburgensis (Sandy Inland Mouse)*			
144.	25724	*Ptilonorhynchus maculatus (Spotted Bowerbird)*			
145.	24757	*Ptilonorhynchus maculatus subsp. guttatus (Western Bowerbird)*			
146.	24452	*Rhipidura fuliginosa subsp. preissi (Grey Fantail)*			
147.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
148.	24454	*Rhipidura leucophrys subsp. leucophrys (Willie Wagtail)*			
149.	24982	*Rhynchoedura ornata (Western Beaked Gecko)*			
150.	-1982	*Scolopendra morsitans*			
151.	30948	*Smicrornis brevirostris (Weebill)*			
152.	24115	*Sminthopsis longicaudata (Long-tailed Dunnart)*		P4	
153.	24116	*Sminthopsis macroura (Stripe-faced Dunnart)*			
154.	24927	*Strophurus elderi*			
155.	25269	*Suta fasciata (Rosen's Snake)*			
156.	-12787	*Symphyella sp. B16*			Y
157.	30870	*Taeniopygia guttata (Zebra Finch)*			
158.	30871	*Taeniopygia guttata subsp. castanotis (Zebra Finch)*			
159.	24175	*Taphozous georgianus (Common Sheathtail-bat)*			
160.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
161.	24851	*Turnix velox (Little Button-quail)*			
162.	25445	*Uperoleia russelli (Northwest Toadlet)*			
163.	41428	*Uperoleia saxatilis (Pilbara Toadlet)*			
164.	25209	*Varanus acanthurus (Spiny-tailed Monitor)*			
165.	25210	*Varanus brevicauda (Short-tailed Pygmy Monitor)*			
166.	30825	*Varanus bushi (Pilbara Mulga Monitor)*			
167.	25211	*Varanus caudolineatus*			
168.	25212	*Varanus eremius (Pygmy Desert Monitor)*			
169.	25224	*Varanus pilbarensis (Pilbara Rock Monitor)*			
170.	24205	*Vespadelus finlaysoni (Finlayson's Cave Bat)*			
171.	24248	*Zyzomys argurus (Common Rock-rat)*			
172.	-12360	*nr Encoptarthria sp.*			Y
173.	-13279	*nr Geophilus sp. B02*			Y
Plantae					
174.	4891	*Abutilon fraseri (Lantern Bush)*			
175.	4895	*Abutilon lepidum*			
176.	4902	*Abutilon oxycarpum (Flannel Weed)*			
177.	42920	*Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)*			
178.	3214	*Acacia ancistrocarpa (Fitzroy Wattle)*			
179.	3377	*Acacia inaequilatera (Baderi)*			
180.	3471	*Acacia orthocarpa (Needleleaf Wattle)*			
181.	3501	*Acacia ptychophylla*			
182.	29015	*Acacia pyrifolia var. pyrifolia*			

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	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
183.	2647	*Alternanthera angustifolia*			
184.	2648	*Alternanthera denticulata (Lesser Joyweed)*			
185.	2651	*Alternanthera nana (Hairy Joyweed)*			
186.	17147	*Alysicarpus muelleri*			
187.	2660	*Amaranthus cuspidifolius*			
188.	2663	*Amaranthus interruptus (Native Amaranth)*			
189.	13700	*Amyema bifurcata*			
190.	204	*Aristida burbidgeae*			
191.	210	*Aristida holathera*			
192.	1364	*Asphodelus fistulosus (Onion Weed)*	Y		
193.	6202	*Astrotricha hamptonii (Ironplant)*			
194.	2769	*Boerhavia burbidgeana*			
195.	2770	*Boerhavia coccinea (Tar Vine, Wituka)*			
196.	2775	*Boerhavia schomburgkiana*			
197.	6608	*Bonamia pannosa*			
198.	239	*Bothriochloa bladhii (Forest Bluegrass)*			
199.	241	*Brachyachne convergens (Spider Grass)*			
200.	2949	*Cassytha capillaris*			
201.	29721	*Cenchrus setiger (Birdwood Grass)*	Y		
202.	32	*Cheilanthes brownii*			
203.	37	*Cheilanthes lasiophylla (Woolly Cloak Fern)*			
204.	13691	*Clerodendrum floribundum var. ovatum*			
205.	18408	*Corchorus lasiocarpus subsp. parvus*			
206.	18415	*Corchorus sidoides subsp. sidoides*			
207.	20242	*Corchorus sp. Hamersley Range hilltops (S. van Leeuwen 3826)*			
208.	4865	*Corchorus tridens*			
209.	17093	*Corymbia hamersleyana*			
210.	17119	*Cullen leucochaites*			
211.	786	*Cyperus cunninghamii*			
212.	12811	*Cyperus cunninghamii subsp. cunninghamii*			
213.	789	*Cyperus difformis (Rice Sedge)*			
214.	798	*Cyperus iria*			
215.	814	*Cyperus squarrosus*			
216.	290	*Dactyloctenium radulans (Button Grass)*			
217.	7424	*Dampiera candicans*			
218.	303	*Dichanthium fecundum (Curly Bluegrass)*			
219.	13741	*Dichanthium sericeum subsp. humilius*			
220.	310	*Digitaria brownii (Cotton Panic Grass)*			
221.	313	*Digitaria ctenantha (Comb Finger Grass)*			
222.	328	*Echinochloa colona (Awnless Barnyard Grass)*	Y		
223.	375	*Eragrostis cumingii (Cuming's Love Grass)*			
224.	378	*Eragrostis dielsii (Mallee Lovegrass)*			
225.	16731	*Eragrostis exigua*			
226.	38505	*Eragrostis surreyana*		P3	
227.	398	*Eragrostis tenellula (Delicate Lovegrass)*			
228.	23997	*Eremophila tietkensii*			
229.	413	*Eriachne mucronata (Mountain Wanderrie Grass)*			
230.	35198	*Eriochloa pseudoacrotricha (Perennial Cupgrass)*			
231.	11011	*Eulalia aurea*			
232.	4617	*Euphorbia australis (Namana)*			
233.	35303	*Euphorbia australis var. subtomentosa*			
234.	4620	*Euphorbia boophthona (Gascoyne Spurge)*			
235.	9048	*Euphorbia careyi*			
236.	31578	*Ficus aculeata var. indecora (Ranji)*			
237.	862	*Fimbristylis microcarya*			
238.	12159	*Fimbristylis simulans*			
239.	2835	*Glinus lotoides (Hairy Carpet Weed)*			
240.	2836	*Glinus oppositifolius*			
241.	7060	*Glossostigma diandrum*			
242.	2680	*Gomphrena cunninghamii*			
243.	7526	*Goodenia microptera*			
244.	12552	*Goodenia muelleriana*			
245.	7556	*Goodenia tenuiloba*			
246.	4918	*Gossypium robinsonii (Wild Cotton)*			
247.	6706	*Heliotropium cunninghamii*			
248.	4925	*Hibiscus coatesii*			
249.	4933	*Hibiscus leptocladus*			
250.	4941	*Hibiscus solanifolius*			
251.	11651	*Hibiscus sturtii var. campylochlamys*			
252.	11385	*Hibiscus sturtii var. grandiflorus*			

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NatureMap
Mapping Western Australia's biodiversity

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
253.	11477	*Hibiscus sturtii var. platychlamys*			
254.	5215	*Hybanthus aurantiacus*			
255.	3974	*Indigofera georgei (Bovine Indigo)*			
256.	3982	*Indigofera monophylla*			
257.	3985	*Indigofera rugosa*			
258.	20317	*Indigofera sp. Bungaroo Creek (S. van Leeuwen 4301)*		P3	
259.	41782	*Indigofera sp. Fractiflexa (S. van Leeuwen 3773)*			
260.	3987	*Indigofera trita*			
261.	6633	*Ipomoea muelleri (Poison Morning Glory, Yumbu)*			
262.	6637	*Ipomoea polymorpha*			
263.	464	*Iseilema membranaceum (Small Flinders Grass)*			
264.	12059	*Jasminum didymum subsp. lineare (Desert Jasmine)*			
265.	43521	*Josephinia sp. Style-topped fruit (M. Maier BES MM 1017)*			Y
266.	37480	*Lobelia arnhemiaca*			
267.	6136	*Ludwigia perennis*			
268.	76	*Marsilea hirsuta (Nardoo)*			
269.	5051	*Melhania oblongifolia*			
270.	6971	*Nicotiana benthamiana (Tjuntiwari)*			
271.	7338	*Oldenlandia crouchiana*			
272.	12635	*Olearia fluvialis*			
273.	518	*Paspalidium clementii (Clements Paspalidium)*			
274.	523	*Paspalidium rarum (Rare Paspalidium)*			
275.	525	*Paspalidium tabulatum*			
276.	13494	*Pentalepis trichodesmoides*			
277.	546	*Perotis rara (Comet Grass)*			
278.	4684	*Phyllanthus reticulatus*			
279.	12075	*Polycarpaea corymbosa var. corymbosa*			
280.	2901	*Polycarpaea holtzei*			
281.	2903	*Polycarpaea longiflora*			
282.	6653	*Polymeria ambigua (Morning Glory)*			
283.	2884	*Portulaca oleracea (Purslane, Wakati)*			
284.	8192	*Pterocaulon sphacelatum (Apple Bush)*			
285.	8193	*Pterocaulon sphaeranthoides*			
286.	2696	*Ptilotus astrolasius*			
287.	2725	*Ptilotus fusiformis*			
288.	2734	*Ptilotus incanus*			
289.	2738	*Ptilotus latifolius (Tangled Mulla Mulla)*			
290.	20862	*Rhynchosia bungarensis*		P4	
291.	4191	*Rhynchosia minima (Rhynchosia)*			
292.	5285	*Rotala diandra*			
293.	5286	*Rotala mexicana*			
294.	964	*Schoenoplectus lateriflorus*			
295.	2604	*Sclerolaena costata*			
296.	12319	*Senna venusta*			
297.	31758	*Sida arsiniata*			
298.	4971	*Sida cardiophylla*			
299.	4976	*Sida echinocarpa*			
300.	15227	*Sida sp. A Kimberley Flora (P.A. Fryxell & L.A. Craven 3900)*			
301.	33698	*Sida sp. Pilbara (A.A. Mitchell PRP 1543)*			
302.	16948	*Sida sp. verrucose glands (F.H. Mollemans 2423)*			
303.	6989	*Solanum ashbyae*			
304.	6995	*Solanum centrale (Desert Raisin, Kampurarpa)*			
305.	7014	*Solanum horridum*			
306.	7029	*Solanum phlomoides*			
307.	18405	*Stackhousia sp. swollen gynophore (W.R. Barker 2041)*			
308.	8240	*Streptoglossa odora*			
309.	41825	*Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)*			
310.	15947	*Tephrosia sp. B Kimberley Flora (C.A. Gardner 7300)*			
311.	17768	*Tephrosia sp. Bungaroo Creek (M.E. Trudgen 11601)*			
312.	41811	*Tephrosia sp. Fortescue (A.A. Mitchell 606)*			
313.	42442	*Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)*			
314.	4285	*Tephrosia supina*			
315.	4287	*Tephrosia virens*			
316.	5313	*Terminalia supranitifolia*		P3	
317.	673	*Themeda triandra*			
318.	44305	*Trianthema pilosum*			
319.	4368	*Tribulopis angustifolia*			
320.	4379	*Tribulus macrocarpus*			
321.	4380	*Tribulus occidentalis (Perennial Caltrop)*			
322.	4381	*Tribulus platypterus (Cork Hopbush)*			

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NatureMap
Mapping Western Australia's biodiversity

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
323.	4383	*Tribulus terrestris (Caltrop)*	Y		
324.	12032	*Trichosanthes cucumerina var. cucumerina*			
325.	679	*Triodia angusta*			
326.	35843	*Triodia sp. Robe River (M.E. Trudgen et al. MET 12367)*		P3	
327.	704	*Triodia wiseana (Limestone Spinifex)*			
328.	706	*Triraphis mollis (Needle Grass)*			
329.	4875	*Triumfetta chaetocarpa (Urchins)*			
330.	14694	*Triumfetta clementii*			
331.	14942	*Triumfetta maconochieana*			
332.	717	*Urochloa piligera*			
333.	4323	*Vigna lanceolata (Maloga Vigna, Wega)*			
334.	5106	*Waltheria indica*			
335.	732	*Yakirra australiensis*			
336.	11894	*Yakirra australiensis var. australiensis*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

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

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Australian Government
Department of the Environment

EPBC Act Protected Matters Report

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

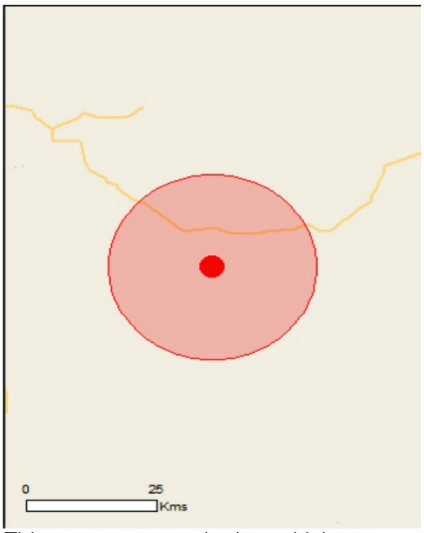
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

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

Report created: 09/03/15 14:28:58

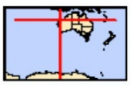
Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 20.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	6
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

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

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

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

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

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	10
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine	None

Extra Information

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

Place on the RNE:	None
State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	8
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus hallucatus Northern Quoll [331]	Endangered	Species or species habitat likely to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat likely to occur within area
Notoryctes caurinus Kakarratul, Northern Marsupial Mole [295]	Endangered	Species or species habitat may occur within area
Rhinonicteris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Liasis olivaceus barroni Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat likely to occur within area

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

Name	Threatened	Type of Presence
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat may occur within area
Hirundo rustica		
Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Migratory Wetlands Species		
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Charadrius veredus		
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum		
Oriental Pratincole [840]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

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

Name	Threatened	Type of Presence
Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Charadrius veredus		
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum		
Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat may occur within area
Hirundo rustica		
Barn Swallow [662]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Pandion haliaetus		
Osprey [952]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia		
Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Mammals		
Capra hircus		
Goat [2]		Species or species habitat likely to occur within area
Equus asinus		
Donkey, Ass [4]		Species or species habitat likely to occur within area
Felis catus		
Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus		
House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus		
Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes		
Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cenchrus ciliaris		
Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area

Coordinates

-21.93472 116.44194

Caveat

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Acknowledgements

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

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

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

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

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Appendix 2: Likelihood of occurrence criteria for flora and fauna species

Likelihood of occurrence criteria for flora and fauna species:

- Likelihood: Previously recorded.
    - The species has previously been recorded within study area from database search results and/or from previous surveys of the study area, and/or the species has been confirmed through a current vouchered specimen at WA Herbarium.
- Likelihood: Likely.
    - The species has not previously been recorded from within the study area. However:
        - the species has been recorded in proximity (<5 km) to the study area, and occurs in similar habitat to that which occurs within the study area
        - core habitat and suitable landforms for the species occurs within the study area either year-round or seasonally. In relation to fauna species, this could be that a host plant is seasonally present on site, or habitat features such as caves are present that may be used during particular times during its life cycle e.g. for breeding. In relation to both flora and fauna species, it may be there are seasonal wetlands present
        - there is a medium to high probability that a species uses the study area.
- Likelihood: Potential.
    - The species has not previously been recorded from within the study area. However,
        - targeted surveys may locate the species based on records occurring in proximity to the study area (5-15 km) and suitable habitat occurring in the study area
        - the study area has been assessed as having potentially suitable habitat through habitat modelling
        - the species is known to be cryptic and may not have been detected despite extensive surveys
        - the species is highly mobile and has an extensive foraging range so may not have been detected during previous surveys.
    - The species has been recorded in the study area by a previous consultant survey or there is historic evidence of species occurrence within the study area. However,
        - doubt remains over taxonomic identification, or the majority of habitat does not appear suitable (although presence cannot be ruled out due to factors such as species ecology or distribution)
        - coordinates are doubtful.
- Likelihood: Unlikely.
    - The species has been recorded locally through database searches. However, it has not been recorded within the study area and
        - it is unlikely to occur due to the site lacking critical habitat, having at best marginally suitable habitat, and/or being severely degraded
        - it is unlikely to occur due to few historic record/s and no other current collections in the local area.

- The species has been recorded within the bioregion based on literature review but has not been recorded locally or within the study area through database searches.
- The species has not been recorded in the study area despite adequate survey efforts, such as a standardised methodology or targeted searching within potentially suitable habitat.

- Likelihood: No.
  - The species is not known to occur within the IBRA bioregion based on current literature and distribution.
  - The study area lacks important habitat for a species that has highly selective habitat requirements.
  - The species has been historically recorded within study area or locally; however it is considered locally extinct due to significant habitat changes such as land clearing and/or introduced predators.

Appendix 3: Vegetation Structural Classification* and Condition Rating Scale

Vegetation Structural Classification

Stratum	Canopy Cover (%)				
	70-100%	30-70%	10-30%	2-10%	<2%
Trees over 30 m	Tall closed forest	Tall open forest	Tall woodland	Tall open woodland	Scattered tall trees
Trees 10-30 m	Closed forest	Open forest	Woodland	Open woodland	Scattered trees
Trees under 10 m	Low closed forest	Low open forest	Low woodland	Low open woodland	Scattered low trees
Shrubs over 2 m	Tall closed scrub	Tall open scrub	Tall shrubland	Tall open shrubland	Scattered tall shrubs
Shrubs 1-2 m	Closed heath	Open heath	Shrubland	Open shrubland	Scattered shrubs
Shrubs under 1 m	Low closed heath	Low open heath	Low shrubland	Low open shrubland	Scattered low shrubs
Hummock grasses	Closed hummock grassland	Hummock grassland	Open hummock grassland	Very open hummock grassland	Scattered hummock grasses
Grasses, Sedges, Herbs	Closed tussock grassland / sedgeland / herbland	Tussock grassland / sedgeland / herbland	Open tussock grassland / sedgeland / herbland	Very open tussock grassland / sedgeland / herbland	Scattered tussock grasses / sedges / herbs

*Based on (Muir 1977), and Aplin's (1979) modification of the vegetation classification system of Specht (1970):

Aplin T.E.H. (1979). The Flora. Chapter 3 *In* O'Brien, B.J. (ed.) (1979). *Environment and Science.* University of Western Australia Press;

Specht R.L. (1970). Vegetation. *In The Australian Environment.* 4th edn (Ed. G.W. Leeper). Melbourne.

Vegetation Condition Scale for use on Pilbara surveys*

E = Excellent (=Pristine of BushForever)
Pristine or nearly so; no obvious signs of damage caused by the activities of European man.
VG = Very Good (= Excellent of BushForever)
Some relatively slight signs of damage caused by the activities of European man. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds such as **Ursinia anthemoides* or **Briza* spp., or occasional vehicle tracks.
G = Good (= Very Good of BushForever)
More obvious signs of damage caused by the activities of European man, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or by selective logging. Weeds as above, possibly plus some more aggressive ones such as **Ehrharta* spp.
P = Poor (= Good of BushForever)
Still retains basic vegetation structure or ability to regenerate to it after very obvious impacts of activities of European man, such as grazing, partial clearing (chaining) or frequent fires. Weeds as above, probably plus some more aggressive ones such as **Ehrharta* spp.
VP = Very Poor (= Degraded of BushForever)
Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species including very aggressive species.
D = Completely Degraded (= Completely Degraded of BushForever)
Areas that are completely or almost completely without native species in the structure of their vegetation; i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

Appendix 4: Flora Species relevant to the study area; Biota (2007a) and NatureMap database search (Parks and Wildlife 2007 - 2015)

Family	Species
Adiantaceae	*Cheilanthes sieberi subsp. sieberi*
Aizoaceae	*Trianthema pilosa*
	Trianthema triquetra
	Zaleya galericulata
Amaranthaceae	*Alternanthera angustifolia*
	Alternanthera denticulat
	Alternanthera nana
	Amaranthus cuspidifolius
	Amaranthus cuspidifolius
	Amaranthus interruptus
	Amaranthus sp. (WES26-16)
	Amaranthus undulatus
	Gomphrena cunninghamii
	Ptilotus aervoides
	Ptilotus appendiculatus var. *appendiculatus*
	Ptilotus astrolasius var. *astrolasius*
	Ptilotus auriculifolius
	Ptilotus axillaris
	Ptilotus calostachyus var. *calostachyus*
	Ptilotus clementii
	Ptilotus exaltatus var. *exaltatus*
	Ptilotus fusiformis var. *fusiformis*
	Ptilotus helipteroides var. *helipteroides*
	Ptilotus incanus var. *incanus*

Family	Species
	Ptilotus latifolius
	Ptilotus obovatus var. *obovatus*
	Ptilotus polystachyus var. *polystachyus*
Apiaceae	*Daucus glochidiatus*
	Trachymene oleracea subsp. *oleracea*
Araliaceae	*Astrotricha hamptonii*
Asclepiadaceae	*Cynanchum floribundum*
	Cynanchum sp. Hamersley (M. Trudgen 2302)
	Rhyncharrhena linearis
Asteraceae	*Calocephalus knappii*
	Calotis hispidula
	Centipeda minima subsp. *macrocephala*
	Flaveria australasica
	Helichrysum luteoalbum
	Olearia fluvialis
	Pentalepis trichodesmoides
	Pluchea dentex
	Pluchea dunlopii
	Pluchea rubelliflora
	Pterocaulon sphacelatum
	Pterocaulon sphaeranthoides
	Pterocaulon sphaeranthoides x *sphacelatum*
	Rhodanthe margarethae
	Streptoglossa bubakii
	Streptoglossa decurrens

Family	Species
	Streptoglossa odora
	Vittadinia virgata
Boraginaceae	*Ehretia saligna* var. *saligna*
	Heliotropium chrysocarpum
	Heliotropium tenuifolium
	Heliotropium cunninghamii
	Heliotropium inexplicitum
	Lepidium muelleri-ferdinandii
	Lepidium pedicellosum
	Lepidium pholidogynum
	Trichodesma zeylanicum var. *zeylanicum*
Caesalpiniaceae	*Cassia* aff. *oligophylla* (thinly sericeous)
	Cassia glutinosa
	Cassia glutinosa x *luerssenii*
	Cassia helmsii
	Cassia luerssenii
	Cassia notabilis
	Cassia oligophylla
	Cassia oligophylla x *glutinosa*
	Cassia oligophylla x *glutinosa* (FMG116-02)
	Cassia oligophylla x *helmsii*
	Cassia pruinosa
	Cassia venusta
	Cassia sp.
	Petalostylis labicheoides

Family	Species
Campanulaceae	*Lobelia arnhemiaca*
	Wahlenbergia tumidifructa
Capparaceae	*Capparis spinosa* var. *nummularia*
	Cleome viscosa
Caryophyllaceae	*Polycarpaea corymbosa* var. *corymbosa*
	Polycarpaea holtzei
	Polycarpaea longiflora
Celastraceae	*Stackhousia* sp. swollen gynophore (W.R. Barker 2041)
Chenopodiaceae	*Bonamia media* var. *villosa*
	Bonamia rosea
	Chenopodium melanocarpum
	Dysphania kalpari
	Dysphania plantaginella
	Dysphania rhadinostachya subsp. *rhadinostachya*
	Dysphania sphaerosperma
	Evolvulus alsinoides var. *villosicalyx*
	Maireana georgei
	Polymeria ambigua/calycina
	Polymeria ambigua
	Rhagodia eremaea
	Salsola tragus subsp. *tragus*
	Sclerolaena costata
	Sclerolaena densiflora
Combretaceae	*Terminalia supranitifolia*
Convolvulaceae	*Bonamia linearis*

Family	Species
	Bonamia pannosa
	Evolvulus alsinoides var. decumbens
	Ipomoea muelleri
	Ipomoea polymorpha
	Operculina aequisepala
	Polymeria ambigua
	Polymeria sp. (site 1365)
	Porana commixta
Cucurbitaceae	*Mukia maderaspatana*
	Trichosanthes cucumerina var. *cucumerina*
Cyperaceae	*Bulbostylis barbata*
	Cyperus cunninghamii
	Cyperus cunninghamii subsp. *cunninghamii*
	Cyperus difformis
	Cyperus hesperius
	Cyperus iria
	Cyperus squarrosus
	Cyperus vaginatus
	Eleocharis atropurpurea
	Eleocharis geniculata
	Fimbristylis dichotoma
	Fimbristylis microcarya
	Fimbristylis rara
	Fimbristylis simulans
	Lipocarpha microcephala

Family	Species
	Schoenoplectus lateriflorus
Droseraceae	*Drosera indica*
Elatinaceae	*Bergia pedicellaris*
	Bergia perennis subsp. perennis
	Bergia trimera
	Bergia trimera
Euphorbiaceae	*Adriana urticoides* var. *urticoides*
	Euphorbia aff. *australis* (B191)
	Euphorbia aff. *drummondii* (MET 15,211)
	Euphorbia australis (mid-green form)
	Euphorbia australis var. *subtomentosa*
	Euphorbia biconvexa
	Euphorbia boophthona (Large seed form)
	Euphorbia careyi
	Euphorbia coghlanii
	Euphorbia sp. (MJB-05)
	Euphorbia sp. (PAN5-15)
	Euphorbia sp. (site 1089)
	Euphorbia tannensis subsp. *eremophila* (Hamersley form)
	Flueggea virosa subsp. *melanthesoides*
	Leptopus decaisnei var. *decaisnei*
	Phyllanthus maderaspatensis
	Phyllanthus erwinii
	Phyllanthus exilis
Fabaceae	*Acacia ancistrocarpa*

Family	Species
	Acacia inaequilatera Baderi
	Acacia orthocarpa
	Acacia ptychophylla
	Acacia pyrifolia var. *pyrifolia*
	Alysicarpus muelleri
	Alysicarpus muelleri
	Cajanus cinereus
	Crotalaria dissitiflora subsp. *benthamiana*
	Crotalaria medicaginea var. *neglecta*
	Cullen pogonocarpum
	Cullen aff. *lachnostachys* (MET 15,154)
	Cullen graveolens
	Cullen lachnostachys
	Cullen leucanthum
	Cullen leucochaites
	Cullen martinii
	Glycine canescens
	Indigofera colutea
	Indigofera georgei
	Indigofera linifolia
	Indigofera linnaei
	Indigofera monophylla (BRO 46-12)
	Indigofera monophylla (MJOPP-2)
	Indigofera rugosa
	Indigofera sp. Bungaroo Creek (S. van Leeuwen 4301)

Family	Species
	Indigofera sp. Fractiflexa (S. van Leeuwen 3773)
	Indigofera trita
	Isotropis atropurpurea
	Lotus cruentus
	Rhynchosia bungarensis
	Rhynchosia minima var. *australis*
	Rhynchosia minima Rhynchosia
	Senna venusta
	Sesbania cannabina
	Swainsona complanata
	Swainsona formosa
	Tephrosia aff. *densa* (WW22-16)
	Tephrosia aff. *supina*
	Tephrosia aff. *supina* (BUN18-09)
	Tephrosia aff. *supina* (HD133-20)
	Tephrosia aff. *supina* (MET 12,357)
	Tephrosia rosea var. *Fortescue creeks* (M.I.H. Brooker 2186)
	Tephrosia rosea var. *glabrior*
	Tephrosia sp.
	Tephrosia sp. B Kimberley Flora (C.A. Gardner 7300)
	Tephrosia sp. Bungaroo Creek (M.E. Trudgen 11601)
	Tephrosia sp. Fortescue (A.A. Mitchell 606)
	Tephrosia sp. NW Eremaean (S. van Leeuwen *et al.* PBS 0356)
	Tephrosia sp. Pilbara Ranges (S. van Leeuwen 4246)
	Tephrosia spechtii

Family	Species
	Tephrosia supina
	Tephrosia uniovulata
	Tephrosia virens
	Vigna lanceolata
	Vigna lanceolata var. *lanceolata*
Gentianaceae	*Centaurium clementii*
Goodeniaceae	*Dampiera candicans*
	Goodenia forrestii
	Goodenia lamprosperma
	Goodenia microptera
	Goodenia muelleriana
	Goodenia stobbsiana
	Goodenia tenuiloba
	Scaevola spinescens (broad form)
Gyrostemonaceae	*Codonocarpus cotinifolius*
Lamiaceae	*Basilicum polystachyon*
	Clerodendrum floribundum var. *angustifolium*
	Clerodendrum floribundum var. *ovatum*
Lauraceae	*Cassytha capillaris*
Lobeliaceae	*Lobelia heterophylla*
	Lobelia quadrangularis
Loranthaceae	*Amyema bifurcata*
	Amyema preissii
Lythraceae	*Ammannia auriculata*
	Ammannia baccifera

Family	Species
	Ammannia multiflora
	Ammannia sp.
	Rotala diandra
	Rotala mexicana
Malvaceae	*Abutilon cunninghamii*
	Abutilon aff. *dioicum*
	Abutilon aff. *hannii*
	Abutilon aff. *lepidum* (1) (MET 15 352)
	Abutilon amplum
	Abutilon dioicum
	Abutilon fraseri
	Abutilon lepidum
	Abutilon malvifolium
	Abutilon otocarpum (acute leaf form)
	Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)
	Abutilon trudgenii
	Abutilon sp.
	Corchorus lasiocarpus subsp. *parvus*
	Corchorus sidoides subsp. *sidoides*
	Corchorus sp. Hamersley Range hilltops (S. van Leeuwen 3826)
	Corchorus tridens
	Gossypium australe (Burrup Peninsula form)
	Gossypium australe (Whim Creek form)
	Gossypium robinsonii
	Hibiscus aff. *coatesii*

Family	Species
	Hibiscus aff. *coatesii* (MET 16,542)
	Hibiscus aff. *coatesii* (site 664)
	Hibiscus aff. *platychlamys* (2MATC2-4)
	Hibiscus aff. *platychlamys* (FMG88-08)
	Hibiscus aff. *platychlamys* (site 1139)
	Hibiscus austrinus var. *austrinus*
	Hibiscus brachychlaenus
	Hibiscus brachysiphonius
	Hibiscus burtonii
	Hibiscus coatesii
	Hibiscus goldsworthii
	Hibiscus leptocladus
	Hibiscus platychlamys
	Hibiscus solanifolius
	Hibiscus sturtii var. aff. *grandiflorus*
	Hibiscus sturtii var. *campylochlamys*
	Hibiscus sturtii var. *platychlamys*
	Melhania oblongifolia
	Sida aff. *cardiophylla* (site 1086)
	Sida aff. *clementii* (site 664)
	Sida aff. *fibulifera* (MET Site 1346)
	Sida aff. *fibulifera* (oblong; MET 15 220)
	Sida aff. *fibulifera* (prostrate A.A. Mitchell 3 572)
	Sida aff. *fibulifera* (site 1394)
	Sida arsiniata

Family	Species
	Sida clementii
	Sida echinocarpa
	Sida echinocarpa
	Sida kingii
	Sida pilbarensis
	Sida pilbarensis (ferruginous form)
	Sida rohlenae subsp. *rohlenae*
	Sida sp. A Kimberley Flora (P.A. Fryxell & L.A. Craven 3900)
	Sida sp. Pilbara (A.A. Mitchell PRP 1543)
	Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)
	Sida sp. verrucose glands (F.H. Mollemans 2423)
	Sida sp. Wittenoom (W.R. Barker 1962)
	Sida spinosa
	Sida subarticulata
	Triumfetta chaetocarpa
	Triumfetta clementii
	Triumfetta maconochieana
	Waltheria indica
Marsileaceae	*Marsilea hirsuta*
Menispermaceae	*Tinospora smilacina*
Mimosaceae	*Acacia ampliceps*
	Acacia ancistrocarpa
	Acacia bivenosa
	Acacia colei var. *ileocarpa*
	Acacia coriacea subsp. sericophylla

Family	Species
	Acacia cowleana
	Acacia dictyophleba
	Acacia elachantha
	Acacia farnesiana
	Acacia inaequilatera
	Acacia maitlandii
	Acacia monticola
	Acacia morrisonii
	Acacia orthocarpa
	Acacia pruinocarpa
	Acacia ptychophylla
	Acacia pyrifolia
	Acacia sclerosperma subsp. *sclerosperma*
	Acacia spondylophylla
	Acacia synchronicia
	Acacia tenuissima
	Acacia tetragonophylla
	Acacia trachycarpa
	Acacia trudgeniana
	Acacia tumida var. *pilbarensis*
	Acacia xiphophylla
Molluginaceae	*Glinus lotoides*
	Glinus oppositifolius
	Mollugo molluginis
Moraceae	*Ficus aculeata* var. *indecora Ranji*

Family	Species
	Ficus brachypoda
	Ficus opposita var. *indecora*
Myoporaceae	*Eremophila forrestii* subsp. *forrestii*
	Eremophila longifolia
	Eremophila tietkensii
Myrtaceae	*Eucalyptus camaldulensis* var. *obtusa*
	Corymbia candida subsp. *candida*
	Corymbia deserticola subsp. *deserticola*
	Corymbia ferriticola subsp. *ferriticola*
	Corymbia flavescens
	Corymbia hamersleyana
	Corymbia zygophylla
	Eucalyptus xerothermica
	Eucalyptus leucophloia subsp. *leucophloia*
	Eucalyptus victrix
	Melaleuca glomerata
	Melaleuca linophylla
Nyctaginaceae	*Boerhavia burbidgeana*
	Boerhavia coccinea
	Boerhavia gardneri
	Boerhavia repleta
	Boerhavia schomburgkiana
Oleaceae	*Jasminum didymum* subsp. *lineare*
Onagraceae	*Ludwigia perennis*
Pedaliaceae	*Josephinia* sp.

Family	Species
	Josephinia sp. Style-topped fruit (M. Maier BES MM 1017)
Phrymaceae	*Glossostigma diandrum*
Phyllanthaceae	*Phyllanthus reticulatus*
Plumbaginaceae	*Plumbago zeylanica*
Poaceae	*Amphipogon sericeus*
	Aristida burbidgeae
	Aristida contorta
	Aristida holathera
	Aristida holathera var. *holathera*
	Bothriochloa bladhii
	Brachyachne convergens
	Brachyachne convergens
	Chloris pectinata
	Chrysopogon fallax
	Cymbopogon ambiguus
	Cymbopogon obtectus
	Cynodon dactylon
	Dactyloctenium radulans
	Dichanthium fecundum
	Dichanthium fecundum
	Dichanthium sericeum subsp. *humilius*
	Digitaria brownii
	Digitaria ctenantha
	Enneapogon caerulescens
	Enneapogon lindleyanus

Family	Species
	Enneapogon polyphyllus
	Enneapogon robustissimus
	Enteropogon ramosus
	Eragrostis cumingii
	Eragrostis dielsii
	Eragrostis eriopoda
	Eragrostis exigua
	Eragrostis leptocarpa
	Eragrostis setifolia
	Eragrostis surreyana
	Eragrostis tenellula
	Eriachne ?flaccida
	Eriachne aristidea
	Eriachne ciliata
	Eriachne helmsii
	Eriachne mucronata
	Eriachne pulchella subsp. *dominii*
	Eriachne tenuiculmis
	Eriochloa pseudoacrotricha
	Eulalia aurea
	Iseilema dolichotrichum
	Iseilema membranaceum
	Paraneurachne muelleri
	Paspalidium clementii
	Paspalidium clementii

Family	Species
	Paspalidium rarum
	Paspalidium sp.
	Paspalidium tabulatum
	Perotis rara
	Setaria dielsii
	Sporobolus australasicus
	Themeda triandra
	Triodia angusta
	Triodia epactia
	Triodia lanigera
	Triodia longiceps
	Triodia schinzii
	Triodia sp. nov.
	Triodia sp. Robe River (M.E. Trudgen *et al.* MET 12367)
	Triodia wiseana
	Triraphis mollis
	Urochloa piligera
	Yakirra australiensis
	Yakirra australiensis var. *australiensis*
Polygalaceae	*Polygala* aff. *isingii*
Portulacaceae	*Calandrinia ptychosperma*
	Calandrinia sp.
	Portulaca oleracea
Proteaceae	*Grevillea eriostachya*
	Grevillea pyramidalis

Family	Species
	Grevillea wickhamii subsp. *aprica*
	Grevillea wickhamii subsp. *hispidula*
	Hakea chordophylla
Pteridaceae	*Cheilanthes brownii*
	Cheilanthes lasiophylla
Rubiaceae	*Oldenlandia crouchiana*
	Oldenlandia sp. *'gilgai'*
	Synaptantha tillaeacea var. *tillaeacea*
Sapindaceae	*Dodonaea coriacea*
	Mimulus gracilis
	Stemodia grossa
	Stemodia kingii
	Striga squamigera
Solanaceae	*Nicotiana benthamiana*
	Nicotiana occidentalis subsp. *obliqua*
	Nicotiana occidentalis subsp. *occidentalis*
	Nicotiana sp.
	Solanum ashbyae
	Solanum centrale
	Solanum diversiflorum
	Solanum gabrielae
	Solanum horridum
	Solanum lasiophyllum
	Solanum phlomoides
Stackhousiaceae	*Stackhousia intermedia*

Family	Species
Sterculiaceae	*Brachychiton acuminatus*
	Keraudrenia nephrosperma
	Melhania oblongifolia
	Melhania sp. (CH15-39)
	Melhania sp. Turee Creek (MJ1-35)
	Waltheria indica
	Waltheria virgata
Stylidiaceae	*Stylidium fluminense*
	Stylidium weeliwolli
	Stylobasium spathulatum
Tiliaceae	*Corchorus crozophorifolius*
	Corchorus incanus
	Triumfetta appendiculata
	Triumfetta maconochieana
	Triumfetta aff. *chaetocarpa* (PAN3/4)
	Triumfetta clementii
	Triumfetta johnstonii
	Triumfetta sp.
Typhaceae	*Typha domingensis*
Urticaceae	*Parietaria cardiostegia*
Violaceae	*Hybanthus aurantiacus*
Zygophyllaceae	*Tribulopis angustifolia*
	Tribulus aff. *hirsutus* (site 500)
	Tribulus astrocarpus
	Tribulus hirsutus

Family	Species
	Tribulus macrocarpus
	Tribulus occidentalis
	Tribulus platypterus

Appendix 5: Framework for Conservation Significance Ranking for Flora and Fauna Species

Legislative Framework for Conservation Significant Flora *Wildlife Conservation Act 1950*

All native flora in Western Australia is protected under the state *Wildlife Conservation Act* 1950. Protected flora which are deemed to be at risk of extinction, rare, or otherwise in need of special protection are listed as "Rare Flora" and published in the *Wildlife Conservation (Rare Flora) Notice 2008*. Specific written approval by the Minister for the Environment is required to take or harm species listed in Schedule 1 or 2 of the *Wildlife Conservation (Rare Flora) Notice 2008*. Flora species which may be rare or threatened in Western Australia but which have not been adequately surveyed for are included in a supplementary conservation list called the Priority Flora List.

In addition to state legislation, some Western Australian native plant species are protected under federal law, namely the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). In the Pilbara, two species *Lepidium catapycnon* and *Thryptomene wittweri* are currently listed as "Vulnerable" under the EPBC Act. Proposals that are considered likely to have a significant impact on EPBC Act listed threatened flora are required to be referred to the Federal Minister of Environment for approval.

Categories of conservation significance for flora species under the *Wildlife Conservation Act 1950* (Atkins 2006)

Declared Rare Flora - Extant Taxa- Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection

Declared Rare Flora - Presumed Extinct Taxa- Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently,

Priority One - Poorly known Taxa- Taxa which are known from one or a few (generally <5) populations which are under threat.

Priority Two - Poorly Known Taxa- Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat.

Priority Three - Poorly Known Taxa- Taxa which are known from several populations, and the taxa are not believed to be under immediate threat.

Priority Four - Rare Taxa- Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors.

Legislative Framework for Conservation Significant Fauna *Wildlife Conservation Act 1950-1979*

Native fauna species that are rare, threatened with extinction, or have high conservation value are specially protected by law under the Western Australian *Wildlife Conservation Act 1950-1979* (WC Act). The *Wildlife Conservation (Special Protected Fauna) Notice* classifies rare and endangered fauna using four distinct conservation codes or schedules (see below).

In addition to the above schedules, Parks and Wildlife produces a supplementary list of Priority Fauna. Priority Fauna are species that have been identified as requiring further survey and evaluation of their conservation status before deciding whether to list them as Schedule Fauna. Five Priority codes are recognised by Parks and Wildlife and are presented below.

Parks and Wildlife Priority Fauna codes

Priority One: Taxa with few, poorly known populations on threatened lands. Taxa which are known from a few specimens or sight records from one or a few localities on lands not managed for conservation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority Two: Taxa with few, poorly known populations on conservation lands, or taxa with several, poorly known populations not on conservation lands. Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority Three: Taxa with several, poorly known populations, some on conservation lands. Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority Four: Taxa in need of monitoring. Taxa which are considered to have been adequately circumstances change. These taxa are usually represented on conservation surveyed or for which sufficient knowledge is available and which are considered not currently threatened or in need of special protection, but could be if present lands. Taxa which are declining significantly but are not yet threatened.

Priority Five: Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Environmental Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* affords protection to species, populations and ecological communities threatened at a national level or to species listed as migratory under various international agreements (e.g. CAMBA, JAMBA RoKAMBA, Bonn Convention). Categories relevant to the current study include:

Endangered – Taxa facing a very high risk of extinction in the wild in the near future.

Vulnerable – Taxa facing high risk of extinction in the wild in the medium-term.

Under the EPBC Act, a proposal which is likely to have a significant impact on threatened species, populations or ecological communities or migratory species must be referred to DEWHA for a decision by the Commonwealth Minister for the Environment. A significant impact is determined through application of Significant Impact Criteria (DEWHA 2000).

Categories of conservation significance for fauna species under the *Wildlife Conservation Act 1950* (Atkins 2006)

Native fauna species that are rare, threatened with extinction, or have high conservation value are specially protected by law under the Western Australian *Wildlife Conservation Act 1950-1979* (WC Act). The *Wildlife Conservation (Special Protected Fauna) Notice* classifies rare and endangered fauna using four distinct conservation codes or schedules.

Schedule 1 – Fauna which are rare or likely to become extinct and are declared to be fauna in need of special protection.

Schedule 2 – Fauna which are presumed to be extinct and are declared to be fauna in need of special protection.

Schedule 3 – Birds which are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction, which are declared to be fauna in need of special protection, and

Schedule 4 – Fauna that are in need of special protection, otherwise than for the reasons mentioned in Schedules 1, 2 or 3.

EPBC Act Significant Impact Criteria

Conservation Code	Significant Impact Criteria
Critically Endangered and Endangered Species	An action is likely to have a significant impact on critically endangered or endangered species if there is a real chance or possibility that it will: Lead to a long-term decrease in the size of a *population*, or Reduce the area of occupancy of the species, or Fragment an existing *population* into two or more populations, or Adversely affect habitat critical to the survival of a species, or Disrupt the breeding cycle of a population, or Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species habitat, or Interfere with the recovery of the species.
Vulnerable species	An action is unlikely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will: Lead to a long-term decrease in the size of an important population of a species, or Reduce the area of occupancy of an important population, or Fragment an existing important population into two or more populations, or Adversely affect habitat critical to the survival of a species, or Disrupt the breeding cycle of an important population, or Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat, or Interferes substantially with the recovery of the species

Conservation Code	Significant Impact Criteria
Critically endangered and endangered ecological communities	An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will: o Reduce the extent of a community, or o Fragment or increase fragmentation of the community, for example by clearing vegetation for roads or transmission lines, or o Adversely affect habitat critical to the survival of an ecological community which consists of, or includes, fauna species, or o Modify or destroy abiotic (non-living) factors)such as water, nutrients, or soil) necessary for the community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns, or o Cause a substantial change in the species composition of an occurrence of an ecological community, including, but not limited to: ▪ Assisting invasive species, that are harmful to the listed ecological community, to become established; and ▪ Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community; or o Interfere with the recovery of an ecological community
Listed Migratory Species	An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will: o Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species, or o Result in invasive species that is harmful to the migratory species becoming established in an area of important habitat of the migratory species, or o Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species.

Appendix 6: Government and Rio Tinto internal operational controls for Environmental Management

Operational Controls for Environmental Management

The manner in which the clearing of native vegetation is regulated, undertaken and rehabilitated is under various Government and internal Rio Tinto operational controls. These operational controls are discussed below.

State Agreement Act Terms and Conditions

The Nammuldi mine, for example, operates under the Iron Ore (Hamersley Range) Agreement Act 1963. This mine is regulated by the DoMP and is subject to assessment of new proposals by DoMP and to the Annual Environmental Report ("AER") inspection system. The AER inspections are carried out by DoMP Environmental Inspectors.

Environmental Protection Authority Guidance Statements

Where possible and/or practical, biological survey and restoration of the areas affected by mining is undertaken in accordance with the following EPA Position and Guidance Statements:

- Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3 (EPA 2002).
- Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia.
- Guidance Statement No. 51 (EPA 2004a).
- Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia. Guidance Statement No. 56 (EPA 2004b).
- Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA-DEC 2010).
- Rehabilitation of Terrestrial Ecosystems. Guidance Statement No. 6 (EPA 2006).

Rio Tinto Operational Controls

Rio Tinto Iron Ore is part of the Rio Tinto group of companies and is obliged to comply with the 10 Rio Tinto global environmental standards, the first of which requires a certified Environmental Management System. Rio Tinto has developed and implemented over 100 Operational Control Procedures ("OCP") to manage environmental issues relating to mining and exploration. A number of these OCPs are of direct relevance in managing and controlling land clearing activities, and include:

- Approvals Permit Guidelines and Procedure;
- IEMS Procedure - Ground Disturbance;
- Rehabilitation Handbook;
- IEMS Weed Management Plan;
- IEMS Procedure - Soil Resource Management;
- IEMS Procedure – Erosion Monitoring; and
- IEMS Weed Field Sheets.